Water and Sewage Works
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MUNICIPAL ENGINEERING

VOLUME XLII — NUMBER ONE

JANUARY, NINETEEN HUNDRED TWELVE

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

Staking Out the Work.

THE county surveyor or local engineer will probably be called on to survey the highway and stake out the work. The following brief suggestions are offered in connection with this most important feature of the improvement:

Preliminary Investigations for New Road.—Upon receipt of instructions to locate a given road, the engineer should refer to such maps as are available, and familiarize himself with the general topography of the land, location and extent of streams, railroads, highways, canals, etc. The mere inception of the idea will furnish at least one terminus. Usually the conditions are such that the general direction of the road is clearly defined, it being only necessary to select the best route between two points so as to serve a certain community. Only when it is practicable to obtain a maximum grade of 6 per cent., with satisfactory drainage and foundation, is it reasonable to keep the road on the lines of legal subdivisions. The trial or preliminary route should be chosen after a consideration of the conditions outlined last month, some of which may suggest sufficient reason for so adopting it.

For the preliminary survey a compass, tape, hand level and a few bundles of lath will be all the equipment necessary. Upon approaching a hill, place a stake where the trial tangent intercepts the slope, and walk over the ground in an effort to find an easy means of ascent. Here the hand level is indispensable. By knowing the personal H. I., or elevation of the eye above the ground, and picking out points a given distance ahead that are on the same elevation, one can readily locate any desirable grade with sufficient accuracy for estimating purposes. The soil and rock should be examined for drainage, foundation and surfacing materials. In this manner the several routes may be investigated, setting only temporary stakes, and keeping such notes as will enable the observer to determine the practicability of each. Usually in skirting a hill, the line should be kept as far down the side as possible, because the slope is flatter, and the excavation for a given width of roadway therefore less. It is well to remember that two short, rather steep grades are to be preferred to one long incline not quite so steep. For instance, two short grades of 8 per cent., with a stretch of level road between, might be better than a 6 per cent. grade for the entire distance. Such an arrangement is especially desirable where very steep grades are encountered. In this way the stretch of level road enables teams to rest when they most need it.

The curves on preliminary work may be staked by eye, by observing the offset from a line produced through the last two stations. All stream crossings are to be noted, the banks examined for foundation, the high-water marks observed, etc. Other things being equal, the most desirable location for a bridge is one with rather high banks and a straight channel. If the stream is of any great size, the crossing should be located first, and the road brought to it by the best route.

From the data acquired in this manner, the engineer is enabled to consider each suggested location, estimating the cost within reasonable limits, and discarding all except the one or two most feasible routes, the final determination of which may wait upon the location survey.

Location.—For this survey will be required transit, level, steel tape, pins, hand level, flag poles, level rod, stakes and note books. The personnel of the party will be determined by the conditions. The importance of taking careful notes on this survey can hardly be overestimated. Upon his records as to obstructions, topography, soil, drainage, etc., must the engineer trust for his final estimate.

The survey should begin at some well-defined point, as, for instance, the intersection of streets or roads, a section or quarter section corner. The direction of some convenient line may be assumed as a base. If this be a section line, and its general direction be north, it may be assumed to be north, and its aximuth be considered 0, or 360 degrees. All other directions are to be referred to this base line. All vernier readings are to be checked by reading the magnetic bearing. The following is a convenient form of notes:

LEFT-HAND PAGE OF NOTE BOOK.

Station	Distance	Azimuth	From Station	Magnetic Bearing	REMARKS

The right-hand page will show sketches of roads, streams and other obstructions, and additional remarks. On this survey more permanent stakes should be used, and hubs driven flush with the ground at every transit point, or at distances not to exceed 1,000 feet along the line. The right of way should be marked by placing stones firmly in the ground, marking their faces so as to permit of ready identification. At angle points these monuments will be placed at the intersections of the right-of-way lines.

On reasonably level ground stakes may be left as often as desired, to aid in picking up the line; where any grading is to be done, however, stakes must be set every 100 or 50 feet. Unless the preliminary line has been very carefully run, it is best not to set monuments on grades or where excavation is required until the slope stakes are set. It is essential that the line, as finally located, be tied into section lines and corners as frequently as is convenient, so as to aid in plotting, and to preserve a check on the field work.

In the 1909-10 report of the Michigan State Highway Department the following instructions or suggestions are offered regarding the making of surveys and plans for State Reward roads:

"1. Stakes should be set 100 feet apart along each side of the proposed roadway, uniformly 25 feet from the center line of the same.

"2. Levels should be taken at each station: (a) on the center line, (b) on the hub at each side stake, (c) in the bottom of each ditch, if there be any side ditches. Plus levels should be taken on railroad tracks, on the floors of culverts and bridges, in the beds of streams that serve as the outlets for road ditches, and at such other points as the surveyor or engineer may deem necessary.

"3. Plan and profile should be placed on the same sheet, projecting the plan vertically above or below the profile. Angles in the line may be indicated by the use of broken lines or other symbols, giving bearings and distances in figures, without attempt at laying out with a protractor.

"4. The profile should contain a description of sufficient detail, so that the road may be platted on township maps. The description should refer to section lines, quarter lines, section corners and quarter corners.

"5. One hundred feet to the inch, horizontal, and 5 or 10 feet to the inch, vertical, are desirable scales.

"6. The profile must show at each station center-line cuts and fills in figures, and should show the depth of each ditch or gutter from the outer side stake, also the distance of the established grade above or below each line of side stakes.

"7. A complete working profile must show: (a) center line profile, (b) profile of each side ditch or gutter, (c) all the figures required to build the complete road staked out in the ground.

"8. It is not necessary to show elevations above the datum plane upon the profile, these notes being preserved by the surveyor or engineer in his note book.

"9. At least three sets of plans should be prepared, one for filing with the township clerk, one for filing with the State Highway Department, together with application for reward, and one for the commissioner or foreman doing the work.

"10. It is desirable to prepare the original profile on tracing cloth, the surveyor or engineer retaining it, and as many prints as required may be furnished the township.

"11. Profile tracing cloth, standard cross-section 10x10, is very convenient for this class of work, and is recommended by the State Highway Department."

The cost of stream crossings and permanent culverts would suggest a thorough study of the conditions and an accurate estimate of the cost of this feature of the improvement. And in order that the structures may be most serviceable, they must be placed in the proper location as determined by the engineer, and constructed with due regard for grade and alignment. During the progress of the location survey a more careful examination of all drainage areas should be made, so that the data may be both accurate and sufficient.

Construction.—Staking out the work for construction includes setting all line and grade stakes, as well as staking the bridges and culverts. For grading earth roads with a grader, the road should be staked about every 100 feet, setting permanent hubs just outside each ditch line, from which line and grade may be taken. To guide the driver, temporary stakes should be set 1 foot outside the line of grader cut. The side ditches may require additional excavation in order that they may have sufficient fall; a minimum grade of 6 inches in 100 feet (or ½ of 1 per cent.) is desirable for these ditches.

Where any cut or fill is to be made, cross-section stakes should be set at intervals of 25 or 50 feet, as the occasion demands, showing the cut or fill at the center and both sides. These stakes are set with the hand level after the grade has been established from careful levels run over the center line, as previously suggested. In earth cut allow a slope of 1 to 1; in rock, ½ or ¼ to 1; in fill use a 1½ to 1 slope. The engineer should remember that if the sections are taken just 27 feet apart, the average end areas will represent the actual yardage for the section; if 54-foot sections are used, the average end area will be one-half the yardage. This greatly facilitates the office computations.

The cross-section notes should be carefully kept in a manner similar to the following:

ROADWAY 16 FEET WIDE.

LEFT-HAND PAGE. RIGHT-HAND PAGE.

Station	Elevation	Grade	Cut or Fill	Remarks	L.	C.	R.
00	100.0	99.0	c 1.0		$\frac{0.0}{8.0}$	$\frac{+1.0}{0}$	$\frac{+1.0}{9.0}$
+50	102.0	102.0	00.0		$\frac{-0.0}{8.7}$	00	$\frac{+0.5}{8.5}$

Or, if the cuts and fills at the center are taken from the profile, both the field notes and computations may be shown on the note book as follows:

LEFT-HAND PAGE.

Station	Cut or Fill at Center	L.	C.	R.

RIGHT-HAND PAGE.

Area Cut	Average	Area Fill	Average	Distance	Cubic Yards—Cut	Cubic Yards—Fill

In case of sharp turns on steep grades, or in side-hill work, where the view is obstructed, the width of roadway should be increased from the usual 16 or 18 feet to 20 or 22 feet. This to avoid accidents.

Computing the Yardage.—In ordinary work the amount of excavation and fill may be obtained with sufficient accuracy by averaging the areas of the "3-level sections," as shown above, multiplying by the length of the section and dividing by 27. As previously mentioned, if the sections are in length 27 feet, or some multiple thereof, the correct yardage will be equal to, or the same multiple of, the average end areas. The computations may be greatly facilitated by using a table made for the purpose. It is not necessary to plot the cross-sections in order to compute the areas. This may be determined by the following rule, applicable only to 3-level sections:

The area of a section equals the sum of the distance from center to side stakes, multiplied by one-half the center cut, plus the sum of the side cuts, multiplied by one-quarter of the width of the roadbed.

Such a grade will have been established, of course, that the cuts and fills will balance as near as may be, and all unnecessary waste will be eliminated. It must be remembered that when earth is excavated and then placed in an embankment, it will occupy less space than in its original condition. This "shrinkage" depends upon the nature of the material, the method of making the fill, the weather conditions, etc. Inasmuch as earthwork is usually paid for in excavation, that may always be accurately measured, a knowledge of the amount of shrinkage is useful only for estimating purposes in balancing cuts and fills. The writer suggests, therefore, that an arbitrary addition of 10 per cent. be made to all "fill" yardage, in order to ascertain the excavation required to form the embankment. In other words, to the total "cubic yards fill" shown above, add 10 per cent., to derive the necessary "cubic yards cut."

It often happens in side-hill excavation that material may be saved by moving the line up or down the slope, in order to reduce the cut or fill at the center. For this reason it is best not to set monuments until the final staking has been done. Observe, too, that on deep cuts and heavy fills it may be necessary to obtain additional right of way; borrow pits, also, may require more land than the regulation width.

Checking the Work.—The engineer will leave bench marks along the line, so as to be able to run check levels over the grade. No contract should be accepted or force account work considered complete until the grade has been checked and the work carefully inspected.

Plat.—A plat of the completed road should be prepared for filing, in the manner suggested by the Michigan Highway Department. Practically all county surveyors are required to preserve plats of the roads in a plat book kept for the purpose. In all cases, when making these permanent record plats, all dimensions, lengths of section lines measured, descriptions of monuments, etc., should be recorded. Accurate cost data of the work should be preserved for future reference.

Uses and Misuses of Concrete and Reinforced Concrete.*

By DeWitt V. Moore, Mem. Am. Soc. Eng. Contr., Indianapolis, Ind.

MISUSE implies abuse, misapplication and waste, whereas use, in its full sense, means the full utilization or application in actual use without waste; in other words, use in the sense of an intelligent, proper adaptation. If there is any other building material which is misused as often as concrete, when viewed from this standpoint, it does not occur to the writer. Many times a use of concrete is a misuse or abuse, and on the other hand, many times an abuse of concrete is in the end a practical use of same.

I suppose most of you present have given the subject of the peculiarities of concrete considerable thought, for really it is a very extraordinary material in construction.

In the first place, a material which can be poured into molds when of the consistency of soup, and yet solidify and become the same as stone, is certainly an adaptable type of construction and one which prompts the designer and the contractor to abuses.

While from the strict use of the English language we should speak of use and misuse, still, to carry out the idea we have in mind it seems more proper to say use and abuse.

The architect who lacks enthusiasm with regard to the use of concrete, and therefore does not follow the full working capacity that he should, is abusing this material.

We next consider a direct abuse by the overzealous, who expect more from this material than is reasonable or based upon good practice. A designer of this class will overstress his concrete and understress his steel, or overstress both. This is a direct abuse of the material. Somewhere between these extremes lies a

*A paper before the Indianapolis Architects' Association.

proper use of concrete and reinforced concrete.

I am not presenting for your consideration a technical paper for the purpose of promoting any special ideas as to design, formulas, percentages of reinforcement, special types of reinforcement, or advocating any stresses to come on either material.

As a matter of common sense, let us consider that with the extreme case of a lean mixture of concrete we have nothing but a pile of gravel and sand, possessing no compressive strength whatever as concrete, and forming no bond with the reinforcement therein. On the other hand, to go to the other extreme, we could mix a batch of neat cement which would possess great strength, but the most of this mixture would be prohibitive.

A mixture of gravel or stone, sand and cement, which provides a solid, homogeneous mass, may be safely relied upon, when given the proper working stress according to proportions, rather than to abuse the material by the addition of more cement on the theory that the corresponding increase in strength will justify the cost.

With this idea in mind, what is the necessity of specifying a 1:2:4 mixture of concrete for heavy monolithic walls, footings or foundations for sidewalks and ground floors?

This thought leads us at once to a consideration of alternate designs, viz.: Where the architect, being perhaps favorable to wood or steel only, allows the concrete construction to compete under the same loading conditions as for the other materials. We design for strength, but with a proper regard for stiffness. Using the ordinary tables for steel and wood, the concrete, if properly placed, will have three to four times the stiffness, and, in addition, will only fail, and that gradually, under a load two or three times as great as will cause disaster in the other materials. Under these conditions, should not the specified load be less for the concrete, resulting in a competition on a fair basis?

A concrete wall need not necessarily be of an extremely rich mixture, if it is for a heavy bearing wall, and therefore an excess of strength and resulting cost due to the specification of a rich mixture is an abuse.

A specification for a reinforced concrete structure under the same conditions, where, through force of habit and experience, the proper working stress is placed on the steel reinforcement, but at the same time where the working stresses on the concrete are reduced to less than their real values, is an abuse, and it must be recalled that such an abuse, in the end, means increase of cost or waste.

The foregoing may be termed indirect abuse, inasmuch as the material is capable of doing more for the designer than he will allow or permit; in other words, it is an abuse due to ignorance or lack of confidence.

This brings to mind that a large number of contractors have in mind that a 1:2:4 mixture means 1:6, or that a 1:3:6 mixture means 1:9. Nothing could be more erroneous.

Referring to Taylor & Thompson's "Concrete, Plain and Reinforced," page 232, we find the quantities for material for one cubic yard of concrete based on a barrel of cement of four cubic feet. This table, which is well accepted, gives for a 1:2:4 mixture, using average gravel, 1.44 barrels of cement, while the 1:6 mixture only requires 1.22 barrels. A 1:3:6 mixture, by the same table, requires 1.01 barrels, while the 1:9 mixture only requires 0.75 barrel.

Take either of these cases, there is approximately a difference of a quarter of a barrel of cement, which, at $1.20 per barrel, amounts to 30 cents per cubic yard increased cost for material alone.

Since the same conditions apply to any mixture specified, is it any wonder that on any ordinary size job of two to three thousand yards of concrete, some contractor bids $600 to $1,000 low?

There has been, and is still, considerable discussion as to how many cubic feet shall constitute a barrel of cement, but I believe at this time the majority of opinions favors four cubic feet, or one bag of cement equals one cubic foot. Naturally, if the contents of the barrel are taken as 3.5 cubic feet, the cost per yard of concrete is much increased. This illustrates the necessity of definitely stating in the specifications what shall constitute a barrel. It is an abuse to adopt these lower capacities.

This difference of specifications as to the number of cubic feet in a barrel of cement would amount to a difference of approximately 0.17 barrel per cubic yard of concrete, a difference approximately of 20 cents. This is a direct waste.

The above calculations are based upon average material; if, in addition, a specification is made requiring screened material of a uniform size for a 1:2:4 mixture, on a basis of 3.5 cubic feet of cement per barrel, the amount of cement is again increased by .33 barrel per cubic yard of concrete. Let us make this point clear. Suppose, unthoughtedly, the designer specifies a barrel of cement as 3½ cubic feet and that all material shall be screened and proportioned 1:2:4. In addition, suppose the contractor is not an engineer, and bases his estimate upon what has been his usual practice in the quantity of materials for a yard of concrete. We have at once one of the peculiarities of concrete construction, and one of the inconsistencies. First, strictly according to the designer's specifications, there are required 1.77 barrels of cement per cubic yard of concrete; the contractor figures on the 1:6 mixture, but overlooks the cubic feet per barrel, and estimates 1.22 barrels of cement per cubic yard of concrete, a difference for material of 66 cents per cubic yard, which, with additional handling and a profit, would certainly amount to not less than 75 cents per cubic yard.

Now, if the use to which the concrete is to be applied does not require so rich a mixture and so strenuous a specification, then the designer is wrong and the contractor is really right in his assumption as to what is really correct, and he may be justified in trying to hoodwink the inspector. On the other hand, granting the purpose for which the concrete is to be used is such that it should be of such proportion and so mixed, then the contractor has underestimated the materials from a cost standpoint. In the first place, the designer causes by the cement specification an extra cost of no real value, but instead a waste, while in the second case the contractor either robs the structure or himself suffers the loss. In either case, not only the owner, but also the community, suffers an economic loss.

As an example of cost data, suppose we assume a few different mixtures or proportions of concrete and work out the cost per cubic yard.

1. Suppose the specifications call for a 1:2:4 mixture to a barrel of cement, to be 3.5 cubic feet, and broken stone screened to uniform size. We estimate as follows:

Stone	.92@ $1.50	$1.38
Sand	.46@ 1.00	.46
Cement	1.77@ 1.20	2.12
Labor		2.00
Water		.10
Forms	.81@ 30.00	2.43
Gen. charges		.54
		$9.03
Profit, 10 per cent..		.90
Total cost per cubic yard........		$9.93

2. Let us now assume a fair specification for the same work, using a 1:2½:5 mixture, with a barrel taken as 4 cubic feet, and using gravel obtained under usual conditions:

Gravel	.87@ $1.00	$ .87
Sand	.44@ 1.00	.44
Cement	1.18@ 1.20	1.42
Labor		2.00
Water		.10
Forms	.81@ 30.00	2.43
Gen. charges.......		.54
		$7.80
Profit, 10 per cent..		.78
Total cost per cubic yard........		$8.58

We have here a difference in bid price of $1.35 per cubic yard, or approximately $4,000 on an ordinary size job.

Suppose the contractor estimates on a basis of past experience, with no particular regard for the exactions of the specifications. We have about the following results:

Gravel and sand...	.98@ $1.00	$ .98
Cement	.83@ 1.20	1.00
Labor		2.00
Water		.10
Forms	.81@ 30.00	2.43
General charge.....		.54
		$7.05
Profit, 10 per cent..		.70
Total cost per cubic yard........		$7.75

We have here a difference of $2.18 per cubic yard, or $6,500 on the ordinary job. Again, suppose that the contractor simply guesses at the cost on a basis of different character of work—say heavy work, when the cost of forms is low per cubic yard. He will say $5.50 for concrete, assuming the same profit of 10 per cent. The difference then is $13,000. These are conditions which actually exist, and the result is a direct abuse, since after the contract is awarded, he, realizing his error, immediately proceeds by the "first law of nature" and protects his pocketbook at the expense of the work.

We appreciate the fact that all building materials suffer abuse to the extent of substitution of inferior grades or inferior workmanship, but concrete is peculiar in that a very slight change in the wording of the specifications may make a great difference in the grade of work, without same being in any way perceptible to the eye after the forms are removed.

It is now quite a fad to require a time limit, with penalty clause, and in some cases a bonus. Such contracts are an abuse of concrete construction for a great many reasons. Concrete should not be hurried, but carefully mixed and placed. The enforced hurry due to a penalty clause results in many a careless manipulation, sacrificing quality for speed. Night work is uncertain, but is often required. This abuse is by the owner, and is an indication of American business methods, where the immediate dollar outweighs the ultimate value. We constantly build for the present, and our impatient dispositions will not await painstaking work. As concrete work is a permanent construction, or as near as we can obtain same, it is the height of foolishness to sacrifice quality, which will exist for years, for speed, which can only gain a few days.

We have approached this subject from the question of the abuse of this material by the designer. The abuses by the contractor and the contractor's organization are many and various, and are perhaps more vital than the points before mentioned.

It is easy to sit quietly down at a desk, and, after giving proper study of the proposition, formulate a specification as to what materials shall be used and as to how they shall be proportioned. It is also comparatively easy for the contractor to arrive at the cost of any specified mixture, at least so far as materials are concerned, but when the contractor attempts the construction of the building, he encounters difficulties innumerable in his attempt to watch materials and men.

If he is experienced he may abuse the material by a leniency which occurs from "familiarity breeds contempt." If not experienced, he may abuse the construction from ignorance. In either case, no matter what his turn of mind, he must employ a large force of men, whose actions and conduct, while nominally under the supervision of the contractor, still are, to a certain extent, dependent upon their own ability and honesty.

Here is a further abuse of the material, which may cover any one or all of the following suggestions:

The quality of the stone, gravel or cement may be an abuse of concrete, regardless of cement and workmanship. Poor material may even cause serious trouble. Walter H. Sawyer, in *Engineering Record* for November 4, claims the failure of the Austin, Pa., dam was caused by laitance. In the placing of wet concrete different gravels will develop more or less of a tendency in this direction, which is indicated by a slimy, light-gray, muddy substance which rises to the top of the mass and which must be thoroughly cleaned away before new concrete can bond with the old. This "laitance" has little strength, and many times its existence and lack of cleaning have caused criticism of the concrete.

In order to construct of concrete within the limits of commercial competition, it is impossible to await exact and mathematically determined proportions for each batch. In order to compete in cost, concrete must be handled expeditiously, which means by wheelbarrows, carts, buckets, etc., loaded by individual laborers in the concrete gang. Some, anxious to please their employer, overload, and thereby injure him by their overanxiety to please. Others shirk their work and load as little as possible. In either case speed and cost demand inspection on the run and an estimate by the eye.

Cement being, next to labor, the largest cost, it is often the case that the concrete is abused by a stealing from each batch of a portion of the required amount. This practice is largely the result of experience in the recent past, when most concrete consisted of heavy monolithic work, where the nature of the work was such that no bad results followed such a practice.

These are certainly direct abuses of the materials for concrete.

Modern practice demands wet concrete, and we are more and more using the term "pouring of concrete" rather than the word "placing." Improper pouring of concrete takes into consideration the nature of the work, the amount of work which can be accomplished within working hours, and the design of the structure. There is a general carelessness with reference to this line of thought evidenced by a disposition to simply get the work done and fill up the boxes or forms, without regard for the connection of the various members and their bond together. This is a direct abuse, inasmuch as it affects the strength of the resulting construction.

In order that we may have finished surfaces we can only adopt a method of manipulation designated as "spading." This is a very simple process, and one which can be handled readily by an ordinary laborer, but lack of intelligent instruction or inspection oftentimes leads to defects in the surface after the forms are removed, which causes criticism where the construction is otherwise good. We too often judge by appearances, but nevertheless this is an abuse of the material, inasmuch as by careful handling there is no occasion for any such results.

While we speak of monolithic work, both in concrete and reinforced concrete, there is really no such thing, inasmuch as we must stop at intervals. The place where these stops are to be made should be planned in advance, and made in an intelligent manner.

In wall work, or work of like character, stops should be made on horizontal and vertical lines, if necessary, with rebate joints to engage the new work. Regardless of instructions or inspection, how many times we find the concrete flowing on an incline down through the forms, leaving an irregular line of demarcation between the old and new work. This is an abuse which is absolutely unnecessary if it were not for the carelessness of the workmen, and affects not only the appearance, but also the strength.

The amount of reinforcement in reinforced concrete work is oftentimes misplaced, due to the disregard or ignorance of the workmen. There seems to be an idea that just so long as the steel reinforcement is covered up or buried in the concrete, all is well. The reinforcement should be placed where indicated by the drawing, and this means that when the concrete is being placed and the steel covered, it should not be violently raised in order that the concrete may flow underneath, for by so doing the reinforcement may be left in a position some little distance above that contemplated by the design. Suppose we have a floor with a reinforcement 6 inches below the top surface. Should this reinforcement be raised carelessly, in order that the concrete may flow under same, we may have a position only 5 inches below the top surface. We have a resulting construction which is only 70 per cent. as strong and only a little over 50 per cent. as efficient in stiffness. On the other hand, a bar which is entirely exposed cannot be expected to be bonded with the concrete.

Modern design in nearly every case, for structures of any importance, contemplates the use of top reinforcement, or, speaking more technically, reverse flexure bars, over the points of support. If the question of placing of the main reinforcement is important, the subject of this top reinforcement is often more important. Improper placing of these bars may result in 50 per cent. reduction in the safety factor.

It is a very common construction to introduce a cement finish for a wearing surface on floors of plain concrete, on the ground floor, and on reinforced concrete floors. To say nothing of the care in the preparation of this mixture and the manner in which same is handled, we have a problem on our hands to place this finish in a proper manner. In the first place, the cement finish is not considered a part of the structural concrete.

If it is placed at the same time as the mixture used for the structural portion, it must also be wet, which introduces an element of uncertainty as to the satisfactory results obtained by the cement finishers. On the other hand, if it is placed at a subsequent period, after the structural concrete has hardened, we are uncertain in our results as to the bonding of the new with the old work. Carelessness in cleaning surfaces is so common that the material is abused by this lack of attention to detail.

We have no material which will better serve the purpose of exterior finish, if properly handled. It is a mistake to mask a concrete structure by using a facing of brick, stone or terra cotta, but the designer and the contractor must be educated to the viewpoint that perfectly finished surfaces cannot be obtained at the price of ordinary concrete work, and yet can be obtained at a much less cost than for the facing of other material. The cheap jobs we ordinarily observe are not due to defects in the material, but to prices which are too low and to workmen not sufficiently adept in this line of work.

This abuse of cement construction should be corrected, and can be by the harmonious co-operation given by your organization. This subject is deserving of a special, prominent treatment in your specifications, instead of being oftentimes an obscure item. The contractor should not be censured for results which are obtained under cheap competition and rush work.

The forms and centers for concrete work, under ordinary conditions, are left entirely to the contractor. It is a question whether same should not form a part of the architect's drawings and specifications, in order that all contractors should figure alike as to requirements. The requirements of tongue and groove lumber, etc., add to the cost, without in any sense adding to the durability of the work. There is a wide variation in the present specifications for forms, but throughout there is a general vagueness and uncertainty which leaves the contractor to design his own work. The result is, some forms are constructed inteligently and others far from it. Inasmuch as this cost, under ordinary circumstances, will run from 25 to 33 per cent. of the entire cost of the work, it would seem that the subject is deserving of a more intelligent study and determination.

In a general way, from a contractor's standpoint, there is no class of construction where carelessness, accumulation of dirt, rubbish, etc., are more detrimental than in concrete. The material is continually abused by a lack of respect on the part of the workmen from the time the raw material is in the piles until it is in the finished work. It is a continual fight to exclude improper material, rubbish and offal.

If it were not for the safety that exists in concrete construction, in addition to the factor allowed, many points of weakness would develop which at the present time are concealed within the mass.

Present European Practice in Sewage Purification.*

By Prof. R. L. Sackett, Purdue University, LaFayette, Ind.

THE sewage works of England alone furnish a great variety and exhibit certain marked tendencies in their present practice. Irrigation has been abandoned in several notable instances while chemical methods are retained in several instances, but usually only as a preliminary step to biological processes.

A wide variety of combinations give acceptable effluents in works of moderate size, but the larger cities have as their great problem the disposal of the sludge. It has been clearly demonstrated that no biological process will take care of the sludge from large cities and that its final disposition is, after all, one of the serious problems.

At Salford, a suburb of Manchester, with a population of 241,000, lime and iron are used as precipitants with elaborate sedimentation basins. From these the surface liquid goes to fixed sprinkling filters of coke.

The sewage, which is concentrated in character, passes first through power-driven screens. It is then lifted 30 feet by a pair of compound, vertical inverted steam pumps with a capacity of 17,000,000 gallons per day. An impeller pump is installed, but as yet has not given a satisfactory duty.

The sewage passes along a central conduit where about eight grains of lime and four grains of sulphate of iron per gallon are fed by hand regulation. There are ten basins, each about 75x100 feet in area, which can be worked in any desired combination.

Any tank can be cleaned at any time without interrupting the flow through the remaining tanks. The sewage is drawn down in that tank and returned to the sewer; sludge gates are opened and the sludge is squeezed out and flows to the sludge tanks, two in number, about 75 feet in diameter. The sludge, from 20 per cent. to 30 per cent. solids, is pumped from these tanks by two direct-acting Tangye piston pumps with flap valves which "never choke" and do not wear excessively. The sludge is discharged into a tank steamer carrying 600 tons and taken to sea via the Manchester canal.

All sewers are combined and some silt is therefore present in the sludge. It is worth noting that Mr. Corbett, the veteran borough engineer, has not found centrifugal pumps as satisfactory in handling sludge as the piston pumps.

From the precipitation basins the top liquor flows by gravity to six roughing filters 2,000 square yards in total area, which replace former settling basins. They are of gravel of varying sizes and three feet thick.

On the tile underdrains are laid cast iron mains with nozzles every 7 inches in each direction. Air at 5 pounds pressure and water are forced upward in cleaning the roughing filters. The wash water passes through the screens to the sewer to be retreated.

From the roughing filters the filtrate passes to sprinkling filters which are 500 feet long. To the 15 beds eight more are now being added. The former ones have the supply mains laid on the bottom with the underdrains. The hollow columns which support the lateral feeders serve as riser mains. The new filters have all feed pipes on top.

There are 2,000 square yards of roughing filters and a total of 39,230 square yards of coke filters. The latter are 7 feet deep and will be built up to 8 feet in depth in time.

During dry weather the flow is about 11 million gallons per 24 hours which equals 45 gallons per individual daily, 280 gallons per square yard of sprinkling filters and 140 gallons per cubic yard of came. In wet weather the flow is three times as great.

Cinders for the sprinkling filters are crushed, screened, washed and then run by gravity in cars to the point where they are to be used. These filters have not been washed in eight years and are now pooling rapidly.

A washing machine has been designated—but not yet used—which will take the eight-foot bank of cinders in front, wash them and replace them behind the machine. The cinders will be washed in place, practically. The material now varies widely in size and quality. It is expected that 20 per cent. will be lost in washing.

Here, as in many other places, a small experimental sewage plant was built for preliminary tests. Further experiments are now being made with varying quantities of different salts of iron in the regular operation of the works.

Mr. Corbett's idea is to make sludge, or remove it from the sewage at the earliest moment and dispose of it at sea. This makes clear one important point, viz., where it is easy to dispose of the sludge

*A paper before the Indiana Engineering Society.

at sea, use that method which removes the solids most completely and at the earliest point in the process. It seems also to be agreed now that the burden on the biological filters must be reduced to a minimum else the cost of cleaning becomes large. The latter conclusion does not perhaps appeal in this instance, as the filters have not been cleaned in eight years—but they are 8 feet deep, and it is quite reasonable to conclude that a three-foot filter would, under the same conditions, need to be cleaned once in three years.

Samples of effluents taken at various points showed clearly the removal of turbidity and the final discharge was very clear. The biological efficiency of the filters was not stated.

The original cost of the works first built in 1883 was $510,000. The recent additions will cost $675,000, making a total investment of $1,185,000 or slightly under $5.00 per inhabitant. The cost of carrying the sludge to sea is stated in Mr. Corbett's report for 1909 at 20 cents per ton.

Manchester has a population of about 600,000. The water consumption is estimated at 29 gallons daily per head, of which 16 gallons are for domestic use and 13 for factory use, etc. The number of pail closets in 1902 was 73,915, of water closets, 45,686. The number of the latter is now rapidly increasing.

The works were originally designed for the treatment of sewage with lime and copperas. The results were inadequate and the total cost just under $10 per million gallons.

The present works include screens, grit chambers, settling tanks—several for storm water—primary and secondary contact, and a few intermittent filters.

The screens for removing the coarse material and the elevators for raising the grit from the large well, dump into tramcars which are hauled away.

The contact beds are constructed on concrete foundations with brick underdrains in the old and half tile in the later ones. A wide variety in size and quality of cinders is employed. The beds are filled by an elaborate system of channels. Two overflows are provided for each bed. There are 92 primary beds and 46 secondary beds each one-half acre in area.

The sludge removed from the settling tanks is pumped by air at 100 pounds pressure to a reservoir from which it flows into a large tank steamer lying in the Manchester Canal just below Bolton Lock.

Particular interest attaches to the additions which are being made to the plant.

A series of intermittent filters is being built of a variety of materials. Some are of very fine cinders, others with crushed granite below and cinders above and still others of granite throughout.

Intermittent filters of clinker have been in use for some time taking sewage after the first contact. These filters distribute the sewage through farm tile laid in parallel lines covered over, giving the surface a furrowed appearance. A dumping pan is used to operate the dosing valve.

The cost of the original works was $1,150,000 and of the additions $2,435,000 or a total investment of $3,585,000.

Mr. Arden, the resident engineer, states that the deposit of colloidal matter makes washing of entire (second) contact bed necessary in from three to six years. 8he loss of cinders is estimated as 25 to 33 per cent. for the first washing. The second washing should show but little loss.

Trade waste is receiving careful attention at Manchester and experiments are being made at various works with a view to finding economical methods of treating these wastes before they reach the sewer rather than after they have reached the works.

Phenol compounds were mentioned as yielding to bacterial treatment when present in small quantities.

The purpose is to require objectionable trade wastes to be treated by the producer on his own grounds, but to assist him in finding the best method. This is certainly an economical and rational principle to follow, but American cities permit gas works tar, oil refinery waste, cereal products and many other disturbing factors to be discharged without restriction, into their sewers.

Salford and Manchester are situated on a canal carrying sea-going vessels; Birmingham cannot ship the sludge to sea and sludge disposal is the problem there.

The entire area of 2,800 acres was originally irrigated and about 60 cows are still milked. But the process is now biological.

At Satley, in the edge of Birmingham, are,

(1) Rough screens.

(2) Roughing tanks with grit chambers at inflow end.

(3) Septic tanks proper.

(4) Three storm-water tanks of 13,000,000 gallons capacity.

(5) A pumping station with four Shone ejectors, two piston sludge pumps to force sludge to lagoon, one and one-half miles away, two air compressors.

(6) A new pumping station with electrically driven centrifugal pumps—two with a capacity of 10,000 gallons per minute and two of 2,000 gallons per minute, a total of 100,000,000 gallons per day—to pump from storm-water tanks onto 15 acres of sprinkling filters provided especially for storm water.

Fig 1. Settling Basins, Salford, England.
Fig. 3. New Sprinkling Filters. Salford, England.

Fig. 2. Sludge Basin, Salford, England.
Fig. 4. Secondary Contact Beds, Manchester, England.

(7) The 15 acres of storm filters are six feet deep of cinders with a layer of broken stone on top to prevent packing.

In dry weather septic sewage flows by gravity to two sets of tanks nearly six miles below. The old tanks are circular with a central trough from which scum is skimmed. The new tanks are rectangular, 30 feet deep and arranged in parallel rows. The sewage flows from these into a rough filter of one-inch material to intercept grease particles. From these tanks and filters, which are elevated a few feet, the liquid flows to the very large area of sprinkling filters.

These are all 7 feet deep, of stone ranging from ¾ to 1 inch in size. The Birmingham nozzle is used exclusively except at one corner of a filter where a most interesting exhibit of all kinds of spray nozzles is kept in operation.

The above filters are all rectangular, but there are one Scott Moncrieff and two Barker mill distributers.

Sewage is applied to all filters at the rate of 168 gallons per square yard daily or about 60 gallons per cubic yard daily or 813,000 gallons per acre daily.

Mr. John D. Watson, the chief engineer, believes all attempts at the ventilation of filters to be useless judging by numerous samples taken at various depths and at various distances from the perforated side wall supporting the filter.

After trying various methods of sludge disposal, Mr. Watson believes his present method best. The sewage is tanked after filtration as well as before. All sludge is pumped from the bottom of the pyramidal tanks by electrically-driven centrifugal pumps to the sludge lagoon which lies between the two works.

The liquor is pumped off the lagoon and back onto the filters. The sludge is from time to time pumped onto beds in layers about six inches thick. Here it dries and is then dug out, carted away to an embankment and the bed filled again.

The black sludge produces very little odor either in the lagoon or on the drying beds.

The effluent from the filters contains a considerable amount of fine black particles, in fact, there is more suspended material in the effluent than in the influent of the sprinkling filters. It is Mr. Watson's belief that the surface of filters should be disturbed as little as possible, and that material should be coarse so that suspended matter will pass through and not lodge within.

Hanley, Stoke-on-Trent and Fenton are three smaller cities near Stafford.

Hanley has a population of 68,000.

The system includes power screens, detritus tanks, a sludge well, septic tanks and fine stone or sagger trickling filters with Hanley type of distribution.

The sludge is pumped from settling tank to well by two pulsometer pumps. The sludge tank holds about 350,000 gallons. When full about 2,500 to 3,000 pounds of lime, as milk of lime is added. The whole is agitated by air and then the heavier portion is raised to 6 sludge presses; from these the lime liquor runs to the septic tanks. The cake is dumped on an embankment which lies between the high level and low level works.

From the detritus tanks the fluid flows to a series of septic tanks and from them to trickling filters, part of broken stone and part of saggers or crushed refuse from the numerous earthenware works in this vicinity. Some improvement has been made here to the Hanley distributer which makes it sprinkle very evenly and without much aeration. The distributer discharges only while going in one direction.

Fenton, near Hanley, has a population of about 30,000 and recently completed works designed by Wilson and Raikes.

There are four septic tanks and from these the sewage goes to 4 trickling filters, 1 acre in total area. The four Hanley distributers are driven by two oil engines here and by electric motors at Hanley.

Four small storm-water contact beds of one-fourth acre total area are provided with a very elaborate and complicated system of Adams automatic filling and emptying apparatus.

The sludge from the tanks flows by gravity to a well from which, when full, the top liquor is pumped back into the septic tanks by an oil engine.

The feature noticeable here is the fine brickwork in the walls supporting the tanks and filters which are all above ground, and the sampling basins where the effluent flows over enameled brick to better exhibit its clearness.

Between Fenton and Hanley is the Stoke sewage irrigation farm. The general appearance of pump-house and tanks was not very complimentary and the report was that the works were not doing very well. In a short time this irrigation works will probably also be replaced by filtration.

The sewage is carried by gravity some two miles down the river to a sloping piece of ground admirably suited for sewage works.

Heretofore the system has consisted of four open septic tanks and two sets of circular trickling filters,. so arranged that they can be used in series or in parallel.

The filtrate runs to river by traveling back and forth in trenches so as to obtain as much ground filtration as possible.

In contrast with the Birmingham idea, the sludge here is run into long, narrow and deep ponds where the sludge stands three to four feet deep. The dry sludge

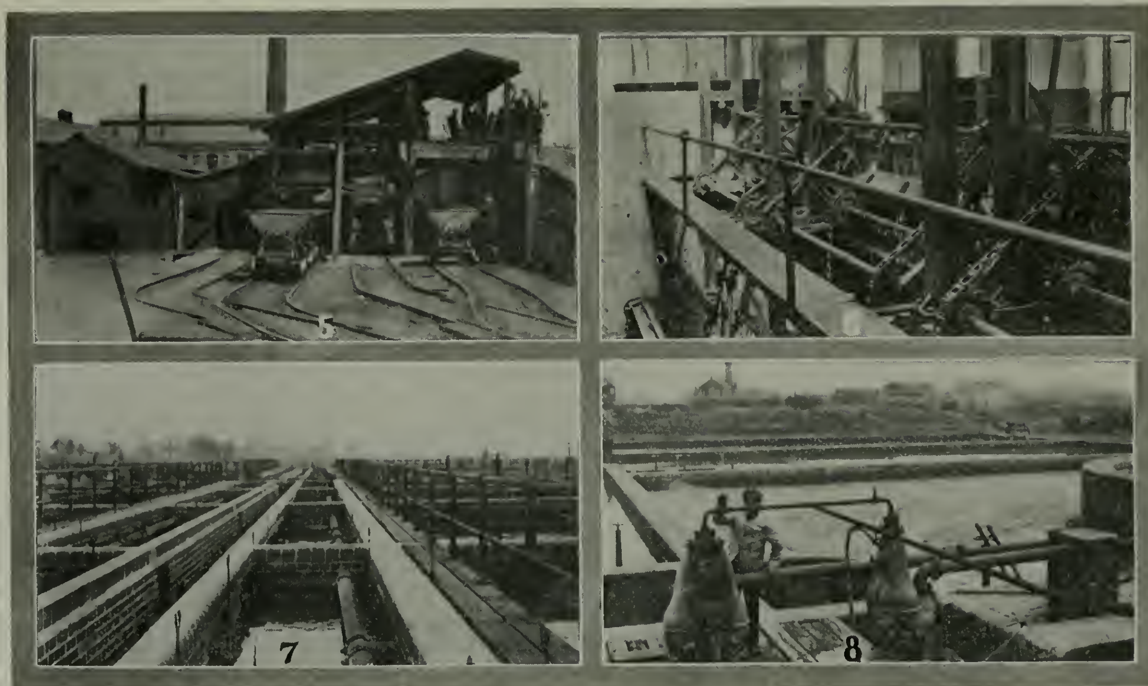


Fig. 5. Rewashing and Securing Cinders, Manchester, England.
Fig 7. Roughing Filters, Birmingham, England.

Fig. 6. Power Screens, Birmingham, England.
Fig. 8. Sludge Tanks and Pumps, Hanley, England.

is dug out and carted away as land filling. No appreciable odor.

At the time of my visit, June 4th, preparations were nearly completted for tests of the oxy-chloride process.

The Oxy-Chloride Company has covered one of the four septic tanks, installed an oil engine and dynamo, lime tanks, a treating tank whereby electrolytic action chloride is produced. A liquor of given chloride content is formed, 0.2 grain chloride per gallon, and this is fed by a float and weir to the inflowing sewage. The quantity of chloride can be varied for experimental purposes.

At the same time Mr. Bell, the resident engineer, intends to use milk of lime in two tanks in order that the relative cost and efficiency of the different methods may be compared.

At Birmingham a small white and black grub was noticed in large numbers in the underdrains and filter effluent. A small gnat probably from this grub was also present. At Stratford, this grub was absent, but on the surface of some filters —not all—a very small black and gray grub was just visible to the naked eye. Others are pink. This Podura is, according to Mr. Bell, a great factor in the removal of the black matter which clogs the surface of filters. Attempts to cultivate it on other filters apparently working under the same conditions, did not succeed and the reason does not appear.

A study of the numerous lower animal forms found about sewage works and the discovery of their function ought to be an excellent field of research.

The most interesting sewage works and engineer in England are at Hampton, near London.

The population served is about 10,000, and the volume of sewage is 30 gallons per individual per day. The system was formerly triple contact, but is now being changed to a tank and trickling filter system.

The tank designed by the engineer, Dr. W. O. Travis, is of interest, but his opposition to the so-called biological processes of purification is still more so. Dr. Travis maintains that in the short time occupied by the passage of the sewage through the works, there can be and is no bacterial action, that all purification is simply the mechanical separation of the suspended matter. The tank is therefore designed to promote sedimentation, and the effluent following the first filtration also passes through a settling chamber. Likewise following the second filtration through a finer material, the filtrate passes to a tank where sediment is deposited. Finally the fluid goes onto the third contact bed which will remain such for the present.

The "hydrolytic tank" consists of two narrow side channels, one-half of the sewage flowing continuously through each. Between them is a central and deeper channel. A slot at the bottom of the V-shaped side channels connects them with the central channel and permits one-fifth the total sewage to flow from the side channels into the central one. The purpose is to induce settlement and at the same time to drag the heavier matter at once into the central channel so that there shall be no gas formation in the outer channels with the consequent disturbance produced by the ebullition. From the ends of the side and central channels weirs lead to a second tank from which it flows to the filters.

The sludge can be discharged at any time out of the central chamber into a sludge well.

The sludge well is circular while the large tank is rectangular, but otherwise they are alike. Through this sludge well goes the sludge from the first filtrate. The entire second filtrate flows through this well on its way to the flooded contact bed—the last step in the process.

The clarification produced by the tank is very evident in samples. The amount of black matter extracted from the first filtrate is equally obvious. One is led to agree with Dr. Travis that the mechanical separation of irreducible material at the earliest possible moment is one of the fundamental principles of sewage purification. There has been too much dependence on biological methods to do the whole work.

But Mr. Travis's laboratory work is, if possible, still more interesting than his working plant. His hydrolyzing tank is worth studying, and the action exhibited there is very suggestive. One awaits with considerable interest the practical working of the plant recently erected at Norwalk.

Less still can be said here about the experiments made by Dr. Travis on sewage and other fluids, to determine the amount of biological action actually taking place. They were interesting even if one hesitated to accept the thesis.

The sewage of Paris is carried first through two large sewers to a grit chamber and power screens situated on the banks of the Seine toward St. Cloud. The grit is removed by clam shell dredgers and carried to the sea.

Centrifugal pumps raise the sewage to a tank from which it flows under the river and to the several large tracts devoted to irrigation.

The city cultivates certain small areas as models for the gardeners who till the rest. These special model gardens, and the whole area which I saw is a magnificent piece of fruit, flower and vegetable culture. Roses in profusion; the small fruits such as pears, cherries, plums, berries; the usual table vegetables. The

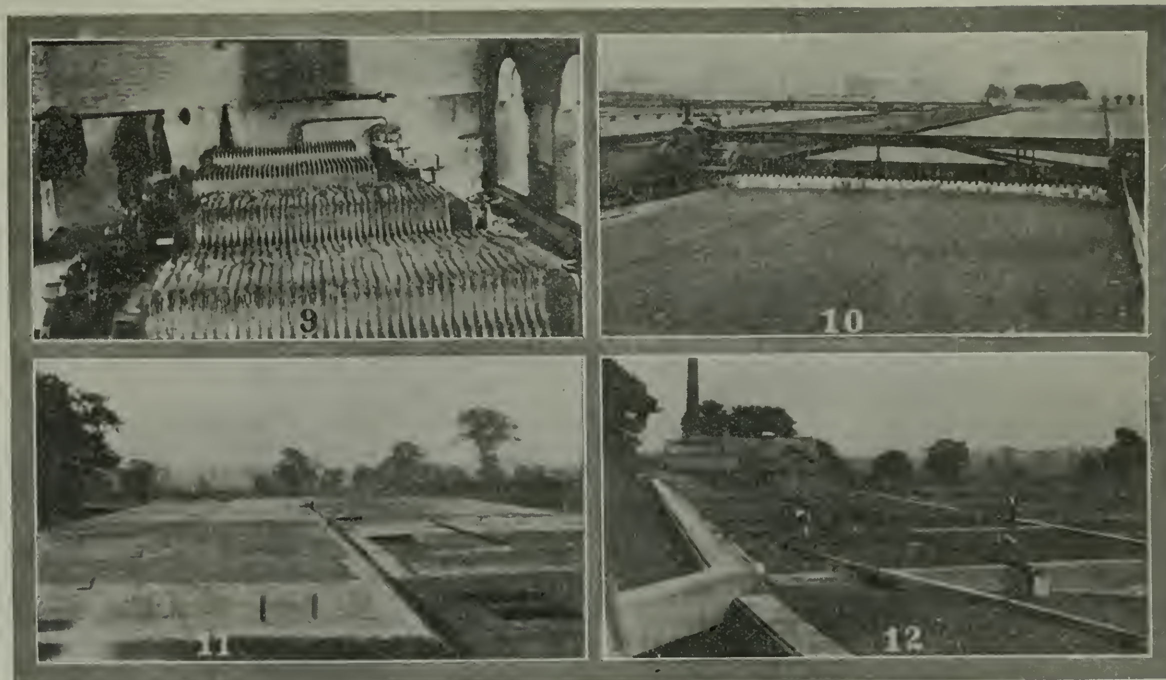


Fig. 9. Sludge Presses, Hanley, England.
Fig. 11. Travis Tank at Hampton, England.

Fig. 10. The Hanley Traveling Distributer.
Fig. 12. Changing Contact Bed to Filter, Hampton, England.

whole was artistically done. No odors were present.

A series of experiments was being conducted with a rectangular cinder trickling filter and two small circular filters.

The entire area observed is devoted to intensive market gardening.

The Berlin farms are likewise distributed at various places out from the city.

The total area controlled by the city was 15,000 hectares (37,500 acres) in 1907, and 17,404 hectares (43,500 acres) in June, 1910. Of the latter 9,241 hectares (25,000 acres) are under cultivation. There are 3,500 hectares (10,000 acres) of forest. The soil is principally a medium to light sand. About 34 cubic metres of sewage are fed to each hectare of land daily, and the results are satisfactory, according to the official report of June 23, 1910. There were 5,298 head of horses, cattle, sheep and swine being fed principally for market—except the horses.

The receipts exceeded the expenditures by 500,000 marks ($125,000) in the fiscal year 1909-10. (This probably does not consider fixed charges).

The farm work is directly done by city employes, men and women, who are housed in large buildings especially built for the purpose.

There is a marked difference between the Paris and Berlin farms, in the crop. Large areas are set out as nurseries for fruit and ornamental trees, other fields are in meadow, cabbage, beets, potatoes and similar crops which require large volumes of water. The Berlin farm has been noted as a money-maker, and its entire appearance is one of close, systematic thrift. The Paris farm is more beautiful.

But how long are vegetables raised on sewage farms to be eaten? Surely science must object strenuously to this anomalous situation. Fruits and vegetables are sold indiscriminately and eaten by all classes. It seems hardly possible that such foods, many of which are eaten raw, can fail to transmit disease. Yet here are two cities with supplies of pure water obtained at great expense and using vegetables grown on sewage farms. It would seem to be a strange development and one inconsistent with our views of the dangers resident in fresh sewage and street washings. It would be

Fig. 13. Berlin Sewage Farm.
Fig. 14. Paris Sewage Farm.

interesting to know what consideration this question has received in Paris, Berlin or elsewhere.

Finally it may be said that European practice is away from irrigation and toward filtration, often preceded by chemical precipitation. The acute discussion in England between those who place much faith on the theory of bacterial purification and those who oppose it will focus attention on the sludge question, which is the crux of the whole matter.

We, in the United States, may well take warning from some of the expensive experiments abroad, not to plunge too deeply into new and untried methods without careful investigation of their adaptibility to our conditions.

Relation Between Engineers and Contractors on Highway Work.*

By Onward Bates, M. Am. Soc. C. E., Chicago, Ill.

IN the first place, road work should be under the direction of an engineer; because the kind of work to be done, the quality of the work, the amount of it and the method of doing it should be determined by an expert. But, suppose the engineer is not an expert, what then? Do not be influenced by any such supposition. Work from knowledge and employ an engineer who is a road expert. There are engineers who are road experts, and there will be many such engineers developed as correct methods are adopted for road work. As the demand arises, the supply will arise to meet it. In any case, whether the work is performed under contract or otherwise, the road engineer is necessary.

The road engineer should know just what is needed. He should be able to plan and describe these needs, so that they are clearly interpreted to those who do the work. He must make his plans to conform to the funds provided to pay for the work. He should possess exceptional executive ability, for in his occupation there is an unusual spread of responsibility for the work itself, and for the number of interests which must be considered. Technical knowledge, good judgment and tactfulness are all essential qualities which he is expected to possess. His field of action is most attractive, for the reason that half of his problems are already solved. Experience is principally gained by the study of failures, and a knowledge of what has been so poorly done in the past will teach him what must be avoided in the future.

To improve the roads in any specified locality requires first of all a head to plan and to supervise the work to be done. This head, whom I designate as the road engineer, must be responsible for all the work in his district; and, since responsibility cannot be disassociated from authority, he should have full authority over the conduct of all the work for which he is responsible to the power that appoints him. The engineer must not be hampered in his work by any other consideration than the performance of his duty as engineer. He should have no affiliations, and should eschew politics, knowing all men only as citizens with a common interest to be served by him. A word of warning here for those who have the power of appointing the engineer—scarcely anything can be more subversive to the public good than to make a political appointment of such an office. The engineer should be chosen as an expert in his line of work, which leads to the conclusion that his office should be an appointive rather than an elective one. His appointment should be after careful examination of his qualifications for the office, and this can only be made by an appointing power which is capable of determining his fitness, and which is responsible for the performance of his duties.

In the second place, road work should be done by contract, because if we are expected to improve our roads we must make a business of road work; and, since the contractor is in that business, we need to engage his services. No better argument can be made in support of this statement than to call attention to road work which was not conducted as a business, and which was performed by men whose business was not that of road making.

A road contractor should know his business. He should know what constitutes a good road, and how to build it. He should be provided with tools and implements required for road construction and maintenance. If the road contractor follows road building as an occupation, it is expected that he will have such plant as will enable him to execute

*From a paper before the American Association for Highway Improvement.

work of the best character with economy of cost, in money and time, and that he will have a following of workmen familiar with road making. We may reasonably expect that road work will be done by a competent road contractor with greater economy and despatch than can be attained under a system where a local government undertakes to buy plant and employ men with which to do its own road work.

The engineer plans and supervises the work, gives instructions to the contractor, inspects material and workmanship and makes the contractor's estimates for payment. Contracts should be awarded by the engineer, or upon his recommendation. In general, the engineer directs the work and is responsible to the power which appointed him, for the performance of all contractor's obligations.

The contractor, on his part, must comply with all the requirements of the contract, and to this end is directly responsible to the engineer.

Thus it rests with the engineer and contractor to get the best roads possible with the expenditure of the people's money. It is obvious that they must pull together or the people will be losers. Their relations are defined in the contract for the work. In the ordinary forms of contract for work to be performed, the engineer is vested with full power of directing the operations of the contractor. The engineer makes the estimates of quantities and of values, upon which the contractor receives payment. It is his duty to fix the standards for material and workmanship, to inspect the quality of materials and of work, to accept such as conforms to the contract and to reject such as does not meet the contract requirements. Nearly all contracts give the engineer arbitrary power to decide all questions arising in the performance of the contractor's obligations; and most contracts state that the decision of the engineer shall be final and binding on the contractor. These powers conferred on the engineer appear to be the outgrowth of experience, and are perhaps warranted by expediency. For so long as the engineer is competent and fair the system works very well, but engineers have the qualities common to humanity, and it would be fairer to them if the provisions of a contract confined their decisions within the limits of justice. Experienced contractors sometimes find that contracts which they must accept, or go without the work, give the engineer such an advantage over them that they attach more importance to the personality of the engineer than to the terms of the contract. Speaking from experience, both as an engineer and as a contractor, I do not favor vesting the engineer with arbitrary power over the contractor's interests. We live under a constitutional government, and contracts between its citizens should preserve the constitutional rights of both parties. A contract which enables one party to work an injustice upon the other is contrary to public policy; and, whether it be legal or not, it conflicts with the principles which all of us claim as citizens. I believe it is possible to draw contracts which will secure the faithful performance of the obligations of both parties, and will at the same time protect the interest of the party at whose expense the work is carried on. Under a general system of road improvement throughout the country, equitable forms of contract will be developed which will supersede forms that are found in practice to be objectionable. Bring together the expert engineer and the competent contractor and it will be found they can work together in harmony and obtain the best results for the community which employs them. It would seem almost superfluous to make the statement that the best form of contract is that which covers the obligations of both parties in the simplest and plainest terms, leaving out all unnecessary language. And yet it is well to be reminded of this, for many contracts for performance of work are so unintelligible that both engineer and contractor find it difficult to decide what are their respective obligations.

Specifications for material and workmanship are usually attached to and form a part of the contract. The preceding remarks favoring brevity and simplicity in the wording of contracts apply with equal force to the specifications. Instead of trying to include in the specifications everything under the sun, it will be better to omit from the contract all items of uncertain and indeterminate character; and this will avoid the necessity of describing and specifying their value and extent.

In the interest of economy and efficiency the work should be classified and grouped in the most convenient manner for letting it by contract. The work should be of such character and volume as will enable the contractor to make favorable prices. The engineer should also try to arrange the work so that a contractor may work continuously through the working season. The expenses of organizing and starting work are understood, and should not be repeated any oftener than is necessary. Changing contractors or employing them at intervals of time involves what may be called "contractor's terminal expenses;" and if these can be avoided there will be a considerable saving in cost, which should be recognized in the contract prices, and the saving divided between the parties. Better prices for work and better service will be obtained from an established local contractor, who, in looking to the work as a means of livelihood, desires to retain in his service experienced workmen and to keep his plant employed, both of which are necessary for economical operations; and he will thus be in a position to make more favorable proposals for the work than when making ventures with scattering bids in various localities and with unfamiliar conditions.

In advocating the contract method of doing road work, I recognize that some work can be more effectively handled by day labor or by special arrangement. There is a distinction between road making and road maintenance. The former may be classed as intermittent work, and the latter as continuous work. Maintenance and repair work will frequently be of such a nature that it cannot be advantageously contracted for; and the engineer must provide for this class of work by day labor, or by some method which is suggested by his experience. In general, it is better to contract for all work which is adaptable to that method. The engineer's operations may cover an extended field and cause him to be unable to personally supervise the work, in which case his inspectors or other assistants must act for him; and they can be better employed in controlling results of work done at the contractor's cost than in becoming responsible for the value of work done by the engineer's employes, who may be so scattered that the cost of supervision will equal the wages paid to the workmen. Another reason for avoiding the direct employment of workmen is that it means the purchase of tools and implements for the workmen; and this will always be unprofitable unless there is sufficient work to wear them out. There is scarcely a worse investment than contractor's outfit which is not employed.

It is not uncommon for a contract to specify that the contractor shall guarantee his work for a certain period of time, sometimes reaching into years. There may be cases where a contractor's guaranty is justified, but it is a questionable practice. Competent engineering will require and secure good work. When a contract is completed the engineer should know that the contractor has given the full value of work specified in the contract; and he should be in a position to pay that value in full. The engineer's employment should be continuous. He should be a permanent officer of the local government, responsible to his superiors for construction and maintenance of the roads. This responsibility, as has been stated, should clothe him with the authority necessary to secure the ends he is employed to attain.

Since the engineer is the official who makes the plans and controls the execution of them, while the contractor works under his instructions, subject to the terms of the contract, any suggestions as to road making should be addressed to the engineer, who will communicate to the contractor as much of them as is necessary in carrying out the work. I purposely avoid mentioning details of contracts, plans and specifications, all of which the engineer must fit to the particular problems he is called on to solve; but, in a general way, I venture to suggest some of the elements of road engineering necessary to be observed in his practice.

He must always maintain an equilibrium between the amount of work he plans to carry out and the funds available to pay for this work. The kind and amount of work will be limited by the sum appropriated for its cost. He must decide whether the limitation shall be placed on the kind or the volume of the work. As a general proposition, the character of the work should be uniform. To secure this he may have to sacrifice his ideals and fit the character to the circumstances controlling the case. The efficiency of a road is determined by the tonnage hauled. For a given distance of haul, unless the road is of uniform quality, the haul will be limited by the worst portion of the road. There is, therefore, such a thing as making the road—or at least a portion of it—too good, if the funds are not within sight to bring the whole distance to the same good quality.

In a rich and populous state, where the people have awakened to the necessity for good roads and contemplate the expenditure of more than one hundred million dollars to secure that end, it is very well to say, "We will build no cheap roads," and to fix a standard of $5,000 or $6,000 per mile for construction. On the other hand, in the case of a state with a population less in density and with a much smaller provision of funds, and yet with, say, 80,000 miles of highway within its territory, it would be folly to adopt such expensive construction. This wonderfully prosperous country owes its prosperity more to its development through the construction of cheap railways than to all other causes combined. The economic results obtained by cheap first construction, in order to provide intercommunication throughout a great area, have been demonstrated beyond question in the case of railways; and the principle has equal application in the matter of highways. The improvement of highways is not to be accomplished by spending all the available money in spots. These highways are for the whole people, and all of them are entitled to benefit by the expenditures. Improve the condition of communication by giving them the best roads they can afford at the present time, and the resulting increased prosperity will provide the means for bringing them to the desired standard. The kind and amount of road construction depends upon conditions, and should be determined by the exercise of good judgment on the part of the engineer.

He must also plan to maintain the road to the standard of quality planned for its construction. This means attention and repairs to meet the deterioration resulting from wear and weather effects. The old adage of "a stitch in time saves nine" is nowhere more applicable than to road maintenance. This is a most important consideration, and it emphasizes the requirement that the office of road engineer should be a permanent one. The maintenance of roads requires a knowledge of all the conditions affecting them. The engineer stands toward a road in his care of a road as a doctor does toward his patient, and to diagnose the case of a road the engineer must feel its pulse, take its temperature and learn all about it. A helpful and satisfactory way of doing this is to keep statistics of work done, of cost of repairs and of the times and seasons of treatment. These statistics can be diagrammed so that the engineer may, with a hasty glance, read the record and learn both what has been done and what is needed to be done.

The road engineer will, in the future, be judged by his performance, as compared with what is accomplished elsewhere. If a system of good roads is promoted throughout the country, there will be precedents and new records established for road work, in kind, quality and cost, which will, from time to time, fix new standards in these respects.

It may appear that my remarks about the duties of engineers are out of place in a brief address on the relation between engineers and contractors, but I have made the digression advisedly, as I will now try to explain. A fair consideration of the work and duties of the road engineer will bring many of us, who have practiced the profession in other lines, to the realization of the great field of employment opening to us in this particular class of work. The practice of the road engineer will require knowledge, skill, experience, judgment and business qualities of high grade, which will lead many of us to engage in this special line of work. This will benefit my profession, and in a great degree will benefit our nation. For the contractor there will be provided a steady and profitable business, which from its nature can be conducted in a moderate way with small capital, a most desirable condition in these days when there is so great complaint about the monopolization of business by combinations of capital, which closes doors of opportunity to men of small means with capacity to work for themselves. The time is auspicious for the road engineers and the road contractors.

Bituminous Roads.*

By Major W. W. Crosby, Chief Engineer of Maryland Roads Commission, Baltimore, Md.

FOR surfacing roads in cities—usually called streets—the larger practice in the use of bitumen has been to use it in the form of asphaltic cement, such as in sheet (or block) asphalt pavements. Such pavements, under proper conditions, give good satisfaction at reasonable expense. The first cost of them varies between $1.50 and $3.50 per square yard, however, and in recent years an effort has been made to secure a similar surface, of even wider applicability, at reduced cost. Incidentally, success in this line would offer a much-needed surfacing for filling the gap between the best macadam—cheap, but sometimes of questionable satisfaction—and the rather expensive asphalt pavements referred to.

In this effort the use of cheaper bitumens, such as the tars, for instance, has been tried, and also new methods and mineral materials for the body of the pavement cheaper than the graded hot sand required for the sheet asphalt. Much success has been had, and naturally some failures.

Bituminous roads proper constitute a

*From a paper before the American Association for Highway Improvement.

modern development to meet both the actual needs under modern traffic and the desires of modern civilization for great efficiency, comfort, satisfaction and better sanitary conditions. The advent of the motor vehicle has greatly changed the conditions under which a road existed. Good roads are in greater demand, owing to the greater radius of action of the automobile. Smoother roads are more desired, because of its sensitiveness, at its greater speeds, to slight inequalities of road surface. More cementitious surfaces are needed, due to its ability to destroy the bond of the stone surface, to cause internal friction and wear of the pieces of stone forming the crust, and to render the road thus more susceptible to the elements. And, further, the dust, which formerly lay on a good road surface and which, when not too profuse, was not only not seriously objected to but was of some actual value in the protection which it afforded the stones composing the road, has been violently brought to our attention by the motor, so violently and powerfully, in fact, that we are now well aware that, under present conditions at least, the disadvantages, discomforts and unhealthfulness of this dust far outweigh any good it may formerly have possessed.

None of us believe that the remedy for this state of affairs is the abolition of the motor vehicle. So the remedy seems to be to cure the defects of the road. And the speaker wishes to here again repeat what he has frequently said before: There is no one "best way" nor one "best material." The decision as to method or material to be used must depend in each case upon conditions of traffic, availability of different materials, desires of locality and probable changes of conditions during the life of the work decided on to be done. A clear recognition of this fact is important for good work and economy. It is somewhat surprising how often it appears to be overlooked, even among those who would be expected to appreciate it most.

Let us suppose now that we have the improvement of a certain road contemplated and that the details have all been worked out, except as regards the road surface itself. That there is no question but that as soon as the road improvement is completed a considerable number of motor vehicles will use the road daily; say, not less than twenty every twenty-four hours. Then there is no question but that the road should be treated with bitumen either during or immediately after the construction of the surface with gravel, shells or broken stone, if economical and satisfactory maintenance is to be had. Its treatment may also be justified for other reasons.

There may be said to be three ways in which a road surface may be treated with bitumen. There are:

A. The mixing method.
B. The penetration method.
C. The method of surface applications after construction in the ordinary manner.

A choice of these methods depends, as before stated, upon conditions. Such choice may be largely affected by traffic conditions, but it is not yet clearly established just what amount of traffic demands justifies a selection of one method from the others. We are acquiring information on this point, and it is hoped it may soon be clear.

Generally, however, the choice is largely affected by other considerations, such as of comfort, health and satisfaction to the users or abutters; and the speaker believes that in making the choice, it is well to be on the safe side from all these viewpoints. It is almost inevitable that, once a road is well improved, the previous traffic records will become almost worthless, except for historical purposes. Consequently, he believes that apparent extravagance in the choice at first may often prove later to have been true economy.

Although the speaker referred to construction alone in the foregoing, the remarks apply equally well to reconstruction or repairs to a road that has deteriorated beyond the point where a surface treatment alone can be safely expected to relieve the needs. At this point the speaker must inject the remark that it is his opinion that reconstruction is often attempted when a thorough surface treatment is all that is needed—not true economy. He is convinced that in the near future the use of proper surface treatments will be far wider and of greater satisfaction than it has been up to the present.

Now, the mixing method, as the term is generally understood, consists of mixing with the mineral material composing the wearing course of the road a sufficient amount of bituminous cement. This mixing is usually done at a plant off the roadway itself, and even perhaps some distance from the site of the work. The materials may be mixed, either heated or at the normal temperatures of either, or both, according to the method and materials employed, and by hand or by machinery for the purpose, as desired. The mixed material is then taken to its place, spread and rolled and then frequently given a flush coat of bitumen and grit and again rolled. Satisfactory results from this method cost from 30 cents to $1.50 per square yard over and above what would have been the cost of an ordinary modern water-bound road under the same conditions. The advantages claimed for the mixing method by its advocates include great uniformity of surface and of composition of same, maximum value of surface for materials used, economy in use of materials, maximum life of surface and economy of results. There seems to be no question but that the mixing method has been proved capable of producing high-class results. .There is grave doubt if it has always been the economical method to follow; and there are many instances of its utter failure. The mixing method frequently involves a considerable investment for machinery, and with its first cost has led to the development of the penetration method.

In brief, the penetration method consists of simply applying a coat of pitch to the wearing course of the road just before the binding of this course by dusting, watering and rolling, as usually practiced in modern water-bound work. The pitch may be applied cold if properly prepared, though it is usually used hot. After its application the pitch is coated with grit and the road thoroughly rolled. The cost of the penetration method varies between 10 and 60 cents per square yard, above the cost of water-bound work under the same conditions, according to methods, materials and quantities of the latter used. The advantages claimed by its advocates include sufficient uniformity of surface, economy in first cost, economy in long run, simplicity of operation and avoidance of complicated and expensive machinery, not to mention freedom from interference by patent infringement claims. There is no doubt but that high-class results can be secured by the penetration method. There are plenty of records of failures, however.

The method of surface treatments is only applicable to road surfaces already finished under other methods, usually to old or new water-bound work. In brief, the method consists of cleaning the old surface to be treated, so that it shall be free from all fine material and refuse, even to washing it with water, if this be necessary. After such cleaning, and when dry and as warm as practicable, the pitch is applied, allowed to soak into the surface for a longer or shorter time, as the material used may demand, then covered with grit and rolled. The process of applying pitch and chips may be repeated immediately, or after an interval, as may be necessary. Sometimes two or more applications of pitch and chips are necessary for satisfactory results; and the interval between applications may vary from a day or so to a year or more, depending on local conditions. The pitch may be spread by hand or machinery, as convenient; and either cold or hot, as its character may permit.

Tht cost of surface treatments varies from 5 to 20 cents per square yard. The advantages claimed for this method by its advocates include simplicity of work, economy of first cost and, in many cases, economy in long run, lack of serious interruption to use of the road, ease of repairs and renewal. Unquestionably, satisfactory results have been secured under the method of surface treatments; and the speaker believes this method offers an easy and economical way for the revivifying of a road, about to otherwise need resurfacing at a far greater cost under the old water-bound methods or under either of the other two methods of employing bitumen.

The earlier success of the mixing method and the consequent attracting of attention to this method led many road workers to rush into it, believing it to be a panacea for all the road ills they were familiar with. A little later its extravagance it many cases became apparent, and the penetration method received some followers. Still later the unnecessary expense of even this method became apparent for many cases, and the method of surface treatments developed. Unquestionably, each method has its uses, and the proper selection of one for a particular case is the end to be aimed at. The sphere of action of each is merged with or overlapped by those of the others; and it will be some time yet before they can be clearly separated. The method of surface treatments is particularly applicable to use on old roads; and, as water-bound roads will predominate for the near future at least, so will surface treatments grow in use.

The speaker is unable to wholly agree with a statement that had been made elsewhere to the effect that "the water-bound road is a thing of the past." He is yearly building a hundred or more miles of water-bound road and looks for such work to be continued indefinitely, as there are many localities where dustiness is less objectionable than increased first cost. But as these water-bound roads develop traffic over them, and as their extent and age increase, there comes a time when treatment is demanded, and then surface treatment with pitch is often most advantageous and satisfactory.

In each of the methods referred to a variety of materials may be used. At the present time, except possibly in the case of certain asphalts used for pavement work, the critical characteristics of a bituminous material to insure its being satisfactory in use under any definite method or conditions are not settled. Gradually, experience with them is clearing up the problem; but it is likely to be some time yet, owing to the variety already available and new forms yearly coming out, before definite knowledge will be had. Such knowledge will, of course, be hastened by co-operative effort, such as this meeting, and carefully co-ordinated records of work done, which records are already being collected by the committee of the American Society of Civil Engineers. About all that can be said now is that certain materials will generally give good results; many materials will be satisfactory when properly used; some are extremely limited in their application; and some are practically worthless.

In the foregoing we have perhaps dealt mainly with the use of bitumens or pitches in connection with ordinary road materials. And, it may seem that it all was toward the end of improving what would, in many cases, have been a fair road, or under earlier conditions have been an excellent road. There is, however, another large consideration for the wider use of bituminous materials in road work. By such use many materials otherwise unfit for road surfaces; such, for instance, as the harder sandstones, granites, flints, etc., without binding powers can be most satisfactorily availed of to great advantage in many cases. Also, by the use of bituminous materials, oyster shells, marl and even sand, can be made to cheaply form a road surface that is both highly satisfactory and most economical in a great many instances. And again, by the use of a relatively light and cheap "carpeting" of pitch and stone chips on its surface, the speaker believes many, if not all, of the defects of concrete for a road surface will be overcome. If so, a large avenue is opened for progress toward satisfaction and economy.

The selection of proper methods and materials to fit the conditions is the particular province of the unbiased and competent expert, and should not be attempted by the inexperienced nor entrusted to an ignorant or prejudiced party, unless failure in some feature of the work is to be expected.

The speaker wishes to briefly suggest two thoughts more:

The first cost of bituminous roads is not a correct basis for the proper comparison of either materials or methods. Desirable, even satisfactory as such roads may be, they, like all other roads, also require maintenance. This maintenance means expense, even though reduced from the earlier figures for such work. And such maintenance should be, with bituminous roads as well as with any others, prompt, sufficient and efficient.

Contracting Practice.

By DeWitt V. Moore, Mem. Am. Soc. Eng. Contr., Indianapolis, Ind.

Progress Reports and Diagrams.

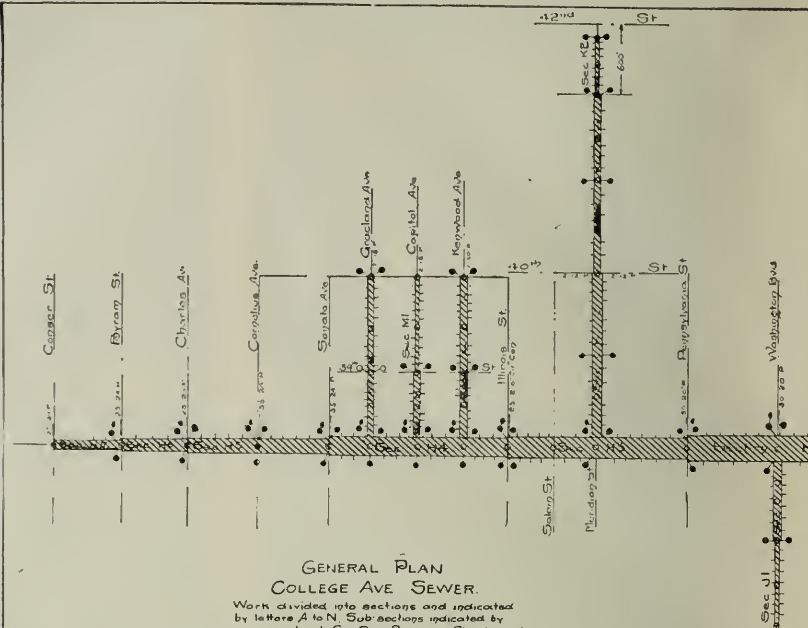
In beginning the construction we have as a basis for our cost keeping and cost analysis the Itemized Quantity Estimate, Plate VI, and Itemized Cost Estimate, Plate VII (August number). In connection with these estimates we have our sketch plans properly divided into sectional divisions, illustrated by Plates IV and V (July number), reproduced herewith.

We have shown that these sketch layout plans are of a benefit to the proper analysis of the work preparatory to the preparation of the estimate and proposal.

Now, in order that we may harmoniously conduct our work with a reference to this preliminary study, these sketch plans are developed and perfected and general progress charts are prepared, giving thereby a picture of the work to be performed and upon which, by the use of colored pencils, the progress of the work can be indicated day by day. In all of the study of contracting practice, in the preceding issues, with reference to forms for estimates, bookkeeping, etc., the effort has been made to recommend such forms as may be used for all the different jobs regardless of the character of same; and there is no doubt but what this can be accomplished.

When it comes to the subject of progress charts there can be no standard, as each and every job must necessarily be handled with reference to the character of the work; and we therefore make the following recommendations:

1. The general progress chart should consist essentially of a condensed plan, or profile, or both, on a small scale, thereby not only serving the purpose of a progress chart, but also giving a picture

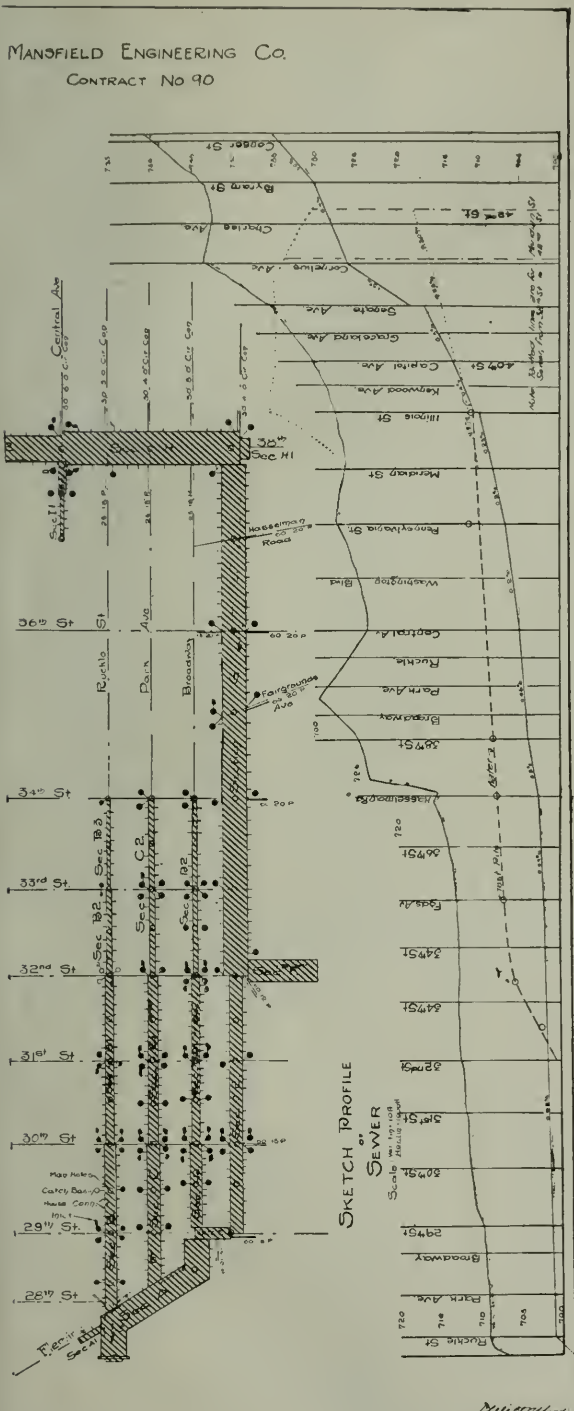


GENERAL PLAN
COLLEGE AVE SEWER.

Work divided into sections and indicated by letters A to N. Sub-sections indicated by numerical sub-fix. See Progress Charts and system of daily reports, also table below.

Section	Location: In	Location: Between		Type: Con	Type: P	Length	Av. Cut	Excavation, Cubic Yards: Estimate	Actual	Surp	Concrete: Yards per Foot	Concrete: Total	Type of Mach: Excav	Type of Mach: Concrete	Progress: Rate Beg	Progress: Rate Com	Av per Day	Foreman	Per Ct	Remarks
A	Flem.		29th	6-0		1265	8	3186		2024	.519	657								
A1	Flem		R'hle		24	350	12	454		67										
B	Ruckle	Flem	30th	3-0		1310	9	2402		747	.285	375								
B1		30th	32nd	2-6		1345	9	2194		592	248	334								
B2		32nd	33rd		20	668	16	1380		126										
B3		33rd	34th		18	645	16	1147		105										
C	Park	Flem	30th	3-0		1150	10	2343		656	.285	328								
C1		30th	32nd	2-6		1340	9	2233		590	.248	332								
C2		32nd	34th		20	1320	8	1832		261										
D	Brd'y	29th	30th	3-6		670	9	1228		382	.285	191								
D1		30th	32nd	2-6		1350	10	2500		594	.248	336								
D2		32nd	34th		20	1315	8	1332		250										
E	College	Bd'y	32nd	3-0		2325		4736			285	663								
F	32nd	Coll.		3-0		400	12	1278			441	176								
G	College	32nd	38th	6-0		3940	13	16128		6304	.519	2043								
H	38th	Coll.	Cent	8-0		1325	34	12936		3678	1.048	1389								
H1		Coll.		5-0		65	23	416			441	29								
H2		Cent	Penn	6-0		1325	21	8743		2120	.519	688								
H3		Penn	Ill'is	5-0		1325	19	6998		1590	441	584								
H4		Ill'is	Sen	4-0		1333	17	5464		1335	.365	484								
H5		Sen	Chas	3-3		1005	18	5832		605	.304	306								
H6		Chas	Byram	3-0		510	14	1432		241	.288	145								
H7		Byram	Con'r		24	500	15	973		95										
I	Cent'l	38th			15	345	14	540												
I1					12	345	14	447												
J	Wsh Bd	38th			18	690	16	1432		100										
J1					12	700	12	404												
K	Merid	38th	40th		20	1330	23	3968		150										
K1		40th			18	1270	22	3105		100										
K2			42nd		15	600	13	866												
L	K'nwood	38th	40th		20	1285	12	2000		126										
M	Capitol	38th	39th		20	370	14	1000												
M1		39th	40th		18	715	14	1113												
N	G'l'land	38th	40th		18	1285	14	2063		100										

PLATE IV. CONTRACTING
Outline of Work for



PRACTICE.
Sewer Contract.

of the entire work to be performed, with the various parts in their proper location with reference to the work as a whole.

It is needless to say that in making such small plans it is necessary many times to distort certain detail features, but the general layout may be so drawn as to be strictly to scale.

2. These progress charts should be supplemented where the work is divided into many sections by tabular information which would be confusing if the attempt was made to make notations directly upon the plan. This idea is shown by Plate IV, reproduced herewith from the July number.

3. These progress plans should be supplemented by detail large scale progress charts for each section of the work. These detail charts need not be finished drawings, but may be very crudely prepared, and generally can be obtained by quick tracings from that portion of the working drawings under consideration. They are to be colored in detail, and should be considered in the cost accounting accompanying the time sheets. Generally speaking, such charts will remain on the work for inspection during the week and will be sent to the bookkeeper at the end of the pay-roll period, for a recording of quantities on the pay-roll distribution book, Plate XVIII (December number).

Quantities should be recorded at regular intervals at the same time as the preparation of pay rolls. This quantity should be accumulative; in other words, the gross amount of work accomplished to any date should be so stated, instead of attempting to calculate the work accomplished for each pay-roll period. This latter method leads to error in the overlapping and uncertainties.

These detail charts not only serve the purpose indicated of supplying the data for the computing of quantities, but they also serve as a permanent record of the work accomplished during any period; and this information is a great many times of the utmost importance in financial settlement of the contract, especially where the same goes into litigation. At this point it is well to call attention to the fact that no work of any consequence should be constructed without progress photographs. These photographs should be taken at regular intervals, coincident with the end of the pay-roll period and the coloring of the progress chart. Under this system we have a thorough field record of the job; viz.: By the time sheet we have a record of the forces employed, the cost thereof, and where such labor was employed; by the detail progress chart we have pay-roll dates, and by the indication by colored pencil a complete record of the work accomplished and the progress of the various kinds of work; and by the photographs we have a pic-

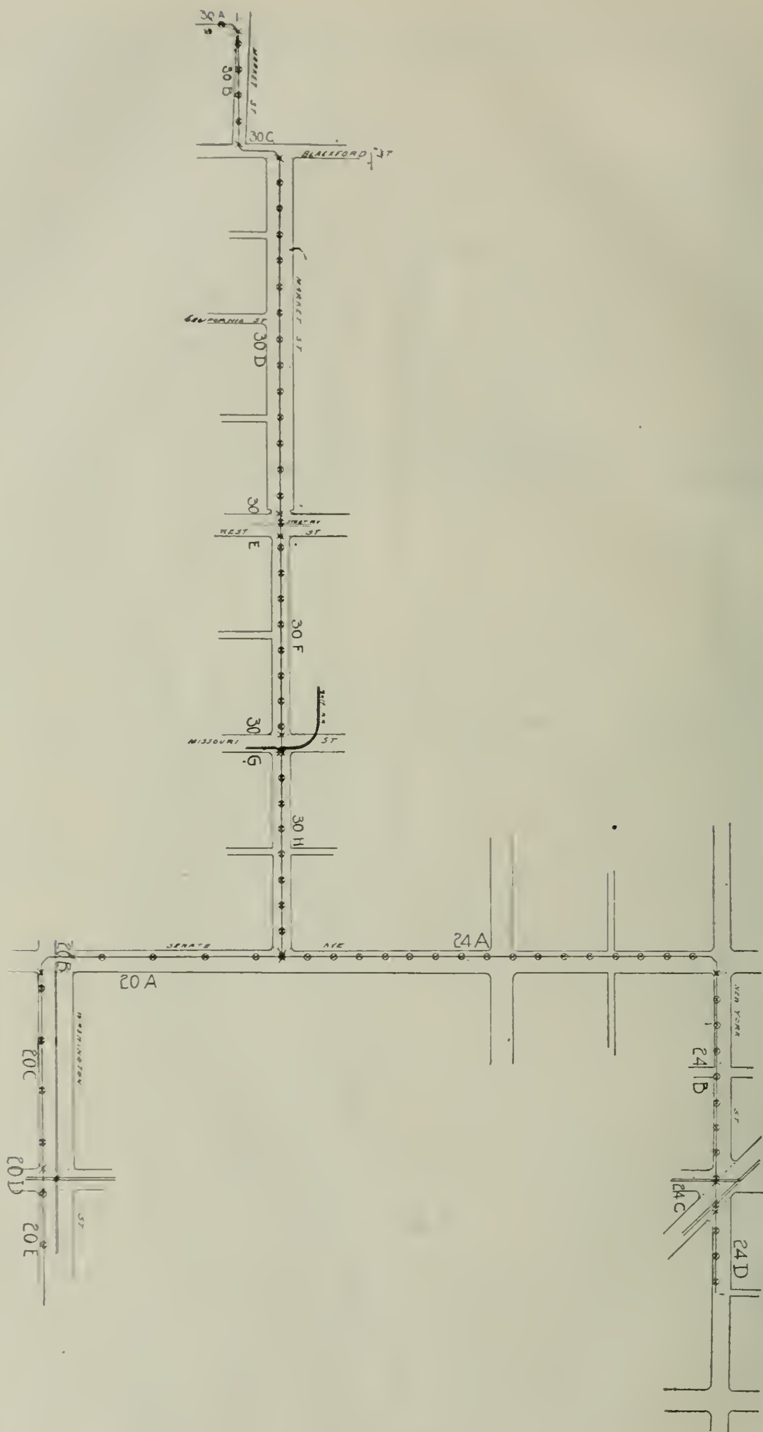
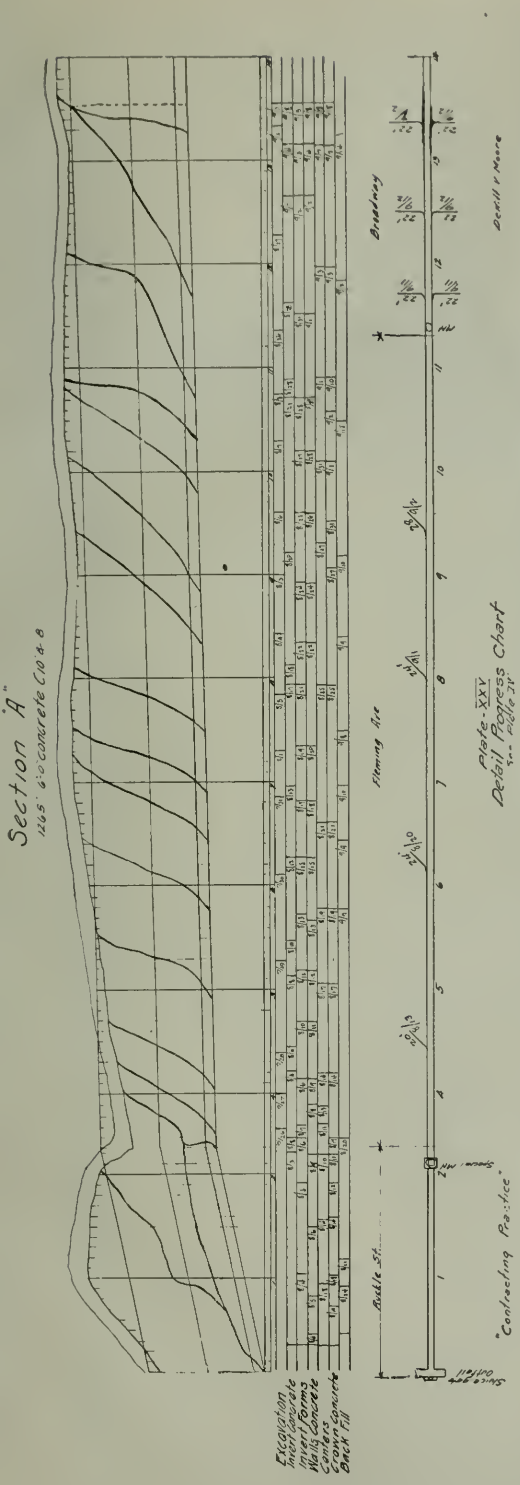


PLATE V. CONTRACTING PRACTICE.
Layout of Section on Reinforced Concrete Conduit.



torial record substantiating the first two records.

These photographs should preferably be 8x10 inches and should be marked on the plate with a consecutive number, date, name of work, name of contractor and name of photographer. These should be kept in consecutive order in a binder. In case of trouble or litigation in making a statement, these photographs may be referenced by notations on the back thereof with reference to plans of the work and with reference to time sheets and progress chart.

As before mentioned, the preparation of the progress chart depends entirely upon the character of the work. Plate IV is an example of the method of handling a sewer proposition. Plate XXV shows the preparation of the detail progress chart, covering section "A," shown on Plate IV. From time to time the progress on this section is shown by the use of the colored pencils, indicating the advancement of the excavation, concrete forms, back fill, etc. The chart is nothing more nor less than a quick tracing from the working plans and profile with the addition of the 10-foot station lines and the horizontal lines below the base line of the profile for the purpose of providing space to indicate the dates of advancement of each class of work. These sheets also offer the opportunity for notation as to the exact point at which special difficulties or extra work were encountered. From time to time, as these progress reports are turned in at pay roll intervals, the general progress chart is so colored as to indicate the advancement of the contract as an entirety.

Plate V (reproduced herewith from the July number) was in its final form supplemented by profiles and tabular information, the same as Plate IV; but, inasmuch as in this case the work was of very nearly uniform depth, width of cut and character of excavation, different forms of detail sectional progress charts were adopted.

As this conduit was to be built through the principal portion of a large city, it was known that interferences and complications would arise, due to sewers, water and gas pipes, street railways, etc., and that many modifications, changes and special work would be required.

Sheets were therefore prepared, showing the work in plan on a scale of one inch to equal twenty feet, and upon this sheet was indicated the location of these complications as they were encountered.

Upon the completion of this work these detail progress charts, with the accumulation of notes made thereon, became a very valuable source of information. It was not only valuable in the final adjustment of the contract, but a copy was furnished the client and served as a permanent

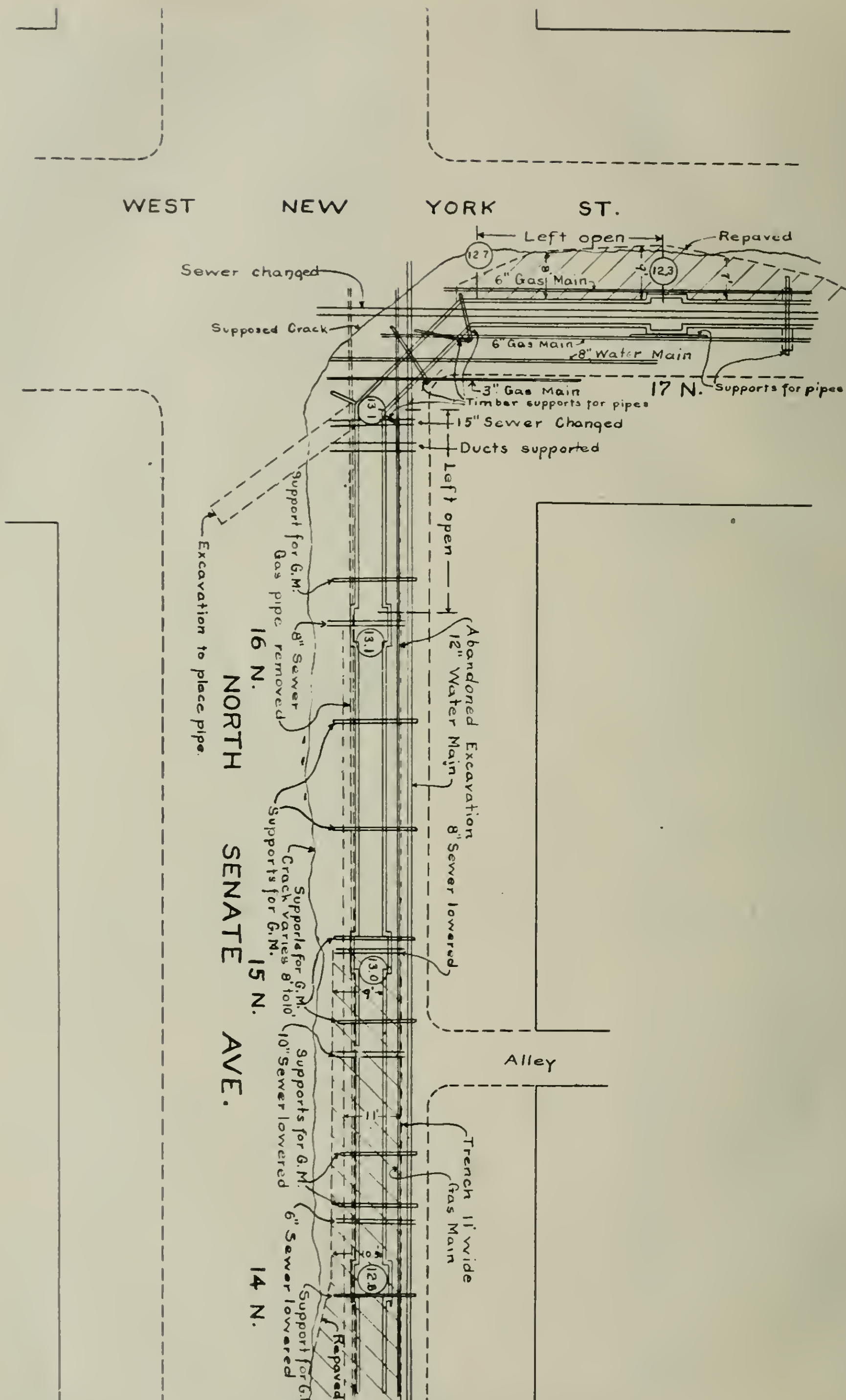


PLATE XXVI. CONTRACTING PRACTICE.

record, showing the work as actually constructed in its position with reference to all of the previous underground and surface work. One sheet of this system of progress charts is shown in Plate XXVI.

In the case of a building it is generally possible to combine on one sheet the foundations, floors and roof by separate sketch plans. These sketch plans may be distorted in scale and show clearly columns, and by a multiplicity of lines around the exterior of the building indicating progress of walls, facing, etc. It is also sometimes advisable to sketch longitudinal transverse sections which constitute in a sense the general progress chart. Naturally any work, such as a building, which is almost entirely above ground, need not be treated as liberally as underground work, where the completed work is covered and concealed for all time, unless the records are taken during construction.

Bridge work may be treated the same as building work, except all that is necessary is a plan and a longitudinal section.

Street paving—sidewalk work—yields itself nicely to the method employed for sewer construction, Plates IV, V, XXV and XXVI.

At the end of the pay-roll period we have, therefore, in the office our progress chart, showing the work completed, and the time sheets. The quantities of work to date, as shown by the progress report, are computed; and this may be done very quickly if the Itemized Quantity Estimate, Plate VI (August number), has been properly prepared in detail. Emphasis is again laid on the fact that this itemized quantity estimate is of constant value as a reference sheet during the progress of the construction, and saves many an hour in supplementary recalculations. The labor cost and these quantities of work are now recorded in the pay roll distribution book, Plate XVIII. Continuously during the progress of the work the invoices for material purchased have been received; and, where there is any question as to what the material is to be used for, such information has been obtained from the field forces. It is customary to stamp invoices as soon as received, calling for approval, with a space provided for information "For What Used."

This detailed distribution of material is now posted on the material distribution book, Plate XVII.

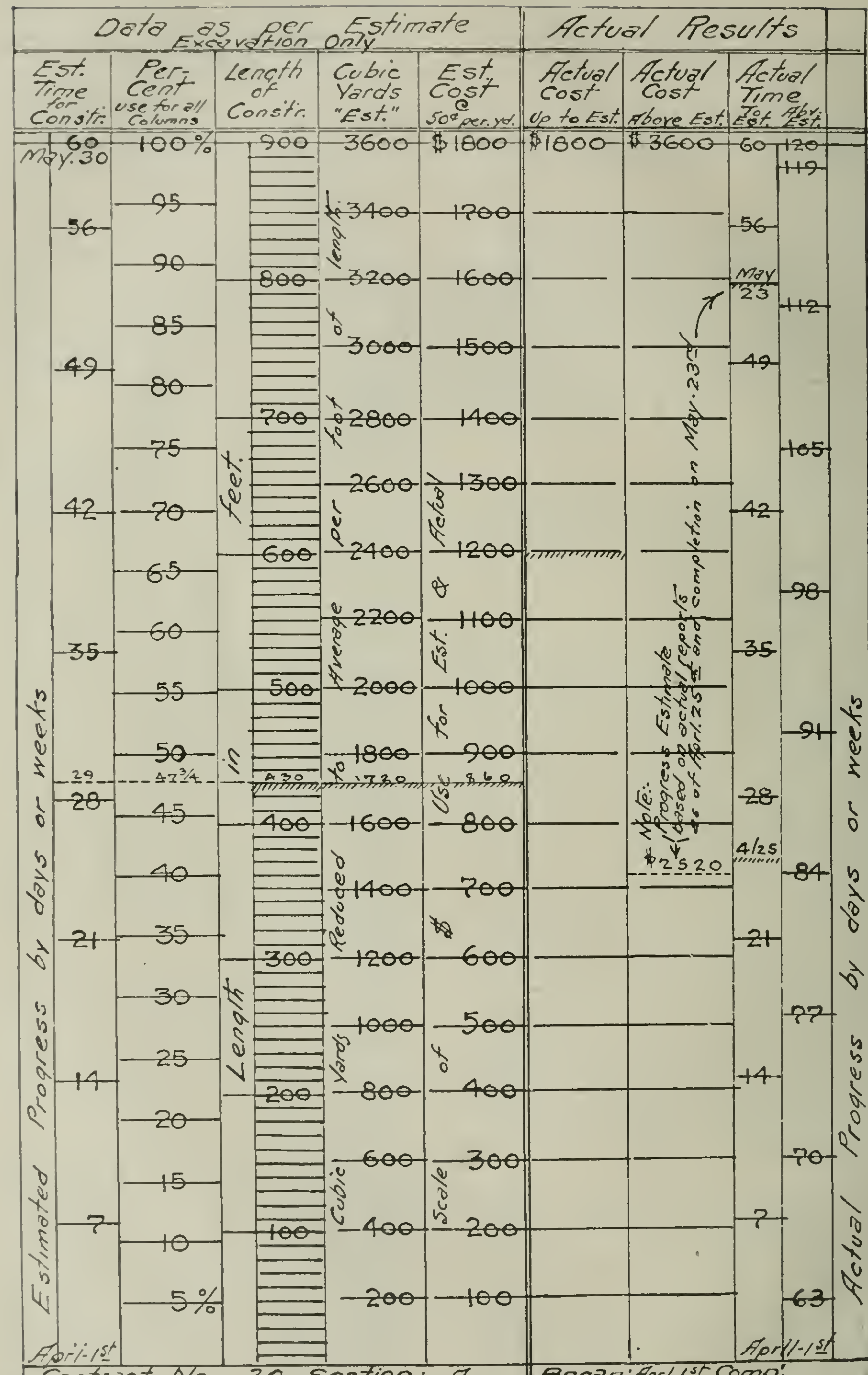
From this information we may now proceed to make a progress estimate which should follow the same form as the Itemized Cost Estimate used for proposals, Plate VIII (August number), making changes only in the quantity of work to be done (in case it has been demonstrated that the preliminary estimate is wrong) and a revision of the unit prices in line with the contract prices for material, and the cost of labor, as shown by the timekeeper's report. Such a progress estimate serves as an analysis of the work to be done in the light of growing experience on the work itself. Such a method will give a better idea from time to time of the actual condition of the work, as to its money making or losing status and probable outcome than the regular books.

These progress estimates furnish the information as to the probable final outcome, but they also show in detail just where and in what the modifications have occurred, and the work where gains or losses are being made. This information is valuable, as it permits us to exert our best efforts on those parts of the work where losses are being made.

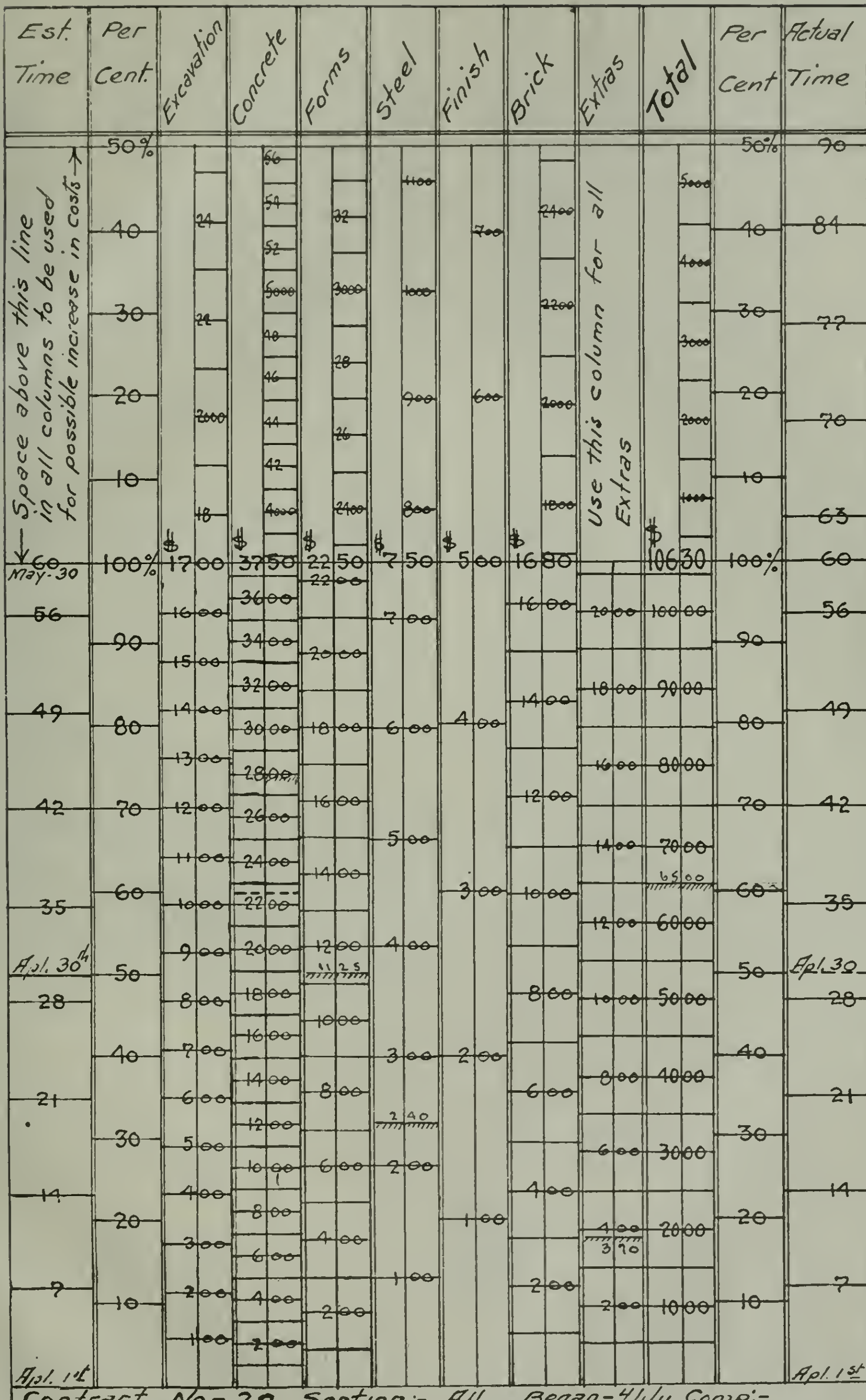
To one familiar with the work, it takes but a short time to prepare such progress estimates; and the one making the same will be many times surprised to find, by making such a careful analysis of the work, that his personal observation in the field is in the wrong. If the work in the field is proceeding nicely, and excavation is being crowded in order to keep ahead of other classes of work, in which we are possibly more interested, we may lose sight of the cost of this excavation work; but, by the study through progress cost estimates, we may arrive at a decision to change the methods of excavation or even readjust the progress of the work, in order to keep the cost within reasonableness. In other words, in a case of this kind it is possible that a loss on the heavy bulk of excavation, at a few cents per yard, is more than can be overcome by a large decrease in unit cost of the relatively smaller quantities of concrete work, which we are pushing at the expense of the excavation cost.

These progress estimates are essential, prepared in the office, and are for office records. Construction work is always in a rush; and the activity gives no time for the study of a long column of figures, in order to refresh the mind as to the conditions on any one character of work, or in one section.

For this reason, as a final step in the line of progress charts, after the progress sheet has been prepared, a final progressive summary chart should be made, as shown in Plate XXVII. In concise form it furnishes quantities, costs and dates. It shows on one small sheet how the work is running with reference to the estimate, and what the probable outcome may be. In other words, it is a complete summary of the job, and it may be condensed on a chart so small that it can be carried in the vest pocket. It is a jogger of memory as to conditions. The chart cannot lie, and will not allow the superin-



Contracting Practice - Plate XXVII DeWitt V. Moore



Contracting Practice Plate XXVIII DeWitt V. Moore tendent to deceive himself, nor to gloss over conditions and make excuses as to cost when communing with himself, or making a report to his employer.

This form of progressive summary along the lines suggested by the writer appeared in its first crude form some two years ago in "Cost Keeping and Management Engineering," Gillette and Dana, (pages 165 to 186), and in its improved state on pages 102-108; also reprinted on pages 107-109 "Handbook of Cost Data."

The foregoing outline of progress charts and estimates may seem complicated, but in reality such is not the case. It is not expected that finished drawings be made. During the progress of the work calculations must be made continuously. If they are made on any old piece of paper, or in a note book, when the job is completed all these records are in such shape that they are really not valuable for reference; in fact, nine times out of ten they cannot be found. By this simple system of progress charts the information is obtained and a record preserved for all time; and it is just as easy to make the notes on such a proper sheet as on the back of an old envelope.

The progressive summary chart, illustrated in Plate XXVII, covers only the subject of excavation, inasmuch as it is desired to make the same as simple as possible in the explanation of its use. The chart, however, can be extended and cover on the same sheet several lines of work, or separate sheets may be prepared. This chart is essential to complete a summary of the work as estimated and as a record of actual progress, giving time cost and quantities. The essential and unique feature and, always the most important, is the percentage column, by means of which the progress in time, length, quantity and cost may be compared. For instance, in the illustration given, we have in construction a piece of excavation work 900 feet in length, amounting to 3,600 cubic yards, which, at an average price of 50 cents per cubic yard, amounts to $1,800; and the work can be done in 60 days. All of these totals are so adjusted in their divisions by the scale of their corresponding columns that the total appears posted on the 100 per cent. line.

The chart is divided into data, as per estimate and actual results. Referring to this, we will assume that 430 feet in length of the work have been completed and a notation made on the chart to this effect. These figures correspond with 1,720 cubic yards, which should cost, according to estimate, $860. By referring back to the percentage column, we note that this is 47¾ per cent. of the entire work; and, that according to schedule, we should have been employed upon the work 29 days. Referring now to the right-hand side of actual results, we find that actual cost has been $1,200, or approximately 70 cents per yard; but that only 25 days have been expended. Referring to the percentage column, we note we have expended 66 2/3 per cent. of our estimate, 41 per cent. of our time limit, and accomplished 47¾ per cent. of the work.

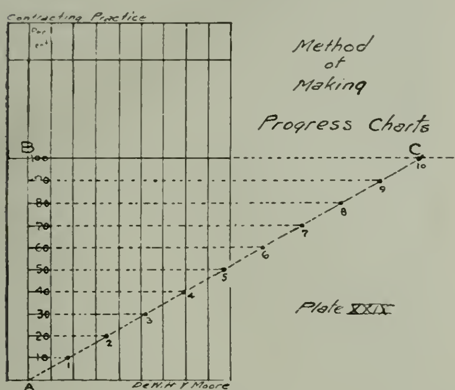
The right-hand side double columns are for the cost and time and are so arranged that, in case the estimate is exceeded, there will be opportunity for the recording. Taking the illustration just given from the chart, it is apparent that the cost is exceeding the estimate and will result, if the same cost is continued, in a final result of $2,520, instead of $1,800; while it is also demonstrated at the rate of progress shown the work will be completed in 53 days, or 7 days less than the schedule.

By using the percentage column as a schedule for the comparison of time, quantity and cost, a complete record and problematical final result are available at all times. It is necessary to say that the chart may be arranged so as to meet any condition; for instance, instead of length of construction there may be substituted square feet or any other unit of measurement. The cubic yard column may be divided in any convenient unit of measurement. It might also be well to bring out the fact that the column used for cubic yards, in Plate XXVII, is shown as an average uniform quantity over the entire length of the work. Where the work is very uneven it is perfectly feasible to divide this column, so that the heavy and light work proportions shall be located exactly as the same appears on the work. In other words, this column may be made in a sense a miniature profile of the work so adjusted that the same results may be attained. This suggestion is deserving of study to the end that the individual contractor may adapt the same to his line of work.

The foregoing description and chart cover only one line of work, but all elements of that one line. On large and important work such a chart should be made for each classification. On smaller work several branches can be placed on one sheet, thereby taking care of the entire job.

The cost of the work is, after all, the main item; and a final Progressive Summary Chart, Plate XXVIII, should always be added to the records, especially for pocket reference. This form of chart is of slightly different form, in that the quantities are not incorporated, but, instead, each branch of the work and the total are carried at their estimated cost equal to 100 per cent., with a provision for an increase in actual cost of 50 per cent. The chart shows constantly how each line of work is progressing, and upon completion of the entire job shows detail results.

Let us suppose a job is opened April 1, and we examine the conditions on April 30. On this date we should be 50 per cent. completed; and our cost should, to conform to the estimate, not exceed \$5,315. We know, however, that our cost is \$6,500, or 60½ per cent. Why? Referring to our chart, Plate XXVIII, we find the excavation complete at a cost of \$2,100, exceeding our estimate by \$400, or approximately 22 per cent. Sixty per cent. of the concrete has been placed at a cost of \$2,800; when, according to the estimate, it should have been done for \$2,250, an increase of cost over the esti-



mate of approximately 23 per cent. The cost of forms we find to be running properly with the estimate, or \$1,125. Fifty per cent. of steel labor is estimated at \$375. Our costs are only \$240, a saving of \$1335, or opproximately 33 1/3 per cent. of cost to construct 50 per cent. of the work. We find that there have developed \$370 in extras, leaving a balance of excess cost over estimates of branches of \$815.

Now, assuming at this date that the branches not yet started can be built for the estimate, we make our progress estimate, allowing for increases and decreases, and find as follows:

1. Time O. K.	Cost. Increase.	Decrease.
2. Excavation, complete	\$400	
3. Concrete. New Estimate	917	
4. Forms O. K.		
5. Steel		\$270
6. Finish, assumed O. K.		
7. Brick, assumed O. K.		
Total increases	\$ 1,047	
Total 1st estimate	10,630	
New estimate	\$11,677	

The chart enables all this information to be read at a glance, and such detail readings as just given are not necessary in actual use. Different colored pencils are used for successive dates. The charts can be made on any size sheet, inasmuch as each column is of a different scale, in order to reach the 100 per cent. line.

It might be said that the chart is too difficult of preparation. Such is not the case. Refer to Plate XXIX, showing a chart to illustrate the method. For our purpose we will construct the percentage column. Produce the 100 per cent. line indefinitely to the right, as BC. From point A, one line of column, draw a line AC by adjusting a scale of 10 equal divisions, so that beginning at point A the scale will reach point C at any point in line BC. Mark all 10 points and draw horizontal line to column AB. All these lines, except those making chart, to be in light pencil.

EDITORIAL COMMENT

Free Engineering Services by Government Departments.—Road Conventions.—Economics of Road Building.

FREE ENGINEERING SERVICES BY GOVERNMENT DEPARTMENTS.

Our esteemed contemporary *Engineering News*, has been raising quite a tempest in a teapot over a circular of the Office of Public Roads, U. S. Department of Agriculture, which on its face appears to offer free engineering services in the design and supervision of construction of roads, culverts and bridges. The editorial, on its face in turn, shows such ignorance of the facts and the practical possibilities behind the offer, as well as of the practices of national and state departments for the past twenty years or more, as to suggest the possibility of new hands in the editorial department following the recent change in the business management of the paper, or pressure of some special sort which has led to the singling out of a really innocent department for attack when there are others much more open to complaint of "undue restriction of trade." The editorial is doubtless in fact as innocent as the circular of the Road Office, and these sample inferences are drawn only as indications that suspicion of the one may be quite as unfounded as suspicion of the other.

The Road Office is an educational institution, only, and, within the limitations of its very meager appropriations has done a very remarkable service in spreading the gospel of good roads, in demonstrating by actual, though small, examples, the value of good methods of construction, in securing information by observation and experiment, in showing the necessity of expert control of design, construction and maintenance. This service has been rendered where it is most needed, in the backward districts, where the value of the engineer has not been recognized and where samples of the benefits of expending a considerable sum upon such services did not exist. As a consequence foci of interest in this part of the subject have been created, from which the knowledge acquired is spreading, and the demand for engineers and expert road builders is developing in these less favored regions as well as in those which are able to raise large sums of money and operate their road construction departments upon a larger scale.

A suggestion that millions might be spent in preparing free bridge plans for all sorts of construction is laughable when it is remembered that the Road Office appropriations are but a few thousands a year. And the high cost of preparing the plans for the small structures covered by the circular, is further evidence of the ridiculous nature of the assumption that the offer is made for anything other than an educational purpose. There can be no doubt that the plans and supervision offered will cost a very large proportion of the total cost of the work, but the extra money is well expended if it results in a sentiment in each locality in favor of expert assistance, from the demonstration that such assistance, as supplied by the department for educational purposes only, produces results far in advance of those obtained heretofore by the local methods.

But it is useless to discuss the impractical and impossible assumptions of the editorial and the available space will be better expended in considering some of the facts in the case and the inferences which may be drawn from these facts. The problem is a large one, far larger than the writer of the attack upon the Road Office seems to realize, and his greatest mistake was in passing the main problem by and concentrating upon a local development, the slightest consideration of which would show that it was actually not pertinent to the subject in the least.

The facts in this particular instance are sufficiently set forth above and in the replies made by others to the editorial in question and may be dropped from further consideration and attention may be called to some of the developments of the past years, to the extent possible in the small space available for this article.

The purpose which seems to underlie the editorial and most of the replies thereto is the protection of the engineering profession. The fact is, that in the field covered by the Road Office there is no engineering profession to protect. It is attempting to create a sentiment which will give an opportunity for the extension of the work of the profession into a field in which it is sadly needed. The public, sooner or later, must protect itself against incompetence in those who are attempting to do its work, and the Road Office is educating the public as rapidly as its funds and its form of organization will permit. The same process of education has been going on in sanitary matters for twenty years or more. Prior to that time the water works and drainage work of the smaller cities and towns was in but little more competent hands than are most of the roads of the country at the present time. The protection of the public from the consequences of such incompetence as well as from lack of system in taking care of the more general features of the sanitary problems of a state, led to the extension of the power of the board of health over such matters as plans for water supply, sewerage, drainage, water and sewage purification, and the like. The same complaints of interference of state departments with private practice appeared at that time, some of them doubtless in *Engineering News*, and still appear when occasion demands. Some of them had real basis, for it has always been difficult to draw the line between efficient control of the work of independent engineers and the securing of the desired results through the department's own engineers. Then, there is always the tendency, shown occasionally in these days, to make to inquirers or those presenting unsatisfactory plans, too pointed recommendation of engineers whose work is satisfactory to the department for one reason or another.

There are real abuses of this nature in both national and state departments, and there are other apparent abuses, which on careful analysis turn out to be only necessary developments of the efforts of a department to better conditions in a state or in a district. Thus a large area may require drainage, and the development of the country is delayed because the local owners and others interested cannot combine to make the necessary surveys and plans. What is more natural than that the Department of Agriculture in its efforts to improve the conditon of agriculture should make these surveys and plans and lend all the aid possible to carrying them out? Such instances in both state and nation may be indefinitely multiplied. Thte question is as to the judgment exercised in discriminating between proper projects for government development and for private operation.

In the case of the preparation of plans by the government office, assuming perfectly good judgment in selecting the project, the young engineer is benefited, because he is given employment which would not otherwise be available. Even if the judgment in selection of projects were not good, and the government assumed a survey and plans which would otherwise have been done by private enterprise, the young engineer, who seems to be the principal concern, would be benefited, for it is hardly to be doubted that more real engineers and fewer hangers on and local aspirants for engineering experience would be employed by the government in its work on the project, and so the general tone of the profession would be improved. It might even happen that the engineers in charge of the work under government operation would be of higher class and would do better work than the displaced prospective employes of the private parties interested.

If anyone claiming to be an engineer thinks the profession needs protection from this sort of thing, it is time he left it and got into some trade closely regulated by a union which takes care of its lame ducks. And he had better take with him the young engineers for whose welfare he is so solicitous.

But these still, are subsidiary questions, and the real question for consideration is the extent to which the national or state government is justified in going in controlling or assuming entirely functions which under simpler conditions of life are safely left to individual effcrt, but which, under the increasing complexities of modern developments, would seem to be more satisfactorily administered by government departments. Our present excursions into this field of governmental operation and control include such organizations as the reclamation service, the state public service commissioners, state boards of health, and the like, besides numerous smaller efforts under branches of the greater departments, such as the drainage investigations referred to, design and construction of bridges under state highway departments not otherwise employed, etc. In this class may be included also, from some points of view, the state aid of highway construction and maintenance, and certainly the proposed national aid. Most of these modify to some extent the practice of engineering and mcst of them improve its status, though they do interfere with individual independence of certain numbers of men heretofore in the practice, whether they were engineers or not. But the great question is not that of the effect of these institutions upon the engineers, but upon the integrity and independence of the people at large.

No attempt can be made here to discuss this question. The purpose of this article is served if it has showed the comparative unimportance of the local developments referred to and the puerility of any effort to "protect" the engineering profession against a movement which, whether right or wrong in principle, has at least a temporary beneficial effect upon some portion of the practitioners in some engineering lines.

ROAD CONVENTIONS.

Municipal Engineering has frequently called attention to the character of the promotion behind the numerous road conventions which have been held in all parts of the country during the past few years and is therefore particularly gratified to note the probability of success in the effort made at the first meeting of the American Association for Highway Improvement, at Richmond, Va., to unite under one general management the organizations which do not have personal or business promotion as their prnicipal, though more or less concealed object, or which are trying to eliminate such objectionable features.

There were present at the Road Congress held by the A. A. H. I., enough representatives from the governing boards of the American Road Builders' Association and the American Automobile Association to warrant the belief that the plan for a joint road congress next year under the auspices of these organizations, according to the general plan discussed by these representatives with the board of directors of the A. A. H. I., will be successful. Another important factor in the success of such a congress is the association of manufacturers of road machinery and road materials which was formed during the congress. This association is the outgrowth of one formed earlier in the year, which has been considering the unsatisfactory nature of the convention field from the point of view of the exhibitor, and seems disposed to restrict its exhibition efforts, so far as national congresses are concerned, to the joint congress now under discussion. A full and complete exhibition is one of the best educational features of a congress and it is to be hoped that the association of the machinery and material men will adhere to the tentative program outlined.

Each of these organizations is asked to appoint two members of a committee to work out the details of the organization and management of the joint congress, keeping the autonomy of the organizations intact, and it seems to be assumed that the association of machinery and material men will take charge of the exhibition, thus doing much to eliminate from all of the other organizations the opportunity for criticism of business methods to which at least one of them has been open.

The question of government aid of road building is becoming very prominent and appeared in the proceedings of the Rochester congress of the American Road

Builders' to some extent, while at the Richmond congress it was pressed strongly by both the Virginia senators, a senator from Alabama, and others, and was the subject of strong resolutions passed on the Road Users' day of the congress, without reference to the expressed objection to such action made by the officers of the association under whose auspices the congress was held. These resolutions were printed on page 485 of the December number of MUNICIPAL ENGINEERING, and the legislative committee appointed under their provisions held a meeting to organize and authorize a regular campaign for appropriations by Congress, and adjourned to meet in Washington at the time of the convention of the American Automobile Association.

As will be seen from the brief statements in the series of articles on the condition of the road problem in the various states, which began in the November number of MUNICIPAL ENGINEERING, there has been a phenomenally rapid spread of the state aid and state control ideas and the state and local appropriations for road purposes have increased enormously within the past four or five years. Many states have but just begun their attacks upon road improvement problems. It would seem that, except in a few backward states, there was enough progress under present conditions without putting on the high pressure which will result from the struggle of the states to secure their proportionate share of national appropriations. While not yet true, it will soon be possible, under the present rapid rate of advance, to say that road work is being overdone.

Consolidation and concentration should be the word all along the line as it is in the road congresses. Any national aid along educational lines which will promote advance in these lines will be welcome, but any material appropriations in aid of actual road construction will be inimical to true progress and will be followed by a natural depression or even more serious consequences.

Then, too, there are many technical road problems which are far from solution as yet. Millions have been wasted already upon construction which was out of date almost before it was completed and upon ill-advised plans based on incomplete experiments. Let us hope that the pressure will be kept off at least until our technical guides are better prepared to spend our money judiciously. It will be better to make haste more slowly and devote ourselves more to the maintenance of the roads we have, than to invest millions in structures too expensive for the work they are to do or too flimsy to be economical under the systems of maintenance which we have developed up to this time.

ECONOMICS OF ROAD BUILDING.

In continuation of the recommendation of more careful consideration of road building projects, made in the preceding editorial article, attention is called to the paper before the American Association for Highway Improvement, by Onward Bates, printed on a preceding page, in which he distinguishes clearly between the conditions in a small, thickly populated state, whose roads run between large cities, and a state of sparse population well scattered. He outlines briefly the same argument which has been made more than once by MUNICIPAL ENGINEERING, demonstrating that the first duty of a state is to get as much of its road traffic up out of the mud as possible, or, as in some states, and in certain districts of many states, to reduce the gradients of mountain roads to a minimum. This duty has sometimes been performed best, as in Indiana, by the district system, roads in that state being built by the county commissioners in some cases and by the township trustees when within the limits of the township. It has sometimes been performed best by the state, as in the case of mountain roads in California, some of which would have struggled on without adequate improvement if the state had not taken them up and spent the proceeds of state taxes upon them.

As has been shown in this department and others in MUNICIPAL ENGINEERING at various times, this system of road management may not produce the best roads which can be built, and almost never results in adequate maintenance, but it has produced in such states as Indiana the largest possible proportion of roads good enough for the traffic over them at the time they are built. They give all the farmers in the township, and perhaps all in the county, a chance to get to market almost any day in the year. This is certainly well worth while, especially since this kind of road development causes a general improvement in land values which makes it possible to pay the increasing bills for maintenance as the traffic increases, and gives a basis for future taxes for building better roads where their need has been demonstrated.

For a rapidly developing new state, as Mr. Bates concurs, this is certainly an economical method of procedure. For Indiana it has resulted in more miles than in any other state of roads of this grade, which may properly be called good roads, though they might be better.

Unfortunately the maintenance under the existing system is defective, and, as the traffic has increased, and especially with the advent of automobile traffic, the cost of maintenance has become excessive and these roads are no longer economical on the lines of the heavier travel. The neighborhood roads are good and with a proper system of maintenance could be kept in condition at a reasonable cost. But the through lines, those to which the neighborhood roads lead on the way to the market towns, cannot be kept in good condition even with a proper maintenance system and are unduly expensive under the present lack of system. These main roads require different treatment. They need, some of them, reconstruction according to modern methods. Others need modern methods of maintenance with only so much reconstruction as special conditions on parts thereof may demand. These modern methods, as well as the maintenance of the ordinary roads in the most economical fashion, require uniformity of specifications, workmanship and inspection, in other words, supervision by an expert state official.

To these main roads may be applied very properly methods of construction ranging from the most expensive down, according to the local demands. To the less traveled of these main roads as well as to the neighborhood roads they should not be applied, for what these roads need is a better method of maintenance rather than a reconstruction.

Ohio is a state which developed a system of good roads similar to that in Indiana and only less in extent. Ohio, earlier than Indiana, has recognized the need of some better roads than were obtainable under the old system, and has entered upon a reasonable scheme of state aid to the reconstruction of main roads, using modern methods, ranging from brick on concrete to waterbound gravel macadam, according to the demands of the traffic of the locality.

Such states as these are wasting little or no money, are developing all their roads and the lands abutting on them by increments which are proportionately equal to the opportunities for improvement.

No doubt there are many individual instances of error, but, consciously or unconsciously, these two states have hit upon the most economical plan from the theoretical point of view and Ohio has made its change almost as soon as such change was demanded by the economic conditions. Indiana is not yet ready to make the change and is wasting money each year in unavailing efforts to maintain roads too weak for the traffic on them, not to speak of the millions wasted in inefficient repair of roads which are really good enough for the work required of them if kept in the highest state of efficiency. These states are not wasting the money on ill-advised new construction above mentioned, like some of the more thickly populated states in the past and possibly at present, but they, particularly Indiana, are wasting nearly or quite as much on inefficient maintenance.

The prime need in Indiana, and in larger sections of other states which are backward in the state highway supervision movement, is expert maintenance under a central responsible state organization. The new construction of main line roads will follow if a state commission is put in charge of road maintenance with full authority over the collection and expenditure of the present road taxes, as soon as this commission can demonstrate the economies of such new construction in special cases.

THE QUESTION DEPARTMENT

Chemicals in Septic Tanks.

It is said in using septic tanks that you must not use lye, copperas and such things as it would kill the aerobic bacteria.

How can you keep urinals free and clean without using something of that kind?

O. O. L., Canisteo, N. Y.

The amount of the materials mentioned, which would probably be used in cleaning urinals, water closets, kitchen sinks, and the like, is not sufficient to have any serious effect upon bacterial action in the septic tanks. Considerable amounts of chemicals in manufacturing wastes can sometimes be taken care of, though they greatly delay the bacterial action, and so it is sometimes necessary to treat such manufacturing wastes to remove these objectionable matters before admitting them to the sewers, especially if the sewage must be treated in septic tanks. But these restrictions do not apply to the use of chemicals for cleaning the drainage apparatus in a house or hotel, for no one would waste such chemicals to the extent necessary to affect seriously the septic action in the mixed sewage in a septic tank.

Apparatus for Thawing Water Pipes by Electricity.

Kindly state where apparatus can be obtained for and the principles underlying the thawing of service pipes by electricity.

Washington County Water Co.,
Hagaerstown, Md.

Thawing of service pipes by electricity is produced by passing a sufficient current through the pipe to warm it and thus thaw the ice within it. A current of 200 to 300 amperes at 50 volts will find enough resistance to passage through the pipe to raise its temperature enough to thaw the pipe out in half an hour or less. The current from electric light wires may be used, reduced by a transformer, and connected to a faucet in the building and a fire-hydrant, or a faucet or pipe connection outside, so that the current will pass through the section supposed to be frozen up.

Larger mains require more current. Thus a 6-inch main 320 feet long is reported by Turneaure in his "Public Water Supplies" ($5) to have been thawed in two hours by a current of 350 amperes at 100 volts.

The method was first applied by Jackson and Wood in Madison, Wis., and D. C. & W. B. Jackson, 508 Commercial National Bank Bldg., Chicago, Ill., can probably give instructions as to apparatus to use under the conditions in a particular case and where to get it.

How to Construct a Sea Wall.

We are in need of information which will enable us to construct, or have constructed, a seawall, part of which will necessarily be under water.

W. E. H., Lima, O.

If the wall is of any considerable extent, or the foundation is not good, or the body of water is difficult to control, the design and supervision of the construction must be put in the hands of a competent and experienced engineer. In any event money will probably be saved by putting the work in the hands of such a man, selected according to his ability and not according to the sum he is willing to accept for his services.

General information on the subject, with details in some cases available for use of the designing engineer, may be found in such books as Baker's "Masonry Construction" ($5); Taylor and Thompson's "Concrete, Plain and Reinforced" ($5); Gillette and Hill's "Concrete Construction" ($5); Buel and Hill's "Reinforced Concrete" ($5).

Record of Water Connections.

Will you kindly inform me if you know of any system by which water companies keep a record of taps, giving number of block and lots, consumer's name, distance from some specified point, etc., also if such record comes in book form, price and where it can be purchased.

Water Co., ———, Nev.

The most satisfactory record of the separate taps which is known to the writer is the card system which is a part of the American Water Works Bookkeeping system published by Municipal Engineering Co., Indianapolis. This card is in two parts, one half being an application card, setting forth the name, owner, place, registry and application numbers, service applied for, signature, and approval of application by the proper office of the water department, and thus becomes a contract for the service between consumer and department. This card, when the two are detached, is filed under the street and number of house thereon.

The other half of the card gives on one side the same information as the first half, copied therefrom, and the inspector's return, showing when water was turned on, and description of meter if one is installed. The back of the card gives a skeleton and blank for making sketch of the location of the connection with description; also space for list of fixtures and connections, all filled out and signed by the plumber and approved by the inspector. This card is filed under the name of the applicant for water.

Exactly similar cards of a different color are used for applications for changes in service and are filed in the same way, the alteration cards being placed immediately after the original application cards for the same service, so that all the information about the service is in one place.

Proper classification of cards enables the office to keep all the live cards together, the dead ones in a separate file, and those which may be revived can also be separated out if desired. The cards are perforated so that they can be locked into their drawers and so cannot be withdrawn and lost without official instructions.

This system is more convenient than a book record, because it is its own index, and can be kept entirely free of dead matter.

How to Figure Radiation Surface for Heating a Room.

I would like to know how to figure the radiation of a room.

E. M. P., Tulsa, Okla.

This is a question which cannot be answered definitely, because there are so many special conditions to be taken into account that no one formula will take care of them all. Carpenter's "Heating and Ventilating Buildings" ($4); Baldwin on "Heating" ($2.50); Billings's "Ventilation and Heating" ($4), are good books from which much information on the subject can be obtained.

For ordinary conditions there are numerous rules which give results differing from each other by 50 per cent. What may be termed an average for dwelling houses heated to 70 degrees temperature may be figured by the following rule:

Add together the area of the glass in windows, one-fourth the surface of the exposed wall or walls, and one-twenty-fifth of the cubic contents of living rooms, or three-fiftieths for halls or one-fiftieth for upper stories. Take one-fourth the sum of these three numbers and it will give the radiating surface required for direct steam heating.

For direct hot-water heating take two-fifths the sum of the three numbers, instead of one-fourth.

There are modifications of these multipliers for churches, offices, etc., depending on conditions, and for indirect heating.

The average number of cubic feet of space heated by one square foot of direct steam-heating surface varies from 50 to 80 according to different authorities and according to temperature conditions of weather.

Baldwin gives quite a different rule which gives a result requiring various modifications according to conditions and does not consider the size of the room other than the areas of the various kinds of glass and wall surface. It is as follows: The glass areas in the wall surfaces will require for each square foot of glass an area of radiator to be obtained by dividing the difference between the coldest outside temperature and the desired inside temperataure by the difference between the temperature of the steam pipes and this desired temperature of room. Outside wall space must be counted in in the proportion of a square yard of wall space equivalent to a square foot of glass. There must also be an addition of an amount up to 50 per cent for leakage around windows and doors, through walls, etc., so that the rule is far from precise.

The first rule given does not take into account the variations in outside temperature and the Baldwin rule does not take into account the volume of the room to be heated. Neither is exact, but exactness is only to be obtained by taking into account all the conditions, something which cannot be reduced to aa single rule. Carpenter gives a number of diagrams which are convenient in taking account of these local conditions.

Asphalt Pavement in Use.

Have you published a table showing the total amount of asphalt pavement laid in the different cities?

J. B., Chicago, Ill.

In the March number of Municipal Engineering, vol. xl, p. 233, will be found a statement of the amounts of various pavements, including asphalt, laid in 1910 and proposed for 1911, in a large number of cities in the United States. Tables taken from the publications of the U. S. Census Bureau, showing the amounts of asphalt laid in a year and the amounts in use in the cities of more than 25,000 population, will be found in vol. xxx, p. 202, and vol. xxix, p. 429. The latest full information in this line will be found in the annual special reports of the U. S. Census, giving "Statistics of cities having a population of over 30,000," the latest issue giving these statistics for 1908, with 1909 soon to follow, probably.

Maker of Chimney Scaffold.

Can you tell me where I can get some information about "The Unique Adjustable Chimney Scaffold"? I am inclosing the circular I have, as it may be of some aid to you in furnishing the information I desire. There is nothing on this to show where it is made.

G. B., Pomeroy, O.

The scaffold rests on the roof on each side of the chimney, is held by adjustable rods or bars with lugs over the ridge of the roof and has uprights and horizontal boards to hold the building materials. Can any of our readers give the desired information?

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Characteristics of Bituminous Highway Materials.

To the Editor of MUNICIPAL ENGINEERING:

Sir—some of the technical journals and various pamphlets issued by the promoters of private interests, have recently spread broadcast many statements in regard to the characteristics of materials used in the construction of bituminous highways, which not only display considerable ignorance but also misrepresent the position of the writer of this communication, by quoting from statements of his, made on different occasions, without regard to the context or the circumstances under which they were made. It puts the matter in an entirely false light before municipal engineers. Suggestions having been made that these publications should not be permitted to pass without notice, the following will serve as an answer to them.

In the discussion by Mr. Geo. C. Warren of the paper by Mr. H. G. Lykken, City Engineer of Grand Forks, N. D., presented at the meeting of the American Society of Municipal Improvements at Grand Rapids, and recently published in MUNICIPAL ENGINEERING he states that the first,. among what he considers to be the four essential properties of a bitumen for highway construction, is the cementing strength "measured by the breaking strain of compressed bars made of sand of standard quality and size, cemented together with 10 per cent. of bitumen." Nothing could be more erroneous. As long ago as 1894, I showed in a letter to the *Engineering News* of June 1st of that year, that the cementing strength of coal tar pitch, which has no value at all for paving purposes, is greater than that of Trinidad or Bermudez asphalt, these bitumens being the lowest in cementing strength of any materials tested, but at the same time well known to be the most desirable materials for bituminous construction. Some of the data there given are as follows:

Coal tar pitch 15 per cent	2.16	3,884	1,254
Coal tar pitch 10 per cent	2.07	3,845	2,655
Land pitch 10 per cent bit..	2.13	1,813	761
Berm. Cement 10 per cent bit..	2.10	1,955	635
Lake pitch 10 per cent bit..	2.14	1,375	548

Mr. Warren again harps upon the fact that the ability of an asphalt to withstand moisture, without deterioration, as used in he laboratory, is the second criterion in determining the valuable properties of a bitumen. Of course his motive in this direction is to attack Trinidad asphalt, which in the laboratory, or in the street if improperly and unskillfully used, is affected by water. He entirely fails to present the strongest evidence of the futility of such a claim by disregarding all the service tests of this material under the most trying conditions, as on Fifth avenue, New York, or in the English climate where pavements constructed with Trinidad aasphalt have shown no evidence of being attacked by water, during a long period of years.

Mr. Warren states that the fourth criterion of the valuable properties of bitumen is "purity, only scientifically valuable in so far as the impurities are soluble salts, organic or other matter, liable to cause deterioration." This is another attack on Trinidad asphalt, and is raising a bugaboo which was laid years ago. The addition of the small proportion, a fraction of one per cent. of the soluble salts found in the water accompanying Trinidad asphalt in its crude state, and which remains in part in the refined material, to other asphalts such as Bermudez and the resilient pitches, produces no effect upon them, either in the laboratory or in construction work. As a matter of fact, experiments have shown that they will increase the capacity of all bitumens to resist water.

Mr. Warren's statement can hardly be attributed to ignorance except, perhaps, with regard to the value of the determination of the cementing strength of a material, but are manifestly made with the object of attacking materials which he does not employ, and with which he is in competition.

In a pamphlet given wide publicity by the Warren Brothers Company, entitled "Asphalt —Its Origin and Development and Asphalt Pavement Construction, by George C. Warren," an attack is made on the writer of the present article, on the ground of inconsistency, by quoting excerpts from a number of his publications, or these of the Barber Asphalt Paving Company, which have appeared at different times. He cites a pamphlet issued by the Company, and quotes a statement in regard to Bermudez asphalt, disparaging to that material, but fails to state that this comparison was between it and the lake asphalt of Trinidad, and not with other asphalts. The facts stated in the pamphlet are as true today as they were when published. Bermudez asphalt does not possess the great uniformity which is characteristic of the Trinidad Lake asphalt, the latter being a standard material, of which every cargo has been of the same character as another, during a period of more than 30 years. Bermudez asphalt is much less uniform in character, and requires much more skill in handling than Trinidad asphalt. It will not withstand the abuse in unskilled hands which is possible without injury, to the latter asphalt. When properly refined and manipulated it is, however, a very desirable solid native bitumen, and especially so where one is required, as in the construction of bituminous broken stone roads by the penetration method, of a higher percentage of bitumen than that offered by Trinidad asphalt. The Barber Asphalt Paving Company is quite justified in pronouncing it the most desirable material available today as a road asphalt or binder.

Mr. Warren and some others, have called attention to what they term a most glaring inconsistency on the part of the writer. In two papers delivered, the one at Atlantic City and the other at Seattle, Wash., at about the same time in 1909, in one of which he recommends the use on the Pacific Slope, of residual pitches and flux of suitable quality as a cementing material or binder for the construction of bituminous broken stone roads, and in the other, presented in the East, suggests that the solid, native bitumens are much more desirable than materials originating in petroleum oils alone, even if the latter are of an asphaltic nature. The writer would make the same statement today. The solid natural asphalts cannot be recommended on the Pacific Slope, as they are not available there in competition with the residual pitches, owing to the cost of transportation. Further, it should be said that on the Pacific Coast a certain amount of residual pitch is available which is carefully prepared under scientific supervision, but in amount not equal to the demands for its use in that locality, in consequence of which the supply reaching the eastern seaboard is of carelessly prepared material which cannot be accepted under strict specifications, such as those of the city of Los Angeles, which require tests showing that the residual pitch must not have been overheated in the process of manufacture. Much of the residual pitch shipped East is a material not manufactured especially for paving purposes, but merely a by-product or residue remaining from the distillation of the California petroleum in the manufacture of burning oil and lubricants.

It is possible that satisfactory residual asphalts may be shipped to the East when the California supply of such materials is larger than that needed to fill the local demands, and at a price which may, when freight rates are reduced below those now demanded by the railroads, enable them to meet Eastern competition. In the writer's opinion, at the present time, it is not safe to permit the use of these materials in our larger cities.

Referring to the "Letters from Prominent Civil and City Engineers" contained in Mr. Warren's pamphlet, the one from Mr. C. W. Adams, dated April 8, 1901, refers to 300,000 yards of pavement laid by Mr. Warren in Utica, N. Y. prior to 1901. This was, of course, laid with Trinidad asphalt, and it is notable that one of the streets had been in use for 15 years, with almost no repairs.

In another letter, that of Henry C. Allen, he pays a deserved compliment to about 400,000 yards of asphalt pavement laid by the Warren-Scharf Paving Company under Mr. Warren's management, and states that the results were wholly satisfactory. This work was done entirely with Trinidad asphalt.

Mr. C. C. McCoomb of Watertown, N. Y., under date of Feb. 23, 1911, certifies that 30,000 square yards of pavement laid by Mr. Geo. C. Warren in that city with Trinidid asphalt is " in good condition and bids fair to last a number of years."

A similar communication from the, at that time, City Engineer of Oswego, N. Y., may be noted and, in fact, nearly all the letters appearing in this portion of Mr. Warren's book, confirm the high opinion in which various officials hold the work laid by Mr. Warren's company using Trinidad asphalt exclusively.

Under the circumstances it is evident that Mr. Warren's statements are misleading and the preceding facts have been put in form for the information and guidance of engineers not having an intelligent understanding of the situation.

Clifford Richardson,
New York City.

Reinforced Concrete Reservoir Construction.

To the Editor of Municipal Engineering:

Sir—I was employed by the contractors to handle the work the same as if it was my own. The reservoir as built measures 60 x 100 ft., 16 feet deep in the inside, constructed entirely of cement reinforced with corrugated steel bars, ranging in size from ½ inch to 1 inch. The capacity at the water line, which is 12 ft., is computed at 500,000 gallons, 250,000 gallons to each room, a partition wall being in the center.

The walls are battered, measuring 16 inches at bottom and 12 inches at top. The floor is 10 inches thick. The main girders in roof are 12 x 19 inches and cross girders 6 x 14 inches thick. In the walls at the outside edge are placed 7/8 inch rods perpendicularly every 9 inches; on the inside of wall 3/4-inch rods every 12 inches; and horizontally 1/8-inch rods every 24 inches against the perpendicular ones; in the floor 3/4 inch rods every 12 inches both ways, lengthwise and crosswise. The footings are 5 feet wide and extend 12 inches under the floor, reinforced with cross rods every 6 inches and lengthwise every 6 inches. The columns, of which there are 6 in each room are 14 x 14 inches reinforced with four 3/4-inch rods riveted every 14 inches in height. The main girders have eight 1 inch rods in each, four of which are near the under side of the girder running straight through. The other four rods are 2 inches higher and are bucked over the columns. The cross girders, of which there are 22, have 4 rods of 7/8 inch thickness, 2 of which run straight through the main girders and 2 at the upper side are bucked the same over the columns and main girders, forming a complete tie for the entire roof. The roof panels are but 3 inches thick, reinforced with expanded metal of 2½-inch mesh. The spans are 16 feet 8 inches and 15 feet in the clear. The panels are about 4 feet by 15 feet. There are 3 main girders. Around the wall at the top is a coping extending out 4 inches and 18 inches deep, in which 5 rods are placed, 3 on the outside of the perpendicular rods and 2 on the outside of the inside perpendicular rods, all being wired together and spaced.

The concrete is composed of 1-2-4. The rock was crushed on the ground, passing a ¾ inch ring. The walls on the inside were finished with a mortar 1 to 1, ¾ inches thick on the sides and 1 inch thick on the uoor.

The entire outside was coated over with one coat of tar applied hot. The entire structure is covered over 2 feet deep with the soil. The depth in the natural ground was about 10 feet (I mean to say that the reservoir is 10 feet in the ground).

There is a man hole to each room with iron steps built in the wall. Each room has 4 ventilators. The entire job was done in about 90 days with the exception of the excavating. In the neighborhood of 45 tons of corrugated steel was used in the work and 800 barrels cement.

F. S. B., Shenandoah, Iowa.

Remedy for Over-Printed Blue-Prints.

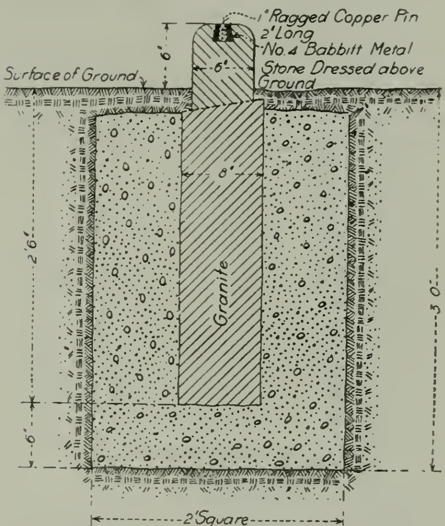
To the Editor of MUNICIPAL ENGINEERING:

Sir—If W. H. R., Kelso, Washington, will as soon as he takes his blue print from the wash tray, while it is still wet, lay it out on the table and by means of a camel's hair brush spread evenly over the surface a wash of hydrogen peroxide and then dry in the shade he will meet with a surprise. A 25 cent bottle will cover 20 to 30 yards of prints and it will sunproof them. To get the best results the prints should be printed dark. They should be exposed to the light until the paper shows a gray motley appearance.

A. H. GILLILAND,
Civil and Consulting Engineer.
Indianola, Iowa.

Concrete Bench-Marks in New Orleans.

New Orleans, La., has 28 permanent bench-marks, recently installed. The construction of the bench-marks is shown in the accompanying diagram. They consist of granite pillars, about 200 pounds in weight,



STREET MONUMENTS FOR NEW ORLEANS.

set in a large concrete base. The marks are placed chiefly in public squares and parks, these locations affording the least likelihood of their being moved by excavation in the course of improvements.

Quality of Creosoted Wood Blocks Used on Michigan Boulevard, Chicago.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Inasmuch as the wood-block pavement which was in successful use for ten years on Michigan Boulevard, Chicago, in front of the Auditorium Hotel, etc., was perfectly good, and when lately removed in order to widen that boulevard and give it a new crown or contour, was still in excellent condition, that wood-block pavement had undoubtedly proven itself to be one of the best and most durable wood pavements under extreme conditions of weather and numerous, heavy traffic. Similar wood-block pavements, treated with creosote oil of 1.04 to 1.06 gravity and which distills off up to 315 deg., between 65 and 70 per cent. of its weight, and which thoroughly impregnates the wood, were heretofore used and are still successfully used on various streets and avenues of important cities.

Therefore, the enclosed copy of a report by me to the Chicago Bureau of Public Efficiency is instructive and shows facts worthy of consideration in connection with specifications for wood-block pavements for such streets as wood-block pavements are suitable.

J. W. HOWARD,
Consulting Engineer on Construction and Testing Roads, Streets, Pavements, New York City.

WOOD PAVING BLOCKS FROM MICHIGAN AVENUE, CHICAGO.

I received the five samples of creosoted wood paving blocks which were taken from the Michigan Avenue wood pavement in front of or near the Auditorium Hotel by the Engineer of the South Park Board and stored at Grant Park until delivered to you and sent by you to me for analysis, tests, etc., especially of the oil used in their preservation. These blocks, according to the records, had been in use on Michigan Boulevard 9½ years. The examination and tests showed as follows:

The wood is a good grade of long leaf yellow pine. The blocks were very well preserved and showed practically no appreciable amount of wear and no decay.

The preservative extracted from the blocks gave following results. The blocks still contained 14.5 pounds per cubic foot of the preservative. The records showed that the original content of the block was 16 pounds. The loss of preservatives, therefore, was only 1.5 pounds per cubic foot in 9½ years. This was the very lightest portion of the preservative and did not materially injure the quality of the blocks in respect to resisting decay nor detract from the physical or wearing qualities as against weather and traffic.

The fractional distillation of the extracted preservatives gave following results:

Between 0 and 170C......	3.30	per cent.
Between 170 and 200C......	1.43	per cent.
Between 200 and 210C......	5.98	per cent.
Between 210 and 235C......	1.57	per cent.
Between 235 and 270C......	12.30	per cent.
Between 270 and 315C......	16.52	per cent.
Total up to 315C.........	41.1	per cent.
315 and above	54.	per cent.
Residue	4.9	per cent.
	100	per cent.

A second or check distillation on another sample of extracted preservative showed that the distillate up to 315C. is 46 per cent.

The specific gravity of the extracted preservative is 108. The specific gravity of the original preservative, which was a creosote oil made from coal tar, I estimate was between 1.03 and 1.06, which confirms certain records of past years indicating that the gravity of the original coal-tar-creosote oil used in the above pavement was 1.06.

As for the natural resin of the wood, I was careful to exclude that from the distillation tests up to 315C. A little of the resin appears in the distillate above 315C.

The distillation was of course made with the exclusion of air in the retort, etc.

The long and successful use of the good yellow pine creosoted blocks on Michigan Avenue, proves that such wood blocks treated with creosote oil of a gravity of 1.06 or a little lighter gravity and an oil which when new yielded, by fractional distillation up to 315C., between 50 and 75 per cent., and after 9½ years, a distillate up to 315C. of 46 per cent, made a successful, durable pavement under severe climatic conditions and numerous and heavy city traffic.

Granite Paving Tests in New York.

A joint committee of delegates from the Fifth Avenue Association, the Merchants' Association, the City Club and the West End Association of New York recently made a report to Borough President McAneny containing a number of recommendations regarding the paving situation in the city. More intelligent methods of construction and maintenance, together with a more careful selection of material, were recommended. Careful tests of different types of pavement were asked, with a view to selecting a material best suited to New York's needs; especial attention being called to stone block pavement, with the recommendation that the Liverpool (England) specifications should be followed in order to compare the paving stones with a small face to those larger types previously used in New York.

Mr. McAneny invited the committee to a conference at which he and his consulting engineer were present. He promised to do as was recommended and plans were made for building two experimental sections of stone pavement on Lafayette street.

These two sections of pavement of 1,800 square yards and 2,690 square yards, respectively, are to be made of cubes and setts. The cubes measure 4 inches on each side and the setts are 3¼ inches wide, 6¼ inches deep and from 5 inches to 7 inches long. The granite is to be imported from the north of Wales. The specifications are modeled on the English one, but do not folow it exactly.

If these pieces of pavement are made as proposed they will serve a most useful purpose. At present there is nothing of the sort in the country. They will serve as a model both as to the cutting and the laying of the blocks, and also as a gauge whereby to test the relative toughness and durability of our own granites. They will demonstrate that the best pavement is the most economical.

One great stumbling block in the way of better methods is the habit of building pavements as if they were temporary affairs and not permanent construction, which must always be maintained. If a new pavement is to be put down it is usual to ask first how little can it be built for, or how much can we get for the money, rather than how to get the longest and best wear at the least ultimate cost. In other words, we consider the first cost rather than the ultimate economy.

It is a fact which has been abundantly proved by the experience of other cities that the best pavement is the most economical in the long run. And New York's experience certainly demonstrates clearly that cheap pavements are not economical, but the authorities have never acted on this assumption. More attention has always been paid to first cost than to durability.

As an illustration of this false economy, even with the sample piece of English pavement which Mr. McAneny has promised to lay, it is proposed to lay blue stone curbs of the ordinary kind rather than the properly dressed and more substantial granite curbs of the kind used in Liverpool, for the reason that the granite would cost too much. Granite curbs may cost more, but they are undoubtedly needed and would prove the most economical in the long run.

If, for instance, a pavement costing $5 per yard can be laid which will last 20 years, such an one is much more advantageous for the city than one costing $3.50 per yard which will last only half of the time. Not only would the actual cost of construction be less, but the better pavement would require less repairs, it would be easier to clean, and, above all, it would furnish the better service to the people.

In many European cities it is the custom to keep the most exact statistics as to the wear and cost of pavements, and in places where this is done one may be sure to find pavements of the best quality, because such pavements invariably demonstrate their greater economy under use.

The city of Liverpool is a notable case in point. In 1874 that city abandoned the policy of using cheap pavements and adopted one, to which it has adhered to ever since, of putting down the pavement best suited to the traffic, regardless of first cost. Since then there has been a constant fall in the expense of maintenance, so that now the gross annual outlay per mile, including interest on the capital invested and the sinking fund charges, is less, by more than 25 per cent, than it was before the city had the superb pavements which it now has. And during this time the inhabitants have had the inestimable benefit of pavements so good that the cost of moving merchandise over them is far less than it was formerly; the cleanliness, healthfulness and appearance of the city has been greatly improved, and the pleasure and convenience of all who use the streets has been increased.

As stone pavements are the most important kind for a city like New York, where traffic is of the heaviest kind, it was felt that attention should first be directed to them. For many years past the tendency in Europe has been towards smaller stone for paving purposes. With small stones, narrow joints and a true foundation of concrete, it is possible to make stone pavements which are smooth and comparatively noiseless. The surface of a stone pavement of the Liverpool type is almost as even as if made of brick, but as the granite of which they are composed is harder and tougher than any artificial substance can be, they will greatly outlast a pavement of that sort.

Most of the streets of Liverpool are paved with 3½ or 4-inch cubes, and the larger stones, which they call setts, are used only for streets where the traffic is of the heaviest kind, but these setts are only about one-quarter of the size of the stones which we use. Few people here have any conception of how small the smallest stone paving blocks now being used in Europe are. In Liverpool streets are now being paved with 2¼-inch cubes laid on a thin bed of granite chips above the concrete foundation.

When it was determined to use pavements of only the best quality for Liverpool, one of the principal streets was paved in sections with granite from different quarries, so that their relative behavior under heavy traffic could be observed. After five years' use it was found that a certain section had worn down so much that it was thought the foundation had given away, but upon examination it was found it had not. The stones were relaid upon a thicker bed of sand, so as to bring them up to the neighboring surface; but they soon became so rutted that they had to be taken up and removed, while granite from other quarries in adjoining sections showed no perceptible wear. Twenty-one years after being laid certain granites from the North of Wales stil showed no perceptible wear, except for a slight rounding off of the edges. Stone of this latter kind is now used entirely for the pavement of Liverpool and it is the same stone which it is proposed to use on the sample pieces of pavement in Lafayette street, New York.

Following the example of Liverpool, it is the intention of the authorities here to lay other pieces of pavement adjoining these, made in the same way, but of American granite, so that we can see how it wears in comparison with the Welsh stone.

American granite is doubtless as good and tough stone as can be found anywhere, but the trouble is no tests have been made and no one seems to know which of our granites will wear the best. This is a matter of the greatest importance, for if some granites will become ruined in five years' wear, as was shown in the Liverpool tests, while others subjected to the same traffic shows scarcely any sign of wear after 21 years, the importance of knowing which is the best can be seen.

In Europe it is the custom to make estimates of the traffic of the different streets by carefully counting the vehicles passing over them during a certain time and calculating their weight. These counts are made at frequent intervals over long periods of time, and thus it is found what the tonnage amounts to per yard of width of street, and the wear of the pavement is computed in that way. Mr. Brodie, the present city engineer of Liverpool, finds that granite blocks properly laid, of the kind used in Liverpool, will stand with impunity a wear of 7,500,000 tons per yard of width, whereas the best quality of macadam of the same stone will stand about 100,000 tons, or only about one seventy-fifth part as much.

Besides laying these samples of stone pavements on Lafayette street, it is the intention of the authorities to lay sections of other kinds of pavement on Second avenue. where their comparative wear and economy can be tested out.

Status of Engineers.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The article in "From Workers in the Field," by H. Y. Carson, December MUNICIPAL ENGINEERING, and contemporaneous articles written by others, and appearing in other publications, in which the writers either state or infer that the engineer is not properly recognized make me want to add to the discussion from my observation and experience.

The attitude of the people toward the medical and engineering professoins differs only in so far as the men of these professions hold different attitudes toward the people. The medical profession have educated the people to look up to them: it is up to the engineering profession to do the same. I quote from a Boston doctor, "I do not allow my patients to run their cases. I run the case in every instance. If you come to my office complaining of a headache or cold feet or loss of appetite, I don't take your word for it merely; I hunt for the cause of the statement by tests, which any gooc physician knows and uses if he cares enough to prove a diagnosis." It appears this doctor would rather lose a few patients than to lose his professional dignity in order to make a few dollars.

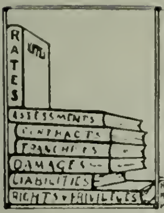
The engineer should hold his profession more sacred than his job. There is a large class of engineers with whom there is no fault to find, but their standing with the public is lowered by their less creditable associates. Foremost among these I would place the would-be, but incompetent, and the professionally immoral. Among the latter are the reckless, those who think their mistakes and shortcomings will not be discovered; and those who are ready to do anything, or leave anything undone, so long as they can thereby increase the immediate monetary receipts. These are the particular friends of the fake promoter and the "stand-in" contractor; also being strong bidders for official and government positions. The strength of the chain is judged by the weak, broken link, not by the strong, unbroken ones. We must either educate the public to distinguish between good, bad and would-be engineers, or, as a body, become worthy of respect before we can rightly expect to receive it.

Being one of the small men of the profession, and coming in contact with the irrigator, I speak from experience. I find the practical irrigators commonly entertain the idea that the engineer is a "man with an instrument," the "instrument" being the only difference between themselves and the engineer. From the mistakes of these engineers (?) I have had to correct I feel the irrigators could be justified in considering themselves superior to the "man with an instrument." The greatest fault I find with most of the engineers I have followed is that they left no records of what they did; and, by their inaccuracy, incompleteness and guessing and accepting the directions of their employers, whether engineeringly sound or not, thereby educating these employers to believe that such methods were good engineering practice. This state of affairs always caused me to do much otherwise unnecessary work, an additional expense for which I never received thanks, or else to do as so many of the others have done, viz: base the operations on a grand guess. Measured by immediate costs, the man who pays the bills is liable to believe that the one who guesses is superior to the one who knows.

Many professional men object to advertising as "unprofessional," but a campaign of publicity and education would result in much good. Each engineer can add his little to help the cause along. For myself, I do some advertising along impersonal, educational lines. I consider it no less professional than the business card, and it does more good.

Since being discharged from a job early in the year because I would not reach a predetermined conclusion, contrary to fact, to benefit one of the directors of the canal for whom I was working, I have made this resolve: Hereafter I will insist on sufficient investigation to know I am right, not accepting careless, incomplete work or assumed facts; I will make it as much a part of the work to leave a record of what I do, for the benefit of employer and future engineers, as to do the work itself: I will do my work as I believe it should be done, from an engineering standpoint, as near as my ability will allow, without fear or favor of the ideas of employer or others; and I will lose my job rather than stop short of, or deviate from, these resolutions. Could our profession, as a whole, take some such determined stand it would be a question of a very short time before the public would look up to us, instead of trying to advise us how to conduct our work. I know this is a hard thing to do, for to quote from E. Tappan Tannatt: "The engineer who upon the completion of the design of a plant informs his client that the pump will show an efficiency of 45 to 50 per cent. is turned down as incompetent and not up to date, because 'Mr. So-and-So will sell me a plant which will show an efficiency of from 65 to 85 per cent.'" In conclusion he says, "When the irrigator learns to look to qualified engineers rather than jobbers for advice, he may expect to learn more accurately as to just what he may expect of the future."

HARTSON A. MARK,
Concrete and Irrigation Engineering.
Morrill, Neb.



MUNICIPAL MATTERS IN COURT

Higher Courts.—Centralia City Court.—No Appeal from Viewers.

Decisions of the Higher Courts of Interest to Municipalities.

Intention of Officials Does Not Modify an Ordinance.—The testimony or opinions of individual members of a legislative body are not admissible to show what in fact was intended or meant by an ordinance; and hence the opinion of a chief of police as to the purpose of a city council in passing an ordinance fixing rates to be charged for electricity, and that a later ordinance not referring to it was intended to aid and supplement it, and the opinion of a city engineer who furnished information and recommendations to the council, before the passage of the ordinance, are not admissible to show the intent of the council, since that must appear from the ordinance itself.—Ex parte Goodrich (Cal.), 117 P. R. 451.

Extension of Water Service by Private Company Does Not Exclude Power of Municipality to Supply Its Own Plant.—That a water company erects its plant and proceeds to supply water to a particular territory pursuant to its charter right, and subsequently, when a borough is created from a portion of the territory, continues to supply the inhabitants with water and to supply the borough with water for fire protection at fixed rates, and on the increase of the borough extends its mains and builds additional fire hydrants at the borough's request, does not raise an implied contract between the water company and the borough, excluding the power of the borough to supply water by its own plant.—Bethlehem City Water Co. v. Bethlehem Borough et al., 80 A. R. 984.

Liquidated Damages Which Have Been Withheld May Not Be Refunded After Part Payment Is Accepted.—A contract with a city for the removal of ashes and rubbish from the streets provided that for each failure to so remove the sum of $2 might be deducted by the city engineer from the payments to the contractors, and that the sum should be considered as liquidated damages, and not as a penalty. For many months the engineer made deductions and the contractors accepted payment, without objection. This went on for a long time until a new city administration came in, when the contractors presented claims for the amount deducted, and brought an action therefor. Held, that, having assented to the deductions each month, they could not now impugn the decisions of the city engineer, for the city authorities had a right to believe that, when the money was accepted, any controversy over the deductions made was final. —Brockway et al. v. City of Utica (N. Y.), 130 N. Y. S. 1013.

City Not Liable for Damages Unless Sidewalk Obstruction is Two Inches or More in Height.—In an action for personal injuries from defect in a sidewalk an instruction that "unless the obstruction exists two inches in height or depression (in this case it is height), that unless it exists to that amount, the sidewalk is reasonably safe, and if it does exist two inches, then it is a question for the jury to determine whether or not the sidewalk is reasonably safe and fit for travel, but, if the obstruction is two inches or less, then there is no dereliction of duty on the part of the city," was not obscure, though the word "exists" was used for the word "exceed."—Baker v. City of Detroit (Mich.) 132 N. W. R. 762.

Failure to Repair Street Does not Make Street Superintendent Liable for Damages.—The San Diego City Charter gives the board of public works, subject to ordinances adopted by the council, control of the streets and all improvements and repairs thereon, and authorizes such board to appoint a superintendent of streets "whose duty it shall be to see that the laws, ordinances, orders and regulations relating to public streets" are executed, and who shall keep himself informed of the condition of the streets and report the same to the board. *Held*, that failure to repair a street which he was not directed to repair by ordinance or order would not make the sureties on the bond of the superintendent of streets liable for resulting injuries, though he knew of its dangerous condition. Edwards v. Brockway et al. (Cal.) 117 P. R. 787.

Future Benefits Cannot be Made the Basis of an Assessment for a Public Improvement. —To determine the amount of benefits from a public improvement, the inquiry is, How much has the improvement added to the fair market value of the property, as between willing sellers and buyers, with reference to the uses to which it is reasonably adapted, and for which it is plainly available, prospective as well as present, by strangers, as well as by the owner? But probabilities of future use, so remote as not to influence the price in a present sale, cannot be the basis of a determination of benefits or value.—Driscoll et al. v. Inhabitants of Northridge (Mass.) 96 N. E. R. 59.

An Assessment is Assumed Correct Until Proven Otherwise.—An assessment levied by the sewer commission of a town for the benefits accruing from a sewer must be deemed correct, unless the landowners show that the same is excessive.—Driscoll et al. v. Inhabitants of Northridge (Mass.) 96 N. E. R. 59.

No Appeal From Appraiser's Report.—Under laws providing for assessment of benefits for street improvements, and declaring that the reports of appraisers shall be conclusive on all the parties thereto, no appeal lies from such reports of the appraisers.—Holderman v. Town of North Manchester (Ind.) 96 N. E. R. 29.

Time Limit of Contract is Applicable Only to the Parties to the Contract.—Stipulations in the contract between the municipal authorities and the contractors who undertook the work of construction, providing for penalties in the event of failure on the part of the contractors to carry out the terms of their contract with the municipality, could not be invoked by the plaintiff in this case, who was not a party to the contract last referred to.—Town of Decatur v. Jaudon (Ga.) 72 S. E. R. 351.

Compensation For Engineering Service Not Affected by Extension of Contract Time Limit.—Where, having reference to the contemplated construction of a system of waterworks, a civil engineer made to the municipal authorities of the town proposing to construct the waterworks a written proposition offering his services in the following language: "I will do all the work necessary to get up a complete set of plans and specifications for your proposed waterworks; said plans and specifications will be such that you will be able to invite bids on the same; and after the contract is awarded from the bids I will supervise the construction of the work and see that the same is carried out according to the plans and specifications adopted by you. I will make a proposition to do all the work for the lump sum of $1,500, this amount to include all expenses of getting up the plans and specifications and the supervision of the work after the same has been contracted"—and this proposition was accepted without additional stipulation or qualification, the engineer could not recover against the municipality for additional services and expenses which were rendered and incurred by him after the time fixed in a contract between the municipality and the contractors who were to construct the waterworks had expired. His right of recovery was limited to the lump sum named in the proposal.—Town of Decatur v. Jaudor (Ga.) 72 S. E. R. 351.

The Report of Viewers on an Improvement Admits of No Appeal.

In a decision by Judge Henderson of Superior Court of Pennsylvania (46 Pa. Super. Ct. 502), the right of viewers to assess the value of damages paid to parties whose property was damaged, was affirmed. The appeal was taken on the ground that none of the appellant's property was "taken, injured or destroyed" but that he was assessed benefits to pay damages for property which was damaged. It was not declared that there was a charge made for damages paid to others whose property was injured; but that there was an allowance of damages to the amount of $2,200 to two property owners whose land was injured, which amount was not declared by the viewers to be assessed against the city, and that for this reason the amount so allowed was included in the total assessment for the cost of construction.

The record brought up in the case showed that the amount assessed against the appellant was only his proportion of the actual cost of the sewer. He gave no statement of means by which the persons allowed damages should recover the same. It was assumed by the court that those having damage claims would doubtless go to the city for reimbursement. But the conclusiveness of the report of viewers on the cost of the work, showing that the assessed value of the improvement represented the benefit of the abutting property owners, allowed no grounds for the implication that damages had been included in the assessment. It was stated that when the report of the viewers on an improvement is confirmed, it is conclusive.

Centralia, Illinois, City Court Sustained.

Judge McBride recently sustained the Centralia City Court in an opinion which he handed down in the test case which was sent first to the Circuit Court, to establish whether the new court was really legal, owing to its peculiar geographical location in two counties.

Judge McBride, in his opinion, says that courts are for threefold purposes, to try common law cases, chancery cases and criminal cases, and that the Centralia court qualifies in all respects except its right to try criminal cases from Clinton County, which would be clearly invalid. Because the local court is unquestionably authorized to try proper Marion County cases, he feels he would not be warranted in saying that the City Court is invalid. In Judge McBride's opinion it is a matter for the Supreme Court to construe the law, or for the legislature to amend the jury act. The petition was dismissed, and the case will be appealed to the Supreme Court.

ROADS AND PAVEMENTS

Recent Progress in Good Roads.—New Hampshire Trunk Lines.

Recent Progress in the Good Roads Cause.
(Continued from p. 470, December number.)

NEW YORK.

The roads of New York are now in charge of a Department of Highways, the commissioners being C. Gordon Reel, superintendent of highways; John A. Bensel, State engineer; Charles E. Treman, superintendent of public works, with Charles P. Dillon as secretary.

The first State-aid law was passed in 1898 and put the selection of roads to be improved and the supervision of construction in the hands of the State engineer. One-half the expense of constructing such roads was paid by the State, 35 per cent. by the county and 15 per cent. by the town or by the property benefited, the latter in case they had petitioned for the road. It was also provided that after the construction of a road all road taxes on the abutting property should be paid in cash. This law, as amended from year to year, was in force until the formation of the State Commission of Highways in 1908. A law passed in 1903 authorized towns to vote to pay all road taxes in cash. On such roads and on the roads constructed by the State the State paid one-third of the cost of maintenance. In 1907 this was changed so that the State paid a graduated proportion of this cast, ranging from one-half in townships where the valuation was $5,000 per mile of road or less, to one-third where the valuation was more than $13,000 per mile. Maintenance of the highways improved by the State was assumed by the State in 1906, the towns to pay $50 per mile per year and the State to pay the remainder from appropriations made for that purpose. The appointment of a county engineer was authorized in 1904. When the number of highways to be improved began to exceed the limits of the State appropriations available a waiting list was provided in order of application, and roads were taken up for improvement in this order.

The people of the State voted in 1905 for a bond issue of $50,000,000 for road construction.

January 1, 1909, the new law creating the Department of Highways and making other important changes in practice went into effect, and for the years 1909 and 1910 the roads were under a commission of three members appointed by the Governor. County superintendents of roads were permitted to be appointed by county boards of supervisors, and district superintendents to be appointed by the State commission to act in counties not appointing them. Town superintendents with enlarged powers and duties were also provided. Labor road taxes were abolished entirely. State highways on prescribed lines to cover the counties of the State and to be paid for by the State, and county highways to be paid for by State, county and town in proportions heretofore fixed were provided for. These proportions were later changed on lines similar to those distributing the cost of maintenance until the State paid an average of 65 per cent. of the cost of construction of county roads. Maintenance was well provided for with appropriations by the State to be distributed proportionately to the counties, according to their needs, as estimated by the commission, and payment by the towns of $50 per mile of road.

This law was again changed in July, 1911, and the highway commission is now composed of the State officials named above, the State Superintendent of Highways being appointed by the Governor and the other two members being such ex-officio. But few of the details of the law were changed.

Appropriations for construction of roads under the State aid law have been made as follows:

Year.	State.	County.	Completed mileage.
1898	$50,000	$63,872	.....
1899	50,000	42,876	5
1900	150,000	431,227	35
1901	420,000	1,055,874	20
1902	795,000	1,748,115	126
1903	600,000	2,198,623	112
1904	1,108,265	2,032,855	158
1905	50,000	480,000	117
1906	5,000,000	2,101,132	94
1907	3,000,000*	1,952,380	311
1908	3,000,000	1,033,034	809
1909	4,200,000	1,000,000†	181
1910	4,524,783‡	1,231,513‡	§430
Totals...	$22,948,048	$15,371,501†	2,398

* Does not include $2,000,000 reappropriated from preceding year.
† Approximate.
‡ Expended.
§ Includes 77 miles of highway all paid for by State.

Maintenance of roads under the system of payment of road taxes in cash and State aid for maintenance resulted as follows:

Year.	Miles under system.	State aid.	County expenditures.
1899	3,696	$34,517	$138,070
1900	6,497	54,057	222,767
1901	7,521	67,655	269,994
1902	11,681	102,509	419,491
1903	24,372	272,249	672,734
1904	30,952	393,493	917,873
1905	36,100	483,355	1,062,803
1906	38,857	594,591	1,206,462
1907	48,190	721,849	1,881,041
1908	54,745	1,062,674	1,757,583
1909*	79,646	1,441,751	2,526,612
1910	79,646	1,591,911	4,673,961

* In 1909 all the roads not improved under State aid were included in the system of maintenance theretofore in force in the towns collecting road taxes in cash.

In 1907 the total amounts expended for maintenance of highways in towns operating under the cash tax system, with State aid for maintenance, were as follows:

State aid	$721,849 32
Raised by towns for highways..	1,881,041 52
Bridge and miscellaneous	886,567 34
Extraordinary repairs	57,627 11
Compensation of town highway commissioners	263,236 04
Total	$3,810,321 33

This amount took care of 48,190 miles of highway and the maintenance cost was therefore $79.07 a mile. These highways are the ordinary roads, not those improved by the State.

In 1907 the expenditures for the maintenance of all the highways in the State which had not been improved under State aid were as follows:

Highway taxes	$2,526,612 39
State aid	1,441,751 20
Balance from 1908	197,012 10
Bridge taxes	749,882 24
Machinery taxes	203,845 26
Miscellaneous taxes	392,142 27
Town superintendents' salaries.	504,562 63
Supervisors' and town clerks' pay	93,327 99
Total	$6,109,136 08

The amount actually expended was less than this sum by the unexpended balance, which seems to have been $1,049,262.74. This includes macadamizing of 2,318 miles, graveling of 8,177 miles and shaping and crowning of 53,621 miles. As there are 79,646 miles in all, the actually expended average cost of maintenance per mile was $63.53.

In 1910 the funds for the maintenance of town roads, being all the roads in the state not improved under state aid, were as follows:

Highway taxes	$4,673,961.69
State aid	1,591,911.72
Balance from 1909...........	1,049,262.74
Bridge taxes	261,553.15
Machinery taxes	602,603.97
Town highway commissioners' salaries	581,652.07
Supervisors' and town clerks' pay	112,685.89
Laying out and altering highways	8,804.29
Total	$8,882,455.52

As there are 79,646 miles of these highways, the average cost of maintenance per miles is $104.84, after deducting $532,181.91 balance remaining unexpended at the close of the year.

The first expenditures directly by the state for repair of roads built under state aid were made from the appropriation of $1,500,000 for that purpose in 1909, when $900,000 was spent in resurfacing about 200 miles of completed roads and about $600,000 in maintaining the other 1,600 miles. For 1910 the appropriation was $1,800,000, of which $725,000 was expended in resurfacing and about $1,000,000 in repairs, patrol system and oiling of about 2,200 miles, the oiling being confined to 1,010 miles, at a cost of about $350,000. The appropriation recomemended by the commission for 1911 was about $1,300,000, less being required for constant maintenance, although the mileage of roads was increased about 500. In resurfacing contracts were let during 1909 and 1910 for the following materials:

	Miles.
Asphalt macadam	71.27
Tarvia	0.99
Vitovia	7.02
Amiesite	1.00
Rock asphalt	1.45
Brick	9.50
Plain macadam	88.50
Gravel	3.15
Surface treatment	4.33
Total	187.21

Patrolling 2,200 miles of highway cost about $106 a mile, supervision cost $24.50, inspectors and superintendents $12.50, office charges $1.50, making total cost of supervision $38.50 a mile, of which about half is chargeable to the patrol system, making it cost $125 a mile in all.

The total mileage of town roads being 79,646, and of improved state and county roads 2,398, the total mileage of roads in the state is 82,044, unless there is some duplication in these reports.

Roads constructed in 1910 averaged in cost about $11,430 per mile for bituminous macadam, $10,000 for water-bound macadam, $15,840 for gravel, $25,300 for brick, and $2,000 for earth.

County boards of supervisors have charge of the county and town work, with the county and town superintendents, required by the latest road laws, as executive officers. Annual reports are required from each office to the one above and from the county to the state highway department. The following will serve to show the activity in the counties which has been developed through the state work.

Cayuga county has 1,482 miles of road outside of incorporated cities and villages, of which 914 are of natural soil graded and drained as needed; about 340 are of gravel, of which about 40 miles in small sections were improved in 1911 at a cost of about $450 a mile; 43 miles are of broken stone water-bound macadam, afterwards oiled; 19

are of bituminous macadam, of which 14 miles were improved in 1911 at a cost of about $12,000 a mile; and 25 are of broken stone macadam laid by town road men without roller, about 5 miles laid in 1911 in small sections at a cost of about $1,500 a mile. One bituminous macadam road 2.4 miles long was built in 1911 entirely at state expense, 16 and 26 feet wide and 6 inches thick, within the Auburn city limits; one 9.1 miles long, 14 feet wide, 6 inches thick, was built at a cost of $101,000, and paid for 50 per cent by the state, 35 per cent by the county and 15 per cent by the towns; another 5.3 miles long, cost $67,000 with some extras and was paid for, 54 per cent by the state, 35 per cent by the county and 11 per cent by the towns. Town road work is paid for, 33 to 48 per cent by the state, according to the valuation schedule mentioned above, and the balance by the towns. The work for 1912 includes two bituminous macadam roads aggregating 5 miles, to be built by the state and paid for by state, county and towns and county work under appropriations probably not less than those for 1911, which were as follows:

Highway taxes	$40,441.04
State aid	23,852.57
Bridge taxes	5,774.00
Road machinery taxes	2,739.61
Miscellaneous road repairs	9,141.77
Total	$81,948.99

Essex county has 1,264 miles of material soil roads, 100 miles of gravel, 19 miles of broken stone macadam, 22 miles of bituminous macadam and 1,200 feet of brick roads. Two bituminous macadam roads, built by the state and paid for by state, county and towns, are under construction, each 6 miles long, 16 feet wide and 6 inches thick, one costing $56,981.51 and the other $77,651.09. It is estimated that 25 miles of state road will be built in the county in 1912.

Jefferson county had 500 miles of graded and drained roads, to which it added 100 miles in 1911 at a cost of $10,000; 100 miles of gravel roads, which was lengthened 20 miles at a cost of $14,000; 100 miles of broken stone macadam, increased in 1911 by 15 miles at a cost of $18,000; 55 miles of oiled roads; and 45 miles of bituminous macadam, stone bottom and asphaltic top, to which 18 miles was added in 1911 at a cost of about $200,000. Of the latter, two roads were constructed by the state, each 16 feet width and 7 inches depth of stone, one 3.24 miles long, costing $30,978, and one 5.25 miles long, costing $52,427.51. Two other roads, built by the state and paid for 50 per cent by the state, 35 per cent by the county and 15 per cent by the towns, were 14 feet wide and 7 inches deep; one was 5.37 miles long and cost $54,120, and another was 4.56 miles long and cost $49,917.

Niagara county has 934 miles of road, exclusive of city and village streets, and 21 miles on an Indian reservation. Of these, about 475 miles are graded earth roads, 40 miles are water-bound macadam and 6 miles are bituminous macadam built by the state and paid for 50 per cent by the state, 35 per cent by the county and 15 per cent by the towns, at an average cost of $12,000 a mile. There are 60 to 70 miles of roads built by town officials as funds warranted at an average cost of about $2,000 a mile, 9 to 10 feet wide and 6 inches deep, of crushed local field stone. The county has 2½ miles of brick road 16 feet wide, with 16 feet of earth road alongside, costing $54,800. The county spends about $80,000 a year on the earth or town roads.

The county superintendent of highways of Monroe county, in which the city of Rochester is situated, has published an elaborate tabular report of the work in that county in 1911. This county has the largest value of farm products of any county but one in the United States, and consequently pays special attention to its roads. Of the 1,367.68 miles of road in the county 800.86 have been improved by the state at an average cost of about $6,800 a mile, half paid by the state, about 35 per cent by the county and about 15 per cent by the towns, and 6.86 miles built wholly by the state at a cost of $85,000. The county has built 4.72 miles of road, costing $10,125 a mile, paid for about two-thirds by the county and one-third by the towns. Towns have spent large sums of money each year on their roads, $168,859 in 1911, for example, and the result is shown in the following table of condition of roads in the county:

	Miles.
State and state-county roads	200.86
Town macadam	299.75
Town gravel	464.15
Town cinders	2.70
Total of improved roads	967.46
Earth roads shaped and crowned	256.71
Earth roads	143.71
Total roads in county	1,367.68

The variety of surfaces on the roads in Monroe county is shown by the following table:

	Miles.
Plain macadam	8.687
Macadam oiled, hot or cold	97.174
Macadam with glutrin	4.626
Macadam with granulated calcium chloride	24.451
Macadam with glutrin and feldspar	0.630
Rocmac macadam	0.750
Bituminous macadam asphalt, penetration method	48.234
Bituminous macadam, tarvia	0.995
Bituminous macadam, vitovia	2.304
Bituminous macadam, amiesite	0.740
Kentucky rock asphalt, Wadsworth	5.720
Sheet asphalt, mixing method	0.870
Concrete cube pavement	1.030
Vitrified clay cube pavement	0.250
Vitrified brick, concrete base and edging	1.840
Sheet asphalt, concrete base, steel reinforcement	2.76

The average age of the state roads in Monroe county is 6.1 years and the average cost per mile per year for maintenance has been $471. The cost of maintenance of the county road has been $588 per mile per year.

Yates county has 730 miles of road, of which 4 miles is gravel and 4.68 miles is bituminous macadam state road. Of this 2.68 miles was built in 1911 at a cost of $37,000. About 20 miles of bituminous macadam will be built by the state in 1912. Ther are no county roads.

The population of New York is 9,113,614 and is increasing about 25 per cent per decade. Its 61 counties vary in population from 4,000 to 529,000, not including Kings and New York counties.

NORTH CAROLINA.

The roads of North Carolina are looked after by Joseph Pratt, state geologist, and W. L. Spoon, highway engineer, of the Geological and Economic Survey. No state aid is given to road building except the advice by these officials, for which department work $8,750 was appropriated for 1910 and $5,000 for 1911.

There are 46,850 miles of road in the state, of which 3,956.5 have been improved. Of these improved roads 967 miles are macadam in 25 counties, 145.5 miles having been constructed in 1910; 1,528 miles are gravel in 12 counties, 269 miles having been constructed in 1910; 1,445.5 miles are sand-clay in 34 counties, 438.5 miles having been constructed in 1910; 17 miles of asphalt macadam in two counties. There are thus 2,512 miles of road improved with stone, gravel or bituminous macadam; 3,956.5 miles improved by special preparation with material brought in. In 1910 814 miles were improved by grading and crowning.

Twenty-four counties have sold $1,888,000 of bonds for road improvement; 68 counties have levied special county or township taxes for roads, amounting to $829,898 in 1910, about three-fourths to be expended by counties and one-fourth by townships; 31 counties have appropriated a part of the poll tax; 68 counties enforce a labor tax, averaging about 5 days per year per man; 39 counties use convicts in road construction and repair, averaging 1,364 men during the year, and 33 counties lease their convicts to other counties. Guilford and Mecklenburg counties are especially active in road improvement. About 50 counties expect to do more or less improvement next year, but the reported appropriation of $4,500,000 for the work seems to be exaggerated. Sand-clay roads cost from 2.7 to 9 cents per square yard, or $190 to $760 per mile of road, 12 to 20 feet wide.

The county roads are in charge of boards of county commissioners of three each, excepting Montgomery county's five. The township roads are in the hands of the board of supervisors, made up of the justices of the peace, who appoint a road supervisor for each district into which they divide the township.

North Carolina has a population of 2,206,287, which is increasing over 15 per cent per decade. Its 98 counties vary in population from 4,000 to 67,000.

NORTH DAKOTA.

North Dakota requires an amendment to the state constitution before state aid can be granted in the construction of roads. The necessary concurrent resolution was passed by the legislature in 1911, and if the program is followed exactly state aid laws can be passed in 1915.

A law was also passed permitting county commissioners to appoint county superintendents of highways and their deputies, and five such officers have already been appointed. License fees on automobiles, which will probably bring in $18,000 a year, were also imposed for the benefit of the highways in the counties in which the applications originate.

Under the regular road laws the township supervisors divide their townships into districts, with a road overseer elected in each district. In the counties with county highway superintendents his deputies take the place of these overseers. In counties without township organizations the county commissioners act as the highway board and appoint the road supervisors for the districts into which they divide the county.

Maintenance funds for highways are obtained from poll tax of $1.50, property tax by county of 1 to 5 mills per dollar, payable in cash or in labor at $1.50 to $2 a day; property tax by township not to exceed 8 mills per dollar, payable likewise; automobile and motor-cycle licenses.

A good-roads experiment station with convict labor at Bismark was authorized in 1909, but no special appropriation was made to maintain it.

T. R. Atkinson is state engineer.

It is reported that there are 59,332 miles of road in the state, of which but 212 miles are improved.

North Dakota has a population of 577,056, which is increasing at the rate of 80 per cent per decade, and its 49 counties vary in population from 4,000 to 34,000.

OHIO.

The state aid law in Ohio, was first passed in 1904 and has been improved from year to year. It provides that the highway commissioner and his three deputies shall, from information furnished them by the county commissioners of the various counties, classify the roads of the state and select roads which shall be known as inter-county highways or main roads of the counties. These inter-county roads shall be the first to be constructed by state aid. After these have been constructed other roads shall be selected and built as state aid roads. Where these roads have been improved heretofore in whole or in part, such roads or parts shall be considered state highways and shall be improved or cared for by the state as provided by law.

In construction the costs and expenses are finally divided as follows: State 50 per cent, county 25 per cent, township 15 per cent and the abutting property 10 per cent.

In maintenance and repair the costs and expenses are to be borne as follows: State 25, county 50 and the township 25 per cent.

A recent county road improvement law directs the county commissioners to apportion the cost and expenses within the following limits: County not less than 35 per cent nor more than 50 per cent, township not less than 25 per cent nor more than 40 per cent, lands and lots lying within one mile of the improvement not less than 20 per cent nor more than 35 per cent. This law seems to be satisfactory where it has been tried.

Another law enacted in 1900 has been quite popular in some parts of the state, but is losing favor. It divides the cost and expenses as follows: Township not less than 50 per cent nor more than 66 2-3 per cent and the lands lying within one mile of road not less than 33 1-3 per cent nor more than 50 per cent.

The state highways are in charge of the state highway commissioner, James R. Marker, Columbus. Local roads are in charge of boards of county commissioners of three members each and a county engineer or surveyor; and township trustees with one or more road superintendents for each township.

The amount of aid given since 1904 up to 1911 was $1,862,410.49 and the amount appropriated for 1911 was $600,365.92.

Of the 88,861 miles of road in the state 24,106 miles had been improved January 1, 1911; 199 miles under state aid law. The improved roads are 14,188 of gravel, 9,687 of macadam and 231 of brick. In 1910 the roads improved under state aid amounted to 72.87 miles, of which 0.38 mile was gravel, 38.08 miles were macadam, 21.25 miles brick, 3 miles macadam with asphaltic surface, 7.67 miles macadam treated with tar by the penetration method, 1 mile of gravel with tar penetration method and 1.49 miles Portland cement concrete.

In 1911 contracts were entered into as follows: Water-bound macadam, 35.33 miles; bituminated concrete, 1.25 miles; brick, 11.54 miles; total, 60.88 miles. On account of the lateness of the appropriation for state aid—June 14th—there were about 30 miles of road carried over for early letting in 1912.

The 1905 appropriation was $10,000; those for 1906 and 1907 were $150,000 each, and since then they have increased each year from $440,000 in 1908. The amount spent by the state for repairs has not been far either way from $250,000 a year since 1908 and the increase in expenditure has been in the amounts appropriated for construction.

Prior to 1911 Cuyahoga county had constructed 212.54 miles of improved roads. Of this mileage 3.77 miles were of gravel, averaging $6,561 per mile; 7.22 miles were macadam, averaging $23,754 per mile; 20.83 miles were of bituminous macadam, averaging $13,062 per mile; 177.42 miles were of brick, averaging $20,608 per mile, and 3.3 miles were asphalt, averaging $37,932 per mile. In 1911 21.1 miles of brick pavement were laid, at an average cost of $17,072 a mile. Cuyahoga county has not applied for state aid and the county pays 75 per cent of the cost of the roads built by it, the township pays 10 per cent and the property benefited pays 15 per cent. The estimated cost of roads built in 1911 is $1,252,360, which represents about 60 miles of work, averaging a little less than $21,000 a mile.

Meigs county built 5 miles of brick road prior to 1911 and built 1 mile in 1911, 12 feet wide, at a cost of $11,465, the cost being distributed under the state aid law.

Some counties have been issuing bonds to increase the amount of construction and will reduce the amount of work proposed for next year, but in most counties the outlook is for much new construction. A notable feature of the good roads development in Ohio is the large mileage of brick and other hard pavements, in which this state takes the lead.

Ohio has a population of 4,767,121, which is increasing nearly 15 per cent a year, and its 88 counties range in population from 13,000 to 637,000.

The Trunk Line Highways of New Hampshire.

The plan of highway development in New Hampshire includes three main trunk line roads extending in a north and south direction through the state. The western route follows along through the farm land district of the Connecticut river, passing through the larger summer resort colonies. The central road, known as the Merrimac Valley boulevard, passes through the manufacturing district of the state. Leaving Massachusetts at Lowell, the road follows the banks of the Merrimac river through Nashua, the second largest city in the state. Here the manufacture of cotton cloth is the city's greatest industry. From Nashua, Manchester, the most prosperous city in the state, standing fifth in the manufacture of shoes in the United States. Concord, the capital, is the next city of importance. From Concord the way passes through Franklin, Tilton and Laconia to Lake Winnipesaukee, a popular place for summer residents. From thence it passes through a region noted for its summer camps maintained by different schools and colleges, to Bretton Woods.

Although there is only a little seacoast in New Hampshire, the third or eastern trunk line has been laid out to include this short shore. This route includes Newburyport with its broad, sandy beaches; Rye with its more rugged coast line, and Portsmouth, one of the oldest seaports in New England. At the northern end of the eastern route some mountainous country, with shelf-like roads along the cliffs, is experienced.

The expense of constructing these trunk lines to the state as well as to the towns through which the roads pass has been in round figures about $1,000,000. Not only have old roads been rebuilt, but often entirely new roads are constructed to do away with curves or grade crossings; for instance, the Lafayette road from Profile Notch to Bretton Woods, which was laid out and constructed through dense woods. The interest of the people in this good roads movement has been awakening gradually since the inauguration of the plan for the three trunk routes.

By July, 1912, the three trunk lines through the state will be practically complete, and the tourist will then be assured of good roads for all time, as nearly all the money received from motor fines and licenses, amounting to a large sum, is in the future to be expended for the maintenance of these three trunk routes.

The Prest-O-Lite Building Failure.

By D. M. Avey, Indianapolis.

The sudden collapse on December 6 of a concrete building being constructed for the Prest-O-Lite Co., Indianapolis, Ind., caused the death of nine men and the more or less serious injury of 18 others. The building, which was being built as an additional factory for the Prest-O-Lite Co., was nearing completion, three stories and the roof having been finished and the parapet wall around the roof was being poured at the time of the collapse.

The building was of monolithic concrete reinforced in a manner similar to the "mushroom" system; that is, with flat floor slabs supported upon the columns without beams and girders. It is true, however, that the system was not the Turner "mushroom" system, which has come into such wide and safe use. Herbert W. Foltz of Indianapolis prepared the plans, which in the original called for only two stories. An additional story was added to the plans and a new design was made later, but the building permit called for only two stories. Hugh Baker, Indianapolis, designed the reinforcing and his plans were checked by the Chicago office of Corey J. Dean, who furnished the reinforcing. The construction was not superintended by Mr. Baker. Wolf & Ewing, Indianapolis, were the contractors.

The plans as revised called for a three-story building, reinforced after the manner above noted, and 70 by 88 feet in dimensions. The panel length, i. e., the distance between columns, was about 22 feet, the two interior rows of columns being placed about 25 feet center to center. The floors were designed for 250 lbs., 250 lbs. and 150 lbs., and the roof for 125 lbs., respectively.

The collapse took place shortly after the noon hour, when the workmen had returned to their posts. There were at the time between 40 and 50 men on the structure, some of whom were carried down with the falling roof and escaped with slight or no injury. The action of the fall was almost instantaneous, one workman describing it as seen from the third floor as a wave sweeping from the rear central portion of the building and carrying the columns transversely in the direction of the wave. Two workmen were imprisoned alive under the debris, which

II. PREST-O-LITE BUILDING FAILURE.
Two Columns at the S. E. Corner.

was held from them by the arch action of the masses of broken concrete and reinforcing. They were rescued after several hours of effort. The character of the debris made the rescue and recovery of the bodies very difficult. The reinforcing rods had in most cases been partially or entirely pulled from the concrete, and were tangled in with the masses of the latter in such a manner as to make the use of picks or shovels impossible. The oxyacetelyne flame proved the solution of the problem and the twisted masses of steel were cut through and removed by its use. The rescue work was continued throughout the night by the aid of "Prest-O-Lite" automobile lamps placed around and in the vicinity of the work. Photograph I shows the debris at 40 minutes after the collapse.

The condition of the debris indicates beyond a doubt that the failure was caused by a collapse of the floor slab of the third floor or roof, causing the other floors to be carried down. In every case the columns were found to indicate by their freedom from buckling or other signs that they had not caused the collapse. The condition of the fallen columns, the direction in which they had been thrown, and the location of the masses of debris indicate that the collapse took place after the following manner:

The third floor or a roof slab near the umn inward, snapping it off at the base. The second photograph shows this portion with the southeast corner column shown broken off toward the interior and the next column thrown outward and the top broken and fallen into the alley. The condition of the reinforcing rods in this case, as was quite generally noted, indicated that the concrete above the second floor was very "green." In no case was a sheared or broken rod noted in the material which came from above the second floor, the rods came ing been pulled clear from the concrete.

The cause of the failure has not as yet been determined, though various theories have been stated by those who have examined the wrecked building. No definite statement has been made regarding the length of time allowed between pouring the concrete and "pulling the forms." There is, how-

I. PREST-O-LITE BUILDINC FAILURE.
View of North West Corner.

southeast corner of the building fell vertically, carrying the second floor with it, as is indicated by the fact that the reinforcement of the first row of interior columns in this portion was bent downward equally on all sides, leaving the columns vertical. The portion to the north of this point of first failure then swept to the north and west, carrying the interior columns and floors with it and pulling the northernmost panel inward and towards the west. That portion to the south of the point of first failure folded downward as if hinged to the south row of columns, knocking the latter outward and in two cases throwing the third floor portion of columns against an adjacent building. This hinging action was also apparently combined with a rotating action toward the west, which drew the southeast corner col-

ever, no doubt that the concrete in the third floor columns and all material above was very "green." The masses of concrete which fell from above the second floor had crumbled and broken some of it to the fineness of the aggregate; and even the third floor columns (which were yet encased in their forms) could be crumbled and broken by a slight kick. Some samples of concrete which came from the third floor were laid away and given an opportunity to come to a set, but after four or five days they were soft and crumbled easily.

An investigation is being made at the present time under the direction of the coroner, but from the character of the testimony reported up to the present time it is doubtful if a definite conclusion as to the cause of the failure will be reached.

ORGANIZATIONS & INDIVIDUALS

Iowa Cement Users.—Technical Associations.—Calendar.—Technology and Efficiency.—Addresses to Engineering Students.—Technical Schools.—Civil Service Examinations.—Prof. Peter Schwamb.—Ira Gould Hoagland.

Iowa Association of Cement Users.

The program of the Iowa Association of Cement Users for its convention at Sioux City, Ia., January 10-12, is not yet completed, but some of the speakers and subjects are scheduled as follows:

Iowa Highway Commission Engineer T. H. MacDonald, on "Recent Types in Concrete Bridges and Culvert Construction"; Director Engineering Experiment Station A. Marston, on "Failures of Drain Tile and Their Prevention"; P. P. Comoli, contractor, on "Construction of Cement Plaster Houses"; Chas. E. Sims, "The Use of Cement Drain Tile in Iowa."

There will be papers also on the manufacture of cement tile, the requisites of good sand and gravel, cement paving, and other topics.

Technical Associations.

Dr. Louis Livingston Seaman, major-surgeon First U. S. V. Engineers, addressed the 306th meeting of the New York Electrical Society, held on December 12, on the subject, "A Scientific Hunting Expedition in Central Africa, with special references to the Tsetse Fly and the Sleeping Sickness."

The regular monthly meeting of the American Society of Engineer Draftsmen was held in the Engineering Societies building, 29 West Thirty-ninth street, New York, on Thursday, December 21, at 8:15 p. m. C. M. Shigley, M. E., of Columbus, Ohio, read a paper on "Patent Office Drawings," and William H. Chorlton, B. S., C. E., of the American Bridge Company (designing department), spoke on "Bridge Drafting from the Engineer's Point of View."

At a meeting of the New England Water Works Association, held in Boston on December 13, William H. Walker, professor of chemical engineering, Massachusetts Institute of Technology, presented a paper on "An Investigation of the Relative Life of Iron and Steel Pipe as Found in Actual Service." The discussion of the paper was led by F. N. Speller, metallurgical engineer, Pittsburg, Pa.

At the Twentieth National Irrigation Congress, held in Chicago on December 5-9, the following officers were lected for the succeeding year: Senator Francis G. Newlands of Nevada, president; R. Insinger, Spokane, Wash., first vice-president; Dr. E. McQueen Gray, Albuquerque, N. M., foreign secretary; Arthur Hooker, Spokane, Wash., secretary.

At the thirty-sixth annual meeting of the New Jersey Sanitary Association, held at Lakewood, N. J., the following officers were elected: President, John B. Smith of New Brunswick; first vice-president, Morris R. Sherrerd, Newark; secretary, Dr. James A. Exton of Arlington; treasurer, George T. Olcott, East Orange.

Two hundred members of the Engineers' Society of Western Pennsylvania were guests at the Cambria Steel Company, Johnstown, Pa., November 25, making an inspection of the works. They were accompanied by a group of 25 Cambria Steel officials, headed by President Charles S. Price. The inspection tour was made over the interworks railway, three gondola cars being provided. The tour included the air compressor house, blowing engine house, machine shop and the mills during the forenoon. Short addresses were made by President Charles S. Price of the Cambria Steel Company, President Walter Riddle of the Engineers' Society, and Superintendent H. C. Welle of the Cambria company.

At the December meeting of the Society of Engineers of Eastern New York, held in Albany, N. Y., December 13, John C. Moore of the New York State Conservation Commission gave an address on "What the State of New York Is Doing for the Conservation of Its Natural Resources."

The third annual dinner of the General Contractors' Association, held at the Hotel Knickerbocker, New York, December 7, was attended by over 200 members and their guests. The speakers for the evening were John F. O'Rourke, Hon. Douglas Mathewson, Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City; Kingsley L. Martin, vice-president of the Foundation Company and formerly chief engineer and commissioner of bridges of New York City, and J. Waldo Smith, chief engineer of the New York Board of Water Supply.

The annual convention of the National Association for Preventing Pollution of Rivers and Waterways was held at Johns Hopkins University on December 13. The object of the association is to create public sentiment to such an extent that laws will be passed by all the states compelling communities to properly purify their sewage before discharging it into streams or other waterways; also to secure the aid of the United States government by the creation of a board to assist in adjusting interstate sanitary matters. Among the speakers and the subjects presented were the following: Dr. William H. Welch of Baltimore, on "The Sewerage Question from a Medical Standpoint"; John D. Watson of Birmingham, Eng., on "Sewerage with Reference to European Conditions"; H. de B. Parsons of New York, on "The Sewerage Status in the United States"; Prof. C. E. A. Winslow of New York, on "Practical Possibilities in the Purification of Municipal Sewage."

The seventh annual convention of the American Civic Association was held at the New Willard Hotel, Washington, D. C., on December 13, 14 and 15. Among the papers presented were the following: "The Business Side of City Planning," by Arnold W. Brunner, New York City; "Modern Street Lighting," by C. L. Eshelman, Cleveland, O.; "The Smoke Problem," by Thomas E. Donnelley, Chicago, Ill.; "Progress in Municipal Shade Control," by William Solotaroff, East Orange, N. J.

Calendar of Technical Meetings.

Pacific Northwest Society of Engineers—Annual meeting, Seattle, Wash., January 6. Joseph Jacobs, secretary, 803 Central building, Seattle, Wash.

American Society of Engineering Contractors—Annual meeting, New York City, January 9. J. R. Wemlinger, secretary, 13 Park row, New York City.

Michigan Engineering Society — Annual meeting, Lansing, Mich., January 9-11. Alba L. Holmes, secretary, 574 Wealthy avenue, Grand Rapids, Mich.

Engineers' Society of Western Pennsylvania—Annual meeting, Pittsburg, Pa., January 16. Elmer K. Hiles, secretary, 2811 Oliver building, Pittsburg, Pa.

American Society of Civil Engineers—Annual meeting, New York City, January 17-18. Chas. Warren Hunt, secretary, 220 West Fifty-seventh street, New York City.

American Society of Heating and Ventilating Engineers—Annual meeting at New York City, January 23-25. Secretary, W. W. Macon, 29 West Thirty-ninth street, New York City.

Ohio Engineering Society—Annual meeting, Cleveland, O., January 24-26. Clyde J. Knisely, secretary, New Philadelphia.

Second Annual New York Cement Show—Madison Square Garden, January 29-February 3. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

Fifth Annual Chicago Cement Show—Coliseum, February 21-28. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

First Clay Products Exposition—Coliseum, Chicago, Ill., March 7-12. International Brick and Clay Products Exposition Co., 813 Chamber of Commerce building, Chicago, Ill.

First Annual Kansas City Cement Show—Convention Hall, March 14-21. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

Technology and Industrial Efficiency.

Indiana Engineering Society — Annual meeting, Indianapolis, January 25-27. Chas. Brossmann, secretary, Indianapolis.

Association for Standardizing Paving Specifications—Annual meeting, New Orleans, La., January 8-12. J. B. Hittell, secretary, Chicago.

Under the title, "Technology and Industrial Efficiency," the proceeding of the Congress of Technology, held in Boston last April at the Massachusetts Institute of Technology, have been published in a volume of about 500 pages. Some 70 papers are included, and these form together a valuable and up-to-date record of the present state of industrial science, and a presentation of some of its problems and probable solutions. The six sections into which the congress was divided are represented by papers on "Scientific Investigation and Control of Industrial Processes"; "Technological Education in Its Relations to Industrial Development"; "Administration and Management"; "Recent Industrial Development"; "Public Health and Sanitation"; "Architecture."

Addresses to Engineering Students.

Waddell and Harrington, consulting engineers, Kansas City, Mo., have published a book called "Addresses to Engineering Students." It includes a carefully selected number of addresses delivered on various occasions by prominent engineers to engineering students.

The authors state as their reason for issuing the book the following facts:

First: Most students who enter technical schools have no adequate idea of the standing of the engineering profession nor of its importance to the world; and the already excessive demands upon the instructor's time make it very difficult for him to impart much information along these lines.

Second: As a rule, mainly because of the excessively large classes that engineering professors have to teach, students are not given sufficient friendly advice concerning how to make the most of their course of instruction, and are not taught how to study to best advantage.

Third: For the same reason, students usually are not taught enough about ethical matters for their guidance both at college and in practical life afterwards.

Fourth: With a few notable exceptions, students generally are not instructed at all adequately in good, sound, forcible, engineering English.

A complete review will be published in these pages at a later date.

Technical Schools.

Dr. Arthur H. Koelker, formerly associate professor of physiological chemistry at Johns Hopkins University, was poisoned to death by fumes of hydrocyanic acid, in the Harriman Research Laboratory of the Roosevelt Hospital, New York City, on December 7.

Raymond C. Benner of the department of chemistry of the University of Arizona has become associated with Prof. R. K. Duncan of the University of Pittsburg, at which place he will make a study of the smoke problem.

George Davidson, professor of geography at the University of California, and for a number of years in charge of the work of the United States Coast and Geodetic Survey on the Pacific Coast, died in California on December 2. Professor Davidson was born in England in 1825, coming to this country in 1832. He was educated in Philadelphia and entered the service of the Coast Survey in 1845. He was an honorary member of the American Society of Civil Engineers.

R. J. Young of the North Chicago works of the Illinois Steel Company, who is a member of the Committee on Safety Devices of the United States Steel Corporation, gave a lecture before the students and faculty of the College of Engineering of the University of Illinois on December 13, in which he described a large number of devices for protecting workmen against accident in steel mills. His lecture was illustrated with lantern slides of devices in actual use.

Professor D. W. Osborn of the Geological Survey of the University of Oklahoma has been appointed director of the Oklahoma Geological Survey to succeed Chas. M. Gould, who has resigned to enter private work.

Mr. Clarence T. Johnston has resigned as vice-president of the W. H. Rosecrans Engineering Co., Chicago, and will hereafter devote his entire time to work coming under his supervision as professor of engineering at the University of Michigan. He graduated from the University of Michigan in 1895 and was afterward engaged in irrigation in Wyoming. He was at one time state engineer of Wyoming.

"Tests of a Suction Gas Producer," by C. M. Garland and A. P. Kratz, is issued as Bulletin No. 50 of the Engineering Experiment Station of the University of Illinois. This bulletin gives the results of 25 tests made on a small suction gas producer, for the purpose of obtaining data on the efficiency, reliability and operation of suction producers of small size, using anthracite as a fuel. The theory of gas producers is discussed at some length. The conclusion is reached that a producer of the above type is a practical piece of apparatus for a class of work not requiring close regulation; also that the percentage of CO_2 in the gas can vary within wide limits without affecting the efficiency of operation. A very complete set of forms for reporting tests has been drawn up, and the formulas for calculting the trials have been deduced.

Civil Service Examinations.

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

January 3. Specialist in rural engineering, office of Experiment Station, Department of Agriculture, Washington, D. C., at salaries of from $1,500 to $1,800 per annum.

January 3. Senior highway engineer, office of Public Roads, at salaries of from $2,000 to $3,400 per annum.

January 10. Assistant Superintendent of Construction of Lifeboats, Apparatus, etc., at salaries of $100 per month and traveling expenses.

January 10. Topographic Draftsman on the Isthmian Canal Service at a salary of $125 per month.

January 17-18. Architectural and Structural Steel Draftsman in the Lighthouse Service, San Francisco, Cal., at a salary of $1,500 per annum.

Professor Peter Schwamb.

Professor Peter Schwamb, who is retiring from active work at the Massachusetts Institute of Technology, has been named a beneficiary by the Carnegie Foundation. He has been connected with the department of mechanical engineering for twenty-eight years and is one of the three important professors to retire the present year at the institute. Professor Schwamb is the product of the institute, being a graduate of the class of 1878, remaining another year in post-graduate work. He was called to the Tech in 1893 as instructor, becoming the next year assistant professor. His next advance was to associate professor, where he remained till 1896, being that year named professor of mechanism. Since 1901 his title has been professor of machine design and director of the mechanical laboratories. He realized that what were formerly termed "shops" are, in fact, laboratories, and under his direction the laboratory method of making use of them for the purposes of investigation has been developed. The study is fundamental and the laboratories turn out no finished products to the trade, but at the same time are able to fill the usual needs of students' work in all the departments.

Ira Gould Hoagland.

Ira Gould Hoagland, who is to become editor and manager of *Insurance Engineering* on January 1, 1912, is prominent in the work of fire prevention and in the literature of the subject.

He was born in Brooklyn, N. Y., in 1877, and was educated in the Brooklyn public schools and in Pratt Institute, where he took the elctrical and mechanical engineering courses.

For several years he was a special inspector of the Philadelphia Fire Underwriters' Association and, for a while, a special agent in Pennsylvania for the Hamburg-American Fire Insurance Company.

Since 1905 Mr. Hoagland has been engaged in improved risk inspection and fire protection engineering with the Underwriters' Bureau of New England, known as "the Little Bureau," and with the Sprinklered Risk Department, or Committee of Nine, of the Southeastern Underwriters' Association. He has resigned his connection with the last-mentioned organization.

Personal Notes.

John R. Stewart has been appointed city engineer of Provo, Utah.

R. D. Brown of Toronto, Ont., has been appointed city engineer of St. Catharines, Ont.

E. Hardgrove, superintendent of sewers of the Borough of Queens, New York City, has resigned.

Emanuel Brandon, superintendent of highways of the Borough of Queens, New York City, has resigned.

Al. H. Day, acting chief of police of Des Moines, Ia., has been appointed chief of police, succeeding George Yeager.

Benjamin Douglas, consulting engineer, Detroit, Mich., was instantly killed by falling from a high bridge near Capoere, Brazil.

The resignation of Ross Canterbury, city engineer of Peoria, Ill., has been accepted by Mayor Woodruff. He is succeeded by Leonard D. Jeffries.

Carl Taylor, city engineer of Lewiston, Idaho, has resigned to accept a position in Berkeley, Cal. W. D. Wright, his assistant, will be appointed to fill his place.

Victor T. Price has been appointed director of public service of Cincinnati, O. He is a civil engineer who has been engaged for a number of years in railroad work.

Joseph O'Neill, associate member of the American Society of Civil Engineers, city engineer of Leavenworth, Kan., has tendered his resignation, to take effect January 1, 1912.

G. H. Preston has resigned as structural engineer with the Turner Construction Co., New York, to become connected with F. T. Ellithorpe & Co., consulting engineers, New York, in similar capacity.

G. P. Hillsman has been appointed district manager for the Koehring Machine Co. and is now established at 857 People's Gas building, Chicago. Mr. Hillsman's district will cover Illinois, Iowa and Indiana.

Henry M. Waite has been appointed city engineer of Cincinnati, Ohio. He has been recently connected with the Clinchfield Coal Co. as chief engineer and was formerly with the Seaboard Air Line Railway.

Caryl Davis Haskins, M. Am. Inst. E. E., manager of the lighting department of the General Electric Co., of Schenectady, N. Y., died from pneumonia at Salt Lake City, Utah, after but two days' illness.

Francis W. Frost, formerly secretary and treasurer of the Engineering News Publishing Co., has been elected to the office of vice-president and treasurer of Suffern & Co., importers and exporters, New York.

W. I. Cherry, Atlantic City, N. J., has resigned the presidency of the United Paving Co., and also from the board of directors. W. E. Shadelford, now vice-president, will succeed Mr. Cherry as president.

Kirkpatrick & Johnson, of Jackson, Miss., have dissolved partnership. Walter G. Kirkpatrick, consulting municipal and hydraulic engineer, formerly senior member of the firm, will continue to be located at Jackson.

T. W. Smith has a testing laboratory in Indianapolis, Ind., for the testing of Portland cement, lime, coal, insulating material, boiler water, clay, paints, oils, tars, asphalts, road and street paving or building materials.

Col. Washington A. Roebling, of Trenton, N. J.; A. A. Woodhill and Prof. William Libbey, of Princeton, have been named as a state committee to conduct an investigation of the Shark River inlet which now becomes obstructed with sand.

Monks & Johnson, architects and engineers, 7 Water street, Boston, have associated themselves with Henry F. Keyes, architect, 161 Devonshire street, Boston, for the preparation of plans and specifications for certain large industrial developments.

Hugh A. Kelley has been appointed city engineer of Jersey City, N. J. The other officers under the city commission plan are: H. Otto Wittpenn, mayor; Frank Stevens, president; Robert E. Jennings, vice-president; Walter G. Muirhead, secretary-treasurer.

Thomas F. Gilroy, formerly commissioner of public works of the city of New York and later mayor, died at Far Rockaway, N. Y., on December 1. While commissioner of public works he gave much attention to paving the city and later to the improvement of the Croton watershed.

Gen. Hugh Bancroft, of Boston, Mass., has been appointed chairman of the new harbor commission of Boston, known as the Board of Directors of the Port of Boston. Other members of the commission are Hon. J. A. Conry, Rear Admiral Francis T. Bowles, W. F. Fitzgerald and George E. Smith.

Walter S. Franklin, a civil engineer of Baltimore, Md., died in that city on December 3. He was born in 1835 and during the civil war served in the engineer corps of the Army of the Potomac and rose to the rank of colonel. Since the war he had been connected with iron, steel and railroad companies in Baltimore.

Paul Schultze has been named as city engineer of Troy, N. Y., under the new administration, which will take office on January 1. He is now serving as county superintendent of highways of Oneida county, New York, with office at Utica. He was formerly city engineer of Utica, and previous to 1899 was engaged for several years on the New York State canals. He is a graduate of Rensselaer Polytechnic Institute.

Nicholas A. Gilman has been appointed city engineer of North Yakima, Wash., to succeed Harold J. Doolittle. Mr. Gilman is a graduate of the engineering department of the University of Minnesota and has been in engineering work for 12 or 13 years, most of the time for the Northern Pacific and the Great Northern. Since 1907 he was assistant to E. M. Kenly, superintendent and chief engineer of the Yakima Valley Transportation Company.

Walter B. Snow announces the recent addition to his staff of Sidney G. Koon, M. M. E., for four years editor of "International Marine Engineering," and later metallurgist Jones & Laughlin Steel Co.; and also the addition some time since of John S. Nicholl, B. S., lately with the New York Edison Co., and formerly acting manager for F. W. Horne, importer American machinery, Yokohama, Japan. Both are members of the American Society of Mechanical Engineers.

MACHINERY AND TRADE

A Complete Hand-Book on Street Lighting.

The Sterling Electrical Manufacturing Company, Warner, Ohio, has issued the most complete publication yet offered on ornamental street lighting. The title, "From Post Hole to Lights On," expresses the scope of the booklet. It is fully illustrated with drawings and photographs of the parts shown.

The following are some of the subjects covered in the booklet:

Cost of lead or steel cable; cost of laying same under various conditions. Cost of fibre conduits; cost of laying under various conditions. Prices and terms on Alba glass globes. Prices and terms on Holophane globes. Illustration of laying out a street for the Magda system. Wooden poles and parts for the same, with costs. Magda series regulators. Reflectors and fixtures. Switch boards; description and cost. Standards, cuts, prices, description of installation under various conditions for both concrete and metal. Transformers, wire, etc., with costs. Sterling D. W. Mazda lamps, both multiple and series. A synopsis of the Warren lighting contract.

Among the lighting standards shown are representative types from a number of manufacturers, including the Electric Railway Equipment Company, 2905 Cormany street, Cincinnati, O.; the Flour City Ornamental Iron Works, Minneapolis, Minn.; the Morris Iron Company, Frederick, Md., and the Union Metal Manufacturing Company, Canton, O.

Ward's Liquid Asphalt Atomizer.

A machine which has proven practical for use in distributing any kind of oil, liquid asphalt or tar, is being used extensively on road construction along the Western coast. This machine will apply any kind of oil, liquid asphalt, or any of the tar products manufactured for road purposes, and will distribute evenly in 6, 8 or 10-foot courses, from one-twelfth to one gallon per square yard of road surface. The process is giving good satisfaction, producing an economy of 25 to 40 per cent in cost of construction and maintenance. It has been adopted by the Highway Commission of Los Angeles, Cal., San Joaquin county, Santa Barbara county, and by many road contractors.

The following, taken from the semi-annual report of the Los Angeles county highway commission, gives a description of the machine and its use:

During the past season's work a new type of oiler, applying the liquid asphalt in a fine spray under high pressure, was introduced on the work, and after a small amount of experimenting and development proved to be the remedy for our previous oiling troubles. During the latter part of the season a considerable number of these machines were in use by contractors who had voluntarily discarded the previous method of oiling.

The machine is a local product, having been developed largely on our work by the inventor, the machine now being known as 'Ward's Liquid Asphalt Atomizer.' Thus far this has been the only machine of this type to have made a success locally.

This machine consists of a light rig trailing on a substantial four-wheel truck, equipped with a small high-class gasoline engine, direct connected through friction clutch to rotary pump, which draws the hot oil through a large steel flexible hose from wagon tank and forces it through distributing boot under pressure of from 30 to 50 pounds, as desired, where it is atomized and forced into the surface of the road in a line film the width of oiler, when applying even as small a quantity as one-eighth of a gallon per square yard. The roads or the portions of roads on which this method of oiling has been used during the past season can now be easily picked out even by the casual observer by the density and uniformity of surface. The uniformity secured makes it possible to use a smaller quantity of oil, which is desirable in this class of work."

The New Hetherington & Berner Factory.

During the past year there has been steadily advancing towards completion, at the intersection of Kentucky avenue and White river, Indianapolis, Ind., the new manufacturing establishment of Hetherington & Berner. At this writing the company is engaged in the work of removing from the South street site, which they have occupied for so many years, to the new location. These new and spacious shops, which represent the most advanced state of factory construction, mark the upward progress of a business that has been closely identified with the general growth of the city of Indianapolis since it was established by the original founders more than forty-four years ago. In the history of American industrial establishments it is unusual to find one that has been handed down from one generation to another intact down from one generation to another intact and complete. In this case a large portion of the details of management are now in the charge of the third generation, represented by C. F. Hetherington, who is treasurer of the company, and Robert Berner, who is its secretary; these two being the grandsons of B. F. Hetherington and Frederick Berner, Sr., both deceased, who began the business in a small way in the year 1867.

The new shops consist of a series of large and fireproof buildings that cover almost three acres of ground that years ago was thought to be worthless river bottom. The series consists of a modern office building, which contains also a completely equipped drafting and engineering department in the second floor, a structural steel shop containing 12,800 square feet of floor space, an iron foundry containing 13,600 square feet, a machine shop containing 13,700 square feet and carrying a mezzanine floor of about 10,000 square feet, which will be the pattern shop. There is also a power house containing powerful engines, electric generators and air compressors, and a blacksmithing shop having about 1,200 square feet of floor space. Added to all this will be storage buildings that will increase the total floor space under roof to nearly 70,000 square feet. The construction of a large structural steel and engineering building for structural iron work has also been completed.

As an object lesson to those interested in fire prevention this series of buildings cannot be equaled in this vicinity. Not only have they been designed and constructed to be absolutely safe from fire, but also every modern appliance or device that may make for the greater safety of the operatives has been adopted and is in evidence; by means of powerful overhead traveling hoists, operated electrically, a very large percentage of the dangerous operations that were formerly accomplished by manual labor is now done by machinery. Especial attention has been given to the interior illumination of all of these shops, and the machine shop is covered with roofs of the latest "saw-tooth" design, provided throughout with steel window sash that are glazed with a semi-opaque glass that permits the entrance of great volumes of light, but breaks up and disseminates the direct rays of the sun.

In the yards and in and about the various buildings are railway spurs or tracks, which connect with the Pennsylvania Railway Company's main line on Kentucky avenue in front of the shops. In these new works all in and outward bound freight is handled directly in the company's yards by electrical and steam hoists and with the minimum amount of hand labor. The street frontage of these new works is about 450 feet upon Kentucky avenue, 637 feet upon Hilkene avenue and 562 feet upon McCarty street.

NEW PLANT OF HETHERINGTON & BERNER, INDIANAPOLIS, IND.

The management and conduct of the business of Hetherington & Berner will be in the hands of the following named persons: Frederick A. Hetherington, president; Frederick Berner, Jr., vice-president; Robert Berner, secretary and in charge of commercial business details; Carl F. Hetherington, treasurer and chief mechanical engineer. The iron founding will be under charge of William Keller, who has been with the company for sixteen years. The machine shops will be under the immediate management of Edward DeVine, who has been with the company for nineteen years. Jacob Hilkene, who has been identified with the company's business for a number of years, will continue to act as superintendent of the steel construction shops and estimator.

From the work of a small machine jobbing and repair shop the business of Hetherington & Berner has grown until now the name is well known. Outside of the State of Indiana it is known principally by reason of its developments in the line of asphalt paving plants and machinery. The first municipal paving and street repair plant in the United States was built for and installed in the city of Detroit, and since that installation its plants have been adopted by many cities all over the country, including San Francisco, Seattle, Spokane, Hamilton, Ontario, and its machinery may also be found operating in the City of Mexico.

The majority of the presses and machinery used in the manufacture of encaustic tiles has also been from the shops of this company.

Oiled Road Successful for Automobile Race Track.

As guests of the Indian Refining Co. some thirty State, city and county officials made a trip to Savannah, Ga., in special cars under the expert guidance of A. B. Chamberlin, the manager of the road oil department, and his corps of able assistants, who made the journey more than usually pleasant. The object of the trip was to see the grand prize automobile race on Thanksgiving Day, at which the records were broken with an average speed for the 411 miles of 74.45 miles an hour.

The track over which this phenomenal time was made is laid out along country roads in the vicinity of Savannah, which roads have been graded and covered with a coating of gravel treated with Indian Refining Company's road oil. The party made an inspection of the course on the day before the race and found it in excellent condition, with but two or three short stretches which were somewhat soft on account of insufficient drainage. These places were put in good condition by rollers and kept so by the unusual frost of the days preceding and the day of the race, so that inspection after the race showed that the road had received no injury and was, in fact, in many places improved by the action of the wheels. The long race of the preceding Monday had a similar effect.

The party also visited the convict camp located, much of it, in the area surrounded by the road, where the jail prisoners, most of them negroes, are kept, and where they perform the farm labor necessary to raise the food which they eat. These convicts have done most of the manual labor of constructing the roadway and are also employed in improving other roads in the county.

On the return trip the party stopped at Charlotte, N. C., where there are several miles of excellent bituminous roads treated with the same oil. The accompanying photograph shows most of the members of the party and was taken at the railroad station in Columbia, S. C.

The party divided at Washington, returning on their respective cars to New York and Chicago, and unanimously voting Mr. Chamberlin to be above imitation as a host and his seconds to be worthy assistants. It included the following persons:

MUNICIPAL OFFICIALS INSPECT GOOD ROADS.

Edward Schoneck, mayor, Syracuse, N. Y.; Thomas H. O'Neill, mayor, Auburn, N. Y.; F. C. Wagoner, mayor, Concord, N. C.; E. L. Becker, commissioner public works, Cortland, N. Y.; Nelson P. Lewis, chief engineer Board of Estimate and Apportionment, New York City; A. Jackson, superintendent of streets, St. Paul, Minn.; J. C. Travilla, street commissioner, St. Louis, Mo.; Walter Leininger, assistant superintendent of streets, Chicago, Ill.; P. McCarthy, assistant superintendent of streets, Chicago, Ill.; R. H. Jones, secretary to the mayor, Syracuse, N. Y.; William H. Connell, assistant commissioner public works, Borough of Bronx, New York City; R. M. Martin, special representative *Manufacturers Record*, Baltimore, Md.; Paul D. Sargent, Bureau of Public Roads, Department of Agriculture, Washington, D. C.; R. T. Childs, associate editor *Engineering News*, New York; M. E. Monahan, city comptroller, Syracuse, N. Y.; Joseph Hanlon, city clerk, Auburn, N. Y.; H. B. Varner, editor *Southern Good Roads*, Lexington, N. C.; Clinton Cowan, county engineer, Cincinnati, O.; W. L. Hempelmann, engineer bituminous highways, St. Louis, Mo.; Charles C. Brown, consulting engineer and editor MUNICIPAL ENGINEERING, Indianapolis, Ind.; H. N. Kasson, vice-president International Asphalt Company, Chicago, Ill.; Stanley Strubel, chairman Hamilton County Commissioners, Cincinnati, O.; H. F. Byrd, president Valley Pike Co., Winchester, Va.; Clinton Smith, city engineer, Concord, N. C.; F. C. Wolff, commissioner of roads, Charlotte township, Charlotte, N. C.; J. P. Beatty, superintendent of roads, Charlotte township, Charlotte, N. C.; M. C. Mayer, commissioner, Charlotte township, Charlotte, N. C.; D. P. Hutchinson, chairman Charlotte township, Charlotte, N. C.; W. M. Long, chairman county commissioners, Charlotte, N. C.; W. C. Borem, chairman county commissioners, Greensboro, N. C.; J. C. Fouchee, director public work, Greensboro, N. C.

They were in charge of A. B. Chamberlin, New York, manager of road oil department of Indian Refining Co.; Wells Chamberlin, Boston; H. B. Cole, traffic manager, New York; S. E. Finley, Atlanta, Ga.; Cassius Finley, Charlotte, N. C., and R. W. Sanders, Chicago representative.

The Pneumelectric Rock Drills.

The use of electricity and pneumatic power for driving drills have both been familiar for a number of years, but there has been placed on the market a new machine which makes use of both electricity and compressed air for power. This machine is manufactured by the Pneumelectric Machine Company, 583 South Clinton street, Syracuse, N. Y.

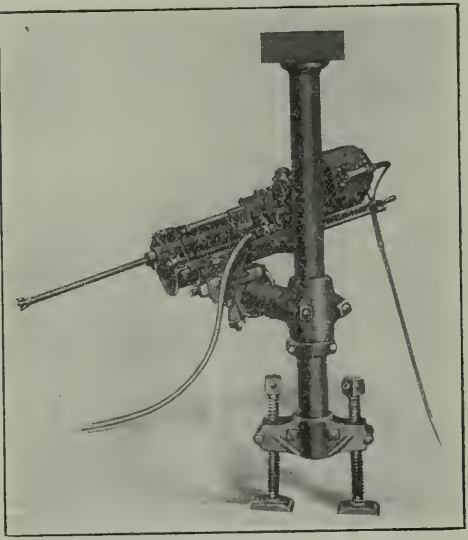
The pneumelectric drill is of the hammer type, in which the steel is not reciprocated, but is constantly in contact with the material drilled, while it is struck by a reciprocating hammer, the work being performed very much in the same manner as when drilling is done by hand.

The motive power is electricity, but the blow is struck by compressed air. The electric motor is used only for the purpose of compressing the air, turning the steel and operating the small pump for supplying water to the steel. All of these features are combined in the compact machine shown in the accompanying photograph.

The mode of operation is briefly as follows: The air is compressed in a cylinder by a piston driven by the motor; the motor and the cylinder being mounted on the same base. In the same cylinder with the motor-driven piston air is compressed until the piston uncovers ports, which permit the compressed air to pass over the piston and expand. The hammer or second piston is free from mechanical connection with the motor-driven piston, but by reason of the air being exhausted from between the piston and hammer, the latter is drawn back with the motor-driven piston and is independently acted upon by the compressed air when it passes from behind to in front of the motor-driven piston, the hammer thus operating under the influence of the expanding air after the same manner as in the compressed air or steam drill. The steel is intermittently rotated by the motor, and in this manner the hole is kept of uniform diameter for each length of steel and the point of contact between the cutting edge of the steel and the material being drilled is constantly changed.

Another feature of the tool is the automatic chuck, which permits the steels to be used as they come in the bar without shanking. No clamping nor adjusting is required, it being only necessary to push the steel in the chuck, after which it is handled automatically.

The steels used are hollow so that water may be fed through them to the cutting face



THE PNEUMELECTRIC ROCK DRILL.

and removing the cuttings so that the whole power of the blow is delivered on the face of the material being cut. The water is delivered by a small pump, which is integral with the drill.

The motor used with the Class 2¼x4¼ drill is a 2¼ h.p., either direct current or induction type machine, especially designed for use with the drill. The drills are mounted either on a column as shown or on a tripod base.

More complete information regarding the economy and efficiency of the drill may be obtained from the manufacturers.

The New Road Machinery Factory in Kingston, N. Y.

A new factory is being constructed by the Universal Road Machinery Company at Kingston, N. Y. This makes the sixth structure that has become necessary for an industry which in 1904 began with a single vacant factory building taken over by the Scholl Company, who four years later went out of business. In the two years it has been in the hands of the Universal, backed with a liberal working capital, owning the sole rights to the standard road machinery in general use, and under the management of material and in so doing draws together all R. E. Leighton, who is experienced in road machinery, this plant has expanded to the largest of road machinery factories in this country.

With its organization fully perfected in 1909, the company placed a force of capable salesmen on the road, who, with the machinery they were sent out to demonstrate, could show how good roads can be made to be kept up at less expense than the maintenance of ordinary thoroughfares. The Universal Company bought connecting tracts of land, erected new buildings and put in additional machinery. Last year its sales doubled that of the preceding year, and this year far exceeded both. In January the company transferred its main office from New York to Kingston, with branches at Boston, New York and Rochester.

Stimulated by the misisonary work of the Universal's intelligent salesmen, who are selected for their practical knowledge of road building, by the utility of the Universal road-building machinery and the facilities of the company for filling orders promptly, many villages are putting in these plants and maintaining them at public expense. That road-building is getting more scientific was indicated in a peculiar way. The company went to a large expense to make up and to keep on hand a supply of screen sections for separating different sized stones most generally used, and they erected a building for storing them. But so many orders came in for screens with entirely different sized perforations the company had to increase its facilities so that they could make what was ordered and ship it the same day. And now most screens they sell are made to order. Road builders have learned to use different sized stones as are best fitted for local conditions. As Mr. Leighton, general manager of the company, explained, people are being taught to use the material they have at hand, even though it is only shale and soft sandstone.

The Denio Electric Fire Alarm System.

The use of the telephone in transmitting fire alarms has become general and has proved for the most part very satisfactory. The personal element, however, enters into the matter to a very great extent and examples are frequently noted in which through excitement or for other reason the address from which the alarm is sent is incorrectly given, leading often to disastrous results.

A new automatic system has been devised which correctly notes and transmits fire alarms and which is installed directly with the phone.

In this system the fire-alarm box is connected to any operating telephone line, and so arranged that, upon breaking a glass and pushing a button the telephone normally connected to this line is temporarily cut off and the connection to fire headquarters is automatically and instantaneously established through the switchboard. The fire-alarm box immediately proceeds to register its own number upon a tape at the fire headquarters, repeating the registering five times, the usual tape-punching apparatus being employed for this purpose. As soon as the transmission of the alarm has been completed the fire-alarm box restores the telephone line to its normal condition so that the telephone may be used immediately. Before beginning the transmission of the alarm the fire-alarm box automatically releases any connection which may be established on the line.

The fact that this fire-alarm system operates on lines which are subjected to a test many times a day renders this method of giving fire-alarm service particularly reliable. In the automatic system the fire department is usually given a low number, which is called practically instantaneously by the transmitting device of the fire-alarm box, and the time required to transmit the signal is the same at all hours of the day or night. It has been used extensively, notably in Rochester, N. Y., where it has given excellent service.

The Denio Electric Company, 6 Triangle building, Rochester, N. Y., are the manufacturers.

Economy in Pumping.

In these days of keen competition, when business must be done on a more or less close margin, the problem of "leakage" must necessarily be one of prime consideration. No contractor can afford not to keep a close watch on this feature of his business. And in foundation and sewer work the matter of pumping is where economy is often overlooked. In this connection a large number of contractors have found the Atlantic diaphragm pumping engine to be a prime factor in not only preventing leakage of profits in this work but also a considerable source of net income. It is claimed that this engine does the work of two hand pumps manned by four to eight laborers and does it at an outlay per diem of 10 cents to 25 cents for gasoline. Its design, material and construction is such that it runs itself for eight hours with one charge of gasoline, thus eliminating practically all cost for labor in this class of work.

The Harold L. Bond Company, 383 Atlantic avenue, Boston, Mass., who makes and distributes this engine, will furnish full particulars of the Atlantic pumping engine, which will be of value to contractors.

Wilshire Boulevard, Los Angeles, to Be Paved With Bitulithic.

Property owners on Wilshire boulevard, who have been trying for eighteen months to get a pavement for the finest boulevard in Los Angeles, were disappointed again on December 14, when the board of public works once more postponed action for a week. There are two and a quarter miles of street involved in the improvement and 65 per cent. of the frontage is signed up on the original petition. Only three individuals were opposing the improvement.

The chief trouble the property owners are having in getting their street paved is that they have attempted an innovation in their proposed improvement. They have been trying to get the best pavement possible and have shown a disposition to pay what it is worth.

Wilshire boulevard, although it is conceded to be the finest show street in Los Angeles, has had a pavement for years which has been a disgrace to it. When the Wilshire Improvement Association was formed one of its first acts was to appoint a committee on paving. This committee went to work scientifically to deal with the problem. It investigated every phase and detail of the paving question, inspected all the pavements within convenient reach and obtained reports on pavements elsewhere. One of the members made a trip East and looked at well-known paving jobs.

When the committee finally reached a decision it was in favor of a bitulithic pavement, and this decision was accepted by the property owners. Then the council was asked to begin the proceedings to give the people what they wanted. Many sessions were necessary in which committees representing the property owners and the city conferred. On December 20 the council unanimously awarded the contract for bitulithic, the area of the pavement being over 75,000 square yards.

Experiments on Weed and Grass Destroyers.

A series of experiments to secure an effective weed destroyer have been carried on under the direction of the Department of Health of Norfolk, Va., by A. P. Pannill, chief of sanitation. Mr. Pannill expresses his entire satisfaction with a compound manufactured by the Atlas Preservative Co. of America, 97 Liberty street, New York City. In brief, Mr. Pannill's statement of the effectiveness of the Atlas "A" is as follows:

In summing up results of recent experiments, I might embrace all in the one sentence: It can be depended upon to do all that you claim for it. I found it clean, effective and easy to use. In the first two respects it exceeds any of the kind I have ever seen, and will so impress any one, if they will only take the trouble to see that it is applied properly. At 1 to 20 Atlas "A" will, in my opinion, kill anything. It killed everything that I applied it to in way of all kinds of grass and weeds; and in making the tests, which I did in every instance in person, I took nothing for granted, simply testing under unfavorable as well as favorable conditions; in fact, took occasion to apply it late in the afternoon after rain. I tried it on streets beween Belgian blocks, where grassing and small weeding is almost impossible by hand method; along the edge of buildings; on sidewalks; thickly grassed dirt sidewalks, on account of being but little used; tough and tender grasses of all descriptions, and every conceivable form of weed growth that I could find in infancy to forest growth, and not in one single instance did it fail. The cost as compared to machine and hand methods depends upon circumstances. If a permanent result is desired in woods as well as sidewalks and dirt driveways, especially in parks, Atlas "A" is indispensable. I put the hoe against it on sidewalks with the result that the work of the hoe requires constant repeating while the effect of the liquid was final. It reaches the roots—gives permanent results.

The Cement Gun.

The increasing use of cement in its various combinations as a material with which to surface various structures has led to the invention and development of the cement gun. The application of this very convenient tool to other uses has followed until at the present time it is used for a great number of purposes, among which are foundation work and waterproofing below grade, coating steel to prevent corrosion, building walls, cement stone and cinder fill for floors, cement stucco and plaster, building fences, sidewalks, tree surgery, interior and exterior decorating, fire retardant coatings, making and lining or covering water pipes, etc. It has been very successfully used in coating the face of disintegrating rock in the Culebra cut of the Panama canal.

The cement gun handles equally effectively hydrated lime, gypsum, cement and other plastic materials. The combination of the elements necessary to produce a plastic material taking place in transit, as it does in the cement gun process, quick-setting cement, lime and gypsum may be employed, avoiding the use of a retardant, and producing thereby not alone better results in point of quality of products, but materially less in cost.

The most serious criticism that has heretofore been made concerning plastic products has been their lack of uniformity, due to the human element in mixing them and in the methods of application—it being a well-known engineering fact, for instance, that the instant moisture is brought into contact with any of these plastic materials the initial set, or crystallization begins; and that subsequent manipulation or handling tends to disturb this initial crystallization and consequently weakens the product. These objectionable features are entirely overcome by the cement gun process, the hydration taking place in transit and immediately before and during emplacement, the crystallization, or initial set, takes place where it belongs, i. e., in the wall and not on the mortar board.

The cement gun process employs only the

amount of water necessary for hydration, and by reason of the materials being projected with considerable force all surplus water and air is expelled, leaving the product denser, more homogeneous and therefore more waterproof than has heretofore been produced.

A very interesting test showing the character of the product of the cement gun was made recently.

Hand-made and cement-gun-made bricks, $1\frac{3}{4}$x$3\frac{1}{2}$x8 inches, made of a mixture of one part cement to three parts sand, exposed to moist air for one day and immersed in water for twelve days, were tested for breaking strength. The bricks were mounted upon round bars of steel 7 inches between centers and another bar of steel was placed above the bricks in the exact middle of the longitudinal length, that is, 4 inches from either end of the brick. From this last mentioned bar was suspended a platform, upon which weight was piled to test the breaking strength of each brick separately. The hand-made brick broke at 303½ pounds, while the cement-gun-made brick stood 533⅓ pounds.

The cement gun is manufactured by the Eastern Cement Gun Company, 32 Church street, New York City. This company is now taking orders to furnish guns on any work in this territory together with instruction for the application of cement, "alca" lime or other plastic materials. The machines are not for sale, the policy being to lease them to responsible corporations, firms or individuals by contract.

Trade Publications.

The Gould Manufacturing Company, Seneca Falls, N. Y., have three bulletins describing their pumps. Bulletin No. 103 contains specifications and lists of parts of vertical, single-acting, triplex plunger pumps. Bulletin No. 104 gives specifications, lists of parts and a repair chart of double-acting triplex plunger pumps. Bulletin No. 106 contains the same sort of matter in connection with vacuum and stuff pumps.

The Sterling Electrical Manufacturing Company, Warren, O., have compiled an attractive booklet entitled "Warren Beautiful." It contains a comprehensive synopsis of the history of the city, outlining in particular the development of street lighting. The present Mazda tungsten lighting system, which extends throughout the city, is fully described.

The Bausch & Lomb Optical Company, Rochester, N. Y., has published a "Handbook for Engineers," by George N. Saegmuller. It contains besides descriptive matter and methods of adjusting various surveying instruments, complete details on making observations and computing latitude, time, etc., and a complete solar ephemeris.

The December Bulletin of the Universal Portland Cement Company, Chicago, Ill., contains illustrations and descriptive matter on the following forms of concrete construction: Buildings, crushing plant and chimney, decorative walls, pavements and bridges.

"Garbage" is the title of a booklet published by Irvin Bair, 116 North Broad street, Philadelphia, Pa. It contains an article on the proper disposal of garbage and one on the collection of refuse and waste in New York City.

The December issue of "Paving and Roads," published by The Texas Company, Battery Place, New York City, contains notes on the recent roads conventions, the oiling of Douglas-Bisbee highway, Arizona, and cost tables for road oiling.

The Troy Wagon Works Company, Troy, O., has a circular setting forth the advantages of their short-coupled bottom-dump wagon.

A Liquid Making Cement Waterproof.

The Anti-Hydro Cement Waterproof Company, 121 Central avenue, Newark, N. J., has a waterproofing material for cement, known as "anti-hydro."

"Anti-hydro" is a solution, neutral to cement, which, when added in certain percentage to the water used in mixing Portland cement in the usual way, has the effect, without retarding its setting, of rendering the cement in all kinds of masonry impervious to water, moisture, frost, gas, odors, etc.

It makes them dustless and gives no discoloration. It acts upon cement while it sets; increases the natural density of that the other constituents of a concrete, mortar or stucco, intensifying the congestion so that their hydrometric natures are changed, capillary action and percolation prevented. Cement coatings with "anti-hydro" are fireproof besides being non-conductors. In color they are light gray, but can be given almost any color. The bond to brick, stone, concrete or to cement finished surfaces is perfect, adhering permanently against any head of water. In addition to the hydrolytic qualities of these "anti-hydro" cement coatings, they have a resistance to acid conditions.

Where water-resisting or water-holding is required the best results are obtained on walls, floors, roofs, etc., by a stucco or mortar about three-fourths of an inch thick, applied in the following manner: First. It is imperative that the surface to which the coatings are applied must be absolutely clean of all paint, whitewash or other foreign substances, and that these surfaces be "roughed" sufficient for the cement to bond to and well dampened. Second. A "slush coat" or grout of neat cement is applied, using "anti-hydro" with water in proportion, one part "anti-hydro" to ten parts water. (Water quantity same as usually used.) Third. The "slush coat" is followed with a "scratch coat," ¼ to ⅜ of an inch thick, this to be a mixture of one part cement to two parts clean, sharp sand (about 12 mesh screening), mixed with "anti-hydro" and water of the same proportion, one to ten. Fourth. This "scratch coat" after initial setting, is followed by a "finish coat" ¼ to ⅜ of an inch thick, of a mixture one part cement to one part clean, sharp sand, mixed with "anti-hydro" and water of the same proportion, one to ten.

Brick Roads Near Danville, Illinois.

Danville, Illinois, was one of the first cities of that state to adopt the brick pavement as a country road surface. There are at present about 6 miles of brick roads in the vicinity of that city and the voters of Danville township will have an opportunity next April to vote upon a proposition to pave three miles of the Georgetown road also with brick. The estimated cost is $20,000.

Boston's New Fish Market.

Henry F. Keyes and Monks & Johnson, architects and engineers, associated, Boston, Mass., are preparing plans and specifications for the Boston Fish Market Corporation for five buildings to be located on tidewater at South Boston. Two of the structures will be 720 feet by 60 feet, three stories high, and will be built on the new state pier that will be 1,200 feet long by 400 feet wide. The other three buildings will be located on the southern side of Northern avenue, just across from the pier. Two of these will be 600 feet by 60 feet and five stories high, while the third, a freezing plant, will be 70 feet square. These buildings will be of the most modern fireproof construction and will house practically the entire wholesale fish industry of Boston.

Bitulithic Pavement Development in 1911.

Warren Brothers Company report December 20, 1911, as the banner day during their eleven years' development in the volume of bitulithic contracts awarded, covering the widest range of climatic conditions of the United States and Canada and comprising the following:

Los Angeles, Wilshire blvd....	76,000 sq. yds.
Edmonton, Alberta..........	80,000 sq. yds.
Strathcona, Alberta..........	70,000 sq. yds.
Jackson, Miss..............	33,301 sq. yds.
Schenectady, N. Y..........	13,700 sq. yds.

The company report during the year 1911 bitulithic pavements contracted for and awarded for carrying over for construction during the year 1912, 125 cities, 5,995,554 square yards, bringing the total area of bitulithic pavements laid and contracted for during the eleven years of their existence up to 19,639,470 square yards, covering an equivalent to 1,116 miles of roadway having a width of 30 feet between curbs.

Trade Notes.

CEMENT.

The Sandusky Portland Cement Co., Sandusky, O., has just completed a five-car order of Medusa white Portland cement for Sydney, Australia; and a two-car order for Delorgo Bay, South Africa. Several thousand barrels will also be used on Woolworth Bldg., New York, the highest office building in the world.

MACHINERY AND SUPPLIES.

Scranton, Pa.—Special—The Engineering Construction Co., Coal Exchange building, Scranton, Pa., desire to sell a steel traveler capable of handling girders and trusses 120 feet long that weigh as much as 50 tons.

Oxford, Miss.—W. L. Smith desires to purchase one direct-connected dynamo for the city.

Pensacola, Fla.—Special—The purchase of an automobile street sprinkler to cost about $3,000 is contemplated. Frank Reilly, mayor.

Washington, D. C.—An American consular officer states that the construction of an electric power plant of 10,000,000 units yearly, for use in connection with the clarification of the water supply of the city, is contemplated. The water supply of the city is 15,000,000 gallons daily. The clarification plant must have a capacity to remove amber-colored vegetable matter from 1,000,000 to 5,000,000 gallons of water daily. Address Bureau of Manufacturers, No. 7618.

St. Elmo, Ill.—P. E. Fletcher, city engineer, desires prices f. o. b. St. Elmo, on paving brick, grates for catch basins and sewer tile.

Wellsville, N. Y.—Special.—The Kerr Turbine Co., Wellsville, N. Y., advises that over 700 of their machines, aggregating more than 50,000 h.p., are in active service, and that more unfilled orders are now booked than at any previous time in the history of the company. Some of the orders are as follows: Two underwriter fire pumps driven by 200-h.p. Kerr turbines, for Stieger & Sons' piano factory, Stieger, Ill.; one fire pump driven by 265-h.p. Kerr turbine, for B. M. Osbun Co., Chicago. The last named will be the only turbine-driven fire pump in the city of Chicago.

Raleigh, N. C.—The Carolina Light and Power Co. is contemplating the installation of additional machinery, including a 500-k.w. transformer.

Springfield, Ore.—The city is contemplating the purchase of a street flushing machine.

Mount Vernon, Wash.—The city is contemplating the purchase of a street sweeper.

MISCELLANEOUS.

Fimerlee, N. J.—The H. W. Johns-Manville Co., Brooklyn, N. Y., has purchased 200 acres and will construct a plant costing about $2,000,000.

The Jeffrey Manufacturing Co., of Columbus, O., manufacturers of mining, elevating, conveying and power transmission machinery and coal mine equipment, has recently opened another branch office at 1201 American Bank Bldg., Seattle, Wash., from where it will handle its business in the Northwest. Percy E. Wright is manager of the Seattle office.

O. D. Hogue has been appointed vice-president and treasurer of the Goulds Manufacturing Co. of Illinois, with offices in Chicago. The Goulds Manufacturing Co. manufactures pumps and hydraulic machinery.

WATER.

Dubuque, Ia.—Bids will be received January 22, at 8 p. m., for furnishing and delivering one 2,000,000-gallon duplex, double-acting, motor-driven pump at pumping station. Certified check, $500. B. S. Stedman, superintendent; R. P. Melendy, engineer.

Zeeland, Mich.—The purchase of a water softener for use at the city plant is contemplated.

Yonkers, N. Y.—Special—The Board of Contracts and Supply will ask for bids in January for furnishing a 10,000,000-gallon pump for the city filter plant. T. L. Peene, water superintendent; Hazen & Whipple, 103 Park avenue, New York, N. Y., engineers.

Lorain, O.—Special—The director of public service has been instructed to advertise for bids for 200 water meters for the water works department. Forest Raugh, president of council.

Youngstown, O.—Bids will be received January 4, at 12 m., for furnishing 1,000 water meters. Certified check, $500. W. H. McMillan, clerk.

Patents Concerning Road and Pavement Construction and Repair.

962,267. Road Grader. Spencer Allen Stone, Chillicothe, Mo.

962,299. Road Grader and Smoother. Henry C. Barnett, Jefferson, Ga.

962,354. Road Grading Machine. Parley J. Jewett, Butler, Mo.

962,728. Apparatus for Saturating the Ground with Oil. Joseph E. Ward, Longbeach, Cal.

963,963. Road Scraper and Grader. Joseph Van Matre, Newcastle, Ind.

965,218. Paving Rammer. Wilhelm Hermann Nordstroem and Niels Christian Quist, Horsens, Denmark.

965,562. Oil Concrete Roadway. Edward M. Chadbourne, San Francisco, Cal.

965,628. Road Grader and Leveler. Jas. S. Haynes, Marion, Mich.

966,081. Road Scraper. Cyrus H. Casner, Hepburnville, Pa.

966,242. Road Scraper. Samuel Richardson, Hoover, Ind.

966,982. Road and Street Construction. Jos. Hay Amies, Philadelphia, Pa.

967,088. Scraper. Samuel F. Vose, Shawnee, Okla.

967,656. Road Grader. Ole Andrew Ness, Zumbroa, Minn.

967,714. Pavement Blocking Device. Rudolph S. Blome and Wm. J. Sinek, Chicago, Ill.

968,422. Street Surface Cutting Device. Alfred Rosenholz, San Francisco, Cal.

968,439. Road Grading Machine. Carl O. Wold, Minneapolis, Minn.

968,912. Road Drag. Joseph D. and Roy E. Adams, Indianapolis, Ind.

970,290. Hand Street Oiler. John Archdeacon, Carlisle, Ky.

970,580. Road Drag, Grader and Scraper. Walter S. Wilker, Helena, Mont.

970,966. Road Scraper. Geo. W. Spicer, Peru, Ind.

971,113. Road Drag. Frank Boeckmann Bartelso, Ill.

971,456. Road Culvert. Wm. F. Looker, Portland, Ore.

974,397. Road Grader. Victor Landholm, Westpoint, Neb.

975,295. Road Machine. Marion M. Sickler, Los Angeles, Cal.

975,580. Road Machine. Walter K. Stebbins, Fairmount, N. D.

975,783. Road Machine. Harrison B. and Henry C. Moulthrop, Conneautville, Pa.

976,012. Road Roller, Marquis J. Todd, Buffalo, N. Y.

978,016. Rotary Road Scarifier. Walter A. Gillette, Los Angeles, Cal.

978,498. Road Grader. Niels K. Skow, Newton, Iowa.

978,973. Asphalt Paving Plant. Chas. I. Williams, Utica, N. Y.

978,974. Pavement. Matthew E. Dunn, New York, N. Y.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Brewton, Ala.—January 4. Grading and surfacing with gravel 9 miles of road. Board of Escambia County Comrs.

Rockville, Ill.—February 1. Constructing 30,000 sq. yds. of brick pavement. Estimated cost $60,000. Aetna Engineering Bureau, Chicago, Ill., engineers.

Bloomfield, Ind.—January 2, 2 p. m. Constructing a macadamized road in Taylor and Fairlay townships. Sacwell H. Jennings, auditor.

Brownstown, Ind.—January 2, 1:30 p. m. Constructing road in Hamilton township. H. W. Wacker, auditor.

Fowler, Ind.—January 2, 1 p. m. Constructing 9 stone roads in Center township. Lemuel Shipman, auditor.

Greensburg, Ind.—January 3, 1 p. m. Constructing macadamized road in Clay township. Frank E. Ryan, auditor.

Huntington, Ind.—January 1, 10 a. m. Constructing gravel road to Dallas township. John W. Weaver, auditor.

Knox, Ind.—January 2, 12 m. Constructing gravel road in Davis township. Lee M. Ransbottom, auditor.

Lawrenceburg, Ind.—January 2, 12 m. Constructing highway in Jackson township. William S. Fagaly, auditor.

Lebanon, Ind.—January 8, 7:30 p. m. Paving North Meridian street, 3,258 feet. Edmond Connor, clerk.

Logansport, Ind.—January 2, 10 a. m. Constructing two gravel roads in Jefferson township, one in Noble township and constructing the macadam road in Eel and Miami townships. J. E. Wallace, auditor.

Newport, Ind.—January 1, 10 a. m. Constructing gravel road in Helt township. H. T. Paynem, auditor.

Paoli, Ind.—January 2, 2 p. m. Constructing a road in Orleans township. Alvin B. Ham, auditor.

Portland, Ind.—January 18, 1 p. m. Constructing gravel road on the line between Adams and Jay counties. W. Lea Smith, auditor, Jay township.

Portland, Ind.—January 18, 10 a. m. Constructing road in Richland township. W. Smith, auditor.

Rensselaer, Ind.—January 1, 3 p. m. Constructing stone road in Hanging Grove township. James N. Leatherman, auditor.

Vincennes, Ind.—January 2. Constructing a gravel road. John P. Scott, auditor.

Winamac, Ind.—January 2, 12 m. Constructing a number of roads. W. E. Munchenburg, auditor.

Montclair, N. J.—January 22, 8 p. m. Repaving Bloomfield avenue, including the following: 34,300 sq. yds. granite block, 13,700 lineal ft. curbing, 2,000 ft. old curb reset. Certified check, $10,000. Harry Trippett, town clerk.

St. Croix Falls, Wis.—January 15, 8 p. m. Improving Washington street. City clerk.

CONTRACTS AWARDED.

Birmingham, Ala.—Paving 8th ave. with bitulithic, to the Southern Bitulithic Co.

Montgomery, Ala.—Paving East 8th ave. with bitulithic, to the Southern Bitulithic Co., $15,172.

Bakersfield, Cal.—Constructing the Colese Levee road, to V. E. Foshier, of Bakersfield, Cal., $14,104.

Washington, D. C.—Furnishing 100,000 gallons of road oil for use on roads in the District of Columbia, to the Gulf Refining Co., of Pittsburg, Pa.

Jacksonville, Fla.—Paving Atlantic blvd., including 6,000 lineal ft. of brick pavement, to the Logan Concrete Engineering Co.; grading New York ave., to William Ligartis, Bay St. Jacksonville, Fla.

Carbondale, Ill.—Paving Poplar st. with macadam, to Craine Bros., $27,644.

Glencoe, Ill.—Paving Vernon, Railroad and Hawthorne aves., to Edward M. Laing, of Highland Park, Ill.; $16,623.

Herrin, Ill.—Constructing 43,000 ft. of granitoid sidewalk, to Keeley & Tweeney, of East St. Louis, Ill.; $52,842.

Watseka, Ill.—The following paving contracts have been awarded: Park ave., to J. A. Palmer, Danville, Ill., $6,430; Ash st., to same, $6,138.

Paoli, Ind.—Constructing road in Paoli township, to James P. Wilson, $5,262.

Valparaiso, Ind.—Constructing a gravel road in Portage and Boone townships, to Ray DeMass, Chesterton, Ind., $11,800; and to Chas. F. Greene, Valparaiso, Ind., $4,317.

Vincennes, Ind.—The following road contracts have been awarded: The Shields road, to H. F. Jones, $2,290; the Cain road, to Columbus Hargrove, $1,190.

Williamsport, Ind.—Constructing gravel road, to W. W. Crane, of Hedrick, Ind., $10,915.

West Terre Haute, Ind.—Paving National ave., to George C. and Foulkese Construction Co.

Fort Scott, Kas.—Paving Burke st., to the Midland Construction Co.

Iola, Kas.—Constructing one and one-quarter miles of stone road, to George Rhoads, of Humboldt, Kas.

Baltimore, Md.—Paving a number of streets, to F. E. Schnider Paving Co., $42,920.

Towson, Md.—Constructing the Glencoe road, to J. S. Parks, Towson, Md., $17,810.

Boston, Mass.—Improving Hallet st., to the John Kelly Co., $15,540.

Boston, Mass.—Constructing macadam road on Pequot st., to J. C. Colman & Sons Co.

Carthage, Mo.—Paving 3rd st. and Main st., to R. J. & W. N. Boyd Construction Co., Kansas City, Mo.

Springfield, Mo.—Constructing 5½ miles of road, to J. A. M. Lanier, $10,500.

St. Joseph, Mo.—Paving Hammond st. with brick, to the Young Bros. Construction Co.

Albany, N. Y.—The following road contracts have been awarded by the highway department: Road No. 969, to Public Service Contracting Co., $39,853; Road No. 687, to town of Sterling, $3,124; Road No. 5151, to Falk & Menzies, Buffalo, N. Y., for $53,913; Road No. 5162, to McGreevey, McGuigan & Baum, Elmira, N. Y., $23,226; Road No. 930, to Welden & Mead, W. Plattsburg, N. Y., $3,380; Road No. 951, to John H. Gordon, Albany, N. Y., $23,395; Road No. 952, to DeGraf & Hogeboom, Kingston, N. Y., $41,629; Road No. 929, to John B. Dower, Ballston Spa, N. Y., $17,779; Road No. 5179, to J. D. Moynehan Co., Mohawk, N. Y., $77,016; Road No. 5181, to J. D. Moynehan Co., Mohawk, N. Y., $45,008; Road No. 5184, to Boynton & McNally, Keesville, $24,482; Road No. 950, to St. Regis Construction Co., Albany, N. Y., $8,396; Road No. 953, Clancy & Vanalst, Long Island City, $17,203.78; Road No. 5149, Bridgeport Construction Co., Poughkeepsie, N. Y., $45,442; Road No. 5165, Bridgeport Construction Co., $54,748; Road No. 5169, to John F. Donavon, Saugerties, N. Y., $41,851; Road No. 5173, Henry McNamee, Eddyville, N. Y., $50,317; Road No. 5192, Joseph Walker, Albany, N. Y., $9,733; Road No. 5177, H. McNamee, Eddyville, N. Y., $41,657; Road No. 5185, Santononi Cont. Co., $71,885; Road No. 5174, to Ed T. Beck & Co., Warren, Pa., $70,515; Road No. 958, to Public Service Contracting Co., Buffalo, N. Y., $40,778; Road No. 5191, Shaughnessy Const. Co., Albany, N. Y., $67,089; Road No. 5167, to Joseph Walker, $101,952; Road No. 5182, J. D. Moynehan Co., Mohawk, $72,298; Road No. 5183, to Boynton & McNally, Keeseville, N. Y., $37,187; Road No. 5186, to Santononi Const. Co., Newcomb, N. Y., $82,011; Road No. 5187, to Santononi Const. Co., Newcomb, N. Y., $80,904; Road No. 5180, J. D. Moynehan Co., of Mohawk, N. Y., $68,439; Road No. 5189, Santononi Const. Co., $98,313; Road No. 5164, Erie Contracting Co., Buffalo, N. Y., $55,510.67; Road No. 313, A. Schunnemunk Const. Co., Highland Mills, $11,528; Road No. 5171, Shaughnessy Const. Co., Albany, N. Y., $24,410; Road No. 5156, to John D. Michiel & Bros., Torrington, Conn., $56,663; Road No. 5178, Shunnemunk Const. Co., Highland Mills, N. Y., $24,405; Road No. 5085, John D. Bower, Ballston, $44,835; Road No. 5160, to E. T. Beck & Co., Warren, Pa., $27,168; Road No. 911, Suffolk Contracting Co., Huntington, N. Y., $33,197; Road No. 5168, Lane Const. Corporation, Meriden, Conn., $40,963; Road No. 5190, to Hallack & Angel, Newburg, N. Y., $13,823; Road No. 5158, Joseph Walker, Albany, N. Y., $72,280.

Yonkers, N. Y.—Paving Prescott st., to R. A. Cescrande, Yonkers, N. Y., $24,225.

Charlotte, N. C.—Paving construction, to the West Construction Co., of Chattanooga, Tenn., about $150,000.

Cincinnati, O.—The following paving contracts have been awarded: Macadam on Alice st., to Henkel & Sullivan, Mercantile bldg., $5,113; concrete steps, to Roos Bros., Cincinnati, O., $1,581; tar macadam on Greise ave., to N. Goodman, 7th ave., $10,139; brick pavement on Jay st., to Henkel & Sullivan, Cincinnati, O., $4,395; brick pavement on Bathgate st., the same, $3,376; brick pavement on Hickory st., to the same, $4,130; tar macadam on Wood ave., to Thomas G. Strack, $7,450.

Dayton, O.—Constructing brick pavement and storm sewers in Burkhart ave., to E. M. Gephart, $41,605; paving Rubicon st., to Warren Bros. Co., Boston, Mass., $1,217; constructing sidewalks and grading Huffman ave., to A. J. Kammer, $1,150.

Tulsa, Okla.—Constructing asphalt pavement to the amount of about $200,000, to the Shelby-Downard Asphalt Co., of Ardmore, Okla.

Philadelphia, Pa.—Repairing roads during 1912, to David McMahon, $202,400.

Pittsburg, Pa.—The following paving contracts have been awarded: Faust st., to the J. B. Shields Co., $2,756; bids on paving

Wilkes-Barre, Pa.—Paving North Main st., to the Warner-Quinlan Asphalt Co., Syracuse, N. Y.

Memphis, Tenn.—Paving Calhoun ave. with wood blocks, to M. Larkin, 658 Vance st., Memphis, Tenn., $10,750.

Bonham, Tex.—Paving 14 blocks, including North Main and West Fifth sts., to the Bert Hahn Co., of Ardmore, Okla.

Everett, Wash.—The following road contracts have been awarded: Asphalt paving on Pilcheck road, to Reinseth Bros., $10,405.

Madison, Wis.—The following paving contracts have been awarded: Asphalt paving on Langdon st., to the Andrews Asphalt Paving Co., $19,475; asphalt paving on Carroll st., to the same, $11,757.

CONTEMPLATED WORK.

San Jose, Cal.—A $300,000 bond issue for the construction of roads in San Benito county has been voted.

Willow, Cal.—A $450,000 road and bridge improvement bond issue has been sold.

Hartford, Conn.—The resurfacing of Main st. with asphalt, to cost about $12,000, is contemplated. T. J. Bennett, superintendent of streets.

Sylvester, Ga.—A $20,000 bond issue for road improvements has been voted.

Lincoln, Ill.—The paving of Elm st. with concrete is contemplated.

Mattoon, Ill.—The paving of about 5 blocks of streets with brick is contemplated. C. L. James, city engineer.

Moline, Ill.—The paving of 7th and 8th aves., with vitrified brick is contemplated.

Pekin, Ill.—The construction of paving in 3 districts, to cost about $500,000, is contemplated.

Peoria, Ill.—The paving of Arcadia ave. with brick, to cost about $32,918, is contemplated. Ross Canterbury, city engineer.

Rockford, Ill.—The paving of about three-quarters of a mile of street is contemplated. City engineer, Main.

Webster City, Ia.—The paving of 19 blocks of street is contemplated.

Elkton, Md.—A $25,000 bond issue for the construction of a highway between Elkton and Perryville has been voted.

Fulton, Mo.—Paving of about 8 miles of road is contemplated by Callaway county.

Maplewood, Mo.—Paving of Manchester ave. with brick for a distance of 4,000 feet is contemplated.

St. Joseph, Mo.—The paving of Mulberry st. with mineral rubber asphalt is contemplated.

Olean, N. Y.—The paving of First st. with vitrified brick is contemplated.

Canton, O.—City Engineer Weber has prepared plans and estimates for paving of Broadway, to cost about $49,000. The paving of Cassilly, West North and Fulton sts. is also contemplated.

Cincinnati, O.—A $203,500 bond issue for paying the city portion of street and alley improvements has been voted.

Hamilton, O.—The construction of roads to cost about $7,000 is contemplated.

Jefferson, O.—The construction of 2 miles of pavement is contemplated.

Wooster, O.—The paving of Pittsburg ave. and East Henry st. is contemplated.

Youngstown, O.—The paving of the following streets is contemplated: Hawn st., Byron st., Himrod ave., Oak st., Truesdale ave. and Coland ave.

East Providence, R. I.—Street improvements to cost about $45,000 are contemplated.

Memphis, Tenn.—Heiskell Weatherford, city engineer, has prepared estimates on concrete paving work to cost about $46,000.

Nashville, Tenn.—The counties of the State have voted bonds to the amount of about $6,000,000 for road improvement.

Big Springs, Tex.—A $100,000 bond issue for road construction has been voted.

Sherman, Tex.—Road improvements to cost about $400,000 are contemplated by Grayson county.

SEWERS.

BIDS REQUESTED.

Mattoon, Ill.—March 1, 1912. Constructing vitrified pipe sewers to cost about $19,000. C. L. James, city engineer.

Hannibal, Mo.—February 1. Constructing vitrified pipe and concrete sewers to cost about $30,000. W. Y. Usc, city clerk.

Springfield, Mo.—January 15, 12 m. Furnishing material for constructing public sewers and outlets; a sewage disposal plant, with all appurtenances. Certified check, 10 per cent. J. H. Langston, city clerk; H. G. Horton, city engineer.

New Philadelphia, O.—January 15. Constructing 11.8 miles of sanitary sewer and 3 miles of storm water sewer, to cost about $140,000. T. E. Arnold, engineer.

Waco, Tex.—January 2, 10 a. m. Constructing sanitary sewers as follows: 2,900 ft. of 15-inch, 12,000 ft. of 12-inch, 10,000 ft. of 10-inch, and 6,000 ft. of 8-inch vitrified clay sanitary sewer pipe; 108 ft. of 16-inch cast iron sewer pipe; 96 ft. of 12-inch cast iron sewer pipe; and all other specials. Certified check, 5 per cent. P. A. Gorman, commissioner of streets, sewers and public improvements.

CONTRACTS AWARDED.

Coalinga, Cal.—Constructing sewer system, to H. M. Shaffer, $26,316.

Denver, Colo.—Constructing a 15-mile santary sewer, lateral on the South Side, to the Denver-Pueblo Construction Co., $50,731.

Hartford, Conn.—Constructing sewers as follows: 2,700 ft. in Scarborough st. and 2,300 ft. in Albany ave., to the Hartford Paving Brick & Construction Co., Hartford, Conn.

Washington, D. C.—Constructing the Petworth Valley outlet sewer, to E. C. Dummel, $24,334.

Bloomington, Ill.—Constructing the Orchard Lane sewer, to Pat McDonald, Bloomington, Ill., $4,149.

Glen Ellyn, Ill.—Constructing about 20 miles of sewers, to the Marquette Constr. Co., 186 West Washington st., Chicago, Ill.

Kankakee, Ill.—Constructing sewer system Nos. 101 and 103, to W. S. Lake.

Plainfield, Ill.—Constructing a complete sewerage system to John Heggie, Joliet, Ill., $22,023.

Dubuque, Ia.—Constructing sanitary sewer in Kaufman ave., to C. B. McNamara & Co., Dubuque, Ia.

Louisville, Ky.—Constructing sewer on 32nd st., to Henry Bickel & Co., about $30,000.

St. Joseph, Mo.—Constructing sewer in District No. 119, to E. F. Mignery.

St. Louis, Mo.—Constructing the McKenzie Place sewer, to Hoessken Bros., of Bellville, Mo., $34,756.

Scotts Bluff, Neb.—A $12,000 bond issue for sewer construction has been voted. Bruce & Standevin, 206 Bee bldg., Omaha, Neb., engineers.

Superior, Neb.—Constructing a sewerage system, to Meeker & Dobson, Lincoln, Neb.

South Orange, N. J.—Constructing sewerage system, to Pasquale Cestone, Montclair, N. J., $10,022.

Buffalo, N. Y.—Constructing sewers in Cambria st., to J. N. Fahning, $5,250.

Rochester, N. Y.—Constructing the Comet st. sewer, to H. N. Cowles, $36,762; constructing the Garrison ave., to William Sours, $42,502.

Cincinnati, O.—Constructing sewers in Linwood ave., to Thomas T. Strack, Goodall bldg., Cincinnati, O., $14,174.

Dayton, O.—Paving and constructing sewers in Burkhart ave., to E. M. Gephart, $41,605.

Oklahoma City, Okla.—Constructing an electrolytic sewage disposal plant, to J. A. McMahan and F. E. Bennett, $16,582.

Ligonier, Pa.—Constructing sewerage system complete, including an ejector system, to William Jones, of Carnegie, Pa., $56,571.

Philadelphia, Pa.—The following sewer contracts have been awarded: Hunting Park ave., to John L. Bocklus, $10,000; Luzerne st., to John L. Bockius, $5,000; Cobb's Creek intercepting sewer, to David Peoples, $30,000; 57th street extension, to Ryan & Kelly, $10,000; Frankfort intercepting sewers, to Donato Delite, $40,000; Pennypack Creek intercepting sewers, to John McNenemy, $30,-000; Rock Run extension, to David Peoples, $30,000.

Richmond, Va.—Constructing a main trunk sewer in South Richmond, to A. W. Maynard, $36,000.

Kennewick, Wash.—Constructing a main trunk sewer, to M. Jennings, of Pasco, Wash.

CONTEMPLATED WORK.

Union Springs, Ala.—A $30,000 bond issue for the construction of a sanitary sewer system has been voted.

Fort Smith, Ark.—The construction of a filtration plant and the extensions of the pumping facilities, to cost about $97,000, is contemplated.

Bakersfield, Cal.—City Engineer Greeley has prepared plans for a supplemental sewer system.

Reedley, Cal.—The installation of a water works plant and a sewerage system is contemplated.

Santa Maria, Cal.—A $75,000 bond issue for the construction of a sewerage system and the purchase of a sewerage farm has been voted.

Tampa, Fla.—Alex. H. Twombly, 111 Broadway, New York, N. Y., has been retained to prepare plans and estimates for a sewerage system for the city.

Douglass, Ga.—A $10,000 bond issue for the construction of sewers has been voted.

Savannah, Ga.—A $600,000 bond issue for the extension of the sewerage system has been voted.

Wardner, Idaho.—The construction of a sewerage system to cost about $40,000 is contemplated. T. R. Jones, city clerk.

Rockford, Ill.—City Engineer Main has prepared plans for a sewerage system in the North End to cost about $40,000.

Saint Charles, Ill.—A bond issue for the construction of a sewerage system has been voted.

East St. Louis, Ill.—The East St. Louis Engineering Co. is preparing plans and estimates for a number of contemplated sewers and drainage ditches.

Gary, Ind.—Arthur Mellen, former city engineer, has been retained to prepare plans for a sewer on Ridge road to cost about $150,000.

South Bend, Ind.—The construction of a trunk sewer on Michigan st. is contemplated.

Belmond, Ia.—The city council will engage an engineer to make a survey for a sewerage system.

Bowdle, Ia.—Complete water works and sewerage systems to cost about $13,600 are contemplated.

Ottumwa, Ia.—Sewer construction to cost about $66,000 is contemplated for the next year.

Lawrence, Kas.—The construction of three storm sewers to cost $17,300 is contemplated.

Rayville, La.—W. H. Wright is preparing plans for the construction of a water works system and a sewerage system and an electric light plant.

Kalamazoo, Mich.—H. A. Johnson, city engineer, has prepared plans and estimates for a sewerage system to cost about $60,000.

Stillwater, Minn.—The construction of sewer outlets to cost about $12,000 is contemplated. L. W. Clark, city engineer.

Springfield, Mo.—A $100,000 bond issue for the improvement of the sewer system has been voted.

St. Joseph, Mo.—An ordinance providing $40,000 for the South Park sewers has been passed.

Gerring, Neb.—A $5,000 bond issue for the construction of a sewerage system has been voted.

Yonkers, N. Y.—F. L. Cooper, city engineer, has prepared plans for constructing a sewer on Prescott st.

Cleveland, O.—T. W. Platt, consulting engineer, is preparing an estimate of the cost of a sewage disposal plant.

Salem, O.—The construction of a sewage disposal plant to cost $55,000 is contemplated.

Aberdeen, S. D.—W. G. Potter, 205 Citizens' Bank bldg., has prepared plans for the construction of a reinforced concrete reservoir and complete sewer purification works.

Nashville, Tenn.—The letting of a contract for a sewer in Pearl st. has been postponed.

Austin, Tex.—The construction of a sewerage system to cost about $200,000 is contemplated.

Dallas, Tex.—The board of city commissioners will within the next 30 days appoint a consulting engineer on the construction of a sewage disposal plant and water purification plant.

Chase City, Va.—The construction of a complete sewerage system is contemplated.

Edmonds, Wash.—City Engineer W. C. Bickford has prepared plans and estimates for a main trunk sewer to cost about $30,000.

West Allis, Wis.—A bond issue of $18,000 has been authorized for the purpose of constructing sewers.

WATER WORKS.

BIDS REQUESTED.

Dubuque, Ia.—Jan. 22, 8 p. m. Furnishings and delivering one 2,000 gal. duplex acting, motor driven pump, at pumping station. Certified check $500. D. S. Stedman, supt.; R. P. Melendy, engr.

Euclid, O.—Jan. 8. Constructing 6-inch water main on Canterbury Ave. Constructing 6-inch water main on Clarewood Ave.: constructing water main on Lake Road. F. N. Shoass, village clerk; F. A. Pease Engineering Co., Williamson bldg., Cleveland, O., engrs.

CONTRACTS AWARDED.

Piedmont, Ala.—Constructing extensions to the water works system to J. E. McCreary Company, Empire bldg., Atlanta, Ga.

Russellville, Ark.—Constructing a water works system complete to the Tonkawa Construction Co., of Kansas City, Mo., $50,000.

Denver, Colo.—Constructing a 60-inch conduit to complete the connecting system of the Denver Union Water Co., to McKay & Gettes, about $250,000.

Rushville, Ill.—Constructing water works system complete to Des Moines Bridge and Iron Works, Des Moines, Ill., $30,986.

Springfield, Ill.—Constructing new pumping station complete, to Wm. M. Allen & Son, Peoria, Ill., $47,866.

Audubon, Ia.—Constructing deep well at the city water works, to J. P. Keller, Artesian Well Co., of Chicago, Ill.

Hill City, Kas.—Constructing a water works system and electric light plant, to Brooks & Son of Jackson, Mich, about $50,-000.

Armory, Miss.—Installing a water works system complete, to Long & Lewis of Bessemer, Ala., $50,000.

Pacific, Mo.—Constructing water works system complete, to James A. Prendle of Montgomery City, $12,940. Bid does not include engine, pump, etc.

Wilcox, Neb.—Constructing water works

plant, to the Des Moines Bridge & Iron Co., of Des Moines, Ia., $12,226.

Hillsboro, N. D.—Constructing extensive improvements to the municipal water works system to the General Engineering Company of Fargo, N. D.

Braggs, Okla.—Constructing a water works system, to the N. F. Sherman Machine & Iron Works, of Oklahoma City, Okla., $17,702.

Rapid City, S. D.—Constructing about 5½ miles of wooden water pipe to the Washington Pipe & Foundry Co., of Tacoma, Wash.

Port Arthur, Tex.—Constructing a 30-inch main to pipe water from Port Nethes, 12 miles distance, to furnish 6,000 gallons of water per day, awarded to Lane and Bowler of Houston, Tex.

Prince Rupert, B. C., Can.—Furnishing materials on the Woodworth Water Project to Balfour, Guthrie Company, Central bldg., Seattle, Wash., $53,111.

CONTEMPLATED WORK.

Alhambra, Cal.—The construction of a complete water works system is contemplated.

Reedley, Cal.—The installation of a water works plant and a sewerage system is contemplated.

Wray, Colo.—The construction of a municipal water works plant is contemplated.

Atlanta, Ga.—The installation of two additional pumping units at the water works pumping station has been recommended.

Brownwood, Ga.—A $10,000 bond issue for the construction of a water works system has been voted.

Cuthbert, Ga.—A bond issue for the construction of a water works system and an electric light plant has been voted.

Douglass, Ga.—A $15,000 bond issue for light and water improvements has been voted.

Creston, Idaho.—A $75,000 bond issue for the installation of a water works system has been voted.

Ilo, Idaho.—Plans are being prepared by the Spokane Engineering Co., for the construction of a water works system to cost about $11,000.

Pocatello, Idaho.—A bond issue for $270,000 has been voted for the construction of a municipal water system.

Moline, Ill.—Bids were received for the construction of a filtration plant at Arsenal Island, but were rejected. New bids will be asked on the works which is estimated at $30,000.

Bowdle, Ia.—Complete water works and sewerage system to cost about $13,6000 are contemplated.

Russel, Ky.—A $75,000 bond issue for the construction of a water works system has been voted.

Covington, La.—The construction of a municipal water works system is contemplated.

Rayville, La.—W. H. Wright is preparing plans for the construction of a water works system, a sewerage system and an electric light plant.

Baraga, Mich.—The installation of a municipal water works plant is contemplated.

Farmington, Mich.—A $15,000 bond issue for the installation of a water works system has been voted.

Standish, Mich.—C. F. Hall has purchased the electric light plant and water works and will erect a new power plant.

Glenwood, Minn.—A $15,000 bond issue for the construction of a water works system has been voted.

New Duluth, Minn.—The construction of an independent water supply system for New Duluth and Gary is contemplated.

Glenwood, Minn.—A $15,000 bond issue for the installation of a water works system has been voted.

Mountain Grove, Mo.—A bond issue for the construction of a water works system has been voted. Address Mayor Candler.

Sidney, Mont.—The Commercial Club desires to secure prices on air pressure water system. William Combes, chairman of committee.

Benkelman, Neb.—A municipal water works system to cost about $12,000 is contemplated.

Tecumseh, Neb.—Improvements to the water works system to cost about $29,000 including a new concrete reservoir are contemplated.

Argyle, N. Y.—A $12,500 bond issue for the construction of a water works system has been voted.

Hudson Falls, N. Y.—A $175,000 bond issue for the construction of a gravity water works system has been voted.

Akron, O.—The city has voted to purchase the Akron water company's plant, and construct extensions, $815,000.

Springfield, O.—Improvements to the water works pumping plant are contemplated. George Cotter, supt.

Inola, Okla.—The constructing of a water works system to cost about $19,000 is contemplated.

Noble, Okla.—An $8,000 bond issue for the installation of a water works system has been voted.

Worthington, Okla.—A $20,000 bond issue for the installation of a water works system has been voted.

Chamberlain, S. D.—A $20,000 bond issue for the construction of a water works pumping station has been voted.

Cookeville, Tenn.—A $30,000 bond issue for extending the water works and electric light system has been voted.

Trenton, Tenn.—Constructing water works extension, to the Allen Engineering Co., Exchange bldg., Memphis, Tenn.

Aransas Pass, Tex.—A $15,000 bond issue for the construction of a water works system has been voted.

Brownwood, Tex.—A $15,000 bond issue for the construction of a water works system has been voted.

Chase City, Virginia.—The construction of a municipal water works system is contemplated.

Dayton, Va.—A bond issue for the installation of a water works system has been voted.

Asotin, Wash.—Laying water mains and constructing reservoir, to W. H. Mitchell, Seattle, Wash., $23,408.

Granger, Wash.—A $15,000 bond issue for the construction of a water works system has been voted.

Fox Lake, Wis.—A $20,000 bond issue for the construction of a water works system has been voted.

BRIDGES.

BIDS REQUESTED.

San Luis Obispo, Cal.—Feb. 5. Constructing a steel highway bridge over the Santa Maria River. F. Rodrigues, clerk.

Santa Barbara, Cal.—Feb. 5. Constructing steel highway bridge over the Santa Maria River. S. J. Rodrigues, clerk of San Luis Obispo County.

Trinidad, Cal.—Jan. 5. Constructing a 50-foot bridge across Canyon Delatua. D. F. Harlan, chairman.

Grundy Center, Ia.—Jan. 3. Furnishing material for bridge construction during 1912 as follows: Steel bridges, reinforcing iron for concrete bridges, bridge lumber and pilings, construction work on bridges as above noted. P. G. Ensminger, county auditor.

New Hampden, Ia.—Jan. 4, 6 p. m. Constructing 10 reinforced concrete bridges. E. S. Malloy, county auditor.

Biloxi, Miss.—Jan. 1. Constructing Patten bridge across the Little Biloxi River. S. S. Hewes, clerk.

Goldsboro, N. C.——Jan. 3, 12 m. Constructing an 80-foot steel bridge over the Little River. Certified check $300. C. D. McKinney, chairman executive committee, state hospital.

Washington, D. C.—The construction of a reinforced concrete bridge over Kentucky Creek. Ed Elliott, county clerk.

York, Pa.—Jan. 9. Constructing all wooden bridges in the county of York during 1912. H. S. Chapin, county clerk.

San Juan, Porto Rico.—Jan. 15, 10 a. m. Constructing a 108-foot steel pony truss highway bridge. P. Warren Allen, supt. of public works.

CONTRACTS AWARDED.

Fresno, Cal.—Constructing 4 bridges to R. S. Ball, $8,000.

Los Angeles, Cal.—Constructing 7th St. bridge, to Merterneau Bridge and Construction Co., $7,490.

Modesto, Cal.—Constructing the Ridon bridge trestle, to the Pacific Construction Co., $5,893.

Jacksonville, Fla.—Constructing reinforced concrete bridge over Trout Creek, to W. B. Kierman & Co., Milwaukee, Wis., $14,200.

Petersburg, Ind.—Constructing the Portersville bridge to the Vincennes Bridge and Iron Co., of Vincennes, Ind., $16,444.

Newcastle, Ind.—Constructing several small bridges and concrete culverts, to P. J. & H. F. Burk, Newcastle, Ind.

La Porte, Ind.—Constructing the Swaby bridge, to the Rochester Bridge Co., Rochester, Ind.

Audubon, Ia.—Constructing three concrete bridges, to Ward & Weighton, of Audubon.

Burlington, Ia.—Constructing a number of small steel bridges, to the Clinton Bridge Co., Clinton, Ia.

Emporia, Kas.—Constructing a steel superstructure for three bridges, to D. H. Young, Lawrence, Kas.

Baton Rouge, La.—Constructing bridge over the Comite river in the Greenwell Springs Road, to F. Hasie, Jr., Dallas, Tex.

Minneapolis, Minn.—Constructing steel bridge across the Snake river between Elmore and Owyhee counties, to the Minneapolis Minn., $26,674.

Vicksburg, Miss.—Constructing a concrete arched bridge over the Glass Bayou, to the Roberts Construction Co., $14,999.

Kansas City, Mo.—Constructing a viaduct on McGee St., to W. P. Carmichael Construction Co., $40,000

Kansas City, Mo.—Constructing the Campbell St., viaduct across the Belt line, to J. J. O'Heron, about $90,000.

Dundee, N. Y.—Constructing an iron bridge on the Pre-Emption Road, to the Lane Bridge Co., of Painted Post, N. Y.

Harisburg, Pa.—Constructing a bridge across the Swatara Creek, to G. W. Ensign, $11,258.

Aberdeen, S. D.—Constructing 5 bridges in Brown County, to A. Y. Bayne Co., of Minneapolis, Minn.

Gonzales, Tex.—Constructing 2 steel bridges, to the Gonzales Bridge and Iron Works.

Norfolk, Va.—Paving Church St. with Belgiam block, to Perry W. Ruth & Co., Norfolk, Va.

Connelly, Wash.—Constructing a bridge across the Okanogan river, to the Graff Construction Co., Seattle, Wash., $5,000.

Davenport, Wash.—Constructing 6 steel bridges, five 40-foot spans and one 100-foot span, to the Coast Bridge Co., of Portland, Ore.

Kent, Wash.—Constructing 133-foot steel bridge, to the Washington Engineering Co., Seattle, Wash.

CONTEMPLATED WORK.

Bakersfield, Cal.—County Surveyor Buffington has been authorized to construct a concrete bridge over the Kern river at Chester Ave., to cost about $75,000.

Grand Junction, Colo.—County surveyor Fisk has prepared plans for the construction of a bridge at Main St.

Nowata, Okla.—Jan. 15. Constructing a bridge between Georgetown and Washington to cost about $275,000 is contemplated. P. T. Bailey, Jr., engineer of bridges, D. C.

Freeport, Ill.—The construction of a bridge at the foot of Spring St. is contemplated.

Waukegan, Ill.—An estimate of $81,000 for the construction of the South Genesee St. bridge submitted by Westcott & Rouneubert has been rejected and a new estimate will be asked.

Toledo, Ill.—The construction of a reinforced concrete bridge to replace one destroyed by a cyclone is contemplated. Estimated cost, $12,000.

Council Bluffs, Ia.—The construction of a concrete bridge at Main St., is contemplated. E. S. Simon, city engr.

Vassar, Mich.—A $10,000 bond issue for the construction of a bridge across the Cass river at Huron Ave. has been voted.

Bemidji, Minn.—The construction of a bridge across the Mississippi river is contemplated.

Minneapolis, Minn.—The construction of a bridge between the villages of Orono and Minnetonka to cost about $30,000 is contemplated.

Kansas City, Mo.—Louis R. Ash, city engineer has submitted plans for the construction of a bridge over the McGee St. traffic way at 26th St., estimated cost, $15,000.

Roxwell, N. Mex.—The construction of a steel bridge across the South Berrendo river to cost about $6,000 is contemplated.

El Reno, Okla.—The construction of a bridge near Darlington is contemplated.

Cleburne, Tex.—A $178,000 bond issue for the purchase and maintenance of the water works system has been voted.

Bellairs, W. Va.—The construction of a bridge across Pinch Run is contemplated.

STREET LIGHTING.

CONTRACTS AWARDED.

Kansas City, Mo.—The following lighting contracts have been awarded: Furnishing 3,500 poles to the Be-R Electrical Co., Kansas City, Mo., $26,642; furnishing 75 miles of wire, to the American Steel & Wire Co., $37,854.

Philadelphia, Pa.—The Philadelphia Electric Co., submitted the only bid for street lighting for the coming year, $1,336,287.

CONTEMPLATED WORK.

Glendale, Cal.—The city has purchased the Glendale Light & Power Co. plant and are planning lighting extension. Purchase price, $55,000.

Tampa, Fla.—The installation of an ornamental lighting system on Franklin St., is contemplated.

Cuthbert, Ga.—A bond issue for the construction of a water works system and an electric light plant has been voted.

Douglass, Ga.—A $15,000 bond issue for light and water improvements has been voted.

Manchester, Ga.—A $15,000 bond issue for the construction of a municipal electric light plant has been voted.

Twin Falls, Idaho.—The installation of a small number of cluster lighting standards is contemplated. City clerk.

Champaign, Ill.—A $35,000 bond issue for the installation of a street lighting system has been voted. A private corporation will furnish the current.

Springfield, Ill.—The Springfield Utilities Co. has been instructed to install boulevard lights on So. 4th St.

Peoria, Ill.—Mayor Woodruff is investigating the street lighting situation.

Galva, Ia.—A bond issue for the construction of an electric light plant has been voted.

Pana, Ia.—The installation of a boulevard lighting system is contemplated.

McCune, Kas.—The construction of a municipal light plant is contemplated.

Perry, Kas.—A $5,000 bond issue for the construction of an electric light plant has been voted.

Rayville, La.—W. H. Wright is preparing plans for the construction of a water works system and a sewerage system and an electric light plant.

Leominster, Mass.—The replacing of 115 arc lamps by 575 tungsten lamps is contemplated. The Leominster Electric Light and Power Co.

Standish, Mich.—C. F. Hall has purchased the electric light plant and water works, and will erect a new power plant.

Kansas City, Mo.—The question of adopting a design for an ornamental street light standard is being discussed by three committees, which are as folows: Commercial Club, H. R. Ennis, S. Jenkins, W. A. Repp; The City, Frank B. Askew, D. H. Talbot; The Kansas City Ad Club, L. H. Scurlock and W. M. Hawkins.

Devil's Lake, N. D.—A $33,000 bond issue for the construction of a municipal lighting plant has been enjoined.

Cincinnati, O.—The Union Gas & Electric Co. have been instructed to provide gas lamps for Parker Ave.

Salem, Ore.—The construction of a municipal electric light plant to cost about $20,000 is contemplated.

Charleroi, Pa.—A franchise has been granted to the West Penn Electric Co., for lighting the streets for a period of five years.

Woodbury, Pa.—The construction of a municipal electric light plant is contemplated.

Flandreau, S. D.—A franchise for the construction of a street lighting system has been voted.

Cookerville, Tenn.—A $30,000 bond issue for extending the water works and electric light system has been voted.

Greenville, Tex.—A franchise for constructing and operating an electric light plant has been awarded to J. M. Carsey, W. J. Simpson and J. P. Simpson of Kausman, Tex.

Murray, Utah.—City council has decided to install fifty new street lamps, at a cost of about $1,000.

Tremonton, Utah.—The installation of electric street lights, with power furnished by the Utah Idaho Sugar Co., is contemplated.

Castle Rock, Wash.—The Castle Rock Light and Power Co. has been incorporated for $250,000 by A. E. Braden, H. B. Davis, and I. W. Selden.

Fond du Lac, Wis.—The city is preparing to install a municipal electric light plant at the termination of the present lighting contract on April 1, 1913.

Harrison, Ont., Can.—The installation of an ornamental street lighting system is contemplated.

FIRE APPARATUS.

CONTEMPLATED WORK.

Gadsden, Ala.—The purchase of additional fire apparatus and the installation of a fire alarm system is contemplated.

Folsom City, Cal.—The purchase of motor fire apparatus has been recommended.

Riverside, Cal.—The purchase of motor fire apparatus to cost about $10,000 is contemplated.

Fort Collins, Colo.—The purchase of motor fire apparatus is contemplated.

New Haven, Conn.—The purchase and installation of a fire alarm system is contemplated.

St. Petersburg, Fla.—The purchase of an automobile fire truck is contemplated.

Augusta, Ga.—The installation of an auto fire company for Summerville is contemplated.

Cedartown, Ga.—The purchase of automobile fire apparatus is being considered.

Freeport, Ill.—The purchase of motor fire apparatus is contemplated.

Columbus, Ind.—The city is contemplating sewer construction to cost about $40,000.

Indianapolis, Ind.—A complete reorganization of the Indianapolis Fire department with the installation of motor apparatus in the outskirts is being planned by William E. Davis, president of the board of safety and Fire Chief Coots.

Mason City, Ia.—A $24,000 bond issue for fire department improvements has been voted.

Auburn, Maine.—The purchase of a hook and ladder truck is contemplated.

Everett, Mass.—The sum of $5,500 for the purchase of a motor fire truck has been voted.

Lynn, Mass.—The purchase of two automobile chemical wagons is contemplated.

Wakefield, Mass.—The purchase of motor combination chemical and hose truck is contemplated.

Winona, Minn.—The purchase of an automobile fire truck is contemplated.

Red Lodge, Mont.—The purchase of an automobile fire engine is contemplated.

Albuquerque, N. Mex.—The purchase of a triple combination motor fire engine is contemplated.

Troy, N. Y.—Extensions to the fire alarm system to cost about $40,000 are contemplated.

Bellfield, N. D.—A $10,000 bond issue for fire apparatus and other improvements has been voted.

Massillon, O.—An $8,000 bond issue for the purpose of converting horse drawn fire equipment into automobile apparatus has been voted.

Mercer, Pa.—A franchise has been granted to the Mercer County Electric Light and Heat Co., to operate an electric light plant in the village.

West Chester, Pa.—The purchase of motor fire apparatus is contemplated.

Pasco, Wash.—The purchase of a steam fire engine to cost about $1,350 is contemplated.

Spokane, Wash.—Bond to the amount of $100,000 for the purchase of additional fire apparatus has been recommended.

Wenatchee, Wash.—The installation of a complete fire alarm system is contemplated.

Manitowoc, Wis.—The installation of motor fire apparatus has been recommended.

Milwaukee, Wis.—Commissioner Briggs of the Board of Public Works has recommended the purchase of automobile fire apparatus for station Number 1.

Waukesha, Wis.—The purchase of a fire engine is contemplated.

Victoria, B. C., Can.—The purchase of an automobile for the use of the fire chief to cost about $35,000 is contemplated.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTRACTS AWARDED.

Indianapolis, Ind.—Removing and disposing of garbage for a period of 6 years to Jesse P. Moorman, of Winchester, Ind.

CONTEMPLATED WORK.

Detroit, Mich.—The city is contemplating the construction of a garbage incinerating plant. Commissioner Haarer.

Hamilton, O.—The public service department has been authorized to advertise for bids for the removal of the city garbage for a period of 10 years.

Oklahoma City, Okla.—The city clerk has been authorized to advertise for bids for the construction of a 50-ton incinerator plant for which about $24,000 is available.

Connellsville, Pa.—A 10 year franchise has been granted to the Connellsville Garbage and Fertilizer Co. for the purpose of constructing a municipal garbage disposal plant.

Homestead, Pa.—The city has voted to provide for the collection and disposal of garbage by the municipality.

MUNICIPAL ENGINEERING

VOLUME XLII | NUMBER TWO

FEBRUARY, NINETEEN HUNDRED TWELVE

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

Construction of Earth Roads.

BY FAR the greater mileage of roads with which the supervisor has to contend is constructed of natural earth. Because of this fact and because such a road must inevitably be used as the foundation for future improvement, the construction and maintenance of the earth road is of vital importance to the taxpayer. The location of all roads having been previously treated, we are concerned chiefly with the construction and maintenance, with this exception: In building a road that has been in use for some time improvement by relocation should be considered. This relocation need not be applied to the entire route. There will be found places where the drainage may be improved, the distance shortened or grades eliminated by slightly changing the location. The making of a good earth road on an old roadbed must begin with this subject of relocation.

A. *Construction.*—Under this head we have: First, clearing, excavating and filling; second, building the foundation and wearing surface.

1. The right-of-way should be cleared throughout its entire width. This clearing might well be done by contract at so much per acre. The following table, showing acres per mile for different widths of right-of-way, will aid in estimating the cost of such work:

One mile of road—

1	foot wide	contains	0.121	acres
10	feet wide	contains	1.21	acres
20	feet wide	contains	2.42	acres
30	feet wide	contains	3.64	acres
40	feet wide	contains	4.85	acres
50	feet wide	contains	6.06	acres
60	feet wide	contains	7.27	acres
70	feet wide	contains	8.48	acres
80	feet wide	contains	9.70	acres
100	feet wide	contains	12.10	acres

No stumps should be left standing above the level of the road, and in the driveway the stumps should be entirely removed. For this purpose blasting is preferable to grubbing, the former method being both quicker and cheaper. All trees, logs, brush, etc., are to be removed from the right-of-way.

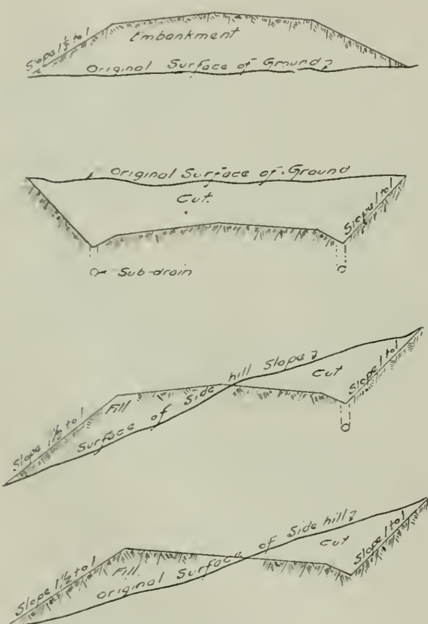
No excavation should be attempted until the work has been staked by an engineer, who will save many times his fee by balancing cuts and fills and eliminating unnecessary waste; slope stakes should be set, showing the cut or fill at both sides and in the center of the grade. It is of primary importance that the supervisor use the proper earth-moving machinery. Enough money is ordinarily wasted using the wrong tools to provide a first-class equipment. Every supervisor should own and use some practical book on earth excavation. In fact, the county would save money by furnishing these helps free of charge.

As a general thing it is economical to use slip or drag scrapers for distances up to 150 or 200 feet. With very small scrapers and strong teams consider using one horse to the scraper. This is more important where there is likely to be any delay in loading or dumping. For distances between 200 feet and 800 feet use wheel scrapers in sufficient number to provide a minimum loss of time. The writer suggests the use of Fresnoes for any distance up to 400 feet. This scraper is used largely in the West for all classes of work, especially in irrigation and highway cnstruction, and is considered the most economical dirt-moving device used. Eastern contractors and municipalities are losing money if they are not acquainted with the merits of this tool.

For hauls longer than 800 feet or 1,000 feet use slat-bottomed wagons, or, preferably, an improved dump wagon. In any case the crew should be arranged so that every man will be kept busy, a maximum amount of work being accomplished by teams with as little hand labor as possible. In hauling from a pit with just enough men to readily load one wagon do not have all teams report at the same time. Have them come into the pit, say, ten or fifteen minutes apart.

Other things being equal, the cost of all excavation depends absolutely on the ability and judgment of the foreman or superintendent.

Embankments should be built in layers of one foot by spreading the material for the full width of grade. If the earth is



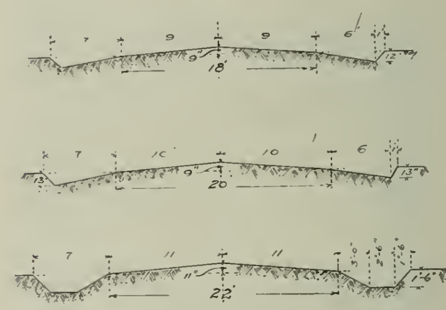
Earth Excavation

1. PREPARATION OF SUB-GRADE.
Excavation and Embankment.

moist, as it will be in the spring, the passage of teams and scrapers or wagons will probably pack it sufficiently. In dry weather, working rapidly, the layers should be rolled. This may be done by using the home-made concrete roller described later. No stumps, brush or heavy vegetable matter should be permitted in the embankment, the sides of which should slope at the rate of 1½ feet horizontal to 1 foot vertical. In earth cuts the banks may slope 1 to 1.

The foundation of an earth road is prepared chiefly by providing drainage and compacting the material. In doing grader work it has been the practice to use the hard, firm surface of the old road for the foundation, and to build the wearing surface of a loose, porous mass of earth and sod. This is proper so far as the foundation is concerned, but we shall see that the surface should receive more attention than is usually given it. In order that we may adhere to the fundamental principles of road building as discussed in the November number, we must have both a dry, solid foundation and a solid and waterproof wearing surface; an attempt to do with the one without the other will result in the failure of the road.

The following sketches show some suggested cross-sections for roads that may be made with the grader. Note that the bottoms of the side ditches are about 2 feet below the crown of the road; that these ditches are wide and shallow; and that the surface of the roadway slopes at the rate of one inch per foot. Observe



Earth Roads.

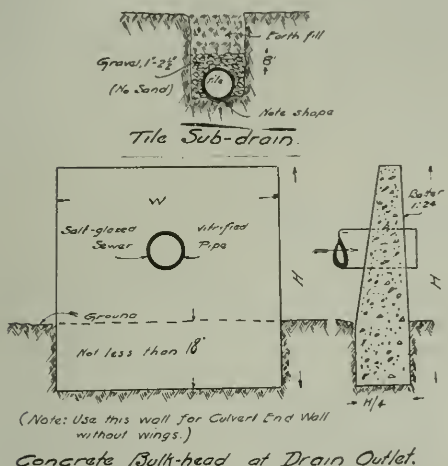
2. TYPICAL CROSS SECTIONS OF EARTH ROADS.

also the intercepting ditches used in deep cuts; they aid in keeping the banks dry, and thus prevent slides.

All grader work should be done in the spring when the soil is moist and will pack; when hard, dry earth is moved into the roadway it grinds into dust and readily absorbs moisture, thereby defeating the very purpose of the grading. If the old surface of the road is not firm, it should be thoroughly rolled, and all soft or spongy earth removed and replaced with good material.

While the drainage of the foundation will ordinarily be effected through the side ditches, it will sometimes be necessary to remedy "seepy" places, or underflow, by means of sub-drains, which are built as follows:

Locate, if possible, the source of the underflow and in the bottom of one side ditch (or both side ditches) dig a trench about 3 feet deep that will tap the wet place. A line of 4 or 6-inch drain tile, laid closely, but with open joints, and having a fall of at least 3 inches per 100 feet, is placed in the trench, true to line and grade. No sharp turns are to be permitted, changes in direction to be effected by easy, gradual curves. Place carefully over and about the pipe about 12 inches of loose screened gravel or broken stone, and complete the back filling with well-tamped earth. An outlet must be provided, either into a side ditch or culvert, or through a bank. Exposed outlet pipe is to be of better grade than



3. DRAINAGE DETAILS.

ordinary drain tile, and must be protected by a head wall of concrete or stone masonry. If it is not possible to secure tile, a very serviceable drain may be constructed by setting two lines of flat stones on edge and covering with stones laid flat, forming an open stone box.

Under-drainage is of permanent value to the road; it is sometimes essential to a dry foundation. Sub-drains should be placed on one or both sides of the roadway, but never under the center, where they are practically inaccessible. Very little surface water finds its way into these drains, their real objects being:

1. To lower the water level in the soil.
2. To cut off the underflow.
3. To hasten the drying of the road after a thaw.

The earth wearing surface must be free from sod and other vegetable matter. If we are to have a "suitable, compact and waterproof" wearing surface the material must be carefully handled and every precaution exercised. The grader or other tool having moved the good earth toward the center of the road, the clods should be broken by harrowing, and the whole thoroughly rolled. During this process depressions and unevenness in the surface will develop, when material should be added where necessary and again rolled until the surface is uniform and conforms to the cross-section adopted. In using the roller begin at the side ditches and roll in the direction of the length of the road, working nearer the center; roll both sides before rolling the center of the road.

Note that on steep grades the crown should be designed to enable the water to run to the side ditches, rather than along the road. Ditches should be paved to prevent wash. No water breaks should be built across the roadway. In order to remove the water from the side ditches carry it under the road at frequent intervals. Earth roads require plenty of sunshine, and shrubbery that interferes with the proper drying of the road should be removed. Occasionally on steep grades in side-hill work, instead of elevating the center of the road, it may be desirable to raise the outer side, slanting the whole surface in toward the ditch on the inner side. This is a help to teams when the road is in a slippery condition, especially at sharp turns.

4. DRAINAGE CANAL BEFORE CONSTRUCTION OF ROAD ON EMBANKMENT.

All side ditches should be left smooth and in such condition as to offer the least resistance to the flow of water. Particular attention must be given the grade of these ditches, insuring the removal of all water that falls on the roadway and that comes on the right-of-way from adjacent land. A minimum grade of ½ per cent., or a fall of 6 inches in 100 feet, is suggested. It is sometimes necessary to use the road ditch as a sort of lateral drainage ditch for low, swampy land, in which case the dimensions of the waterway must be determined to suit the conditions.

Where drainage canals have been dug through wet land, it is often convenient to build a road on one bank of the canal. For this reason during the construction of the canal all stumps excavated should be placed on one side of the ditch, leaving the other bank free from obstructions. A bank similar to the one shown in the accompanying photograph was graded with plow and drag and made into a serviceable roadway 22 feet wide for $70.00 per mile. (See Fig. 4).

When it is found necessary to construct a road through a swamp some means must be adopted to prevent disastrous settling of the material. A very common method is to lay logs and poles crosswise of the road, covering with a layer of brush, on which the earth fill is placed; the object being to place the roadway above the water, and to prevent its settling into and becoming a part of the wet and unstable sub-grade. Another plan is to throw large rock into the side ditches, confining the material under the roadway and thus increasing its bearing power. Willow mattresses placed on the soft ground have been used to distribute the load. Each case of this nature usually presents a problem in itself, and must be solved by the experience and ingenuity of the supervisor.

Tannery Wastes in Sewage.

WHILE litigation over tannery wastes in sewage is not widespread, the growing disposition of the public to seek damages and to enforce purification makes the subject of the inoffensive disposition of such wastes a matter of by no means remote interest to the tanning industry in general. Gloversville, N. Y., the center of the glove industry in this country, has a particularly lively experience with damage suits against the tanneries there, and under pressure of adverse verdicts, backed by an extensible injunction, the city has had to devise a new system of sewage disposal. A report on the matter, by Harrison P. Eddy, civil engineer of Boston, and Morrell Vrooman, city engineer of Gloversville, who were assisted by H. B. Hommon, chemist, sets forth certain features of the new system that are likely to be imitated in other tanning centers whenever the question of sewage disposal becomes acute.

In addition to the glove manufactories, Gloversville has 26 tanneries at which glove leather and the finer grades of shoe leather are prepared. There is also one hair mill, where the hair from the wastes of the various tanneries is recovered, besides knitting and silk mills and one brewery. All of the domestic sewage, tannery refuse and mill wastes were formerly emptied into the adjoining creek, and it was by riparian owners on this creek that the successful litigation was begun.

The gross weight of wet and dry hides tanned in Gloversville annually amounts to 9,,000,000 lbs. and about 8,000,000 lbs. of chemical reagents and other substances are used in the process. The waste liquors from this process contain spent chemicals, more or less of the active reagents, as it is not possible to completely exhaust the solutions, together with large quantities of hair, bits of flesh and dirt.

The shrinkage of weight in hides during the process of tanning probably amounts to not less than 50 per cent., or 4,500,000 lbs. per year. It is also probably true that 50 per cent. of the chemicals and other agents employed in the process of tanning are carried away from the tanneries in the form of refuse. The only process which is employed to recover any portion of these wastes is that carried on at the hair mill for the recovery of the hair. While over 6,000,000 lbs. of wastes are annually conveyed to the hair mill, only a comparatively small portion of these wastes is recovered in the form of hair. Much of the balance, together with chemicals from the exhausted tanks, constitute a part of the sewage.

Analyses of the creek water indicate that the quantity of wastes which finds its way from the tanneries to the creek averages over 30,000 lbs. per day, or 9,000,000 lbs. per year. From the studies that have been made, it appears that fully one-half of the total weight of hides and chemicals used in the process of tanning eventually finds its way into the creek. This is undoubtedly a low estimate of the total amount of solid and liquid wastes, for the reason that considerable portions are of such a nature that they do not readily flow along with the water and may not, therefore be included in the samples. At nearly every tannery are to be seen large quantities of lime and other refuse which have been dumped out upon the land, much of which could not be included in the samples analyzed, although some is washed into the creek in times of storm. The liquid wastes from the various tanneries and the hair mill contain not only large quantities of impurities in solution, but also much matter in suspension.

As the admission of the tannery wastes without the removal of any portion of the matters in suspension would not only place upon the purification plant a heavy burden for the disposal of sludge, but also might cause considerable deposit in the intercepting sewer, the city council passed an ordinance requiring all wastes from the tanneries to be passed through settling tanks before they were discharged into the intercepting sewer. Some of the interesting sections of this ordinance are as follows:

"No mill, factory or other manufacturing establishment having mill waste shall use the sewer system of the city of Gloversville for sewering purposes without first connecting said mill, factory or other manufacturing establishment with settling tanks.

"The purpose of the tanks at the mills is to remove the suspended solids, hair, leather and other heavy material from the mill wastes by sedimentation, and any chemical or biological action that may take place in the tanks, so that the combined mill and domestic sewage may be purified; also to avoid the clogging of city sewers or unnecessarily burdening the sewage disposal plant.

"The size of the tanks to be constructed or used at any mill that is connected with the sewer system of the city of Gloversville shall be sufficient for the purpose for which they are intended, and they shall be constructed with such features and of such dimensions as may be required by the common council.

"Tanks must be regularly cleaned at such intervals as their operation proves necessary or at any time when the city engineer deems they should be cleaned. In cleaning the tanks no solids shall be emptied into the sewer or outlet from the tanks, nor in any other way shall solids from the tanks be permitted to enter the sewer in cleaning. If the tanks are not properly cared for or if they are not cleaned when necessary or when directed by the city engineer, they will be cleaned by the city and the expense thereof charged to the owner of the mill.

"Free access to the tanks must be given to the common council or their representatives at any time for either the purpose of measurement, analysis, experiments or inspection, or for any other purpose connected with the operation or regulation of said sewer system."

It has been found when the tanks are kept properly cleaned that their efficiency is very satisfactory. Occasionally the quantity of suspended matter is slight, while at other times it is very high, occasionally exceeding 2,500 parts per million. Over 90 per cent. of the suspended matter has been removed in some cases, and it appears that there will be little difficulty in maintaining an average efficiency of 70 per cent. in all cases. If an efficiency of 90 per cent. could be maintained, all of the effluents would pass a standard of 300 parts per million of suspended matter. Difficulty has been experienced in securing the full co-operation of some of the mill owners in cleaning the tanks, so that the results of this preliminary treatment have not been as satisfactory as had been hoped. It has been found necessary to establish a systematic inspection of the tanks, and to require the owners to clean them whenever the accumulation of sludge is so great as to interfere with their efficiency.

It has been found that a single tank has retained over 8,000 pounds of sludge (10 per cent. solids) in a single day, and in several cases from 3,000 to 3,500 pounds has accumulated in the same length of time. As a result of tests made at one time, it was found that the tannery wastes contained as much as 61,600 pounds of sludge in a single day, and that of this amount over 26,000 pounds were retained in the mill tanks. Had a uniform efficiency of 70 per cent. removal been secured, over 43,000 pounds of sludge would have been produced.

After removal of a large part of the suspended matter in the settling tanks built by the tanneries the sewage at Gloversville was subjected to experimental purification by means of sedimentation and septic tanks, sprinkling filters and then further sedimentation, followed by sand filtration. The important point established by these processes was the fact that the chemicals in the tannery sewage did not prevent bacterial purification, though such action was perhaps somewhat retarded.

Undoubtedly the most striking result of the whole investigation by Messrs. Eddy and Vrooman is the establishing of the fact that by the use of settling tanks at the tanneries the sewage from these places could be made to contain a low proportion of suspended matter, so that they conformed nearly to the standard of ordinary domestic sewage. This fact is of practical importance to every tannery which has to consider actual or prospective litigation over the disposal of its wastes.

Stone Pavements of England and America.

By Ernest Flagg.

THE street pavements of American cities are as much inferior to those of Europe as our country roads are inferior to the roads of Europe.

To one who has not made a study of the subject it would seem incredible that there could be such a difference between them.

Not only are our pavements poor beyond what could be thought possible in Europe, but their cost both for construction and maintenance is all out of proportion to their worth.

The pavements of New York may be taken as typical of those of most other American cities. They consist generally of stone blocks, mastic asphalt, wood, brick, compressed asphalt blocks, etc.

The stone pavements are made of what are called Belgian blocks. These are large, roughly shaped pieces of stone, varying in width from 4 to 5 inches and in depth from 8 to 9 inches. (See Figure 1.) They are often laid on the bare earth in a bed of sand, but in pavements of the best sort they have a concrete foundation about six inches thick, which is not always made of the best material. Upon this foundation the stones are laid in a bed of sand from one to two inches thick.

The curbs which line the roadway are not usually laid by the municipality, and they vary in kind, size and quality.

The cross-walks are made of large pieces of stone, which are generally so soft and have such wide joints that wheels soon work in between them, rounding off the edges and making ruts.

After the paving blocks are laid gravel is spread over them and brushed into the joints, which are then grouted with hot pitch; but the stones are so large that the pitch cools before it can reach the bottom of the joint and does not impregnate the sand bed below. Even if the pavement is impervious at the start, it ceases to be so and water entering between the stones, disturbs the sand and causes depressions in the surface, which rapidly spread under the blows of traffic. The irregular shape of the stones and their great size cause them to ride or tilt when struck by heavy loads, thus aggravating the mischief. The joints are so wide that wheels soon find their way into them.

When steel strikes a stone the stone gives way; and it is not uncommon to see the surface of these pavements covered with granite powder formed by a single day's wear, indicating the rapid rate of disintegration.

Such a pavement is full of slight irregularities at the start, which makes it disagreeable to pass over even when new, and after three years of heavy traffic it is not fit for use. This is a fair description of our best type of stone pavement.

I was more impressed by the contrast which the stone pavements of the cities of England presented to ours than by anything else I saw when abroad which related to roadways. My automobile met me at the dock at Liverpool, and as it rolled onto the stone pavement I could hardly credit my senses, so different was the sensation from what it would have been at home in driving over a pavement of this kind.

To all appearances the pavement was like ours, but the automobile passed over it as smoothly as if it were made of newly laid brick or asphalt; the disagreeable irregularitics of our stone pavements were entirely lacking. My curiosity was aroused, and I drove my car for many miles through the city and, to my astonishment, found everywhere the same true and even surfaces. Not a rut nor a hole did I see, but on every street the same smooth roadway. I looked up a city engineer to find out how it was done.

I asked him how it was possible to keep all the streets free from ruts and holes such as one sees here on every block. He smiled as he said: "A ratepayer in Liverpool would not for a minute stand for a hole in the pavement in front of his property."

Happy ratepayer who has a government responsive to his rights!

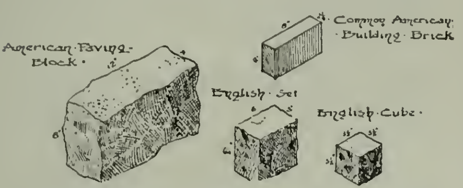
I thought of our free country and had visions of what would happen to a property-owner here who refused to pay taxes because his pavement had holes in it.

I tried to find out what caused the surprising smoothness of the stone surface, but even after the engineer's explanation it was some time before I could account for it. The method of laying seemed quite ordinary to him, and his description of the way it was done appeared to tally exactly with ours.

I found the secret lay in the very small and uniform size of the blocks used, in the fineness of the joints, the thinness of the sand bed, the excellence of the foundation, the great care used to keep all rails and manhole covers absolutely flush with the surface, in the substantial character of the curbs and channels, and in the wonderful toughness of the material used.

I was told that the traffic of Liverpool is the heaviest in the world, and judging from the prodigious size of the loads I saw, I could well believe it.

The wheels of the drays are all small, not small in front and large behind as here, and the platform extends over them,



1. ENGLISH AND AMERICAN PAVING BLOCKS CONTRASTED WITH BUILDING BRICK.

so that, although the distance from outside to outside of hub is no greater than with us, the floor area is half again as large and more than twice as serviceable. The average weight of the horses seemed twice that of ours, and one sees, on every hand, single horses hauling loads that would require three horses here. Teamloads weigh from eight to twelve tons, as against three to five here.

Under this terrific traffic the pavements of Liverpool stand from twenty to thirty years, and as I have said, I was unable to find any depressions, irregularities or other signs of failure in them anywhere, although I made a pretty thorough search.

The stone pavements of Liverpool are of two kinds.

Most of the streets are paved with little cubes of granite of three and a half inches in every dimension, or not as large cubically as an ordinary brick. (See Figure 1.) These are cut like ours with a hammer, but with such regularity that the greatest permitted variation in size is only one-quarter of an inch. They are laid in a half-inch bed of sand on a six-inch foundation of the best concrete. The joints are limited to one-quarter of an inch. They are covered with shingle, then grouted with hot pitch. The stone being so small, the pitch finds its way not only to the bottom of the joint, but into the sand bed, which it thoroughly impregnates, so that the pavement becomes absolutely impervious (see Figure 2).

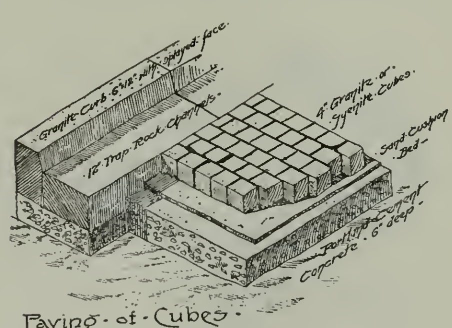
For the streets exposed to the greatest wear the engineers prefer what are called sets. These are oblong blocks three and a quarter inches wide by six and a quarter inches deep, and from five to seven inches long, laid in the same way; but, so far as I could see, the cubes answered just as well and made even a smoother pavement than the sets (see Figure 3).

ECONOMY OF GOOD PAVEMENTS.

Mr. Bulnois, formerly city engineer of Liverpool, says that when these impervious granite pavements were first introduced Liverpool had 200 miles of pavement, which cost for maintenance £38,280 ($185,275), and for interest and sinking fund £15,756 ($76,303), making the total cost per mile £270 ($1,307), whereas twenty-two years later, when the city had 258 miles of pavement, the annual maintenance cost was only £14,205 ($68,752), and the interest and sinking fund was £36,917 ($178,678), making the total cost per mile £198 ($959). Thus the excellent pavements of the present day are costing the city 26 per cent. less per mile than the poor ones which they replaced.

I have no doubt that the general introduction of similar pavements here would result in a corresponding saving to New York City. But the saving to the city would be one of the least of the benefits which would accrue from them. The saving in the cost of moving merchandise through the streets and in lessening of the wear and tear on vehicles would be monumental in comparison to it.

Before seeing the pavements of England I had always regarded stone pavements as the worst possible kind, but after my experience there my views have changed, and I now regard them, when properly made, as undoubtedly the best for any place where traffic is heavy.



2. TYPICAL LIVERPOOL PAVEMENT.

We all know what a perfect pavement brick makes when it is newly laid. It is pleasant to ride over and affords an excellent footing for horses. The objection to it is that it cannot stand much traffic and soon wears out. The stone pavements of Liverpool have all the good qualities of brick without its one defect.

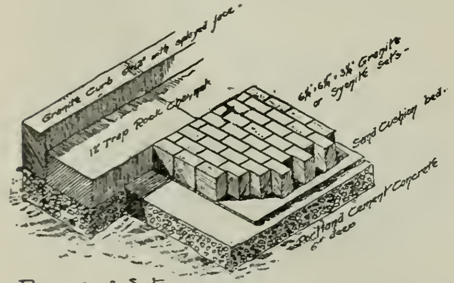
The stones—even when sets are used—are hardly larger than bricks (see Figure 1), and the surface formed by them is almost as true, but being made of the toughest kind of stone, they are harder than any artificial substance can be and therefore do not wear out like brick.

It is interesting to see how the use of a little common sense in construction can make such an amazing difference in the wearing quality and utility of pavements apparently so similar as the stone pavements of New York and Liverpool; and it is extraordinary that two cities which are in such constant communication as these should be so far apart in the condition of their streets.

During the last forty years we have made no progress here in our methods of stone paving. The specifications today are practically the same as they were in 1869, when Broadway was first paved with what we call Belgian blocks. Since that time the paving methods of Europe have made great progress, of which the statement of Mr. Bulnois, which I have quoted, is an illustration.

Stone as large as we use went out of use in England and France early in the last century, since which time the tendency has constantly been toward smaller sizes and a more uniform cut (see Figure 1).

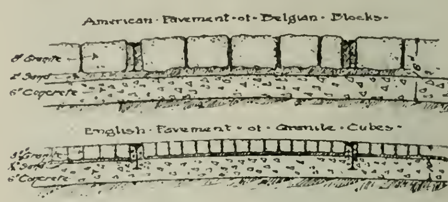
A short time ago specifications were gotten out for 25,000 square yards of granite pavement for Webster avenue in the Bronx, New York City, upon the regulation specifications. The old stones were to be discarded and new ones supplied in their place.



3. TYPICAL LIVERPOOL HEAVY TRAFFIC PAVEMENT.

The successful bidder for the work offered to take $20,000 off his bid if he might be allowed to split the old blocks and use them again. He guaranteed a better job than if new stone was supplied, and called attention to the fact that blocks of smaller dimensions were used everywhere but here, and that when the old blocks were cut in two the wearing blocks which were being used on another surface would still be more than twice as thick as the much softer composition part of the same street.

After a good deal of hesitation he was allowed to use the old stone, and although the pavement is far from perfect and so irregular that it would be thought but a sorry job in England, still it is probably the best piece of stone pavement we have in the city today.



4. TYPICAL ENGLISH AND AMERICAN BLOCK STONE PAVEMENTS.

One might suppose from the greatly superior wearing qualities of the Liverpool pavements that they were more massive than ours, but they are really thinner and require less material to build; where sets are used they are thirteen inches thick, including foundations, and where cubes are used, only ten inches thick. Our pavements are from fourteen to sixteen inches thick. The superiority of the English pavements lies in their design and in the better quality of workmanship used in making them.

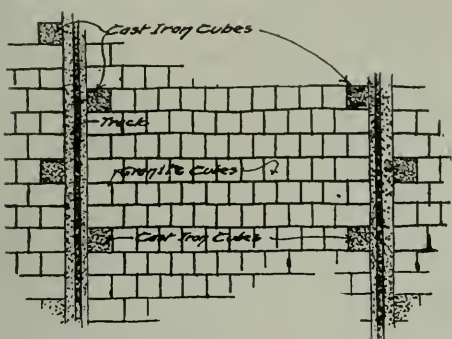
OUR ROUGH PAVEMENTS.

We are very careless in the building of pavements and in the selection of material for them, and seem to think that any kind of workmanship is good enough. They lack that true, substantial, well-made appearance which is characteristic of English pavements.

We appear to think that pavements should be rough and actually seem to go out of our way to make them so. Manhole covers are not laid flush with the stones, and even the covers are often not set flush with the rims. On Broadway, New York City, many of the covers are more than two inches below the rims. Car tracks here, even where the best kind of rails are used, are generally set considerably below the stone, forming ruts all along the tracks, whereas in European countries, and especially in England, the greatest care is taken to keep the contour of the roadway true in every part and the rails absolutely flush with the pavement; and so perfectly is this done, and so truly is the contour of the road preserved, that it is just as agreeable to drive over the rails as over any other part of the street surface (see Figure 4).

In Liverpool experiments extending over ten years on streets where the traffic is greatest have shown that the rails wear away faster than the stone, so if there is to be any difference in level the tracks should be raised slightly rather than depressed.

One very important detail which seems to be entirely overlooked here is lateral support for the blocks which line the car rail on either side of it. There is a concavity along the rails which should be carefully filled in with concrete before the blocks are laid (see Figure 4), other-



5. PAVING BETWEEN CAR TRACKS SHOWING CAST IRON BLOCKS.

wise the abutting blocks will have no lateral support and will soon break down. I have seen innumerable instances here where this has occurred. In fact, it can be seen almost wherever rails are found in connection with pavements which have been down a few years.

In Liverpool the greatest care is taken not only to give the necessary lateral support to the stones which line the tracks, but also to break the continuous joint along them. This is done by making every fourth or fifth block which adjoins the rails of cast iron (see Figure 5).

Another detail which adds wonderfully to the fine and substantial appearance of English pavements is the massive granite curbs and channels which form the borders (see Figures 2 and 3). These are supplied and set by the municipality, not by the abutting property owners, as with us, and they are generally uniform for the whole city. They give a finish and an appearance of solidity to the pavement which is entirely lacking here. These curbs and channels are of cut granite and are so well laid that they are as solid and substantial as they are good-looking. Indeed, the whole pavement presents a fine, workmanlike appearance which it is a pleasure to see.

The chief reason for the long wear of the English pavements lies in their smoothness. They are so smooth that there is no chance for the wheels to strike and wear away the stone, and the material used is so tough that it wears actually better than iron. This was shown in tests of the wear of tramway tracks already referred to. "It was found from actual measurements and weights that in ten years the wearing surface or treads of Bessemer steel rails had worn down half an inch under tramway traffic of 318,689 tons per annum on each rail. The abutting syenite sets showed very little wear except where the edges next to the steel rails were rounded off."—*The Century Magazine.*

The Park Heights Experimental Road, Baltimore, Md.

By D. M. Avey, Indianapolis, Ind.

An experimental stretch of road, known as the Park Heights road, and comprising twenty-nine sections, upon which fifteen different road compounds were used, was constructed near Baltimore, Md., in 1909. This road, which was built under the direction of Major W. W. Crosby, chief engineer of the Maryland State Roads Commission, has been carefully maintained and repaired, and regular inspections have been made to determine the progress of the experiment. A full report of the method of constructing the road was made by Major Crosby before the second International Road Congress, and has been published at various times.

The method of construction differs only in minor details throughout the road, the base being constructed according to the regular manner of building a macadam road. The binding material was applied by the penetration method to the clean rolled second course, though in some instances a layer of sand was applied to the rolled second course and rolled so as to partly fill the voids, before the application of the material with which the road was treated.

The Park Heights road is particularly adapted to use as an experimental road, being 8¼ miles in length and extending from the city limits into the country in such a manner that the traffic varies from that which is very heavy at the city end to the very light and infrequent at a distance of seven or eight miles out. The experimental sections have been so distributed that a comparison of the same materials under different conditions of traffic is possible.

The following traffic count over the different sections was prepared by Major Crosby and presented, together with some data on quantities and cost, before the American Society of Civil Engineers. The figures are averages per day of 12 hours:

SECTION NO. 1, CITY END.

One-horse vehicles	254
Two-horse vehicles	104
Three-horse vehicles	10
Four-horse vehicles	14
Six (or more) horse vehicles	1
Motorcycles	8
Motor runabouts	26
Motor touring cars (4 or 5 seats)	141
Motor touring cars (6 or 7 seats)	66
Motor wagons	4

SECTIONS NOS. 1 TO 3, INCLUSIVE.

One-horse vehicles	195
Two-horse vehicles	101
Three-horse vehicles	3
Four-horse vehicles	19
Six (or more) horse vehicles	1
Motorcycles	5
Motor runabouts	15
Motor touring cars (4 or 5 seats)	141
Motor touring cars (6 or 7 seats)	55
Motor wagons	7

SECTIONS NOS. 14 AND 15.

One-horse vehicles	52
Two-horse vehicles	23
Three-horse vehicles	3
Four-horse vehicles	4
Six-horse vehicles	1
Motorcycles	7
Motor runabouts	11
Motor touring cars (4 or 5 seats)	94
Motor touring cars (6 or 7 seats)	39
Motor wagons	3

SECTIONS NOS. 16 AND 17.

One-horse vehicles	31
Two-horse vehicles	19
Three-horse vehicles	3
Four-horse vehicles	1
Six-horse vehicles	1
Motorcycles	3
Motor runabouts	6
Motor touring cars (4 or 5 seats)	69
Motor touring cars (6 or 7 seats)	40
Motor wagons	4

The following table of construction and maintenance cost and quantities of material was compiled by Major Crosby and presented to the American Society of Civil Engineers, January 21, 1911, with the exception of the last sections, the data on which are supplementary:

TABLE OF QUANTITIES AND COST ON THE PARK HEIGHTS ROAD.

Section No.	Material Used	Time when Used	Quantities Gal. per yard	Cost per square yard of resurfacing macadam	Cost of pitching, including chipping	Cost per square yard of maintenance to 1-1-11	Total cost per square yard of treatment to 1-1-11	Total cost per square yard of road surface to 1-1-11
1	Texaco	7 and 8/09	2.8	$0.337	$0.327	$0.088	$0.415	$0.752
2	Gulf	8 and 9/09	3.97	0.339	0.434	0.080	0.514	0.853
3	Texas	9/09	3.22	0.336	0.418	0.187	0.605	0.941
4	Fairfield	9/09	3.67	0.337	0.449	0.081	0.530	0.867
5	U. G. I.	9/09	3.12	0.339	0.344	0.081	0.425	0.764
6	Warren	9 and 10/09	4.19	0.333	0.606	0.079	0.685	1.018
7	Tarvia	10/09	5.4	0.337	0.618	0.082	0.700	1.037
8	Tarite	10/09	4.41	0.336	0.605	0.080	0.685	1.021
9	U. G. I.	11/09	4.46	0.340	0.454	0.091	0.545	0.885
10	U. G. I.	5 and 6/10	1.42	0.397	0.242	....	0.639	......
11	Texas	6/10	1.25	0.397	0.264	....	0.661	....
11-A	Mixed Tar	6/10	1.65	0.397	0.262	....	0.659	......
12	Headley	6 and 7/10	1.7	0.397	0.327	....	0.724	......
13	B. A. P.	7 and 8/10	1.45	0.397	0.325	....	0.722	......
14	Fairfield	8 and 9/10	1.65	0.397	0.292	....	0.689	......
15	Fairfield	10/10	0.60	0.397	0.084	....	0.481	......
16	U. G. I.	9 and 10/10	0.94	0.397	0.140	....	0.537	......
17	Sarco	1910	1.42	......	....	....	....	......
18	Standard	1910	1.7	......	....	....	....	......
19	Standard	11/09	3.92	0.241	0.174	0.087	0.261	0.502
20	U. G. I.	10/09	3.86	0.230	0.408	0.088	0.496	0.726
21	Texas	10/09	4.7	0.228	0.551	0.088	0.639	0.867
22	Gulf	10/09	2.95	0.229	0.405	0.082	0.487	0.716
23	Warren	10/09	4.71	0.224	0.691	0.082	0.773	0.997
24	U. G. I.	9/09	2.23	0.229	0.257	0.081	0.338	0.567
25	Fairfield	9/09	2.73	0.228	0.353	0.057	0.410	0.638
26-27	Local & U. G. I.	8/09	2.98	0.216	0.303	0.057	0.360	0.576
28	Texaco (special)	....	......	......	....	....	....	......
29	Glutrin	....	0.43	......	....	....	....	......

The progress of the experiment has been the subject of comment at various times since the construction of the road, but up to the present time the results do not warrant a comparison of the various classes of materials used. During the summer of 1911 the writer, in company with a representative from the Maryland Highway Commission office, made an inspection of the road, and noted the points which are set forth in the following. Although no full comparison can be given until the road has seen two or three more years of service, yet there are in a number of cases special defects or merits which indicate the value of the material used.

Section 1. The Texas Company. Texaco.

This section was constructed in the summer of 1909, and the material used was a Texas asphalt manufactured by The Texas Company. The application was made with buckets, and evidently too much of the material was used; as, even at the time of inspection two years after the construction of the road, the material was flushing to the surface.

Section 2. Gulf Refining Company. Asphalt oil "A."

The surface of this section was badly rutted, and large stones had been loosened from the road bed, causing the formation of hollows, which, in some cases, were two feet by three or more feet in size, extending transversely across the road.

Section 3. The Texas Company. Texas Road Asphalt.

This section of road was, at the time of inspection, undergoing a complete resurfacing, owing to the fact that the binder seemed to have entirely lost its cementing power, allowing the surface to ravel. It is due, in fairness to the manufacturers of this binder, to say that the construction of section 3 was not satisfactory, either to Major Crosby, or to The Texas Company. The difficulties were due partly to the amount of material which was used and partly to the consistency of the same. The material which was being used in resurfacing the section was a heavy grade of road asphalt, mixed by the penetration method, about one and one-half to two gallons per square yard being used.

Section 4. Impervious Products Company. Fairfield.

There was a great excess of bituminous material in this section; and the surface showed plainly the marks of horses' hoofs. It was not rutted, however, and was smooth and in excellent condition otherwise.

Section 5. United Gas Improvement Company. No. 4.

This section, though given a heavy treatment, showed no evidences of bleeding, nor was any surplus material in evidence along the shoulders of the roadway. The surface was hard, smooth and in excellent condition.

1. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 11. The Texas Co.

Section 6. Warren Brothers. Puritan Brand No. 10.

A peculiar condition was evident in this section. The surface had formed into rolls; and the material, both binder and aggregate, had pushed out over the shoulders. The binder seemed dead, and the larger stones were becoming loosened from the surface.

Section 7. Barrett Manufacturing Company. Tarvia.

In this section the dead condition of the binder in the center of the roadway was almost as evident as in the preceding section; but the stones were held firmly in place, and the surface was hard and smooth. A quantity of the binder had exuded from the surface and flowed to the sides of the roadway. This material did not have the dead properties of that at the center of the road, but possessed plasticity and binding qualities.

Section 8. American Tar Company. Tarite.

The surface of this section had become rolled into transverse ridges, and the binder was elastic, but dead. The flush coat appeared to have run towards the shoulders, but disintegration had not commenced.

Section 9. United Gas Improvement Company. 1909 construction.

Section 10. United Gas Improvement Company. 1910 construction.

These two sections should properly be considered together, as it was stated that the same grade of material was applied under identical conditions, the only difference being in the quantity of binder used. The 1909 work, though it was constructed with 4.46 gallons of binder per square yard, was smooth, hard and in excellent condition. The 1910 section, on which 1.42 gallons of binder were used, showed evidences of bleeding, the surface containing small waves where the excess material had collected; and in other ways was not in as good condition as that which was constructed the previous year. It is probable that some unmentioned detail of construction caused this condition, or else that, under the rolling effect of the traffic, the surface will be improved.

Section 11. The Texas Company. Road Asphalt.

Photograph No. 1 shows the condition of this section. The surface was, for the greater part, hard and smooth with no excess of binder. Some material had pushed out at the side of the road; but for the most part there was no evidence of bleeding over the roadway. The binder was apparently in as good condition as that which was being taken from the barrels to repair section 3.

Section 12. 11 A. Fifty-two barrels of mixed material.

This haphazard mixture of various materials was in fair condition, though the surface was soft and gave evidence of bleeding.

Section 12. Headley Manufacturing Company. Road asphalt.

There was a great quantity of surplus binder evident on the surface of this section, and chips had been used to relieve the condition. The material was so sticky as to give a sharp smacking sound, due to its adhesion to the tires of passing automobiles.

Section 13. Barber Asphalt Paving Company. Road asphalt.

There were two divisions to this section, different grades of material being used. The surface in both cases was in good condition. In the case of the heavier grade of material there was a slight evidence of surplus binder; but it was by no means an objectionable quantity. The lighter binder was holding firmly, and the surface was hard and smooth.

Section 14. Fairfield tar.

This section was broken off at the shoulders where vehicles had passed over the edges, and patches had been placed in a number of places. The surface at the time the inspection was made was in fair condition, there being no evidences of raveling or bleeding.

Section 15. Fairfield Antidust.

The chemical content of the material used is not available, but in this action it resembles a road material produced from a refuse of wood pulp. The road was hard, dustless and smooth; but had been patched in a few places. The surface had a brownish appearance similar to concrete which had been covered with iron rust. Photograph No. 2 shows this section.

2. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 15. Fairfield Antidust.

Section 16. United Gas Improvement Company. Antidust.

This section, which was treated with a surface coat of the above material, was one of the best noted up to that point. It was smooth, hard and with no dust or particles of any sort upon the surface. The top coat seemed to be crystalized; and only a narrow line was made when the surface was scratched with a knife blade. Photograph No. 3 shows the smoothness of the surface.

Section 17. Standard Asphalt and Rubber Company. Sarco.

The faults in this section appeared to be due entirely to the method of construction rather than to the material used. The surface has the appearance of a terrazzo floor, was firm and dustless; and, except for a few patches, showed no signs of bleeding. The shoulders on one portion of the road were breaking slightly, apparently due to their foundation. This section is shown in Photograph No. 4.

Section 18. Standard Oil Company. 1910 construction.

Section 19. Standard Oil Company. 1909 construction.

A marked difference was evident in these two sections; and the 1909 section was much superior to the one which was constructed in 1910. There was an excess of binder in the new section, which was sticky and had made necessary the application of stone chips and sand. The older section, whether it had improved under traffic or was originally better, was in excellent condition.

Section 20. United Gas Improvement Company. Road asphalt.

This section, though constructed in 1909, had an excess of binder along the edges of the roadway, and still gave evidence of bleeding. The surface had not suffered from this condition, but was smooth and firm.

Section 21. The Texas Company. Road asphalt.

The material for this section was furnished by a Baltimore contractor, and was similar to that used on section 3. It was evidently too light for the purpose intended, as it was rutted, and the larger stones were exposed and loosened from the road surface.

Section 22. Gulf Refining Company. Asphalt oil "A."

The surface of this section was badly rutted, as in the case of section 2 of the same material. The loosened material, though not held together in any marked degree, was spongy.

Section 23. Warren Brothers Company. Puritan brand No. 17.

This section offers a marked contrast to that which was constructed with Puritan brand No. 10 of the same company. There was but little excess binder, and the surface was as smooth and even as a city asphalt pavement. Photograph No. 5 gives an idea of the character of the surface.

3. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD
Section 16. U. G. I. Antidust.

Section 24. United Gas Improvement Company. Road asphalt.

A lighter treatment was given this section than in the case of the previous sections upon which the U. G. I. compounds had been used. The surface was spongy, but the large stones were held firmly in place, and the top was smooth and showed few signs of wear.

Section 25. Impervious Products Company. Fairfield.

It was interesting to note in connection with this section that that portion which was constructed over a dirt sub-grade was firm and the stones were held in place, while another portion built on a sand sub-grade was deeply rutted in some parts. There were no signs of bleeding, though the material had pushed out over the shoulders to some extent.

Section 26. Consolidated Gas, Electric Light and Power Company. Tar With a Top Coat of United Gas Improvement Company Compound.

It was found that the tar supplied by the Consolidated Gas, Electric Light and Power Company was too light, so the second material was added as a supplementary coat. The surface was smooth and in excellent condition.

Section 27. Consolidated Gas, Electric Light and Power Company. Tar.

A heavier grade of binder was used on this section, and the result obtained was very good. The surface was spongy to a certain extent, but was not rutted nor marred in any manner.

Section 28. The Texas Company. Texaco Special.

This section was the best of those constructed of The Texas Company material. The surface was smooth and firm; and, though the binder covered the top in such a manner that the individual stones were not visible, yet there was no stickiness nor tendency to flow to the shoulders.

Section 29. Robeson Process Company. Glutrin.

This section is the longest of the entire road. It covers about two miles at the end of the experimental road farthest from the city. Photograph No. 6 indicates the character of the surface. It was hard and smooth, with the individual stones held firmly in place. In fact, some of the stones showed evidence of marked abrasion without any perceptible loosening. The appearance of the edges of the roadway indicated that a small quantity of the material had been washed out from the surface, but no signs of disintegration were noted.

As was stated, the progress of the experiment, together with a lack of complete information as regards sub-grades and features of construction, makes a comparison at this time impracticable. It is interesting to note, however, the behavior of the same material under different traffic conditions, and with different quantities.

A comparison or comment on the Texas product is unfair, for reasons already given. Further progress of the experiment will serve to indicate the value of the material under the exceptional traffic conditions at the city end and under the ordinary country road use.

4. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 17. Standard Asphalt & Rubber Co., Sarco

The two sections of Impervious Products Company, Fairfield, which were laid in 1909, were similar in appearance, and both showed little signs of wear. Section 4, which was in the heavily-traveled section and which was constructed with 3.67 gallons of binder per square yard, showed a slight excess of binder, and is not in as good condition as section 14, upon which 1.69 gallons of binder was used.

In the case of the United Gas Improvement Company, compound the sections which were constructed in 1909 were better than those which were built in 1910. The best sections were those upon which was used from 2 to 3.5 gallons of binder per square yard.

Warren Brothers' Puritan brand No. 17 was much better than their Puritan brand No. 10. It is true that the first mentioned came under the heavy traffic, while

5. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 23. Warren Brothers Puritan No. 17.

the other did not; but, on the other hand, the No. 10 brand was laid on a hill and was subjected to a heavy wash from drainage water, and to extra abrasion due to the grade.

Special mention is due to the three surface treatment materials or antidust compounds; namely, Fairfield Antidust, U. G. I. Antidust and Glutrin. While the experiment is not old enough to develop their lasting qualities to any extent, yet their appearance and condition at the time the inspection was made was of the very best.

The scope of the experiment, the number of materials used, the length of test sections, none of which are less than 400 feet, make it of marked interest. The present mention is merely in the nature of an account of the work. The results developed and the conclusions developed by the Maryland Highway Commission should prove of particular value.

6. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 29. Robeson Process Co., Glutrin.

Outline for Standard Sewer Specifications.*

By E. J. Fort and A. J. Provost, Jr., New York City.

SEVERAL meetings of your committee have been held and substantial progress has been made, but its work has not yet advanced to the point where any portion of it can be submitted to the society for adoption.

Your committee realizes that sewer specifications, in order to be worthy of general confidence and adoption as standard, and to insure as general unanimity of opinion as possible as to their various provisions, must cover a wide range of conditions and must be in general harmony with the conclusions of committees of other technical societies and associations which are working upon similar problems.

The members of your committee have also been appointed as officers (chairman, vice chairman and secretary) of the committee of the American Society for Testing Materials, to report upon standard specifications and tests for clay and cement sewer pipes. Such a specification must be a large and important part of any sewer specification and its preparation, in order to satisfy all interests and opinions, those of municipalities, manufacturers and professional men, must be given most careful and extended consideration.

Your committee, in the interests of both societies, is proceeding with deliberation and thoroughness with this portion of its work.

Much valuable information has been collected both in this country and abroad. Extensive series of tests have been carried out, the results of which are available, and arrangements are being made for such other experiments and tests as may be necessary to furnish information that is not obtainable from any other source.

No standard specification for sewer construction which has been generally recognized or adopted as such, has up to the present time been produced and the specifications in use by even the largest and most important municipalities, vary widely in many of their most important provisions. Difference in local conditions would, no doubt, warrant special provisions in regard to some of the more important details, but there would seem to be little reason why, in the most important particulars, standard requirements may not be applicable.

Materials of construction of acceptable quality are usually available.

The functions to be performed by the finished structures are substantially the same, and if the structures are designed to be permanent, as economy and expediency would generally require, the standards of excellence in the materials and workmanship employed, may well be uniform.

Specifications for sewers of extraordinary size and special design, will generally require addenda supplementing the standard specifications to meet the requirements in each particular case, while for pipe and masonry sewers of ordinary size, standard forms should ordinarily suffice.

It is the opinion of your committee that the complete instrument designed to govern every detail in the execution of contracts for sewer construction, should contain:

First—*A Notice to Intending Bidders.*

Such a notice should state clearly:

- (a) Time and place at which bids will be received.
- (b) Location and extent of the work to be bid for.
- (c) Time allowed for the execution of the contract.
- (d) Amount of security required.
- (e) Manner in which the bid shall be be presented and its contents.
- (f) Engineer's estimate of cost.
- (g) General cautions in regard to preparation of bid and execution of work.
- (h) Other information for the assistance of the contractor in the preparation of his bid.

Second—*Contract or Agreement Proper.*

The contract form should contain in addition to the language of the agreement, bonds, official signatures and acknowledgements of the same, and official designations of the fund from which the expense is to be met.

- (a) A certified copy of the official action granting authority to execute such a contract.
- (b) A description of the parties to the contract and the officials or employees under whose supervision it is to be executed.
- (c) A statement covering in detail all the work to be done and the prices bid for same.
- (d) A definition of the authority and duties of the engineer and assistants in control of the work

*A report to the American Society of Municipal Improvements.

as the representatives of the city or party of the first part.

(e) A definition of the rights of the contracting authority in determining the time of commencement, supervision of work, methods of procedure, force to be employed, etc.

(f) A definition of the contractors' obligations in executing the work in accordance with specification requirements and the directions of the supervising authority, and in maintaining the same, in the protection of property from damage, the payment for labor and materials, the completion within contract time, manner and time of payment, liquidated damages for delay beyond the contract time, etc.

(g) Method of procedure in modifying the contract.

(h) Clauses relating to liens, claims, damages, guarantees, assignments, etc.

(i) Enumeration of the provisions of laws and ordinances especially applicable to municipal contract work which must be observed.

(j) Other clauses of special or local application.

Third—*Specifications.*

Following a general description of the work embraced in the contract and the limits within which it is to be done, the limits within which the lines may be located, manner and times of fixing grades by the engineer, the manner in which measurements shall be made, etc., the specifications should include

(A) A DESCRIPTION IN DETAIL OF ALL LABOR PERFORMED BOTH PRELIMINARY AND SUBSEQUENT TO THE EMPLACEMENT OF THE SEWER STRUCTURE, AND THE MANNER OF ITS PERFORMANCE.

(a1) Excavation of Trenches.

1. Dimensions for various sizes of sewers and lengths to be opened at one time.
2. Shoring and bracing.
3. Pumping and bailing.
4. Foundations, their preparation to receive the sewer.
5. Disposition of excavated material.
6. Provisions for the maintenance of street traffic while work is under way.
7. Removal of pavements and disposition of paving material.
8. Protection and support of other structures.

(a2) Refilling of Trenches.

1. Character of material to be used especially about sewer.
2. Manner of placing, ramming, flooding, etc.
3. Disposition of surplus, deficiency, how met.

(a3) Embankment.

1. Dimensions.
2. Character of materials, how placed and compacted.
3. Provisions for traffic through intersecting streets.

(a4) Replacing of Street Surfaces.

1. Unpaved streets. Surface to be restored; maintenance period.
2. Pavements, curbs and sidewalks out of guarantee; how restored; maintenance period.
3. Pavements, etc., under guarantee; how restored.

(B) A DESCRIPTION IN DETAIL OF ALL MATERIALS TO BE EMPLOYED; THEIR QUALITY AS SHOWN BY STANDARD TESTS, AND THEIR PROPER MANIPULATION TO PRODUCE THE FINISHED STRUCTURE.

(b1) Cement and Mortar.

1. Cement, quality, standard tests to be met.
   Cement, how delivered and stored.
   Cement, measurement of volume.
2. Mortar, measurement and proportions of ingredients.
   Method of mixing.
   Character of sand.
   Amount of water.

(b2) Concrete.

1. Size and character of stone or gravel.
2. Size and uniformity of sand grains.
3. Proportions of ingredients to be used in mixture.
4. Methods of mixing, placing and surfacing.
5. Molds and forms.

(b3) Brick Masonry.

1. Quality and size of bricks to be used.
2. Manner in which they are to be laid and protected from injury. (Inverts, arches, haunch walls, manholes and catch basins, spurs and branches.)

(b4) Stone Masonry.

1. Quality and dimensions of stones. Rubble, ashlar and dry masonry, coping stones, basin heads, etc.
2. How laid to produce finished walls and structures.

(b5) Steel and Iron.

1. Rods for reinforcement, quality, dimensions and tests.
2. Structural shapes, quality, dimensions and tests.
3. Expanded metal, wire mesh, etc.
4. How placed in the finished structure.
5. Spikes used in platforms, grill-

ages, cribs, etc., quality, dimensions, etc.
6. Cast iron.
Quality and tests.
Conformity to place.

(b6) Sewer Pipe.

Specification for pipe sewers and sewer pipe is to be in accordance with recommendations of Committee C4 of the American Society for Testing Materials, appointed to report upon "Standard Specifications and Tests for Clay and Cement Sewer Pipe." The work of that committee is not yet completed. Its last annual report, June, 1911, is referred to.

(b7) Pile and Timber Foundations.
1. Bearing Piles.
 a. Kinds and quality of timber.
 b. Dimensions.
 c. How driven.
 d. How measured and paid for.
2. Foundation timber.
 a. Kinds and quality of timber.
 b. Dimensions as shown on plan.
 c. How laid and secured.
3. Sheathing and Bracing Timber.
Manner of Placing.
 a. To remain in the work.
 Kind, quality, dimensions, etc.
 b. To be withdrawn.
 Kind, quality, dimensions. etc.

(b8) Sewer Connections.
1. Manner and time of connecting house drains.
2. Connections intersected to be reconnected.
3. Flow of old sewer—how cared for.
4. Method of making all connections.

(b9) House Connection Drains.
1. Spur pipe to receive house connection drains. Spacing and size. How laid.
2. Stand pipes on deep sewers.
3. Cast iron pipe for house connection drains, where necessary, how laid, quality, etc.

(b10). Manholes.
1. Concrete, brick.
How built, dimensions, etc.
2. Manhole heads and covers.
Standard plan.
Weights, dimensions, etc.
Quality of iron.
Inspection.

(b11) Sewer Basins or Inlets.
1. Standard plan.
2. Excavation, dimensions, how made.
3. Heads and gratings or pans.
4. Traps.
5. Culverts, dimensions, how laid and connected to same, etc.
6. Restoration of curb, sidewalk and pavement after construction.

Discussion is invited upon the above outline of the subject matter to be incorporated in the finished specification, and suggestions and criticisms will be welcomed.

Bituminous Macadam Construction.*

By A. N. Johnson, State Engineer Illinois State Highway Commission.

OBSERVATION of macadam roads built with a bituminous binder seems to point to the success of this form of construction on many miles of road, and it is with this construction that the present paper will deal, without an attempt to discuss further the relative merits of this construction with other classes of pavement.

There are many features to be considered in the construction of bituminous macadam which the limited scope of this paper will necessitate passing over with but slight mention. As with any ordinary macadam construction, it is of prime importance that the roadbed be properly prepared both as to drainage and compactness; yet, fundamental as are these requirements and as supposedly well understood, no small number of the failure seen today can be attributed to lack of attention to these important features of the construction. If the roadbed has been properly drained and compacted, there will not be required a greater thickness of completed pavement than seven to eight inches. The material should be put on in two layers, the first layer forming the base on which the wearing layer is to be placed.

The method of placing the base usually does not vary, whatever may be the type of construction used for the top layer. It is essential that this base layer be compact and true to shape, and this cannot be accomplished unless the stone is well spread, thoroughly harrowed and rolled, and then well bonded with stone dust or gravel in the same manner and with as much thoroughness as though the road were to be left with an ordinary water-bound surface.

*Paper before the Indiana Engineering Society.

The size of the pieces of stone in the different layers is a matter for some consideration. It has been the practice of the Illinois Highway Commission to use stone varying from one inch to two and one-half inches in size. As practically all of the stone available for road work in Illinois is limestone, there is required a somewhat larger sized material for surface work than is demanded with a harder variety of stone. Also, it has been found convenient to use but one size of stone in both layers of the road, so that the screens at the state crushers are provided with one-inch holes and two and one-half-inch holes, and no intermediate size. A dust screen with three-eighths-inch holes is used to prepare stone chips from the one-inch material.

The depth to which the stone is to be spread for the base depends upon the thickness the base is to be after it has been rolled. If the total thickness of the pavement is to be eight inches, the wearing surface is not usually made less than two and one-half inches in thickness, leaving five and one-half inches for the thickness of the lower course. If the material for the top course is composed of two and one-half-inch sized pieces, it is recommended that this layer be made three inches thick, leaving five inches for the thickness of the base. A layer of stone about six inches thick, measured loose, will roll to five inches, possibly a little less, depending somewhat upon the nature of the material.

After the stone has been spread to the required thickness, which should be done with great care so that there will not be more in one spot than in another, it should also be thoroughly harrowed with a coarse-tooth harrow. The effect of this is to shake the various sized pieces of stone into place, and, as is well known, a box of loose stone can be compacted no better than by shaking them; so, too, we find that the loose stone in the road is compacted by shaking or harrowing, which allows the smaller pieces to take their natural position at the bottom of the layer and the larger near the top. It will be found, moreover, that harrowing the material in this way will permit the roller to compact the material without the creeping that is often observed, and with one-half as much rolling.

The lower course should not be covered with screenings until it has been thoroughly compacted and each piece of rock keyed tightly in place so that when a wagon load of screenings is driven upon it the wheels will disturb the rolled stone scarcely any, if at all, and leave no decided rut or track. The screenings should be spread evenly over the whole surface and slightly watered. If the foundation is clay and wet weather has prevailed, the greatest care must be taken in watering the screenings of the first course before the road is tightened, otherwise the surplus water will soften the foundation, which must be dry before further progress can be made. After the screenings have been slightly washed or worked into the stone more should be spread and again watered and then rolled to tighten the surface, more water and screenings being added until the surface of the base, or lower layer, is water-tight. Screenings should not be applied so as to separate the pieces of rock which have been already keyed, but merely to fill the voids in the compacted stone with as little disturbance as possible.

The amount of crown that the finished road is to have will decide the amount of crown that the earth roadbed and the base should have. Space will not be taken here to present the various arguments for a greater or less amount of crown. In general, the observation of the writer is that one-half-inch per foot is not enough for the average country road with a bituminous macadam top, nor is it practical to exceed three-quarters of an inch per foot. On roads to sixteen feet in width, not less than three-quarters inch per foot is advisable. On roads twenty feet in width or wider, indicating that there is a large amount of traffic spread more or less evenly over the whole road, the crown can be somewhat less than on the narrower roads, but it should never be less than one-half inch. On the wider roads a good practice is to increase the crown somewhat towards the gutter, perhaps starting on three-quarters of an inch and gradually flattening towards the center, which would be effected by a curved cross-section.

On narrow roads twelve to fifteen feet in width it is necessary to give special attention to consolidating at least three or four feet of the earth shoulder on either side of the road to hold the stone in place. As can readily be appreciated, when the roller is near the center of the road, there is a tendency to push the stone sidewise, and if there is nothing to resist this movement the stone becomes more and more open as the roller proceeds and the pieces of rock do not tighten. On wider roads there is not so much difficulty from this cause, as a small amount of rolling towards the edge of the stone at first will place it sufficiently solid to resist any further movement of the stone at the center, for which reason it is very much easier to get a well-shaped, well-compacted road that is eighteen feet or wider, than one but twelve feet wide. We now come to a discussion of the bituminous surface proper.

There are various methods of construction employed for bituminous macadam surfaces. They are usually divided into two general classes, one where the material is mixed with the binder before being applied to the road, called the "mixing method," the other by which the rock is first placed upon the road and the binder poured into it, usually called the "penetration methods." By far the largest amount of work undertaken by highway engineers on country roads is by the penetration method, for the simple reason that it is very much cheaper and more practical for the conditions usually existing in country road work. This method alone will be discussed in detail. Moreover, it is the conviction of the writer that with the binders ordinarily employed for this work and for the traffic conditions usually prevailing on the majority of country roads, the best results will be possible with good construction by the penetration method.

As is well known, the stability or strength of a macadam road surface to resist the action of traffic depends entirely on the mechanical locking together of the pieces of stone making up the road surface, and until this is accomplished the road surface has no cohesion. The more perfect this keying or locking together of the pieces of the stone, the more rigidity, therefore the object of any binder, whether of stone dust or of bituminous character, is to hold the pieces of stone firmly in position after they have become well keyed and locked together. In many pieces of road that have been constructed, and in some forms of construction that have been proposed, this essential principle of the macadam construction seems to have been ignored; as, for example, in the type of road employing some form of bituminous binder in which the pieces of stone of the wearing surface do not come in contact at all, but are held apart by the bituminous material, which here acts as a matrix, forming in reality a bituminous concrete similar to ordinary concrete, in which the matrix of cement mortar is replaced with a matrix of bituminous material. If, therefore, the matrix is not in itself sufficiently strong and rigid to withstand the pressure of traffic, such a road is doomed to failure, particularly if submitted to the traffic conditions on most country roads where the traffic tends to keep to a more or less narrow strip of the road, bringing undue pressure thereon. The fact that some of the roads built with a bituminous matrix have proven fairly satisfactory is chiefly because the traffic conditions, under which they are used, so rolls and works the road that one portion receives about as much pressure as another, and if there is a slight tendency to give at one time at one point subsequent traffic will tend to roll out the unevenness that has been formed. Roads of this character that have come under the writer's observation, although giving fair satisfaction with the conditions under which they are used, would last but a short time under country road traffic. Thus it would appear that if bituminous macadam is to be successful it is necessary in its construction to follow what has been learned by long experience, and that is to have the macadam itself firmly locked and keyed together and the stability of the road thereby assured before any binder has been applied.

The next step, therefore, after the base course has been prepared, as has already been described, is to spread the stone for the wearing layer. The stone for this layer, if limestone, should be composed of pieces two and one-half inches in size and graded from this downward. If a three-inch layer is to be made when consolidated, which is as thick as this layer need be, the stone should be spread to a thickness of three and one-half inches and thoroughly raked or harrowed so as to bring the larger pieces to the surface in order that the surface may be composed in the first instance of as nearly uniform sized material and to give as great compactness as possible after it is rolled. As soon as spread uniformly and harrowed, the surface is to be rolled until it is thoroughly tightened. It may be found that there will be places where the stones do not lock together firmly; on such places a small amount of stone should be spread, just sufficient to fill the interstices, and then rolled. The effect of this rolling is to force the pieces of stone into the interstices, thus keying the whole surface until tight. It is important that great care be taken in rolling this upper layer that it be thoroughly tightened. When this has been accomplished there will still remain interstices of appreciable size which should be filled with stone chips. These chips should be perferably of some harder material than limestone, and it is often possible to secure screened gravel that will prove excellent for this purpose. The size of the chips should vary from one inch to three-eighths of an inch, and they should be spread over the surface of the upper course- just sufficient to fill the inter stices.

A good method to insure this being done is first to shovel the chips on by hand, throwing each shovelful so as to cover as much area as possible; then follow with hand brooms, sweeping ahead the surplus pieces and allowing all the interstices to become thoroughly filled. When this is done the road is ready for the bituminous binder, as no rolling should be attempted after the chips have been spread and before the binder is applied. If the chips are rolled before the binder is applied the effect would be merely to allow them to set in between the stones which have already been keyed and tend to loosen the surface rather than tighten it, so it is important that after the surface has been thoroughly keyed and the chips spread, no rolling be done until after the bituminous binder has been applied.

There are various methods of applying the bituminous binder. One method is to turn the heated binder into cans, thence pouring it on the roads, and many roads have been built in this manner. There is to be seen in almost all work of this character, unless an exceptionally skillful man is employed to do the spreading, places in the road where the binder has been applied thicker in one place than another, and the joints where one sweep of the can is followed by another can usually be seen. This unevenness is generally much more pronounced after the road has been in service than immediately after construction, so that evenness in the distribution of the binder is found to be a most important detail. Binders have been spread by machines having a number of nozzles or openings side by side, which are moved over the surface of the road, the binder being thus distributed in a layer a number of feet wide at a time. In some of these machines the binder flows from the nozzles merely by its own weight, generally termed gravity machines, while with others pressure is applied. Binders have also been applied through a single nozzle at the end of a hose.

Experience seems to show the importance of the following conditions being observed: The binder must be spread uniformly, that no more binder be used than is necessary to cover the surfaces of the stone and the chips. To get these results it is necessary that the binder be put on, as nearly as possible, in the form of a spray; and, owing to the fact that it is practically impossible to get a thoroughly uniform surface condition before the binder is applied, it may be necessary to apply slightly more binder at some point in the surface than another, so the writer has found in his work the best results have been obtained by applying the binder through a single nozzle of such a form that the binder is thoroughly atomized and is delivered to the road in the form of a finely divided spray. With this method of application there has been found no difficulty whatever to get the binder on as uniformly as is required and at the same time to have sufficient control to give those spots on the road that may need it the special attention they require.

The device that has been in use on the work of the Illinois Highway Commission consists of a tank wagon, holding about five hundred gallons, supplied with a fire chamber. The tank, which is cylindrical, is sufficiently strong to withstand a pressure of sixty to eighty pounds if found needful. The tank wagon is fastened behind a roller or tractor, to which is attached a Westinghouse air pump with a metal hose leading from the air pump to the distributing tank, on which is a gauge so that the pressure may be controlled by the operator of the tractor. Leading from the tank wagon is a metal hose which ends in a nozzle made of a two-inch iron pipe with a right-angle bend, in the end of which a plug is screwed, having an opening about one-half inch in size; on the inside is a small cone, so that by screwing the plug or less tight the size of the orifice can be regulated.

Leading into the two-inch pipe forming the nozzle there is introduced a one-half-inch steam pipe which is connected back to the boiler of the tractor. The steam pipe extends within the nozzle to just above the orifice. When in operation the pressure is applied to the wagon, thus forcing out the bituminous binder. The steam is turned into the nozzle as the binder issues, which tends to spray and break the bitumen into very fine particles, the effect being a sort of mist which can be very nicely regulated so that any given amount of material from a mere wash to any quantity desired, can be applied.

It is important that all hose connections for this work be of metallic type, as lighter hose or hose of any other material will soon become rotted or burned by high temperature necessary for most of the bituminous compounds used.

Also, the complete outfit includes an extra heating tank of the same capacity as the distributing wagon, which, as soon as empty, may be readily filled from the auxiliary tank. To do this the air pump is reversed, creating a partial vacuum in the distributing wagon and the binder is sucked back through the distributing hose which is inserted into the auxiliary wagon. With one auxiliary kettle and one distributing wagon, each of five hundred gallons capacity, fifteen hundred to two thousand gallons per day can be applied. Additional auxiliary heating kettles would increase the output. Working continuously, a maximum of five hundred gallons per hour can be applied. On most jobs, however, where but one roller is available, fifteen hundred to two thousand gallons per day will be about as fast progress as can be handled efficiently.

The binder issuing under pressure and carried by the force of the steam will fill all the interstices and cover the sides of the rock and the chips with a thin layer. Enough of the binder should be applied as to leave none of the surfaces of the stone that are visible uncovered. Care should also be taken that the binder strikes the surface perpendicularly, otherwise if applied in a slanting position or if the nozzle is moved too rapidly across the road it will be found that one side of the stones will be covered with the binder while the other side will have but little. The amount of binder to be applied should be as little as is necessary to secure a thorough coating for all the exposed surfaces of the stone. This usually requires from three-quarters of a gallon to one gallon per square yard. When this treatment has been applied the surface should again be treated with the stone chips so as to make practically one layer of the chips evenly distributed over the entire surface of the road. These chips had better be applied as soon as possible after the binder has been spread, if practicable, following immediately behind the spreader. They may be spread somewhat in excess and swept ahead with a broom. It is important that the chips be clean and have as little dust adhering to them as possible. One advantage noticed with the steam jet in connection with the operation of this apparatus is that the force of the steam seems to blow the dust from the surface of the stone and thereby insures a cleaner surface for the binder.

After the chips have been spread the second time more binder is applied, which should be sufficient thoroughly to cover all of the chips. This usually requires one-half to three-quarters of a gallon per square yard. Coarse sand, if available, should then be spread upon the road, or finely screened gravel may be used; if neither are available, then the stone chips. There is no objection to the stone chips if the stone from which the chips are made is a hard variety of rock, but it is better to use some other kind of chips than from limestone. After the surface has been sanded or chipped just sufficient to prevent the wheels of the roller from sticking, the road should be rolled. The roller should be provided with pipes with small orifices an inch or two apart so as to keep the wheels of the roller wet while rolling. If this is done there will be no difficulty whatever with the binder sticking to the roller wheels. The rolling should continue until the surface is seen to be well set and compacted. It will then perhaps be found that there are some spots needing further treatment to bring them to a uniform appearance with the remainder of the road, in which case, if there be any dust, it should be swept away, a few chips, binder and sand applied and the whole rolled to give a uniform surface. It is probable that quite as good or better results can be obtained, after the road has been sanded and rolled, to throw it open and let the traffic develop any places in the road that need further attention.

This form of construction, it will be seen, gives a road which has the strength and rigidity of the ordinary macadam, with a water-tight covering of bituminous compound holding the surface of the road intact against the action of motor traffic or dislodgement by the mud that adheres to the wagon wheels. So long as the waterproof covering can be maintained the road should be in perfect condition, and therefore the only maintenance required in this construction is to keep this bituminous covering intact. The chips or sand, whichever may be used, with which the covering is mixed, furnishes the resistance to abrasion. This is greatly helped by the binder, if of proper quality, which will tend to keep the particles covered or imbedded as fast as they may become loosened or broken by the traffic. When in the course of time the surface has become sufficiently worn to expose the stone making up the wearing course, it can be renewed by thoroughly cleaning the road, putting on a light application of the binder and renewing the chips or sand. From present observation there is every indication that such a form of maintenance will be possible at a comparatively small expense and furnish, in the meantime, a character of road surface that is well adapted, as any so far devised, to the ordinary traffic conditions on our main highways at present.

It is evident in this form of construction that the character of the bituminous binder plays no small part and that to be successful the binder must have sufficient stability in hot weather that it will not be easily pressed or displaced and cause an uneven road surface; nor at the same time must it become so brittle or hard in winter that it will be broken by the traffic and dislodged by the wind or other forces. To say that such a binder has been found would mean that most of the difficulties in this form of construction had been solved. Some binders have certain qualities that give good results under certain conditions and poor under others. Some binders more nearly meet the requirements than others, but there has not been sufficient time elapsed with this form of construction and in the use of these different binders to state definitely what, in the long run, will prove to be the best. While we might draw a conclusion as to which binder was best, further experience might show that some other binder, with somewhat different properties, would have greater durability.

There are two general classes of bituminous binders—those produced from the coal tars and those produced from asphaltic oils and natural asphalt, one being a coal-tar bitumen and the other asphaltic. Much study has been devoted to both the chemical and physical properties of the various coal tars and coal-tar compounds and the result of the various compounds in road construction observed, to the end that definite specifications could be drawn from which the compounds should be manufactured. The same is also true of the asphaltic binders. While the variety of compounds of a bituminous nature on the market today is equalled only by the variety of breakfast foods, there is, however, one very encouraging fact, and that is there are very few of the binders that have come under the writers observation that are absolute failures, while with the majority very good results have been obtained. He has found, however, that it is absolutely essential, if any knowledge whatever is to be had concerning the character of the bitumen used, that it be brought under some definite specification and that it be tested before being applied to the road; that trade names are no criterion as to the composition and characteristics of a given compound. Doubtless the manufacturers of these compounds can in a measure justify or excuse the variability of their products by the fact that they are called upon to fulfill so many various specifications that they might well argue if engineers and road builders are so divided in their opinion as to what is desired and wanted, surely little or no harm could result by furnishing binders of various characteristics, waiting, before standardizing their output, until the chemists and engineers are more nearly in accord as to what should be used. However, the latitude that manufacturers allow themselves in many of these cases is rather greater than most engineers and chemists, who have given the subject careful study, usually desire, and therefore the recommendation is here made that the binders be bought under specification and be tested to see that the qualities desired have been secured. There is very little or no difficulty to manufacture binders to meet any reasonable specilcation.

For coal tars the following specification has been used by the Illinois Highway Commission:

Specific gravity at 25 degrees C. shall not be over 1.24.

Free carbon shall not be over 20 per cent. by weight.

The consistency as determined by the Howard & Morse float apparatus at 50 degrees C. should be between 2½ mins. and 3 mins.

The fractional distillation shall result as follows:

To 110 degrees C. not to exceed 2 per cent., with no ammoniacal water.

From 110 degrees C to 170 degrees C. not to exceed 5 per cent. distillate, of which not more than ¼ shall be naphthalene when cold.

From 170 degrees C. to 270 degree C. not to exceed 30 per cent. nor less than 20 per cent., of which not over one-third shall be solids when cold.

Over 270 degrees C. not less than 50 per cent. by volume of pitch residue to be obtained, which shall be sticky and not greasy or granular in appearance.

When a cylindrical prism of tar 1 centimeter in diameter is maintained at a temperature of 0 degree C. it shall bend into a semi-circle of 2 centimeters in diameter without checking.

For asphalt binders the following specifications are now in use:

The asphalt shall have a specific gravity not less than 0.97 at 25 degrees C.

The asphalt shall be soluble in cold carbon bisulphide to the extent of at least 98 per cent.

Of the total bitumen not less than 20 per cent. nor more than 25 per cent. shall be insoluble in 86 degrees B. naphtha.

When 20 grams (in a tin dish 2½ inches in diameter, with vertical sides) are maintained at a temperature of 170 degrees C. for 5 hours in a N. Y. testing laboratory oven, the evaporation loss shall not exceed 2 per cent. and the penetration shall not have been decreased more than 25 per cent.

The fixed carbon shall not exceed 12 per cent. by weight.

The penetration as determined with the Dow machine, using a No. 2 needle, 100 gm. weight, 5 sec. time and a temperature of 25 degrees C., shall not be less than 5.0 mm. nor more than 10.0 mm.

The asphalt shall not contain to exceed 2 per cent. by weight of paraffine.

For details as to methods of analysis of bituminous compounds the reader is referred to Bulletin No. 38 of the U. S. Office of Public Roads.

The question as to whether tar or asphalt compounds give better results is one on which the writer can not at present express an opinion, merely because the experience so far had with these different compounds has not proven sufficiently conclusive to warrant any definite conclusion. Both good results and poor results have been obtained with each of these bituminous materials.

Some engineers are of the opinion that under certain traffic conditions better results are obtained with one class of materials than another; for instance, with a preponderance of motor traffic, the opinion seems to be in favor of asphaltic compounds, and with a preponderance of steel tire traffic, that the tar compounds prove the better. However, these conclusions, as far as they have come under the writers observation, seem to have been drawn chiefly from merely surface treatment of old roads. Nothing that he has observed would seem to indicate that a similar distinction could be made from roads constructed as has been described.

The specifications for bituminous material for the form of construction herein outlined are presented, not so much as being necessarily a criterion, but as a suggestion and guide to those who desire to purchase these materials and use them and who may not have given the subject very extended inquiry. It is entirely possible—in fact, quite probable—that these specifications will be changed and other requirements found necessary as more experience has been gained from the work already done. In general, it has been the plan in the past year or two in the use of these binders, on the work under the supervision of the Illinois Highway Commission, to use on each stretch of road at least two binders and so to distribute them on different jobs so that each will be placed in juxtaposition with some other. Thus, with a chance to compare each binder with a large number of other binders, and by observation of each binder under various conditions, it is hoped that reasonably exact conclusions as to their fitness for use in this form of construction may be formed.

The Youngstown Slag Road.

Editorial Correspondence.

IN connection with a series of experiments along the line of dust prevention and road preservation by the U. S. Office of Public Roads, a slag road was constructed in Youngstown, Ohio, in the summer of 1909. This experimental section, while not the first slag road, possesses features of construction which are unique and which indicate the value of this material as road metal.

The road chosen is known as Belle Vista Avenue and is a main travelled thoroughfare 2,754 feet in length, terminating in macadamized main roads at either end. The material was furnished by the Carnegie Steel Co., and was laid under the direction of an engineer from their office and Randolph Martin, an engineer from the U. S. Office of Public Roads. The county graded and prepared the sub-grade, and furnished a ten-ton steam roller for the work. The steel company furnished all material including the blast furnace slag and binding materials and performed work incident to laying and finishing the road.

The first 1,500 feet of the road was constructed in two courses, the bottom course consisting of a six inch rolled layer of screened slag ranging in size from three and one-half inches to one and one-half inches; and the top course consisting of screened slag ranging from two inches to three-eighths inch in size and rolled to four inches at the center and one inch at the edges. This first division is divided into three sections of 500 feet each which were constructed as follows:

Section 1. The surface of this section was bonded with blast furnace slag screenings, three-eighths inch to dust, in the usual manner.

Section 2. The surface of this section was bonded with blast furnace slag screenings, three-eighths inch to dust, which had been previously mixed with five per cent of its own weight of powdered quick lime.

Section 3. The surface of this section was bonded with slag screenings as as described for section 1, with the exception that a solution of concentrated waste sulphite liquor was used to puddle the surface instead of water. One gallon of sulphite per square yard was used.

Section 4. This section consists of 300 feet of roadway adjoining section 3, and was constructed in the following manner: The foundation course was laid in the same manner as sections 1, 2, and 3, and was rolled until absolutely firm. A three-inch compacted course of tarred slag was placed upon the foundation course. The mixture of tar and slag being approximately as follows: To every fifteen cubic feet of slag running from two inches to dust about six gallons of hot tar was added and mixed by hand until the slag particles were completely coated. Unless the slag was warm and dry it was required to heat it before mixing. While still warm this mixture was applied and rolled. A light coating of hot tar was then painted upon the rolled surface and sufficient screenings were applied to fill the surface voids and take up all surplus tar, this surface being again rolled.

Section 5. The second division is 300 feet in length and is known as section 5. It consists of a single course of screened slag ranging from three and one-half inches to three eighths inch, rolled to a thickness of eight inches at the center and five inches at the edges, and bonded with slag screenings.

The third division consisted of two sections laid in two courses. The bottom course consists of a seven inch layer of rolled unscreened slag, and the top course consists of a layer of three and one-half inches to three-eighths-inch broken slag rolled to five inches at the center and two and one-half inches at the edges. Section 6 was bonded with blast furnace slag screenings three-eighths-inch to dust. Section 7 was constructed in the same manner as section 6 with the exception that open hearth slag screenings three-eighths-inch to dust was used as a binder.

The experimental road was officially inspected by representatives from the U. S. Office of Public Roads during January, 1911, eighteen months after construction. The weather at the time of this inspection was rainy and during the previous months there had been a succession of frosts and thaws. The following is the comment noted on the road:

Blast-furnace Slag.—When inspected just after a thaw the first section showed to advantage in comparison with the fifth and sixth. The surface, while not as firmly bound as some of the sections in which a binder other than blast-furnace slag screenings had been used, was in excellent condition. In experiments Nos. 5 and 6 the center of the roadway had been quite badly raveled by horses' hoofs, but little difference between the two sections of road was to be noticed, except that in experiment No. 5 a rather soft spot had developed in the center of the road at the middle of the section.

Blast-Furnace Slag—Open Hearth Slag Screenings.—The section, (section 7), treated in this experiment was at the time of inspection undoubtedly superior to any of the others, with the exception of the tar slag section. The surface was very firmly bonded and could not be dug into with a knife, except in a number of small spots from two to four inches in diameter, where the surface was soft and powdery. These spots were scattered irregularly over the road to the extent of seven or eight to each 100 linear feet and were evidently caused by the presence of a few soft, crumbly fragments of blast-furnace slag. With this exception the entire surface appeared almost as solid as Portland cement-concrete. On one side of this section, about 50 feet from the the northern end, the earth shoulder had settled and sloughed away for a distance of about 35 feet, and the edge of the road at this place had been cut back by traffic for a distance of six inches. The trouble can undoubtedly be attributed to a fresh fill, which was not consolidated sufficiently before the road was constructed. This place is to be repaired by building a crushed slag shoulder.

Blast-Furnace Slag Screenings and Lime. The section treated in this experiment was somewhat raveled and scarcely better than those described under sections Nos. 5 and 6. During construction it seemed that this section would prove more satisfactory than any of those bound with plain blast-furnace slag screenings and during the past summer it actually proved somewhat more satisfactory. The open winter, however, showed section No. 1 up to better advantage.

Blast-furnace Slag and Waste Sulphite Liquor Preparation.—The section treated in this experiment was in good condition and showed a fairly well bonded surface. This section was in slightly better condition than that described under experiment No. 1, but it was not as well bonded as the section described under experiment No. 7.

Blast-Furnace Slag and Refined Coke-Oven Tar.—Section 4 showed up to better advantage than any of the others at time of inspection. The surface was perfectly bonded and presented a rather mosaic appearance. Although the road at this point had been constructed on a fresh fill which had settled somewhat since, the tar slag surface showed no evidence of having cracked when adjusting itself to this settlement.

An inspection by a representative of MUNICIPAL ENGINEERING, made on July 27, 1911, about two years after the construction of the road, showed that the results indicated in the previous inspection have become more marked during the additional six months wear. The road surface was dry and dusty in parts, due to a continued period of dry weather.

Of the three experimental divisions constructed of blast-furnace slag, the first, section 1, was by far the best. This is the section constructed of two courses of screened blast-furnace slag with a slag binder. It showed some signs of rutting, though the ruts were not of sufficient size to be objectionable. The surface was dusty to a slight degree.

The second experimental division, section 5, was constructed in one course of screened blast-furnace slag. This section is badly rutted and the surface has raveled to a marked degree. A very noticeable hollow filled with loose particles of slag had formed at the junction of this section with the preceding tar and slag section.

The third experimental division, section 6, was constructed of a course of rolled screened blast-furnace slag laid on an unscreened base, and with a binder of the same material. This section, while better than section 6, is not nearly so good as section 1. The traveled portion has been left practically bare of binder and a heavy dust has formed at either side, indicating that raveling is likely to result.

Section 7 was constructed after the same manner as section 6, except for the fact that open hearth slag was used. It is far superior to section 6, the surface being hard and smooth and less dusty than any of the sections, with the possible exception of that constructed with tar and blast-furnace slag.

Section 2, constructed of two courses of blast-furnace slag, the top course being bonded with a mixture of slag screenings and dust and five per cent of powdered quick lime, was not in as good condition as section 1, which had only the slag binder. It had rutted more than section 1, and the larger particles of the top course were left exposed.

Section 3, which was constructed in two courses and on which waste sulphite liquor was used instead of water, is superior to the section in which lime was used in the binder, but is not so well preserved as the slag binder section. It seemed, however, to be a little less dusty than either of the two preceding sections.

Section 4 is the best division of the road. It was constructed in two courses, with a tar binder in the top course as noted previously. It extends across a bridge located between and on the lower portions of two hills, so is subjected to the additional wear incident both to the high speed of descent and extra friction of ascent of vehicular traffic; as well as possible erosion of water, which, owing to side embankments, must at times overflow the side ditches and cover the road. The surface is hard and dustless and resembles a much worn asphalt street in appearance. The larger particles of slag are exposed in spots, but are held firmly in place by the tar binder. The binding material, a crude coke-oven tar, seems to possess valuable properties for use in this connection, superior by far to most crude tars which have come to the writer's attention. The following is an analysis of the material made for the Carnegie Steel Co., by the U. S. Office of Good Roads, A. L. Cushman, director Division of Tests:

Specific Gravity 25° C.	1.187
Results of Distillation:	
Ammoniacal water, by volume	1.0 %
First light oils to 110° C. by volume	1.0 %
Second light oils, 110°-170° C. by volume	6.0 %
Dead oils, 170°-200° C., by volume	9.2 %
Dead oils, 200°-270° C., by volume	23.6 %
Pitch residue by difference	59.2 %
	100.0 %
Pitch residue by weight	64.70
Material insoluble in cold carbon bisulphide (free carbon)	8.56 %

Remarks: This is a crude coke-oven tar containing a considerable amount of napthalene. The second light oils and dead oils to 200° solidified when cold and the dead oils from 200° to 270° C. contained about one-half their volume precipitated solids when cold. The pitch residue was brittle and showed a fairly lustrous fracture.

To produce a material at all suitable for road construction from this tar, at least 17 per cent. should be distilled off. This will give a viscous residue showing the following characteristics:

Specific Gravity 25°	1.225
Melting point (cube method in water)	30° C.
Penetration No. 2 needle, 5 seconds, 50 grams, 5° C.	47
Distillate to 270° C, by volume	28.4%
Pitch residue	71.6%
	100.0%

A still better product could be obtained by distilling the crude tar until 40 per cent. had been removed and then diluting the residual pitch with dead oils from which the crystallizable napthalene had been separated, until it showed a melting point of approximately that given above.

The use of slag, as set forth in this experimental road, indicates that the material possesses value as a cheap road metal, in a community situated near a large steel mill. Laid after the manner of a limestone macadam road, the blast furnace slag road at Youngstown does not possess the durability, even in the best portion, of the section with the slag binder; and those sections laid with lime and sulphite liquor seem inferior to that in which the slag binder is used, though there is little difference between them.

The open-hearth slag section approaches more nearly to the limestone macadam road of the same age; and it is probable that with a more uniform hardness of material the small holes caused by soft particles might be eliminated. The cementing quality of the open hearth slag seems to be excellent.

As used with a tar binder, an excellent road is obtained with the blast-furnace slag and it is probable that the Youngstown tar slag road will prove very nearly as durable as a similar road in which limestone is used.

A comparison of slag with various materials used in road construction is given herewith. The tests as recorded are the standard tests for hardness, toughness, cementing value, etc., and the weight refers to the solid material.

The fact that the slag dust is heavier than the ordinary trap rock or limestone macadam dust is a factor which should add to the durability of the road, owing to this fact that the binder is not so easily drawn from the surface and blown from the road. It was noted that an automobile traveling at the rate of about twenty miles an hour along the intersecting macadam road on Mahoning Avenue, raised a cloud of dust which arose to a height of about fifteen feet and was blown along the road for a considerable distance. Upon coming onto the blast-furnace slag section with the slag binder, the dust arose only to a height of about four feet and the wind, which was blowing at right angles to the line did not carry it off of the road.

MAXIMUM AND MINIMUM RESULTS ON ROCK AND SLAG SAMPLES, UNITED STATES DEPARTMENT OF AGRICULTURE—OFFICE OF PUBLIC ROADS.

		Dolomite	Granite	Gravel	Limestone	Sandstone	Shale	Slag	Slate
No. of Samples		105	122	85	489	193	9	33	42
Specific Gravity		2.75	2.60	......	2 70	2.55	2.65	2.80	2.75
Weight, lbs. per cu. ft		172	162	......	168	159	165	175	172
Water absorbed Lbs per cu. ft.	max.	6.91	2.77	......	13.22	11.60	4.84	4.40	2.10
	min.	0.07	0.04	......	0.03	0.02	0.50	0.04	0.05
Per Cent of Wear	max.	18.6	24.6	......	34.2	41.7	16.2	13.5	6 9
	min.	2.1	1.1	......	1.8	1.0	3.2	2.7	1.6
French Co-efficient of Wear	max.	19.2	37.0	......	21.7	40.8	12.6	14.6	24.4
	min.	2.2	1.6	......	1.2	1.0	2.5	3.0	5.8
Hardness	max.	18.3	19.2	......	19.1	19.5	17.7	18.0	19.7
	min.	4.4	13.6	......	0.0	0.0	13.9	10.7	1.1
Toughness	max.	27	31	......	25	60	12	21	40
	min.	4	2	......	2	2	3	3	1
Cementing Values	max.	179	255	500	500	500	367	463	500
	min.	9	3	3	10	3	28	1	1

Refuse Disposal in Cambridge, Mass.

LAST SPRING a committee was appointed by the city council of Cambridge, Mass., which spent about two months in the study of the problems of the city streets, devoting their attention particularly to street paving, the maintenance of pavements, and the collection and disposal of refuse and wastes, not including garbage. This committee consisted of George M. Clukas, representing the city at large; Lewis M. Hastings, city engineer; Edward W. Quinn, superintendent of streets, and Harrison P. Eddy, representing the Cambridge taxpayers' association.

The report of the committee has recently been published, and the portion concerning the collection and disposal of refuse is reproduced in the following pages, as an indication of the ordinary result of such brief investigations. It would seem that only the most obvious modifications of existing processes had been presented, and considering the large problems assigned and the short time allowed, it is not surprising that an exhaustive study could not be made. The report is valuable, nevertheless, and its recommendations, if followed, will result in sanitary improvement and efficient service.

Committee Report.

Our attention has been called by the city officials to the increasing difficulties of finding suitable dumping places for the refuse collected by the city departments, and the increasing cost of such collection. We have, therefore, given much consideration to this subject, feeling that it is one of the most important problems with which the department is confronted at the present time.

The refuse and waste collected and disposed of by the city may be classified as follows:

(a) Garbage.

(b) Papers and other combustible material.

(c) Ashes and other incombustible material.

(d) Street scrapings and sweepings.

(e) Material excavated from street catch basins.

(a) The disposal of garbage in Cambridge is now in the care of the overseers of the Poor Department. It is collected by city carts, transported to the City Home, where most of it is sold to outside farmers, by whom it is carried away. This method of disposal has many objectionable features, and at some not distant day will have to be supplanted by a more modern and sanitary method of disposal. However, as the present method is in many respects fairly satisfactory, and as any radical change would involve a very large expenditure of money, and a loss of upwards of $10,000 in revenue, it is not considered best to make at this time any recommendations looking toward such a change.

(b) At present this class of material is more or less mixed by the householders with class "c," no strict separation being insisted upon. Part of the material is burned at the incinerator on Main street, and the rest is burned as well as possible in the open air at the various dumps.

Much well-founded objection is made to this method of disposal by residents near the dumps. Moreover, the dumps are not convenient and are being rapidly filled up. It is clear that this method of disposal must and should be soon abandoned and a different one adopted.

The most feasible plan seems to be to construct at the city yard on Raymond street, another incinerator. A strict separation should then be insisted upon and all of this class of refuse which cannot be sold should then be carried to the two incinerator stations and burned.

(c) Much the larger proportion of the refuse collected in Cambridge consists of ashes or other incombustible materials constituting class c. Data relating to the collection of such materials are shown in the accompanying table.

In a clay pit near the city yard no Raymond street.

All these dumps, except the last, are nearly filled and are the subject of complaint from persons owning property near them, and therefore they cannot be used for this purpose much longer. Furthermore, in many cases the haul to them from the points where the refuse is gathered is so long as to make the cost excessive.

(d) In addition to the daily cleaning of the paved streets, twice a year at least, all the public streets of the city are scraped and the material so gathered has to be removed and disposed of. This in the past has been accomplished largely by filling low lands, and raising the grade of yards and lots at the request of the owners. It is being found increasingly difficult to find places of disposal for this heavy material without making very long hauls at correspondingly increased cost.

(e) The material taken by the Sewer Department from the street catch basin is generally regarded as more obnoxious than the refuse already referred to, and it is correspondingly difficult to find any place in Cambridge where it may be dumped.

It is clear that steps must be taken to secure some better method of disposal for the three classes of refuse last referred to at an early date, and to this the commission has given its attention.

In the extreme western parts of the city are located a number of disused clay pits which would require something over two million (2,000,000) cubic yards of filling to bring them to the original grade. These clay pits are controlled by one corporation, the New England Brick Company,

DATA RELATING TO COLLECTION OF CLASS C REFUSE.

Year	Carried to dump. cu. yds.	Carried to Incinerator, cu. yds.	Total Cubic Yards	Total Cost of Collection per year	Cost per Cubic Yard
1900	70,656			$27,999.94	$0.396
1901	85,756			28,829.92	0.336
1902	89,549			28,999.94	0.323
1903	87,636			28,797.78	0.328
1904	103,426			32,096,98	0.310
1905	100,084			32,499.23	0.324
1906	106,106			33,686.46	0.316
1907	113,604			37,458.48	0.329
1908	99,486	23,415	122,901	40,152.36	0.319
1909	109,799	22,347	132,146	44,599.62	0.337
1910	120,667	20,956	141,623	47,099.23	0.335

The refuse of this class not carried to the incinerator is mainly carried to dumps situated as follows:

Near Brookline bridge.

Near the foot of Pleasant street.

Near Bird's pond.

In an old clay pit near Concord avenue.

and it seems that some equitable arrangement might be made with the company by which the city could fill these pits without charge to either party.

If this can be done the problem becomes one of economical handling and transportation.

As already shown, the total quantity of class "c" refuse collected in 1910 was 141,623 cubic yards. Of this quantity 20,956 cubic yards were taken to the incinerator, where similar materials will continue to be carried. Of the 120,667 cubic yards of other refuse collected, about 37,262 cubic yards were collected by the city ash carts in districts within convenient hauling distance of the pits. If the new method of disposal to be proposed had been in use in 1910, this quantity of refuse would have required no special method of transportation. There would have remained about 83,400 cubic yards to be transported to the pits, or otherwise disposed of. It is estimated that of this quantity 25 per cent. was paper, which in the future should be carried direct to the two proposed incinerators, leaving 62,554 cubic yards as the amount of refuse class "c" collected in 1910 to be disposed of in some other manner—as, for example, dumped into the clay pits.

The average weight of this class of material was found to be 1,150 pounds per cubic yard, so that the total weight for the year 1910 would be about 36,000 tons.

The amount of street scrapings taken up yearly is estimated at 17,200 cubic yards, or about 18,323 tons. Of this 4,583 tons can be carried to the pits direct from the areas adjacent, leaving 13,740 tons to be transported by some new method.

The amount of material removed annually from catch basins is estimated as about 3,129 cubic yards, or about 5,000 tons. Of this about 1,250 tons can be carried direct to the pits, and the balance, about 3,750 tons, must be transported by special conveyance.

The estimated present amount of refuse to be transported by special methods would be as follows:

Class (c)	62,554 cu. yds., or	36,000 tons
Class (d)	12,733 cu. yds., or	13,740 tons
Class (e)	2,344 cu. yds., or	3,750 tons
Totals	77,631 cu. yds., or	53,490 tons

The daily quantity to be transported varies greatly. The largest amount of class "c" was collected in December, 1910, 172 tons. The smallest amount was collected in August, 1910, 90 tons. Collection of class "d" occurs mostly in April and October, the maximum amount to be transported being about 228 tons daily. The collection of class "e" is fairly uniform, about 24 tons daily. Thus the maximum requirement might be, for April or October, as follows:

Class (c) average amount $\frac{72+90}{2}$	131 tons
Class (d) average amount	228 tons
Class (e) average amount	24 tons
Total	383 tons

The minimum during August would be as follows:

Class (c)	90 tons
Class (e)	24 tons
Total	114 tons

Recommendations.

First.—It is recommended that a strict separation be made by citizens of class "b" from class "c" refuse.

That a new incinerator of simple, yet suitable, design be constructed at the Raymond street yard, and that all of class "b" refuse be taken in suitable carts to the two incinerators and the material there disposed of either by sorting, pressing, baling and selling, or destroyed by burning, as shall be found most economical and practical.

Second.—It is recommended that steps be taken to secure the right to use the clay pits above referred to as dumps for classes "c," "d" and "e" refuse.

Third.—That the refuse collected in the western part of the city be taken to the proposed dumps by carts in which it is collected.

Fourth.—That the collection of refuse class "c" from the rest of the city be made by flat platform wagons carrying steel refuse tanks or boxes, which may be easily transferred to other means of conveyance to the dumps.

The collection of class "d" refuse could be done partly by the same method. The balance could be collected by carts, etc., and transferred by temporary means to the transportation vehicles. Class "e" refuse would be collected in tight covered tanks or small wagon bodies and transferred in the same manner.

Fifth.—That five and possibly six central stations or yards be established in the central and eastern parts of the city, to which the wagons will bring refuse in cans.

These stations to be located as follows:

1. Incinerator yard on Main street, near Ames street.
2. Portland street, rear of hook and ladder house.
3. City lot on Norfolk street, or city lot on Harvard street, near corner of Prospect street.
4. City lot on River street, corner of Blackstone street.
5. Some lot to be selected near Harvard Square.
6. Lot on or near Baldwin street.

Sixth.—Install at each station suitable appliances for transferring by power the tanks or boxes from the collecting wagons to the transportation vehicles and reverse.

Seventh.—The question of the best

method of transportation of the material from the stations to the dumping pits, the commission has been unable to decide. Two methods have been suggested and considered—the first, the Boston Elevated Railway Company is to lay side-tracks into the yards of the several stations and connect them with the tracks of the company in the street. A track is also to be carried from the Concord avenue track at Huron avenue to the pit near Sherman street, a distance of about one-half mile, where a power derrick would be set up for taking the tanks from the cars and swinging and dumping them into the pit. All this to be paid for and owned by the city. The railway company to furnish cars, wiring and operators, at rate per hour or per diem to be agreed upon.

The right to transport material of any kind through the city streets by the railway company is dependent upon the permission to do so being granted by the city council, and this has recently been refused, so that unless special permission to transport the material is granted, this plan would be impracticable. It might be found advantageous to the city to grant permission to transport its own refuse.

By the second plan considered, the transportation of the refuse collected is to be done by means of gasoline motor trucks, using the same stations, equipped with suitable transferring devices, the trucks to be owned by the city and operated by men in the employ of the city.

An approximate estimate of the outlay required shows that whichever plan is adopted an expenditure of from $80,000 to $100,000 will be required for the necessary equipment, land for stations, collecting wagons, cranes and other equipment.

It shows also that the cost of transporting the material from the central stations to the dump will probably be from 30 to 50 cents per ton, not including the cost of collecting and delivering it to the central stations, which will be reduced from the present cost of collecting, owing to the more convenient location of the stations to which the deliveries will be made.

It is apparent from the above figures that either of these methods of transportation will render the disposal of refuse more expensive than it is at present. As long as the present dumps hold out, or their use is permitted, it will be more economical to continue to carry the refuse to them. It would seem wise, however, to take preliminary steps toward the adoption of a more complete and lasting method of disposal, by securing, first, the dumps themselves, and, second, the two lots which will be needed for central stations. We would recommend that immediate action be taken on these two suggestions.

Contracting Practice.

By DeWitt V. Moore, Mem. Am. Soc. Eng. Contr., Indianapolis, Ind.

Final Analysis.

WE have reached the point where, in logical sequence of events, our outline of work is completed and we are ready to make a final analysis and summary of our results and experience. This thought leads us back to the June issue, wherein several definitions of analysis are given.

For the purpose of our final analysis probably the definitions; viz., No. 2, "Digest," that which is worked over, classified and arranged, and the definition No. 6, "Ratiocination," the necessity of reasoning, or probable reasoning, or the great principle of order in thinking, cataloging the accumulation of knowledge, putting us in shape to correct our own mistakes, are the best expressed for the purposes of this discussion.

It would seem that a very few have a proper idea of the meaning of the phrase "Cost Analysis." Time and time again articles have been called to our attention under the caption of Cost Analysis, which were nothing more or less than a bare statement of cost records, and although in a great many cases these cost records are divided in an intelligent manner to form the basis of cost analysis, still in no sense can they be said to be Cost Analysis as a Digest, or in the definition of Ratiocination or the great principle in order of thinking, cataloging our accumulation of knowledge.

It is true that to carry out to a full extent the meaning of Cost Analysis as we interpret same, it is necessary to have had an experience extending over more than one job, but it is presumed that we are dealing with contracting organizations having had experience, present activity and promise of future development. Under these conditions Cost Analysis implies a systematic study of results secured on each job, so that any form of digest or cataloging information as illustrated by differences or inconsistencies are harmonized so that all the jobs are brought to a comparable basis.

In other words, Cost Analysis in this final summary eliminates non-essentials, individualities and specialties; reduces the pay hours of work, etc., to a uniform basis to the end that we may reach a point where the results can be tabulated on a comparative scale.

Such a Cost Analysis summary also implies a study of the work accomplished in a broader sense than simply as so many cubic yards of earth excavation, cubic yards of concrete, thousands of brick laid or feet board measure of lumber. Such an analysis takes into consideration the conditions under which such work was done, giving due credit for location of raw material and methods of operation, the extent of work under construction and the average unit of work.

In other words, we in reality are approaching the ideal which is to reduce our cost data to a basis of foot pounds of work, although we are only doing so in a very crude manner, inasmuch as we are using ordinary standards of measurement in order to introduce comparisons.

It is certainly true that the ordinary laborer is capable of so many foot pounds of work per day. If his time is expended in doing work at a long distance from the point of supply, his energy will be expended in distance at the expense of actual quantities handled. If, on the other hand, the work is arranged either naturally or by proper supervision, so that large quantities can be handled at a minumum of effort, the cost per unit of quantity is correspondingly decreased.

If we should attempt to completely analyze each and every job within the limit of practical supervision so that we might trace the foot pounds of work of each operation for each class of labor we would have a monumental task which would fail of real value through the difficulty and cost of securing information, but it is entirely possible to estimate on a basis of arbitrary units for the different classes of work, thereby giving us the same relative comparisons without difficulty. Such arbitrary assumptions based upon our familiarity with the work in question furnishes a definite basis of Digest or Cataloging of the information obtained.

As an instance of our idea in this connection, let us estimate a job in reinforced concrete.

The cubic feet of concrete to be placed in the building, bridge or other structure, divided by the square-foot area covered gives the average thickness of concrete in inches per square foot. This is an arbitrary indication of foot pounds of work necessary, inasmuch as it indicates without any direct statement of distance or haul the foot pounds of work and energy expended in order to place certain work. See Plate XXX. Such results are shown for reinforced concrete building work wherein a graphical form is shown, the increase in cost due to distance and decrease of thickness in work accomplished. The same style of a chart may be used for bridge work, pavements, sewers, sidewalks, etc.

Plate XXXI shows such a form of analysis as carried through the construction of the sewer job shown by Plate IV, with a special reference to the concrete work. In this case the arbitrary unit is the cubic yards of concrete per lineal foot of sewer.

Considering the subject of sewer construction leads us again to a consideration of Cost Analysis as applied to the construction and placing of steel centers or forms. To say that this cost is so much per lineal foot is insufficient, inasmuch as we are certain that the cost depends upon the size of the sewer, and the next job we have for estimate may give an entirely different size or a different proportion of sizes. Suppose, however, we analyze the situation and consider the square foot of forms set, taking the intrados of the arch, or in other words, the inner circumference, and reduce our cost to a square-foot basis, we find very interesting figures that are immediately valuable for future estimates on any other work.

To a certain extent the same results may be assumed to exist on pavement or sidewalk work both in the foundations and finishings. A four-foot width walk and a twenty-five-foot width street cannot be built for the same cost per square foot as a twenty-five-foot width walk or a fifty-foot street, that is so far as relates to the unit cost of work accomplished.

Cost Analysis is not cost recording, no matter how elaborated or how much in detail. Cost Analysis is based on cost records properly segregated, but the analysis eliminates unfamiliar items but making a note of same and places the different elements of work on a comparative basis reducing the quantities, units, hours and rates, so that all jobs may be compared on a certain definite uniform basis.

Much depends on the individual and therefore it is not possible to lay down any fixed rules. Illustrations accompany these articles, showing how these methods may be applied to practical and actual conditions, but exactly the same forms are not recommended for the readers hereof, it being our desire to suggest rather than to dictate and to develop the Cost Analysis turn of mind, which will prompt each man to formulate his own forms.

The writer of these articles is perfectly willing to offer free of charge to any reader of MUNICIPAL ENGINEERING his personal suggestions by letter to the end that the inquirer may receive the best results along the line of his own work.

The plates illustrative of Final Summary of Cost Analysis will appear in the March number of MUNICIPAL ENGINEERING, and it must be understood that these charts are based upon actual working jobs. In other words, there is nothing theoretical or visionary in this proposition.

The writer has had a practical contracting experience of twelve years, and it should be understood that the methods outlined during this series of articles are those in actual contracting practice within his own organization.

With the interested readers of this series of articles but of different ideas there is no quarrel. The facts are that not only in a small business but in large affairs these methods have proved satisfactory in practical experience.

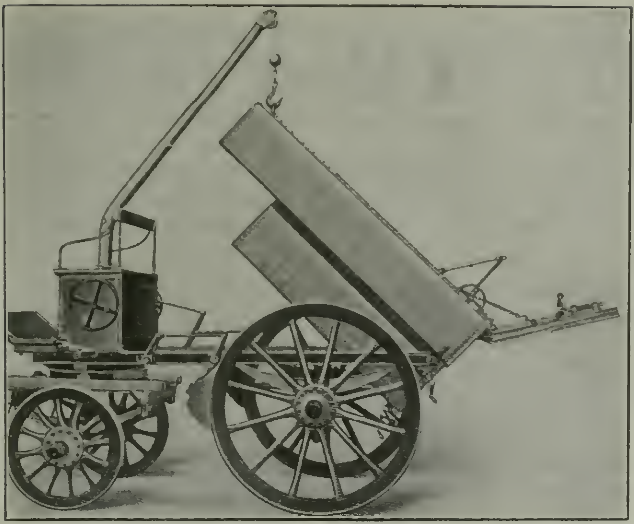
In order to continue our idea of Cost Analysis Charts and present same in a form easily understood, it has seemed advisable to extend this series of articles to the March issue and include all the above mentioned forms at that time.

German Garbage Carts.

By Robert Grimshaw, Dresden, Germany.

IN the Dresden Hygiene Exhibition there are naturally exhibited several styles of garbage carts, one of which, built by the Casseler, Muellwagen & Geraetefabrik Co., and in use in several German cities, is here shown. The system is that in which the cart is filled from the house cans, and its contents as a whole are dumped by tipping the cart body about a transverse axis; over 100 German cities adopting this method. But the special feature is the method of filling it without causing dust or slop in the action, or allowing the odors from the cart to escape during this process. Another feature is that the cart can be turned very shortly, so as to permit it being used in narrow streets and alleys. The body has an angle-iron main frame and profile iron subsidiary frame, usually

1. A CERMAN DUMPING GARBAGE CART.
In Dumping Position, with Open End Gate and Screw Elevator for Raising the Front End.



2. A GERMAN GARBAGE CART WITH DUMPING CRANE.

with wooden panelling with feather and groove; the whole being lined with galvanized sheet iron; although sometimes the entire sides are of the latter material. The width is somewhat less in front, to facilitate dumping; there are two springs behind and three before. Dumping is accomplished by a screw resting on ball bearings and driven by a crank through bevel-gears without any ratchet device, as shown in Fig. 1.

On each side of the body there are three dust-tight arangements for filling from the cans, which latter are square in section and furnished with hooks by which they may be hung to the cart body while being tipped. The action of tipping them opens inwards a flap which otherwise closes the opening of the hopper, and which returns to place as soon as the can is removed. In some cases the cans are carried by two men between them; in others, on a two-wheeled cart.

A special cart or wagon shown at the Dresden Hygiene Exposition by the Vereinigte Fassfabriken of Cassel is, with exception of the wheels and the driver's box, entirely constructed of iron and steel. The running gear has four leaf springs; the fore axle can be turned square across; the axles are steel tubes; the wheels have iron hubs with dust-tight bronze bushings and constant lubrication. The whiffletree has springs to ease the draft in starting. The wagon box is closed water-tight, and is emptied by tipping to the rear about trunions at mid-height of the rear end. The rear axle is goose-necked, in order to bring the weight of the box and contents low down, but not so low as to hinder dumping clear from the wagon. The rear door is made water-tight by felt packing. The box, which holds 1.75 cubic meters or 61.8 cubic feet, is tilted by a crane, as shown in Fig. 2.

EDITORIAL COMMENT

Specifications for Wooden Block Pavements.—Standardizing Specifications.—What is the Matter with Business?—Selection of Administrative Officers of Municipalities.

SPECIFICATIONS FOR WOODEN BLOCK PAVEMENTS.

Some advancement in the knowledge of the action of wooden block pavements, and of the mutual relations of the methods of treatment of blocks and of laying them in the street to this action, seems to have been made recently, much of this being shown in the report on creosoted wood block pavements made in November, 1911, by John Ericson, city engineer of Chicago, and in the discussion of the report of the committee on wooden block pavements made at the recent New Orleans convention of the Association for Standardizing Paving Specifications.

Mr. Ericson's report shows excellent results obtained from various treatments of blocks with oils with specific gravity even as low as 1.03 and with specific gravity of not less than 1.09. He finds more trouble from "bleeding" of blocks and also from buckling of pavements under expansion on streets in Chicago laid under the latest specification requiring oil of 1.10 to 1.13 gravity than on streets laid earlier under specifications admitting the lighter oils. He does not attribute the increase in trouble to the oil but says it may be due in part to this or to character of wood, manner of treatment or of laying the blocks.

Indianapolis, which has had longer experience with wooden block pavements, reports some trouble with buckling on streets laid with blocks treated with oils of all gravities, light and heavy, and also some trouble with bleeding, but its specifications do not admit admixture of tar in the oil used for treatment.

Reports as to penetration of oil into blocks are equally various, good and poor penetration being reported with all grades of oil.

There was much complaint of the specification for an oil heavy enough to require the use of a considerable admixture of tar, which was passed by the A. S. P. S. at its New York meeting last year, by some on account of a supposed monopoly of the tar, by some because of the greater complaints of "bleeding" and by some because it prevented the laying of pavements treated with lighter oils, concerning which there was less complaint of "bleeding" and but little, if any, more complaint of buckling.

The committee of the New Orleans convention of the A. S. P. S. took cognizance of these complaints and offered an alternative specification providing for the use of oils of 1.03 to 1.08 gravity, which agrees with the specification proposed by Mr. Ericson in his report, although the specifications as to details of distillation results differ somewhat. The former specification of 1.10 to 1.14 gravity oil was retained, thus giving the engineer the choice of the two oils. These specifications preclude the use of oils of 1.08 to 1.10 gravity, in the face of the facts stated in Mr. Ericson's report that excellent results were obtained with oils of not less than 1.09 gravity, and without explanation as to why oils of this medium gravity should be so objectionable as to be cut out entirely.

Some have contended that the lighter gravity oils were necessary as preservatives and some have contended that the heavier gravity oils are necessary to waterproof the blocks and it seems to be true that the good oils of less than 1.08 gravity are free from tar while those above 1.10 must contain tar. The question immediately presents itself as to the propriety of excluding the oils between 1.08 and 1.10 which may be mixtures of the lighter and heavier oils and possess greater preservative qualities than the one and greater waterproofing qualities than the other.

All that precedes is simply indication of the chaotic state of our knowledge regarding the comparative values of the lighter and the heavier oils and mixtures of the two and of the necessity of further careful study. The block manufacturers represented at New Orleans seemed to be united in recommending the heavier oils, and their recommendations are worthy of the utmost consideration, but it is quite possible that investigation and experiment by men with their eyes not quite so close to the everyday operation of the plants may develop modifications of their ideas, especially in the light of facts presented in Mr. Ericson's report, made by such outsiders, and others of similar import.

Some of the facts stated by Mr. Buehler and other representatives of the manufacturers indicate that the troubles from bleeding and buckling, which are the principal troubles in wooden block pavements, can be remedied largely, if not altogether, by attention to other factors than the gravity of the oils. Mr. Buehler stated that expansion of the blocks after laying in the pavement could be prevented by keeping the block up to its maximum size until it is laid. He proposes to do this by taking for treatment blocks which are green or fully expanded with moisture, stating that these blocks, when the treatment is finished, will then be of their maximum size and can not further expand in the pavement. It is then a matter of the permanency of the oil in the blocks or the sealing of the blocks or the treatment of the pavement to keep the blocks up to their maximum size, or of the joints between the blocks to keep them always full so that contraction of the blocks, filling of joints with dirt, and subsequent expansion will not buckle the pavement. Both Mr. Buehler and Mr. Sibley recommended laying the blocks in a waterproofing bituminous layer to prevent absorption of water by the blocks from below, and the latter described a method of dipping two sides of the blocks in tar just before laying to further close the surfaces against absorption of water.

The report on wooden block paving specifications of the American Society of Municipal Improvements at Grand Rapids was held over for further consideration largely because of the desire expressed by one member of the committee that some of these details of treatment of blocks and construction of pavement should be worked out, the change in specification from light to heavy oils apparently not being sufficient to meet all the existing difficulties.

The question of monopoly may well be dropped out of consideration, first, because the main consideration is quality of pavement and not the business of supplying it, and second, because the question is rather one of the ability of the supply to meet the demand, and as creosote is made from coal tar the supply of creosote must always be less than that of coal tar. Mr. Ericson's report contains some interesting information upon this point.

If the state of knowledge regarding materials with which to treat blocks is chaotic, that regarding methods of treatment and methods of laying is almost equally so, and the specifications for wooden block pavements must still be open to improvement. The desire expressed in the modifications made at New Orleans to admit all good pavements and the information furnished by the manufacturers, much of which is stated above, indicate progress and it is to be hoped that the expert committee of the A. S. M. I. will make still further progress by the time of the next convention of that association in Dallas, next October.

Notwithstanding these complaints it is generally admitted that wooden block pavements have almost reached their highest point of perfection and the improvements asked for are the final touches needed to round out the rapid development of the past ten or fifteen years.

STANDARDIZING SPECIFICATIONS.

The procedure at the New Orleans convention of the Association for Standardizing Paving Specifications and the results obtained, when compared with those of the Grand Rapids convention of the American Society of Municipal Improvements demonstrate the superiority of the program followed by the latter society in several respects. This program was outlined in MUNICIPAL ENGINEERING, vol. xii, p. 370.

Both societies had committees at work during the year, but those of the former did not bring with them to the convention formulated reports. All the members of the committees did not appear at the convention and the vacancies were filled from those present, some of them not experts in the subjects covered by their committees and all unfamiliar with the year's work of the committee. Two of the committees had new chairmen and at least one had a majority of new members. The policy of closed committee-room doors was not enforced so that the discussions were more free than last year, but there was much loss of time in getting the new members of the committees into line on what had been done, and there was much hard work expended in educating the less expert members up to the standard of the best.

The reports formulated as the result of these committee-room discussions were necessarily somewhat hastily prepared and lacked the accuracy and finish which may be expected of reports prepared more carefully in advance so that there are definite statements to discuss and modify if necessary. Some of the committee chairmen confessed their inability to make reports satisfactory to themselves within the time set, and as a consequence the association felt itself but little, if any, better prepared to declare its work finished than after the New York convention. The double satisfaction of a report prepared by experts and presented after a full discussion before a judicial body, was lacking at this convention and increased this feeling of the need for further consideration.

A considerable proportion of the membership was on the committees, but there were some who had little to occupy their time from the adjournment of the first session Monday afternoon until the opening the second session of the convention on Thursday morning. This seems like a useless loss of time and demonstrates the economy of the program followed by the A. S. M. I. This program puts these committee-room discussions on the two days preceding the convention proper, and requires formulated reports as the basis of these discussions. This saves time in the committee room and the delegates to the convention who are not particularly interested in these discussions need not arrive until the convention proper opens. Much time is therefore saved the convention.

It is hardly to be doubted that the more carefully and expertly prepared specifications will be accepted as the most reliable and acceptable in case any differences should appear. Another reason for the specifications of the older society being more satisfactory is the fact that its membership includes not only city officials but also consulting engineers, chemists, and others who are specially expert in their respective lines at the same time that they are free from any commercial bias.

Full information about the New Orleans convention will be found in the report of its proceedings to be found elsewhere in this number. The principal changes in specifications adopted were the addition of alternative specifications for lighter oils for treating wood blocks; the addition of specifications for two-course bituminous concrete pavement; the abandonment of a water-bound macadam specification and the insertion of a bituminous macadam specification, penetration method, in place thereof. Rather important, though less extensive changes were also made in the brick and stone block specifications.

WHAT IS THE MATTER WITH BUSINESS?

So many articles on this subject have appeared of late that one more may not do any harm and possibly may do no good, although the answer to be given to the question is "nothing." The trouble is to be found in the idea of what is good business rather than in business itself. The American business man has become so imbued with the idea that his business is a failure unless it shows a large percentage of gain over previous periods that he cannot bring himself to believe that it is possible to do business on a uniform basis or even on a basis fluctuating according to the demand, and still retain his self-respect.

Business boomers have preached this idea of growth as a measure of success until they have secured its general acceptance as a principle, though actually it is true in particular only for a certain period in the history of an enterprise and is true in general only during a certain period in the development of a country.

Big business, as that term is generally understood, is only possible, on the one hand during the period of rapid development of a young country or a new industry, or on the other hand by the smothering of competition when development has passed its rapid stages and has settled down to the steady rate which is inevitable. The former may in a sense be legitimate but the latter never is. The business which is in neither class should not attempt to imitate its more (or possibly less) fortunate contemporaries and should be content with such reasonable returns as industry, honesty and business ability may bring and should not attempt to create demands which do not exist legitimately.

That is the matter with business at the present time. We have reached a period of more leisurely development and our business men are not willing or possibly not able to recognize the fact and so they try to attribute the less rapid pace, the reduction in the rate of increase of demand, to any other cause or causes which may attract their attention.

It is doubtless true that suppression of competition and excess of competition, combinations and lack of combinations, tariff and free trade, labor and capital conditions, surplus and deficiency of currency, and many other pairs of opposites affect individual business or groups of business, but these effects are largely artificial, as are the conditions which produce them, and changes in them will inject artificial energy or produce artificial depression within certain limits. But the laws of supply and demand are far more extensive in their application and their full effect must be expected in the outcome no matter how many attempts are made to induce changes in their action.

Satisfaction with nothing less than the whole that legitimately belongs to the business, and the omission of no effort which promises to bring it, are principles essential to success, but recognition of the limitations of the field and of the impossibility of artificial stimulation without its consequent and inevitable reaction are no less essential to success.

Business men must recognize the latter as well as the former and then they will not so often ask "What is the matter with business?" They will provide for the possibilities of the future and will foresee, at least in part, the results of the operations which are in progress and as a consequence business will be more steady and the wrecks will not to so numerous nor so disastrous.

SELECTION OF ADMINISTRATIVE OFFICERS OF MUNICIPALITIES.

The cities act of the province of Saskatchewan, Canada, provides that the city council may appoint one or more commissioners, to serve with the mayor, who is ex-officio a commissioner, as the administrative officers of the city. The powers and duties of the commissioners are fixed by ordinance, which may be altered by the council at any time. With a few minor restrictions the control of the commissioners seems to be entirely within the power of the council.

In accordance with this law the city of Moose Jaw advertised for applications from qualified engineers to fill the position of engineer commissioner, leaving the provisions of the ordinance governing the office for determination in connection with the consideration of the applications for it. It was generally understood that the two commissioners, viz., the mayor and the commissioner to be appointed by the council, would have the oversight of the city engineering, electrical and health departments and that the salary would not be less than $5,000 a year.

After a month or so of consideration the council on January 2 decided to appoint L. W. Rundlett, formerly city engineer of St. Paul, Minn., as engineer commissioner at a salary of $6,000 a year and also appointed W. F. Heal, who has been city clerk, as a third commissioner at a salary of $3,000 a year.

The city also advertised for applications for the position of city engineer, and the time for reception of applications expired early in December. The appointment has apparently been delayed for the consideration and advice of the new commission, as the filling of the position is not yet announced. The advancement of Mr. Heal to the position of commissioner leaves vacant the city clerkship and advertisements are now made for filling this position at a salary og $125 a month.

Moose Jaw is a city which had a population of only 6.249 in 1901, but is rapidly increasing in population, in wealth and in business, indicated by an increase in the rateable assessment of $4,000,000 in 1911 and an increase of 100 per cent. in value of buildings for which building permits were issued.

The city has water and sewer systems, is constructing a modern sewage disposal plant and completed in 1911 a new incinerator plant and many extensions of sidewalks, pavements, sewers, water pipes and electric light lines. Plans for over $1,000,000 worth of new public and semi-public buildings are under way for construction in 1912.

The plan followed by the city of securing for consideration the applications of competent men for vacancies, and of making appointments for merit and without reference to citizenship or even to national boundary lines is one which is very generally followed in England and is notable as being the first important occurrence of the sort on this continent which has been so open to all available talent.

It is to be hoped that a fashion has been set which will grow in Canada and that it may extend to the United States. There is no information at hand as to the method of determining the qualifications of the various candidates for commissioners, nor as to the competency of the city council for making the determination, but the result thus far is highly satisfactory and these questions of detail must be settled for each individual case.

The general principle followed in this case has been discussed so often in MUNICIPAL ENGINEERING that it is not desirable to continue it at this time. It is enough to call special attention to this application of it that the workings of the method followed may be under observation by those interested. Much can be learned by study of the local developments both as to the value of the general method and as to the advisability of changes in the details of its application.

THE QUESTION DEPARTMENT

Books on Surveying.

Will you please tell if you can furnish the following books and price: Bagott's "Surveying" and Gillespie's "Treaties on Leveling." W. A. B., Millgrove, Ind.

The first volume of Staley and Gillespie's "Surveying" ($3.50) contains the treatises on land surveying and on direct leveling. The second volume on "Higher Surveying" ($2.50) contains full chapters on trigonometric leveling and precise spirit leveling. The other book mentioned is not known to the writer. The Gillespie books can be supplied at the prices named.

Restriction and Removal of Dangerous Buildings Within Fire Limits.

I write you concerning an ordinance for the destruction, removal, or condemnation of certain buildings within the fire limits of this city.

There are a number of old buildings within the fire limits of this city and they have become a menace to the other buildings, and I desire to draft an ordinance which will enable the city to abate such buildings.

Kindly send me any information you have along this line and if you know of any city where they have such an ordinance, that has been sustained by the courts, kindly inform me and I will try and secure a copy of the ordinance.

CALVIN STEWART, City Attorney,
Kenosha, Wis.

The city council has instructed me to draw an ordinance for the tearing down and removing at the expense of the owner some buildings that are unsightly and that endanger other buildings because they are "fire traps." Will you furnish me a model that will stand the test in this state?

M. A. GRAY, City Attorney,
Corbin, Ky.

In MUNICIPAL ENGINEERING, vol. xxxvii, p. 184, will be found extracts from the building ordinances of Cincinnati, O., and Dubuque, Iowa, covering this question, and some information regarding procedure in other cities. In vol. xxxviii, p. 271, are extracts from the ordinances of Atlanta, Ga.

All these ordinances refer more particularly to buildings damaged by fire or, in some cases, otherwise, or to permits for repairing old buildings, and possibly could be stretched in one or two cases to cover buildings which are dangerous as fire risks, though not otherwise.

The problem of removing usable buildings because they are dangerous from the point of view of fire is one which has never been solved completely, so far as the writer knows. The above cited ordinances approach as near it as any with which he is acquainted. It is quite possible that in some states it would be necessary to condemn such buildings and pay the damage resulting from their removal.

Can any of our readers cite valid ordinances more directly covering the conditions which our correspondents describe?

Form of Ordinance Assessing Cost of Sewer.

This city has just constructed a system of sewerage and Section 3 of the Act of the Legislature, authorizing the city to issue bonds for this purpose reads as follows:

"Be it further enacted by the authority aforesaid, That said city shall have the right and power to charge the owners of property along the line or lines of said sewer system when laid abutting thereon the amount of one-fourth of the actual cost along said abutting property and on each side of said line or lines."

I have been asked by the council to draft an ordinance providing for the assessment of the abutting property owners, as provided in the above section.

The bond money was expended in the construction of the sewerage system with the exception of about two thousand dollars. Please furnish me with all the information you can relative to the drafting of this ordinance, and oblige.

C. B., City Attorney, ———, Ga.

The exact form of the ordinance must be worked out by one familiar with the laws of Georgia and the charter of the city. The following, abstracted from the ordinances of Atlanta, may indicate what is sufficient for cities in Georgia, although evidently, details must be modified to conform with the differences in the charters of the two cities:

Whereas the sanitary consulting engineer, heretofore engaged by said city and the city engineer of said city, both advised the mayor and general council, prior to the introduction and passage of act hereafter referred to, amending the charter of said city relating to the construction of sewers by said city, that a proper and necessary system of sewerage for said city would cost on an average from $4 to $4.50 per lineal foot of said sewerage, small lines of sewers costing less and large lines costing more than said average, and it so appearing; and, whereas, the small lines costing less than said average, are dependent upon and drain into the large lines or sewers costing more than said average; and whereas, sewerage benefits the real estate in front of which and through which it is laid or constructed, and also benefits the general public of said city; and whereas, an assessment of 70 cents per lineal foot on the real estate abutting on a sewer on each side of a street in which a sewer is laid or constructed; and an assessment of 70 cents per lineal foot on the real estate abutting on each side of a sewer laid or constructed through private property will realize an average of $1.40 per lineal foot of sewerage laid or constructed, less deductions for exemptions at street corners, which is less than one-half of the whole average cost; and whereas, the remaining cost of more than one-half thereof will be paid from the city treasury from appropriations for sewers; therefore, be it ordained:

All sewers laid or constructed by said city shall be laid or constructed under and in accordance with the act of the General Assembly of Georgia, amending the charter of said city, approved, November, 1889.

In all cases where a sewer shall be laid by or under the authority of said city in any street, the sum of 70 cents per lineal foot shall be assessed upon the property and estates respectively abutting on said sewer, on each side of said street, on which said sewer is laid or constructed, and in consideration of the payment of said assessment, the owners of said estates shall have the right to connect their drains from said abutting property for the discharge of sewerage into said sewer, and, in case any such sewer is laid down or constructed through or over any private property along the course of any natural drain or otherwise, a like sum of 70 cents shall be assessed upon said property abutting on each side of said sewer for every lineal foot, making in all $1.40 for every lineal foot to be assessed upon such property through which sewers are constructed, as aforesaid, and in consideration of the payment of said assessment, the owners of said estate respectively on each side of said sewer, through or over which such sewer shall be constructed shall have the right to connect their drains from said abutting property for the discharge of sewerage into said sewer.

(Section prescribing powers of mayor and council in constructing sewers and making assessments.)

The remaining cost of sewers not thus assessed shall be paid out of the sewer appropriations for the year; provided that the defendant shall have the right to file an affidavit denying the whole or any part of the amount for which the execution is issued, and stating what amount he admits to be due, which amount so admitted to be due, shall be paid or collected before the affidavit is received, and the affidavit received for the balance, and all such affidavits so received shall be returned to the superior court of Fulton county and there tried and the issue determined as in cases of illegality, subject to all pains and penalties provided in cases of illegality for delay.

(Section controlling connections with sewers.)

(Two sections providing for claims for damages for sewers through private property.)

In the case of real estate situated on street corners, and having frontage on two streets, the owner and real estate thus situated shall be assessed by this act provided for the frontage on the street in which the sewer is first laid, and where a sewer is laid on the other street 75 feet of frontage shall be exempt from assessment on the owner and real estate for the last named sewer

The amount of such assessment for sewers on each piece of real estate shall be a lien on said real estate from the date of the passage of the ordinance providing for the work and making the assessment.

The charter of the city provides authority to pass ordinances for the collection of assessments for the construction of sewers in installments running through a series of years to be fixed by such ordinances in all cases where the construction of the sewers is performed by contract.

The above ordinance, which follows the provisions of the city charter exactly, provides for assessments in proportion to frontage. The following provision of the charter of Savannah, Ga., also provides for frontage assessments for sewers with allowances for corner lots:

The rates which the breadth or face of any lot abutting on the line of any such drain bears to the length of such drain on said line shall be the ratio of computation of the amount to be assessed upon the owner of such lot as his pro rata of expense in the construction of such drain, it being understood that the total cost of construction of a primary drain shall be divided between the owners of the lots abutting on both sides of the street or lane, or portion thereof, through which said primary drain shall have been constructed; provided that when a primary drain lies abreast of one front of any lot, and a cross or trunk drain shall be constructed along another front of the same lot, no assessment shall be made upon said lot except for its pro rata apportionment of the cost of such primary drain; and provided further, that in the case of said larger cross drains or main trunk outlets, such assessments shall be distributed between the lot owners and the corporation as provided for in another section,, viz: the cost of a primary drain on the owners of the lots and the excess of cost of said larger drains over the cost of a primary drain upon the city.

These charters seem to indicate that the frontage method of assessment is popular in Georgia. In Indiana sewer assessments are made according to areas of lots and lands.

The question of methods of assessing cost of sewers is discussed to some extent in an article in MUNICIPAL ENGINEERING, vol. xxxviii, p. 191, in which are references to a large number of earlier articles on the subject, of which perhaps the most important are those in vol. xviii, pp. 252 and 247, and vol. xxi, p. 82.

Assuming that the Atlanta ordinance is sufficient in other ways, the principal point to discuss is the method of distributing the assessments. If the whole sewer system has been constructed, as seems to be indicated by the first paragraph of the question, any method which will make the assessment uniform will be satisfactory. If the lots are rectangular and of reasonably uniform depth, the assessment by frontage is practically equivalent to the assessment by area, provided the long sides of the corner lots are not counted in the frontage. This may be done even if the sewer is actually laid along the long side of some of the lots, as is doubtless the case, or there are sewers along two or more sides of a lot. If, however, the assessment is made according to area of lots, all these complications disappear and each lot receives its assessment in proportion to its area without any allowances of any sort.

The law, as quoted, provides that one-fourth the cost shall be assessed upon the abutting property, so that there is no provision for spreading an assessment on any lot which is benefitted by the outlet for its drainage, supplied by the sewer, unless the sewer is in front of the lot. There seems to be nothing in the quotation from the law to prevent the assessment by area of abutting lots, and probably nothing to prevent the assessment by frontage omitting the long sides of corner lots, unless it be the last words "on each side of said line or lines." It seems hardly probable that these words could be construed to limit the assessment to the actual lengths on both sides of the street which abut on the sewer, thus exempting such parts of lots as do not have a sewer in front of them and requiring assessment of the long sides of corner lots when the sewers are on the long sides of the lots, and double or triple assessments when the sewers are on two or three sides of a lot.

The details of the assessment are left to the proper bureau by the Atlanta ordinance and it is necessary only to provide the general method in the ordinance.

The articles in MUNICIPAL ENGINEERING, above referred to, are based upon difficulties in making assessments and are worthy of study, containing, as they do, discussions of the principles underlying the methods of assessment described. Some help in the formation of the ordinance may also be derived from them.

Charges for Municipal Engineering Services.

Will you kindly give me information in regard to proper engineering charges on a percentage basis for paving, sewerage and other municipal work? I have been acting as City Engineer of a small city for several years and have found it hard to ascertain just what the custom is in this matter. Some say 4 per cent; some 5 per cent, and others 6 per cent. There is also a difference of opinion as to whether this includes just the preparing of plans and specifications, or the entire work.

I also would like to know what the custom is, as to inspecting. Is it the duty of the engineer to furnish an inspector on the paving and sewerage work, or should the city provide this at its expense? Perhaps you could answer the same questions in regard to drainage work when done under organized districts.

W., ———, Ill.

This subject is discussed to some extent in MUNICIPAL ENGINEERING, vol. xxxix, p. 36, and to a greater extent in vol. xxxviii, p. 346, which article refers to still earlier discussions of the subject and to detailed schedules. The schedules of fees which have been proposed vary charges according to amount of money expended. For work costing from $50,000 to $100,000, one schedule works out a charge of 2.3 per cent for surveys, plans and specifications and 2.8 per cent for engineering superintendence and inspection of construction, or 5.1 per cent in all. For work costing less than $50,000 the total percentage varies from 6.1 per cent if the work costs over $20,000 to 10.2 if it costs less than $5,000. The superintendence and inspection increase most rapidly as the cost of work decreases, because of the delays in small work which take the time of the inspectors and engineer much more in proportion to the cost of the work than in large work where several inspectors may be necessary. It would seem to be most satisfactory for the city to employ its own inspectors for small jobs, provided men satisfactory to the engineer and subject to his direction can be obtained, in which case his fees without supervision of construction might range from, say, 2.5 to 5 per cent as the total cost of the work drops from $50,000 to less than $5,000. From 1 to 2 per cent should be added to this for supervision of construction in case the inspection is paid for by the city but is done under the direction of the engineer.

Our readers may have some suggestions to make on this subject; if so they will be published if sent in for that purpose.

Should Earth Work Be Paid for in Both Cut and Fill?

The specifications for the construction of concrete sidewalks and cross walks provide.

"GRADING. That portion of the streets, avenues and alleys to be covered by the walks heretofore described shall be brought to a sub-grade by excavating or filling, as the case may be, the cross-section to conform in every respect to the cross-section of the finished walk, and having its upper surface a distance below the grade heretofore given equal to the thickness of the finished walk. The sub-grade shall be tamped or flooded, if necessary, so as to bring the same to a compact and even surface. Fills exceeding 1 foot in thickness shall be made in layers of not exceeding 6 inches and thoroughly compacted by tamping or flooding. The top of all fills shall extend at least 18 inches beyond the edges of the walk, and the sides shall have a slope of not less than 1 vertical to 1 1-2 horizontal. All soft and spongy places shall be dug out and depressions filled with suitable material and thoroughly compacted by flooding."

"SURPLUS EARTH. All material and surplus earth shall remain the property of the city and shall be removed and conveyed by the contractor to such places as the Board of Local Improvements shall designate, a distance not to exceed 500 feet. Excavation shall be paid for by the cubic yard and shall be measured in excavation only. No materials for sub-grade shall be borrowed, except upon the permission of the Board of Local Improvements or their engineer."

Also under GENERAL CLAUSES:

"1. The contractor shall be required to carefully set aside whatever blocks, planking, cobble stones, crossing stones, macadam, brick or any other material that may be in the walk, and he shall deliver the same wherever directed by the engineer. The length of the free haul not to exceed 500 feet."

"19. The plans and specifications are intended to be explanatory of each other; but should any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the decision of the engineer shall be final and binding on the contractor; and all directions and explanations required, alluded to, or necessary to complete any of the provisions of these plans and specifications and give them due effect, shall be given by the said engineer."

"20. The contractor shall furnish all the necessary ways and means for the transfer of the material to its proper place."

"22. The contractor shall do such extra work as may be required by the Board for the proper construction or completion of the whole work herein contemplated; he shall make no claims for extra work unless it shall have been done in obedience to a written order from the said Board or their duly authorized agent; all claims for extra work done in any month shall be filed in writing with the engineer before the 10th of the following month; failure to file such claims within time required shall forfeit all claims for such extra work. The price to be paid for all extra work shall be its actual reasonable cost to the contractor, as determined by the engineer, plus 10 per cent."

"24. In the interpretation of these specifications and upon all questions concerning the execution of the work, the decision of the Board of Local Improvements shall be final."

The proposal has an item of "10,900 cu. yds for excavating, grading, preparing subgrade, and doing all work described under term "grading" in specifications, per cu. yd., 25 cents," a total of $2,834.

The contract contains the same description of work to be done and price per cubic yard but not the quantity estimated.

There was something over 14,000 cubic yards of excavation and 3,000 cubic yards of fill, and some of the fill was hauled half a mile. The excavation was dug out and thrown outside and what fills were made were taken and hauled in wagons from the dirt that had been thrown out and from borrow pits.

It is claimed by the contractor that he should be paid for excavating per cubic yard and for making fills, and by the city that pay should be for excavating only.

L., ———, Ill.

A careful reading of the paragraph on "Surplus Earth" above indicates that the measurement of earth-work shall be in excavation only. This is customary and for earth excavated from one part of the work and placed in another part pay is due but once, on the measurement of the excavation. Where the Board permits taking materials from borrow pits the material so moved should also be measured at the excavation and not in the embankment.

It is evident from two of the quoted clauses of the specifications that free haul of materials does not exceed 500 feet. If, therefore, either earth excavated from one part of the work and deposited in another, or earth excavated from the work and hauled outside to a dump, or earth excavated from a borrow-pit and hauled to a place on the work, is hauled more than 500 feet, the over-haul should be paid for.

The profile from which the 10,900 cubic yards of excavating and grading given in the proposal was computed should show whether this was all excavation or included both excavation and fill on the work, and in that case would show whether the statement made above agrees with the original intention of the engineer who made the plans and prepared the specifications and the schedule of quantities.

The provision that no materials for subgrade shall be borrowed except by permission of the Board is at least a partial confirmation of the conclusion that it was the intention of the engineer to use earth excavated from the job as far as possible. The most obvious conclusion to be drawn from this is that the borrowed earth paid for in excavation would cost more than the earth from the job, which would be true if the earth from the pob was free, except for over-haul, unless the over-haul were quite long, and so the amount of such borrowed material was to be kept under the engineer's control.

The omission of over-haul from the schedule of quantities and the failure to call for a price for over-haul makes it necessary to fall back on the provision for payment for extra work at actual cost to the contractor plus 10 per cent. Under the contract this must be determined by the engineer.

Forms of Ordinance for Sidewalk Construction.

I would like you to send me a copy of an approved city paving ordinance, preferably one of some city in Alabama, if possible. We wish to put down sidewalks in certain parts of town, and will probably be opposed in our efforts to put them down, or in our efforts to collect for same as assessments against the property. I wish to be careful in the drawing of the ordinances providing for these matters and would like such information upon such proceedings as you can give me.

J. H. J., City Attorney, ———, Ala.

The writer does not have at hand an ordinance passed by an Alabama city concerning the construction of sidewalks. The Statutes of Alabama are quite specific on this subject as shown by the following sections reproduced from the political code of the state:

Sec. 1266. Cities and towns * * * shall require the sidewalks to be kept in repair and if not repaired by the owners of property abutting thereon, upon reasonable notice, to be determined by the council in the manner to be provided by ordinance, they may be repaired by the municipality at the owner's expense, and the amount expended shall be a lien upon the property, which, with interest, may be collected as taxes or assessments.

Sec. 1358. All cities and towns in this state may design or cause to be designed, contract for, and to execute or cause to be executed the construction or improvement, or the reconstruction or reimprovement, of any street, avenue, alley, highway, or other public place, of any sidewalks thereon, by filling, grading, leveling, graveling, slagging, macadamizing, curbing, guttering, paving, or otherwise improving the same, in such manner and with such material as the council of such city or town may prescribe; * * * and to cause the cost and expense of all or any part of the aforesaid works and improvements to be assessed against the property abutting on said street, avenue, alley, highway, or other public place so improved or drained by said sewer or sewers to the extent of the increased value of such property by reason of the special benefits derived from such improvements.

Sec. 1361. When the council of any city or town shall determine to construct or improve any street, avenue, alley, sidewalk, highway, or other public place, or to make any other improvement or undertake any work authorized, the cost of which, or any part thereof, it is proposed to assess against the property abutting on or drained by said improvement, it shall adopt an ordinance or resolution to that effect, describing the nature and extent of the work, the general character of the materials to be used, and the location and terminal points thereof, and the streets, avenues, alleys, or other highways, or parts thereof, and shall direct that full details, drainings, plans, specifications, and surveys of said work and estimates be prepared by the city engineer, or such other person as may be designated in such ordinance or resolution, or the said council may adopt plans for such work already prepared.

Sec. 1362 provides for filing plans for examination by property owners and for hearing objections or remonstrances as to the improvement or manner of making or materials to be used, not less than two weeks after first publication of ordinance.

Sec. 1363 provides for publication of ordinance.

Sec. 1364 provides the program for the meeting to hear objections and stoppage of improvement by a remonstrance from owners of a majority of the frontage, unless overridden by two-thirds vote of council.

Sec. 1365 provides that council may pay any portion of the cost from city funds, and that the cost includes all the preliminaries, supervision, notices, etc.

Sec. 1366. Before the passage of the final resolution or ordinance to make any improvement on any street, avenue, alley, or sidewalk, the cost of which, or any part thereof, is to be assessed to the abutting property, if the grade of such street, avenue, alley, or sidewalk has not been established, or if said improvement necessitates a change of grade, the council shall by ordinance fix and establish the grade of such street, avenue, alley or sidewalk about to be improved, and also the grade of the curb on each side thereof.

Secs. 1367-1372 provide for letting contract, supervising work, accepting same, power to levy taxes and methods of levying taxes for sewers, drainage and street intersections.

Sec. 1373. In case of sidewalk improvements, including curbing, the costs, or any part thereof, of the improvement of the street or avenue corner, may be assessed against the lots abutting on or nearest said improvement, and the entire cost or any part thereof of the improvement at the intersection of any alley with a street or avenue, or other highway, may be assessed in fair proportion against the respective lots or parcels of land abutting or cornering on the alley at such intersection; provided, however, that in no case shall the assessment against any lot or parcel of land be greater than the increased value of such lots or parcels of land by reason of the special benefits to be derived from such improvement.

Subsequent sections provide methods of preparing assessment rules and books, notice of same, hearings of objections, fixing of final amounts of assessments by order or resolution of council, enforcement of the assessment liens thus created, appeals, executions, etc.

In Municipal Engineering, vol. xxxvi, p. 30, will be found two forms of ordinance in use in other states which cover the case very completely, and are evidently prepared for use under statutes containing provisions almost identical with those quoted above. An ordinance can doubtless be drawn from them which will fit Alabama conditions exactly. In vol. xxxvii, p. 238, is another brief article on the same subject.

Articles on Mineral Rubber Pavement.

Will you please advise us of the date of any articles which have appeared in your publication describing the mineral rubber pavement as laid by the South Park Commission, Chicago. And if you have back files of your magazine, could you supply us with copies in which these articles appear? This courtesy will be much appreciated.

J. M. W., Chicago, Ill.

The mineral rubber pavement laid under the Chicago South Park Commission was described by Linn White, engineer of the commission, in a paper before the American Society of Municipal Improvements at its meeting in 1908. It will be found in the volume of proceedings of the society for that year. An abstract of the paper was published in Municipal Engineering, vol. xxxv, p. 372.

Cities Owning Their Asphalt Paving Plants.

I am desirous of obtaining a list of those cities in the United States which have (own or operate) municipal asphalt plants for paving, and the names of the mayors of such towns.

D. B. G., New York City.

Following are the names of cities owning their asphalt repair plants, some of which are used also for paving new streets and resurfacing old pavements:

San Francisco, Cal.—The Hetherington & Berner plant. P. H. McCarthy, mayor; Marsden Manson, city engineer.

San Jose, Cal.—Small inprovised repair plant. Charles H. Danson, mayor; Charles H. Pieper, city engineer.

Denver, Col.—Hetherington & Berner plant. Robert W. Speer, mayor; George A. Collins, city engineer. S. R. Murray, superintendent in charge of the plant.

St. Augustine, Fla.—Hooke portable repair plant. Eugene Masters, mayor.

Decatur, Ill.—Hooke portable repair plant. C. M. Borchers, mayor.

Joliet, Ill.—Small repair plant. John R. Crowin, mayor; H. A. Stevens, city engineer.

Bluffton, Ind.—Hetherington & Berner plant. A. W. Hamilton, mayor; B. A. Batson, city engineer.

Indianapolis, Ind.—Hetherington & Berner plant. S. L. Shank, mayor; H. W. Klausmann, city engineer.

Marion, Ind.—Hooke portable repair plant. John C. Willson, mayor; T. E. Petrie, city engineer and street superintendent.

New Orleans, La.—Warren plant. Martin Behrman, mayor; W. J. Hardee, city engineer.

Detroit, Mich.—Hetherington & Berner plant with additions from F. D. Cummer & Son. P. H. Breitmeyer, mayor; Jacob J. Haarer, commissioner of public works; R. H. McCormick, city engineer. C. A. Proctor in charge of the plant.

Kansas City, Mo.—Warren plant. Thomas P. Crittenden, mayor; L. R. Ash, city engineer.

St. Joseph, Mo.—Repair plant. A. P. Clayton, mayor; D. L. Lawler, city engineer. Henry L. Meyer, superintendent of plant.

Omaha, Neb.—A specially-designed plant

Frank E. Moores. mayor; George Y. Craig, city engineer.

Newark, N. J.—Hooke and local portable repair plants. Jacob Haussling, mayor; M. R. Sherrerd, chief engineer; William A. Howell, engineer of streets and highways.

Brooklyn, N. Y.—Warren plant. John C. Sheridan, chief engineer bureau of highways; W. H. Broadhurst, chemist. Charles K. Leonard, superintendent of plant.

Syracuse, N. Y.—Hooke portable repair plant. Edward Schoeneck, mayor; H. C. Allen, city engineer.

Watertown, N. Y.—Hooke portable repair plant. Francis V. Hugo, mayor; E. E. Sayles, city engineer.

Cincinnati, O.—Specially-designed plant. W. T. Hunt, mayor; H. F. Waige, city engineer.

Columbus, O.—Hetherington & Berner plant. ——— Marshall, mayor; Henry Maetzel, city engineer. W. W. Horn, superintendent of plant.

Dayton, O.—Hetherington & Berner plant. E. E. Burkhardt, mayor; F. J. Cellarius, city engineer; M. K. Huffman, superintendent of streets.

Toledo, O.—Repair plant. Brand Whitlock, mayor; G. W. Tonson, director of public service.

Sandusky, O.—Hooke portable repair J. J. Moller, mayor; C. M. King, city engineer.

Pittsburgh, Pa.—Specially-designed plant. William A. Magee, mayor; C. A. Findlay, city engineer.

Erie, Pa.—Plant designed by city engineer, B. E. Briggs.

Newport, R. I.—Hooke portable repair plant. P. J. Boyle, mayor; W. H. Lawton, city engineer.

Nashville, Tenn.—Warren bitulithic plant. A. S. Williams, mayor; W. W. Southgate, city engineer.

Chattanooga, Tenn.—Hooke portable repair plant. Robert Hooke, city engineer.

Houston, Tex.—H. B. Rice, mayor; T. C. Tarver, city engineer.

Fort Worth, Tex.—Downard-Lester rock asphalt paving plant. F. J. Powell, mayor; J. D. Trammell, city engineer; Sam Davidson, commissioner of streets.

Seattle, Wash.—John F. Miller, mayor.

Spokane, Wash.—C. Herbert, mayor; Morton Macartney, city engineer.

Milwaukee, Wis.—Guelich portable repair plant and heater and mixer for old materials. Charles A. Mullen, superintendent of streets; Harry E. Briggs, commissioner of public works.

Toronto, Ont.—Warren plant. Charles H. Rust, city engineer.

Kingston, Ont.—Small portable outfit.

Winnipeg, Man.—Specially-designed plant. H. N. Ruttan, city engineer. Warren Rodney, superintendent of plant.

Montreal, Que.—Warren plant.

Information About Water Works Plants.

I desire to obtain considerable information concerning water works plants, particularly those under municipal control in cities of population of from 6,000 to 20,000. Our city has a population of 10,000. I would appreciate very much if you will send me a list of 15 or 20 cities of population mentioned, cities for the most part western or middle western which have municipally owned plants. Also any general information on this subject which you may have at hand or statements as to where such data may be obtained will be gratefully received.

City Engineer, ———, Mont.

The following articles in recent numbers of MUNICIPAL ENGINEERING will give some information concerning water works in the smaller cities and names of cities owning their own plants.

In vol. xli: An article giving a list of cities in Indiana, Ohio and Kentucky between 3,000 and 10,000 population, whether public or private ownership, meter and flat rates, on p. 131; one giving references to a number of earlier articles on water rates and water works management on p. 291.

In vol. xl: "Charges for sprinklers and standpipes for fire protection," giving the practice in a large number of cities, on p. 120; new work of the years 1910 and 1911 is outlined on pp. 265 to 276; there is a good article on rate making on p. 319 and one on water works management on p. 493; the method of determining the water rates for Madison, Wis., is given in some detail on p. 502.

In vol. xxxix: Forms of water bills and schedules of rates in various cities will be found on p. 120; meter rates in gravity systems in all parts of the country classified as private and municipal plants are given on p. 208; a list of combined electric light and water plants is given on p. 387.

In vol. xxxviii: Forms of water bills and schedules of rates are given on pp. 184, 347 and 423; there is a list of cities having both municipal and private plants on p. 185.

In vol. xxxvii: An article on "Depreciation and Water Rates" on p. 183, gives also references to many previous articles on allied subjects. Valuable data regarding water supplies for cities of 25,000 to 50,000 population will be found on pp. 258, 330, 401.

The list could be indefinitely extended. There are several articles in each of these and earlier volumes giving descriptions of works or of special features in existing works.

The following cities of about the populations named and west of the Mississippi river own their water works; Winona, Minn., San Diego, Cal., Treat Falls, Mont., Cheyenne, Wyo., Mankato, Minn., Sherman, Tex., Oklahoma, Okla., Guthrie, Okla., Fargo, N. D., Beaumont, Tex., Paris, Tex., Astoria, Ore., Emporia, Kan., Laramie, Wyo., Tyler, Tex., St. Charles, Mo., Vallejo, Cal., Faribault, Minn., Marshall, Tex., Grank Forks, N. D., Grand Island, Neb., Tucson, Ariz., Red Wing, Minn., Fremont, Neb., Hastings, Neb., Whatcom, Wash., New Iberia, La., Santa Rosa, Cal., Baker City, Ore., Santa Barbara, Cal., Terrell, Tex., Newton, Kan., Provo, Utah. San Bernardino, Cal., Boulder, Colo., Arkansas City, Kan., Bonham, Tex., Kirksville, Mo., Iola, Kan., Santa Cruz, Cal., Alexandria, La., Owatonna, Minn., Brookfield, Mo., Austin, Minn., Logan, Utah, New Ulm, Minn., Hillsboro, Tex.,, Trinidad, Colo., Victor, Colo., Coffeyville, Kan., Santa Ana, Cal., Fulton, Mo., Grass Valley, ,Cal.,, Corpus Christi, Tex,. Junction City, Kan., Ballard, Wash,. Albert Lea, Minn., Pendleton, Ore., McKinney, Tex., Popular Bluff, Mo., St. Peter, Minn., Wellington, Kan.,, Waxahachie, Tex., Crowley, La., Chanute, Kan.,, Osawatomie, Kan., Yankton, S. D., Donaldsville, La., Aberdeen, S. D., Mitchell, S. D., Victoria, Tex., Brownwood, Tex., Nerfolk, Neb., Navasota, Tex., Orange, Tex., Canon City, Colo., Aberdeen, Wash., Moorhead, Minn., Florence, Colo., Salida, Colo., Ely, Minn., Belton, Tex., Santa Clara, Cal., Sulphur Springs, Tex., Oak Cliff, Tex., Eureka Springs, Ark., Prescott, Ariz., The Dalles, Ore., Columbus, Neb., Grand Junction, Colo., Deadwood, S D., Oregon City, Ore., Richmond, Mo., Cherryvale, Kan., Shawnee, Okla., Olathe, Kan., Enid, Okla., Manhattan, Kan., Cuero, Tex., Bozeman, Mont., Abilene, Tex., Willmar, Minn., Concordia, Kan., Paragould, Ark., Durango, Colo., Two Harbors, Minn., Rosedale, Kan., Thibodaux, La., Nevada City, Cal.

The list of private water companies is somewhat longer than the above.

Much special information regarding the water works in medium and large sized cities is on file in this office and can be supplied in response to specific questions as to what is wanted. Direct reference to articles regarding special water works questions and descriptions of works can often be made upon specific request.

The volumes of MUNICIPAL ENGINEERING have much information upon all water works problems. Other prolific sources of infarmation are the annual volumes of proceedings of the American Water Works Association, John M. Diven, secretary, Troy, N. Y., and the more frequent issues of the journal of the New England Water Works Association, Boston, Mass.

Municipal Ownership of Water Power.

I have a proposition put up to me which involves the combining of a number of water powers owned by private owners all of which are lower down on the stream than a fairly good power owned by the village. I have been asked what to do about the matter. The idea seems to be to bring about municipal ownership of one large power. Have you any suggestions?

L. R., ———, N. Y.

It would seem necessary first to determine the powers of the village regarding ownership of water powers and condemnation of others desired under the plan proposed, so that there may be no insurmountable obstacle in case some one or more of the private owners should not be willing to sell without legal proceedings for condemnation. This is a question for an attorney familiar with the New York constitution and statutes and may be complicated by the question as to whether the proposedF combination is for public purposes or for the convenience of private power users.

Second, a competent engineer should make a thorough study of the proposition as regards methods of making the combination, making preliminary plans and estimates of cost of construction and operation, so that the results can be compared with the present conditions and with the utmost improvements possible under the present conditions. This study should be based on ample surveys and observations of rainfall, runoff, available running water and storage, control of floods, etc., etc. These surveys, plans and estimates will cost some money if the good engineers required for an adequato report are employed, but they will save their fees many times over if they prevent entrance upon an impracticable scheme, or by setting the village on the right way to construct the most economical and efficient system to secure the best results possible.

Further steps, after these two fundamental steps have been taken, will show themselves at the proper time.

Slag for Concrete.

Please advise me if you have information on the use of iron furnace slag for aggregate in concrete. It is abundant and cheap, while we pay in carloads about $1.50 per cu. yd. for gravel. It seems that slag might be used, but I have not known of any use of it here. I have tried in a small way to set granulated slag in cement and find only very partial success. I find it hardens quite well on the surface but not throughout. Probably yourselves or the cement chemists can tell us how this may be done or the reasons why it cannot. But aside from this, if the lump slag can be used for coarse material successfully, that would be a help.

C. E. V., East Palestine, O.

There seems to be no reason why slag, broken to proper sizes, should not be used for concrete. It is hardly probable that the slag named by our correspondent would be different enough from other slags to produce an injurious effect upon the cement. Slag cements are made by grinding lime and slag together and are intermediate in qualities between natural and Portland cements. Finely-ground slag has been used as an adulterant for Portland cements, but its use is prohibited at the present time.

In the "Handbook for Cement Users" ($3) it is stated on authority of Joseph A. Shinn that mortar made of Portland cement and slag sand has from 10 to 36 per cent. greater tensile strength than mortar of the same proportions using river sand. Most of the text-books on concrete name slag, crushed to proper sizes, as an acceptable material for concrete. English experiments, quoted in Potter's "Concrete" ($3), show that slag concrete compares favorably with concrete of other standard materials in compressive strength. Our correspondent's experiments indicate that some study should be given to the special slag available, that its qualities and the best method of using it may be determined before the specifications governing its use are adopted. There is nothing in them which would demonstrate that it is impossible to use the slag, especially for mass concrete, pavement foundations, and the like.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. Never mind style of composition, the fact is what is wanted.

Characteristics of Bituminous Highway Materials.

In the article by Clifford Richardson on the above subject, which appeared on page 41 of the January number of MUNICIPAL ENGINEERING is a table the heading for which was inadvertently omitted. The table with its head should read as follows:

	Density of Test Piece	Cementing strength lbs. per sq. in. 38°F.	Cementing strength lbs. per sq. in. 77° F.
Coal tar pitch 15 percent	2.16	3,884	1,254
Coal tar pitch 10 percent	2.07	3,845	2,655
Land Pitch 10 percent. bit.	2.13	1,813	761
Bermudez cement 10 p.c. bit.	2.10	1,955	635
Lake pitch 10 percent. bit.	2.14	1.375	54

Treatment of Over-Exposed Blue Prints.

To the Editor of MUNICIPAL ENGINEERING:

Sir—For several months I have noticed so many proposed remedies for over-exposed blue prints, some of which cost as much as a cent a yard beside much trouble in brushing, etc., that I would advise your subscriber that if he will put ten cents' worth of potassium bichromate in a quart bottle of water, by using the liquid over and over again he can bring back his over-baked prints for several months. Our expense for this item for four years has been $1.80.

C. A. BINGHAM, City Engineer,
Carlisle, Pa.

Influence of Cold Wave on Setting of Concrete.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Although I have heretofore heard of the failure of the Prest-O-Lite building I have today read the article by D. M. Avey in the January issue of MUNICIPAL ENGINEERING.

This fall I had several concrete jobs under supervision and there was a time or particular period when, for some reason or other, the concrete did not set or harden. A particular case in mind is a concrete building, and during the last two weeks in November, 1911, the contractor was placing the concrete roof slabs in position. On November 25 we had a sudden change in temperature, a very heavy drop from 60 or 70 degrees above zero down to 18 degrees. There was a large piece of this roofing put in place on Saturday, November 25, but was covered late Saturday evening, and upon examination two or three days afterward it apparently had not frozen.

My advice to the contractor, however, was to leave the forms in position as long as possible. At the end of three weeks, however, he needed the form lumber and removed the form from under this slab. It immediately settled or sprung downward about four inches; it had a ten-foot span. Needless to say it cracked very badly, but did not fall. On examination I found that the concrete had still not set sufficiently to justify the removal of the forms.

Another case in mind was the foundation wall which was also a retaining wall placed on the same Saturday. The wall was not especially covered, but had the forms on both sides of it and was left about two weeks before removing the forms. I found that this work also had not sufficiently set to warrant the removal of the forms, but the wall remained in position. It is not a good wall today, as the concrete is not as hard as it should be for the time it has been built.

Another case of foundation, built on the same day, after setting three weeks was considered unsafe on which to build a brick wall and was removed and replaced with fresh concrete upon which a wall was built after seven days.

I have had experience in concrete work for thirty years and I have found in doing work in the fall of the year that occasionally there is a temperature proposition which apparently cannot be overcome on ordinary work on account of the inability to properly cover the work.

My conclusion is that in cement work that has not reached a certain period in setting and is reduced in temperature to almost freezing point there is considerable injury done to the cement. If not injury, this condition retards the setting qualities in cement so that it will not set for weeks or months afterward.

On the other hand, I have had the same

class of work frozen solid which remained so for perhaps a month or more, in which time an examination showed that the concrete was in good condition.

In Mr. Avey's article he speaks of the upper work on the Prest-O-Lite building being soft, not having set sufficiently. I have no doubt but that the contractor experienced the same conditions that we did on the building above mentioned and that the concrete work should either have been removed or else the forms should have remained in place for several months.

In all the work of which I speak the usual proportions were used and the same proportions and brand of cement as used in previous work and work since, which has turned out to be first class. I think a contractor or builder cannot be too careful in pulling the forms on any class of cement or concrete work when the temperature is as changeable and reaches as low a degree as it did the night of November 25. Even though the concrete has not frozen it may have been injured or retarded by the temperature. J. J. WEAVER, C. E.,
Ludlow, Ky.

Wooden Paving Block Machine In Paris, France.

A rapid and economical paving block machine is in use in the municipality owned plant of Paris, France. This machine, which was invented by the director of the plant handles the material from the plank furnished to the finished block in a very efficient manner.

The planks are hand fed onto a conveyor which in turn delivers them to the machine. Two guides keep the planks in position, and assure their alignment when delivered on a horizontal cutting table. The planks are pushed along this cutting table by combs attached to endless chains. In front of each tooth of the combs is a spring which presses the planks against the horizontal table both before and after sawing. Brushes are provided at either side of the combs to sweep the waste material into slots provided for that purpose.

The first process of sawing is accomplished by two sets of saws each containing five saws. Each cuts a waste end of trimming and four blocks from each plank. These two sets of saws operate at the ends of the plank, and after the material is carried forward a third set of seven saws divide the remaining portion into eight blocks. Thus 16 blocks are cut from each plank and are carried along on the horizontal table to a stationary table which terminates in an inclined plane to another conveyor which carries them to workmen engaged in loading cylinder cars.

The machine is operated by a 110 h. p. motor; and is controlled, including the loading operation, by 20 men. The machine is 100 feet long, and as was noted has 17 circular saws of 25-in. diameter, which revolve at the rate of 2,000 r. p. m. The output is 24,000 blocks per hour.

The procedure in this country is very different from that noted above. While the output of the individual machines is not nearly so large, the method of handling is much more economical and efficient; for from the time the blocks enter the sawing machines until they are delivered to the paving contractors, they are not handled by hand in any process. The method of treatment after sawing is practically the same in both instances.

Financing Road Repairs in Japan.

A report from Consul General Thomas Sammons, at Yokohama, Japan, gives brief mention of the method of providing for road repairs in that country.

The last Cabinet put aside $85,000,000 as a fund for flood repair, but of all the bureaus in the newly organized Home Department the most important seems to be attached to that of public works. This bureau is planning two distinct kinds of work—harbor repair and road repair. One method proposed for carrying out these plans is that of granting subsidies to this or that prefecture or city and delegate the work to the local officials, while another plan is to require the local authorities to supply one-half or one-third of the total amount required, and the Government, supplying the remainder, is to place the work in the hands of competent engineers under its direct supervision.

It has heretofore been the policy to distribute a sum of $100,000 to $150,000 very promiscuously among the various prefectures, to be used in a general way for repairs to the roads. The plans of the new bureau, however, are more definite, and contemplate the separation of prefecture and Government roads, making separate appropriations for each.

Record of Water Fixtures and Meter Readings.

The accompanying diagram shows the form of record used in the water department of Jamestown, N. Y., for showing name and location of water consumer, kind of meter and fixtures used, meter readings and detail of charges. It is presented for criticism by our readers. As it stands it provides for nearly six years of an account. The sheet from which the reproduction was made has four times the area of the cut. There are one or two suggestions which will probably occur to many, such as the separation of the more permanent left half of the sheet and placing it on a card, with the consequent reduction in size of the book required for the continuing record of service rendered and payment therefor.

Consumer	Location			Fixtures	When Read	Reading	Cubic Feet	DR Bal.	CR Bal.	Charge	Date Paid	Amount Paid	Rebate or Discount	1234. Date On	Off
				Size Tap	Oct. 19	00	00								
				Size Service	Jan.	00	00								
				Len. Main to Curb	Apr.	00	00								
				Cocks	July	00	00								
				Stops	Oct.	00	00								
	Meters			Street Washers	Jan. 19	00	00								
	Name	No.	Size.	Rooms	Apr.	00	00								
				Baths	July	00	00								
				Closets	Oct.	00	00								
				Bowls	Jan. 19	00	00								
				Set Tubs	Apr.	00	00								
				Urinals	July	00	00								
				Horses	Oct.	00	00								
				Cows	Jan. 19	00	00								
				Autos	Apr.	00	00								
				No. Persons	July	00	00								
					Oct.	00	00								
					Jan. 19	00	00								
					Apr.	00	00								
					July	00	00								
					Oct.	00	00								
					Jan. 19	00	00								
					Apr.	00	00								

RECORD OF WATER FIXTURES AND METER READINGS.

MUNICIPAL MATTERS IN COURT

Higher Courts.—Obstruction of Natural Drain.

Decisions of the Higher Courts of Interest to Municipalities.

A Petition by a Land Owner Outside of the City Limits Does Not Authorize an Assessment on His Land—Where a trustee, holding title to land situated outside the boundaries of a municipality, signed a petition for the construction of a sea gate as a municipal improvement, the legal owner was not estopped to question the validity of a municipal assessment for benefits, on the ground of the location of the property, since the petition could not extend the assessing power of the municipality to lands beyond its boundaries. —Edmonds Land Co. vs. City of Edmonds (Wash.) 119 P. R. 192.

Reasonable Minimum Gas Charges Sustained—Unpaid Bills—An ordinance, enacted by a city furnishing natural gas to its inhabitants, is not presumptively unreasonable, because it requires a minimum charge of 50 cents a month, regardless of the amount of gas used, a rental of 20 cents a month for meters furnished for the use of tenants, and also provides that owners of tenant property, and not their tenants, will be dealt with, unless separate service pipes are supplied for each tenant using gas.—Cunningham, et al. vs. City of Iola et al., (Kan.) 119 P. R. 317.

Notice of Defective Sewer Plan Not Ncessary Before Damage Suit—Where plaintiff sued defendant city for flooding his mine, by reason of a defective plan adopted for the construction of a sewer, the cause of the injury was not a "defect," within a statute providing that notice of claim for injuries must be given before the city shall be liable for damages for any defect in a bridge, street, public work, etc.—Kelley vs. City of Butte (Mont.), 119 P. R. 171.

Second Condemnation Proceeding Not Invalidated by a Previous Action—A former proceeding by a city to acquire, by condemnation, land for opening a street, is not a bar to a second proceeding, more then five years later, and not covering the same property, there being nothing in the second proceeding to impeach the good faith of the city.—City of Chicago v. Walker et al. (Ill.), 96 N. E. R. 536.

Refusal to Correct Damaging Conditions in a Sewer After Notification Constitutes Willful Injury.—A complaint in an action against a city for damages by converting a sanitary sewer into a storm and surface water sewer, which alleges that plaintiff informed the city that he was being damaged by the sewerage backing up into his cellar, that the city refused to remedy the condition, but continued to connect other drains with the sewer thereby increasing the damage, and that the city knowingly and willfully and negligently turned large volumes of surface water into the sewer, states a cause of action for willful and intentional injury.—Union City v. Murphy (Ind.), 96 N. E. R. 589.

A Lease of Machinery for a Definite Number of Days is Invalid.—A contract between a town and a roller company, whereby the town was to have possession of a steam roller and to pay a rental of $10 per day for 64 days each year for five years, at the end of which time it might buy the roller for $1, even if a lease and not a sale,, is invalid under Highway Law ,Consol. Laws 1909, c. 25) Section 50, providing that the town superintendent may rent a roller at not exceeding $10 per day for each day it is actually used upon the highway; the town binding itself to pay for 64 days whether or not the roller was used that length of time.—Gardner et al. v. Town of Cameron et al. (N. Y.), 131 N. Y. S. 894.

Per Diem Fee and Expenses of an Inspection Trip Do not Constitute a Fraud in the Sale of Material to a Town.—A contract between a town and a steam roller company for the lease of such a roller is not fraudulent because the representative of the roller company, in negotiating the contract, paid the per diem fee of the members of the town board to attend a special meeting to authorize the contract and the expenses of the superintendent of highways and the town clerk on a trip to examine the roller.—Gardner et al. v. Town of Comeron et al. (N. Y.), 131 N. Y. S. 894.

Town May Not Evade Law Forbidding Purchase of Machinery by Leasing Under a Definite Time Contract.—A contract between a steam roller company and a town, whereby the town was to have possession of a steam roller and to pay a rental of $10 per day for 64 days each each year for five years, at the end of which time it was to have the right to buy the roller for $1, though called a "lease," was a "sale," considering that all the negotiations between the roller company and the town were for a sale and the life of the roller was many times the period of five years, and hence was invalid under a highway law, providing that a town may, out of its own funds, purchase a roller, for which purpose the town board cannot pay more than $500 a year without submitting the matter to a vote, and that the town superintendent, where a town does not own a steam roller, may rent one at a rental not exceeding $10 per day for each day such roller is actually used.—Gardner et al. v. Town of Cameron et al. (N. Y.), 131 N. Y. S. 894.

Franchise Providing for Purchase at the End of Ten Years, Allows of Purchase at Any Time After That Period.—Where a borough ordinance, giving a franchise to enter on the streets to supply water to the borough and its inhabitants, provides that the borough shall have the option, before all other persons or corporations, to purchase the plant of the grantee of the franchise at the end of 10 years, as provided by the existing laws of the state, and, if no purchase is made at the end of 10 years, the ordinance shall remain in full force until the waterworks are purchased by the borough, the borough has the right to acquire the water plant on the terms provided at any time after 10 years, instead of at any time after 20 years as fixed in the statutes.—New Cumberland Borough v. Riverton Consolidated Water Ca. et al. (Pa.), 81 A. R. 548.

City Not Obliged to Construct Sewers, But Must Maintain Them After Construction.—While a municipality is not bound to construct sewers and it is not liable for damages occasioned by the lack of them, yet where it either constructs sewers or adopts a private one it is liable for damages occasioned by its failure to keep them in proper repair.—City of Maysville v. Brooks (Ky.), 140 S. W. R. 665.

City Liable for Bad Condition of Dumping Ground.—A city authorized to maintain a dumping ground is liable for damages to adjoining owners, caused by its maintenance as a nuisance.—City of Haskell v. Webb (Tex.), 140 S. W. R. 127.

Refusal to Accept Material Specified in Bid Releases Contractor From Obligation to Enter Into a Contract.—A contractor made a bid for sewer construction, offering to supply steel for concrete reinforcement known as "Calumet steel bars" at a specified price per pound. The contractor executed a bond to enter into a contract if his bid was accepted. The bid was accepted, but the sewerage commissioners, not being familiar with Calumet steel bars, thereafter refused to accept such bars or to permit them to be used. Held, that the contractor's bid was based on the use of the bars named, and that, on the commissioners' refusal to permit their use, there was no acceptance of the bid, so as to entitle the commissioners to sue on the contractor's bond for his refusal to enter into the contract.—Commissioners of Sewerage of Louisville v. National Surety Co. (Ky.), 140 S. W. R. 62.

City Not Relieved From Liability by Letting Repair Work to an Independent Contractor.—A municipality cannot relieve itself from the duty to keep its streets in proper repair by transferring it to an independent contractor, and it will be responsible for the acts of a contractor if the matter involved in his contract is one of absolute duty owed by the city to an individual, or if the work is intrinsically dangerous, or if, even when properly done, it creates a nuisance, so that a municipality which authorizes the performance of work which necessarily renders the streets dangerous is liable for injuries due to the absence of barriers, lights, and other precautions for safety, but it will not be liable for acts of the contractor where the injury is through some negligence of the contractor in a matter in which the city owes no duty to the person injured.—Bailey v. City of Winston (N. C.), 72 S. E. R. 966.

City Not Relieved From Liability to Pay Price of Improvements, by Notice to the Contrary.—A city engineer having filed his estimate of the total cost of certain public work, the board of public works after finding that the special benefits on property within the assessment district and the benefits to the city would be equal to the estimated cost of the improvement ordered it done, and sent out a notice to bidders, declaring that the city would not be liable for any sum due from the properties or the owners, or for the payment of any bond., or certificates issued to the contractor in payment for the work, except for such moneys as were actually received by the city from the assessments for the improvement. Held that such notice did not relieve the city from liability to the contractor for that part of the price for which the board failed to provide either assessment bonds or city funds.—City of Indianapolis v. American Construction Co. (Ind.), 96 N. E. R. 608.

Culverts or Drains in Natural Flow Line May Not Be Obstructed.

It was decided in a recent case in equity in Pennsylvania that, while a municipality is not responsible for the natural flow, yet if more water is thrown upon private land than the watercourse would contain, an owner is entitled to redress.

In the case in question the defendants, G. A. Buch and H. R. Gibbel, owned land which was in the natural water course of flood water from one of the turnpikes of the village of Liberty. The flood water flowed down on the side of the turnpike opposite to the defendants' property, and the village and the Conestoga Traction Company had jointly placed a line of tile culvert to conduct the water across the pike when the grade of the roadway was raised so as to prevent the natural flow. The defendants thereupon began to fill up their lots and also the drain or water course, which runs across them, with loads of dirt and closed or threatened to close the openings of the terra cotta pipes. Whether or not they had the legal right to close up these pipes and the drain or natural water course is the question which was decided.

It was held from previous decisions that a person who builds a house in a ravine is bound to sustain any injuries which may occur from the natural flow of water into that ravine, and he is not bound for anything further than that. If, by any means a larger quantity of water is thrown upon him by the defendant's act than the natural flow of the watershed would contain and injury results thereby, without fault of plaintiffs, then they may recover compensation for whatever damage they have sustained by reason of this increase of water flow, taking it together with the ordinary water flow. A municipal corporation is liable for changing by the digging of ditches for that purpose the natural course of the water collecting on its streets and thereby throwing it on the land of a private owner.

But with those questions fully determined, another one arose which was the serious point of controversy in this case. In Reilly vs. Stephenson, 222 Pa. 252, it was decided as follows:

Some things, of course, he may not do. He may not proceed negligently so as to do unnecessary damage to others. But so far as he acts upon his right to protect his enjoyment of his own property any incidental loss to his neighbor is damage without injury. It is clearly settled, however, first, that he may not obstruct a natural channel for the flow of water or a channel that has acquired the character of an easement; and, secondly, he may not gather surface water into a body and discharge it on the adjoining land. His right is to shut out the invading water as a common enemy for the protection of his own land. If then there was a natural channel or water course over the defendant's lots—and it was found that this was the course for the water for a long series of years—had the defendants any right to fill up the lots so as to obstruct the pipes which carry the water to it? In Scranton City's Appeal, 121 Pa. 97, it appears that the plaintiff's lot was located upon the line of a natural water course of surface drainage; that, for some distance above the lot the line was marked by a ravine in which a small stream formerly flowed, kept alive by springs which afterward failed, but that for fifteen years the surface water had run into this ravine, usually a small stream occasionally dry and in rains a torrent. The city constructed along a street a culvert for this water to go through, and the court said that it was apparent that if no culvert had been built the ravine would have continued open and all the water that came into it would have flowed through it, and in time of flood would have been precipitated upon the plaintiff's land without restriction. A bill was filed against the city, and the court held that a court of equity would not restrain the municipality from the reconstruction and enlargement of the culvert across the street upon the allegation of a property owner that the proposed work would cause injury to his lot by the increased force and volume of water cast upon it, and the bill was thereupon dismissed at the costs of the plaintiff.

The only difference in the present case was that here the lot holder was endeavoring to close up the drains which carried the water accustomed formerly to flow over and along the turnpike, and the borough had filed a bill to prevent interference with those drains. It may be that, by reason of the opening of streets and the laying of cement gutters, a larger quantity of water had come through the pipes upon those lots than before flowed upon and over them. That question, however, did not seem to arise in this proceeding. If this part of the defendants' contention was true the borough might perhaps have been restricted to the amount which formerly drained over the land at the place or an action of damages might have been maintained for any injury which the defendants had received by reason of an increased flow of water upon their land. If, however, there was a natural channel or water course over the defendants' land and the water from the east side for a long period of time flowed through it, and the water of the west side at times also flowed to the same place, it made no difference to the defendants whether the water flowed upon the surface or through pipes, so long as the amount conducted along and across the turnpike through the pipes was that which would have ordinarily flowed to this point had no pipes been placed under the turnpike and pavement by the borough in order to so conduct the water.

It was therefore decided that the defendants had no right to complain on that account nor had they any right to obstruct the pipes. It was further held that as the pipes to conduct the water across the roadway had been lawfully placed and as the defendants were obstructing them and interfering with the flowage of the water, that an injunction should be issued restraining them from so doing. C. P. Lancaster Co. in equity, Docket No. 5, page 269.

ROADS AND PAVEMENTS

Road Progress.—Effect of Good Roads.—Grooved Rails for Los Angeles.—Street Improvements in Portland.—Road Asphalt in Birmingham.

Recent Progress in the Good Roads Cause.
(Continued from p. 53, January number.)

OKLAHOMA.

The good roads law in Oklahoma was adopted in 1911. Sidney Suggs is state highway commissioner, Oklahoma City, and apparently his funds are derived from an annual state tax on automobiles of $1 each. There are 43,554 miles of roads in the State, with no reports from which to estimate the mileage of improved roads. Several counties are bonding themselves to raise funds for good roads, one for $1,250,000. The State will doubtless invest over a million dollars in good roads in the near future. The county roads are in charge of boards of county commissioners and a county surveyor. Local roads are under a township board of three members, who divide the township into suitable districts and appoint a road overseer for each.

Oklahoma has a population of 1,657,155, which increased nearly 110 per cent. in the last census decade. Its 77 counties range in population from 5,000 to 85,000.

OREGON.

Oregon has as yet done nothing toward state construction of roads. John H. Lewis, Salem, is state engineer. In 1904, according to statistics collected by the U. S. Office of Public Roads, the State had 34,258 miles of road, of which 2,235 had been surfaced with gravel, 209 miles with stone and 145 with plank. The road expenditures for the year were $796,376. Expenditures had increased in 1907 to $997,701, of which $182,697 were for bridges. One county has voted to bond itself for $1,500,000 for constructing roads, and the validity of the bonds is now under consideration by the Supreme Court. Macadam roads built under the direction of the U. S. Office of Public Roads cost from $5,100 to $6,600 per mile.

The roads are in charge of county courts of two commissioners each, who divide the county into districts and appoint a supervisor for each district.

Oregon has a population of 672,765, which increased nearly 65 per cent. in the last census decade. Its 34 counties range in population from 2,000 to 40,000, with one county of 226,000 population.

PENNSYLVANIA.

The roads of Pennsylvania are in charge of E. M. Bigelow, state highway commissioner, Harrisburg. The first state aid law was passed in 1903 and, including 1910, $9,920,489 had been spent under that law and its amendments. The appropriations for 1911 for construction and maintenance were $4,000,000.

The law as amended in 1911 puts the department in charge of the state highway commissioner and two deputies, all appointed by the Governor, and one a competent civil engineer, and a chief engineer, also appointed by the Governor. The commissioner appoints assistant engineers, superintendents, draftsmen, clerks, stenographers and bookkeepers. He can purchase materials, tools, horses, etc., as necessary. Highways designated are taken over from the counties and townships as conditions permit and improved at the expense of the State. Two hundred and ninety-six routes, amounting to about 8,000 miles, are described and defined in the act. Roads in boroughs or incorporated towns are only taken over by the State in case there would otherwise be a break in the line of improvement of the route. Half the cost of maintenance by the State must be paid by the towns or boroughs on parts of roads within their borders, unless they have heretofore been paved with other than telford water-bound macadam, in which case they must be maintained by the corporation according to state specifications. The commissioner improves the state roads according to specifications adopted by him, and they are paid for by the State upon his certificate. Maintenance contracts may be let. Construction must be by contract. All contracts must be approved by the Governor. Signs and guide-posts on state highways are provided for. The state highway commissioner has control of the use of highways by railroads, street railroads, water, gas or conduit lines, or wire lines and poles, also of methods of use of roads by vehicles. The materials named for use in state roads are macadam, telford or other stone road, brick, gravel, cinder, oyster shells, or other good materials or combinations of materials. Width must be at least twelve feet and length at least one-half mile. Surveys of all the roads in the State, compilation of road statistics, establishment of standards of construction suitable for the various conditions in the State, consultation with local authorities in charge of highways and bridges, promotion of road improvement, issue of bulletins, publication of county road maps, are some of the duties of the state highway commissioner. Counties and townships by process prescribed can secure state aid in construction and maintenance of roads not included in the list of state roads, the State paying not more than 50 per cent. of the cost of construction and maintenance, the county and the township each to pay 25 per cent. of cost of construction and the township 50 per cent. of maintenance cost, or in such proportions as county and township may agree upon or accept. The township must levy tax enough each year to pay its share of annual cost to the State in cash. The state highway commissioner lets the contracts for the improvement of state aid roads, and they are thereafter under his control. Property owners may petition for state aid roads and owners of a majority of the property in a township can prevent the improvement by proper remonstrance. State aid funds are apportioned to the counties in proportion to mileage of roads, and if not used by a certain time are reapportioned to counties asking for more roads than their first share of the State appropriations would pay for. Counties, townships, boroughs and towns can bid for construction of state aid roads and have same privileges and duties as other bidders. The State pays the contractors and the counties and townships pay the State on requisition of the highway commissioner. The act appropriated $3,000,000 for construction, maintenance and repair of state highways and maintenance and repair of state aid highways under its provisions, and $1,000,000 for the State's share of state aid highways, to be available until expended.

Another act takes the first step toward the amendment of the State Constitution so that the State can issue $50,000,000 in bonds to raise funds for road construction. If the program laid down is followed the first of this money will be available in 1915.

Another act provides for levying of road taxes in cash in townships of the second class and for the payment to such townships by the State of half as much as the township tax raises, provided that no township shall receive more per year than $20 per mile of township road, and that the limit of the appropriation is not exceeded, viz: $500,000, to be distributed over the years 1912 and 1913.

The State has 99,041 miles of road, of which 3,365 miles have been improved, 784 of which had State aid. These state aid roads were paid for, part of them, 75 per cent. by the State and 12.5 per cent. each by county and township, and part two-thirds by the State and one-third each by county and township.

The average cost of macadam roads in Pennsylvania is $11,646 a mile; of bituminous macadam, $15,649, and of brick, $13,320.

Five contracts, amounting to about $500,000, have been made under the new law. The commissioner has received 29 applications for state aid on 64 miles of road.

The income from automobile licenses approximates $500,000 a year.

County roads are in charge of a board of three county commissioners and some counties employ county engineers. Township roads are under boards of three road supervisors each, who divide their township into districts of not less than 5 miles length of road and appoint a roadmaster for each district.

Pennsylvania has a population of 7,665,111, which is increasing about 20 per cent. per decade. Its 67 counties range in population from 8,000 to 260,000, with one county of 1,000,000 and one of 1,500,000 population.

The Effect of Good Roads.*

BY J. H. HAWLEY, SECRETARY GULF COAST GOOD ROADS ASSOCIATION.

The territory of Texas, of which Fayette county forms the center, is perhaps the most productive in a diversified way of any like area within the confines of this imperial state. You have here, as in nearly every other county in Texas, fine railroad facilities, but you lack, as is also the case in other counties in Texas, good, hard-surfaced highways upon which the farmer and producer, both in manufacturing and agriculture, can cheaply and without regard to weather conditions deliver his products to and take away his purchases from the various towns and villages which make up the condensed population of the county.

Good roads cost money, and this should not be overlooked in making the initial calculations. You must figure the cost of your roads against what the present condition of your roads cost you, to see where you come out, and then you can determine what outlay is essential to put your section of the county, if that is your final determination, up out of the mud and bring your town of Roundtop and its surrounding tributary country in active and cheap contact with your railroad station and your court house town. Generally a precinct can supply itself adequately with hard-surfaced improved high-

*Abstract of paper before a roads mass meeting at LaGrange, Texas.

ways by the construction of from thirty to thirty-five miles, if due regard is paid to the location of your population.

The proper course can be reached by the employment of a highway engineer, who must be, first, a locating engineer, a man who understands establishing a route or line of travel, considering all the factors involved, that is to say, gradients and water courses, as well as drainage. Economy of construction is the first considerataion after you have established lines of least resistance and your engineer must also be a practical road builder, a man who knows how to draw up specifications involving efficiency and economy, and who knows how to utilize the materials which he may find suitable for the purpose close at hand and who knows how to prepare a contract or assist the legal adviser of the precinct in doing so. Such a man as that is worth his hire, every dollar of it, because he prevents you from getting into bad contracts and guarantees you against bad work and the loss of money, which too frequently is to be found the case in such enterprises.

No one will question the integrity of your county commissions, but they know, as well as you do, that they are not highway engineers and that their knowledge of road building must be of the most superficial character, and therefore not to be considered for one moment where the expenditure of any large sum of money is intended. In point of fact, without derogation from the county commissions of the various counties of the State, it should be clearly understood that the automatic 15 cents per $100 dollars authorized by the constitution for the road and bridge fund, as well as the 15 cents that is sometimes authorized by vote of taxpayers for the same character of work, making a total of 30 cents on the $100, is the most abused fund handled through the county treasurer's office. It comes nearer being wasted than it does accomplishing the purpose for which it is collected. It can not be, without the advice of a first-class engineer, wisely spent. No man who does not know the business thoroughly can spend money wisely in that business, and where you have such a large assessed valuation as is shown by the statistics of 1910, and I presume, considering your county in relation to other counties of the State on the same basis, that the assessment for 1911 must be at least two or three millions of dollars more for your entire county, you can readily understand the importance of having engineer's advice to handle so large a sum of money in road maintenance and repair as will often arise from the 15 cents automatically allowed by the constitution, giving you in the county $30,000 a year, and if you add the 15 cents that is authorized by a majority vote of the taxpayers, you have under those two tax rates $60,000 a year with which to take care of the roads of the county.

The average distance of the farm from the railroad station throughout Texas is about ten miles. Of course there are a great many which are further away, and, when you are informed firmly and solemnly that when you can pass over your roads at all, the cost of handling a ton of freight over them is nearly forty cents per mile, as against the actual cost of haul on a good road of less than 10 cents a ton per mile, some appreciation can be had of the difference between a good road and a bad one. If the difference in the cost of haul was all, it would be merely a matter of money. Of course, it doesn't make any difference to you gentlemen in the country who are engaged in agricultural pursuits, about the serious loss you sustain in money, because you would rather evidently continue to lose the difference in money and enjoy the difficulties and troubles and delays in your bad roads than to vote a bond issue and pay annually a fixed sum for permanent and substantial relief from the incubus of bad roads, but forget if you can the difference in cost between the good and bad road in money and consider the difficulties surrounding your family.

There has been a great deal said in the papers recently regarding National aid for the construction of roads in the States. Do not listen for a moment to such specious arguments. The National government can not aid in the construction of roads without an amendment to the constitution of the United States. President Monroe said so, and President Jackson, in his message of 1828, said so, and since he issued his veto, no attempt has been made to get highway legislation through the congress. I have a letter from a cabinet officer, in which he specifically states that the administration does not favor National highway legislation, appropriating money to build highways in the States, and the recent convention at Richmond, Va., split asunder on the subject. The American Association for Highway Improvement of which the Gulf Coast Good Roads association is a member, takes the high ground that constitutional objections exist to National aid and the people of the various States must rely upon themselves for the construction of "good roads." You know full well that the constitution of the State of Texas, article 3, sections 43 and 50, specifically provide that the State of Texas can not issue bonds nor lend its credit to any such enterprises. State aid is therefore not to be expected under any circumstances. Under the most favorable conditions, the advocates of National aid make it a condition precedent that the sum of money appropriated by the National government shall be equally appropriated by the State. As we are denied the privilege of extending any credit, issuing any bonds, or lending any money, our chance in Texas for getting National aid, even if it was constitutional, is so slim that it is absurd to think of it for a moment. If you want good roads in your precinct or county, build them yourselves.

Grooved Rails for Paved Streets in Los Angeles.

As a result of continued agitation against the use of center bearing or "T" rails upon paved streets, action has been taken by the board of public works of Los Angeles, Cal., to enforce the use of grooved rails. The objection raised to the "T" rail was the fact that the granite blocks or bricks laid next to it in order to form a groove for the car wheel flange, became rough and were forced out of place by the heavy traffic.

The grooved rail adopted was what is known as section No. 292 of the Pennsylvania Steel Co. It is of the girder type, 7 inches in height, over all, and 5⅝ inches in width across the head and lip forming the groove. The lip or side of the rail, which forms the wall of the groove opposite from that on which the wheel runs, is ⅜ of an inch lower than the other. It is estimated by engineers that the grinding of the wheels on the rail will wear that part of the rail down even with the other side in a few years. For this reason the rail is beveled on the outside so that when it is laid the top will be slightly above the pavement.

The groove of the rails is of such a shape as to make them self-cleaning. Dirt or other material which lodges in the groove is supposed to be forced out by the flange of the car wheel passing through it.

In some of the far northern cities of the country, such as St. Paul and Minneapolis, the chief argument used against the girder rail is that ice, snow and frozen dirt clog the groove in cold weather. This, of course, does not apply to Southern California.

Following is a list of cities in which the grooved rail is being used on paved streets:

Atlanta, Ga.; Baltimore, Md.; Buffalo, N. Y.; Brooklyn, N. Y.; Boston, Mass.; Cambridge, Mass; Camden, N. J.; Chicago, Ill.; Cincinnati, O.; Cleveland, O.; Elizabeth, N. J.; Fall River, Mass.; Harrisburg, Pa.; Kansas City, Mo.; Lowell, Mass.; McKeesport, Pa.; Memphis, Tenn.; New York, Manhattan, Bronx and Queens Boroughs; New Bedford, Mass.; Norfolk, Va.; Omaha, Neb.; Philadelphia, Pa.; Pittsburg, Pa.; Portland, Me.; Portland, Ore.; Richmond, Va ; St. Louis, Mo.; San Francisco, Cal.; Springfield, Mass.; Troy, N. Y.; Washington, D. C.; Yonkers, N. Y.

Some of the larger cities which still have the old style of "T" rails on paved streets are Duluth, Minn.; Minneapolis, Minn.; New Haven, Conn.; Milwaukee, Wis.; Rochester, N. Y., and St. Paul, Minn.

Street Improvements in Portland.

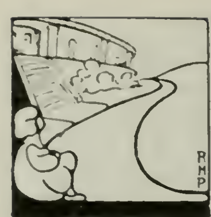
According to a recent report of Mayor Rushlight, of Portland, Ore., $7,000,000 in street improvements have been laid under the direction of the city engineer during the year. One hundred miles of hard-surface pavements have been laid and other streets improved amounting to 75 miles. He asserts that a substantial reduction in the cost of street improvements has been made and predicts that under the competitive method recently put into effect, a more sweeping reduction in the cost of such improvements will result. He requested the city engineer to devise some plan for roughening the surface of the pavements so that they will provide a firm foothold for animals. The establishment of a municipal street repair plant is urged, which he believes will result in a big saving of expense to the city.

Road Asphalt in Birmingham, Ala.

Birmingham, Alabama, in common with a great many cities of the South, has a number of streets which are constructed with gravel. The constant traffic on these streets has made a solid foundation, but through the disintegration of the surface, the city had the dust nuisance to contend with in the summer and the reavy mud in winter. In order to eliminate this condition it was decided to use Texaco Road Asphalt on the surface of the roads.

Tuscaloosa Avenue is one of the most heavily travelled streets in the city. The traffic on this avenue includes not only a large number of automobiles daily but a considerable amount of heavy trucking, so that conditions are about as severe as it would be possible to find in this part of the country. This condition is further complicated by a double set of car tracks and switches running through the center of the street. The specifications call for the surfacing to be carried right to the edge of the rails, the whole proposition representing a very severe test.

The method of building this road was a little unusual. After the sugbrade had been finished to conform to the required grade of the road, ten inches below; the paving surface about 720 feet in length and 35 feet in width was laid with 8 inches of 2½ and 1½ inch stones. This was filled with screenings and rolled to a surface with a ten ton roller, thus leaving a solid foundation. After this was accomplished the road was ready for a wearing surface of 2 inches of 1½ inch stone, rolled again and filled with Texaco Road Asphalt applied at the rate of approximately two gallons to the square yard, poured by hand with the ordinary pouring can. One-quarter inch screenings were sprinkled over the surface, swept into the voids, rolled and finished off with a ten ton roller. The street was then open for traffic and up to the present time is in excellent condition.



ORGANIZATIONS & INDIVIDUALS

Standardizing Specifications.—Indiana Sanitary Association.—Chicago City Club.—Technical Schools.—Technical Associations.—Calendar.—Personal Notes.

Association for Standardizing Paving Specifications.

The third convention of the Association for Standardizing Paving Specifications was held in New Orleans the week of January 8, the convention being the guests of Capt. W. J. Hardee, city engineer, and the city of New Orleans. Trains were so seriously delayed that the opening session, including the address of welcome from Mayor Behrman, the responses by N. P. Lewis and President Tillson and the appointment of committees, was not called until late Monday afternoon.

About 24 cities were represented in all by about 55 delegates, and there were about 30 associate members and visitors from cities not members of the association.

The statement was made by the president that committees of five each had been at work during the year. But they had not presented formal reports and all the members of the committees were not present, so the vacancies were filled and in some cases the numbers increased by appointments made by the president. But four of the eight chairmen who acted during the year were present. The new committees varied in membership from five to eight and either two or three members had acted during the year on each committee except that on wooden blocks, of which only one member survived. Upon appointment of the committees the convention adjourned until Thursday to give the committees an opportunity to prepare reports.

Each committee was given a room and the committee meetings were much more open and informal than at either of the preceding conventions. The committee rooms were busy places during much of the time on Tuesday, Wednesday and Thursday morning and the results met with far less criticism than those of either of the preceding conventions, largely because the methods of conducting the meetings were far less open to criticism. The loss of time of the convention was not so serious as it might have been, since nearly every delegate present was a member of a committee.

Most of the committee reports were presented at the Thursday sessions, but one report and the election of officers and other business being left for a meeting Friday night, at which there were a number of vacancies in the representations of cities. The specifications adopted at previous conventions were taken as the basis of work and the new specifications presented by the committee and adopted with little modification by the association differ in but few respects from the earlier work of the society. Statement of some of the changes follows.

The objects of the committee on wooden blocks were stated to be to prevent the absorption of water at the bottom of the blocks and to give greater latitude for selection of preservative. The minimum number of annual rings in yellow pine timber was changed to 6 per inch, averaging not less than 8. Sizes of blocks were modified somewhat, and length of blocks 3 inches deep was limited to 8 inches. The specification for heavy oil for treatment of blocks was slightly modified, the limit of specific gravity remaining 1.10 and 1.14 at 38 degrees C. The alternative specification for lighter oil for treatment calls for specific gravity at 38 degrees C. between 1.03 and 1.08, with some increase in percentage of distillates. The temperature of treatment of blocks is fixed at 240 degrees F. and amount to be injected is reduced to 18 lbs. per cubic foot, except for gum, which is fixed at 22 lbs. Variations in specification between 16 and 20 lbs. are permitted to suit local conditions. An alternative to the 1-in. sand cushion of the former specification is a mortar cushion made of 1 part Portland cement and 4 sand, mixed, laid dry, sprinkled lightly and the blocks set in it. A note is added for special conditions allowing instead of the cushion a bituminous coating on dry concrete in which the blocks are set while it is still hot. Bituminous filler for joints is provided except that over a bituminous cushion sand filler may be used.

The committee on stone block made few changes, adding preference for blocks of over 1,600 lbs. crushing strength, making sand cushion 2 in. and changing details of tests of asphaltic filler and method of applying.

The committee on brick added a specification for abrasion loss and process of determination which is practically the same as that adopted by the Am. Soc. Mun. Imp., with the maximum loss for first-class street fixed at 22, but a note permitting 25 or even 28 per cent. for medium and light traffic streets. Sand cushion is made 1¼ in. after rolling. Bituminous filler specification is also modified to agree with that for stone blocks.

The committee on cement, concrete and concrete pavements slightly modified range of sizes for fine aggregate, fixed maximum time between laying of bottom and top coats at 45 minutes, stops laying when materials or air are below 32 degrees temperature. The principal additions were an alternative provision for preparation of concrete for a bituminous surface and for what may be termed a contraction rather than an expansion joint, being a line of creosoted soft wood timber set at right angles to the street line each 50 feet of its length, the wood being set with fibres vertical.

The committee on bituminous concrete retains the specification for a one-layer pavement of last year and adds one for a two-course pavement which it deems safe from suit for infringement. The former specification is modified, giving more detail as to limits of penetration of asphaltic cement for various weights of traffic and characteristics of coal tar cement. The latter calls for a binder course of 1-in. to 2 or 2½-in. stone, one stone deep without or with bitumen by penetration or mixing method and a wearing surface of 0.1-in. to 200-mesh fine aggregate and 25 per cent. ½ or ⅝-in. to ¼ or ⅜-in. crushed stone, to which is added 8 to 10 per cent. of bituminous cement, mixture and laying being as prescribed for the former specification.

The committee on macadam expressed itself as opposed to a water-bound macadam for a permanent pavement on a city street and submitted a specification for a bituminous macadam pavement providing for a macadam base of coarse stone well filled with fines, a second layer of medium size stone well filled with screenings and a top surface to be filled with asphaltic material or refined coal tar of specifications given and laid carefully as provided, and finished with a squeegee coat and screenings. The committee report was adopted with but little change, which doubtless carries the condemnation of water-bound macadam.

The report of the committee on bonds and guarantees was adopted although some delegates thought it contained too many blanks which it was the province of the association to fill. It did not differ very materially from last year's report.

The principal change in the asphalt specification was to add a clause to provide for the admission of good artificial asphalts of low ductility and high penetration, which reads, "Asphaltic cement not varying more than 125 in penetration between 32 and 115 degrees F., shall have a ductility of not less than 6 cm. at 77 degrees and not less than 2 cm. at 32 degrees F."

The officers elected were: W. J. Hardee, city engineer of New Orleans, president; N. P. Lewis, chief engineer of board of estimate and apportionment of New York, Geo. W. Tonson, director of public service of Toledo, N. E. Murray, superintendent of sidewalks of Chicago, and L. R. Ash, city engineer of Kansas City, vice-presidents; J. B. Hittell, chief engineer of streets of Chicago, secretary and treasurer. Pittsburgh was chosen as the next place of meeting, the time being left to the president and the executive committee.

A theater party on Tuesday night, a luncheon and automobile trip for the ladies on Wednesday, a banquet on Thursday night, a river trip on Friday and a trip about the new water and sewerage systems of the city on Saturday made the stay of the delegates and their friends most agreeable and instructive.

The Indiana Sanitary and Water Supply Association.

The fifth annual meeting of the Indiana Sanitary and Water Supply Association will be held in Indianapolis February 15 and 16. The program includes such men as Prof. Halford Erickson, of the Wisconsin Railway Commission; Dr. George B. Young, commissioner of health of Chicago; T. C. Phillips, of the department of water waste survey, Chicago; R. L. Sackett, professor sanitary engineering, Purdue University; Geo. E. Kessler, landscape engineer; Geo. W. Fuller, consulting engineer, New York City; Prof. McGee, of the National Department of Agriculture, Washington, D. C.; H. E. Barnard, Indianapolis, State Food and Drug Commissioner; Dow R. Gwinn, president Terre Haute Water Works Company; E. L. Loomis, superintendent water department, Valparaiso; J. F. O'Donnell, Indianapolis Water Company; Richard Lieber, member Indianapolis Commission on Fire Insurance; J. F. Newell, chief of the U. S. Hydrographic Survey, Washington, D. C.; Dr. J. N. Hurty, secretary Indiana State Board of Health, and others.

Among the papers to be given are the following: "Fire Waste and Fire Prevention"; "Latest Development in Water Purification Methods"; "Management of Water Plants in the Smaller Cities"; "The Wisconsin Public Utilities Commission"; "The Value to a Community of the Purification of Its Streams"; "Pitometer Surveys and Other Rigid Inspections"; "The Report on the Condition of White River, with Suggestions on Sewage Disposal."

W. F. King, M. D., Indianapolis, Ind., is secretary of the association.

The City Club of Chicago.

The City Club of Chicago was formally installed in its new building on 315 Plymouth Court, on January 8th. In connection with the opening a civic exhibit by the civic committees of the City Club was maintained from January 8 to 13, inclusive. The exhibits included matter relative to financial control; municipal publicity and statistics; education and recreation; charities and public health; elections, civil service and public safety; city planning, municipal art, traffic, and lighting.

The City Club was founded in 1903 by a small group of public-spirited citizens. It has grown steadily. Its main purpose is to bring together for conference and discussion those who are interested in civic problems and civic improvements, who wish to understand municipal questions and to promote good municipal administration. The club is not in partisan politics and takes no formal action as a club. It is organized in such a way, however, that every set of questions can be and is studied by a committee, and the committees, with the approval of the directors, are free to make suggestions or offer aid to the various municipal departments.

Technical Schools.

Prof. Filibert Roth, of the forestry school of the University of Michigan, has been selected as the head of the forestry department of the New York State College of Agriculture at Cornell University. Professor Roth has been engaged in important government forestry work during recent years.

The Pennsylvania Railroad Company has placed a dynamometer car at the disposal of the Pennsylvania State College. The drawbar capacity of this car is twenty-eight thousand pounds. It is quite a complete piece of apparatus, costing originally about $30,000. Some time ago, the same railroad company placed at the disposal of the same college, an eight-wheel locomotive. These two pieces of equipment serve an excellent purpose for experimental and instructional work.

The Industrial Bureau and School Board of Winnipeg, Canada, have taken steps to inaugurate a series of technical lectures to school boys and tradesmen of that city. Briefly the plan is to have experienced and qualified men in different trades address the boys of the fifth, sixth and seventh grades an hour and a half each week at the schools and to have these instructive talks prepared in advance and published in pamphlet form, in order that the boys may carry the message home to their parents. The other feature of the plan is that the Bureau will get expert men in different trades to come to Winnipeg and address factory men on different technical subjects. W. J. Bulman, of the Industrial Bureau, is chairman of the special committee in charge of the work

H. M. Byllesby, president of the H. M. Byllesby Company, gave an address before the students and faculty of the College of Engineering of the University of Illinois on Thursday, January 18. His subject was "Organization in Engineering." The occasion for the address was an assembly of the College of Engineering. Twelve hundred engineering students and one hundred members of the faculty were in attendance. The members of the Illinois Society of Engineers and Surveyors, in convention at the University, were the special guests at the assembly. Brief addresses were also made by J. G. Gabelman, president of the Illinois Society of Engineers and Surveyors; by W. L. Abbott and F. L. Hatch, trustees of the University of Illinois, and by Dr. W. F. M. Goss, dean of the College of Engineering.

In connection with the graduate course in highway engineering at Columbia University, the following illustrated lectures were given during the month of January: "Problems of the Sales Departments of Road-Material Manufacturing Companies," by Charles P. Price, manager, The American Tar Company, Boston; The Organization of the Engineer' ing Forces of the State Roads Commission of Maryland, Major Walter W. Crosby, Chief Engineer, Maryland State Roads Commission.

Technical Associations.

At the annual meeting of the Civil Engineers' Club of Cincinnati, Prof John P. Fait, University of Cincinnati, was elected president; Prof. Herman Schneider, University of Cincinnati, vice president, and E. A. Gast, secretary and treasurer.

The third annual meeting of the Indiana Public Improvement Association was held at the Hotel Denison, Indianapolis, Ind., on January 11th and 12th. The association was organized in 1909 for the purpose of furthering of public matters generally. The following officers were elected: President, Fred Cunningham, Linton, Ind.; vice president, John Holloran, Indianapolis, Ind.; secretary-treasurer, Alfred H. Barnes, Logansport, Ind.

At a regular meeting of the Brooklyn Engineers' Club, held on January 11th, Frederick L. Cranford presented a paper on "The Relation of the Business Man and Engineer to the Present Industrial Problem."

At a regular meeting of the New York Electrical Society held on January 25th, E. P. Edwards, of the General Electric Company, Schenectady, N. Y., presented a paper on "Electricity as a Factor in Progressive Agriculture."

The thirty-second annual convention of the American Water Works Association will be held at Louisville, Ky., June 3d to 8th. After February 1, 1912, the address of the secretary of the association will be J. M. Diven, secretary, 271 River street, Troy, N. Y.

The Mayors' Society of New Jersey was organized at a meeting held January 13th in Elizabeth, N. J. The following officers were elected: Frederick W. Donnelly, mayor of Trenton, President; A. F. Pierson, Morristown, secretary; A. B. Seymour, of Orange, treasurer.

At the annual meeting of the New England Water Works Association held in Boston on January 10, the following officers were elected: President, George W. Bachelder; secretary, Willard Kent; treasurer, Lewis M. Bancroft.

The following officers have been elected by the Western Society of Engineers: President, W. C. Armstrong (Engineer of Bridges, C. & N. W. Ry.); vice-presidents, A. Bement, G. T. Seely and E. C. Shankland; treasurer, A Reichmann; secretary, J. H. Warder.

The annual meeting of the American Society of Civil Engineers was held at the society house on January 17. The officers elected for the current year were: J. A. Ockerson, president; C. S. Churchill and C. D. Marx, vice presidents; J. M. Knap, treasurer; Lincoln Bush, T. Kennard Thompson, Emil Gerber, Wiliam Cain, E. C. Lewis and W. A. Cattell, directors. The new members of the nominating committee elected at the meeting are: Merritt H. Smith, H. P. Eddy, A. E. Kasti, J. F. Murray, A. F. Baldwin, J. F. Coleman and R. H. Thompson.

At the annual meeting of the St. Louis Engineers' Club, A. S. Langsdorf was elected president; John Hunter, first vice president; H. H. Humphrey, second vice president; W. W. Horner, secretary; W. E. Rolfe, treasurer, and E. A. Sweetser, librarian.

At the annual meeting of the American Society of Agricultural Engineers, in St. Paul on December 28, H. W. Riley, of Ithaca, N. Y., was elected president; J. B. Bartholomew, of Peoria, Ill., first vice president; W. Chase, second vice president; O. O. Reed, of Champaign, Ill., secretary, and J. L. Mowrey, of Minneapolis, Minn., treasurer.

The Des Moines Engineers' Club has elected the following officers for 1912: President, L. H. Stone, vice president, J. E. Van Liew; secretary-treasurer, F. R. Hubbard.

The thirty-second annual meeting of the Indiana Engineering Society was held in Indianapolis January 25-27. The following were among the papers presented: "Concrete Pavement for City Streets and County Roads," by J. H. Chubb, Chicago, Ill.; "The Vertical Posts of Bridges," by Prof. Albert Smith, Lafayette, Ind.; "The Foundation of the Cherry Street Bridge, Toledo, O.," by Willard A. Knapp, Lafayette, Ind.; "Bituminous Macadam Pavement" (printed on page 92 of this issue), by A. N. Johnston, State Highway Commissioner, Springfield, Ill.; "The Care, Maintenance and Construction of Country Roads," by Robert E. Gibbons, Terre Haute, Ind.; "A Pneumatic Street Cleaning Machine," by Charles A. Tripp, Indianapolis, Ind.; "Inspection and Cost Data in Relation to City Improvements," by F. O. Hodson, Gary, Ind.; "Oil Mixed Concrete," by Logan Waller Page, Washington, D. C.; "Bitumens Mixed With Concrete," by Prof. H. H. Schofield, Lafayette, Ind.; "Practical Concrete Construction," by DeWitt V. Moore, Indianapolis, Ind.; "The Failure of Dams," by Prof. R. L. Sackett, Lafayette, Ind.; "Filtration Plant Operation," by Harry E. Jordan, Indianapolis, Ind.; "Electrical Methods of Water Purification," by Prof. R. L. Sackett, Lafayette, Ind.; "Economic Features in Pumping and Power Plant," by Charles Brossman, Indianapolis, Ind.

Ornamental Street Lighting in Poughkeepsie.

Poughkeepsie, N. Y., has recently installed a combination ornamental lighting system, using the trolley poles to support the lamp arms.

The pole decided upon has an over-all length of 30 feet, with three successive diameters, 7-inch, 6-inch and 5-inch, and several ornamental collars and an ornamental base 19 inches in diameter. Each one of the four lamp arms is cast separately and then bolted to a semi-circular collar, two of which are bolted together around a small shoulder, which projects from the pole. The poles are set 6 feet in the ground, filled in with concrete, which runs inside of the pole through a hole purposely left in the casting, and then left for ten days before being subjected to any strain. The poles are painted green, with the exception of the ornamental collars and extremities of the arms, which are aluminum color. The equipment for each cluster consists of four 100-watt Mazda multiple lamps of the drawn wire type, on a 120-volt alternating current circuit; each lamp is pendant, enclosed in a 12-inch opal globe 13 feet from the ground. Some sand blasted globes were also used, but are being discarded on account of glare.

The system is similar in many ways to that contemplated for Dearborn street, Chicago, Ill.

Calendar of Technical Meetings.

Second Annual New York Cement Show.—Madison Square Garden, January 28-February 3. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

New England Association of Gas Engineers.—Annual meeting, Boston, Mass., February 14-15. N. W. Gifford, secretary, 26 Central street, East Boston, Mass.

Indiana Sanitary and Water Supply Association.—Fourth anual convention, Indianapolis, Ind., February 15-16. Dr. W. F. King, secretary, Indianapolis, Ind.

Iowa Engineering Society.—Annual meeting, Davenport, Ia., February 21-23. S. M. Woodward, secretary, Iowa City, Ia.

Fifth Annual Chicago Cement Show.—Coliseum, Chicago, Ill., February 21-28. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

National Brick Manufacturers' Association.—Annual convention, Chicago, Ill., March 6-9. T. A. Randall, secretary, Indianapolis, Ind.

International Brick and Clay Products Exposition.—Coliseum, Chicago, Ill., March 7-12. Office, 815 Chamber of Commerce Building, Chicago, Ill.

First Annual Kansas City Cement Show.—Convention Hall, March 14-21. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

American Water Works Association.—Annual convention, Louisville, Ky., June 3-8. John M. Diven, 271 River street, Troy, N. Y.

Personal Notes.

Frank D. Mount has been appointed city engineer of Atlantic City, N. J.

John L. Kirk, for twenty-one years chief of the Bureau of Lighting, of Philadelphia, Pa., has resigned.

J. W. Barnett has been reappointed city engineer of Athens, Ga. He has held this position since 1890.

Henry F. Waige, formerly chief engineer of the Crichfield Coal Co., has been appointed city engineer of Cincinnati, O.

L. W. Rundlett, former city engineer of St. Paul, Minn., has been made commissioner of public works of Moose Jaw, Canada.

Thomas Wilson, former engineer of construction for Atlanta, Ga., has been appointed engineer of highways of Fulton county, Ga.

M. R. Watson has opened an office at 308 American National Bank building, Tampa, Fla., for the practice of general civil engineering.

Herbert W. Pierce has been appointed commissioner of public works of Rochester, N. Y. Edwin A. Fisher has been reappointed city engineer.

G. H. Herrold, M. W., Soc. of Eng., M. Am. Ry. Eng. Assoc., has opened an office in the Hackney building, St. Paul, for the general practice of engineering.

Gaylord C. Cummin has been named as city engineer of Dayton, O. He has recently been engaged on irrigation work in connection with the transcontinental railroads.

Frederick S. Parkhurst, Jr., has been reappointed city engineer of Niagara Falls, N. Y. Norman G. Ray has been appointed deputy city engineer, a newly created position.

W. T. Thompson, formerly general manager o fthe Iroquois Iron Works, Buffalo, N. Y., has been elected vice president and general manager of the Monarch Road Roller Co., Groton, N. Y.

C. F. Brown, Assoc. M. Am. Soc. C. E., and H. S. Kleinschmidt, Assoc. M. Am. Soc. C. E., have formed a partnership under the firm name of Brown & Kleinschmidt, for a general civil and consulting engineering practice, with offices at 1005 Newhouse building, Salt Lake City, Utah.

Frederick W. Ballard, manager of the engineering and construction department of the Sherwin-Williams Company and secretary of the Cleveland Engineering Society, was appointed by Mayor Baker of Cleveland as consulting engineer of the $2,000,000 municipal electric light plant.

Charles E. Treman has resigned as superintendent of public works of the State of New York and Franklin W. Peck, of Syracuse, has been appointed to succeed him. Mr. Peck has been serving as assistant superintendent in charge of the middle division of the State canal system.

Peter F. Huntington has been appointed city engineer of Eveleth, Minn., and Edward F. Forrestal, superintendent of water works.

Charles U. Powell has been appointed assistant engineer of the Topographical Bureau of the Borough of Queens, New York City. He has been serving in that department since 1902.

John M. Diven, superintendent of water works at Charleston, S. C., has been appointed to a similar position with the city of Troy, N. Y. Mr. Diven is a native of New York state and was for a number of years connected with the water works of Elmira, becoming superintendent in 1883. He is secretary of the American Water Works Association.

James W. Synan, of Pittsfield, Mass., has been named by Governor Foss to fill the vacancy on the State Highway Commission caused by the resignation of Harold Parker.

George W. Fuller, consulting engineer, New York, has been retained by the city of Lincoln, Neb., to make recommendations for protection to the city water supply and changes and additions to the sewerage system.

George W. Jackson and E. A. Clark announce the formation of a consulting engineering firm with offices at 756 West Jackson boulevard, Chicago, and 228 West Forty-second street, New York. The new firm is entirely separate from George W. Jackson, Inc.

W. T. Wooley, formerly engineer of the Public Improvement Commission of Hoosick Falls, N. Y., has been appointed city engineer of Schenectady, N. Y.

The Bureau of Associated Geological Engineers, a firm of consulting experts on water supplies, bridge and dam foundations and other problems of municipal engineering, will hereafter maintain offices at 131 State street, Boston, and 331 Fourth avenue, Pittsburg, Pa. The Boston office will be under the management of Myron L. Fuller, formerly in charge of the water supply investigations in the Eastern United States for the United States Geological Survey.

Austin B. Fletcher, M. Am. Soc. C. E., State Highway Engineer of California, has announced the following appointments as division engineers in charge of preliminary surveys and construction: W. C. Howe, Assoc. M. Am. Soc. C. E., Sacramento, division No. 3; F. C. Sumner Willits, division No. 1; T. A. Bedford, M. Am. Soc. C. E., Redding, division No. 3; A. E. Loder, San Francisco, division No. 4; W. S. Caruthers, San Luis Obispo, division No. 5; J. B. Woodson, Fresno division No. 6; W. L. Clark, Los Angeles, division No. 7.

W. E. Davis, vice president in charge of sales of the Goulds Manufacturing Company, Seneca Falls, N. Y., has just started on an extensive trip to visit their representatives in Boston, New York, Philadelphia, Richmond, Pittsburg, Wheeling, Cleveland, Warren, Cincinnati, Louisville, Chicago, St. Louis, Kansas City, Joplin, Memphis, Birmingham, Montgomery, Mobile, New Orleans, Beaumont, Houston, Galveston, San Antonio, El Paso, Phoenix, Tuscon, Albuquerque, Los Angeles, San Francisco, Portland, Seattle, Tacoma, Boise, Salt Lake City, Denver and Omaha, and expects to complete his trip and return to Seneca Falls early in March.

MACHINERY AND TRADE

Germicidal Value of Calcium Chloride.

The use of calcium chloride as a road binder has been commented upon and its action fully described in these pages. A new factor, namely, its antiseptic value, has recently been demonstrated and this, combined with its value as a dust layer, makes it particularly desirable for use in residential districts, on playgrounds, near reservoirs, etc.

Tests of the germicidal value of solutions of calcium chloride upon bacteria coli communis, made by M. L. Trowbridge, indicate that a solution of 2 per cent. of chloride of calcium inhibits the growth of bacterial life within a period of three to four hours. Higher strengths up to 15 to 20 per cent. destroy all bacterial life in from ten to fifteen minutes.

When calcium chloride is put upon roads for the purpose of laying dust, whether in solution or in the granulated form, it soon takes up moisture from the air or gives up moisture to the air until it comes to a state of equilibrium with the moisture in the air. Under ordinary conditions of humidity in the summer calcium chloride upon roads is reduced by the moisture in the air to a solution containing from about 15 to 40 per cent. calcium chloride. In rainy weather this solution is diluted considerably, but after the rain ceases it again concentrates with evaporation of water to the strength mentioned above.

It is, therefore, clear that calcium chloride, when used upon roads in sufficient amounts to lay the dust, exists as a solution containing a sufficient amount of calcium chloride to be fatal to all bacterial life.

Actual tests upon roads treated with calcium chloride and roads in the same vicinity not treated with calcium chloride show that over 98 per cent. of the bacteria present in the road surfaces are destroyed by the calcium chloride dust treatment. In fact, a road properly treated with calcium chloride and protected from additional contamination will become absolutely sterile.

Since the dust from roads and city streets is acknowledged to be the most common means of spreading contagious diseases, the calcium chloride treatment for laying dust not only contributes to the general comfort, but to a great extent, not yet fully appreciated, to the general public health.

Books on Sewage Lifting Apparatus.

"The Priestman Ejector System" and "Progress in Sewage Treatment, No. 7," have just been issued by Merritt & Co., Camden, N. J., and deal mainly with the Priestman ejector system and the subject of sewage pumping. "The Priestman Ejector System" contains 14 pages and takes up first the various applications of the Priestman hydro-pneumatic ejector. These applications are discussed at further length after a page devoted to a description of how a Priestman ejector operates, attention being directed to the absence of moving parts in contact with the sewage and how the compressed air is made to work expansively for discharging sewage. In subsequent pages the various advantages of this type of sewage pumping apparatus are given, and also details regarding its construction. Standard dimensions of the horizontal type are not included since the design and installation of horizontal ejectors depends upon local conditions. Ejectors of this type are used where the amount of head room available is very limited. The last two pages comprise data sheets which outline the figures which are necessary for proper recommendation of the ejector systems in basements of deep buildings or for city pumping stations.

The second publication, "Progress in Sewage Treatment No. 7," is a technical paper, 18 pages of which are devoted to articles, 3 to editorial matter and 3 to advertisements. The leading article is from a report by Mr. Geo. T. Hammond, M. Am. Soc. C. E., and is entitled "Automatic Sewage Lifting Station Equipment." It analyzes the various advantages of the centrifugal pump and the compressed air ejector.

Following Mr. Hammond's article, some 6 pages are devoted to an article on pneumatic ejectors abstracted from the Surveyor, London, and another describing the sewage ejectors at the Pennsylvania station, New York.

In the editorial section a page is devoted to the water waste at Memphis by flush tanks, and another to the subject of Mr. Hammond's paper. Particular reference is made to the table of efficiency of compressed air in ejectors and a note is given covering the equations for adiabatic air compression.

The Dolarway Bituminous Surface Concrete Pavement.

Road authorities generally recognize that if durability is desired it is a mistake to lay a pavement without a concrete foundation. The only reason for not using such a foundation in the past on all pavements has been the matter of cost. The introduction of a pavement known as the Dolarway pavement has now made it possible to construct a highway with a concrete foundation at a cost of a little over a dollar per square yard.

After several years' experience with Dolarway pavement at Ann Arbor, Mich., during which time about 100,000 square yards were laid, the authorities are enthusiastic and declare it to be the most satisfactory and economical pavement they have ever used.

ONE OF THE METHODS OF APPLYING AND SPREADING DOLARWAY BITUMEN ON CONCRETE BASE.

The construction consists of from five to six inches of Portland cement concrete provided with the necessary expansion joints. The surface is then treated with adhesive Dolarway bitumen and with coarse sand or fine gravel or screenings. This seals the concrete, prevents cracking and chipping and produces a wearing surface which is clean, noiseless, resilient and similar in appearance to other forms of bituminous pavement. From the fact that no machinery is necessary for the construction of the Dolarway pavement and from the further fact that it is constructed almost entirely out of local materials, with little or no skilled labor required, this proposition is an unusually economical one.

The Dolarway Company owns and controls the Dolarway pavement and is now making arrangements with local contractors to lay this form of pavement in various parts of this country and Canada. Considerable of the territory has been already allotted, as the proposition, owing to the low cost of the pavement, is a most attractive one from the contractor's standpoint.

Engineers, contractors or city authorities interested in this proposition may obtain further information from the Dolarway Paving Company, either at their New York office, 95 Liberty street, or their western office, 510 Title and Trust building, Chicago.

A Gas Engine Water Works Pumping Plant.

The high economy of the gas engine driven power pump is generally known, and interesting data on results obtained with this type of pumping equipment are frequently brought to attention. The results obtained in the plant of the Bellevue water works, Bellevue, Ohio, are of particular interest, a saving of 75 per cent. having been shown in the plant by the installation of this type of equipment. This includes the cost of fuel only; if the other items, such as maintenance, attendance, etc., were taken into consideration, even greater increases in economy would probably be shown.

In this city an average of between 600,000 and 800,000 gallons of water, against a normal pressure of about 42 pounds and a fire pressure of 110 pounds, is pumped in 24 hours. The stand pipe is cut out in case of fire and the pressure is taken direct from the pump.

The original equipment, which has been in service several years, consisted of a reciprocating steam pump. About a year ago this equipment was replaced by a double-acting triplex power pump, made by the Goulds Manufacturing Company, Seneca Falls, N. Y., and a natural gas engine, made by the Bruce-Macbeth Engine Company, Cleveland, Ohio. The pump has 9 in. cylinders and the engine is rated at 55 horsepower.

Bellevue is located in the natural gas belt and they obtained gas for fuel under the boiler for the old steam pump equipment at a cost of 15c per thousand feet. The gas for the engine now used costs them 30c per thousand feet.

During the month of August, 1910, with the steam pump they pumped 20,000,000 gallons at a fuel cost for gas under the boilers of $128.

During the month of August, 1911, with the new power pump equipment they pumped 21,000,000 gallons at a fuel cost for gas supplied to the engine of $31.

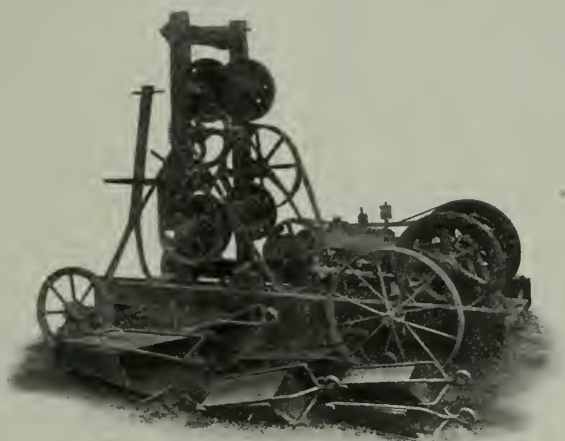
During a test of nine days the gas engine and power pump delivered 5,900,450 gallons of water with a gas consumption of 31,000 feet. This is equivalent to about 5 cu. ft. of gas per 1,000 gallons, giving a cost of 3/20 of 1 per cent. per thousand gallons.

The Stewart Sewer Cleaning Machine.

Some practical, efficient form of sewer cleaning device is a most essential part of the equipment of the sewer department of any city. This fact has been established and proven by the experience of many cities and towns.

W. H. Stewart, Sixteenth and Locust streets, St. Louis, Mo., has been demonstrating for a number of years the efficiency of the Stewart sewer cleaning machine, using for purposes of introduction a rental proposition, which allowed of the rental fee being applied upon the purchase price. During this time the machine has been used in more than one hundred cities.

The Stewart patent sewer cleaning machine is of the drag type, consisting of a set of buckets semi-circular and cone shape, having the large end open. Heavy iron rod form a guard which prevents the bucket from dragging on the bottom of the sewer and catching on high or rough joints. The bucket is operated with a cable attached to each end and a windlass at each manhole. A bucket of a smaller size than the diameter of the sewer is first drawn into the sewer backwards as far as possible over the dirt, then in pulling forward, the pull coming from the upper back corner of the bucket, as it is hung there, forces the digging edge to the bottom of the sewer, and as it is drawn out it carries to the manhole not only the bucket full of dirt, but also a considerable amount of dirt which is pushed ahead of the bucket. The dirt ahead of the bucket is taken out by shoveling it into a pail and hoisting through the manhole. The machine bucket can either be dumped in the manhole and shoveled out or hoisted to the surface and dumped.



ENGINE TYPE STEWART SEWER CLEANING MACHINE.

The buckets are made of boiler steel, about ⅛ of an inch thick and from 12 to 36 inches in length, with a cage of iron from ⅜ to ¾ of an inch in diameter, according to size The largest size is made to go in a manhole in sections. These are for trunk line sewers and do not come to the surface full.

When being drawn back into the sewer

(for a distance according to the amount of sediment), the bucket, hanging as it does from the upper edge of the cage, allows the point to rise easily, and if the sediment is very hard the construction of the cage is such that it will positively cut into it and loosen it up, because the top of the cage touches the top of the sewer and cannot rise.

The accompanying photograph shows a new type of the Stewart machine. The motive power for the buckets on this machine is a 3 to 5 h.p. air-cooled gasoline engine, provided with special clutch connections. A double-geared windlass and extra frame is provided for use in case it is desirable to use hand power.

W. H. Stewart also manufactures a special hook sewer and conduit rod, which is widely used.

Attractive Ornamental Light Standards.

The Davenport Machine and Foundry Company, Davenport, Iowa, have a very attractive line of electric light poles or standards for streets, boulevards and parks. A booklet issued by them contains photographs and descriptive matter relating to twelve of their principal designs.

The standards shown are for the most part adaptions of the classic column forms, with ornamental bases and arms and short column heads, supporting the lights and globes. The height of the five-light cluster standards shown is in most cases 12 feet 9 inches to the top of the center globe. Ten-inch side globes and fourteen-inch top globes are specified in most cases.

The Davenport Machine and Foundry Company also manufacture a very complete line of municipal castings, such as manhole covers and rings, catch basin frames and grates, inlets, etc., in addition to heavier structural shapes.

The Hetherington & Berner Brick Testing Machine.

Hetherington & Berner, Indianapolis, Ind., have placed on the market a brick rattler which is constructed strictly according to the National Paving Brick Manufacturers' standard.

Owing to the indefiniteness of the specifications for a rattler, which were adopted at the meeting in 1901, the rattlers that were built under the said specifications did not produce uniform results, and the matter wa taken up by the N. P. B. M. Association and the specifications were revised and improved by the committee and presented to and adopted by the National Paving Brick Manufacturers' Association at its meeting in Louisville in February, 1911. The revised specifications are those under which are constructed the testing rattler built and offered to municipalities and to the brick-making trade by Hetherington & Berner.

For the abrasive charge the Hetherington & Berner machine is supplied with spheres of a special grade iron according to the following composition:

Combined Carbon—Not less than 2.50 per cent.

Graphite Carbon—Not more than 0.10 per cent.

Silicon—Not more than 1 per cent.

Manganese—Not more than 0.50 per cent.

Phosphorus—Not more than 0.25 per cent.

Sulphur—Not more than 0.08 per cent.

An extra 200 pounds of shot is furnished with each machine, making 500 pounds in all supplied.

Hetherington & Berner have a special descriptive circular giving the full specifications, directions for testing and a list of parts for this machine.

H. W. Johns-Manville Co. in Louisville.

Owing to their fast increasing business in Louisville, Ky., the H. W. Johns-Manville Company have found it necessary to move their offices from the Lincoln Savings Bank building to 205 Paul Jones building. These new and more spacious quarters are much better adapted to their requirements.

The office will be in charge of Mr. J. R. Chowning, who is well known throughout that section, having traveled in that section from the Milwaukee office a considerable time. A complete line of J-M asbestos and magnesia products, electrical supplies, packings, pipe coverings, roofings, etc., will be handled from this office.

Trade Publications.

The General Fire Extinguisher Company, Providence, R. I., has a quarterly bulletin known as the Automatic Sprinkler Bulletin. This quarterly publication, devoted to the interests of fire prevention from the standpoint of the automatic sprinkler, contains a great deal of detailed information regarding the actual operation of sprinklers in cases where fires call them into action. The January number carries with it digests of the reports of the Chamber of Commerce of Rochester, N. Y., and Boston, Mass.

C. A. P. Turner, 816 Phoenix building, Minneapolis, Minn., has issued Bulletin 12, giving examples of the "Mushroom" system of reinforced concrete construction. Photographs and much detailed information are contained in the bulletin. The wide distribution of the work can be judged from illustrations in this publication showing buildings scattered from Portland, Me., in the east, to Portland, Ore., in the west, and from the cities of Winnipeg, Man., and Regina, Sask., in the north to Melbourne, Australia, in the south.

The American Asphaltum and Rubber

Company, 600-617 Harvester building, Chicago, Ill., has published an attractive reprint of a short poem, "The Army of God Knows Where," by Alfred Damon Runyon. The poem is dedicated to "our civil engineers," and shows an appreciation of the civil engineer as a pioneer in all great works.

The J-M sectional conduit is fully described and very completely illustrated in Catalog No. 112 of the H. W. Johns-Manville Company, 100 William street. New York, N. Y. The conduit described is manufactured from a thoroughly ground and mixed combination of stoneware clay, fire clay and spar; and is molded in two sections, an invert and a covering, which may be united in place by cement. The catalog is very complete and is a very valuable addition to the files of the engineer or contractor.

Bulletin No. 102 of the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., treats of the Diesel oil engine as applied to brewery and ice plant requirements. A very complete technical discussion is given in addition to tables of dimensions, weights and power ratings of two of their types of engine.

The Lehigh Portland Cement Company, People's Gas building, Chicago, Ill., has a new form of publication, which is in fact a small magazine devoted to Lehigh cement and the dealers who distribute it. "Lee-Hi," the new addition to their advertising force, receives an introduction in the first issue of their new publication.

The following are some of the articles in the current number of "Lubrication," a quarterly publication of The Texas Company, New York: "Losses Caused by Inadequate Filtering Systems," "Conditions Where Lubrication Has Been Impossible," "Practical Troubles Remedied," "An Unusual Condition in Hydraulic Pump Work."

The Thomas "Acme" air-cooling and purifying system is described in two pamphlets published by Thomas & Smith, 116-118 North Carpenter street, Chicago, Ill.

The January Bulletin of the Universal Portland Cement Company, 72 West Adams street, Chicago, Ill., contains among other matters of interest illustrated descriptions of concrete piles for foundations, a county bridge of concrete, concrete building construction and concrete pavement construction.

The Goulds Manufacturing Company, '31 West Fall street, Seneca Falls, N. Y., has for distribution three bulletins: No. 107, "Deep Well Triplex Pumps"; No. 108, "Deep Well Working Heads," and No. 109, "Pumps for Special Service."

Trade Notes.

ASPHALT.

Kearney, Neb.—After considerable discussion relative to the merits of different kinds of material, the council has ratified the choice of bitulithic manufactured by the Warren Brothers Company, 59 Temple place, Boston, Mass., for use in the paving of Kearney avenue.

MACHINERY.

Quitman, Ga.—The purchase of road machinery and a gasoline traction engine is contemplated by the county commissioners of Brooks county.

Dana, Ind.—Special—H. L. Fillinger desires information regarding ditching machines for digging tile ditches.

Laurenburg, N. C.—Special—Moxey L. John desires to purchase a transit for city work.

Cleveland, O.—The purchase of automobile trucks for hauling trains of garbage wagons is contemplated. W. J. Springborn is director of public service.

MISCELLANEOUS.

The MacArthur Concrete Pile and Foundation Company, 11 Pine street, New York, have been recently awarded the following Pedestal concrete pile contracts: Foundations for a manufacturing building, Saginaw, Mich., for Hammond-Standish; architects, Coles & Mutcheller, Saginaw. Foundations for a warehouse building at Hamilton, Ont., for Oliver Chilled Plow Works, ltd., of Canada. Prack & Perrine are the architects. The third contract is for a foundation for a three-quarter-million-dollar court house for Fulton county, Atlanta, Ga. Over 1,200 Pedestal piles are being driven. A. TenEyck Brown and Morgan & Dillon are the architects.

Patents Concerning Apparatus for Preparing and Handling Concrete and Concrete Materials.

893,168. Cement Spreading Machine. Isaac Hewitt, Victoria, B. C. Canada.

928,858. Concrete Holding and Carrying Device. Arthur N. Doud, North Stockholm, N. Y.

932,746. Cart for Distributing Concrete, Etc. Nils F. Ambersen, Newton, Mass.

934,092. Bucket for Concrete Building Material. Nicholas C. Newer, Buffalo, N. Y.

951,754. Method of Handling Plastic Material. Josiah W. Buzzell, E. Orange, N. J., and Wm. H. Larking, Jr., Laporte, Ind.

957,565. Apparatus for Separating Gravel from Sand, Etc. Carsten E. Fergusen and Wm. Idstrow, New Orleans, La.

968,928. Sand and Gravel Separator. Herbert A. Frankenstein and Frank H. Amos, South Bend, Ind.

972,792. Mortar Feeding Device. Chas. E. Allred, Oakland, Cal.

978,693. Apparatus for Washing Sand and Like Material. Seth A. Capron, Westfield, Mass.

989,263. Gravel Loader and Excavator. Fred Hallowell, Orleans, Ind.

990,194. Loader for Concrete Mixers. Jas. DuShane, South Bend, Ind.

991,450. Concrete Conveyor and Distributer. Geo. Mingo, Cedar Rapids, Iowa.

991,814. Apparatus for Mixing and Applying Plastic or Adhesive Materials. Carl E. Akeley, Chicago, Ill.

992,724. Concrete Bucket. Willard D. Lockwood, Schenectady, N. Y.

1,004,663. Rock Crusher. John M. Landrum, East Lake, Ala.

1,005,138. Bucket for Transporting Plastic Material. Chas. L. Bartlett, Cedar Rapids, Iowa.

1,005,516. Furnace for Drying Sand and Crushed Stone. Wm. D. Craven, Jr., Ridley Park, Pa.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Atlanta, Ga.—February 5, 3 p. m. Street improvement work during 1912 as follows: 1. Furnishing and setting granite curbing. 2. Furnishing and setting concrete curbing. 3. Furnishing and laying tile sidewalks. 4. Furnishing and laying sheet cement sidewalks. 5. Furnishing and laying brick sidewalks. 6. Furnishing gravel. 7. Furnishing brick for repair work. 8. Furnishing stone and crushed stone for macadam. 9. Furnishing cement for street department. R. M. Clayton, chief of construction.

Rome, Ga.—February 14. Paving First street between Third and Second avenues, and Third avenue betwen Broad and East First. Board of Public Works.

Lawrenceburg, Ind.—February 6, 12 m. Constructing road in Jackson township. William S. Fagely, auditor.

Logansport, Ind.—February 6, 10 a. m. Constructing macadam road in Tipton township. J. W. Wallace, auditor.

Madison, Ind.—February 6, 1 p. m. Constructing macadamized road in Madison township. A. M. Hass, auditor.

Monticello, Ind.—February 6, 12 m. Constructing stone roads in Big Creek township. A. B. Fisher, auditor.

Rensselaer, Ind.—February 6, 3 p. m. Constructing macadam road in Wheatfield township. Joseph P. Hammond, auditor.

Williamsport, Ind.—February 5. Constructing gravel roads in Steuben and Jordan townships. E. H. Moffitt, auditor.

Winamac, Ind.—February 6, 12 m. Constructing highway. W. E. Munchenburg, auditor.

Decatur, Ind.—February 5, 10 a. m. Constructing 5 macadam roads. H. S. Michaud, auditor.

Vincennes, Ind.—February 6, 2 p. m. Constructing gravel road in Vigo, Vincennes and Busseron townships. John C. Scott, auditor.

Topeka, Kas.—February 19. Furnishing a road roller and grader. Board of County Commissioners.

Tompkinsville, Ky.—March 8. Constructing 4 miles of pike. Certified check, $200. C. L. Bradshaw, chairman Board of Road Commissioners.

Winona, Minn.—April 9. Constructing 21 miles of macadam road. Jos. Winczewski, county auditor.

Steubenville, O.—February 15, 12 m. Grading, macadamizing and draining the Smithfield and Hopedale road under the following sections: Section 1, 10,283 feet; section 2, 9,735 feet; section 3, 984 feet. Certified check, $500 on each bid. Howard M. Bell, chairman road commissioners.

Jonesboro, Tenn.—February 15. Constructing portion of the Memphis-Bristol highway. Engineer Huffaker, Jonesboro, Tenn.

Racine, Wis.—February 3. Constructing 10,900 sq. yds. pavement, 2,221 lineal ft. concrete gutter and 2,723 lineal ft. concrete curb and gutter. P. Connolly, city engineer.

CONTRACTS AWARDED.

Lodi, Cal.—Paving Sacramento, Pine and Elm streets, to the Ransome-Crunney Co., $35,672.

Los Angeles, Cal.—Paving Wilshire boulevard, to the Barber Asphalt Co., $227,109.

Monterey, Cal.—Paving Pine street, to the P. A. Work Co., $13,300.

Hartford, Conn.—Paving Albany avenue and Scarborough street, to the Hartford Paving and Construction Co., Hartford, Conn., $17,849.

Chicago, Ill.—The following paving contracts have been awarded: Indiana street, with granite, to James A. Sackley & Co., Chamber of Commerce, Chicago, Ill., $30,786; Western avenue, with brick, to the Calumet Coal & Teaming Co., 2946 East 95th street, Chicago; Lawndale avenue, with brick, to the Citizens' Construction Co., 133 West Washington street, Chicago, $27,417; West 59th street, with brick, to the Calumet Coal and Teaming Co., $34,858; 56th street, with brick, to the Rennaker Construction Co., 9 South La Salle street, $14,000; 43d avenue, with brick, to the Citizens' Construction Co., $10,333; Exchange avenue, with macadam, $48,572, and Charles street, with macadam, $29,194, to Farr Bros., 356 West 111th street, Chicago; Avenue N, to the Illinois Improvement and Ballast Co., 72 West Adams street, $17,029; alleys in Arlington place, with brick, to the Central Paving Co., 179 West Washington street, $4,832; alleys in Washington boulevard, with brick, to James A. Saxley Co., $1,860; alleys, Wilson avenue, etc., with brick, to the Central Paving Co., $2,985.

Rockford, Ill.—Paving North Water street with brick, to A. E. Rutledge, $9,000.

Benton, Ind.—Constructing the Pitscick road, to Nicoson & Pierce, Alexander, Ind., $10,832.

Fowler, Ind.—Constructing the Schnider road and a series of streets, to George Matthews, $7,157.

Louisville, Ky.—Constructing the Bardstown road, to the American Standard Asphalt Co., Louisville, Ky.

Louisville, Ky.—Paving Spratt street, to B. W. Gosnell, $13,200.

New Orleans, La.—The following paving contract has been awarded: Burgundy street, to Thomas Egan, $55,283.

Minneapolis, Minn.—Furnishing 175,000 yards of creosoted wood block for paving, to A. W. Van Hassten.

Maplewood, Mo.—The following paving contracts have been awarded: Manchester road, to the E. A. Heman Construction Co., St. Louis, Mo., $21,200; constructing sidewalks, to the Graham Granitoid Co., St. Louis, Mo., $18,183.

Lincoln, Neb.—Constructing pavements in 4 districts, to Able & Roberts, $46,600.

Ocean City, N. J.—Constructing Ocean City boulevard, to Sutton & Corson Co., Ocean City, N. J., $94,258; constructing Sea Isle City road, to H. Y. Clouting, of Beesle's Point, $24,971.

Cincinnati, O.—Constructing sections of the Ludlow avenue viaduct, to C. H. Glandorff, Thomas P. Strack and the Kirchner

Construction Co., Cincinnati, O. Contract price, $259,585.

Cincinnati, O.—Constructing asphalt pavement on Hackberry street, to Henkel & Sullivan, $13,767; paving Moorman avenue with asphalt, to the same, $6,035.

Cincinnati, O.—Constructing the Shady Lane road, to Van Camp Bros., Newtonville, O., $18,143.

Dayton, O.—Constructing brick pavement and storm sewers in Burkhart avenue, to E. M. Gebhart, $41,605; paving Rubicon street, to Warren Bros. Co., Boston, Mass., $1,217; constructing sidewalks and grading Huffman avenue, to A. J. Kammer, $1,150.

Findlay, O.—Constructing 3½ miles of stone road, to Chas. Edgington, McComb, O., $18,195.

Toledo, O.—Constructing municipal asphalt plant, to the East Iron Machine Co., Lima, O., $9,000.

Youngstown, O.—The following street contracts have been awarded: Grading Plum street, to James Cumisky, $900; paving Glenhaven street, to Miller Bros., $4,073; paving Grace avenue, to Miller Bros., $6,952; paving Walnut street, to Charles Harris, $12,629.

Portland, Ore.—Paving Raleigh street, to the Warren Construction Co., $52,000.

Portland, Ore.—Resurfacing Sandy boulevard, to the Oregon Independent Paving Co., $192,000.

Greensburg, Pa.—The following road contracts have been awarded: The Puckety Creek road, to Reinhardt Bros., East Liverpool, O., $42,018; Perrysville road, to the Duster Contracting Co., of Tarentum, Pa., $48,897.

Wilkesbarre, Pa.—Constructing roads in Luzerne county have been awarded as follows: Section 1, to B. G. Coon, Dorrancetown, at $55,450; section 2, to E. P. Post, Wilkesbarre, at $60,417; section 3, to Herrick Construction Co., at $40,695; section 4, to Freeland Construction Co., Freeland, at $82,416.

Dallas, Tex.—Paving Collett avenue and East Side avenue with asphalt macadam, to the Standard Engineering and Construction Co., Dallas, Tex.

Seattle, Wash.—Paving 26th avenue, to Becker & Walker, $15,207.

Kenosha, Wis.—Constructing 9,500 sq. yds. of vitrified brick pavement, to the White Construction Co., Majestic building, Milwaukee, Wis., $18,000.

Edmonton, Alta., Can.—The Bitulithic Paving and Contract Co., of Winnipeg, has been given the contract for constructing 75,000 sq. yds. of bitulithic pavement during 1912, and the National Paving and Contracting Co., of Winnipeg, has been awarded contracts for 25,000 sq. yds. of asphalt paving during 1912. A. J. Lagorell, city engineer.

CONTEMPLATED WORK.

Little Rock, Ark.—The paving of West 23d street, to cost about $45,000, is contemplated. W. S. Reichardt, engineer.

San Diego, Cal.—A $1,250,000 bond issue for 450 miles of highway and boulevard has been voted.

Stamford, Conn.—A $50,000 bond issue for the paving of West Main street and Elm street has been authorized.

Quitman, Ga.—The purchase of road machinery and a gasoline traction engine is contemplated. The county commissioners of Brooks county.

Sylvester, Ga.—A $20,000 bond issue for road improvement has been voted.

Centralia, Ill.—The paving of about 8 miles of street is contemplated. L. F. Trainor, city engineer.

Chicago, Ill.—The construction of a creosoted block manufacturing plant to cost about $60,000 is contemplated. L E. McGann, commissioner of public works.

Kankakee, Ill.—The paving of West Court street with vitrified brick, to cost about $21,000, is contemplated.

Mattoon, Ill.—The paving of about twenty miles of roadway in Mattoon township with brick is contemplated. Estimated cost about $140,000.

Moline, Ill.—The paving of 23d avenue with brick, to cost $37,840; 14th avenue with asphalt, to cost $17,322, and 13th street, to cost $4,584, is contemplated.

Peoria, Ill.—The paving of Linn street, to cost about $20,000, and the paving of Spring street, to cost about $11,000, is contemplated.

Rockford, Ill.—The paving of East State and Charles streets, estimated cost $44,790, is contemplated.

Waukegan, Ill.—Paving construction as follows is contemplated: Steele Court and Corey avenue, estimated cost $15,900; Lawn Court with macadam, $1,006; Gillette avenue with brick, estimated cost $9,789.

Bourbon, Ind.—The construction of about two miles of 28-foot brick roadway is contemplated for 1912. V. C. Keller, president board of trustees.

Elkhart, Ind.—The paving of about two miles of street, to cost about $65,000, is contemplated.

Davenport, Ia.—Proposals for the city paving during 1912 will probably be asked by the Board of Public Works on Feb. 6.

Webster City, Ia.—The construction of 20 blocks of concrete asphaltic concrete or brick pavement is contemplated.

Murray, Ky.—The county court has appropriated $10,000 for the construction of the Jefferson Davis highway.

Kalamazoo, Mich.—The paving of a number of streets with macadam, estimated cost $80,000, is contemplated. H. A. Johnston, engineer.

Menominee, Mich.—Road improvements to cost about $100,000 are contemplated by Menominee county.

Owosso, Mich.—A $15,000 bond issue for paving construction has been voted.

Fulton, Mo.—A $100,000 bond issue for the construction of permanent roads has been voted.

Wentworth, Mo.—The construction of a 13-mile gravel road to connect Wentworth and Diamond, Mo., is contemplated.

Avon, N. Y.—An $18,000 bond issue for street improvement has been voted.

Canal Dover, O.—The paving of a number of streets, to cost about $32,000, is contemplated.

Canton, O.—The paving of West 9th street and Lynch street, to cost about $19,000, is contemplated. Phil H. Webber, city engineer.

Cincinnati, O.—A $203,500 bond issue for paying the city portion of the street and alley improvement has been voted.

New Philadelphia, O.—Constructing two miles of roadway, to cost about $13,000, is contemplated. County commissioners of Tuscarawas county.

Portland, Ore.—The establishment of a municipal street repair plant is contemplated.

Blountville, Tenn.—A $200,000 bond issue for road construction has been voted bv Sullivan county.

Gallatin, Tenn.—A $200,000 bond issue for the construction of roads has been voted.

Knoxville, Tenn.—A $15,000 bond issue for paving construction has been sold.

Beaumont, Tex.—A $60,000 bond issue for paving improvements and a $60,000 bond issue for park extension have been voted.

Comanche, Tex.—A $1,600,000 bond issue for the construction of roads and bridges in the county has been voted.

Lufkin, Tex.—Road improvements to cost about $200,000 are contemplated.

Mexia, Tex.—A $150,000 bond issue for road construction has been voted.

Midland, Tex.—The construction of sample stretches of highway for educational purposes is contemplated.

Palestine, Tex.—A $150,000 bond issue for road construction has been sold.

Sherman, Tex.—A $400,000 bond issue for road construction has been voted.

Tehuacana, Tex.—A $150,000 bond issue for the construction of roads in Limestone county has been voted.

Victoria, Tex.—A $200,000 bond issue for road improvements has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Lynchburg, Va.—A $550,000 bond issue for street improvement and sewer construction has been voted.

Richmond, Va.—The construction of a boulevard to Riverside Park to cost about $12,000 is contemplated. Chas. B. Bolling, city engineer.

Bellingham, Wash.—The paving of Meridian street to cost about $60,000 is contemplated.

Everett, Wash.—The construction of a boulevard to Mukilteo, a distance of three miles, is contemplated.

Milwaukee, Wis.—Street paving to the amount of $2,397,450 is contemplated as follows: Asphalt, 1,000,000 sq. yds., estimated at $1,500,000; stone block, 50,000 sq. yds., estimated at $175,000; macadam, 10,000 sq. yds., estimated at $10,000. Harry E. Briggs, commissioner of public works.

Woodstock, Wis.—A $25,000 bond issue for paving construction has been voted.

SEWERS.

BIDS REQUESTED.

Pine Bluff, Ark.—Feb. 17, 3 p. m. Constructing sanitary sewers in District No. 15. Certified check, $300. William J. Parks, Citizens Bank building, engineer; T. A. Wilson, president commissioners.

Atlanta, Ga.—Feb. 5, 3 p. m. Sewer construction during 1912 as follows: 1, constructing eastern section sewer; 2, constructing western section sewer; 3, furnishing vitrified sewer pipe; 4, furnishing castings for sewer; 5, furnishing cement for sewers. R. M. Clayton, chief of construction.

Mattoon, Ill.—Mch. 1. Constructing vitrified pipe sewers. C. L. James, city engineer.

Hannibal, Mo.—Feb. 29, 12 m. Sewer construction as follows: Estimated cost of work, $37,000; 10,000 ft. of 6-in., 6,000 ft. of 7-in., 3,000 ft. of 8-in, 500 ft. of 12-in. pipe, 1,200 ft. of 6x8 concrete box, 1,300 ft. of 6x6 concrete box, 1,100 ft. of 6x4 concrete box and 500 ft. of 2½x2½ concrete box. No excavation or fill on concrete part, shallow excavation on vitrified pipe. B. F. Smiley, city engineer.

Watervliet, N. Y.—Feb. 14, 2 p. m. Sewer construction as follows: 80,000 cu. yds. of earth excavation; concrete overflow and outlet works, 9,100 ft. concrete conduit from 3 ft. to 8 ft. 6 in. in diameter; 1,000 ft. of terra cotta sewer pipe. Certified check, 5 per cent. John D. Brown, president sewer commission; Solomen, Norcross & Keif, Atlanta, Ga., engineers.

Madison, S. D.—Feb. 15, 8 p. m. Constructing sewage disposal works as follows: Settling tank, contact and filter beds; 5,000 lbs. structural steel, 175 cu. yds. reinforced concrete, 1,500 ft. 4-ft. to 18-inch drain tile, 1,000 ft. 6-in. to 10-in. gutter pipe, 200 lin. ft. 18-in. double strength sewer pipe. Certified check, $500. George H. Waskey, mayor; William Rae, city auditor.

Mitchell, S. D.—Feb. 5, 8 p. m. Sewer construction as follows: Branch R. 1,292 ft. 8-in. pipe, 4 manholes; Branch R, 1,065 ft. 8-in. pipe, 3 manholes; Branch T. 1,690 ft. 8-in. pipe, 4 manholes. Certified check, 5 per cent. on each bid. M. H. Jenson, city auditor.

CONTRACTS AWARDED.

Mobile, Ala.—Constructing concrete storm sewers in the tenth paving district, to Sullivan, Long and Hagerty, Bessemer, Ala.

San Francisco, Cal.—Construction Section C of the Ingleside outlet sewer, to the Contra Costa Construction Company, San Francisco, Cal., $60,500.

Denver, Colo.—Constructing sewers in sub-District No. 14, to the Denver and Pueblo Construction Co., Denver, Colo., $50,732.

Hartford, Conn.—Constructing sewers as follows: 2,700 ft. in Scarborough street and 2,300 ft. in Albany avenue, to the Hartford Paving & Construction Co., Hartford, Conn.

Unadilla, Ga.—Constructing sewers and a water works system, to Walton & Wagner, $22,825.

Vincennes, Ind.—The city has contracted with the Vincennes Sewer Association for the construction of a complete sanitary system to be rented by the city for a period of 25 years.

Atchison, Kan.—Constructing a sewer in West Atchison, to Williams & Sample, Kansas City, Mo., $22,560.

St. Paul, Minn.—Constructing the Snelling-Edmund sewer system, to Gilbert W. Haggert, Fargo, N. D., $39,000.

Kansas City, Mo.—Constructing tile sewers in Raytown road, to T. W. Roberts, $26,461.

St. Louis, Mo.—Constructing sewers in Lindenwood, Sewer District No. 1, to John S. McMahon, $19,820.

Las Cruces, N. M.—Constructing sewers and a water works system, to Bash & Gray, Joplin, Mo., $54,953.

Gates, N. Y.—Constructing sewer in Otis street, to Whitmore, Rauber & Vicinus, Rochester, N. Y., $42,298.

Johnstown, N. Y.—Constructing a 30-in. trunk sewer and lateral, to Chas J. McAleer, 1307 Lafayette street, Schenectady, N. Y.

Rochester, N. Y.—Constructing Contract No. 3 of the intersecting sewers, to Whitmore, Rauber & Vicinus, Rochester, N. Y., $261,845.

Troy, N. Y.—Constructing the Pawling avenue intercepting sewer, to Evelind Bros., Waterford, N. Y., $28,323.

Dayton, O.—Paving and constructing sewers in Burkhart avenue, to E. M. Gebhart, $41,605.

Springfield, O.—Constructing a Belmont avenue sewer to Hounker & Williams, $10,451.

Springfield, O.—Constructing sewers in Columbia street, to M. J. Cooney, $9,030.

Oklahoma City, Okla.—Constructing an electrolytic sewage disposal plant, to J. A. McMahan & F. E. Bennett, $16,582.

Waco, Tex.—Constructing extensions to a sanitary sewer system, to H. C. Gass, Independence, Kan.

North Yakima, Wash.—The city commission has rejected the bids of Robinson & Foster, of Spokane, and awarded the construction of the West Side sewer to B. T. Daniels, of North Yakima, Wash., $43,031.

Toppenish, Wash.—Constructing a complete sewer system to cost about $50,000, to McKim, Nevin & Co., of Puyallup, Wash.

Lethbridge, Alta, Can.—Constructing a sewage disposal plant, to Hodson, Leader & Goode, of Lethbridge.

CONTEMPLATED WORK.

Fort Pierce, Fla.—A $30,000 bond issue for sewer construction has been voted.

Lakeland, Fla.—A $75,000 bond issue for sewer construction has been voted. C. S. Brush, city engineer.

Douglas, Ga.—A $10,000 bond issue for the construction of sewers has been voted.

McDonough, Ga.—The construction of a sewerage system to cost about $18,000 is contemplated.

Savannah, Ga.—A $600,000 bond issue for the construction of both storm water and sanitary sewers has been voted.

Sylvester, Ga.—A $20,000 bond issue for water works and sewer construction has been voted.

Kellogg, Idaho.—C. H. Green, Spokane, Wash., has prepared plans and specifications for a joint sewer system for Kellogg and Wardner, Idaho, to cost about $44,000.

Sand Point, Idaho.—A $14,000 bond issue for sewer construction has been voted.

Alton, Ill.—C. B. Stakemiller has been retained as the consulting engineer on the construction of a trunk sewer in Upper Alton.

Galesburg, Ill.—Construction of a sewer in East Main street to cost $18,000 is contemplated. F. N. Connelly, city engineer.

Rochelle, Ill.—The Aetna Engineering Bureau, 17 N. LaSalle street, Chicago, has prepared plans for the construction of a sewer system to cost $90,000.

Sparta, Ill.—The construction of a sewerage system to cost about $79,000 is contemplated.

Evansville, Ind.—The construction of a sewer to cost $15,000 is contemplated.

Griswold, Ia.—Bruce Standeven & Co., Omaha, Neb., have been retained to prepare plans for a complete sewerage system.

Mason City, Ia.—The city has been instructed by the Iowa state board of health to construct a sewage disposal plant.

Ottumwa, Ia.—The extension of the West End trunk sewer to cost about $66,000 is contemplated. John C. Brady, engineer.

Sioux City, Ia.—The construction of storm water sewers are contemplated.

Wardner, Ia.—The construction of sewers to cost about $20,000 is contemplated.

Columbus, Kan.—A $14,000 bond issue for sewer construction has been voted.

Lawrence, Kan.—The construction of storm sewers to cost about $17,300 is contemplated.

McPherson, Kan.—H. A. Rowland, city engineer, has been instructed to prepare plans for the construction of sanitary sewers.

Mulvane, Kan.—The construction of a sanitary sewer system to cost about $10,000 is contemplated.

Wabena, Minn.—John Wilson, consulting engineer, Duluth, Minn., has prepared plans for a complete sewer system to cost about $23,000.

Newark, N. J.—Rudolph Hering and John H. Gregory, 170 Broadway, New York City, have been retained to prepare plans for the construction of a sewage disposal plant for Orange and Montclair.

Middleport, N. Y.—Plans for a sewer system to cost about $55,000 are being prepared by Engineer Hopkins, Buffalo, N. Y.

Scarsdale, N. Y.—The installation of a sewerage system to cost about $125,000 is contemplated.

Athens, O.—A $10,500 bond issue for storm water sewer construction has been voted.

Cincinnati, O.—Sewer construction to cost about $95,000 is contemplated. J. J. Wenner, clerk department of public service.

Sallisaw, Okla.—Winters and Dove, Fort Smith, Ark., have been retained to prepare plans for a sanitary sewer system and sewerage disposal plant. A $45,000 bond issue has been sold.

Portland, Ore.—City Engineer Hurlburt has completed plans for an intercepting sewer to extend from Marquam Gulch to Nicolai street. Estimated cost, $500,000.

Everson, Pa.—A $15,000 bond issue for sewer construction has been sold.

Williamsport, Pa.—Plans are being prepared for a new disposal plant for the Warren State Asylum to cost about $45,000.

Beaumont, Tex.—A $30,000 bond issue for sewer construction has been voted.

Warwood, W. Va.—H. J. Watson, Wheeling, W. Va., has prepared plans for the construction of a sewerage system to cost $15,000.

Cowley, Wyo.—A $25,000 bond issue for water works and sewer improvements has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Lynchburg, Va.—A $550,000 bond issue for street improvement and sewer construction has been voted.

WATER WORKS.

BIDS REQUESTED.

Stillwater, Minn.—Feb. 15, 3 p. m. Constructing steel standpipe. Louis W. Clark, engineer of board of water commissioners.

Manhasset, L. I., N. Y.—Feb. 15, 8 p. m. Water works construction as follows: Two 8-in. driven wells; brick pumping station; three sets of fuel oil engines, triplex pumps and accessories; oil tanks; water tower and foundation; 21 miles of cast iron pipe; 4 to 10-in; laying the same; 170 hydrants, valves and specials. Certified check, $8,000. Johnson & Fuller, 115 Nassau street, New York City, engineers; Daniel S. Wooley, chairman board of water commissioners of Manhasset-Lakeville water district.

Twist, Wash.—Feb 15. Constructing water works system costing about $12,000. Town clerk.

Cumberland, Wis.—Feb. 27, 12 m. Constructing 4-in. water main. A. F. Wright, city clerk.

CONTRACTS AWARDED.

Exeter, Cal.—Constructing water works system complete, to C. E. Vincent, Oakland, Cal., $31,592.

Fullerton, Cal.—Constructing a reservoir, to C. E. Burker, Fullerton, Cal.

Alamosa, Colo. — Constructing water works improvements to cost about $10,000, to Marshall Bros.

Pueblo, Colo.—Constructing a concrete reservoir, to B. R. Gibbons, Pueblo, Colo.

Tallahassee, Fla.—Furnishing cast iron pipe for water works extension, to the Central Foundry Co., 90 West street, New York City.

Jessup, Ga.—Constructing water works system complete, to B. F. Roberts, Macon, Ga., about $30,000.

Unadilla, Ga.—Constructing sewers and a water works system, to Walton & Wagner, $22,825.

Lewiston, Idaho.—The laying of new water mains to cost about $6,000 is contemplated.

Tremont, Ill.—Constructing water main extension, to A. D. Thompson, Peoria, Ill., $8,327.

Audubon, Ia.—Constructing deep well at the city water works, to J. P. Keller Artesian Well Co., of Chicago, Ill.

Waterville, Kan.—Constructing water works and electric lighting system, to the Des Moines Bridge and Iron Co., of Des Moines, Ia., $27,976.

Loreauville, La. — Constructing water works system complete, to the General Contract Co., New Orleans, La.

Boston, Mass.—Laying water pipe in Draper and Regent road, to Daniel K. Lynch, $1,051.

McComb, Miss. — Constructing water works extensions, to B. A Heidenreichs & Co.

Manhattan, Mont.—Constructing water works system, to E. Lindstrom, Billings, Mont., $25,000.

Las Cruces, N. M.—Constructing water works and sewerage system, to Bash & Gray, of Joplin, Mo.

Charlotte, N. C.—Constructing pumping station for municipal water plant, to J. W. Haas, Charlotte, N. C., $20,000.

Euclid, O.—Constructing water main in Lake road, to Wilhelmi & Smith, 1329 Cove avenue, Lakewood, O., $30,319.

Olustee, Okla.—Constructing water works system, to E. B. Lundsen, Oklahoma City, Okla.

Portland, Ore. — The following water works improvements contracts have been awarded: 3,800 tons of cast iron pipe, to the Oregon Iron and Steel Co., Sherlock building, Portland, Ore., $117,900; 8,200 tons cast iron pipe, to the U. S. Cast Iron Pipe and Foundry Co., 71 Broadway, New York, $255,270; 500 tons cast iron pipe, to Smith and Watson Iron Works, 412 Tenth street, Portland, Ore., $24,500.

Columbia, S. C. — Constructing water works and sewer mains, to the Columbia Concrete Co., $5,300.

Elma, Wash. — Constructing pumping plant and distribution system, to Welton, Kibbe and Cochran, Portland, Ore., $14,806.

Seattle, Wash. — Constructing water mains and sewers in Dearborn street, to C. J. McHuth, Third avenue, North, Seattle, Wash., $36,888.

Tacoma, Wash.—Laying water mains, to Tony Fermo & John Cheva, $1,125.

Wacato, Wash. — Constructing water works plant complete, to the Fairbanks, Morse & Co., $7,497.

Kimball, W. Va.—Constructing water works system and electric light plant, to the Russell Co., Dayton, O., about $50,000.

CONTEMPLATED WORK.

Montgomery, Ala.—Water works improvements to cost about $20,000 are contemplated.

Madison, Fla.—A $30,000 bond issue for the purchase of the water works system and electric light plant has been voted.

Bainbridge, Ga.—A $10,000 bond issue for the installation of a water works system has been voted.

Sylvester, Ga.—A $20,000 bond issue for water works and sewer construction has been voted.

Salmon, Idaho.—A $50,000 bond issue for the purchase and improvement of the water works system has been voted.

Georgetown, Ill.—The installation of a water works system complete to cost about $10,000 is contemplated. H. O. Cook, city clerk.

Montgomery, Ill.—The installation of a water works plant to cost about $50,000 is contemplated.

Tampico, Ill.—Plans for a water works system to cost about $16,000 have been completed.

Owensville, Ind.—The installation of a water works system is contemplated.

Independence, Kan.—Extensive improvements to the water works system are contemplated. C. L. Wint, superintendent of water works.

Wichita, Kan.—The construction of a new water works plant, to cost about $1,000,000 is contemplated. Fred Ailey, superintendent of water works.

Keokuk, Ia.—The Keokuk Water Works Company has been incorporated by W. J. Davis, M. L. Rogers and F. E. Robertson, Wilmington, Del. Capital stock, $95,000.

Williamsport, Md.—The installation of a water works system to cost $25,000 is contemplated. W. D. Byron, mayor.

Ashburnham, Mass.—Ivers Adams, Boston, Mass., has offered to install a complete water works system for the town.

Wazatah, Minn.—A $20,000 bond issue for a water works system has been voted.

Bozeman, Mont.—The construction of a water works system to cost about $35,000 is contemplated.

Manhattan, Mont.—A $25,000 bond issue for water works installation has been voted. The contract has been awarded to E. Lindstrom, Billings, Mont.

Hastings, Neb.—A $75,000 bond issue for the installation of a municipal water plant has been voted.

Hudson Falls, N. Y.—A $175,000 bond issue for the construction of a gravity water works system has been voted.

Irondequoit, N. Y.—The Rochester & Lake Ontario Water Co. has been granted a franchise and will construct water works improvements to cost about $100,000.

Black Mountain, N. C.—A $15,000 water supply system is contemplated.

West Asheville, N. C.—Water works extensions to cost about $20,000 are contemplated. J. J. Merrimon.

Malvern, O.—An ordinance providing $18,500 bond issue for the construction of a water works system has been passed.

McAlester, Okla.—A $50,000 bond issue for water works improvement has been voted.

Sutherlin, Ore.—A $30,000 bond issue for the construction of a gravity water system has been voted.

Ambridge, Pa.—The purchase of a water works plant from the Harmony Water Co., at $55,000, is contemplated.

Barnesboro, Pa.—The Citizens Water Co. will construct a small pumping station, storage reservoir, pipe line, etc. A. B. Crichton, Title and Trust building, Johnstown, Pa., engineer.

Brookeville, Pa.—The city has purchased the Brookeville Water Company plant for $116,500.

Etna, Pa.—A $25,000 bond issue for water works improvements has been voted.

Greencastle, Pa.—A $10,000 bond issue for water works improvement has been voted.

Somerset, Pa.—A charter has been granted to the Hooversville Water Co. for the construction of a 16,000,000 gallon reservoir. O. P. Thomas, Johnstown, Pa., engineer; Telford Lewis, president.

Chamberlain, S. D.—A $20,000 bond issue for the installation of a pumping station has been voted.

Lexington, Tenn.—Richard C. Huxton, of Memphis, Tenn., has been retained to prepare estimates on the construction of a water works and electric light plant, and a sewerage system for the city.

Memphis, Tenn.—Water works extensions to cost about $250,000 are contemplated.

Calvert, Tex.—Improvements to the water works and electric light plant to cost about $14,000 are contemplated by the Calvert Water, Ice and Electric Light Co.

Decatur, Tex.—An $18,000 bond issue for the purchase of the water works and electric light system has been voted.

Leonard, Tex.—A $10,000 bond issue for water works construction has been voted.

Me. Vernon, Tex.—A $20,000 bond issue for water works improvement has been voted.

St. Albans, Vt.—A $60,000 bond issue for water works extension has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Seattle, Wash.—The sum of $18,700 has been appropriated from the water fund for the construction of mains in Dearborn street.

Spokane, Wash.—Alexander Lindsay, superintendent of water works, has prepared plans for high pressure water mains to cost about $200,000.

Kimball, W. Va.—A franchise has been granted to the Russell Co., Dayton, O., to construct a water works system to cost about $50,000.

Rowlesburg, W. Va.—The construction of a complete water works system is contemplated. George Hayes, town clerk.

Cowley, Wyo.—A $25,800 bond issue for water works and sewer improvements has been voted.

Medicine Hat, Alta, Can.—Water works extensions to cost $45,000 are contemplated.

BRIDGES.

BIDS REQUESTED.

San Luis Obispo, Cal.—Feb. 5, 10 a. m. Constructing steel highway bridge over the Santa Maria river. Certified check, 10 per cent. F. J. Rodrigues, clerk.

St. Jacob, Ill.—Feb. 10, 2 p. m. Constructing three reinforced concrete bridges in St. Jacob township. W. P. Sweeney, town clerk.

Brownstown, Ind.—Feb. 5, 1 p. m. Constructing bridge in Salt Creek township. H. W. Wacker, auditor.

Newport, Ind.—Feb. 5, 10 a. m. Constructing two bridges in Vermillion county. H. P. Payne, auditor.

Rensselaer, Ind.—Feb. 5, 2 p. m. Constructing four steel bridges in Kankakee township. Joseph C. Hammond, auditor.

Rushville, Ind.—Feb. 6, 2 p. m. Constructing two bridges on the Rush-Hancock line. Jesse M. Stone, auditor Rush county.

Winona, Minn.—April 9. Constructing an 80-ft. steel truss birdge. O. Leland, engineer.

Cincinnati, O.—Feb. 2, 12 m. Constructing a bridge over the Little Miami river under Specification No. 293. Bond, $5,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

Portland, Ore.—Feb. 16, 4 p. m. Constructing a reinforced concrete viaduct over Sullivan's gulch at East Twenty-first street. A. L. Barber, city auditor.

Bellefourche, S. D.—Feb. 6. Constructing all steel bridges during 1912. Certified check, $100. E. C. Barr, county aufied check, $1,000. E. C. Barr, county auditor.

Bellefourche, S. D.—Feb. 6. Constructing all wooden bridges during 1912. Cerditor.

Chehalis, Wash.—March 4, 2 p. m. Constructing a 24-ft. reinforced concrete culvert. H. A. Swofford, auditor.

CONTRACTS AWARDED.

Imboden, Ark.—Constructing steel bridge across Eleven Points river at Birdell, to the Vincennes Bridge and Iron Co., Vincenes, Ind.

Lake Village, Ark.—Constructing steel and concrete bridge across the Bayou Macon, to the Vincennes Bridge and Iron Co., of Vincennes, Ind.

Jacksonville, Fla.—Constructing a concrete bridge over Goodby's lake, to W. C. Kierman & Co., $14,200.

Atkinson, Ill.—Constructing 140-ft. steel viaduct, to the Joliet Bridge and Iron Co., Joliet, Ill., $5,170.

Bloomington, Ill.—Constructing a bridge across the Illinois river in Tazwell county, to the Union Bridge and Iron Co., of Kansas City, Mo.

Jerseyville, Ill.—Constructing a bridge over Otter creek, to the Missouri Bridge and Iron Co., St. Louis, Mo.

Murphysboro, Ill.—Constructing a bridge across the Little Mundy river, to the Vincennes Bridge and Iron Co., Vincennes, Ind.

Springfield, Ill.—Constructing a bridge over Sugar Creek, to the Springfield Bridge and Iron Co., Springfield, Ill.

New Albany, Ind.—Constructing a bridge over the Little Indian creek at Lanesville, to the Vincennes Bridge Co., Vincennes, Ind.

Council Bluffs, Ia.—Grading and bridging on the Northwestern railway, to E. A. Wickham & Co., Council Bluffs, Ia., about $500,000.

Creston, Ia.—Furnishing material and constructing bridges in Union county, Ia., during 1912, to the Standard Bridge Co., Omaha, Neb., $16,730. Theodore S. Delay, county engineer.

Dennison, Ia.—Constructing bridges during 1912, to the Lana Construction Co., of Harlam, Ia.

Wichita, Kan.—Constructing a bridge over the Minnestah river, to the Wichita Construction Co., Wichita, Kan.

Baltimore, Md.—Constructing the Monroe street bridge over the Baltimore and Ohio railroad, to the McClintic-Marshall Co., of Pittsburg, Pa., $15,000.

Saginaw, Mich.—Constructing highway bridge on the Gratiot road, to the Joliet Bridge and Iron Co., Joliet, Ill., $10,650.

Duluth, Minn.—Constructing a 2-span bridge over the St. Louis river, to the Continental Bridge Co., $6,490.

Warrensburg, Mo.—Constructing 31 steel bridges in Johnson county, to the A. E. Shorthill Co., Marshalltown, Ia., $12,989.

Libby, Mont.—Constructing three bridges across the Kootenai river, to the Pacific Coast Bridge Co., Portland, Ore., $82,103.

York, Neb.—Constructing all steel and wood bridges in 1912, to the Western Bridge & Construction Co., Omaha, Neb.

Lima, O.—Constructing bridge in Woodlawn cemetery, to the Lima Stone Co., $6,720.

Massillon, O.—Constructing a Strauss Trunion Bascule Lift bridge over the Ohio canal at West Main street, to the Massillon Bridge and Structural Co., $9,930.

Toledo, O.—Constructing the new Cherry street bridge, to the Scherzer Rolling Lift Bridge Co., Chicago, Ill., $132,980.

Portland, Ore.—Constructing the steel work of the Broadway bridge, to the Pennsylvania Steel Co., of Steelton, Pa.

Oregon City, Ore.—Constructing a bridge at Sunnyside gulch, to the Coast Bridge Co., Portland, Ore., $17,965.

Roseburg, Ore.—Constructing the Browns Ferry, the Umpqua and Winston bridges, to the Portland Bridge Co., Portland, Ore., $42,000.

Brownsville, Pa.—Constructing the Monongahela river bridge at Brownsville, Pa., to the Drake & Stratton Co., Philadelphia, Pa.

Houston, Tex.—Constructing two reinforced concrete bridges on Houston avenue, to the Gulf Concrete Construction Co., Housston, Tex., $31,000.

Salt Lake City, Utah.—Constructing steel bridge across the Jordan river at North Ninth street, to A. A. Clark, $6,980.

Davenport, Wash.—The Coast Bridge Co. will construct six bridges in Lincoln county to cost $8,500.

Seattle, Wash.—Constructing reinforced concrete viaduct on Fremont avenue, to P. Ryan, Sullivan building, Seattle, Wash., $46,323.

Quebec, Can.—Removing old bridge and constructing new one over the Richelieu river, to J. S. Metcalf, Montreal, Que., $75,000.

CONTEMPLATED WORK.

Bakersfield, Cal.—County Surveyor Buffington has been authorized to construct a concrete bridge over the Kern river at Chester avenue, to cost about $75,000.

Lodi, Cal.—The construction of a steel bridge across the Mokelumne river to cost about $35,000 is contemplated.

Scotia, Cal.—O. W. Simonson, engineer of the Pacific Lumber Co., has prepared plans for the construction of a steel bridge across the Eel river to cost about $148,000.

Willows, Cal.—Forest P. Boardman, professor of civil engineering, Nevada State University, has been retained as a consulting engineer on the construction of the Orland bridge over Stony creek at Stony Creek. Estimated cost, $150,000.

Yuba City, Cal.—The construction of a bridge across the Sacramento river at Meridian to cost $30,000 is contemplated by Sutter and Colusa counties.

Washington, D. C.—The construction of a bridge between Georgetown and Washington to cost about $275,000 is contemplated. P. T. Baily, Jr., engineer of bridges, District of Columbia.

Grand Junction, Colo.—County Surveyor Fisk has prepared plans for the construction of a bridge at Main street.

Bliss, Idaho.—F. Smith, Gooding, Idaho, has prepared plans for a bridge across the Snake river to cost about $11,000.

Gary, Ind.—The Lake county council has appropriated $75,000 for the construction of a bridge across the Calumet river at Indiana Harbor.

Richmond, Ind.—John Meuler, county engineer, is preparing plans for a bridge over the White river to cost about $100,000.

Toledo, Ill.—The construction of a reinforced concrete bridge to replace one destroyed by a cyclone is contemplated. Estimated cost, $12,000.

Topeka, Kan.—The construction of ten new bridges across the Shunganunda creek is contemplated.

Lynn, Mass.—Plans for a bridge across the Saugus river to cost $150,000 have been prepared by George I. Leland, city engineer.

Vassar, Mich.—The construction of a bridge over the Cass river to cost about $10,000 is contemplated. Perry Dean, town clerk.

Kansas City, Mo.—Louis R. Ash, city engineer, has submitted plans for the construction of a bridge over the McGee street traffic way, at Twenty-sixth street. Estimated cost, $15,000.

Minot, N. D—Park improvements and road construction to cost about $30,000 are contemplated.

Dayton, O.—City Engineer Cellarius has prepared plans and specifications for the construction of a bridge at Keowee street to cost about $65,000.

Enid, Okla.—Bids for the construction of about 50 bridges and culverts have been rejected and new proposals will be asked.

Norristown, Pa.—The construction of a bridge across the Schuylkill river is contemplated. W. H. Wetherell.

Pawling, Pa—The construction of a 3-span plate girder bridge over the Schuylkill river is contemplated by the commissioners of Chester and Montgomery counties.

McMinnville, Tenn.—The construction of a 565-ft. highway bridge over the Caney Fort river to cost about $15,000 is contemplated.

Comanche, Tex.—A $1,600,000 bond issue for the construction of roads and bridges in the county has been voted.

Orange, Tex.—A $200,000 bond issue for road construction has been voted.

Norfolk, Va.—W. T. Brooke, city engineer, has prepared plans for the construction of a bridge to cost about $450,000.

Aberdeen, Wash.—The construction of a $75,000 bridge to connect the city with South Aberdeen is contemplated.

Auburn, Wash.—The construction of a steel bridge to cost $10,000 is contemplated.

Chehalis, Wash.—Bowerman & McCloy, Central building, Seattle, Wash., have been instructed to prepare plans for a bridge over the Lewis river to cost about $60,000.

Mt. Vernon, Wash.—The construction of a steel bridge across the Skagit river to cost about $70,000 is contemplated.

Ocosta, Wash.—The construction of a new road and bridge between Ocosta and Westport to cost about $50,000 is contemplated.

Spokane, Wash.—The construction of four new county bridges to cost about $50,000 is contemplated. F. K. McBroom, chairman of county commissioners.

New London, Wis.—The construction of a bridge across the Wolf river to cost $15,000 is contemplated.

STREET LIGHTING.

CONTEMPLATED WORK.

Half Moon Bay, Cal.—The installation of a street lighting system is contemplated. Joseph H. Nash, clerk.

Los Angeles, Cal.—Lighting streets with arc lamps during 1912, to the Los Angeles Gas and Electric Corporation at $6.30 per arc lamp per month. The installation of 500 additional lights is contemplated.

Redwood City, Cal.—The installation of a street lighting system in the business district is contemplated.

Longmont, Colo.—The power plant of the Longmont Service Co. has been purchased by the city for the sum of $41,500. Extensions to the lighting system are planned.

Douglas, Ga.—A $15,000 bond issue for light and water improvements has been voted.

Peoria, Ill.—Mayor Woodruff is investigating the street lighting situation.

Anderson, Ind.—The city engineer is preparing plans for the installation of a new lighting system in the business district.

Allison, Ia.—A franchise has been granted for the installation of streets lights.

Carbon Cliff, Ia.—The construction of a municipal lighting plant is contemplated.

Columbus Junction, Ia.—The construction of an electric light plant and a street lighting system is contemplated.

Keokuk, Ia.—The Stone & Webster Co. is preparing plans for a new street lighting system.

Mobile, Ia.—Edgar Metcalf is planning the construction of an electric light plant.

Shenandoah, Ia.—A private lighting company has been granted a contract to install 155 tungsten lamps of 100-candle-power, and 20 3,600-candle-power lamps for the residence district.

Perry, Kan.—A $5,000 bond issue for the installation of a municipal electric light plant has been voted.

Island, Ky.—The installation of a street lighting system is contemplated.

Lexington, Ky.—The construction of a sewerage system and electric light plant and a water works system is contemplated.

Whitesburg, Ky.—E. P. Milling & Son, of Partridge, Ky., aer preparing plans for the construction of an electric light and power plant.

Lafayette, La.—Extensions to the municipal electric light and water works plant to cost about $50,000 are contemplated.

Biwabik, Minn.—The installation of an ornamental lighting system is contemplated.

Waterville, Minn.—A franchise has been granted to the Consumers Power Co., to furnish electricity for street lighting purposes.

Wazatah, Minn.—A $15,000 bond issue for an electric light plant has been voted.

Grand Rapids, Mich.—A committee appointed by the Business Men's Association has reported in favor of the cluster system for lighting the business district. Meyer F. May, chairman Retail Merchants' Association.

Kalamazoo, Mich. — A special lighting committee has been appointed by Mayor Farrell, to secure data on a street lighting system.

Kansas City, Mo.—The question of adopting a design for an ornamental street lighting standard is being discussed by three committees, which are as follows: Commercial Club, H. R. Ennis, S. Jenkins, W. A. Repp; the city, Frank B. Askew, D. H. Talbot; The Kansas City Ad Club, L. H. Scurlock and W. M. Hawkins.

St. Louis, Mo.—A franchise has been granted to David E. Leahy, Richard J. Baldwin and Philip A. Smith, to furnish light and power to St. Ferdinand and Central township for a period of 50 years.

Ventnor, N. J.—The construction of a municipal lighting plant to cost about $75,000 is contemplated.

Millville, N. J.—The construction of a municipal electric light, heating and power plant is contemplated. C. F. Chard, city engineer.

Elmira, N. Y.—A contract with the Elmira Water, Light and Railroad Co., for furnishing arc lights for a period of five years, has been completed. Ornamental lights are contemplated. Harry M. Beardsly, superintendent.

Rochester, N. Y.—The installation of several ornamental lighting units for test services is contemplated.

Maiden, N. C.—The installation of an electric street lighting system is contemplated.

Milton, N. D.—The installation of an electric street lighting system is contemplated.

Alliance, O.—The construction of a municipal light plant is being urged.

Napoleon, O.—The installation of ornamental light in the business district is contemplated.

Springfield, O.—The city is contemplating street lighting improvements to cost about $60,000. J. J. Miller, mayor.

Oklahoma City, Okla.—The Chamber of Commerce is agitating the question of an ornamental lighting system. Walter B. Moore, secretary.

Wagoner, Okla.—The Benham Engineering Co., Oklahoma City, Okla., has prepared plans and estimates for water works and electric light extensions.

Easton, Pa.—The construction of a municipal lighting plant is contemplated.

Harrisburg, Pa.—The consolidation of the Paxtang Electrical Company and the Harrisburg Light, Heat and Power Co., is contemplated. An ornamental lighting system will probably be installed.

McKeesport, Pa.—The merchants have petitioned for the installation of 100 ornamental lighting standards. R. E. Stone, chairman of committee.

Olyphant, Pa.—John P. Kilellen Burgess, of Olyphant has recommended the installation of an ornamental lighting system.

Philadelphia, Pa.—The Philadelphia Electric Co. submitted the only bid for street lighting for the coming year, $1,336,287.

Pittsburg, Pa.—The installation of an ornamental street light on Federal street is contemplated.

Scranton, Pa.—A $5,000 increase in the appropriation for street light has been provided for the addition of 24 new arc lights.

Weatherly, Pa.—A $10,000 bond issue for the construction of a municipal light plant has been voted.

Wilkes Barre, Pa.—A franchise has been granted to the Wilkes Barre Light Co., for the furnishing of light and power.

Woodbury, Pa.—The construction of a municipal electric light plant is contemplated.

Lexington, Tenn.—Richard C. Huxton, of Memphis, Tenn., has been retained to prepare estimates on the construction of a water works and electric light plant, and a sewerage system for the city.

Decatur, Tex.—An $18,000 bond issue for the purchase of the water works and electric light system has been voted.

Oak Bay, B. C., Can.—The city clerk has been instructed to advertise for bids for an electric street lighting system.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTRACTS AWARDED.

Hoboken, N. J.—Removing ashes and garbage, to the Central Contracting Co.

Ocean City, N. J.—Collecting garbage for a period of one year, to George W. Ernest.

Rochester, N. Y.—Collecting and disposing of garbage for a period of five years, to the Genesee Reduction Co., Rochester, N. Y., $77,500.

Philadelphia, Pa.—Disposing of garbage during 1912, to the Penn Reduction Co., $278,588.

CONTEMPLATED WORK.

Birmingham, Ala.—The construction of a garbage incinerator is contemplated.

Washington, D. C.—The District commissioners are contemplating the installation of a garbage reduction plant.

Cairo, Ill.—The bids for garbage removal have been rejected and new bids will be asked.

New Iberia, La.—George S. Earl, New Orleans, La., has been retained as consulting engineer on the construction of a garbage disposal plant.

Springfield, Mass.—The installation of a garbage disposal plant has been recommended. Edward H. Lathrop, mayor.

Dallastown, Pa.—The construction of a garbage disposal plant is contemplated. Jacob P. Grim, president of council.

FIRE APPARATUS.

BIDS REQUESTED.

Eureka, Cal.—Feb. 6, 8 p. m Furnishing one automobile combination chemical and hose wagon Certified check, 10 per cent City clerk.

CONTEMPLATED WORK.

New Decatur, Ala.—The purchase of an automobile fire engine is contemplated.

Hillsborough, Cal.—The purchase of an automobile fire engine is contemplated.

Pasadena, Cal.—The purchase of additional fire apparatus is contemplated.

Peoria, Ill.—The purchase of a combination fire engine and ladder truck is contemplated.

Springfield, Ill.—Fire Commissioner Davis has recommended the purchase of an automobile truck.

Sioux City, Ia.—The purchase of motor fire apparatus is contemplated. G. L. Kellogg, chief.

Independence, Kan.—A $32,000 bond issue for the purchase of motor fire apparatus and land for park purposes has been voted.

East Hampton, Mass.—Chief Kienle has recommended the installation of a fire alarm system.

Medford, Mass.—The purchase of two pieces of motor fire apparatus is contemplated.

Northampton, Mass.—Fire Chief Chase has recommended the purchase of an automobile fire truck.

Escanaba, Mich.—The purchase of a combination chemical and hose wagon is contemplated.

Lincoln, Neb.—The purchase of an automobile fire engine to cost about $8,000 is contemplated.

Beverly, N. J.—The extension of the sewer system is contemplated. George W. Abbis, chairman of sewerage commission.

Plainfield, N. J.—The purchase of an automobile hose wagon is contemplated. T. O. Doane, fire chief.

Summit, N. J.—The purchase of an automobile hose wagon has been recommended by the city council.

Buffalo, N. Y.—The purchase of a combination hose wagon and truck automobile propelled is contemplated.

New Rochele, N. Y.—The purchase of a motor fire engine is contemplated.

Niagara Falls, N. Y.—A $14,500 bond issue for fire apparatus has been sold.

Cincinnati, O.—The purchase of an automobile truck and 3,000 ft. of hose has been recommended.

Dayton, O.—The purchase of three automobile fire wagons and a chief's automobile has been recommended.

Lakewood, O.—A $15,000 bond issue for the purchase of fire apparatus and material has been voted.

Norwalk, O.—The purchase of an automobile fire engine is contemplated.

Washington Court House, O.—The purchase of new fire apparatus is contemplated. B. H. Millikan, president of council.

Allentown, Pa.—The purchase of an automobile combination wagon for the Pioneer Fire Company is contemplated.

Beaver, Pa.—The purchase of a new automobile fire truck is contemplated.

Ellwood City, Pa.—The purchase of motor fire apparatus is contemplated.

McKeesport, Pa.—The purchase of motor fire apparatus is contemplated.

Scranton, Pa.—The purchase of motor fire apparatus is contemplated.

Fort Worth, Tex.—Chief Biddeker has recommended the purchase of an automobile fire engine and other automobile propelled aparatus.

St. Johnsbury, Vt.—The purchase of an automobile combination fire truck is contemplated.

Aberdeen, Wash.—An appropriation of $8,500 for the purchase of an automobile combination pumping engine and hose wagon has been voted.

TOO LATE FOR CLASSIFICATION.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Grove Hill, Ala.—Feb. 7, 2 p. m. Grading and resurfacing with sand clay about 6 miles of state aid road. W. S. Keller, Montgomery, Ala., state highway engineer.

Daytona, Fla.—Feb. 7, 2 p. m. Improving road in St. Lucie county. C. M. Rogers, city engineer.

CONTRACTS AWARDED.

Little Rock, Ark.—Paving Rector avenue with brick, and Third street with creosoted wood block, to Geo. B. Swift & Co., Chicago, Ill.

Portland, Ind.—Constructing stone road in Richmond township, to Nicoson & Pierce, Alexandria, Ind., $15,260.

Hamilton, Ala.—Constructing road from Hamilton to Guym, to A. F. Beardon, Birmingham, Ala., $17,350.

CONTEMPLATED WORK.

Sanford, N. C.—A $100,000 bond issue for the construction of roads in Lee county has been voted.

Schenectady, N. Y.—The construction of a municipal paving plant to cost about $15,000 is contemplated.

Freeport, Ill.—The paving of Float, Benton and Delaware streets with brick to cost about $25,000 is contemplated.

Hendersonville, N. C.—A $24,000 bond issue for the paving of Main street and Sixth avenue with asphalt has been voted.

SEWERS.

BIDS REQUESTED.

New Philadelphia, O.—Feb. 8. Constructing sanitary sewer and syphon line. H. B. Fribley, director of public service.

Salem, O.—Feb. 14, 12 m. Constructing a sewage disposal plant including the following: 22,000 cu. yds. earth excavation, certified check, $200; 623 yds. concrete and masonry work, 416 sq. yds. brick paving; two gate chambers; one small pump house, certified check, $200; filter material, pipe, ironwork, valves and setting same; 4,100 yds. gravel, 20,900 yds. sand, 8,424 lin. ft. sewer and drain pipe, wooden troughs for filter and sludge bed, certified check, $200; steel rods, iron pipe, valves, sewage siphons, and metal work. B. H. Rummell, director of public service; L. E. Phatin, 1017 Frick building, Pittsburg, Pa., engineer.

CONTRACTS AWARDED.

Seneca, Kan.—Constructing complete sewerage system, including 12 miles of pipe line and a disposal plant, to Wm. F. Plummer Co., Springfield, Mo., $62,000.

Springfield, Mo.—Alexander Potter, 114 Liberty street, New York, N. Y., is preparing plans and specifications for a sewage disposal plant.

WATER WORKS.

CONTEMPLATED WORK.

Berryville, Ark.—The Will F. Plummer Co., of Springfield, Mo., has been retained to prepare plans and estimates for the construction of a complete water works system.

BRIDGES.

BIDS REQUESTED.

Chillicothe, O.—Feb. 12, 12 m. Constructing concrete substructure for the Downs bridge on the Sulphur Springs road. Certified check, $100. Robert D. Alexander, auditor.

Chillicothe, O.—Feb. 19, 12 m. Constructing reinforced concrete culvert near Mattaville in Concord township. Certified check, $100. Robert D. Alexander, auditor.

Cincinnati, O.—Feb. 16, 12 m. Constructing concrete bridge on River road under Specification No. 230. Certified check, $1,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

CONTEMPLATED WORK.

Philadelphia, Pa.—Constructing roadway and bridge across Barnegat Bay, New Jersey from Manahawken to Long Beach, to the General Contracting and Engineering Co., New York City, $75,000.

Milwaukee, Wis.—A $175,000 bond issue for a bridge at Buffalo street has been voted.

GARBAGE

BIDS REQUESTED.

Millvale, Pa.—Feb. 6, 3 p. m. Collecting and removing garbage for year ending January, 1913. Wm. Fox, president of council; H. H. Dixon, clerk; James Houlahan, burgess.

MUNICIPAL ENGINEERING

VOLUME XLII — NUMBER THREE

MARCH, NINETEEN HUNDRED TWELVE

Contracting Practice.*

By DeWitt V. Moore, Mem. Am. Soc. Eng. Contr., Indianapolis, Ind.

EXAMPLES OF COST ANALYSIS CHARTS.

IN line with suggestions in the February issue three examples are given this month showing how each individual may tabulate for future reference the results secured through his cost analysis methods.

It should be borne in mind that these cost analysis charts should be kept up to date, that is, as fast as the new records are secured they should be plotted upon the charts so that they may be compared with past work either confirming or modifying such experience and better qualifying the estimator for new work.

It should also be borne in mind that such a cost analysis chart must be necessarily reduced to a uniform scale of wages, but this in no way makes it difficult either in preparation or use in estimating.

It is not expected that any one job may be maintained at a uniform or definite scale of wages and there will be many rates of pay and men of different trades and different rates and hours, but in the operation of the pay-roll the charge of the hours should be carried forward the same as the total dollars, and this way the average rate of pay is determined again. Every contractor familiar with his own work has a very certain idea about what is his average rate of pay for labor per hour.

It is best to prepare the charts on a basis of say 20 or 25 cents per hour and then reduce or increase as the case may be, this being of course, for work of ordinary labor and very few skilled artisans. To reduce the reading from the chart to a 17½ cent basis from the average of the 20-cent per hour basis, all that is cessary to do is to deduct ⅛. Plate XXX shows the results of numerous jobs of reinforced concrete building work. These jobs covered all designs and classes of structures, viz.; light and heavy reinforced concrete slabs with and without beams and columns. The average of all concrete over the entire area is indicated by the scale giving the inches in thickness within the border of the chart.

Plotting upon this chart the actual cost per cubic yard of jobs of various character, we arrive at a very satisfactory curve line, indicating what may be reasonably expected in new work. Naturally there are a few abnormal cases, generally caused by special conditions.

It should be noted that the average conditions are found between the limits of 5 inches and 8 inches, or an average of 6½ inches at the apex of our curve. Above this limit, as the thickness increases the cost decreases very slowly. Below this limit, as the thickness increases the cost increases very rapidly. This is logical and is an example of the foot-pounds of work accomplished by the laborer.

Plate XXXI is a further example of sewer construction wherein various sizes of the concrete work determine a fluctuating price of labor on concrete per cubic yard. In this case an attempt has also been made to discriminate between that class of work which can be handled over the trench as the work proceeds, the concrete operations being advanced as the work is completed, and second, where the operation must be handled from some little distance and the material wheeled and the plant only advanced at intervals.

On no one of these charts is it to be expected that we can arrive accurately at foot-pounds of work, but, as has been mentioned in all the foregoing articles,

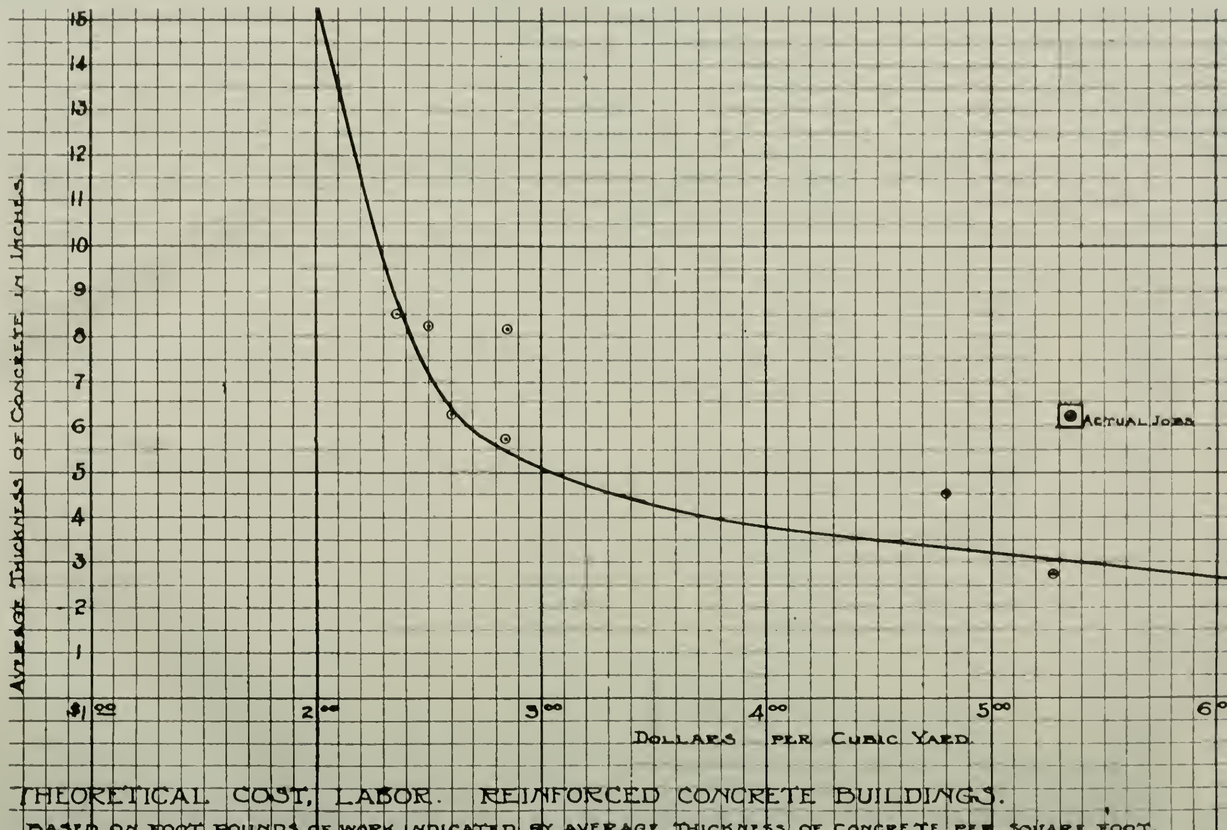
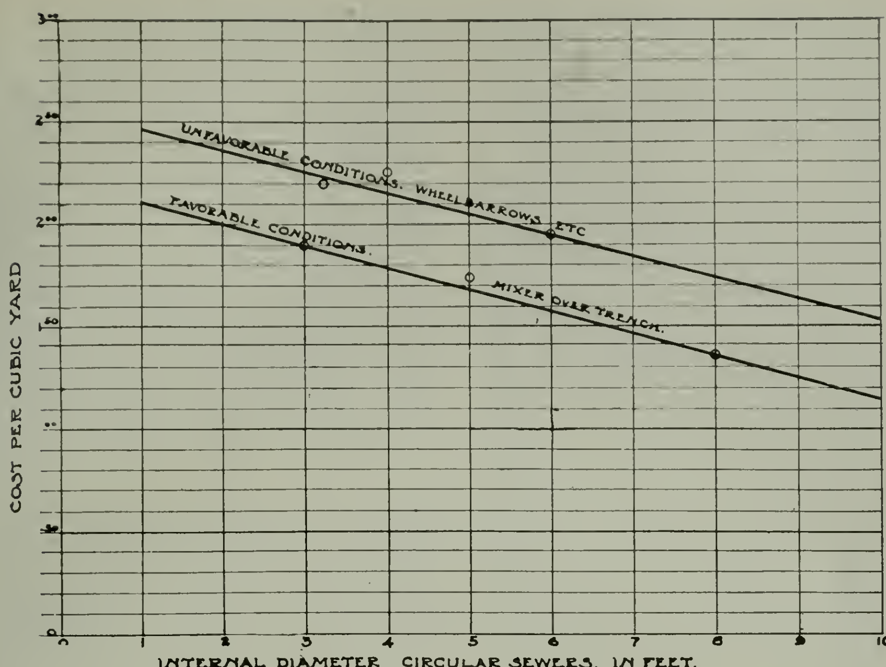


PLATE XXX. CONTRACTING PRACTICE.



THEORETICAL COST. LABOR. CONCRETE SEWERS VARIOUS SIZES.

PLATE XXXI. CONTRACTING PRACTICE.

we are working along a certain definite line of information, wherein, from the time of the preparation of the estimate until the final cost summary of the job, our methods have been harmonious and along a certain definite basis. To the individual contractor the information is of the most value, as the moment a certain job is called to attention, by reference to these charts there is presented to his mind a picture of the particular job, which is explanatory of the results. For this reason it has been brought out time and time again in this series of articles that the value of the methods suggested lies in their constant adaptation to the individual man's work for his own use and his own benefit.

Ruskin says "The crime which bankrupts man and nation is job work declining from the main design to serve a turn here and there." Certainly no really good results can be expected from any system of estimating, bookkeeping, operating cost keeping, and analysis which is not entirely consistent in all its parts.

Plate XXXII shows the analysis of the cost of installation of Blaw steel centers in a number of concrete sewer jobs. This chart is based upon a table from which we arrive at a quite uniform price per square foot for centers of any size of sewer within reasonable limits. The square foot is arbitrarily taken as the complete internal circumference of the sewer, the sewers in this illustration being all circular.

In order to reduce our figures as comparably as possible to a working basis for estimating, and also to present to the eye as clearly as possible a complete summary, we prepare a chart from which we may take directly the cost for labor in cents per lineal foot for labor on centers for sewers of this character.

The same remark applies in this case as to the foregoing to the making of the chart on a uniform rate of pay.

It should be noted that on any of these charts a definite purpose is attained, in that it is much easier to present in such a way the past experience and future probabilities than from scanning a table of figures. Such a chart should, however, not be used without mental analysis of the new job in question and results as shown by the chart should not be used without careful consideration.

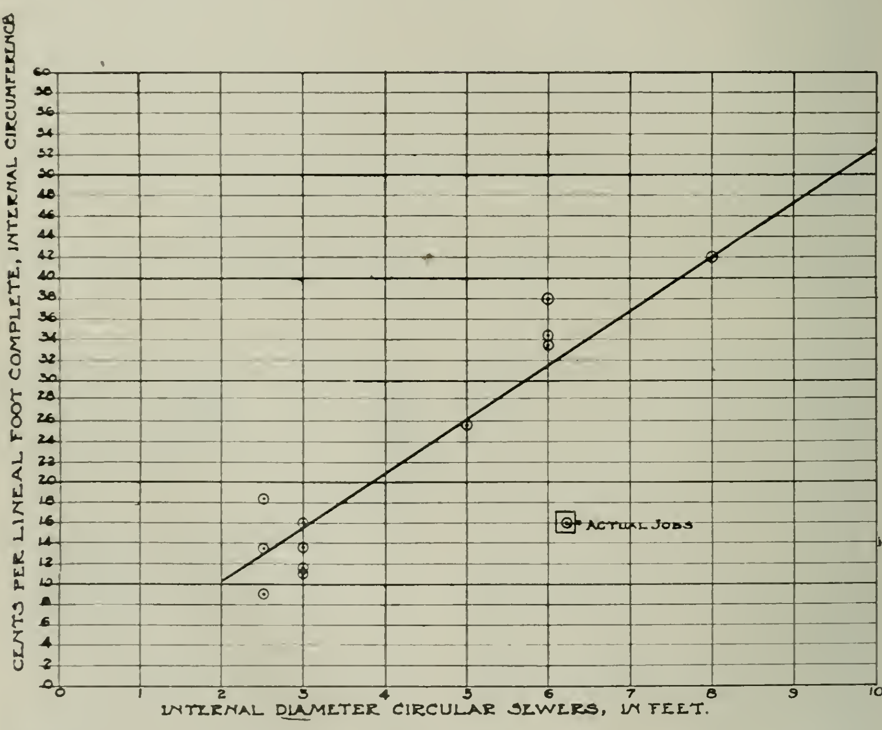
Systematic organization demands that it be distinctly understood a system once adopted cannot be modified and must not be disturbed or reorganized because of the individual ideas of any one man in the organization. Improvements may be suggested and recorded and worked in as new work demands, but it should be done gradually and the departments correlated.

The hardest task to the contractor is to insure that men employed do not incorporate some particular idea of their own mind by invention or experience in previous employment.

The worth of the final analysis in the preparation of these charts depends upon the individual. It would be a very easy matter for the author of this series of articles to submit thirty instead of three examples but the principles would not be any further advanced by so doing.

It is our intention to incorporate into book form in logical sequence the series of articles which have appeared in MUNICIPAL ENGINEERING during the past ten months, in doing which a larger number of illustrations will be given. Magazine space will not allow us to elaborate along these lines. It is also intended to include in connection with the various departments of work such instructions to workmen as will make this series a complete outline of contracting practice.

In conclusion, if it may be permitted, the author suggests, first, "Any system is better than no system," and second, "Any system results in mental analysis," which after all is the one thing gained.



THEORETICAL COST, LABOR, STEEL CENTERS. SEWER WORK PER LINEAL FOOT.
BASED ON AVERAGE OF FOURTEEN JOBS, — SEVEN DIFFERENT SIZES.

PLATE XXXII. CONTRACTING PRACTICE

Acid Conditions in the Monongahela River.

A VERY complete and detailed study of acid conditions in the Monongahela River has recently been completed by Thomas P. Roberts, of the U. S. Engineer Office, Pittsburg, Pa. The results of this study and suggested means for the mitigation of the evils were recently presented in a paper before the Engineering Society of Western Pennsylvania.

The extreme acidity of the water may be judged from the statement of Mr. Roberts that the river is practically unfit for the navigation of the ordinary type of steamer, and the installation of costly purifying plants is necessary before the water is available for making steam at the various power plants along the river course.

Owners of the steel mills have not made any concerted effort to abate the acid nuisance in the river water, but have one after another chosen instead to invest large sums of money in the erection of softening plants where the water, before it is permitted to reach their boilers, is treated usually with soda ash and lime to neutralize it. The cost of operating softening plants is very considerable, being several hundred dollars daily, in some cases.

Besides the enormous consumption of soda ash in treatment of boiler water, there are establishments where it becomes occasionally necessary, in order to save pipe lines, laid in underground drains, from rapid corrosion, to place great quantities of the soda ash in the drains.

Only a passing reference is made to the damages and expenses incurred by the domestic users of acid water in the Monongahela Valley. Its importance may be imagined from a few words; brass pipes necessary, mistakes in use of household softeners ruining clothing in washing, potable water sold in bottles, etc., etc.

According to the investigations of Charles E. Ashcraft, Junior Assistant United States Engineer, Pittsburg Office, much the largest proportion of the sulphuric acid reaching the river comes from the coal mines. He has ascertained that of the twelve galvanizing establishments on the Monongahela River or its tributaries, eight of them are estimated to use 59,000 tons of acid per annum. The four plants not included in his estimate are very extensive users, and it is probably within the mark to say that 75,000 tons of acid are annually consumed in the district.

It appears that while the records of tests for acids available for study are exceedingly numerous, covering, as they do, daily reports from mills and pumping plants for a number of years past, nevertheless the records have not been coordinated with the river's discharge. This co-ordination would require tests to obtain the mean acidity of the entire river conjointly with measurements of the river's discharge per unit of time.

The best time for making such comparative tests and measurements would be after the passage of a freshet from headwaters which has swept the river from the West Virginia mines to its mouth, so that no areas high in accumulated acid would be left in any of the pools. A favorable opportunity for making this determination under conditions mentioned occurred on September 21, 1911, when the discharge over Dam No. 1 was about 15,000 cu. ft. per second, a decrease from 40,000 feet per second a few days before. Samples were taken from five well distributed points across the river at a point about 100 yards above Dam No. 1. The discharge was represented by about 3.9 feet depth on the crest of the dam for 720 feet of its length. The remaining 200 feet length of the dam was "shut off." For the entire length of the dam the same discharge would have given about three feet depth on its crest. The samples were taken from one foot depth below the surface. The determinations for acid were made by the United States Bureau of Standards at the testing laboratory, Arsenal Park, and were as follows:

No.	Location—Distance from Shore Feet	Aspect of river surface	Velocity—Miles per hour	Free Acid—Grains per gallon	Remarks
1	Forebay of Locks	Clarified	0.00	.099	Right shore.
2	50	"	0.25	.099	Distance from right shore.
3	200	Mottled*	1 00	.086	Distance from right shore.
4	Mid-river	"	1.20	.009	
5	125	Slightly muddy	0.25	.082	Distance from left shore.
	Mean		0.65	.093	

Weather fair and warm. Temperature of river water 70 deg. F.

*By "mottled" is meant minute particles of curdled clay or mud suspended in clear water, but so numerous, that unless examined closely, it might be considered dissolved mud, or "muddy water."

The violent reaction below the dam broke up the curdling process, the color of the river from shore to shore becoming yellowish and nearly opaque. Next day, September 22nd, all of the water approaching the dam appeared to be very nearly clear, the river in the meantime having fallen about 4 inches. With a discharge of 112,500 gallons per second it would appear from the above determination that there is carried daily by the river about 64.5 tons of free acid. With the discharge of the river reduced to 300 cu. ft. per sec., as occurs during ordinary low water periods, the acidity of the river with the same quantity of acid would be increased 50 times, or to 4.65 grains per gallon.

It is necessary to have some clay or "mud" with the acid to produce a good coagulant, such as sulphate of alumina, and, where all the clay is used up, fresh increments of acid entering the river bring about other reactions, causing areas of the river to assume a yellowish color or sometimes a chocolate brown, which might be mistaken for ordinary mud in suspension.

An interesting phenomenon observed by Mr. Roberts at Lock No. 6, 70 miles above Pittsburg, was to see the river as black as ink, though it was really transparent for six inches depth. Such a decided blackness was never seen before at No. 6 and indicated that acid from above in unusual quantities was combining with the tannin from natural sources always carried by Cheat River water, and making a diluted ink. A peculiarity of this very dark water was that when waves dashed it against a rough stony edged shore it developed masses of suds, or foam, floating on the water higher than the sides of skiffs moving through it.

It has been found at some of the locks that in filling them through deeply submerged valves, the water introduced into the lock chambers was higher in acid than surface water. To settle this point, in one of the locks which was closed for repairs, and containing almost perfectly still water, tests were made, with the result that water drawn from twelve feet depth contained considerably more acid than that from near the surface, in the case tried, two grains per gallon more. It would thus appear that there is a tendency in the acid to gravitate towards the bottom, but as to whether in time the surface water would become neutral is an open question.

In speaking of the dangers of the acid condition as related to boiler water, Mr. Roberts says that a very extensive steel plant on the river in Pool No. 3, during the fall of 1910, was on the verge of being closed down owing to the inadequacy of its devices for softening the river water. Never before had the company's chemist noted such acid conditions in the river. The plant would have been shut down had it not been that at the critical time the flashboards on Dam No. 4 were partially lowered in the hope of helping things for some pump and other boats in the Government Service whose boiler tubes were giving much trouble. The stirring up of the river resulting from a sudden increment of water in Pool No. 3 raised the pools below only a few tenths; nevertheless it did a great deal of good, especially to the steel company referred to. Already one of the railroads paralleling the river has extended a pipe line from a service. The situation is only bearable now at a large cost annually for repairs, while the future promises, with the rapid increase in the output of acid, the extinction of the well approved types of engines and boilers at present in use.

The great majority of the steamers place their sole dependence for safety in the use of boiler compounds, but as the proper doses of this material are largely a matter of guess work, there are chances for mistakes. As a rule, however, the engineers are on the safe side and overdose their boilers.

Not only the mills and boating interests but the General Government as well is interested financially in the solution of the problem, for the lock gates, valves, wickets, miter irons, and adjustable tops on the dams along the river are all subject to deterioration and call for frequent attention. While this trouble is present to a greater or less extent at all the locks, it appears in its most aggravated form at Lock No. 2. In this case several inches of metal ¾-inch thick had been corroded from the edges of structural steel pieces which were exposed to the action of water which was flowing in contact with them.

Three years ago the miter sills of the lower gates of the inshore lock were shod with new angle steel ¾-inch thick with top leg on the sill six inches wide, and vertical leg eight inches wide, against which latter the lock gates rested when closed. After the lock was pumped out recently the vertical legs mentioned were found to have been entirely consumed by the acid. Evidently the current in a very thin sheet had passed upward under full lock pressure between the gate and the sill with its angle steel covering. As the gates were not in closed position probably for more than 1-3 of the time, and after further deductions of several months for high water with weak acid conditions in the river, it may be assumed that the corrosion of the ¾ in. metal took place in eight or nine months of effective acid duty. This with acid ranging from two to six grains per gallon in the water.

The action of acid is less rapid in the

outer lock, though all four of its valves have been removed for extensive repairs, and still less rapid farther out in the river, evidencing the fact that the acid was for the most part following the shore from Turtle Creek, which enters the river a few hundred yards above the lock. Turtle Creek water for the most of the time ranges from 8 to 80 grains of acid to the gallon.

In the conclusion of his report Mr. Roberts presents a statement from J. K. Clement, physicist of the U. S. Bureau of Mines, regarding an interesting experiment made at Lock No. 2 on the Monongahela River. The method used in the experiment of the Bureau of Mines is based on the electrolytic theory of corrosion, which is now very generally accepted. According to this theory, when iron is oxidized in the wet way it first goes into solution as ferrous ions. The ferrous ions are then oxidized by the oxygen present in the water to ferric ions, which are then precipitated as ferric hydroxide. At the same time that iron is passing into solution at one part of the surface an equivalent amount of hydrogen is liberated at another point. The passage of the iron from the atomic to the ionic state and of the hydrogen from the ionic to the atomic state is accompanied by a transfer of electricity, the electric current following in the direction from iron to solution at the point where the iron is dissolved and from solution to iron at the point of evolution of hydrogen.

The tendency of metals to go into solution is known as "solution pressure" or "solution tension." The more positive the metal the greater is its solution tension; thus the solution tension of sodium or potassium is very high and that of gold is zero. The solution tension of zinc is greater than that of iron. If, therefore, strips of zinc and iron are immersed in an acid solution and connected through a wire, zinc will pass into solution and hydrogen will be liberated at the surface of the iron. At the same time a current of electricity will flow through the wire from iron to zinc. The principle has been applied successfully to prevent the corrosion of boiler surfaces.

In preliminary experiments made by F. M. Stanton of the Bureau of Mines, two steel plates, 6 by 8 by ⅛ in., one of which was connected in series with a two-volt accumulator, and a carbon anode, and the other of which was unprotected, were immersed in the Monongahela River near Lock No. 2 for a period of fifteen days. The loss in weight of the protected plate was 0.7 gram and of the unprotected 10.9 grams.

Before immersion each plate was carefully polished on one side. At the conclusion of the test it was found that the unprotected plate was corroded and pitted over its entire surface whereas on the protected plate there was no evidence of corrosion.

Arrangements are now being made for experiments on a larger scale and it is hoped that a method may be developed for the protection of steel against the corrosive action of acid waters.

Practical Road Building.*

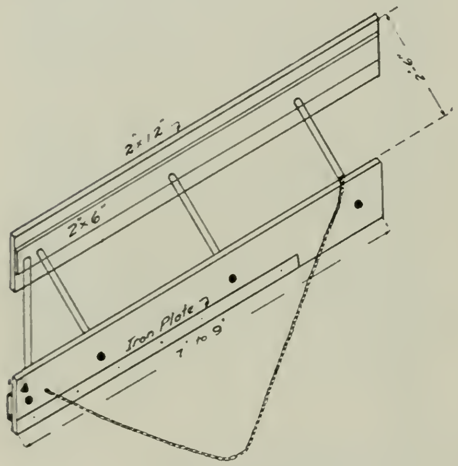
By John N. Edy, C. E., Highway Engineer, Billings, Mont.

Maintenance of Earth Roads.

MAINTAINING an earth road consists in keeping the weeds down, culverts open, the surface of the road free from ruts and chuckholes, and preserving the crown. But one system of maintenance will be considered, that by means of the road drag. For thoroughness and economy of results the split-log or plank drag has no equal, and it is both cheaply made and easily operated. Not only does this simple tool maintain the road in a smooth condition and preserve the crown, but it kills weeds, prevents chuck-holes, and its use compacts and waterproofs the surface, causing it to offer greater resistance to the abrasive action of traffic.

The principle of drag maintainance is directly opposed to the system of annual re-construction with which we are so familiar. Instead of making a road and leaving it to go to pieces only to be rebuilt at excessive cost, drag maintainance keeps the road in good condition, and actually improves it. Dragged roads get better, instead of worse, with age. The following sketch shows the ordinary type of road drag made of planks. It should be light enough for one man to lift easily, and is used with but one team, dragging at an angle of about 45 degrees with the road. Such a drag may be made by any person of average intelligence, and at a cost of but a few dollars.

The drag shown is made as follows: Procure two pieces of light 2x12-inch stuff and two pieces of 2x6-inch, about 8 ft. long; securely fasten the 2x6's along the middle of the 2x12's, as shown, thus approximating the shape of a split log. Place the slabs on the ground in an upright position 2 ft.-6-in. apart with the 2x6's on the inside. The right or ditch end of the front slab extends past the same end of the rear slab as shown. The slabs are fastened together with four hardwood stakes wedged into 2-inch holes. The bottom of the front 2x12-inch is shod with an iron plate, an old wagon tire serving for this purpose. The hitch is made to a chain, the one end of which extends over the top of the front slab and is fastened to the brace stake; the other end passes through a hole near the end of the slab.



I. ROAD DRAG.

The cost of dragging varies with the locality and the condition of the road. The road should be dragged after every rain or other wet spell. At the rate of ten draggings per year, the team costing 60 cents per hour and walking at the rate of two miles an hour, the cost for the year will be $6.00 per mile. A recent report indicates that for the years 1906 to 1909 the cost of maintaining with the drag the earth roads of the state of Iowa averaged but $5.00 per mile per year. Comparing this insignificant expense of a good road with the usual cost of periodic reconstruction, which nets only indifferent results, clearly demonstrates the economy of this system of maintenance.

The road drag preserves the crown and builds up a solid wearing surface by moving material in thin layers into the driveway, each layer being packed by traffic and baked by the sun. It is a mistake, therefore, to move a large mass of loose earth into the middle of the driveway and leave it to obstruct and hinder travel, and to defeat the purpose of the dragging. An experienced man will spread the material evenly as he drags; and if for any reason a ridge of earth is deposited in the middle of the road, the drag should be hitched square with the driveway and the loose material spread evenly. This precaution is to be noted in connection with the use of small, 2-horse graders in "dressing up" a road or street. Leaving clods in the middle of the road drives vehicles into the side ditches, subjecting them to unusual wear and injury. A bulletin on "The Use of the Split Log Drag on Earth Roards" may be obtained free upon application to the U. S. Department of Agriculture. The following brief suggestions are presented:

Use a light, 2-horse drag, so light that you can lift it.

Do not drive too fast.

The driver should ride the drag standing on planks placed on the rods, shifting his weight from side to side to cut or drop material.

Drag when the road is moist but not sticky; the only time the drag will actually injure the road is when it is too dry.

Drag after every rain, melting snow, or when the frost comes out of the ground.

Drag during the winter thaws to prepare the ground for the next freeze.

Use a grader for grading, and a drag for dragging. Each has its separate and distinct field of usefulness.

The tools required for the work outlined in this chapter are:

Plows; 2 or 4-horse Grader; Harrow; Road Roller; Drag; Slips, Wheelers or Fresnos; Wagons, shovels, picks, etc.; Dynamite.

Note that the list includes a roller; no supervisor is properly equipped unless he has some kind of a road roller. Its use is necessary in building all types of roads and road surfaces. If a steam or horse roller is not on hand, a very serviceable one may be made of concrete as follows: Procure a piece of boiler shell about 5 ft. long and 4 ft. in diameter. Set on end, place an iron shaft in the center, and fill with 1:3:6 concrete. The result is a five-ton roller to which a frame for hitching may be readily attached, and which has cost but little.

Perhaps the most indispensable road tools are those which the supervisor makes himself, namely, the drag and roller.

SAND ROADS.

What has been said in the foregoing is not applicable to sand roads. With a light sandy soil, that shifts when dry, the object should be to retain enough moisture to add stability and compactness. It requires moisture to compact sand. Because of this condition, sandy roads should be given very little, if any, crown: in fact, it may even be necessary to depress the center of the roadway slightly. In comparatively dry regions, it may be desirable to bring water to the sand road, rather than to permit it to drain away.

However, the proper method of treating a sand road is the addition of clay and the construction of a sand-clay road, which will be described in a later chapter. In this manner, the road surface is improved to a higher state of perfection than is possible with either material used alone.

II. GRADED EARTH ROAD.

Note the loose material thrown to the center, which forces traffic to sides of roadway.

Excellent results have also been obtained by treating sand roads with asphaltic oil. This method will appeal to those communities favorably situated as regards the purchase of oil. A description of this type of road surface will be presented in another chapter.

MISCELLANEOUS SUGGESTIONS TO SUPERVISORS.

1. Drag all earth roads after every rain or other wet spell; drag during winter thaws.
2. In the absence of a roller, drag earth roads and fill during construction.
3. Do earth work in the spring, when the ground is moist and will pack. In doing grader work, never leave a ridge of loose earth in the middle of the roadway; spread the material evenly before rolling or leaving the job.
4. Never dump a scraper in the road and leave the material in a pile. It should be spread as it is dumped.
5. In side-hill work keep the ditch on the upper side of the driveway. In deep cuts, dig intercepting ditches farther up the slope to catch some of the foreign water before it reaches the road, and to keep the banks dry.
6. On earth road grades see that the fall from the center to the sides is greater than the fall *along* the road, so that water will run toward the side-ditches.
7. When a large volume of foreign water must be cared for, use wide, shallow ditches in preference to narrow, deep ones.
8. Be sure that there is a continuous fall from the center to the side-ditch. Keep all weeds down.
9. Never drag a lot of loose earth to the middle of the road and leave it there in a ridge to drive traffic to the sides. Hitch the drag square with the road and spread the earth; a better way is to spread it as the dragging progresses, which can be done after some practice.
10. If ditches "wash", pave the bottoms with flat stones.
11. Never fill a mud-hole with rock.

See special instructions on this point above.

12. Use the proper tool for moving earth.

13. Keep side-ditches free from obstructions of all kinds; report at once any wilful obstruction by residents along the road.

14. Do not use wood box culverts if it can possibly be avoided.

15. Lay all pipe culverts with the bell up stream, and in a trench that is shaped to fit the pipe.

16. Allow at least 18 inches of fill over all pipe culverts; if this involves building up the dump, begin far enough back on each side of the culvert that there will be no pronounced hump over it.

17. Clean away any deposit that may form at the inlet end of the culvert.

18. Keep the barrel of all culverts clean.

19. Replace at once any stone that falls from a culvert head-wall.

20. Use no pipe of less diameter than 12 in. for culvert purposes.

21. When a culvert or bridge is found to be in a dangerous condition, fix it before reporting.

22. Inspect all bridges; see that all nuts are tight and plank securely nailed.

23. Never nail a new plank over an old one; remove the worn piece and replace with the new.

24. Replace all timber culverts with permanent material as quickly as possible.

25. See that all hand rails on bridges are secure.

26. Do not hire poor teams; if the team will not give satisfaction for an individual, the county does not want it.

27. Spend the public money with as much discretion as you do your own.

28. In case of accident to traveller, report immediately, if caused by condition of the road or bridge.

29. Attend the monthly meetings of the supervisors; you can not fail to profit by the discussions.

30. Mail your monthly report regularly on the date specified.

31. Follow such instructions as you may receive from your superior; he will assume the responsibility therefor.

32. Do not contract for supplies without consulting your superior.

33. Remember that ability is not measured by visible results alone; but by these results, together with what they cost the tax-payer.

III. ROAD DRAG IN USE.
Note the angle it makes with the Road and small amount of material pushed to center of road.

The Chloride Process for Water Purification.*

By W. B. Bull, Chicago, Ill.

ABOUT one year ago, while experimenting with a ferrous salt and an alkaline re-agent (both produced electrolytically) that would be an improvement on the iron and lime process used in water purification, quite by accident a ferric salt was produced with its characteristic cherry red precipitate.

It was found that this ferric salt could be produced cheaply, reliably and with certainty in any water works plant large or small, by simple apparatus, and it was later proven by a small experimental plant, set up for the purpose at the Toledo, Ohio, water works, that this ferric salt was the equivalent of sulphate of alumina, both as a coagulant and also as a color or stain remover, for which latter use, the iron and lime process had been unsuccessfully tried at Toledo, to be discarded, and the more expensive sulphate of alumina treatment reluctantly substituted.

It further appeared that, in using this ferric salt, an alkaline re-agent was not needed, in waters that were sufficiently alkaline to precipitate a sulphate of alumina solution, and in consequence, it appeared that the alkaline product of the electrolytic process referred to (caustic soda) was a by-product of great value, and being unnecessary in the coagulating process, the operator was free to dispose of same to his financial advantage, so that in plants of sufficient size, the proceeds of the soda by-products would entirely, or approximately, pay for the cost of producing the coagulating ferric salt.

The above conclusions were based upon power costs at eight cents per horse power per 24 hours (the ascertained cost at Toledo from the producer gas engines at their low service pumping station), salt and iron borings, each at $4.00 per ton, and a salable by-product of caustic soda at $40.00 per ton. The Toledo water works would apparently effect an economy of approximately $20,000.00 per annum, their present expenditures for sulphate of alumina, and accomplish identical results.

The process and apparatus are simple, do not require expert attention and may be thus described:

Using an electrolytic cell, or cells, which by decomposition of salt brine, produce chlorine gas from the positive side and a caustic soda solution from the negative side, the soda solution flows away and is concentrated by a simple procedure, and sold. Caustic soda is as staple a substance as sugar, and in demand everywhere by laundries, soap makers, etc., etc. If a purification plant was too small to warrant the saving and disposition of the caustic product of the process, it would serve a useful purpose as a softening agent in the water supply, or in softening the boiler feed, and if used for softening of the general supply, there would be an unobjectionable chloride of lime resulting, in place of the more or less sulphate of lime, which is produced and left in the water by the present iron and lime process.

The chlorine gas produced from the positive side of the cell is mixed with water, which greedily absorbs it, and this chlorinated water is passed upwards through a conical receptacle, containing fine refuse iron chips or borings, passing off thence as a strong solution of ferric chloride, which is used in the same way as a solution of sulphate of alumina, and is thoroughly precipitated into an insoluble, flocculent hydrate, which, as previously stated, has properties identical to an alumina hydrate, and at a fraction of the cost of the same. Broad method and apparatus patents have issued to the writer on the above.

Upon taking up the business end of the proposition, it was found that there was no great choice of electrolytic cells for chlorine and caustic production available, and the one cell that seemed best suited to this use was held by the owners of the patents at a price which was very burdensome. The cell in question seemed to possess disadvantages that appeared capable of correction, and some nine months ago the writer, and his colleague, William M. Jewell, undertook to construct an electrolytic chlorine and caustic producing cell, that would be efficient, durable, convenient and cheap to build.

It was soon evident that there was very little in English print upon this subject and every step had to be laboriously thrashed out by tedious experimentation. Fortunately, however, with gratifying results, so that a cell has been finally produced that apparently represents the results that were sought for, and which appears to meet the approval of a number of people who are expert in such matters.

It is probable that the cell is now in such shape that rapid progress can be made from now on in the installation and

*A paper before the Indiana Sanitary and Water Supply Association.

demonstration of a process that, by virtue of its merits and great economy may, perhaps, supersede existing methods of treating water chemically, in connection with its clarification, and also its sterilization; for it may be said in addition, that, inasmuch as the ferric chloride solution may be produced to contain any desired amount of free chlorine, it does not seem improbable that one and the same solution would take the place of not only the sulphate of alumina (or sulphate of iron) solution, but also of the hypochlorite solution now so frequently used as a sterilizing agent, as the function of the latter is due entirely to the free chlorine it contains. This latter application is mentioned here simply as a possibility, or rather as a probability, and is something that can be simply and promptly tried and proved or disproved, but in the press of more important features of the case, simply has not been reached as yet. The experiment might have been tried at Toledo, but was overlooked as a possible function of the process, until the experiments had ceased and the apparatus was dismantled.

The name Chloride Process has been used for this new chemical treatment of water, although speaking more strictly, the salt now produced is not a chloride but a perchloride of iron.

In conclusion, to answer inquiries as to approximate cost of an installation of the Chloride Process, which, in view of widely differing conditions and capacities of water works plants is a difficult matter to state, even in general terms, it may be said that an investment in such a coagulating producing plant should show an annual economy equal to a return of not less than 20 per cent on its cost, including interest, depreciation and renewal for a small water works plant, and from that upwards to fifty or more per cent according to the character of the water, amount and cost of coagulating materials at present used, and size and location of the water works plant.

Pneumatic Street Cleaning.*

By C. A. Tripp, Consulting Engineer, Indianapolis, Ind.

IN comparison with the advances made by sanitary science in providing pure water supplies, pure food, and in the disposal of sewage, very little progress has been made in the direction of the gathering and disposal of street wastes, and the prevention of air pollution from street dust.

Quoting from an address by Dr. George A. Soper, president of the Metropolitan Sewerage Commission of New York, before the Boston Society of Civil Engineers:

"The conservation of health has no better field for effective operation than systematic warfare against dust. With one notable exception, the use of oil on thoroughfares and railroads, no new method of combating this evil has been developed by sanitary science in recent years, while the quantities of dust produced enormously increased with the growth of our cities. As matters stand, the greatest dust scavenger is the atmosphere. Into it we cast the dust of our houses with the same heedlessness with which we dump our sewage into the water courses. We do not stop to think that this air must serve to ventilate our dwellings and shops, and the lungs of our children and ourselves.

"If the filthy dust of our streets were to be kept from the lungs by efficient methods of street cleaning, consider the progress in decency and order, not to mention health, which this reform would accomplish."

At the present time probably 90 per cent. of the street cleaning is done by the horse drawn rotary brush which has been in use in substantially its present form for the past 25 years. It is certainly not to the credit of American ingenuity that this has been the case, as the machine is far from a satisfactory one and falls far short of accomplishing its purpose. When used on dry streets it does gather up the heavy dirt, but as a dust producer it can hardly be excelled. If the street is sprinkled before sweeping, the principal result of the brushing is to spread the mud in an even layer over the street and fill the cracks, leaving it in perfect shape to dry and blow away.

From the standpoint of cleanliness, the method of flushing by water under a considerable pressure leaves little to be desired. Machines for this purpose were put on the market a few years ago, and were received with considerable favor. Constant use, however, has shown that the water striking the pavement with

*A paper before the Indiana Engineering Society.

the force necessary for satisfactory work, has a very injurious effect, particularly upon asphalt and bitulithic surfaces. The amount of water used, approximately 2 gallons per square yard, makes this a serious item of expense. Furthermore, the street dirt is only transferred to the sewers, where a large part of it settles in the catch basins and must be removed. This latter item of course does not appear in the street cleaning cost but is a real and very considerable item, nevertheless.

The general attention which is being attracted by the damage done by this method is well shown by the following letter from Mr. J. W. Howard, Consulting Engineer on Roads, Streets and Pavements, published in *Engineering-Contracting.*

FLUSHING PAVEMENTS WITH WATER UNDER PRESSURE.

"Sirs: The above heading is quoted from an article, page 307, of May issue of MUNICIPAL ENGINEERING, entitled "Causes and Defects in Asphalt Pavements," by Isaac Van Trump, Chicago, Ill. The article includes "flushing with water under high pressure" as one of the "causes of defects in asphalt pavements which are almost entirely under the control of the municipal engineer," and adds, "it is entirely unfair to the municipality, the taxpayer and the contractor for the municipal engineer through ignorance or neglect to permit conditions to exist during the construction or after the street has been completed, that will permanently impair the usefulness or appearance of the thoroughfare." This is sound advice from one who has closely watched the evils of the high pressure flushing system of street cleaning; but what heed does the city of Chicago pay to its and some other cities' technical advisers? In the current number of another engineering journal we find a half-page photograph of "one of Chicago's 41 new flushing machines" forcing water, from about one foot above it, under pressure, on the surface of the pavement. Is it any wonder that contractors and surety companies in Chicago and elsewhere are repudiating their guarantees, as shown by an able paper in 1907 by John W. Hittell, Chicago's Chief Engineer of Highways, before the American Society of Municipal Improvements."

The writer and others who have had long experience with the construction and maintenance of pavements, have condemned this injurious system of street cleaning which ruins pavements of all kinds, fills sewers with street dirt, consumes an excessive portion of water supply and is otherwise not economical.

A recent test of cleaning by high pressure flushing system in New York City shows, as reported: (a) cost 72 cts. per 1,000 sq. yards. per cleaning, for labor and water; (b) 2 gals. water consumed per sq. yd. of pavement cleaned; (c) cost of water, 9 cts. per 1,000 gals.

At this rate in a city having 200 miles, say 4,000,000 sq. yds. of pavement, cleaned daily (Sundays excepted), say 300 times per year, the cost would be $2,880 per day, or $864,000 per year.

The water consumption figures 8,000,000 gals. per day, at 9 cts. per 1,000 gals. equals $720 per day, or $216,000 per year, or approximately the cost of water supply of a city of 50,000 population. Knowing that the water used in flushing carries to the sewers at least 10 per cent. of its bulk of street dirt and a large portion of the dirt settles in the sewers, we see the great additional cost of sewer cleaning.

Every engineer, or official, and every periodical which is interested in construction and maintenance of street pavements, should persistently and at all possible times and places raise their voices in loud acclamation against this system of "pavement ruination."

On this subject I quote the following from the St. Louis Daily News of May 20th:

"Present Method of Flushing the City's Streets Detrimental to Their Proper Maintenance—Volume of Water Employed is Excessive—Unnecessary Expense to Tax Payer.

"From more than one source have lately reached the Daily News complaints, which would seem to be justified, with regard to the system of flushing the city's streets.

"No one can have failed to notice the tremendous force with which the water is projected from the flushing machine employed in cleaning our streets, a force sufficient to drive the sand and soil from between the interstices of the granite blocks with which some of the streets are paved and to work serious damage to those of artificially constructed asphalt or bituminous surface. The result has been that repairs to the streets become necessary much more frequently than is at all necessary or than would be the case if a more natural system of cleaning were employed.

"Nor is this all. The volume of water consumed in street cleaning operations at the present time is excessive; and is also a source of unnecessary expense to the long-suffering taxpayer. So great indeed is the flow of water sewerwards down the gutters when the "flushers" are at work that few can get off the sidewalk without wading. With this stream goes not only all the street refuse but also much of the paving materials.

"During the past year the Street Department has curtailed the use of flushing machines and the improvement in the condition of the pavements is marked.

"Interviewed by a News reporter the Street Commissioner, Mr. Travilla, admitted that these flushing machines now in use, if employed too frequently, damage asphalt or bituminous paving. The damage to brick, granite and wood pavements is also great, causing the joints to be opened, the pavements to be loosened and steadily dislocated, uneven and need excessive repairs.

"Constant patrol hand sweeping, with occasional machine sweeping and light sprinkling just before sweeping, to allay dust, has been demonstrated to be the most economical, satisfactory and efficient method not only for preserving pavements but especially for keeping streets constantly clean at all times of day."

The squeegee is another type of machine which has recently come into use. It uses a smaller amount of water than the flushing machine, and depends for the cleaning action on a soft rubber spiral mounted on a revolving roller. On a perfectly smooth asphalt surace it produces good results, though the amount of water used is such that much of the dirt finds its way to the sewer. It necessarily fills all depressions level full of dirt, and cannot be used over street car tracks.

Hand scraping is effective as far as removing the heavier dirt is concerned, and as an auxiliary means for cleaning streets subject to heavy traffic has without doubt a permanent place.

Pneumatic cleaning bears the same relation to street sweeping that vacuum cleaning does to broom sweeping for floors. It is dustless, and the street which has been swept is dustless. It removes all the dirt, the fine light dust as well as the heavy, not only from the surface, but also from all the cracks, the spaces between bricks and granite blocks, and from street car tracks. A rough pavement is cleaned as thoroughly as the smoothest asphalt surface. No sprinkling is required; there is no possibility of damaging any kind of pavement. The passing of the sweeping gang ceases to be a nuisance to the residents.

FURNAS AUTOMOBILE AUTOMATIC STREET SWEEPER.

These results are accomplished by the Furnas pneumatic street cleaning machine.

The picture shows a general view of the machine, which is of the automobile type, propelled by a gasoline engine.

The sweeping hood is shown resting on the street. This is preceded by a set of coarse brushes or rather scratchers, which loosen any dirt which may be stuck to the street surface.

The dirt is taken up and deposited in the dirt box, the bottom of which consists of two doors which can be dropped for depositing the load.

The small boiler shown, furnishes a supply of steam which dampens the dirt, aiding in its separation from the air, and also forms it into a dustless mat or cake in the box, so that no dust is made when dumping, or when loading into wagons.

The sectional view shows the air circulating system, which is the interesting and all important part of the machine. The general plan is that the air used for sweeping is recirculated, being used over and over again, with the exception of a small amount which is taken out to provide for leakage as will be explained later.

You will notice that the sweeping hood consists of an inner and an outer portion. The outer portion is enclosed by short curtains, or lines, made of canvas, to which small plates of iron are riveted. These plates serve to weight down the canvas and also to take the wear, due to dragging on the street. They are sufficiently light, however, to pass over the dirt, and not act as a brush or scraper.

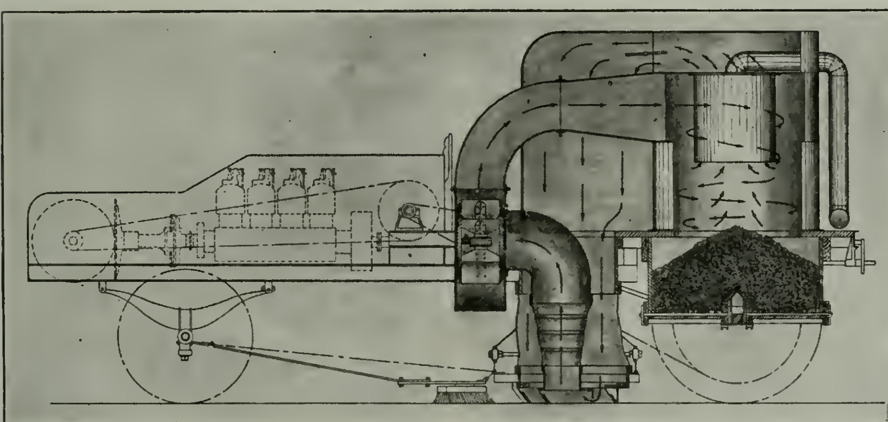
The inner portion is separated from the outer portion on the front side by a similar line, but on the rear side by a metal strip which runs at a distance of about one-half inch from the street surface. This is the real sweeping point. The air comes down in the outer portion at a comparatively low velocity and at substantially atmospheric pressure.

The inner portion is under the full suction of the fan. The air rushing through this narrow opening at high velocity, and in a direction practically parallel with the street picks up the dirt, which is then carried up through the opening in the center of the inner portion.

As shown this opening is connected directly to the fan suction.

From the fan the air and dirt enter the centrifugal separator, which is directly above the dirt box. Here a small amount of steam is blown in as previously described. After the air has deposited the dirt picked up from the street it leaves by the center tube and returns directly to the outer portion of the hood. Within the center tube by which the air leaves the separator is a small pipe, which is open at the lower end. A small amount of the air leaves by this pipe, which leads to the ash pit of the boiler. The amount of air taken out through this pipe is equal to the inward leakage to the outer portion of the hood.

The pressure in the separator, and hence the amount of air leaving by the small pipe, is controlled by the damper shown in the passage between the separator and the hood. Indirectly this determines the pressure in the outer portion of the hood, which is maintained at or slightly below that of the atmosphere, so that any leakage is inward, thus preventing dust.



SECTIONAL VIEW—FURNAS STREET SWEEPER.

The small steam boiler serves a double purpose. Steam added to the dirt and air as it enters the separator, increases the weight of the dust particles and thus aids in the separation. It also dampens the mass of dirt so that dust is prevented when dumping. The air returning to the hood, and therefore the air leaving the separator by the small off-take pipe carries a fine dust which it is very difficult to separate. The fire in the boiler serves as an effective filter for removing this from the small volume of air which must be discharged, while the air acts to produce draft for the fire.

The power equipment consists of a 6 x 6 four-cylinder engine, located at the forward end of the machine. The sweeping fan is driven from the rear end of the engine shaft through a cone clutch and spur gears running in oil. The power for propulsion is taken from the front end of the shaft and transmitted through a friction drive and differential jack shaft to the rear wheels. The maximum speed of travel is 5½ miles per hour, which may be reduced by the friction transmission, as required by the condition of the street being swept.

The machine is operated by two men. The driver controls the steering, and propulsion and fan speeds. The operator controls the pressures in the air system, raises and lowers the hood as required by means of the two levers shown, fires the boiler, and dumps the dirt.

For average conditions this machine will sweep 15 to 18 great squares of 10,000 sq. ft. per hour.

Management of Water Plants in the Smaller Cities.*

By E. L. Loomis, Superintendent Home Water Co., Valparaiso, Ind.

THE first and foremost duty of a waterworks enterprise is to supply its patrons abundantly and constantly with a good, clear, clean and wholesome water. How well or how poorly that duty is performed rests solely with the management of such an enterprise. Most of our larger cities are now meeting these public requirements fairly and squarely, and while it is true that many of our smaler cities are providing such a satisfactory quality of water to their patrons, it is likewise true that there are many others which are not doing so.

Good water is one of the prime necessities of human life, and to serve it meagerly where an abundant supply is obtainable, or to serve an unfit and impure quality, should be no longer tolerable by an intelligent community, nor should it be considered good business management on the part of the enterprise. Each succeeding year as we note the ever-increasing pollution of our streams and public water supplies, the demand is proportionately, and very properly, becoming more and more insistent for a better water. And with these changing conditions, so great has been the advancement in sanitary engineering that with modern methods of filtration, the vilest supplies, even though thick with mud, foul of smell and laden with the germs of disease, may be so purified as to become entirely potable and safe for human use.

In former days it was supposed that only the larger cities could afford up-to-date water plants with their splendid filtration systems such as we have all been privileged to examine here in Indianapolis, and while it is still true that our smaller cities cannot afford such extraordinary equipment, yet none are so poor but they can well afford to dispense at least a good safe water. For us in this age to be satisfied to serve our patrons an impure and inferior product is at once to acknowledge our own delinquency in the highest offiicial duty with which we are charged. Whether the plant be municipally or privately owned does not matter. The standard of quality should be placed just as high in the one case as in the other. Nor should there be any doubt existing in our minds as to what the standard of purity should be. The time for hap-hazard suppositions or guess-work has long since passed by. Every waterworks man should really know his product, and in order to do so, wherever possible, he should install his own laboratory equipment for making the necessary tests. But in cases where this may not be done, nearby laboratory assistance could doubtless be easily obtained; or the state if called upon is always willing not only to furnish analyses but to give valuable expert assistance and counsel at any time, to the end that the healthfulness of the people of the state residing within the borders of our municipalities may be be properly safeguarded and conserved.

Water which is merely good enough for fire protection, manufacturing purposes and lawn sprinkling in our smaller cities is, and should be, no longer regarded as satisfactory. Any city, however small, if it is large enough for a waterworks system at all, is large enough to afford, and can afford a water of good quality for its citizens. The demand of the times as related to all human sustenances, to water supplies as well as to food supplies, is for a higher standard of purity—the best which nature and science can produce.

Therefore, in the judgment of the writer, with such a demand existing on the part of the public, it is not only bad management but may we not say the grossest sort of mismanagement for any municipality or company to furnish its consumers with any kind of water but good water. Though actuated by no higher motive than purely selfish busi-

*A paper before the Indiana Sanitary and Water Supply Association.

ness policy it is still the best evidence of good management, even in our smaller cities, when a high-grade water is produced.

In the discussion of this topic the writer has dwelt upon the quality of water supplies for the reason that more especially in our smaller cities this fundamental consideration in the management of waterworks utilities is all-too-frequently disregarded, whereas it should be of paramount importance both to the enterprise itself and the public which it serves.

Wherever water exists at all it is possible to make it good, and that, too, at a price easily within the reach of all. The public wants the best, and as a general rule is willing to pay the necessary price for it, notwithstanding the fact that some neighboring city may charge a somewhat lower rate for a poorer water. The old, time-worn antedated theory that all cities of about the same size should pay about the same rate for water, no matter how different the cost of production or how dissimilar the service, thanks to the growing intelligence of our times, has about run its course. Such a theory was discarded by the larger cities years ago, and there is no surer indication of progress on the part of our smaller cities than when observed following their good example in this regard. Next to furnishing a good water, it is the highest mark of good management when the rate for water is made to depend upon the cost of the finished product, without regard in any way whatever to the rates in vogue in any other city, whether higher or lower. No fact is better recognized or more firmly established among the fraternity than that rates are comparable only so long as conditions in the different cities are comparable. It is likewise recognized that no two cities have precisely the same conditions to meet. Hence the utter impossibility of exactly similar rates.

Thus, having first of all, produced a good water and having established a fair rate of charge for the same, the management of an enterprise of this character has taken upon itself responsibilities and duties that are legion. Not merely must a clear, wholesome and sparkling water be produced but the service must be up to the standard in every particular. The pressure must be as constant and unvarying as is possible to give. In case of fire, the equipment must be in such condition as will permit it to be instantly brought into action for its highest and most efficient duty.

If a manager must know his product, so must he also know his plant, its capacity for constant service, its durability under intense strain, and the proper economy with which it should be operated, not only as related to fuel supplies and attendance, but economy in conserving the output as well, the accomplishment of all of which will be found to tax to the limit all the watchfulness and skill of which the most active manager is capable.

If flat rates should be in vogue a frequent inspection of all fixtures in any way connected with the system is necessary in order to keep the waste and leakage reduced to the minimum. Water closets will get out of order. Urinals will become opened too full. Faucets will be turned on to prevent freezing, as doubtless most managers have been brought to realize during the unusually severe cold weather of the past few weeks. Rigid rules to conserve the supply, and a rigid enforcement of them are indispensable and imperative necessities as against those who willfully abuse the flat-rate privilege. Wherever such conditions of wastefulness prevail the department should very promptly enforce meterage or shut off the supply. Indeed, meterage to begin with, is the only fair or equitable way to sell water; and as we approach the entirely metered system just so much nearer do we come to the ideal toward which all our cities, large and small alike, should constantly strive.

But even water meters are sometimes prone to err. They, also, need attention from time to time as well as leaky fixtures or wasteful patrons. Every meter in service should be zealously looked after from month to month to note any unusual variations in readings. Frequent tests should be made to verify their correctness. As meters almost invariably register in favor of the consumers when incorrect such watchfulness will be found to result in largely increased returns to the water department or company, as the case may be. Records of all tests and repairs should be made and conveniently filed for reference.

Because a waterworks plant is small is no adequate reason for laxity in its system of records and accounting. Indeed, all the greater should be the necessity for accurate, convenient, systematic and comprehensive records. Good bookkeeping and well-kept records are absolute necessities to the successful conduct of any enterprise no matter how small or large it may be. Even in the smallest water-works plant such a system should be employed as will disclose at any time the actual working conditions of the business. Moreover, it should be in such form that comparisons may readily be made with any corresponding period in the history of the enterprise. To the alert and wide-awake manager such comparisons are fraught with many enlightening suggestions which he will find to be valuable aids in the prosecution of his work. For instance, in the purchase of coal, a comparison of the results obtained from the different grades will disclose which is best and most economical to use. A comparison from day to day of pumpage records, laboratory test records, coal consumption records, recording pressure gauge records and watchmen's clock-dial records will all be found to be abundantly worth while. Likewise, a comparison from month to month of receipts and disbursements, when properly classified, will tend to emphasize conditions needing correction, and by so pointing out the way to the right sort of management as the business develops and grows, will make failure improbable and some degree of success, at least, not too difficult to be realized.

The office records should show completely of what the physical plant consists. Every water main should be definitely shown as to location, connection and size. Every valve, fire hydrant, curb stopbox and service pipe should be correctly mapped, and each service record made to fully indicate every fixture and purpose for which it is to be used by the consumer. These really important matters too many of our smaller cities entirely disregard.

Good accounting will not permit the capital investment account to be charged with replacements and repairs, nor will it attempt to deceive by failing to take into consideration the very important item of depreciation.

Thus may we not safely conclude that, with good water, fair rates, a proper public demand, good operating equipment for the service required and a good system of accounting, all that can remain essential to make the concern a success are the right men on the job. And of these at least a passing word is here thought to be well worth while.

It is observed that the larger cities and water companies which have achieved the greatest success in our field of operation have and keep in their employ the very best help they can obtain. They are in constant touch with every phase of water works development in other cities. And although the heads of these larger enterprises are high-class, capable men, whenever difficult problems arise, either in construction work or management, they are quick to avail themselves of the help of eminent professional water works men upon whose aid they know they may safely rely.

With our smaller cities, however, as a rule such a progressive tendency is not so marked. Too frequently does it occur that as managers we are found lacking in a full appreciation of the importance of the work devolving upon us to perform. The manager of a water works plant, however small, has in his care many thousands of dollars of invested capital represented by the physical value of the plant. To properly care for the same and to obtain therefrom the highest economy, efficiency and returns, he should avail himself of every aid in his power to obtain. The best trade journals should come regularly to his desk. Conventions of water works men should be attended and every available opportunity should be taken advantage of in order to learn what others are doing and to keep in constant touch with the advancing progress of the times. And if those of larger capacity and a much wider range of experience than we could possibly possess require the assistance of expert knowledge in their work occasionally, how much greater is our need for help from time to time when important problems in our own work must be met and solved.

Indifference on the part of a manager as to what others are doing will, in nine cases out of ten, result in the stamp of failure being placed upon his work. If we would make our business a going-concern, therefore, it is imperative that we should bring to our aid as much of the knowledge and experience acquired by other companies and other cities as possible, and this the progressive manager will not be slow to do.

Another thing the right sort of manager will do: No matter how heavy his own burdens, or how great the provocation, he will bear in mind in dealing with the public that, "a soft word often turneth away wrath," and also that a smile once in a while will cost him nothing at all. Courtesy and consideration toward the public, as well as patience under unwarranted criticism, in the long run he will find always to pay. And if we deal courteously with the public, what shall we say of our help, upon whose everyday loyalty and untiring efforts much of our success must of necessity largely depend. Every helper in the enterprise, from the highest to the lowest, should be made to feel that he is a valued partner in the business, in spirit at least. Having once obtained good, loyal help the most cordial and mutually helpful relations should be maintained. Frequent changes of help not only look bad for the management, but detract from the highest state of efficiency in the service as well. One of the most baneful influences of municipal ownership of our utilities is the tendency to repay political obligations with these positions without proper regard to the qualification and fitness of appointees, sometimes changing the entire force with each successive administrative change in the city's political affairs. Under such conditions any substantial progress is almost beyond the realm of human probability.

No department of public work has devolving upon it larger and more far-reaching responsibilities toward the public than the water department, the correct and successful handling of which requires years of constant study and the most untiring devotion to duty that is possible for any man to give. Without good men to direct and without loyal co-operative help on the part of employes, even the best of physical plants must fail. Ultimate and lasting success cannot be achieved in a day or a year. If it comes at all it must be to those who by their work are able to prove their worth. Intelligent supervision and the most diligent application to the multitude of details and duties which daily arise constitute the price of success in the water works business just as in any other enterprise. In all our cities, whether large or small, there is no better or worthier work to be performed than to supply our fellow-beings with good water, and in doing this, if we are able and willing to pay the price of success in our work, we surely cannot entirely fail.

Bituminous Concrete Pavements in Washington, D. C.*

By Captain Mark Brooke.

IN the search for a satisfactory solution of the problems which have arisen since the introduction of the automobile, road engineers seem to be working toward a definite type of pavement, bituminous macadam. In this, history is repeating itself, for many of you in your attendance on this convention will have ridden over a pavement of the same type, the bituminous concrete, laid forty years ago, in response to the demand for a better type of pavement than the rough block and cobble then existing. The highway engineer of today should, therefore, find something of interest, possibly of practical value, in a brief history of Washington's bituminous concrete pavements.

Washington today has 3,000,000 sq. yds. of bituminous pavement, other than asphalt block, of which 1,200,000 sq. yds. are are cement concrete base, and 800,000 sq. yds. on a base of bituminous concrete. Of this amount 600,000 sq. yds. have, at some time, been resurfaced with asphalt over the original pavement, and less than 200,000 sq. yds. of old tar and tar-asphalt pavements exist as originally laid.

In point of time the history of these pavements may be divided into three distinct periods, in each of which a different class of pavements was laid.

The first period is that from 1871 to 1878, the period of the old patented types, to which the designation "concrete" has been applied locally. The second period was from 1888 to 1893, when a type of bituminous base pavement known here as "coal-tar distillate" was laid, and the third is embraced in the last two years, during which time a limited amount of bituminous macadam has been put down.

In attacking the task of paving the streets of this city, which had been cut to pieces by the supply teams of the army during the Civil War, the city authorities sought for a smoother type than the cobble with which the city was partially paved, and Washington for a number of years was a fertile field for inventors of wood block and bituminous pavements. Between 1870 and 1875 about 700,000 sq. yds. of bituminous base paveemnts were laid under various patents, among which were the Evans, the Filbert or Vulcanite, the Scharf, Abbot, Bailey and Parisen.

While differing in detail they were generally similar in character, and in all of them the attempt was made to get a pavement in which a more or less accurately graded aggregate should be bonded with a bituminous cement into a dense concrete.

The method in which this object was sought to be obtained in the different pavements is interesting, and I will give a resume of the specifications of several of them.

The Bailey pavement consisted of a foundation about 1 ft. in depth of stone from 2 to 10 in. in size, into which was poured a cement composed of a mixture of asphalt fluxed with tar, ground slate, soapstone, pulverized dry clay, shells and stones. Upon this foundation was spread a 2½-in. course of ½ to 1½-in. stone, over which was poured a mixture of hot tar, asphalt and oil .of pitch. On this second course was laid a third, 1½ in. in depth, composed of fine gravel, coarse and sifted coal ashes mixed with the tar of asphalt cement. All these layers were then rolled with a heavy roller.

The Parisen pavement, of which about 70,000 sq. yds. were laid between 1872 and 1875, was constructed as follows: A base course of 2 to 4-in. stone thoroughly mixed with coal tar, lake asphalt, fine screened gravel and calcined gypsum was laid to a depth of 6 to 8 in. and rolled. In the voids in the surface of this course was rolled a light course of stone chips or

*A paper before the American Association for the Advancement of Science.

gravel mixed with medium tar and Portland cement. The surface was then painted with a coat of the cement used in the base. On top of this was a 2-in. course of gravel, gypsum and Portland cement mixed with bitumen in the proportion of ¾ medium distilled coal tar, ⅛ mined Cuban asphalt and ⅛ "dipped" or Trinidad asphalt. After rolling this course, it was painted and the last course was repeated. The object of the paint coat, it was stated, was to serve as a seal and to form a bond between the adjacent courses, and the inventor claimed as one of the advantages of this pavement that the base courses were firmly bound and the spaces filled and solid.

The Scharf pavement, of which about 200,000 sq. yds. were laid, consisted of three courses, a base course of 4 to 7 in. deep, composed of a mixture of stone and stiff bitumen obtained from the slow distillation of coal tar; then a 2-in. course of stone mixed with a cement of 1 gal. of pitch to ½ lb. of asphalt; and a wearing surface of small stones and gravel, hydrated lime, cement, pitch and asphalt.

The Vulcanite or Filbert was the simplest in construction and proved the most lasting of all the patented pavements. It was composed of a mixture of 80 lbs. of asphalt, 30 lb. of either rosin, pitch coal tar or pine tar; 5 lb. of sulphuric acid, 90 lb. of lime, and 600 lb. of sand, fine gravel, ground iron cinder and broken stone. The sand and aggregate were first mixed and dried, and then the other ingredients added, and the mixture heated to a suitable consistency. The hot mixture was then spread upon the sub-grade and rolled. The proportion of cement in this mixture, approximately 14 per cent., is slightly greater than the percentage of asphaltic cement in our own present standard top mixture.

The foregoing descriptions have been taken from the specifications in the patents as recorded in the Patent Office, but I believe that they should be taken as descriptive of a theory rather than a condition, as they probably do not accurately describe the pavements as actually laid in many cases. The specifications themselves, it will be noted, are generally vague as to sizes of aggregate and proportions, leaving considerable to the discretion of the contractor doing the work. Those specimens of the different pavements which have been preserved could scarcely be identified by the patent descriptions, and different samples of the same pavement show marked dissimilarity. They all possess one common characteristic, small proportion of voids.

The cost of these pavements varied from $1.74 to $3.70 per square yard. Many of them proved unreliable and had to be resurfaced within a few years. The trouble appears to have been in the wearing course, for whenever a new asphalt or Vulcanite surface has been laid on the old pavement it has stood many more years of service.

Of the 190,000 sq. yds. of Evans pavement, laid for the larger part in 1873, nearly the entire amount was resurfaced within two years. Two-thirds of the Parisen pavement was resurfaced within five years and the remainder within the next three.

Part of these pavements were resurfaced with asphalt and a portion with the Vulcanite pavement. The Scharf and Vulcanite proved much more durable, and many of them have been refurfaced or replaced only in the last few years in which they have been in service.

The experience with bituminous concrete as a whole was so unsatisfactory that when the first board of commissioners was established in 1878 it expressed its intention of abandoning this class of pavement in the following terms:

"In determining the class of pavements to be laid the commissioners maintain that each class of pavement must prove its qualities under the test of actual traffic before being extensively laid upon the streets of this city.

"While some of the later and better class of coal-tar pavements show good surfaces and give fair promise of a reasonable durability, yet the general condition of this class of pavement in the city is such as to lead to their condemnation as faulty in principle and deficient in vitality. The use of bituminous bases has also given rise to many perplexing problems in the grades of streets upon which they have been used, and as, when properly laid, their cost is as great, if not greater, than the hydraulic concrete, they have been definitely abandoned."

From that time on sheet asphalt on a 6-in. hydraulic cement base has been the standard pavement of this city, and no more bituminous concrete was laid for a period of nine years.

The opinion thus expressed seems to have been modified in the succeeding years, for the report of the engineer department for 1887, after quoting the report of 1878, goes on to say:

"In the meantime, however, a period of nine years has elapsed and the well-preserved condition of some of the later and better class of coal-tar pavements has led many to believe that the faults of the earlier pavements are not irremediable and that with proper care such pavements can be laid nearly equal to the asphalt in most respects, and superior in the quality of economy of first cost as well as in some other minor particulars."

The annual expenditure for maintenance of the bituminous concrete for the 15 years ending July 1, 1886, was 5½ cents per square yard. For the first five years the average cost was 3.7 cents; for the second five years 6 cents, and for the last five years 6.6 cents.

The 100,000 sq. yds. of Vulcanite, which at that time had been down 14 years, averaged only 2.9 cents per yard per year during that period, about the cost to-day of maintaining our standard pavement.

It is not probable, however, that there would have been a return to the bituminous type had it not been for the action of Congress in virtually compelling the abandonment of the hydraulic base pavement.

The paving appropriation act of 1886 contained a clause to the effect that no contract should be made for laying concrete or asphalt pavement at a higher price than $2.00 per yard for a quality equal to the best previously laid. Bids were then taken on a pavement with a 4-in. natural cement base and some laid at the $2 price. The following year Congress stipulated that the cost should not be higher than $2 for a quality equal to the best laid prior to July 1, 1886, and with the same depth of base. This condition, with varying limitations, has been retained in every appropriation act to this day. This meant that asphalt could not be laid on less than a 6-in. base, and as bids could not be obtained for this pavement at $2, recourse was had to a bituminous concrete, and during the next five years 425,000 sq. yds. of such pavement were laid.

This pavement, laid under District specifications, was of two kinds, known locally as the "coal-tar distillate" and the "combination."

Both pavements were 7 in. in depth and consisted of 5½ in. of base and binder and 1½ in. of wearing surface, the difference being in the character of the top course.

The base consisted of stone passing a 3-in. ring, rolled to a depth of 4 in. and then coated with a No. 4½ coal tar paving cement, 1 gal. to the yard.

The binder course was composed of screened stone not larger than 1¼ in. and No. 4 coal tar cement. The stone for this course was heated, mixed with the cement in the proportion of 1 gal. of cement to a cubic foot of stone, then spread on the base to a depth of 2 in. and then rolled.

The wearing surface of the "distillate" pavement was composed of about 60 per cent. sharp sand, 25 per cent. screenings, 14 per cent. paving cement and small quantities of hydraulic cement, slaked lime and sulphur. The cement consisted of about 30 per cent. asphalt to 70 per cent. No. 4 coal tar.

The surface of the "combination" pavement consisted of the standard asphalt top mixture laid on the tar base and binder courses just described.

These pavements continued to be laid until 1893, when they were abandoned for the hydraulic base pavement, the cost of which had come within the $2 limitation fixed by Congress.

Since 1908 we have resumed laying bituminous concrete in the form of a limited amount of bituminous macadam. This pavement, however, belongs to the present, it is not a matter of history and its description does not properly fall within the scope of this paper.

While both the "distillate" and concrete pavements are of the same general type, the difference in construction and quality is very marked.

The pavements of the period from 1871 to 1878, which run in depth all the way from 8 to 14 in., are a dense, tough concrete in which the stone is thoroughly coated, and the voids, small as they are, completely filled with a tar which appears as bright and fresh as though just laid. The distillate pavements, on the other hand, which have a uniform depth of 7 in., are brittle, the base course deficient in tar and, such as there is, inert and lusterless. The difference in the quality of toughness will be appreciated from the fact that in our resurfacing contracts we have different prices for the removal of bituminous pavements of the class laid before and that laid after 1880, paying $1.85 per cubic yard for the removal of the former and $1 for the latter. The older pavements are much more homogeneous in character, and even in those that were laid in successive courses there is no well-defined line of demarcation between the successive layers. However, the large quantity of cement, in some cases as much as 4 gal. to the square yard, used in the old pavements made them objectionable, wavy and in more than one instance, on a grade, they have been known to flow over the top of the curb.

The theory of these pavements was that they would form an indestructible base for a wearing surface which would be renewed as occasion demanded, and many of them, particularly of the distillate class, were laid with very flat sections, with a view to crowning, which was anticipated as the result of successive resurfacings.

As a matter of fact it proved impracticable to resurface them properly, as the old surface did not wear away uniformly, and it was impossible to strip it from the base, so intimately bonded were the two courses. Moreover, the street engineering of those days was rather crude, and many faulty grades were established. In a number of cases the surface deterioration was undoubtedly partially due to the poor drainage resulting from insufficient crown. It is rather from the necessity of correcting these conditions than from any other inherent defects of the pavements themselves that they are being replaced instead of being resurfaced.

The average age of all the street pavements resurfaced in Washington last year was slightly over 25 years, and it is safe to say that the old bituminous concrete averaged over 30 years.

There are not many of the old pavements left to-day. The Vulcanite pavement on De Sales street, laid in 1875, has never been resurfaced. The south side of Pennsylvania avenue, N. W., from Eighteenth to Twenty-first street, is a Scharf pavement laid in 1875 and resurfaced in 1887 with a tar distillate top. F street, in front of the Willard Hotel, is a Scharf pavement laid in 1873 and resurfaced in 1878 with an asphalt top. The Scharf pavement on Vermont avenue, in front of the Arlington Hotel, than which there was no better pavement in this city until gas recently got into it, was laid in 1871, and resurfaced in 1878 with an asphalt top over the original pavement.

Whatever may have been the faults of our bituminous concrete pavements viewed in the light of our greater knowledge and experience, they have served their purpose well and early formed a standard which made Washington the best paved city in the country. At one period of this city's history there were over 1,000,000 sq. yds. of this pavement, and to-day, either in original forms or as the basis of a later pavement, they form over 25 per cent. of our smooth pavements.

A detailed history of these pavements would doubtless give us many valuable suggestions. I am going to refer to but three which have impressed me, and they are, that the mixing method is better than the penetration, that the more homogeneous a pavement is and the fewer courses in it the better, and that nature and modern process patentees are not unique in their abhorrence of a void.

Notable Work on the Catskill Aqueduct.

THE construction work going on in connection with the carrying out of the Catskill Queduct project is deservedly attracting widespread attention. It is inevitable that important problems have to be solved when it is proposed to bring an enormous supply of water from a mountain district one hundred miles distant, conducting it across a score of valleys, some of them several miles in width, as well as across so deep and broad a river as the Hudson. The problems have especial interest for the municipal engineer because of the very character of the enterprise. They have large interest for the concrete engineer for the reason that the construction of the aqueduct is everywhere involving the use of Portland cement and concrete. The steel siphon work should have the earnest attention of the engineer and manufacturer concerned in the possibilities of steel construction. The mining engineer has his interest claimed by the shaft and tunnel construction. Portland cement (in cement mortar or in concrete) plays a most important part in all of this. It is not only involved in the concrete of the cut-and-cover sections, but it is relied on to make possible a protective covering for the inside and the outside of the steel siphons. It has been found of exceedingly great value in the sinking of one of the deep working shafts; in fact, it may be questioned whether the sinking of this shaft would not have failed without it. Consider then the Rondout pressure tunnel and the steel siphons.

THE RONDOUT PRESSURE TUNNEL.

The Catskill Aqueduct may be said, if one speaks broadly, to parallel the Hudson river. Consequently, the route cuts across the tributary streams. These are creeks, or brooks of no special importance, so far as size goes. However, they mark the positions of valleys, some of which are a number of miles in width. One of the largest is the valley of Rond out creek. In making the crossing at this point, the aqueduct drops far below the surface of the ground, far below the bottom of the creek, and thus makes the 4½-mile passage from one side to the other. A vertical shaft at each end, and a third located at an intermediate point will remain permanent features. In addition, five other shafts were sunk to the tunnel grade in order to facilitate construction. One of these, Construction Shaft No. 4, is 500 feet deep. It is 10 x 22 feet in horizontal section. Eighteen months were occupied in putting down this shaft. It was flooded six times. The strata passed were:

Glacial drift	6 feet
Helderberg limestone	226 feet
Binnewater sandstone	39 feet
High Falls shale	92 feet
Shawangunk grit	134 feet
Total	497 feet

The trouble with the water came, no doubt, almost altogether from the sandstone and the shale. But the water made its presence felt long before these strata were reached. The site of the shaft included the location where a 4-inch test hole had been put down. When a depth of about 80 feet had been reached, a sudden inrush occurred through this hole, filling the shaft half full. The emergency pumping plant had not yet been delivered; so that the contractors were caught unprepared. However, by the use of an airlift and a couple of sinking pumps, the water level was lowered to a point near the bottom. A nipple was driven into the hole and casing attached to it. The purpose was to grout up the hole. In order to carry out this plan a 1-inch pipe was put down to the level of the Shawangunk grit—that is to the 363-foot level. The water was now permitted to return. Pressures were thus equalized and currents prevented. The grout was made according to the formula 1:1, and poured down the 1-inch pipe. This latter was withdrawn as the grout filled in.

CASTKILL AQUEDUCT. STEEL PRESSURE SIPHON.
Concrete Cradles in Foreground.

The problem of this one hole was solved in this way. But fears began to be entertained as to whether the ordinary methods of shaft sinking would prove successful. It was understood that there was below a great deal of water under considerable pressure. With subsequent events in mind, it is not difficult to see that a special pumping chamber in the side of the shaft should have been provided before permitting the excavation to pass out of the limestone. This arrangement was made later, but the delay was the source of much trouble. However, excavation went on, and the sandstone was penetrated. At the 260-foot level, the amount of incoming water was only about 225 gallons per minute. However, during the drilling of the sump, an additional 600-gallons per minute came in suddenly through one of the drill holes, with the result that the shaft was flooded again. After some trouble, the shaft was unwatered, only to be flooded three additional times in as many weeks. Pretty much all this water came in through bore holes, none of which was probably over two inches in diameter. When the fifth unwatering had been completed, the conditions below were known to forbid further progress apart from special precautions. In fact, it had been ascertained that large crevices were a short distance beneath the bottom of the excavation. One of the largest of these crevices ran up to 8 inches. As compared with the 2-inch bore holes, they promised plenty of trouble.

It was now proposed to deal with the water question by means of grout. Four special machines were set up at the mouth of the shaft. A 2½-inch pipe led down the shaft to the bottom, where a 2-inch hose carried the grout to the point of use. At the beginning of operations, the grout gave trouble by leaking back. It would come in through the spaces around the pipes and through cracks in the bottom. This difficulty was successfully met by mixing finely ground horse manure with the grout. The manure produced a clogging effect. Somt grout was wasted, but success was eventually obtained. In this procedure, a total of 2,900 bags of Portland cement was consumed. When the grout had hardened in the crevices, a few more holes were drilled. Water having a head of 65 pounds was found 14 feet below. These holes were soon grouted up, only 60 bags of cement being required.

But sinking was not at once resumed. It was deemed advisable to deal further with the question of the water. The grit was now about 100 feet further down. It was proposed to grout up the intervening water-bearing strata with more grout. Accordingly, six diamond drill holes were put down to the grit. Half were of the size corresponding to a 1-inch core; and half to a 2-inch core. With a pressure of 275 pounds per square inch, these holes were grouted up with 175 bags of cement. Nobody knew whether this small quantity of cement meant that the problem was a small one or whether it had been only partially solved. It would seem that the thorough application of the method of grouting ahead of the excavation should have been employed sooner—that is, before the water bearing strata had been penetrated.

Sinking was now begun again, and prosecuted until a depth of 320 feet was reached. A couple of collecting rings had been arranged, and many sinking pumps installed in the shaft. The working space was much impeded. Besides it was difficult to secure easy, certain and adequate pumping capacity by the use of sinking pumps alone. It was determined to construct a pumping chamber off to one side at the 309-foot level. This chamber was quite large being 10 feet high and having horizontal dimensions of 17 and 24 feet.

Beneath its floor a sump 5½ feet deep and 16 x 22 feet in area was arranged. It had a capacity of 14,500 gallons. In the special chamber were installed three Cameron horizontal condensing pumps. These were all the 24 x 10 x 20-inch size and had a combined capacity of 1,050 gallons per minute. They were run by the steam supplied by three 100-h. p. boilers set up at the mouth of the shaft. As the pumps were of the condensing type, this whole arrangement was a possible one. Before the installation of this powerful pumping plant, the sixth flooding of the shaft took place. Subsequently no especial difficulty was encountered from the water. More grouting was done, but none of the seams required more than 100 bags of cement, with one exception. When the grit was reached, a hole gave trouble and required 348 bags of cement. The amount of water pumped from this one shaft was 86,181,000,000 foot-gallons. The total amount of Portland cement consumed in the grouting operations was 971 barrels.

THE STEEL SIPHONS.

Where the Catskill Aqueduct crosses a very broad valley, a permanent vertical shaft is put down on each side and the two bottoms are connected by a more or less horizontal tunnel through the solid rock. But where the valleys are quite narrow, the practice is to make the crossings by means of steel tubes. These are of enormous dimensions. Three parallel tubes are required for each crossing in order to furnish full capacity. Only one is being put in at present—the middle one. There are to be in all fourteen steel siphon crossings of an average width of 0.455 mile. This work is divided into two contracts, one of which is held by the T. A. Gillespie Co., of New York City.

Altogether the fourteen siphons will require for the single central tube something over six miles of steel pipe. The diameters are 9.50, 9.75 and 11.25 feet. The thicknesses of the steel plate vary from 0.438 to 0.750 inch. The variations in diameter and thickness of plate are made in order to permit a standard capacity to be maintained under varying conditions and to enable varying bursting pressures to be withstood. The joints are riveted ones. Circular joints are lap riveted. With the thinnest plates (0.438 inch), the longitudinal seams are also lap riveted. For plates thicker than 0.500 inch the longitudinal seams are butt riveted. For the 0.500-inch thickness both methods are employed on longitudinal joints. The butt riveting is done by bringing the edges together—edge to edge—and then covering the joint inside and out with a steel strap. The inner strap is wider than the outer ones. The rivets securing the outer strap to the tube are also the central rows of rivets for the wide inner strap. They thus hold together three thicknesses of plate. In addition, two single rows of rivets are arranged in staggered positions relative to the two central rows. The two rows outside of all, which secure only two thicknesses of plate, have their rivets placed at double the interval used in the other rows.

In crossing the Peekskill valley over a mile and a quarter of pipe is required. All of it is of the smaller diameter. A short length (139 feet), presumably at the lowest point, is of the thickest plate (0.750 inch); then there is a total of 1,000 feet or more of the 0.688-inch thickness. Apparently no other of the crossings require such thick plate as the 0.750-inch thickness. This will be understood when it is stated that the maximum head at Peekskill is 340 feet—45 per cent. greater than in any other case. It is the widest and the deepest of the steel siphon crossings.

The steel pipe is furnished in 15-foot lengths. A circular joint has accordingly to be made every 15 feet. This fact has to be taken into account in the preparations for the reception of the giant tubes. Concrete cradles are arranged at such intervals as to permit the shop and field joints to come between them. The concrete cradles are 8 feet or more across—measured transversely the line of the aqueduct; and about 3 feet wide. The same style is not used everywhere. A typical cradle has, however, a curved depression above to fit the pipe. It is then continued horizontally for a short distance, Underneath, a vertical section across the line of the aqueduct discloses a flat curve. The manner of casting is quite simple. Two bulkheads of the required form are placed on the earthen surface, which has been given the required curvature. The bulkheads are held temporarily in position by a couple of wooden strips nailed across. The concrete is poured in and the upper surface formed by hand. However, a transverse and several longitudinal grooves are described where cradle and pipe are to come into contact. These are provided by using short lengths of wooden strips. The object of these depressions will appear later.

When the cradles have been cast, the pipe suitably placed, and the field joints made, the entire siphon is filled with water, the pressure being brought to the conditions that are to exist when the aqueduct is in actual service. This is done not merely to test for possible leaks, but especially to give the pipe the exact form it will have when in actual use. While filled thus with water, the concrete envelope is put on. This is a proceeding requiring time. During this period, it is important that the pressure be maintained at the required point. It is necessary, therefore, not merely to pump the pipe full, but to maintain the pressure night and day. In this and other duties, the Cameron pumps have been engaged.

It is necessary or at least advisable to clean the surface of the pipe thoroughly preparatory to the application of the concrete envelope. It is possible that the concrete would absorb and take care of a thin coating of rust. But no chances are being taken on that. Removable ribs are employed to hold the lagging in place. At Bryn Mawr, narrow wooden strips making lap joint with each other were in use, upon the writer's visit. The concrete is dumped upon the crest of the pipe. The jacket of concrete completely envelops the tube, except where the cradles themselves are located. Prior to placing the concrete of the envelope, a grout is poured into the grooves arranged on the upper surface of the cradles. Access is gained from the side. This grout fills the system of grooves beneath the steel plate and effects a close joint.

The placing of the interior shell of cement mortar is one of the most interesting and important matters connected with the steel siphon work. This lining is required to have a minimum thickness of 2 inches and a smooth internal surface when finished. A little consideration will show that we have here a considerable problem. Of course, any satisfactory solution of the problem must be a commercial one. Considerable experimenting has been done.

A steel form presents perhaps the best surface adapted to securing the desired smoothness. It would, perhaps, be difficult to provide ribs strong enough and yet sufficiently flexible to permit slight variations in form to be made. The tube is not a circle—it is, rather, an ellipse. A device for blowing the grout on to the steel and thus building up to the required thickness was tried for a while. It seemed to put the mortar on satisfactorily, except that it left a rough surface expensive to smooth. On the Gilliespie contract, wooden forms are used. The bottom of the lining is put in by hand. The remainder—about 270 degrees—is placed at a single pouring when a section of form, perhaps 20 feet long, is ready. This consists of nine segments, each covering about 30 degrees. Each segment is a unit. They are all alike, so that no mistakes can occur in arrangement. Ribs giving strength to one segmental form interlock with ribs of the next one, and so on. The interlocking is secured by providing a tongue or protuberance on one end of a rib and a corresponding notch on the other. The tongue of one rib is placed in the notch of the rib next to it around the circle. We thus get a long rib of 270 degrees. Five struts are now put in place at a number of the 270-degree ribs. These extend from a joint on one side to the joint opposite on the other. They are easily placed, and easily taken down. Altogether, there are about 20 such struts used in setting one section of form. The struts contact at each end, not with the joints, but with intervening longitudinals. There is a simplicity and flexibility about this form that makes it quite successful. Metal stops are employed to regulate the distance between form and pipe. When all is ready, the pouring is accomplished by means of a tube running up through the roof. This permits the cement mortar to be furnished from an outside point. The tube is arranged at one end of the form. The end selected is the lower one. A hole is left open at the other end to provide a suitable vent. No provision is made for expansion and contraction. It is assumed, perhaps, with the pipe full of cold water and the exterior well protected there will be but a small variation in temperature.

The concrete on the outside and the cement mortar on the inside are to be considered as having no other service of importance to perform besides that of protecting the steel pipe. Time will alone tell how perfectly this has been accomplished.

Wells and Well Pumping Machinery.*

By Charles Brossmann, Indianapolis, Ind.

THERE is no definite record as to when man first had to secure water from wells, nor the reasons which made him endeavor to secure water from below the surface. No doubt at first water was used directly from the streams, which at that time certainly were pure; but the human family increased. By multiplication and dissension it spread to all corners of the land, after which wells are spoken of again and again in the Bible.

"And Isaac's servants digged in the valley and found there a well of springing water." Gen. 26:19. This seems to be the first mention of a flowing well.

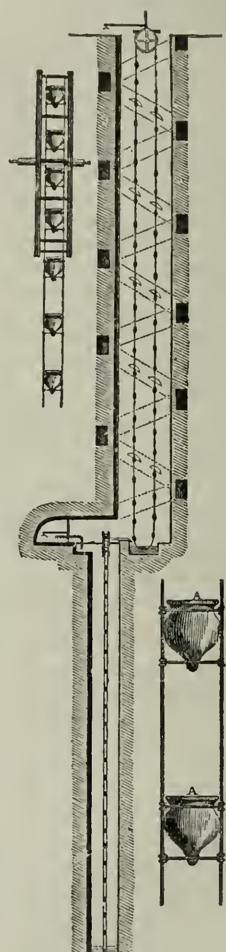
History and romance are singularly interwoven and associated with the description of wells. In Isaac and Rebecca's romance a well is mentioned. The well called Jacob's well is replete with ancient history. Numerous other instances are probably remembered by most of you.

No doubt the first wells were crude excavations, mere holes in the ground of very shallow depth and built wholly in soft materials; but, with the discovery of metal, wells were dug into the solid rock; not only shallow wells, but wells of prodigious depth for such times, and of no mean size, accurately fashioned and designed with a view toward permanency.

The well called Jacob's well, located on the road to Jerusalem, was used for 3,500 years by his descendants. The exact date of its construction is unknown. It is not known whether Jacob built this well himself. Sunk in the solid rock, this ancient hole drops to a depth of 105 feet and is 9 feet in diameter.

In Fig. 1 is shown one of the most remarkable engineering works of the ancients, Joseph's well at Cairo. This extraordinary well is nearly 300 feet in depth. For a depth of 165 feet through the solid rock it is 18x24 feet in section. At this depth is a relay chamber to receive water from the lower level of the well. The lower shaft extends 130 feet below through the rock into a bed of water-bearing gravel. The lower shaft of the well is 9x15 feet in section, the water from the bottom being raised to the 165-foot level by machinery, consisting of an endless chain of pots and toothed wheels; the motive power being horses or oxen. Making their countless rounds in this subterranean chamber, these beasts of burden raised the water from the very bottom to their own level; from there the water was again elevated the remaining 160 feet to the surface of the earth by similar beasts of burden.

Access from the surface of the ground to the lower chamber was obtained by a winding passage way following around



JOSEPH'S WELL.
Fig. 1.

the large shaft. This passage way is between 6 and 7 feet wide, and a little over 7 feet in height. Dropping with a very easy grade it winds around the well with a wall with little over 6-inch thickness

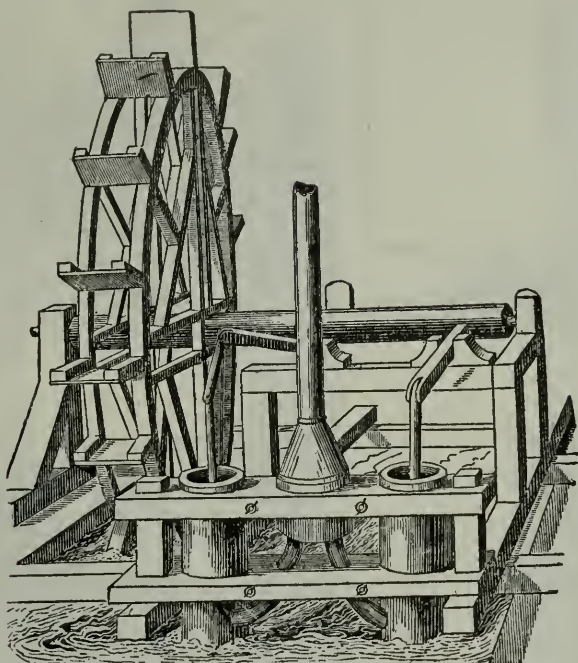
*From a paper before the Indiana Engineering Society.

between it and the well shaft itself. Built in the solid rock with such extraordinary care and accuracy, this well is truly remarkable; and it would be especially interesting to know more of the methods and tools used to build this great engineering work. The building of this well is commonly credited to Joseph, a patriarch of Egypt. Some scientists attribute this well to the same people who built the pyramids. Others, believing that Cairo is situated upon the location of the ancient city of Babylon, hold it to be part of the remains of this historic city.

The genius of some ancient engineer (believed to be Conon, residing in Egypt) is shown in the form of a screw pump used by the Egyptians and the Romans. This is usually named the Archimedean screw, after the man who introduced it. These pumps have been reinvented time and time again, some driven by hand and some by beast, and some even by water power. Pumps of this principle have only recently been taken up again, and with slight modifications and improved mechanical construction, give for moderate depths a machine that will displace a very large volume of water. Unlike the old machine, these of later day make are operated at very high speed.

An improvement of the chain of pots used in Joseph's will is the chain pump. The exact credit of its invention is clouded in the dim chronicles of mechanical history, but it is likely that its development is due to the Chinese.

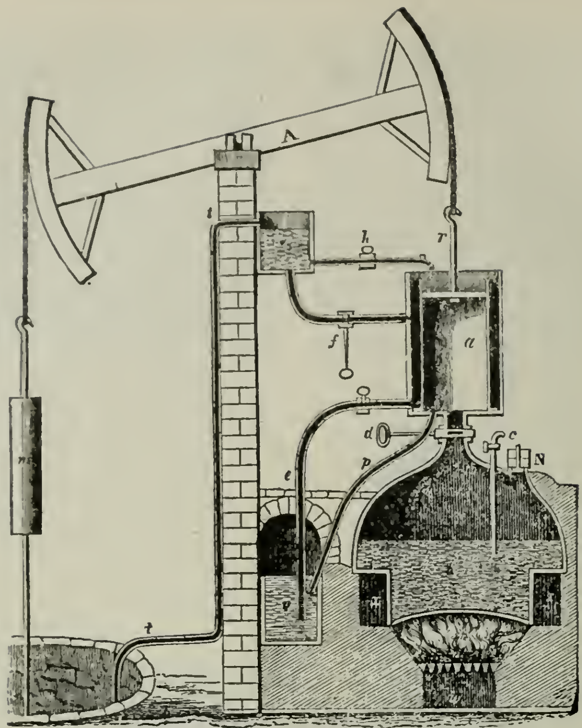
The syringe and the valve were evidently the forerunner of the improved pump of Ctesibius. This machine was the forcing pump of the ancients, and could force water to considerable heights. The improvement and combination of pistons, valves and air chambers giving a machine that produced a continued flow of water, entitled this ancient inventor to the thanks and regard of our modern engineers. Fig. 2 shows the pump of Ctesibius from the description of Vitruvius. The latter application of this old pump is herewith shown as used in the rotative machinery of the fifteenth and sixteenth centuries. Note the weighted arms showing the flywheel principle.



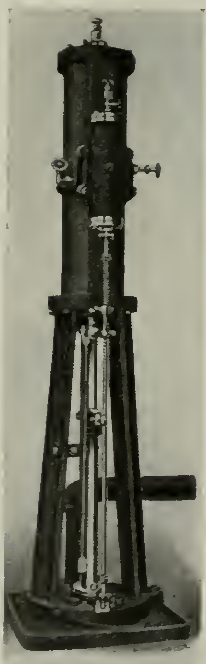
Machine of Ctesibius.
Fig. 2.

About 1641 the first suction pump was constructed at Florence, Italy. This led to the discovery of vacuum and atmospheric pressure by Torricelli. This natural law was even the subject of religious bickerings at that time. The bellows pump was, however, used over a hundred years before that time, but the above mentioned theory did not seem to be understood. The differential plunger pump is also mentioned about this period.

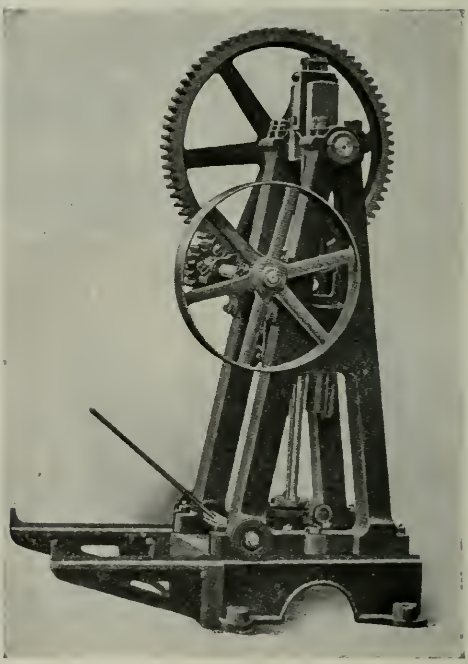
Heretofore all the machines described



Newcomen and Cawley's Engine. A. D. 1705.
Fig. 3.



DEEP WELL, STEAM HEAD.
Fig. 4.



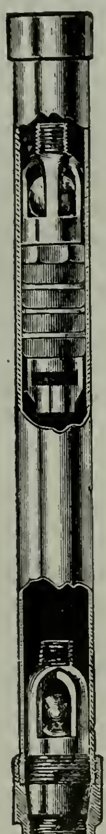
DEEP WELL, POWER HEAD.
Fig. 5.

have been operated by manual labor, or by animals. In 1655 the Marquis of Worcester, England, mentioned his ideas on the raising of water by steam power; in fact, shortly after 1600 the use of steam for pumping water was causing comment in England. Rapidly following came the fire engine and machines of Papin, Savery, Newcomen, Cawley and others. The general form of Newcomen and Cawley's engine of the early part of the eighteenth century is shown in Fig. 3. Following these came the great improvement by James Watt, using steam expansively. The advent of the steam engine, of course, gave a corresponding impetus to the improvement in pumping machinery of every type, and during the years following the invention of utilizing the expansive force of steam rapid progress was made, and many machines were built that were efficient and reliable.

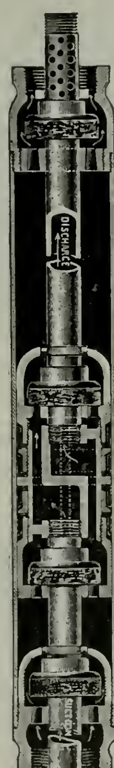
The Mather and Platt pumping engine for wells used a single cylinder and two plungers, one rod inside the other. This pump had two bell cranks to transmit the motion to the plungers, the dead center of one lever was obtained before the other was passed, thus the column of water was always in motion without shock or vibration. Such pumps have been used in England with lifts of 150 and 200 feet. The original pump of this type was invented in 1780 by Taylor, of South Hampton. (Acknowledgement is made on parts of historical matter to "Ewbank.")

The pumps of the present day are in almost every instance modifications or improvements over some of the older types of pumps, most of which have been mentioned above. The air lift and the internal explosion pump probably being exceptions.

The present day deep-well pumps may be classified as direct acting, rotary, centrifugal and the air lift or air displacement pump. The direct acting deep-well working barrel, either single or double acting, has been used probably more than any type of well pump, using generally a steam head (Fig. 4), or in many cases a power head driven by steam, gasoline or

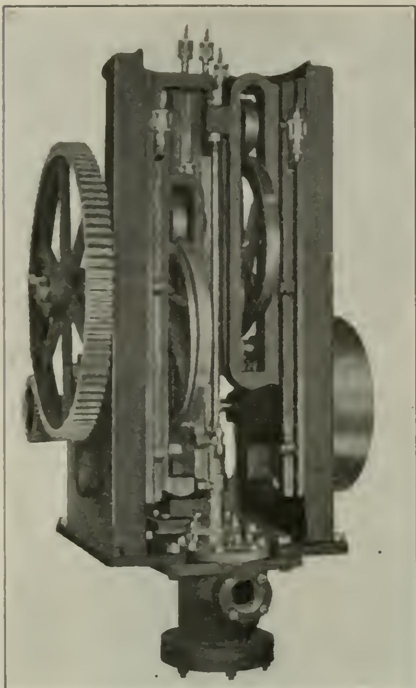


SINGLE-ACTING BARREL.
Fig. 6.



DOUBLE-ACTING BARREL.
Fig. 7.

CONTINUOUS-FLOW BARREL.
Fig. 8.



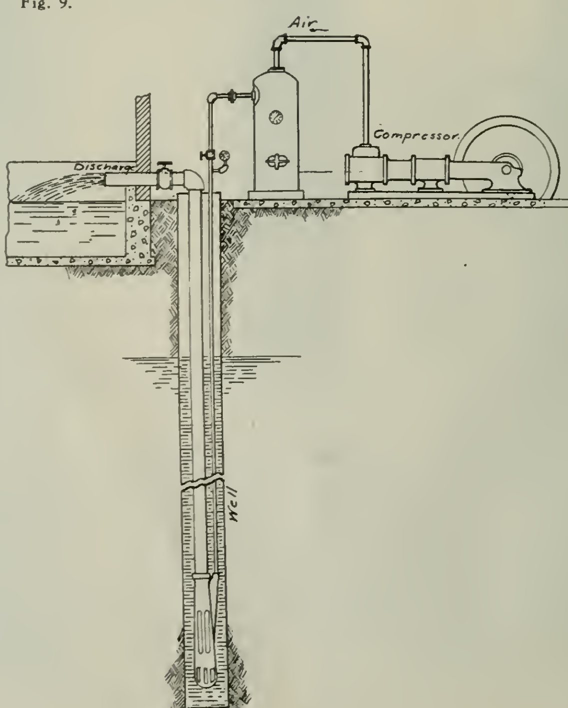
POWER WORKING HEAD FOR CONTINUOUS-FLOW PUMP.
Fig. 9.

electric power (Fig. 5). The single acting barrel is shown in Fig. 6, the water, of course, being discharged only on the up stroke. The double acting barrel, of which a type is shown in Fig. 7, gives a discharge on both the up and down stroke. The differential plunger pump gives a somewhat similar effect by using a single acting barrel with a displacement plunger placed at the discharge end.

Still another type is the continuous flow style of barrel, shown in Fig. 8. In this there are two plungers, the rod from the lower plunger being inside the rod from the upper plunger. These barrels are usually operated by power heads. In some the motion is given the rods by means of cranks and gears; in others, the rods are connected to rollers riding on cams. The claim for pumps of this class is that the double plunger gives a continuous flow without pulsation, which insures smoother and more economical operation.

Fig. 9 illustrates a power head for the continuous flow type using cams and rollers to operate the two plungers.

The air lift pump is operated by introducing a jet of air at the bottom of a water column. The air from its buoyancy forms bubbles, or an air piston which forces or displaces the water to the surface. The air lift is about as simple a

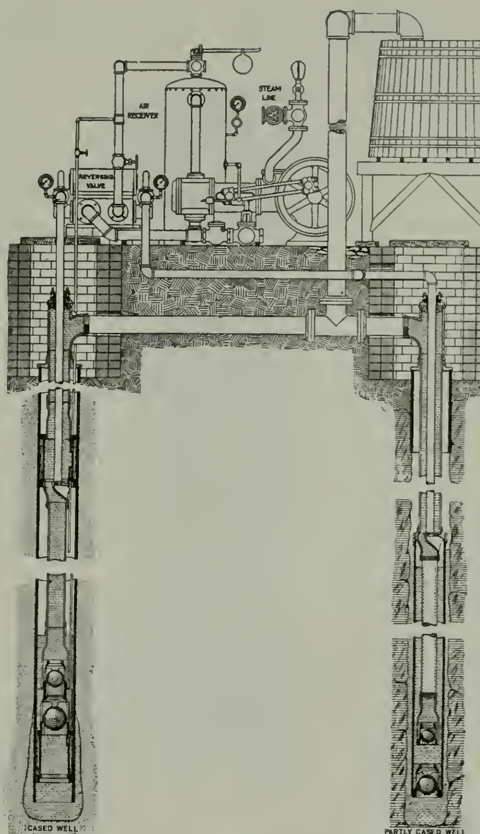


AIR-LIFT PUMP.
Fig. 10.

mechanism as can be placed in a well for the pumping of water. A compressor is placed at the surface, and the general arrangement of the outfit is shown in Fig. 10.

The air pump head itself is made in numerous forms ranging from a simple pipe with an opening at the bottom to those of more recent date, which are arranged to reduce to a minimum the frictional losses in the air and water. The air lift is most economically operated at a minimum of 60 per cent. submergence. Under proper condition this type of pump will deliver more water than the direct single or double acting deep well pump.

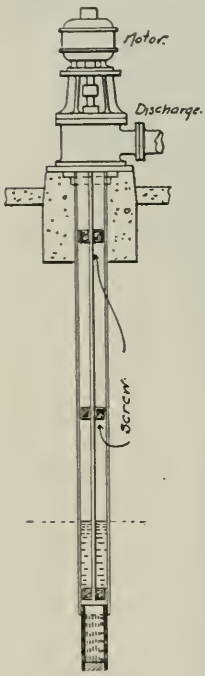
The displacement pump, operated by compressed air, consists of a compressor and necessary piping to the well, and the displacement pump itself placed within the well, and some type of automatic valve to regulate the inlet of air to the pump. In the simpler forms air is admitted to the pump in the well, forcing the water upward and discharging at some given point; the air is then exhausted in some cases into the atmosphere, or in some of the more recent types the exhaust being returned directly to the compressor, and a considerable saving being thereby effected. The important mechanism of such a system is the reversing air valve supplying the air to the pump. Fig. 11 shows the general arrangement of the return air system. The detail of the working barrel, it will be noted, is quite simple. No special submergence is required for this type of pump. The water fills the pump by gravity, after which the air pressure is applied and the water is forced upward until the water level in the pump chamber is close to the bottom, then the reversing valve cuts off the air supply, and connects the air compressor suction to the pump, the exhaust air being returned to the compressors, thus saving the wasting of air to the atmosphere.



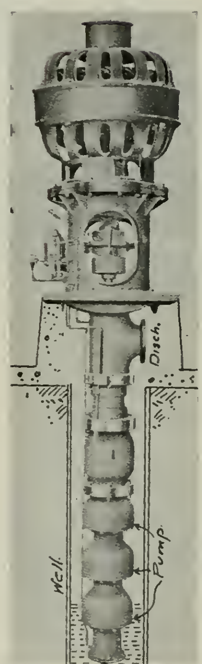
AIR-DISPLACEMENT PUMP. RETURN SYSTEM.
Fig. 11.

The pumps of the rotary class are improvements of the Archimedean screw or the centrifugal pump. Fig. 12 illustrates a modern pump of the screw type. These pumps are operated at high speed and will discharge large quantities of water. They can be driven by steam turbine, electric motor or belt. In some instances an additional centrifugal pump is placed on the same shaft to raise the water from the surface to any desired elevation, thus giving a very compact installation. The impeller or screw pump itself, it must be understood, is used only for lifting from the well to the surface, the attached centrifugal at the surface being used for pressure. Fig. 13 illustrates a deep-well multiple stage centrifugal pump. This type of pump is capable of operating direct against fairly high pressures, but will not give as large amount of water as the impeller or screw type. The shafting is hung entirely from the top and is provided with ball or roller bearings, thus reducing friction to a minimum.

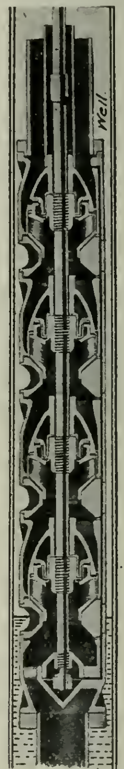
The general construction of the deep-well multi-stage centrifugal is shown in Fig. 14.



SCREW PUMP,
MOTOR DRIVE.
Fig. 12.



MOTOR DRIVEN
CENTRIFUGAL PUMP.
Fig. 13.



SECTION OF WATER END
CENTRIFUGAL PUMP.
Fig. 14.

In the selection of a machine for any installation, the type will be governed by a number of conditions. The size of the well, its depth and the amount of water per minute that the well is capable of yielding, all have a direct bearing in determining the particular type of pump that is best suited for the well to be pumped. It will be found that in the majority of installations where water has to be pumped from considerable depth, it usually takes more power to get the water out of the ground than to distribute the water afterwards. Each installation should be carefully considered, and after the type of pump is determined that is most suited to the conditions found, comparisons can then be made between the various makes as to cost, efficiency, etc., and the proper selection can then be made.

EDITORIAL COMMENT

Should a City Grant a Franchise to a Competing Public Service Corporation.—Obsolescence in Public Utility Plants.—Politics, Pull or Incompetency.

SHOULD A CITY GRANT A FRANCHISE TO A COMPETING PUBLIC SERVICE CORPORATION?

A correspondent asks a question concerning a franchise for a gas company which is answered in the "Question Department" and raises a question of public policy which merits some discussion. The city owns and operates an electric light plant and a company is asking for a franchise to furnish citizens with gas for cooking, lighting, etc. What would be the effect of this competition upon the revenues of the city's electric light plant, and what return should the company pay to the city for the franchise?

There are several sides to the problem and the balance can be struck only after a careful and detailed study of all the local conditions and possibilities. A few general suggestions may be made, however.

From the point of view of the company: The returns from the investment must be sufficient to pay the operating and maintenance expenses, depreciation of the plant and interest on the capital invested. To do this the price of fuel gas must be sufficiently attractive to induce the citizens to use the gas instead of coal or other fuel. Most of the use of fuel in a city located as far south as this being for cooking, it should not be difficult to do this, although a schedule of $2 to $1.25 such as that decided to be necessary for Taylorville, Ill., would not be low enough to induce the change from coal to gas unless the price of coal is high or the citizens are well-to-do and would use gas for its convenience and comfort without much reference to its price. To induce the use of gas for lighting the price of gas for that purpose must be low enough to compete with the electric light furnished by the city, and overcome the advantage of greater convenience which the electric light has. The rates for electric light which are charged by the city are not known, but they are probably lower than they would be if the plant were owned by a private corporation. The price for gas for lighting can therefore not be very high. This means, probably, that the income will be quite low as compared with the expenditures and reserves necessary to make and the company can hardly afford to pay any large percentage of its earnings as compensation for its franchise. It is quite probable that in so small a city the revenue from gas for cooking would not be sufficient to warrant the construction of a plant for gas only, although it might warrant some extra expenditure in a by-product coke-oven plant to utilize the gas which is generated in the process of making the coke. In an iron-smelting district a coke plant of this sort would be possible as the coke could be used in the iron furnaces and the gas would be a by-product costing little or nothing except for its distribution through the city.

From the point of view of the city: The pipes in the streets are a burden for which the city should have compensation. If the gas company is to have the share of business which is necessary to keep it alive, and the city's electric light plant now has a business as fully developed as it should be, the gas plant must take business from the electric light plant. This will reduce the revenues and the profits of the electric light plant. If, as is very probable in a municipal plant, the profits in the electric light plant are small or there is a deficit, this will mean a payment from the general funds of the city to keep up the electric light plant, and so far as this is due to the competition of the gas plant, the city is justified in requiring from the gas company a payment for its franchise which will meet this reduction in revenues in addition to the compensation for the use of the streets. It is quite possible, however, that the electric light business has not been developed to its utmost, being a municipal plant, and that a well managed small gas plant could develop new business enough to live without interfering materially with the present business of the electric light plant, although interfering materially with its future development.

From the point of view of the citizens: Gas is a very desirable fuel, especially in cities of the far south, and would be a great convenience to the citizens, one for which they would doubtless be willing to pay a reasonable advance over the price of coal, but, unless the price is materially less, it would not displace electric light. It would seem to be hardly fair to require the taxpayers at large to pay a deficit in the electric light plant to help a part of the citizens to secure these benefits.

To one with some knowledge of the general possibilities in cities of the size named for electric light and gas business, but unfamiliar with the local conditions, it would seem that the prospects for a gas plant using the ordinary coal, water or oil gas process were not very flattering. But the investors may be left to decide this question for themselves. It is the city's duty to protect its own investments and other interests by proper safeguards and payments in case the investment is decided upon by the company. Careful study by one familiar with the class of problems should be made and his report used as the basis for franchise requirements.

Even then a strict reading of moral and business principles should induce the city officials to consider carefully the propriety of granting such a competing franchise, without the assurance through this report or otherwise that the conditions are so favorable that future serious trouble and loss will not result to city or to company. Some future city administration may find it necessary, or at least expedient, to donate the remnant of the city's electric light plant to the gas company to reconstruct and operate for its own benefit. Such things have happened where local influences, political or otherwise, have resulted in neglect and consequent rapid depreciation of the municipal plant.

OBSOLESCENCE IN PUBLIC UTILITY PLANTS.

Prof. Halford Erickson, of the Wisconsin Railroad Commission, presented a paper on February 15 before the Indiana Sanitary and Water Supply Association on the methods of appraising public utilities used by the commission of which he is a member. In the discussion of the paper Prof. J. D. Forrest, who is now the manager of the Citizens' Gas Company, of Indianapolis, asked a number of questions, among them one as to the proper practice in allowing for obsolescence in apparatus not wholly depreciated but rendered useless by the advance in the art whereby improvement in service or increase in economy of operation demands replacement by more modern inventions.

There are some points in this connection which are occasionally mentioned, but which do not often receive full attention, to which Professor's Forrest's attention may be called. A company does not of its own motion dispose of old machinery and replace it with new unless it expects full return from the new investment. Under a certain progressive management of a prominent railroad the men in authority in the shops were informed, when they wished to make improvements, that whenever they could show a saving by new machinery which would pay 10 per cent on the cost of installing it, authority would be given for making the change. The evident expectation was that the improvement would pay for itself and that the plant would be increased in value by the resultant difference between the value of the old machine and the new one. So in making a valuation of the plant, the old machine might be written off entirely and the new one written in with depreciation deducted from the date of its installation. This would allow the good judgment of the managers to receive as a dividend the increased returns from cheaper operation or increase of business, as well as the interest on the increase in capital, and they could well afford the deduction of the remnant of value of the old machine. If the judgment of the managers was not good and the returns were not as great as was expected, they would still have the increased valuation of the plant on which interest and depreciation must be computed in fixing the charges which the rates must be large enough to meet.

It is hard to see why any allowance should be made for future obsolescence in fixing a depreciation rate for the future, if the company of its own motion makes such replacements with more efficient machinery. It then exercises its own judgment as to the chances for profit in making the change and gains or loses according to whether that judgment is proven good or not, a matter with which the patrons of the utility or the public have no concern.

If, however, a financial improvement by the change cannot be demonstrated, and therefore the company refuses to make it, and the public or the patrons desire the better service which the change would bring, then they should pay the deficit arising from the increased expense under the changed conditions, a sufficient addition to the capital account should be made to insure the proper return to the company, and the rates should be raised to meet the additional charges. Such occurrences are so exceptional that it is impossible to make any general prediction concerning them, and each case must therefore be treated when it arises. Some such cases have arisen, especially in telephone service, under the Wisconsin commission and they have been treated in accordance with the principles stated.

In other words, as has already been shown several times in Municipal Engineering, there is no justice in making a charge for obsolescence if the company makes the replacements of its own motion, for it is expecting to profit by them, and if the patrons demand the replacements they are really demanding better service, and if that service costs more than the old service they should pay the difference. They are paying for better service, however, and not for obsolescence, so that, whatever the fact may be as to obsolescence of machinery, there should be no charge under that name in the financial accounts.

POLITICS, PULL OR INCOMPETENCY?

In a city, which shall be nameless here because the occurrence is not so unusual as it should be, and what may be said is therefore of quite general application, the garbage disposal question has been under discussion for about two years. The serious study of the problem was first made by a committee under the direction of the city's efficient health officer and with the aid of a civil engineer who was familiar with the difficulties to be met and with the methods of meeting them.

A general plan for sanitary and economic collection and disposal of the garbage was formulated and presented to the city council, by which it was discussed for some time. Attempts seem to have been made by interested parties to induce the council to adopt one or another of certain methods of disposal without opening the matter to competition, but ultimately the preparation of plans and specifications was referred to the city engineer and they were prepared in consultation with the engineer referred to. Again there was difficulty in keeping the competition open, but changes in the specifications to this end were successfully resisted. Bids were received and were held for consideration for some time, but no way opened for influencing the award in the desired direction. They were rejected and new bids were called for on the ground that if the contracts were divided so that contractors could bid on buildings and apparatus separately better prices could be obtained. This claim was supported by the results, the total of the two lowest responsible bids being somewhat less than the lowest responsible bid under the first advertisement. There was no change in the situation, however, for the lowest responsible bidder at the first letting was again the lowest bidder for furnishing and putting in place the machinery and apparatus, and by a difference too great to be ignored.

In the meantime another complication had arisen, whether through the agitation of those trying to secure a "pull" or of political opponents of the administration. The most available site for the plant from almost every point of view happened to be owned or controlled by persons quite close to the administration, and, although the price and terms were wholly unobjectionable, the suspicions expressed had enough influence to prevent the acceptance and purchase of the site by the council, and so the final award of the contracts and orders to proceed with the construction have been delayed by the lack of a site on which to locate the plant.

Then comes an election and a new administration comes into office. This administration ignores wholly the work of the preceding administration, including its engineering department, makes no new plans for garbage collection and disposal but advertises for bids for collection and disposal; the collection under no specification except that it "be made directly from the receptacles of the producers" once a week for five winter months and twice a week for the rest of the year; and the disposal under the specification that it must be satisfactory to the state health department.

The consequence of this advertisement is two bids, one of which is perfectly definite as to price to be paid, and the other has a definite price "per family per month" but no definite method of determining the number of families served and the total payment to be made. Neither is there any information as to the methods of collection to be used nor of disposal, nor any provision for sanitary or business control of the carrying out of the contract.

The case seems to concentrate in it all three of the objectionable elements mentioned in the title to this article, but is not exceptional on that account. As is most usual in such cases, the "pull" has been kept well out of sight, but politics have been more evident, while incompetency due mainly to ignorance has been evident in several places, but particularly in the latest developments.

Reformers have been trying to improve these conditions, in the first place by concentrating responsibility for expenditures and for competence of service by taking the administrative functions away from the legislative body and providing methods of placing the treatment of technical questions in the hands of technical men who have a tenure of office not terminable for reasons of policy or politics; second, by removing the choice of candidates for office as far as possible from the manipulations of professional politicians, in the bad sense in which that term is used at present; and third, by placing the supervision of the processes of spending money and the bookkeeping of the city under a state board, also as free as possible from the influence of policies and politics as well as the local city influences.

Scarcely any cities have all these safeguards, and the city in question has none of them. That it is in dire need of them all, the evidence in this case alone demonstrates conclusively.

THE QUESTION DEPARTMENT

Franchise for Gas Company.

This city is being asked to grant a franchise to furnish the citizens gas for cooking, lighting, etc. The city has its own electric light plant and it is a valuable asset, but the city does not care to go into the gas business. We would therefore be very thankful if you will give us some data on the subject of gas franchises, something in connection with the present grants in the various small cities of near 10,000 population.

What per cent. of the gross earnings should be exacted? The maximum price that should be charged citizens? In your opinion what effect would the installation of gas have on our electric light revenues?

L., City Clerk, ———, Ala.

The following extracts from a franchise recently granted Taylorville, Ill., may serve as a guide for the consideration of a franchise suited to the local conditions in this Alabama city. No franchise can be copied exactly for any other town or any other company than that for which it was made originally.

ORDINANCE NO. ———.

Being an Ordinance granting to the Taylorville Gas and Electric Company, a corporation organized under and by virtue of the laws of the State of Illinois, the right to construct * * * and to lay down, maintain and operate, along, in and under the streets, alleys and public grounds of said City hereinafter specified, all pipes, mains and fixtures necessary for the conveying and distributing gas for illuminating, heat and power purposes.

Whereas, the Taylorville Gas and Electric Compan has presented a petition to the City Council of the City of Taylorville, Christian County, Illinois, requesting an Ordinance granting to the said Company the right to occupy certain streets, alleys and public grounds with its necessary appurtenances for the distribution of electricity, gas and steam.

Whereas, petitions signed by the property owners fronting upon streets, alleys and public grounds hereinafter set forth have been presented to the City Council and filed in the office of the Clerk of said City of Taylorville, the said petitions being signed by the owners of the majority of the foot frontage along each streets, alleys and public grounds hereinafter specified, as is required by law;

Therefore, be it ordained by the City Council of the City of Taylorville:

Section 1. That the Taylorville Gas and Electric Company, its successors and assigns, is hereby authorized and empowered and the right, and privilege and franchise be and is hereby granted to the said Taylorville Gas and Electric Company, its successors and assigns, to * * * (concerning electric light).

And the said Taylorville Gas and Electric Company its successors and assigns are granted the right, power, license and permission to lay down all necessary mains, pipes, connections, fixtures and apparatus and to maintain and operate the same in and under the following named streets, avenues, alleys, and public area ways in said City, for the purpose of conducting and distributing gas to the citizens of the City of Taylorville for illumination, heat and power purposes, viz. * * * .

Section 2. The use of such streets, alleys and public grounds for the purpose herein set forth, by the said Taylorville Gas and Electric Company, shall be subjected to and governed by the Statutes of the State of Illinois, in relation thereto, now in force or hereafter to be enacted, and subjected to the Ordinances of the City of Taylorville, in relation to telephone, telegraph, electric light, gas and steam companies, or corporations, now in force or hereafter to be enacted.

Section 3. No poles, wires, fixtures, conduits, pipes or mains, or other implements or appurtenances, or other use or occupation of any of the additional streets and alleys of said City for the conveyance and distribution of electricity and gas, shall be permitted or enjoyed by the said Taylorville Gas and Electric Company, until proper petitions therefor, in accordance with the Statutes of the State of Illinois, shall be presented to the City Council of the City of Taylorville; and permission granted by said City by a proper Ordinance for the use and occupation of such streets, alleys and public grounds, as set forth in said petitions, and subject to the conditions contained in this Ordinance. And said Company shall, as far as practicable, make such extensions in and upon alleys of said City, and shall extend its system as reasonable demands arise so as to supply at all times the reasonable demands of said City and its citizens.

Section 4. (Concerning electric light.)
Section 5. (Concerning electric light.)
Section 6. (Concerning electric light.)

Section 7. That the said Taylorville Gas and Electric Company, its successors and assigns, in the installation and furnishing of said electric light, heat and power plant, and gas and steam heating plant, its appliances, appurtenances and apparatus shall be subject to the Ordinances of the City of Taylorville, in relation thereto, which are now in force or shall hereafter be passed by the City Council of said City of Taylorville. And said Company shall adopt reasonable and proper regulations to insure the safety of the public, and all persons of said City, to avoid injury to persons and property in said City.

And if said Company in erecting its poles and laying its pipes and mains or replacing or removing the same, or any other appliances or appurtenances shall disturb the condition of the streets, alleys, or public grounds, or other property of the City of Taylorville or belonging to any of its citizens, it shall restore to its original and proper condition, such streets, alleys, public grounds and private property, in as good condition as originally found.

And all excavations in said streets, alleys or public grounds for the construction or repair of the aforesaid poles, mains, pipes, appurtenances and works, shall be made under the supervision of the Street and Alley Committee of the said City; and where made in or upon paved streets, such excavations shall be governed by the Ordinances of the City of Taylorville, in such case made and provided; and when it is practicable all of said pipes for gas and steam, and conduits for underground wires shall be laid in and along the alleys in preference to the streets and sidewalks.

Section 8. In the event of the making of any public improvements hereafter, in the streets, alleys or public grounds of said City, in and upon which the said Taylorville Gas and Electric Company has erected poles, wires, conduits, or other appurtenances or apparatus, it shall be found necessary or proper to change the location of any or all of the said poles, wires, conduits, appurtenances and apparatus, such changes shall be promptly made by said Company upon receipt of notice from the said City of Taylorville, and if said changes are not promptly made, within a reasonable time after such notice, the City hereby reserves unto itself the right to remove all such poles, wires, conduits, appurtenances, and apparatus, from such streets, alleys or public grounds, and collect the cost and expense thereof from said Company. And if said Taylorville Gas and Electric Company shall not promptly pay such costs or expenses on demand, the same shall be taken and held by the parties to be grounds for the revocation of the rights and privileges of said Company, on the streets, alleys, and public grounds affected.

Section 9. (Concerning electric current.)

Section 10. (Concerning steam heat.)

Section 11. Said Taylorville Gas and Electric Company shall furnish gas unto the City of Taylorville and to all persons, companies or corporations living along or upon the streets alleys and public grounds of said City, occupied by said Company with its gas mains, pipes and other appliances for the transmission of gas, upon proper application being made to said Company for said service by such person, persons, company or corporation, subject however to all rules and regulations which may be adopted by said Company which shall be just, equitable and uniformly applicable to all other persons, companies and corporations receiving the same, or similar services, and shall charge the same rates for the same amount of service to all such persons, companies and corporations similarly situated and under similar circumstances, without discrimination except on behalf of the City of Taylorville. And said company shall furnish gas for illumination, heat and power to any person, persons, company or corporation making application therefor as hereinbefore provided, at not to exceed the following maximum rates:

* * * .

Section 12. It is further expressly provided, that said Taylorville Gas and Electric Company shall present to each consumer of electricity and gas, a written or printed statement of his account, which statement shall contain the date of the two prior meter readings: the total difference between the two said readings, the rate, and the total amount charged; and shall bear in a prominent place, either on the face of said statement of account, or on the back thereof, a schedule of the rates in force at the time of the reading of said meter.

And it is further expressly agreed that said Company shall not read meters for any person, persons, company or corporation, at less intervals than thirty days, except by consent of such consumer, or in the event that service by said Company shall be discintinued for any cause.

Provided further that any person, persons, company or corporation obtaining service from said Company through a meter installed by said Company, may have the same tested, and the results thereof delivered by the said Company to consumers, at any time after reasonable notice to said Company(for which service, said Company may at their option, charge a fee of 25c for such examination, to be charged and collected as for other services). Such tests may be required at reasonable intervals, not less than six-months, and shall be made under the supervision of some one person authorized by the City Council of the City of Taylorville, and in the presence of such person, persons, company or corporation, asking for the test, on the premises of such consumer and the results of such test duly attested by such person representing the City of Taylorville.

Section 13. Either party shall have the right to have either or all of the above and foregoing rates revised and determined after sixty days notice to the other, but not oftener than once in five (5) years, during the existence of this grant, but it is expressly agreed that no changes in the maximum rates hereinbefore established or to be hereafter established, shall be made by the said Company, without the consent of the City Council of the City of Taylorville, expressed by ordinance, duly passed and approved, and no changes shall be made as herein provided until after a period of five years.

If either party shall give notice as herein provided, for a change in the maximum rates, and the said City of Taylorville and the said Company fail to agree upon what shall be taken and held to be a proper maximum charge for electric current and gas for light, heat and power, or either of them, the same shall be submitted to a Board of Engineers, consisting of three disinterested Engineers, to be selected by the City, and by the Company in such manner as may be mutually agreed upon, but no one of whom shall be considered, nor to be the representative of the interests of either the City or of the Company, which said Board of Arbitration shall investigate the question of the reasonableness of the charges contained in said notice, and make a report thereof to the City Council and said Company, which said report shall be binding upon the parties hereto, as to the reasonableness of the charges, submitted to such Board of investigation and report.

And should such Board find that a change should be made in such maximum charge or either of any of them, the City Council shall, by proper ordinance, fix the maximum charge for electric current and gas for light, heat or power and steam for heating purposes, or any or either of them, as found by said Board of Arbitration, which said maximum charge, shall be and remain the maximum charge for such electrical current or gas for the period of five years next succeeding, and until changed as herein provided, and the costs and expenses of such arbitration shall be borne in equal parts by the said Company and the said City of Taylorville.

Provided, however, that such Board of Arbitration shall not take into consideration, the value of any franchise granted by the City of Taylorville to said Company, or to any other person, persons, company or corporation, and owned or controlled by the said Taylorville Gas and Electric Company.

And both the City and said Company shall render such aid and assistance to said Board as they may require, to enable them to reach a decision with regard to the rate or rates under consideration.

Section 14. It is further expressly provided, and is one of the considerations moving from said Company to said City, that the said Taylorville Gas and Electric Company, promises and agrees to and with said City, that during the existence of this grant, it will furnish free of charge from its electric and steam heating plant, the steam for heating purposes, for the Public Library Building, and City Hall building in said city, all free of charge to said City.

Section 15. (Concerning street lighting.)

Section 16. The rights hereby given to the said Taylorville Gas & Electric Company shall not be deemed exclusive, but the City of Taylorville expressly reserves the right and power to grant a like franchise to any person, persons, company or corporation, covering the same streets, alleys or public grounds in said City, the same however, not to nullify or interfere with any of the powers, rights or privileges, or the reasonable exercise of the same which are hereby granted.

Section 17. It is further expressly provided, and is one of the considerations for the grants in this Ordinance contained, that the said Taylorville Gas & Electric Company, its successors and assigns shall save and keep harmless the city of Taylorville, at all times and during the existence of this grant or franchise, from any and all costs, and expenses, damages and liabilities of every kind, and character, arising from or growing out of the exercise of the rights and privileges, or any of them herein granted, and the said Taylorville Gas & Electric Company, for itself, its successors and assigns, covenants and agree to reimbure and repay the said City, on demand, any and all moneys that it shall be compelled to pay or become liable to pay, growing out of or resulting from the exercise by said Taylorville Gas & Electric Company, its successors, or assigns, of any of the rights or privileges, given or granted to it, by the Ordinance, and nothing in this Ordinance contained shall be construed to release said Company, its successors or assigns from its or their liability, arising from the occupation by said Company of any public square, street, alley or other public or private grounds in said City.

And it is one of the conditions of this Ordinance that said Taylorville Gas and Electric Company, shall upon accepting this Ordinance as herein provided, file in the office of the City Clerk, an indemnifying Bond to the people of the State of Illinois, for the use of the City of Taylorville or any person interested, in the penal sum of Ten Thousand Dollars, conditioned upon said Taylorville Gas & Electric Company, its successors and assigns, saving and keeping harmless, the city of Taylorville from all suits, damages, judgments, costs and expenses, and liability of every kind and character, consequent upon or resulting from the exercise by said Company, its successors, assigns, agents, or employes, of any or all of the rights and privileges, or any of them herein granted, and to repay to the said City of Taylorville, all moneys it shall have been required to pay on account of, or resulting from the granting of the rights and privileges herein contained, and from the exercise thereof by said Company; said Bond may be either a personal bond or furnished by some casualty or indemnity Company authorized to do business in the State of Illinois, and all subject to the approval of the City Council of said City; for good cause the City Council of said City may require said bond to be renewed or additional bond given if deemed necessary for the protection of the City of Taylorville.

Section 18. If the said Taylorville Gas & Electric Company shall fail, neglect or refuse to comply with the material provisions of this Ordinance or any or either of them, or to carry out the stipulations and agreements on its part to be kept and performed; or shall make default in complying with any lawful ordinance, now in force or that shall hereafter be passed, or with any statute of the State of Illinois, now in effect or that shall be hereafter enacted, relating to the rights, powers and privileges herein granted, or the business of said Company, and shall fail to comply with such ordinances or statutes, within thirty days after notice of such default:

Or if the said Tayloville Gas and Electric Company shall fail to operate its electric light plant continuously during the term of this grant, except such failure shall result from unavoidable injury and accident to the plant, or to the machinery therein contained, or to strikes, lock-outs, or the acts of Providence:

Or if the said Taylorville Gas & Electric Company shall be guilty of willful overcharges or discrimination between consumers other than the City of Taylorville, or giving of rebates, or entering into combination with any other person, persons, company or corporation, in restraint of competition, or for fixing or maintaining prices in the business in which said Taylorville Gas & Electric Company is engaged, or shall enter into collusion with any other person, persons, company or corporation, for the purpose of fixing or maintaining prices, and thereby preventing free and competitive bidding for the contract for the lighting purposes of the streets, alleys and public grounds in said City, then and in any or either of said events, all rights, privileges and franchises granted by this Ordinance, may be declared forfeited, by the City Council of the said city of Taylorville, by proper Ordinance passed therefor. And in such event, said Taylorville Gas & Electric Company shall forthwith proceed to remove all poles, wires, fixtures, appurtenances and apparatus belonging to it, from the streets, alleys and public grounds of said City, and upon its failure so to do, the City shall have full power and authority to remove the same at the expense of said Company.

Section 19. If the said Taylorville Gas & Electric Company shall assign their rights, privileges and license granted to it by the terms of this Ordinance, they shall file a notice in writing at the office of the Clerk of the City of Taylorville giving the name and address of the assignee and if the said assignee shall exercise any of the rights, privileges and licenses granted in this Ordinance, it shall be deemed to have accepted all the terms, conditions and limitations in this Ordinance contained, and subject to all duties, responsibilities and liabilities imposed upon said Taylorville Gas & Electric Company.

Section 20. The powers, provileges and license contained in this Ordinance for the occupation of the streets and alleys of said City, for the operation and maintenance of poles, wires and other apparatus for the conveyance and distribution of electricity for current unto the Taylorville Gas & Electric Company, its successors and assigns, for a period of twenty (20) years next succeeding the date of passage of this ordinance, and the rights, privileges and license contained in this ordinance for the use and occupation of the streets and alleys of said City for laying down, maintaining and operating pipes, mains, and other apparatus, for the conveyance and distribution of gas and steam is granted to the Taylorville Gas & Electric Company for a period of twenty-five (25) years next succeeding the date of the passage hereof, subject to the conditions contained in this ordinance. And upon the further condition that the said Taylorville Gas and Electric Company shall file an unconditional acceptance of this Ordinance in writing in the office of the City Clerk of the City of Taylorville within twenty (20) days after the date of the passage of said Ordinance. And upon the termination of the period of the grants herein provided for the said Taylorville Gas and Electric Company shall remove all poles, wires, appurtenances, appliances, apparatus, for the transmission and distribution of electricity from the streets, alleys and public grounds of said City. And shall cease to use the streets, alleys and public grounds of said City for the conveyance and distribution of gas and steam, and any failure to comply with the terms of this section within sixty (60) days after the expiration of this Ordinance shall authorize the City to have the same done and performed. And the said Taylorville Gas and Electric Company, its successors, and assigns shall have no further rights by virtue of this ordinance unless granted by Ordinance of the City of Taylorville, or its legal successor.

The rates for gas proposed in the above franchise not being satisfactory to the company, they were left to the determination of an arbitration Board appointed under its terms. This Board fixed the maximum rates as follows:

First 500 cu. ft. or less used in any month, $2.00 per 1,000 cu. ft.

Next 2,500 cu. ft., $1.75 per 1,000.

Next 7,000 cu. ft., $1.50 per 1,000.

All in excess of 10,000 cu. ft., $1.25 per 1,000.

It will be noted that this franchise is granted to a company which is operating both the gas and the electric lighting systems, and there is in this case the additional complication that those who control the company also practically control the supply of coal for domestic uses, a condition which seems to have been ignored in fixing the rates for gas.

In the case of the Alabama city there is probably opportunity for competition between coal and gas, so that if the gas company wish to introduce the gas for fuel they must make the price for fuel gas low enough to be attractive. Although not so stated definitely, it is assumed that the city's electric light plant furnishes light to citizens as well as for street lighting. To secure any lighting patronage the company must make their prices for gas lighting attractive to the city's electric light customers enough to induce them to change to their service. Unless the gas is a by-product, as it is in the case of the Otto-Hoffman and like coke-oven processes, the chances for the profitable operation of a gas plant do not seem to be very promising, and, from the point of view of the company, it could not afford to pay a large return, if any, to the city for its franchise. On the other hand, the company must get lighting business from only two sources, development of new business and taking business from the city's light plant. The city certainly has the right and duty to protect its electric light plant from this competition or to secure from the gas company a return sufficient to make up for the loss in net profits of the electric light plant due to the gas company's competition. This phase of the subject is discussed somewhat in detail in the department of "Editorial Comment" on another page of this issue of MUNICIPAL ENGINEERING.

This is evidently a case in which a careful study by one experienced in the franchise field from the municipal standpoint is a necessary preliminary to intelligent action.

Street Railway Franchises.

I have been appointed secretary of the committee on public utilities of our city government and we are now investigating the franchise rights of the street railway company operating in our city. We are very anxious to obtain as much light as possible on the matter. I have been informed that you would be able to give us something in relation to the question of franchises, etc., in various cities of the country and ask that you would kindly let me know as soon as possible, if you could send what you would deem helpful in investigating such a question? G., ———, Me.

MUNICIPAL ENGINEERING has much that will be of assistance in the consideration of this question. With reference to franchises in general the discussion of depreciation and sinking fund accounts in vol. xxxix, p. 26 may be of interest; also the article "A Municipal Franchise is a Valuable Asset and Should be so Treated," vol. xxxv, p. 301.

Regarding street railway franchises in particular the following articles will be found valuable: "Report of the St. Louis United Railways Investigating Committee," vol. xli, p. 64; "Valuations of Public Service Corporations," vol. xxxix, p. 200; "Railway Company Must Comply with Paving Specifications," vol. xxxix, p. 301; "Percentage of Receipts as Compensation for Street Railway Franchises," vol. xxxviii, pp. 317 and 340; "Payments for Street Railway Franchises," vol. xxx, p. 276, being a compilation of information from the U. S. Census Bureau report on street and electric railways.

Some provisions in franchises for other public utilities may be applied in modified form to a street railway franchise, such as those stated in an article on cooperative franchises for municipal public service corporations in vol. xxxviii, p. 335; "An Outline of a Contract Between a City and a Water Works Company," vol. xxxvi, p. 247; "Terms of a Water Works Franchise," vol. xxxvi, p. 177; "Franchise Terms and Rights," vol. xxiii, p. 166; "Some Provisions in Modern Franchises for Municipal Public Service Utilities," vol. xxxix, p. 456; "Principles Underlying a Street Lighting Contract," vol. xxxv, p. 96; "A Modern Municipal Franchise," vol. xxxv, p. 306; "Factors That Should be Considered in Making Street Lighting Contracts," vol. xxxviii, p. 393.

There are many other articles in these and other volumes which can be referred to if the subject is to be studied in great detail.

Among the books treating the subject probably Wilcox's "Municipal Franchises," (2 vols. $10), is the most complete. Over 600 pages of the second volume are devoted to transportation franchises, three-fourths of this space treating of street railways. The three volumes of the report of the National Civic Federation on "Municipal and Private Operation of Public Utilities" has much of value, and can probably be obtained for the publication price of $10. About 100 pages of the third volume are devoted to street railways, and the general discussion occupies a small part of the first volume. The annual reports of the state public service commissions may also be useful, particularly those of the Wisconsin Railroad Commission and of the two New York Public Service Commissions.

The safest course to pursue is to insure a competent committee and then to obtain detailed technical assistance from competent experts of experience in franchise matters.

Terms of Electric Light Franchise.

I wish to ask your assistance on a matter of drawing up a franchise for electric light plant.

1. Should there be anything said in the franchise about the kind of service and if so what? That is something about the kind of power, etc.

2. What is a 2000 C. P. arc light? Should there be some method of testing the lights and power?

D. R. J., City Attorney, ———, Ind.

MUNICIPAL ENGINEERING has a number of articles on this subject, a list of which will be found in vol. xl, p. 37, in articles on "Specifications for Electric Lighting Contract" and "Electric Light Franchise."

Enforcement of Collection of Local Improveemnt Assessment Against Railroad.

I have this question, namely, right to sell part of the right of way of a railroad by force of execution on local assessment for abutting improvement.

I would appreciate your early reply with such cases as you have access to.

M., City Attorney, ———, Ga.

The Cyclopedia of Law and Procedure, p. 1211, says "The rule generally recognized is that the road-bed or right of way or other property so connected with the operation of a railroad that its loss by conveyance or sale would dismember the road as a line of travel cannot be sold to satisfy a local assessment, but that other property of a railroad may be subjected in the same manner as property of individuals." Cases cited are Kansas City, etc., R. Co. v. Silvan Springs Water Works, Imp. Dist. No. 1, 68 Ark. 376, 59 S. W. 248; Minneapolis, etc., R. Co. v. Lindquist, 119 Iowa 144, 93 N. W. 103; Boston v. Boston, etc., R. Co., 170 Mass. 95,. 49 N. E. 95; Detroit, etc., R. Co. v. Grand Rapids, 106 Mich., 13, 63 N. W. 1007, 58 Am. St. Rep. 466, 28 L. R. A. 793.

On the opposite side are Chicago, etc., R. Co. v. Elmhurst, 165 Ill. 148, 46 N. E. 437; Cleveland v. Cleveland, etc., R. Co., 4 Ohio Dec. (reprint) 315, 1 Clev. L. Rep. 304, holds that a special assessment on a street railway gives the city a lien on the franchise and track of the company for the payment thereof.

Terminal property, i. e., freight house, road bed and right of way cannot be sold to raise local assessments, is decided in Lake Shore, etc., R. Co. v. Grand Rapids, 102 Mich. 374, 60 N. W. 767, 29 L. R. A. 195.

That personal property of a railroad company can be levied upon and sold to satisfy assessment for local improvement is decided in Atchison, etc., R. Co. v. Peterson, 58 Kan. 818, 51 Pac. 290, affirming 4 Kan. App. 103, 48 Pac. 877. Other cases in this line are Philadelphia v. Philadelphia, etc., R. Co., 177 Pa. St. 292, 35 Atl. 610, 34 L. R. A. 564; and 1 Pa. Super. Ct. 236, 38 Wkly Notes Cas. 15.

Legality of Extension of City Limits.

I have a knotty little legal question on hands now, which you may be able to give me some assistance on. It is this: This city is a city of the Fourth Class, organized under the general statutes of Missouri. The city recently attempted to extend its limits by ordinance over some adjoining territory. The extending ordinance was regularly passed, and the special election required by our statute was held at the same time and place of the regular city election of city officers, and carried by a large majority of the vote cast. Now, the State, by information of the prosecuting attorney, at the relation of one of the annexed tax-payers, files its information in the nature of a quo warranto, questioning the legality of the extension on the following three grounds only: (1) Because the notice of the special election was insufficient, in that it simply published in full the extending ordiinance; (2) Because this notice was not given sufficient publicity, being published in the newspaper with smallest circulation in the city; and (3) Because the place of holding the special election was not properly designated. The last mentioned point is the only one of which I have any fears. The extending ordinance only described the place for holding the special election, as "the same place as that of the regular city election."

As city attorney, I am trying to uphold the extension of the city limits. If you can cite me to any authorities to uphold my side of the case, I shall be thankful. Our courts have held that the electors are presumed to know where the place is for holding the regular elections. So that being true, they are, then, therefore, presumed to know where this special election was held.

M., City Attorney, ———, Mo.

In the Cyclopedia of Law, vol. 15, p. 326, under the title "Elections," it is said that where an election has been held and the will of the voters has been executed by the proper authority, it may be presumed that due notice of the election was given under the rule that where performance of a prior act is necessary to the legality of a subsequent act, proof of the latter carries with it a presumption of the due performance of the former." Cases cited are Brownell v. Palmer, 22 Conn., 107; Knox County v. N. Y. City Ninth National Bank, 147 U. S., 91, 13 S. Ct., 267; in re Walker, 3 Luz. Leg. Reg. (Pa.) 130; Clark v. Wardwell, 55 Me., 61.

Also, "Proof of order to post notice of election is sufficient" even if the order was not obeyed by the proper officer: San Luis

Obispo County v. White, 91 Cal., 432, 24 Pac., 864, 27 Pac., 756.

Regarding general election designated as special election, reference is made to Att'y-Gen. v. Trombly, 89 Mich., 50, 50 N. W., 744.

"Whether or not the publication of an election notice was duly made is a question of law for the court." P. v. Voorhees, 187 N. Y., 327, 80 N. E., 196. Lancaster Intelligencer v. Lancaster County, 9 Pa. Dut. 392.

"There can be no remedy by quo warranto in contesting an election on a proposition, for that remedy is employed only to test the right to an office or franchise." 15 Cyc., p. 394, with references to People v. Grand County, 6 Colo., 202, and People v. Whitcomb, 55 Ill., 172.

Again, "specifications of mere irregularities not affecting the result of the election will be stricken out on motion," with references to Mann v. Cassidy, 1 Brewst (Pa.) 11; Matter of District Attorney, 2 Phila. (Pa.) 199; Kneass' Case, 2 Pars. Eq. Cas. (Pa.) 553; Brightly Lead. Cas. El., 260, 337.

Unless there is some Missouri statute which is directly applicable some of these cases should have considerable effect. Possibly some help can be obtained from State v. Westport, 116 Mo., 582, 22 S. W., 888, and Hayward v. Guilford, 69 Mo. App. 1.

Can City Ordinance Make Usury a Misdemeanor?

I have recently been requested to draft an ordinance for the city making the charging of usurious rates of interest a misdemeanor. The legal rate of interest in this state is 8 per cent. Do you know of any city having such an ordinance, and if so, can you procure a copy of the same for me.

J. W. W., City Attorney, ———, S. C.

The writer knows of no city in which this subject is covered by a city ordinance. Indeed, the matter seems to be one properly regulated by statute and violation of the statute is punishable under the state law so that it should not be necessary for the city to attempt to govern practice. Can any of our readers refer us to such a city ordinance?

Information About Small Water Works.

Could you give me any information regarding the installing of waterworks in small villages of about 1,200 people? We would like to know the cost of cast iron piping and the cost of excavation, cost of stand pipe, and pumps. We have a good waterpower for the drive, and good high point to build a stand pipe. Any information you can give us would be greatly appreciated, or if you have a book that would help us. We have to lay about 1 mile of pipe 4 to 5 feet deep.

L., Village President, ———, Mich.

A good book on this subject is Goodell's "Water Works for Small Cities and Towns" ($3). Cast iron pipe costs at present $24.50 to $26.50 per ton in Chicago. It will probably be safe to estimate the cost of 4-inch pipe at 50 to 60 cents a foot, including pipe and laying, and 6-inch pipe at 70 to 80 cents. Capacity of pumps and standpipe, kind selected and design of system so influence cost that no close estimate can be made on the data given. It is quite possible to bring the cost of the whole system to $10,000 or to spend $20,000 on it if desired. Expert engineering assistance in designing the plant and constructing it will be worth its cost.

Rates for Water.

Kindly give me, a subscriber, the following information: (1) average number of gallons of water used for family use per day; (2) average daily consumption allowed for all purposes in a city of (a) 7,000, (b) 10,000, (c) 12,000, where there are no unusual demands for manufacturing purposes; (3) annual rates in cities of the sizes above mentioned for kitchen sink (hot and cold), basin (hot and cold), bath (hot and cold), water closet.

I would like to have reference to works (with addresses of publishers) on the above subjects. I would like also to know the usual practice in the segregation of rates; that is, the basis on which rates are divided between family uses, municipal uses and industrial uses.

A. E. K., ———, Pa.

Turneaure and Russell's "Public Water Supplies" ($5) gives much information on this subject. The consumption per person for domestic purposes varies in cities in Massachusetts using meters, from 11.2 gallons a day in Fall River to 43 in Brookline. The ordinary allowance is 20 to 30 gallons. When supplies are not metered the consumption is ordinarily larger, in small cities not much larger, but in large cities often several times as much. In cities of the sizes named the consumption, where all services are metered, may be as low as 40 to 50 gallons per person, per day, of which 40 per cent. may be unaccounted for loss or leakage, or it may be as high as 130 gallons with few or no meters. There are so many variables besides population that there would be no difference in the estimate of consumption for cities of no greater differences in population than those given. In a table given in the book referred to consumption in 1890 varied in the cities below 13,000 population named in it from 21 to 90 gallons per person daily in 1890. In 1905 the consumption in the same towns had increased so that the variation was from 35 to 130 gallons per person daily. In another table are given averages for six years in Massachusetts cities, which, in cities of less than 13,000 population range from 36 to 89 gallons per inhabitant daily.

Goodell in his "Water Works for Small Cities and Towns" ($3) estimates 50 to 60 gallons per capita daily in a city of 20,000 population with many towns to be sprinkled in summer and 40 gallons for a mill village of say 10,000 population, in which cases the amount necessary for fire protection would govern size of pipes and amount of supply.

The "Manual of American Water Works" for 1897 ($3) gives a long list of rates for water reduced as nearly to comparable form as is possible. The family rate in the table is assumed to cover the kitchen sink with cold or both hot and cold water and in many towns and cities is proportional to the number of persons in the house, the number of rooms, the front width, etc. Following are ranges of rates per year selected from this table for towns in Pennsylvania:

Family rate, $3 to $13; wash bowl, 0 to $2.50; bath tub, 2 to 6; water closet, 1 to 5.

In addition to the above books reference may be made to several volumes of the proceedings of the American Water Works Association, the transactions of the American Society of Civil Engineers, the Journal of the New England Water Works Association, the volumes of MUNICIPAL ENGINEERING, *Engineering News, Engineering Record,* etc.

Books on Town Planning.

Can you recommend a reliable book on the subject of Town Planning? I would like something treating the subject from the legal and legislative standpoint, as well as from the view of a surveyor.

G. G. M., St. John, N. B.

"An Introduction to City Planning" ($1), by B. C. Marsh, discusses the subject from the points of view of the congestion of population, the physical factors in city planning, legislation, building codes, the technical places, and the methods used in securing city plans. He also has a bibliography on the subject, covering most of the publications of recent years. Practical examples will be found in the reports on various cities, some of which are in his list, and some are later. Among the latest are Robinson's "Better Binghamton" ($1.25), and Nolen's "San Diego," which can probably be obtained for the same price.

The "Proceedings of the Third National Conference on City Planning" is a book full of excellent material on all phases of the subject.

A very valuable publication in this line is "The Town Planning Review," published by the University of Liverpool, England, quarterly, which can be obtained for about $3.50 a year.

What City Has Set of Instructions to Inspectors?

We are anxious to compile a set of instructions to street paving inspectors. Could you advise us in regard to any cities you may know of, that publish instructions which might be used as a model or guide in formulating such a set.

H., Engineer of Streets, ———, N. J.

Will our readers send us copies of such instructions to inspectors of any sort which they may be using, no matter how brief or how lengthy? They will be published if permission is given. The only help in this line known to the writer is Byrne's "Inspectors' Pocket Book" ($3), which covers materials and workmanship in construction, but would probably be supplemented by special instructions by each engineer requiring its use.

Book on Piers and Abutments.

I wish to obtain a good book on design and construction of highway bridge piers and abutments. Can you refer me to something in this line?

E. R. W., Parham, Mich.

Fowler's "Ordinary Foundations" ($3.50) is probably the fullest treatment of this subject. There is a chapter in Ketchum's "Design of Highway Bridges" ($4) and chapters on the subject will also be found in Baker's "Masonry" ($5). These books can be furnished at the prices named.

Information About Imhoff Tanks.

Please inform me if there are any books on Dr. Imhoff's method of sewage disposal.

R. H. G., Oakland, Cal.

The method has not yet reached the textbooks, for, although the tanks have been in use some years they have not become prominent in the minds of engineers until they were taken up by some well known American engineers and fully described and their construction promoted by them. The latest edition of Folwell's "Sewerage" ($3), has a very brief description of the tanks in connection with others. There is a like brief description in Easdale's "Sewage Disposal Works" ($4). Each has sectional drawings of an installation.

Ohio Sewers Built by Order of State Board of Health.

Please advise in Question Department, what if any towns of about our size (4,000) have been commanded by our State Board of Health to build sewer systems (as we understand they have the power to do), also with any available information as to what was built with conditions or circumstances that affected the case if known. Also I would like to learn of any towns near us that have sewage disposal.

C. E. VAUGHN, East Palestine, O.

So far as the writer knows there is no municipality in Ohio which has built a sewer system under Bense Act giving the State Board of Health the power to order such construction and enforce its order. An attempt to enforce such an order at Greenville has resulted in a decision by the circuit court of Darke county, that the law is void because it excepts certain cities from its provisions. The point has not yet been passed upon by the State Supreme Court.

Sewage disposal plants near Columbiana county are located at Alliance and Canton. Plants at public institutions at Alliance, Massillon, Morgans, Warren are near at hand.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. Never mind style of composition, the fact is what is wanted.

Coal Tar for Paving Purposes.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I notice in Mr. Clifford Richardson's teresting letter on the subject of the "Characteristics of Bituminous Highway Materials" in the January number under "From Workers in the Field," the statement that "Coal-tar pitch has no value for paving purposes." I should like a little further information as to why coal tar is not useful for paving purposes.

GEORGE E. SMITH, Civil Engineer,
New Haven, Conn.

This letter was referred to Mr. Richardson, who makes the following reply:

To the Editor of MUNICIPAL ENGINEERING:

Sir—In reply to your correspondent's inquiry for a little more information as to why coal tar is not useful for paving purposes, I would say that this has been proved by service tests extending over more than half a century. It is due to the fact that coal tar is not, in the first place, a material of any uniformity.

In the second place, it is a product of an industrial process which cannot be carried on with great uniformity; and third, it is a material which becomes so altered with age that after a certain length of time it loses its cementing properties and becomes quite brittle. In order to use it at all satisfactorily it must in the first place be of such a consistency that it makes a very soft surface and one very susceptible to the hot summer sun. It has been used more successfully in connection with coarse mineral aggregate where such a soft material could be used without unpleasant results. In this connection the following statement of Mr. A. Brown, of Nottingham, England, may be of interest to your correspondent:

"There is nothing on earth which differs so greatly as the liquid called tar. Good and poor qualities of tar are quite common and chemical analysis so far does not always help you, and besides the analysis of tar is rather an expensive matter, and unless you have every load analyzed you are not certain, and this analysis would add 50 per cent. to the cost of your material. Tar varies in quality at different gas works, hence the futility of giving prescriptions of 'so much tar to so much pitch,' which in another town, buying tar from another gas works, would cause failure.

"But the same thing applies to tar from any works, it differs at the same gas works at different seasons of the year. The tar from one gas works is quite different to the tar from another works in the same town. A different method in carbonizing the coal, using a lower grade of coal, and very aften a change in the management alters entirely the nature of the tar and renders it unsuitable for tar-macadam purposes."

CLIFFORD RICHARDSON,
Consulting Engineer,
New York City.

Bituminous Roads.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The writer has been much interested in paper on the above subject by Maj. W. W. Crosby, C. E., before the convention of the American Association for Highway Improvement.

The writer most heartily endorses Maj. Crosby's statement "There is no one "best way" and no one "best material.'" The decision as to method or material to be used must depend in each case upon conditions of traffic, etc. It has been the aim and effort of the writer and his business associates to develop methods of construction of varying costs to meet such varying conditions but always confining development to strictly first class construction and to avoid everything of the nature of makeshift.

Maj. Crosby well says "The first cost of bituminous roads is not a correct basis for the proper comparison of either materials or methods." Perhaps the most extensive and recent development forcibly illustrating the futility of adopting cheap "makeshift" method of construction is in Los Angeles County, Cal., which during the past two years has expended $3.500,000, in "penetration" and "surface" treatment with the result that at the Santa Barbara convention of the California League of Municipalities in October, 1911, the consulting engineer of the Los Angeles County Automobile Association stated that practically all the county has left for this large expenditure is the experience that this expenditure of millions has been wasted. The Los Angeles Times of October 7th, 1911 comments as follows on the Los Angeles County highways.

"As the result of a thorough and searching inquiry into the roads and highways situation in Los Angeles county, the grand jury yesterday returned a partial report setting forth that the oil macadam type of road construction which has been in general use in the highway building under the $3,500,000 bond issue cannot be considered otherwise than as a failure."

To the Editor of Municipal Engineering:

During the past few years Maj. Crosby as chief engineer of the Maryland Roads Commission has earnestly endeavored and worked to secure satisfactory road construction at low cost. The writer is one who believes, independent of his commercial interest, that it is poor economy to adopt a form of construction to meet modern automobile traffic which is not strictly first class and which does not recognize the fact that utility is of far greater importance than first cost even though the adoption of such strictly first class construction may necessitate the use of "expensive machinery not to mention freedom from interference by patent infringement claims."

Is the avoidance of a reasonable return to the inventor under a patent franchise granted by the Government in accordance with the Federal Constitution a valid reason for turning to an inferior or questionable form of construction?

It is of especial value to note Maj. Crosby's conclusion that the mixing method costs from "30 cents to $1.50 per square yard over and above what would have been the cost of an ordinary water bound road under the same conditions." In other words, if an ordinary water bound macadam road costs say $1.00 per square yard then the cost of a strictly first class bituminous road may be as high as $2.50 per square yard.

Maj. Crosby says he "is unable to wholly agree with a statement that has been made elsewhere to the effect that 'the water bound road is a thing of the past.'" The writer believes that when this statement has been made it is generally, if not universally coupled with a statement of the additional factor "as a road which will successfully withstand the ravages of modern automobile traffic." That Maj. Crosby had this in mind, although he did not state this factor to the proposition, is shown by his further statement of a supposed case where "as soon as the road is completed a considerable number of motor vehicles will use the road daily, say not less than twenty every twenty-four hours. Then there is no question but that the road should be treated with bitumen." The writer would class a road carrying less than twenty automobiles in twenty-four hours as not subjected "to the ravages of modern automobiles traffic," and that such a road practically is confined to the problem which confronted John Macadam, and the water bound road invented by him would doubtless resist such traffic practically as well as the macadam roads built prior to the advent of the automobile, only about twelve years ago. Even under such conditions, however, there remains the serious question "All things considered, is not the adoption of high grade modern bituminous road surface justified by its greater utility, comfort, freedom from dust and other advantages even though the first cost is much higher?"

Suppose the answer is to be in the affirmative, there still remains the question that many communities have not yet made financial arrangements such as to make such modern construction possible at present and in such cases they must for the present be content with the best they have the money to buy and depend on future appropriations for providing a modern high grade bituminous surface.

George C. Warren,
Boston, Mass.

Granite Pavements in Manhattan.

To the Editor of Municipal Engineering:

Sir—The recent article by Mr. Ernest Flagg on Stone Pavements of England and America, taken from the *Century Magazine,* contains an interesting, although incomplete description of the Liverpool stone pavements. The description of the New York City stone pavements is, however, so misleading as to call for a statement of the situation as it actually is and the conditions which have led up to it.

The author of this paper states that the stone pavements in the borough are made of what are called Belgian blocks. There are in fact, 89 miles of granite block pavement and about 17 miles of Belgian block stone pavement. The Belgian blocks are small trap blocks of a truncated pyramid form. They are laid on sand with the small end down. No blocks of this type have been laid in the borough for twenty-five years except a few experimental ones at the intersection of Broadway at Canal St., which were imported, laid in concrete with grouted joints and gave good service.

The size of the granite blocks used in the borough has been 3½ to 4½ inches wide, 8 to 12 inches long and 7 to 8 inches deep. The author has exaggerated the size of the blocks, as they will average well under the maximum limits prescribed. No granite pavement has been laid on sand without a concrete foundation for more than twenty-five years in Manhattan, except repairs. The quality of the concrete foundations has been much better than the author would seem to think, as the writer can testify from personal observation. He has found no case where the pavement failed because of faulty foundation and has found very numerous instances where the concrete was in excellent condition after several years service, although not laid under ideal conditions.

Curbs. The curbstones are very frequently laid by the municipality. Indirect permission is at times granted to owners erecting large office buildings or elaborate structures to lay a more substantial or costly curb than the city would be warranted in laying. The curb laid in Manhattan is of bluestone five inches thick and tests have shown that its crushing strength is greater than that of granite. When dressed smooth it presents a better appearance than granite because it matches in color the sidewalk materials. The Liverpool curbs are one inch thick, which adds to the substantial appearance of the street but not necessarily to the life of the curb. The author fails to point out the real reason why our curbs are not in satisfactory condition, which is that they are not to any great extent set in concrete as they undoubtedly should be to assure permanency of line and grade.

Crosswalks in this borough are almost entirely of the hardest and toughest granite and compare very favorably with Liverpool stones. The greatest defect they have is in not being dressed to a smooth surface.

The author's description of what happens when the joints of a granite pavement are poured fails to agree with the writer's, who has had opportunity for observation of pavement conditions in the borough of Manhattan for twenty-five years. The pitch or paving cement almost invariably reaches the bottom of the block, If it does not do so at once it will after a hot summer. I have seen many trenches cut in granite pavement and find it a rare thing when the conditions are not as described.

Rocking blocks are also a rarity and invariably indicate defective work.

The author's criticism that the joints of paving work are too wide is certainly in accordance with the best practices. The writer desires to direct attention to a discussion (see Transactions Am. Soc. Civil Eng'rs., vol. lix, p. 336, July 10, 1907) by Mr. Geo. W. Tillson, formerly Chief Engineer of Highways, Borough of Manhattan, for the purpose of showing that the Liverpool pavements have been familiar to city engineers for a long time. Mr. Tillson says: "It is admitted by all that the first-class streets of Europe are better than streets of a similar class in America. The difference is in the blocks themselves. They are better dressed and more uniform in size. * * * Granite as it is used becomes smooth and consequently slippery. This can be helped by making the blocks smaller; and if they are well dressed, they can be set closely together and so make it practicable to fill the joints with a bituminous paving composition alone without gravel." The author assumes that the prevalent British practice in stone paving is unfamiliar to New York City engineers. The above remarks by Mr. Tillson indicate that the construction was familiar for four years at least before he made his discovery. Mr. H. Percy Boulnois in 1895 published his "Construction of Carriageways and Footways" containing the original of Mr. Flagg's diagrams and a complete description of the Liverpool pavements. This book has long been familiar to city engineers.

Regarding the traffic the author fails to state that wide tires are the rule in Liverpool and also to give any figures of the amount of traffic in tons per foot width of street and above all fails to state that the amount of street opening is insignificant compared with those made on any heavily traveled street in Manhattan.

Traffic statistics based on observations taken on Jan. 23, 1912, 10 hours per day, show on Broadway, between Leonard and Franklin Sts., a traffic of 137.6 tons per foot of width. Street has a double line of tracks but is considered as one roadway. Granite paved.

That there are many more influences in the borough of Manhattan which tend to destroy granite pavement there can be no question. Among these may be mentioned numerous openings, narrow tires, fire burns, etc., all of which tend to increase the maintenance cost and have been active influences in deterring the city authorities from taking up a more expensive type of stone paving such as the author suggests. That the time is now ripe for the adoption of a smooth granite pavement, whatever its cost may be, there can be no question. The improved granite pavement (⅜-inch joints) recently laid on Fourth Ave., between Eighth and Twenty-Third Sts., cost about $3.55 a square yard including a six-inch concrete base. A smooth granite such as that had in Liverpool will probably cost between $5.00 and $5.50 per sq. yd. in New York City, which is so high as to be under the circumstances, almost prohibitive.

DANIEL B. GOODSELL,
Assistant Engineer, Department of Public Works, Borough of Manhattan, New York City.

Proposed Method of Treating Wood Paving Blocks.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I herewith enclose a copy of correspondence between myself and Mr. Cherrington. The subject matter I think is of great interest to the municipalities using treated wooden blocks for street paving.

I suggested during the convention of the Association for Wood Preserving, held in Chicago recently, that every engineer representing a city using treated wooden blocks for street paving be requested to lay down a sample pavement, no matter how short or long, treated with an oil having a heavy asphaltic base. GEO. A. SCHILLING.

Pres. Board of Local Improvements, Chicago, Ill.

Mr. Frank W. Cherrington, care Indian Refining Co., Cincinnati, O.

Dear Sir—We have had considerable trouble with the creosoted block pavements laid in this city because of expansion and bleeding, and we have changed our specifications from the oils used this year to a lighter oil.

I send you under separate cover a report just issued by this city, made by John Ericson, our city engineer, with regard to the heavy oils that have been used for the past two or three years. It is contended in some quarters that the heavier oil is not only a preservative, but a water proofing oil, but by the report which I send you you will note that many of the blocks have not been penetrated with this oil, and the swelling which we noticed would indicate that it does not waterproof.

The question arises whether we could not treat blocks with the thinner oil and secure a thorough penetration, say with about twelve pounds to the cubic foot, and then charge the cylinder with a heavy oil with an asphaltic base and inject six pounds additional into the block. While this second treatment would probably not penetrate the block it would do so sufficiently to seal it and thereby waterproof it. This conclusion has been forced upon me by reason of the fact that tar, which is an important element in the heavy oils heretofore used, melts at about 110 F., whereas asphalt does not melt until it reaches about 220 to 240 F. It is claimed that the heat of the sun during the hot days of last year registered 140 on the surface of the street and it is therefore not surprising that the tar was drawn to the surface of the blocks.

It was suggested that I take this matter up with you as you had likely been carrying on a number of experiments along this line. Have you ever tried it thus, and if so, what were the results?

As the wood block manufacturers will have a convention in the Sherman House in this city on January 16 I would like to know whether you will be there.

Thanking you for any information on this matter, I am, Very truly yours,

(Signed) GEO. A. SCHILLING,
President.

Cincinnati, O., January 3, 1912.

Geo. A. Schilling, Pres. Board of Local Improvements, City of Chicago, Ill.

Dear Sir: I have your letter of the 22d instant, relative to the adaptability of our timberasphalt as a seal in a two-stage injection of say 12 lbs. creosote, and 6 lbs. residual oil (timberasphalt) per cubic foot on wood block for pavement.

We have carefully noted the contents of your letter and the circular or report made by your city engineer, regarding the use of heavy creosote employed in your specifications for the past three years. We are reasonably certain that the treatment in the way you suggest would prove the means of preventing the expansion of the treated wood block paving, due to the absorption of moisture after treatment, and at the same time preventing the bleeding of the oil from the blocks in hot weather.

The only tests we have regarding this most important factor of expansion and buckling of the treated blocks are laboratory experiments upon blocks first treated with 16 lbs. of creosote per cubic foot and then followed by an injection of 6 lbs. of residual oil (timberasphalt).

Blocks so treated stood up under the tests generally given creosoted blocks for waterproofing as follows: The blocks were first dried in an oven at a temperature of 120 degrees F. for a period of 24 hours, weighed, and then immersed in clear water for a period of 24 hours. The gain in weight was found to be 0.02 of 1 per cent. Almost every city has a clause in their specifications which states that a block treated with 20 lbs. per cubic foot of creosote, subjected to this same test, shall not gain more than 3 or 4 per cent. in weight.

The same test was made on blocks treated with straight residual oil (timberasphalt) at 16 lbs. per cubic foot, and showed the same result, proving that the water did not get past the penetration secured by the injection of the 6 lbs. per cubic foot in the two-stage treatment.

The writer expects to be in Chicago for the Wood Preservers' Association this month, and will at that time take pleasure in calling upon you to go into the subject more thoroughly.

No doubt it would be easy to arrange several tests in the experimental cylinders of the commercial plants who have been treating your blocks for you in the past, in order to bear out the assertions we have made regarding our own laboratory tests with residual oil (timberasphalt).

If you are anxious to take up this matter before the convention the middle of this month, kindly advise in order that I may arrange to see you in the near future.

Very truly yours,
THE CINCINNATI WOOD PRESERVING CO.,
(Signed) Frank W. Cherrington,
Gen. Mgr.

Cities Owning Their Asphalt Paving Plants.

To the Editor of MUNICIPAL ENGINEERING:

Sir—On page 117, of your February issue, we find a question from D. B. G., New York City, asking for a list of those cities in the United States which have (own or operate) municipal asphalt plants. In going over the list we do not find that we have credit for one of our portable plants which has been in use by the city of San Antonio, Tex., for the past three or four seasons. This plant is in charge of Wm. J. Mortimer, superintendent.

We find also that Toledo, O., is marked as "repair plant," whereas we sold them one of oud small size portable plants, which will be installed early in April.

THE EAST IRON AND MACHINE CO.
Lima, O.

Further corrections or additions to the list are requested that it may be made as complete and accurate as possible.

ROADS AND PAVEMENTS

Recent Progress in the Good Roads Cause.

(Continued from p. 127, February number.)

PHILIPPINES.

Between 1901 and 1910, over $12,000,000 were expended on roads in the Philippines. Of this sum $2,724,067 were from relief funds appropriated by the U. S. Congress, $4,060,611 were from revenues of the general government of the Islands, $358,584 from proceeds of bonds issued by the same, and $5,010,678 from provincial funds.

The government funds are distributed to provinces which increase their taxes by certain amounts for road purposes and place the construction of their roads and bridges under the central bureau of public works, in proportion to the total population of the provinces accepting the provisions of the act. Maintenance under the act requires at least one patrolman for each kilometer of road in the wet season, five months, and for each two kilometers in the dry season, and the supply along the roads of at least 50 cubic meters for each kilometer of gravel or broken stone, according to the material of which the road is constructed.

A system of roads has been laid out, consisting of first-class roads with substantial foundations, good drainage, durable and continuous surfacing, and permanent bridges and culverts; second-class roads, partly surfaced and of width and light grade permitting passage of light traffic for entire length; and third class roads, narrow, passable with difficulty by light traffic, or even pony trails. The first-class roads already constructed will be extended and connected together as rapidly as possible.

There is a permanent appropriation of 500,000 pesos a year for road construction and maintenance, with other special appropriations, in addition to the local provincial funds. The total of these funds for the fiscal year 1910 amounted to about 6,000,000 pesos.

The length of first class roads increased from 395 kilometers in 1908 to 914.6 kilometers in 1910. The patrol system of maintenance was established on the whole of the first class roads, and on about 2,000 kilometers of second-class roads. The mountain trails and part of the second-class roads are maintained by what is called the gang system. The cost of the patrol system was somewhat more than 500,000 pesos in 1910. Prizes are awarded to various provinces from the general government funds of 10,000 pesos each for the best maintained and most complete system of first-class roads; the greatest expenditure for roads in proportion to total revenue; and for the most complete and best maintained system of second-class roads. Individual prizes to members of the provincial maintenance organizations are also made.

The roads are under the Secretary of Commerce and Police, the organization including the advisory committee of the director of public works, two appointees from that bureau and two from the executive bureau; the director of public works, who is in charge of all construction work; the inspection force of a general road engineer and four division engineers; and the construction force of district engineers, assistants and superintendents.

PORTO RICO.

Prior to 1910, 977.4 kilometers of good roads, suitable for motor vehicles, had been constructed in the interior of Porto Rico, at a cost of about $7,000,000. The cost of maintaining these roads, estimated at about $300,000 a year, takes about all the available annual funds. However, a loan of $425,000 and a direct appropriation of $170,000 was made for construction purposes under an act authorizing the use of convicts, with the expectation that this system would be possible to maintain with the funds regularly available. A small part of this sum will serve to close gaps in the coast line around the island and the majority can be used on the roads of the interior.

The Governor of the island has general charge of the roads.

Porto Rico has a population of 1,118,012, and its 68 counties range in population from 1,000 to 63,000.

RHODE ISLAND.

The good roads law in Rhode Island was adopted in 1902. John H. Edwards is chairman of the State Board of Public Roads. The roads are constructed and paid for by the state. Including 1910, $1,898,910 had been so expended.

The revenues of the board for 1910 included appropriations of $5,000 for office and traeling expenses and $30,000 for construction; $66,056 from automobile licenses; and for state highway construction, $300,098 balance on hand at the beginning of the year, and $17,957 received from towns. The revenues for 1911 were about $97,000. The mileage constructed in 1910 was 36.5 miles.

A law passed in 1910 provides that any

town appropriating at least 20 cents per $100 of taxable property for road maintenance and repair, under the care and direction of the state board of public roads, may receive from the state one-fifth the resulting amount for addition to the town's fund. But one town took this action in 1910, and asked the legislature to make the appropriation, $1,240, to make the law effective.

The state board made, at one time, a plan for a complete network of good roads, connecting all the counties and the important towns and the cities of the state, under a law authorizing $600,000 for the construction. Some of this system has not yet been constructed although the board recommends appropriations for the purpose in each of its annual reports. The legislature, however, has added numerous other roads to the system, without much, if any, reference to their value or adaptability thereto, and has made appropriations for their construction until the road map of the state now shows some very peculiar plans, not to be understood unless the political nature of the selection of the routes is explained.

The state board now has 250 miles of state road under its supervision.

The total mileage of improved roads in the state in 1909 was 2,120.75, of which 1,042.07 miles have been improved, which is 49.14 per cent. of the total mileage. Of these improved roads, 21.97 miles are bituminous macadam, 409.1 miles are stone, and 605 miles are gravel, of which latter 6 miles appear to be sand-clay. There was an increase of 5.87 per cent. in the proportions of improved roads, between 1904 and 1909. The percentage of improved roads to the total mileage varies in the counties of the state from 17.54 in Kent county, to 61.25 per cent. in Providence county.

Maintenance of roads cost $68,148 in 1910, and $80,000 in 1911.

The county board has 3 to 7 members. The town council has charge of the highways in the towns, and divides the town into 4 or less districts, with one surveyor appointed for each district.

The population of Rhode Island is 542,610, and it increases about 25 per cent. per decade. Its five counties range in population from 18,000 to 39,000, with Providence county 424,000.

The Minneapolis Wood-Paving Experiments.

Forest Service Circular 194 of the U. S. Department of Agriculture describes the experimental wood pavement laid in Minneapolis, referring to Circular 141 for more detailed description, and also the condition of the pavement in August, 1910, when inspected by a committee including Francis M. Bond in charge of the wood preservation section of the U. S. Forest Products laboratory, the author of this circular. Measurements were taken of wear, depressions, etc., but the general conclusions are that no more definite comparisons of the different kinds of wood can be made than their arrangement in the order of their value; viz., (1) long leaf pine; (2) Norway pine, white birch, tamarack, eastern hemlock; (3) western larch; (4) Douglas fir. The Douglas fir sections were so badly worn that they were relaid with better timber of the same kind in June, 1911.

Travel records and analyses and specifications for oils used in treating blocks are also given in the circular.

Length of Improved Roads in the United States.

After an investigation extending over many months, Logan Waller Page, Director of the Office of Public Roads, has ascertained that there are now 2,199,645 miles of public roads in the United States. The figures include all the new roads built up to the year 1909. In 1904 there were exactly 2,151,379. It is apparent, therefore, that the increased mileage of new roads within a period of about five years has been 48,266.

In summarizing the results of this investigation Mr. Page says:

It is interesting to observe the growth of improved methods in road construction. For instance, the total mileage of stone roads in 1904 was 36,818, while in 1909 it was 59,-237. The total mileage of gravel roads in 1904 was 109,905, while in 1909 it was only 102,870. This decrease in gravel roads, however, was due to a reclassification of roads. Many of those reported in 1904 to be of gravel proved to be of some other substance, while exaggerations were eliminated.

The percentage of roads which were really improved, amounted to 7.14 in 1904, while in 1909, to which year statistics are now available, the percentage was 8.66.

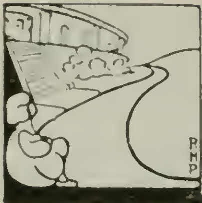
The total mileage of sand-clay, brick, bituminous-macadam and other improved roads in 1904 was 6,806, while in 1909 the mileage reached 28,372.

The circular contains a table showing the mileage of improved roads, the following states having the largest mileage:

	1904.	1909.
Indiana	23,877	24,955
Ohio	23,460	24,106
New York	5,876	12,787
Wisconsin	10,633	10,167
Kentucky	9,486	10,114
Illinois	7,924	8,914
California	8,803	8,587
Massachusetts	7,843	8,463

Portland Cement Manufacturers.

The 1912 edition of the *"Directory of Portland Cement Manufacturers,"* which also includes the manufacturers of gypsum and lime, has been received. The list of companies gives names of officers, capacity, process and other like information. The officers also appear in an alphabetical list, which includes chemists and superintendents. There are alphabetical lists of brands, of officers of societies, and a buyers' guide. The little pocket book of 250 pages is published by the *Cement Era*, Chicago, Ill., and can be obtained for $1.



ORGANIZATIONS & INDIVIDUALS

Indiana Sanitary Association.—Clay Products Show.—Illinois Water Association.—Technical Associations.—Calendar.—Technical Schools.—Civil Service.—Personal Notes.

Indiana Sanitary and Water Supply Association.

The Indiana Sanitary and Water Supply Association held its fifth meeting in Indianapolis, February 15 and 16. Under the fostering care of the Indianapolis Water Company and the State Board of Health, which has provided excellent programs for all its meetings, the association has increased rapidly in numbers and in the interest which it has excited among the water works men of the state. The only criticism of the program was that it was too extensive for the time allotted to it, there being sixteen papers and fourteen formal discussions of the same scheduled for the three regular sessions of the convention, besides two luncheons and a banquet with their attendant speeches and an evening address at a joint meeting with the Indianapolis Commercial Club. There were very few failures to appear. The character of the papers presented may be judged from those printed in this number of MUNICIPAL ENGINEERING, and others that will appear later.

The subjects treated included sanitary surveys of rivers, beautifying streams, purification of water and sewage, well supplies, public utility commissions, fire protection, and water works and electric light plant management. Besides the experts from Indiana, there were present in person or by paper or discussion, Paul Hansen and Edward Bartow, of the Illinois state water survey; George W. Fuller, consulting engineer, New York; Charles B. Burdick, consulting engineer, Chicago; Dr. W. J. McGee, of the U. S. Department of Agriculture; Prof. Halford Erickson, of the Wisconsin Railroad Commission; T. C. Phillips, in charge of the Chicago water waste survey; and Dabney H. Maury, consulting engineer, Peoria, Ill.

Frank C. Jordan, of the Indianapolis Water Company, was re-elected president; Dow R. Gwin, superintendent of the Terre Haute Water Company, H. E. Barnard, state pure food and drug commissioner, C. S. Woods, city sanitarian of Indianapolis, J. W. Elms, superintendent of the Cincinnati water filtration plant, and J. W. Peck, of the Evansville city water works, were elected vice-presidents; and Dr. W. F. King, assistant secretary of the state board of health, was elected secretary-treasurer.

Municipal Displays at the Clay Products Show.

By reason of the municipal features of the Clay Products Show at the Coliseum in Chicago on March 7-12, Mayor Harrison has extended a personal invitation to the mayors of the United States and Canada to attend the exposition. The entire Annex of the Coliseum has been set aside for the municipal display. This will include a demonstration of correct practice for below-level street construction and sewerage system. A $10,000 sewerage ditching plant will be installed by the Austin-Western Company on a full width city street, and from this a complete line of vitrified sewer pipe will be run to a portion of a public comfort station installed by Wolff Brothers, the owners of the Montezuma Pottery Co., at Trenton, N. J. Alongside of the sewer line will be laid a line of electric wire conduits, and on the opposite end of the street will be demonstrated the perfection of brick paving, showing the construction of the base and the various phases of the work of surfacing. A complete street will be demonstrated, showing the sanitary value, and permanence of brick paving. The block used will be the Wire-Cut-Lug type, which is now being manufactured by eleven prominent paving brick companies.

Connected with this display will be indivual displays of various sewer pipe manufacturers and paving brick manufacturers, extending down both sides of one aisle on the main Coliseum floor. Other paving block plants in the country will be represented in this exhibit, which is under the auspices of the National Paving Brick Manufacturers' Association. Included in the exhibit will be a large size model brick street, showing correct methods of paving under "No. 1 specifications." Various demonstrations of brick testing will also be made at the exposition, and many other features of municipal interest.

Perhaps the chief value of the exposition to municipal authorities will be in the visible demonstration of modern fireproof construction methods. In fact, the show is largely promoted for the purpose of demonstrating to the public the necessity of fireproof construction, and the methods by which burned clay materials can be used for fireproof business blocks, factories and residences.

This feature of the exhibit is so important that it has been given the endorsement of the fire marshals and building inspectors of many cities throughout the country, and it is believed that the attention given to the subject will result in greater interest in the revision of the building codes.

A number of societies will meet during the convention. One of the most important conventions to be held at that time will be that of the National Brick Manufacturers' Association. This organization includes the manufacturers of common building brick, facing brick, ornamental brick of all kinds, paving brick, fire brick and refractories, gas retorts, crucibles, glass furnaces and furnace linings, hollow block, sewer pipe, conduit for underground wiring, farm drain tile, silo blocks, fireproof hollow tile for skyscrapers, building terra cotta, architectural terra cotta, faience for interior work, floor and wall tile, mosaics, pottery, sanitary ware, semi-porcelain, chinaware, art pottery, kitchen ware, clay pipes, clay pigeons, marbles and electrical insulators.

The American Ceramic Society, the technical organization of the clay industry, will also meet in annual convention there. This society ranks with the British Clayworkers Institute, and is made up of scientists and college professore.

The National Paving Brick Manufacturers' Association is another organization scheduled to meet in Chicago while the Clay Products and Permanent Home Exposition is being held at the Coliseum from March 7 to 12. This association represents twenty-five million dollars capital and concerns itself with the manufacture of block for the surfacing of city streets and country highways.

The Building Brick Association of America, another name in the list of conventions, is an organization comprised of the advertising men connected with the brick industry. Members of this association spend $50,000 annually in advertising.

Other organizations to meet are the Association of Manufacturers of Clayworking Machinery, representing twenty million dollars invested capital; the Western Drain Tile Bureau, with a membership of 2,000 manufacturers; the Illinois Clay Manufacturers' Association and the Wisconsin Clay Manufacturers' Association.

The Illinois Water Supply Association.

The Illinois Water Supply association will hold their annual meeting at the University of Illinois, Urbana, Ill., on March 5 and 6, and a very interesting program has been outlined. Papers on water purification, sterilization and on filtration plans will be presented by W. M. Cobleigh, professor of chemistry, Montana State Agricultural College; Dr. W. M. Cross, city chemist, Kansas City, Mo.; W. W. DeBerard, western editor; Dr. Arthur Lederer and Frank Bachman, sanitary district of Chicago; W. Lee Lewis, professor of chemistry, Northwestern University. Waterworks and pumping problems will be discussed in papers by R. A. Gabbert, Mattoon, Ill.; E. MacDonald, superintendent Water and Light Co., Lincoln, Ill.; H. Ruthrauff, commissioner of public property, Decatur, Ill.; W. J. Spaulding, commissioner of public property, Springfield, Ill.; M. M. Symons, chief engineer, Danville Water Co., Danville, Ill.; H. A. Stevens, city engineer, Joliet, Ill.; and C. C. Young, chemist, Kansas State Water Survey. Paul Hansen, engineer Illinois State Water Survey; Dr. J. A. McLaughlin, United States Public Health and Marine hospital service, Washington, D. C.; and H. N. Parker, bacteriologist, University of Illinois will discuss the relation of impure water supplies to typhoid fever.

Technical Associations.

At the annual meeting of the American Road Builders' Association, held February 2, in New York, N. P. Lewis, chief engineer of New York board of estimate and apportionment, was elected president; Harold Parker, Worcester, Mass., J. D. Merriwether, territorial engineer, Socorro, N. M., and W. A. McLean, of Ontario highway department, Toronto, were elected vice-presidents; E. L. Powers, of New York City, secretary; W. W. Crosby, of Baltimore, Md., treasurer; A. W. Dean, of Massachusetts high commission, F. D. Lyon, of New York road department, P. L. Hardison, state highway commissioner of Maine, S. D. Foster, of the Pennsylvania highway department, W. J. Roberts, state highway commissioner of Washington, and Clifford Richardson, of New York, directors.

The annual meeting of the Iowa Cement Users' Association elected the following officers: F. P. Wilson, city engineer of Mason City, Iowa, president; H. H. Dean, city engineer of Glenwood, first vice-president; P. H. Armstrong, of Atwood, second vice-president; Keyes C. Gaynor, city engineer of Sioux City, treasurer, and A. O. Anderson, of Ames, secretary.

At the seventeenth annual convention of the Minnesota Surveyors' and Engineers' Society, W. R. Hoag read a paper in which he discussed "Drainage in Northern Minnesota." J. T. Elwell spoke on "Good Roads Legislation," Francis C. Shenehon, dean of the University of Minnesota, read a paper on "The Engineer as a Citizen," and E. K. Coe, engineer of highways for St. Louis county, told of "St. Louis County Highways." The following officers were elected: W. C. Fraser, of St. Paul, president; Thomas F. McGilvray, of Duluth, vice-president; Charles A. Forbes, St. Paul, secretary-treasurer.

Announcement has been made that the annual convention of the National Association of Cement Users will be held in Kansas City, March 11-16, 1912, during the Kansas City Cement Show. The Missouri Highway Engineers' Association will meet in Kansas City at the same time.

At a meeting of the Municipal Engineers of the City of New York, held on February 28, H. McL. Harding, consulting engineer, presented a paper entitled "Municipal Problems of Terminal Freight Transference."

The third annual meeting of the American Society of Engineering Contractors was held in New York City on the 9th day of January, 1912. The retiring president, W. R. Harris, spoke on workmen's compensation in Canada, and on the need of further safeguards in concrete work. A general discussion of methods of gathering and compiling cost data, followed by a paper by J. R. Wemlinger on "Methods and Costs of Driving and Pulling Sheet-Piling," completed the evening's program. The result of the election of officers was as follows, President, Maj. C. E. Gillette, of Philadelphia, Pa.; first vice-president, H. J. Cole, of New York, N. Y.; second vice-president, John Marshall, of Regina, Sask., Can.

At the February meeting of the New England Water Works Association, held in Boston on February 14, the following papers were presented: "Some Recent Applications of the Venturi Meter," by Frederick N. Connet, mechanical engineer, Providence, R. I.; "Some Things Domestic Meters do Not Accomplish," by William S. Johnson, sanitary and hydraulic engineer, Boston, Mass.; "Economy of Circular Reinforced Concrete Reservoir Construction," by Alexander Potter, consulting and constructing engineer, New York.

At the annual meeting of the Oregon Society of Engineers, held on February 5, the following officers were elected: D. C. Kenny, president; W. S. Turner, vice-president; J. C. Stevens, secretary; F. A. Naramore, treasurer.

The following were among the papers presented before the meeting of the Iowa Engineering Society, held at Davenport, Iowa, on February 21, 22, 23; "Uniformity in Methods of Staking Out Work and Measuring up Concrete," by Theo. S. DeLay; "Concrete Pavements in Davenport, Iowa," by A. M. Compton; "Concrete Pavements with Bituminous Top," by N. H. Tunnicliff; "Street Lighting," by A. H. Ford; "Electric Motors for Use in Pumping," by J. B. Hill.

The Ohio League of Municipalities, which was organized at Columbus, Ohio, on January 26, elected the following officers: Newton D. Baker, mayor of Cleveland, president; Mayo Fesler, secretary of the Cleveland Municipal Association, secretary; Elliott H. Pendleton, Cincinnati, first vice-president; Mayor F. A. Hartzenstein, Youngstown; Mayor J. J. Miller, Springfield, and David Gottlieb, Tiffin, manufacturer, were elected second, third and fourth vice-presidents, respectively. The executive committee is headed by Mayor Brand Whitlock, of Toledo.

The Virginia Road Builders' Association, organized at Richmond, Va., in November, held a meeting at Norton, Va., on January 25, when a number of papers on highway construction were presented. The officers of the association are: S. H. Fletcher, president, Lebanon; H. M. Darden, vice-president, Suffolk; William F. Cocke, treasurer, Norton; C. B. Scott, secretary, Lynchburg, Va.

The eighth annual convention of the Wood Preservers' Association was held in Chicago, January 16 to 18. Officers elected for next year are: E. A. Sterling, president; A. M. Smith, first vice-president; H. Rollins, second vice-president; Grant B. Shipley, third vice president, and F. J. Angier, Mount Royal Station, Baltimore, Md., secretary and treasurer.

At the annual meeting of the Indiana Engineering Society, held in Indianapolis, January 25, 26 and 27. The officers elected for the coming year were: DeWitt V. Moore, president; H. W. Klausmann, vice-president; D. B. Luten, E. E. Watts and C. A. Tripp, new trustees, and Charles Brossmann, secretary.

The annual meeting of the Illinois Society of Engineers and Surveyors for 1912 was held at the University of Illinois on January 17, 18 and 19. The program was of unusual excellence. The more important engineering topics discussed were Stream Pollution, Sewage Disposal, Accuracy in Surveying, Road and Pavement Problems, and the Bridge Work of the Illinois Highway Commission. Two illustrated lectures of great interest were given, one by Professor I. O. Baker, on the Panama Canal, and one by Mr. H. L. Cooper, chief engineer, on the Keokuk Water Power Plant. An afternoon was spent in inspecting the buildings and discussing the work of the College of Engineering. Officers elected for the coming year are: J. A. Harman, president; L. K. Sherman, vice-president, and E. E. R. Tratman, secretary.

Calendar of Technical Meetings.

National Paving Brick Manufacturers' association.—Annual meeting, Congress Hotel, Annex, Chicago, Ill., March 4-6. Will P. Blair, secretary, Engineers building, Cleveland, O.

American Ceramic Society, Chicago, Ill. March 4-6. Prof. Edw. Orton, Jr., Columbus, O., secretary.

Wisconsin Clay Manufacturers' association, Milwaukee, Wis., March 6-7. S. Weidman, Madison, Wis., secretary.

National Brick Manufacturers' association, Chicago, Ill., March 6-9. T. A. Randall, Indianapolis, Ind., secretary.

Illinois Clay Manufacturers' association, Chicago, March 8-9. A. E. Huckins, secretary, Champaign, Ill.

International Brick and Clay Products exposition, Coliseum, Chicago, Ill., March 7-12. F. L. Hopley, secretary, 815 Chamber of Commerce Bldg., Chicago, Ill.

First Annual Kansas City Cement Show. Convention Hall, March 18-21. J. P. Beck, general manager Cement Products Exposition Co., 72 W. Adams St., Chicago.

American Water Works association. Annual convention, Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River Street, Troy, N. Y.

Technical Schools.

In connection with the graduate course in highway engineering the following illustrated lectures were given during the month of February by non-resident lecturers in highway engineering: February 9—"Contracts and Specifications," Harold Parker, vice-president and manager, The Hassam Paving Company, Worcester. February 16—"Trinidad and Bermudez Asphalts and Their Use in Highway Construction," Clifford Richardson, consulting engineer, New York City. February 19—"The Design of Highways and Systems of Highways," Nelson P. Lewis, chief engineer, Board of Estimates and Apportionment, New York City. February 23—"Inspection of Sheet Asphalt Pavements," A. W. Dow, chemical and consulting engineer, New York City. February 26—"Technical Literature," John M. Goodell, editor-in-chief, *Engineering Record.*

Bulletin No. 52, of the University of Illinois Engineering Experiment Station, states the results by Herbert F. Moore of an investigation of the strength of rolled zinc. Tests of the strength under tensile and shearing stress are noted and a comparison is made with mild steel.

U. S. Civil Service.

The U. S. Civil Service Commission will hold examinations as follows:

March 13, 1912: Aid, Coast and Geodetic Survey; assistant, Philippine service; assistant examiner, Patent office; civil engineer, Philippine service; civil engineer student; computer, Nautical Almanac Office (men only); computer, Naval Observatory (men only); draftsman—copyist topographic, junior engineer, Engineer Department at Large; topographic, departmental; forest assistant, Forest service; forest assistant, Philippine service; industrial teacher (men only), Philippine service; junior engineer (mechanical), Bureau of Mines; junior engineer (mining), Bureau of Mines.

March 20: Laboratory aid and engineer for the forest products laboratory in Madison, Wis.

March 20-21: Assistant engineer in forest products, for duty at Madison, Wis.; engineer in forest products for duty at Madison, Wis.; assistant chemical engineer in forest products, for duty at Madison, Wis.; ballistic engineer, ordnance department at large, Frankford Arsenal, Philadelphia, Pa.

April 10, 1912: Agricultural inspector, Philippine service; assistant observer, weather bureau; cadet engineer, lighthouse service; cadet officer, lighthouse service; civil engineer, departmental service; civil engineer and draftsman; computer, Coast and Geodetic Survey (men only); draftsman—mechanical, Isthmian Canal service; topographic, Isthmian Canal service; engineer, Indian service; junior engineer (civil), engineer department at large; junior engineer (mechanical or electrical), engineer department at large; scientific assistant, department of agriculture; surveyor, Philippine service.

Road Funds to be Provided for Ohio.

The second amendment to the constitution has been adopted by the Ohio constitutional convention, which has been in session since January 9. The amendment permits the state legislature to issue bonds in the sum of $50,000,000 for the support and maintenance in the county of wagon roads. It was adopted by a vote of 72 to 40.

Personal Notes.

Fred R. Charnock has been reappointed city engineer of Medford, Mass.

Samuel J. Paul, Los Angeles, Cal., has been appointed city engineer of Santa Barbara, Cal.

Charles Cottingham, C. E., Danville, Ill., has prepared a steropticon lecture on the Panama canal.

E. P. Roberts, president of the Cleveland engineering sociey, has been appointed city smoke inspector.

H. E. Phelps has been appointed city engineer of Boulder, Colo., succeeding Fred R. Dungan, who has resigned.

W. F. Tye has been elected president of the Canadian Society of Civil Engineers. Henry H. Vaughn is vice-president.

R. F. Stoddard and M. F. McKenna announce the opening of an office for the practice of civil engineering at 83 Fairfield avenue, Bridgeport, Connecticut.

Frederick E. Beck and Alvin L. Gilmore have opened an office at Binghamton, N. Y., to engage in the practice of civil engineering under the firm name of Beck & Gilmore.

Howard A. Parker has been appointed assistant highway engineer by the Wisconsin State Highway Commission. He was ormerly an instructor in civil engineering at the University of Wisconsin.

C. A. Jennings, superintendent of filtration of the Union Stock Yards & Transit Co., Chicago, has been retained by the city of Quincy, Ill., to investigate and report on the water works plant, making recommendations of improvements.

Alexander Potter, consulting engineer, of New York City, has been retained by the city of Springfield, Mo., to design and supervise the construction of sewage disposal plants for the existing north and south sewers. The city voted $100,000 in November to carry out this work.

J. U. Isaacs has been appointed engineer of the division of sewers in the department of the city engineer of Baltimore, Md.; S. R. Alexander has been appointed engineer of bridges; James Paige, engineer of street repairs, and L. J. Houston, Jr., engineer of improved paving.

Edlow W. Harrison, of Jersey City, who has long been identified with the proposed Passaic Valley intercepting sewer as consulting and chief engineer, has tendered to the Sewerage Commission his resignation from the latter office. In Mr. Harrison's place the commission appointed William M. Brown, of Boston.

D. D. Jackson, director of laboratories of the Department of Water Supply, gas and electricity of New York, will have charge of the experiments made with a view to purifying the water supply of Cleveland, O.

Charles E. Collins, of Philadelphia, Pa., has been retained as engineer on the proposed sewerage system and disposal plant at Pottstown, Pa.

MACHINERY AND TRADE

The Standard American Asphalt Pavement.

The use of natural rock asphalts found in the region a few miles south of Ardmore, Oklahoma, has developed a type of asphalt paving, which is unique in many particulars. The different steps in the development of this "Standard American Asphalt Pavement" are very well described in a series of articles by J. S. Downard, president of the Shelby Doward Asphalt Co., Ardmore, Okla., which are briefly abstracted in the following:

The primitive types of bituminous rock pavements are those laid out of a single asphalt rock, which was pulverized, heated, raked over a firm base to a thickness of 2 inches, compressed with a steam roller and opened to traffic. This bituminous rock contained from 7 to 10 per cent. of bitumen (asphalt) ; the remaining 90 per cent. was sand —these materials being found in nature naturally combined. No bituminous limestone was used.

The second step in the industry was to take three different kinds of bituminous rock and combine them, selecting those containing soft bitumen, which would temper others containing harder bitumen, and density was obtained by adding to the sand rocks certain bituminous limestone rocks and certain sand rocks that contained very fine sand. The mixture termed "Standard" carried about 20 per cent. of bituminous lime rock, and the remaining 80 per cent. was composed of a mixture of different kinds of bituminous sand rock. The entire mixture contained from 7 to 10 per cent. of bitumen (asphalt), the balance being limestone and sand.

The third step was to eliminate most of the bituminous sandstone in the paving mixture, retaining the bituminous limestone. The bituminous sandstone was replaced by a mixture of pure graded sand with bitumen (asphalt) added to it, and the bitumen used was the same bitumen that was extracted from the asphaltic sandstone, properly tempered with other asphalts (bitumens), so as to be as near like rubber as possible but to have the durability of natural bitumen. A portion of the bituminous sand rock was retained in the pavement so as to secure the benefit of very fine pure silica, contained only in this material.

Ardmore asphalt is a mixture of sand and natural mineral bitumen, and the Standard specifications call for one-third of the pavement being made out of this material, and to this natural mixture of asphalt, a quantity of sand is added, and to the quantity of pure graded sand, sufficient artificial asphalt and natural asphalt mixed with proper flux to bring up the entire mixture to 100 parts. The result is as follows: Natural sand asphalt—3.3 parts of pure bitumen and 29.7 parts of fine silica sand naturally combined as taken from the mines; 6.7 parts of Oklahoma natural Gilsonite properly fluxed; 60.3 parts of sand obtained locally.

Such part of sand as is deemed necessary to give proper percentage is added.

The bituminous limestone or rock asphalt found in the vicinity of Ardmore consists of a pure limestone formation which is saturated with pure native bitumen. This bitumen is found through the body of the rock whereever it contains voids, and also in seams that exist in the formation. These seams, or rather lines of cleavage, once caused the entire mass of rock to have sufficient minute cracks in the bed to allow the passage of the

ARDMORE ASPHALT READY FOR SHIPMENT.

bitumen through the entire bed of limestone, and under pressure it infiltrated, not only these seams, but the entire body of the rock, eccepting an occasional crystalline limestone mass. The result is a stone of pure carbonate of lime, filled with pure natural bitumen.

The mass breaks into these pieces because of the natural seams, or cleavage. The result, therefore, of a crushing operation is to produce angular and sub-angular pieces of a solid stone, thoroughly coated with bitumen and thoroughly filled with bitumen so that no moisture can be absorbed, and of such quality that the bitumen on the surface of the stone will be increased in quantity by the application of heat, or new supplies will come to the surface if the supply of coating bitumen is removed from any cause. The accompanying photograph shows the rock asphalt ready for shipment.

The material has been used very extensively in the various forms above described and has for more than ten years proven satisfactory under heavy traffic and in climates as diverse as those of Kansas City and Galveston.

The Smith "Hot" Mixer.

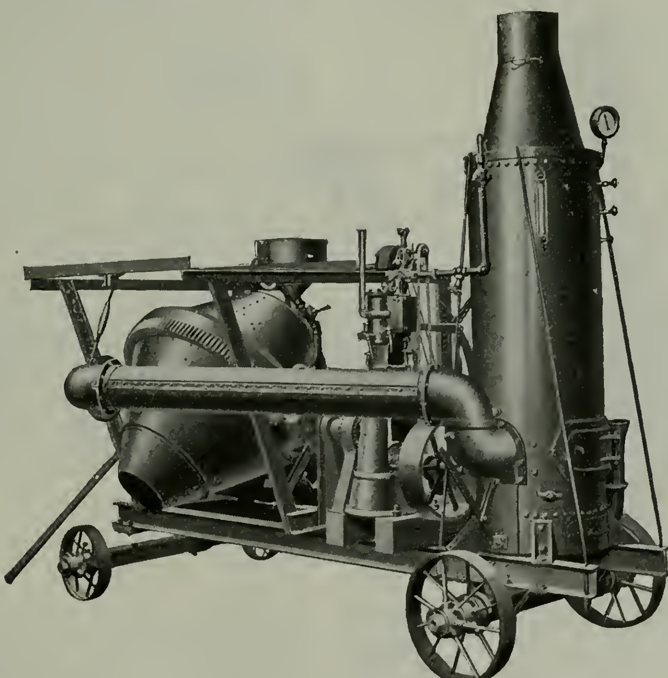
To the road contractor and engineer who has had experience with the heavier types of mixers for bituminous road material, the new Smith "Hot" mixer, manufactured by the T. L. Smith Co., 1330 Majestic Building, Milwaukee, Wis., will at once prove of interest. It is a light but thoroughly efficient machine, having the points of good design and construction, which have characterized the Smith concrete mixers, of which it is really an adaptation. There has been added to the concrete mixer plant, a power charger, tar ladle and tank of special construction, an asbestos-lined heating pipe to conduct the flame from the fire-box to the mixer drum and a steam blower to force the heat through the pipe.

The accompanying photograph shows the discharge end of the machine, with the drum tilted while running; a feature of great value in handling the viscous road material. The operation of the mixer is briefly as follows:

The flame from the fire box is forced into the drum through an asbestos-lined heating pipe, by means of a powerful steam blast. A slide valve at the boiler permits of the accurate control of the heat. By means of a damper in the hood of the boiler, the draft can be diverted through the stack when the heat is shut off from the mixer. The heating attachment is swiveled on the upper, cast-steel elbow, so as to swing away when the drum is tilted.

The power charging attachment is the same as is furnished for concrete mixer service. The lift is vertical and direct, insuring smooth, easy operation. The bituminous ingredient must be introduced into the mixer in liquid form. The ladle is filled, placed upon the sideloader brackets and elevated with the skip. When the skip reaches its highest position, the operator upsets the ladle into the a special tar tank, from which the contents can be fed into the drum as soon as the stone is heated to receive it.

The gases enter the drum at a temperature above 600 degrees Fahrenheit. The materials are "sprayed" by the blades in the drum, al-



THE SMITH "HOT" MIXER.

lowing the heat to reach every particle in the mass. With the ordinary run of stone, as delivered directly from the quarry bins, 2½ minutes are ample to both heat and mix the batch.

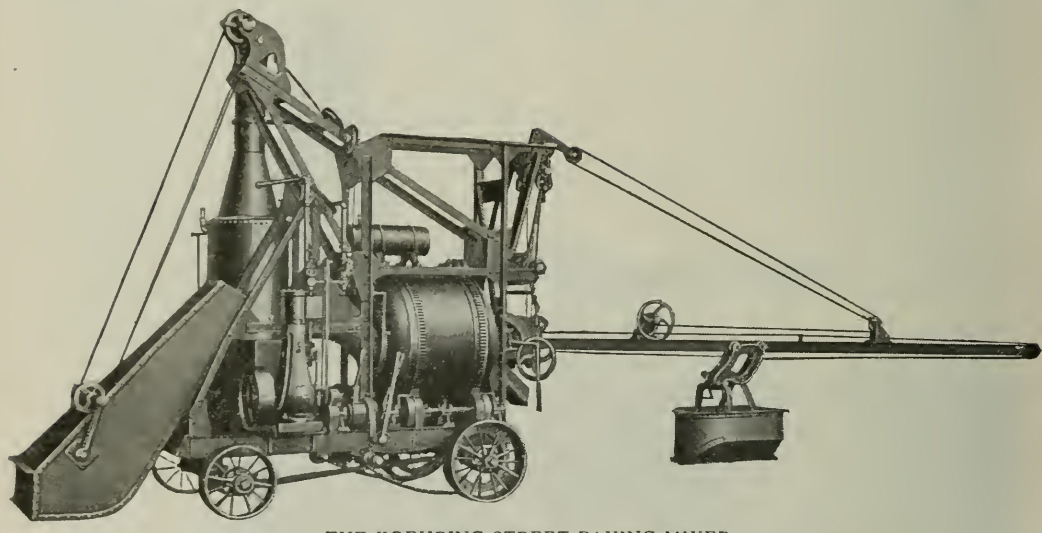
In commenting on a five days test of the mixer, F. O. Brown, president of the Municipal Paving Co., says:

We used various kinds of material.

First. Oklahoma sand rock asphalt in the pulverized state. Second, old Barber material taken off the streets and broken up in small chunks, the size of a person's fist. Third, we used it for asphaltic concrete composed of small trap rock 1-inch in size and under, together with sand and melted asphalt.

For the material first named—pulverized rock asphalt—we heated 11 cu. ft., which is the capacity of our machine, in from 3 to 5 minutes at a temperature of 350 degrees, which is really more than this material requires.

For the second material, it required from 5 to 10 minutes to heat it and reduce it to a condition fit for paving. With this material we added a small percentage of California asphalt.



THE KOEHRING STREET PAVING MIXER.

The last material above mentioned, to-wit: asphaltic concrete, it required from 5 to 7 minutes for a batch of 11 cu. ft. We heated all the material to an average of 350 degrees.

The machine worked entirely to our satisfaction and required from 3 to 7 men to operate it, depending on the class of work we were doing.

I believe that this machine, which is a medium size, made by the Smith people, will lay from 500 to 600 yds. per day of 2-inch think paving material.

For a small capacity of work, we consider this machine a valuable thing to use for asphalt hot mixers.

The Koehring Concrete Mixer Catalog.

The Koehring Machine Co., Milwaukee, Wis., have issued a most complete and very attractive catalog of concrete mixers, hoists and hoisting dumps. This catalog, No. 16, is a most tasteful and complete booklet, illustrated throughout with halftones which are notable for their clearness of detail as regards machine parts and the comprehensive nature of the subject matter.

The fore part of the catalog contains a general description of the mixing feature of the Koehring dump with cutaway views of the interior showing the action of the blocks during the process. Other details of mechanical operations, such as the trunnion rollers supporting the dump; the heavy truck construction; the side loader, etc., are fully dealt with in this portion.

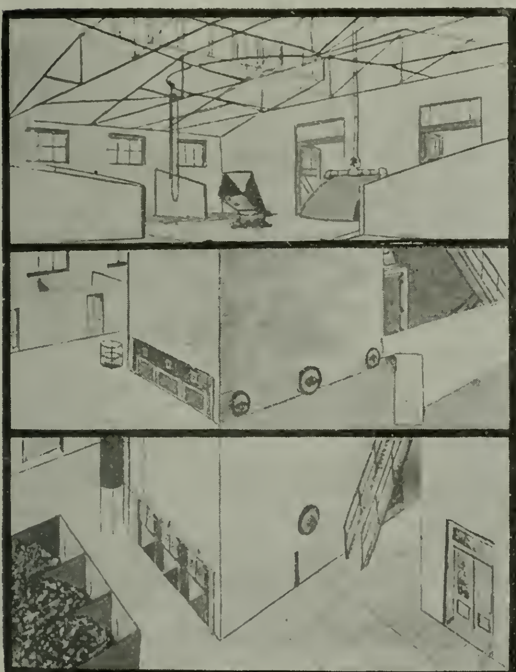
Then follow a number of excellent halftones of the different types of machines; the steam power mixer, the gasoline engine mixer, the motor driver mixer, the mixer with a batch hopper bin, etc., all being shown in full detail. A small mixer shown on page 18 is particularly adapted for concrete work in city parks and other small jobs.

The next portion of the catalog is devoted to concrete hoists and street paving mixers. The street paving mixer, of which a photograph is shown, has been fully described in these pages. The special delivery device is noteworthy and a further improvement consisting of an automatic trip on the delivery bucket has been recently added. This is followed by a number of photographs of actual construction work in which the Koehring machine has played a prominent part. The last twenty-five pages contain specifications and tables, and a number of shop views showing the manufacture of the machine and its various parts.

The catalog apart form its value as an aid to the buyer is of interest and has an educational value by reason of its complete detail and the clear presentation by illustration and description the points set forth.

Harris Combination Incinerator and Power Plant.

J. B. Harris, 210 Stahlman Building, Nashville, Tenn., has entered into connection with the Nashville Bridge company, East Nashville, Tenn., whereby the latter company is to handle all contracts for the Harris combination incinerator and power plant. The Nashville Bridge company has a plant fully equipped for the manufacture and erection of all buildings and equipment. Bids have been entered for several cities and it is contemplated that five or six plants will be built during the present year.



INTERIOR VIEW HARRIS INCINERATOR.

The Harris invention has been perfected after many exhaustive practical tests and its efficiency both as an incinerator and as a power plant probably excels that of any other similiar device on the market. It is built in units varying from 10 to 250 tons capacity per day, generating power from 100 to 1200 horse power per unit from self-contained water tube steam boilers. It will burn all fumes of city refuse without smoke or odor.

That the plant will pay its operating expense and a good dividend on the investment, is strongly stated by the inventor.

Fireproof Construction Imperative.

Prominent business men, aroused by the discussion concerning House Bill No. 357, just introduced in Congress, say that while it is certainly time that something should be done to put a check upon the appalling fire waste in the United States, yet the investigation of insurance rates is far from offering a solution of the real trouble.

One of the leading Chicago insurance men, Louis Kohtz, Gen. Agt. Aetna Insurance Co., discussing the subject said:

The first effort should be made in securing the united support of all municipalities to establish a standard building code, which will foster genuine fire proof construction, and which will put an end to the building of such flimsy structures as are now a menace to the congested districts of all our cities.

The fire loss in European countries averages only about 30 cts. per capita annually, as against $2.50 per capita annually in this country. There can be no other reason for this difference than that there is something radically wrong with our methods of construction in the United States. Fully 25 per cent. of the new buildings constructed simply replace those destroyed by fire. In this country about one billion dollars worth of new buildings are built annually, and buildings to the value of two hundred and fifty million dollars are burned. To this must be added the cost of fire insurance and the cost of maintaining expensive fire departments, making a total fire waste of over five hundred million dollars. The total fire waste annually amounts to more than the annual production of gold, silver, copper and petroleum in this country.

It is discouraging to note that while our population has increased 74 per cent. in thirty years, our fire loss has increased 134 per cent. in the same period.

Within the last few years, there has been developed a form of construction which can be called absolutely fire-proof, and many of the modern business buildings, of this type, will stand for an indefinite time as monuments to the wisdom of their builders. Such splendid buildings offer the best kind of a fire wall and do much to prevent the spread of fire and serious conflagrations.

Many people have an idea that fire-proof construction is too expensive to be practical for all kinds of buildings, but this is a most erroneous belief, for today it is possible to build, not only business buildings and factories of fire-proof construction at reasonable cost, but also city and suburban residences. In fact, there is no excuse whatever for a building being erected of anything but fire-proof construction at the present time. The slight additional first cost is more than made up by many savings in maintenance and repairs, and in the longer life of the building.

One of the greatest menaces to the public welfare is the misrepresentation regarding the fire-proof character of business buildings. Many so-called fire-proof structures are nothing more than fire traps and a fire well started in them will gut their interiors from cellar to roof. Merely the construction of walls and partitions from fire-proof materials does not make a fire-proof building.

Modern progress in fire-proof construction will be fully demonstrated at the Clay Products Exposition, to be held at the Coliseum, in Chicago, March 7th to 12th. All kinds of fire-resisting and fire-protective ideas in building construction work will be shown in actual structures, which will be erected on the floor of the Coliseum, including a full size modern fire-proof house.

This fire-proof feature of the Exposition is so important that fire marshals from municipalities throughout the country will be sent to Chicago to attend the show and the movement has the endorsement of the National Fire Marshals' Association.

I heartily commend the plan to show the country at large the merits of fire-proof construction through an industrial exposition, such as that to be held in the Chicago Coliseum, March 7th to 12th.

Reflectors and Illuminating Specialties.

The H. W. Johns-Manville company, already known in the lighting field by reason of their J-M Linolite system of illumination, have acquired the sole selling agency for the entire products of I. P. Frink, who have been engaged in this line of work for fifty consecutive years.

"Frink" reflectors and fixtures need no introduction to the lighting trade aand consumers throughout the country, and this arrangement means that the H. W. Johns-Manville company will be in position to design and sell lighting systems for every known form of artificial illumination.

An engineering department will be maintained along very extensive lines. This department will maintain a corps of engineers throughout the United States and Canada, and will be equipped to place data and recommendations in the hands of all interested in any subject pertaining to illumination.

Rapid Development of Wire-Cut-Lug Paving Blocks.

The latest addition to the brick manufacturing companies which have installed the machinery for making Dunn's wire cut-lug paving blocks, is the Deckman-Duty Brick Co., of Cleveland, O. They will make the blocks at all three of their plants, at Cleveland, Malvern, and Carrollton, O. The list of plants recognizing the necessity of readiness to supply the growing demand for these blocks is growing with increasing rapidity and apparently will end only when all the paving brick plants have entered it.

To aid in taking care of the numerous important problems arising in the development of the business, Mr. Dunn has secured the services of W. T. Blackburn, formerly city engineer of Paris, Ill., and more recently connected with the national and the Illinois paving brick manufacturers' organizations in an advisory capacity, as his consulting engineer. The Dunn Wire-Cut-Lug Brick Co. is located at Conneaut, O.

Good Roads Year Book.

The American Association for Highway Improvement is preparing a Good Roads Year Book of about 350 pages for publication, probably in April, which will be sent to members of the association and will be sold to others at $1. The book will contain much information not heretofore available under such headings as Associations, Appropriations, Books, Brick Roads, Bituminous Macadam, Bridges and Culverts, Chronology, Convict Labor, Concrete Roads, Earth Roads, Gravel Roads, Legislation, Macadam and Telford Roads, Maintenance, Periodicals, Patents, Sand Clay Roads. It will contain lists of bonds issued and contemplated for road purposes, of road contractors, of state expenditures in 1911, of national and state highway officials, of institutions having highway engineering departments, of mileage of roads and improved roads in each state, of manufacturers of road material, vehicles and machinery and of trade names. It will explain fully the work of the U. S. Office of Public Roads and of the association itself.

Application for membership in the association or remittances for the book should be sent to J. E. Pennybacker, Jr., secretary, Colorado Building, Washington, D. C.

Trade Notes.

Hartford City, Ind.—Bids are requested on March 7, at 7 p. m. for removing two old boilers and furnishing and setting two 100-h. p. boilers. Certified checks 2½ per cent. J. G. Trant is city clerk.

Indianapolis, Ind.—Bids are requested on March 11, at 10 a. m., for furnishing 210 carloads of crushed stone, for Marion county highways and 40,000 gallons of Tarvia binder or equal; machines for applications to be loaned by the county. William T. Patton, auditor of Marion county.

Schenectady, N. Y.—An appropriation of $30,000 will be made by the city to install water meters in residences. F. W. Bentley, water superintendent.

Laurinburg, N. C.—Maxcy L. John desires to purchase a transit for city work.

Oxford, O.—Rial T. Parrish desires to purchase a dumpy level and Philadelphia rod.

Pittsburgh, Pa.—The rapidly increasing demand in Pittsburgh and vicinity for the asbestos magnesia and other products of the H. W. Johns-Manville Co., has necessitated a move from their present location in Liberty Avenue, about Ninth Street, to larger quarters. After January 24, 1912, the Pittsburgh branch of the H. W. Johns-Manville Co. will occupy the entire eight-story stone, reinforced concrete and steel building at the northeast corner of Wood Street and First Avenue, which has been leased by them for a term of years.

San Antonio, Tex.—The contract between the city of San Antonio Texas and the San Antonio Water Supply Co., owned by Belgian capitalists, expires in June of this year. The city of San Antonio has engaged the services of Alexander Potter, consulting engineer, of New York, to make an appraisement of the existing water works plant, and prepare plans for the extension and rehabilitation of the existing system to make the system efficient from a fire-fighting standpoint as well as adequate for domestic use; also to prepare a new contract with the water company, suggesting a schedule of rates at which, in his judgment, the company should be willing to supply water to the city for fire purposes and domestic consumption. The work also includes an audit of the books of the water company on behalf of the city. Mr. Potter has agreed to present a complete report, with plans, by the first day of June, 1912.

San Juan, Porto Rico.—Special. The Commissioners of the Interior desire to obtain for file and reference for the different divisions of the department, public works; buildings; irrigation, etc.; catalogs and price lists of machinery, tools, materials, supplies, etc. E. S. Wheeler, assistant commissioner.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Daytona, Fla.—March 5. Road construction as follows: 100,000 cu. yds. embankment and 90,000 cu. yds. hard surface rock. E. C. & D. M. Rogers, 447 North Beach St., Daytona, Fla., engineers.

Jacksonville, Fla.—March 15, 10 a. m. Paving the Hogan road for a distance of 4 miles. Gail L. Barnard, county engineer.

Brookville, Ind.—March 5, 1 p. m. Constructing highway in Whitewater township. Chas. E. Reifel, auditor.

Crawfordsville, Ind.—March 5, 10 a. m. Constructing highways in Union and Brown townships. Bennett B. Engle, auditor.

Crown Point, Ind.—March 6, 12 m. Constructing 4 gravel roads in North township. E. A. Johnson, auditor.

Decatur, Ind.—March 4, 10 a. m. Constructing a macadamized road in Monroe township. H. S. Michaud, auditor.

English, Ind.—March 4, 2 p. m. Constructing a pike road in Ohio township. J Evans Jones, auditor.

Hartford City, Ind.—March 5, 2 p. m. Constructing macadam road in Harrison township. James Cronin, Jr., auditor.

Huntington, Ind.—March 7, 10 a. m. Constructing 4 highways in Warren township. Harold Guthrie, auditor.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving with wooden block, asphalt, bituminous concrete, bitulithic, or brick, Ruckle st., from Thirtieth to Thirty-third st. C. A. Schrader, president board of public works.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving Wallace st., from Washington to New York st., with wooden block, asphalt, bituminous concrete or brick. C. A. Schrader, president board of public works.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving with wooden block, asphalt, bituminous concrete or brick, Emmett st., from Alabama to Hudson st. Board of public Works.

Lawrence, Ind.—March 5, 10 a. m. Constructing highway in Jackson township. Williams S. Fagaly, auditor.

Marion, Ind.—Feb. 29, 2 p. m. Constructing highway on line between Waltz and Liberty township and Richland. E. H. Kimball, auditor Grant county.

Monticello, Ind.—March 5, 12 m. Constructing a stone road in Jackson county. A. B. Fisher, auditor.

Newport, Ind.—March 11, 10 a. m. Constructing a macadamized road in Vermillion and Engene townships. H. T. Payne, auditor.

Princeton, Ind.—March 6, 10 a. m. Constructing gravel road in Johnson township. William C. Roberts, auditor.

Shelbyville, Ind.—March 7, 10 a. m. Constructing 2 highways in Noblesville township. Frank W. Fagel, auditor.

Shoals, Ind.—March 4, 10 a. m. Constructing macadam road in Perry and Halbert townships. John Morris, auditor.

Valparaiso, Ind.—March 5, 10 a. m. Constructing 3 roads in Porter county. B. A. Blakly, auditor.

Vevay, Ind.—March 4, 1 p. m. Constructing highway in Pleasant township. John Culbertson, auditor.

Vincennes, Ind.—March 5, 10 a. m. Constructing 2 gravel roads in Miami township, macadamized road in Eel township and gravel road in Clinton township. J. E. Wallace, auditor.

Williamsport, Ind.—March 4, 1 p. m. Constructing gravel road in Pike township. David H. Moffett, auditor.

Williamsport, Ind.—March 4, 1 p. m. Constructing a gravel road in line between Pike and Steuben townships. David H. Moffett, auditor.

Winamac, Ind.—March 5, 12 m. Constructing a number of public highways. W. C. Munchenburg, auditor.

Winchester, Ind.—March 7, 10 a. m. Improving 12 public highways. Henry F. Wood, auditor.

Petoskey, Mich.—March 1. Constructing county road. G. W. Dickinson, clerk of Emmet county.

Helena, Mont.—March 4. Paving construction as follows: 19,000 cu. yds. grading, 94,000 sq. ft. concrete walk, 2,500 lineal feet concrete cross-walks, 16,200 lineal feet concrete curb, 565 sq. yds. granite pavement. Chas. W. Heimick, city engineer.

Yonkers, N. Y.—March 4. Grading and improving 241st. James V. MaHony, secretary, board of contract and supplies.

Caldwell, Ohio.—March 15. Improving the Combs road. Harry A. Smith, clerk.

Delaware, Ohio.—March 9, 1 p. m. Road construction as follows: County Line road, .49 mile; the Oxford and Norton roads, .36 mile; the Felkner road, 1.02 miles. Macadam construction. Certified check $300 on each bid. W. H. Whittier, county surveyor.

Richwood, O.—March 9, 2 p. m. Paving portions of Ottawa st. O. Boggs, village clerk.

Steubenville, O.—March 5, 12 m. Constructing a retaining wall. Certified check $100. Sherman Floyd, clerk board of Jefferson county commissioners.

Salina, Pa.—March 16, 6 p. m. Constructing about 500 feet of brick road. Certified check $200. W. H. Wilson, Saltsburg, Pa., engineer.

Racine, Wis.—March 9, 10 a. m. Paving McKenzie ave., including 10,900 sq. yds. of pavement. E. H. Connolly, city engineer.

CONTRACTS AWARDED.

Hamilton, Ala.—Constructing road from Hamilton to Guym, to A. F. Beardon, Birmingham, Ala., $17,350.

Stockton, Cal.—Improving nine miles of Roberts Island road with oil macadam and for graveling and oiling a road between Tracy and Vernalis, a distance of about 14 miles, to Cy. Moering, Jr., at $50.301 and $51,132 respectively; improving Mariposa road, to F. C. McIntyre, for $42,957.

Barnesville, Ga.—Paving a number of streets, to J. B. McCrary, Atlanta, Ga., $30,000.

Lewiston, Ill.—Constructing 20 blocks of brick paving to the Fuller-Coult Construction Co., Chemical Bldg., St. Louis, Mo.

Bloomington, Ind.—Constructing macadam road in Perry township and Bean Blossom township, to Wm. Smith, Bloomington, Indiana, $11,738.

Indianapolis, Ind.—Constructing gravel roads in Warren county, to W. O. Thomas, Pine Village, Ind., $6,760, and to Greenup & Co., Ambia, Ind., $10,805.20.

Lebanon, Ind.—Paving North Meridian st., to Geo. G. Miller, $20,035.

Michigan City, Ind.—Constructing 3 pavements, to the Western Construction Co., Lafayette, Ind.

Portland, Ind.—Constructing stone road in Richmond township, to Nicolson & Pierce, Alexandria, Ind., $15,260.

Rushville, Ind.—The following road contracts have been awarded: the John Jordan road, to O'Connor Bros., $9,400; the William Leisure road, to J. A. Hardin & Co., $15,659; the J. M. Amous road, to J. B. Reasoner, $15,934; the Issac Webb road to Thurston & Steel, $4,490; the Earl Beaver road, to J. W. Stevens, $8,350; the Robert Nixon road to Nicholson & Pearce, $16,667; the W. A. Mull road to Thurston & Steel, $14,440; the E. B. Louden road to Nicholson & Pierce, $39,098.

Corning, Ia.—Constructing 13,869 sq. yds. brick paving, 457 sq. yds. concrete paving, and 11,463 lineal feet combined curb and gutter to Dunnegan & Hamilton, Shenandoah, Ia. T. F. Delay, Creston, Ia., engineer.

Eldora, Ia.—Constructing 22 blocks of concrete pavement, to J. S. McLaughlin & Son, of Red Oak, Ia.

Louisville, Ky.—The following paving contracts have been awarded: Alta, Sherwood and Bonnycastle aves., between Bardstown road and Cherokee Park, to the Jefferson County Construction Co., $67,341; Thirty-fourth st., from Chestnut st. to first alley south of Magnolia ave., to the Louisville Asphalt Paving Co., $6,426; Barbee st., from First to Brook st., and Rosewood ave., from Baxter ave., 466 ft. south, and Bolling ave., to the S. S. Saxton Co., at $8,779 and $11,116 respectively.

Tompkinsville, Ky.—Paving, with vitrified brick, four miles of pike from Tompkinsville toward the Cumberland river, to W. C. Overly & Co., Joplin, Mo., $114,000.

Boston, Mass.—The following paving contracts have been awarded: preparing asphalt pavement, to the Warren Bros. Co., Boston, Mass., $32,370; furnishing curbing, to F. & R. J. Lombard, Boston, Mass.

Kansas City, Mo.—Constructing pavements and grading subways, to C. F. Betz, Sioux Sity, Ia., $25,000.

Syracuse, N. Y.—The following paving contracts have been awarded: Elk st., with sheet asphalt and vitrified brick, to Fred J. Baker, $11,570; Granger st., with asphalt, to the Warner-Quinlan Co., $1,460; constructing sidewalks on Onondaga ave., to Antonio Mando, $949.

Ravenna, O.—Constructing brick pavement in Section So. 1 and 2 of the Ravenna-Randolph road, to Morgan Bros., of Ravenna, at $59,500 and $37,586 respectively.

Portland, Ore.—The following paving contracts have been owarded: paving Alameda park tract with gravel bitulithic, Warren Construction Co., $147,000; grading and laying concrete curbs and sidewalks as follows: E. 11th st., to Oregon Independent Paving Co., $2,089; Webster st., to Beehill Bros., $725; Sumner st., to Carter Bros., $6,139.

Johnson City, Tenn.—Paving in district number 9, to the Cleveland Trinidad Paving Co., $87,000.

Houston, Tex.—Paving Houston Heights blvd. with vitrified brick, to E. J. Overly & Co., Joplin, Mo., $114,845.

Houston, Tex.—Paving the Houston Pike blvd., to the Creosoted Wood Block Paving Co., New Orleans, La., $22,349.

Paris, Tex.—Paving North Main st., to Western Paving Co., Oklahoma City, Okla., $30,760.

North Yakima, Wash.—Paving 9 blocks with bitulithic, to the Pacific Paving Co., $43,737.

Seattle, Wash.—Grading and curbing 22nd ave. N., to L. H. Goerig, Seattle, for $18,766.

Milwaukee, Wisc.—Paving Grand ave., extension west of the Grand avenue viaduct, to R. W. Forrestal, Milwaukee, Wisc., $22,400.

CONTEMPLATED WORK.

Bentonville, Ark.—W. G. Patterson, Ridge, Ark., has prepared plans for the construction of 25 miles of gravel macadam road, to cost about $40,000.

Ft. Smith, Ark.—Bids will soon be asked for paving Garrison ave. M. H. Reed, engineer.

Oakland, Cal.—City engineer has been directed to prepare plans for paving 14th st., from Jackson to Oak, and for improving Lake Shore ave., Fifth ave., and E. Twenty-second st.

Suffield, Conn.—A $20,000 bond issue for road construction has been voted. E. Halladay, town clerk.

Washington, D. C.—An American consul reports that a municipality in his district is contemplating street improvement to cost $33,000. Address Bureau of Manufacturers, Number 8027.

Live Oak, Fla.—The paving of three streets with brick to cost about $22,000 is contemplated.

Atlanta, Ga.—The street and sewer committee of the city council has outlined paving work and sewer construction for the coming season to cost about $1,000,000.

Barnesville, Ga.—Grading and paving a number of streets, to J. M. McCrary Company, Atlanta, Ga.

Aurora, Ill.—The construction of about 5 miles of brick paving is contemplated.

Chicago, Ill.—The extension, boulevarding, parking and illuminating of Sheridan road from Devon ave., thirty miles north, is contemplated. Lincoln Park Comrs.

East St. Louis, Ill.—Edward F. Harper, city engineer, is preparing estimates for the paving of State St., to cost about $800,000.

Freeport, Ill.—The paving of Float, Benton and Delaware sts., with brick, to cost about $25,000, is contemplated.

Pana, Ill.—The paving of 8 streets is contemplated and bids will be asked about March 5.

Rochelle, Ill.—The construction of about 30,000 sq. yds. of brick pavement is contemplated. Aetna Engineering Bureau, 17 La Salle, St., Chicago,, are engineers.

Rock Island, Ill.—The paving of 6 blocks on Second ave., with asphalt is contemplated. Wallace Treichler, city engineer.

Sterling, Ill.—Street paving, to cost about $40,000, is contemplated. Board of local improvements.

Waukegan, Ill.—The construction of a new pavement in County St., at an estimated cost of $10,000 is contemplated.

Indianapolis, Ind.—The paving of Park ave., from Fall Creek blvd. to 34th st., Thirtieth st., from Central to College ave., and Thirty-fourth st., from Illinois to Central, is contemplated. Board of public works.

Richmond, Ind.—The paving of 8 blocks on South Eighth st., with brick is contemplated.

Cedar Falls, Ia.—City council has passed a resolution authorizing nearly five miles of paving in the residence districts.

Clinton, Ia.—R. C. Hart, city engineer has prepared plans and estimates for the paving of 5th ave., figures being given, on wood block, concrete, vitrified brick, and asphalt.

Iowa Falls, Ia.—The paving of 16 blocks of street with concrete is contemplated.

Sheldon, Ia.—The city engineer has been instructed to prepare plans for paving 22 blocks of streets.

Sioux City, Ia.—The paving of Jackson st. is contemplated. A. A. Smith, mayor.

Baltimore, Md.—The paving of street sections aggregating about eight miles is contemplated. Estimated cost, $40,000. Paving commission.

Salisbury, Md.—A bond issue of $50,000 for street and sewer improvements will be voted.

Alma, Mich.—A $30,000 bond issue for the paving of Main st., has been voted.

Bessemer, Mich.—A bond election will be held in April for the purpose of voting $150,000 for road improvement, in which event the Marenisto-Gogeit road will be constructed for 39 miles. Contracts will be let in the early spring for 18,000 yards of dirt excavation and grading on the above road. H. A. Harper, engineer.

Grand Rapids, Mich.—E. H. Christ, cons. engineer is preparing plans for paving Lowells st. with brick. A $25,000 bond issue has been voted.

Pigeon, Mich.—A bond issue of $25,000 has been voted for stone road construction.

St. Paul, Minn.—Bids will soon be advertised for repaving Fourth st., from St. Peter st. to Seven Corners, at an estimated cost of $15,000.

Joplin, Mo.—Asphalt paving to cost about $25,000 is contemplated.

Greenwood, Miss.—The construction of a mile of paving esimated by the council to cost about $6,000 is contemplated.

Gowanda, N. Y.—Laying 2½ miles of brick pavement, is contemplated. President board of trustees.

Schenectady, N. Y.—The construction of a municipal paving plant to cost about $15,000 is contemplated.

Seneca, Falls, N. Y.—Paving construction to cost about $20,000 is contemplated.

Warsaw, N. Y.—Brick pavement construction to the amount of $35,000 is contemplated.

Hendersonville, N. C.—A $24,000 bond issue for the paving of Main St. and 6th ave., with asphalt has been voted.

Statesville, S. C.—A $400,000 bond issue for highway construction, including a number of steel highway bridges, has been voted. W. S. Fallis, county engineer.

Canton, O.—The paving of Allen st. with vitrified blocks is contemplated.

Cleveland, O.—Plans have been prepared for paving the following streets: E. 99th st., 2 sections; Adams ave., and Ostend ave. R. E. Collins, city clerk.

Genoa, O.—Geo. Champe, of Toledo, O., is preparing plans for the paving of Main st.

Tulsa, Okla.—P. C. Hughes, city engineer, has prepared plans for the construction of 5 blocks of brick pavement with asphalt filler to cost about $23,000.

Bonham, Tex.—According to the plans of city engineer Thurmond, $60,000 will be spent this year for concrete sidewalks.

Fort Worth, Tex.—The paving of West 5th st. has been ordered by the city commission.

Port Arthur, Tex.—A bond issue of $12,000 for sidewalk improvements has been voted by property owners of Stillwell Heights.

Victoria, Tex.—A $200,000 bond issue for roads construction has been voted.

North Yakima, Wash.—The paving of Yakima ave., Turner st., Miles ave., W. Chestnut st., and 7th ave., South, is contemplated.

Neenah, Wisc.—The paving of the Boulevard in East Wisconsin ave., to cost about $60,000 is contemplated.

SEWERS.

BIDS REQUESTED.

McLeansboro, Ill.—March 9, 1 p. m. Drainage construction as follows: Number 1, 2 foot base, 1 to 1 slope and 4 feet deep, 13,600 cu. yds.; number 2, six-foot base, 1 to 1 slope and 5 feet deep, 31,600 cu. yds. Certified check $100 on Number 1, and $200 on Number 2. L. E. Lambert, county clerk.

Lansing, Mich.—March 4, 4 p. m. Constructing sewer in Herbert st., Isabel and other streets. Certified check $2,000. Peter F. Gray, city clerk.

Rochester, N. Y.—March 13, 11 a. m. Sewer construction as follows: 9,300 feet of 66-inch pipe for discharge of effluent from disposal works into Lake Ontario, 2,300 feet in open trench and 7,000 submerged and in 50 feet of water at the timber crib. Certified check $20,000. Bond $100,000. F. X. Piper, secretary board of contracts and supplies.

Yonkers, N. Y.—March 4. Constructing sewer in 242nd st. James V. MaHony, secretary board of contract and supplies.

Carnegie, Pa.—March 7, 7:30 p. m. Constructing 15-inch storm sewer on Jane St. Certified check 5 per cent. John B. Hiles, chairman street committee.

St. Elmo, Tenn.—March 1, 7 p. m. Sewer construction as follows: 14 mile pipe sewer 18 to 24 inches; one sewage disposal plant; bridge across Chattanooga st., 400 lineal feet of tunnel. H. B. Wilson, mayor. Cushman-Fairleigh Engineering Co., 724 J. E. Bldg., Chattanooga, Tenn., engineers.

CONTRACTS AWARDED.

Pasadena, Cal.—Constructing sewers on El Molino ave., to R. S. Mikeevich, 2824 7th ave., Los Angeles, Cal.

San Francisco, Cal.—Construction section C of the Engleside sewer to the Contra Costa Construction Co., $60,500.

Atlanta, Ga.—The following sewer contracts have been awarded: furnishing iron castings, to the Southern Iron and Equipment Co., Atlanta, Ga., $75,000; cement, to R. O. Campbell Coal Co., Atlanta, Ga., $10,000; sewer pipe, to the Bibb Sewer Pipe Co., of Macon, Ga., $50,000; constructing sewer complete, to the McCrary Excavating Co., Atlanta, Ga., $100,000.

Columbus, Ind.—Constructing the Maple Grove Sewer, to Lea & Everroad, Columbus, Ind., $32,225.

Atchison, Kas.—Constructing West Atchison sewer, to Williams & Sample, Kansas City, Mo., $22,561.

Lawrence, Kas.—The following sewer contracts have been awarded: to Graeber Bros., 3 contracts at $5,377, and $2,129; to W. J. Gilmore, $3,192; W. C. Keller, Kansas City, Kas., $2,748.

Seneca, Kas. — Constructing complete sewerage system including 12 miles of pipe line and a disposal plant, to Wm. F. Plummer Co., Springfield, Mo., $62,000.

Baltimore, Md.—Constructing High Level Interceptor, to McDermott Construction Co., Washington, D. C., $183,156.

Minneapolis, Minn.—The following contracts for sewer material have been awarded: 1,000,000 sewer brick, to the Wisconsin Red Pressed Brick Co., at $9.35; lumber, to the Northland Pine Co., $7,299; 20,000 barrels of Portland cement, to the Northwestern State cement company, at 86½ cents; 300,000 paving brick, to the Minnesota Paving Brick Company, at $16.50;

200 tons of sewer castings, to the American Brake Shoe & Foundry Company, $31.75.

St. Paul, Minn.—Building the St. Anthony ave. sewer to Fraser & Danforth, 411 Hackney Bldg., St. Paul, $14,500.

Canton, O.—Constructing sanitary sewer in Harrison ave., to P. Christiansen, $2,145; constructing sewer in Cedar st., to F. A. Downs Construction Co., $62,590.

New Philadelphia, Ohio.—The following sewer contracts have been awarded: to the Van Meter Construction Co., Steubenville, Ohio, sanitary sewer, $52,410; to Henderson Bros., Coshocton, Ohio, storm sewer, $27,-363.

Roseburg, Ore.—Constructing sewerage system, to J. N. Calvert, Grants Pass, Ore., $8,962.

Harrisburg, Pa.—Constructing sewers, to the Central Construction & Supply Co., Harrisburg, Pa., and to Stecker Bros., Harrisburg, Pa.

Seattle, Wash.—Constructing sewers in North 78th st., to Johnson & Co., Seattle, Wash., $13,031.

CONTEMPLATED WORK.

De Queen, Ark.—Dickinson & Watkins, Little Rock, Ark., have been retained to prepare plans and estimates for a sewerage system to cost about $35,000.

Van Buren, Ark.—W. B. Bell, has prepared plans and estimates for the construction of sewers in sewer district Number 3 which covers practically the entire city.

Fullerton, Cal.—Cloan and Robeson, San Francisco, Cal., are preparing plans for the construction of a municipal water works system and a complete sewerage system.

Oakland, Cal.—An $82,000 bond issue for main outlet sewers in sanitary districts 1, 2, 3, and 4 has been issued.

Ordway, Colo.—The George H. Fachman Co., Denver, Colo., has been retained to prepare plans and estimates for a complete sewer system.

Hartford, Conn.—Plans have been submitted by city engineer Clark for a trunk sewer in Maple ave., to cost about $180,000.

Washington, D. C.—An American consul reports that a municipality in his district is planning sewerage improvements to cost $712,000; sewerage connections to cost $100,-000; and storm water drainage to cost $200,-000. Address Bureau of Manufacturers, number 8027.

Atlanta, Ga.—The street and sewer committee of the city council has outlined paving work and sewer construction for the coming season to cost about $1,000,000.

Morrison, Ill.—Civil engineer Hills, Fulton, Ill., has been retained to prepare plans for a sewerage system.

Quincy, Ill.—W. P. Bushnell, city engineer is preparing plans for the South Quincy sewer system.

Gary, Ind.—H. P. Melton, has prepared plans for a sewerage system to cost about $225,000.

Des Moines, Ia.—Bids on sewer work estimated at $140,000 have been rejected. New bids will be requested. John Budd, city engineer.

Des Moines, Ia.—Plans for the construction of a sewer in the 7th ward to cost $125,000 have been approved.

Sioux City, Ia.—The city clerk will soon advertise for bids for constructing a storm water sewer in Upper Jackson st.

Tipton, Ind.—The construction of a sanitary sewer system is contemplated.

Jeffersonville, Ky.—The Jeffersonville Power, Light and Water Company has made application for a franchise for the construction of a sanitary sewerage system to be leased to the city for $12,900 per year.

Salisbury, Md.—A bond issue of $50,000 for sewer and paving improvements will be voted.

Lynn, Mass.—The construction of a sewage purification plant has been recommended by the Lynn Harbour Board, Wm. C. Dorman, president.

Minneapolis, Minn.—The council sewer committee has recommended the sale of $100,000 bonds for sewerage works.

Annabelle, Mo.—Construction of sewers in district Number 200 is contemplated.

Fayette, Mo.—Rollins and Westover, Kansis City, Mo., are preparing plans for a sewer system to cost $29,675.

Springfield, Mo.—Plans are being prepared by Alexander Potter, and bids will soon be asked for a new sewage disposal plant. J. H. Langston, city clerk.

Lewiston, Mont.—Plans for the construction of a sewerage system to cost about $50,-000, have been prepared.

Libby, Mont.—Building a main sewer, to cost about $15,000, is contemplated.

Longport, N. J.—The installation of a sewage disposal plant is contemplated.

Trenton, N. J.—The construction of a sewage disposal plant to dispose of 100,000,000 gallons of sewage daily is contemplated. Estimated cost $45,000. City clerk Salter.

Albion, N. Y.—Chas. Engersoll has prepared plans for a complete sewerage system and disposal plant to cost about $150,-000.

Brooklyn, N. Y.—An expenditure of $5,-000,000 for the erection of sewage disposal plants to take care of the surplus sewage now flowing into Jamaica Bay, is being urged.

Oswego, N. Y.—Olin H. Landreth has been retained to prepare plans for a complete sewerage system.

Schenectady, N. Y.—Plans are being made for a new sewage disposal system. W. Thomas Wooley, city engineer.

Syracuse, N. Y.—Constructing sewers in Spencer and W. Division sts., contemplated.

Winston-Salem, N. C.—Plans for extension of sewerage system in East Winston have been completed. J. N. Ambler, C. E.

Alliance, O.—The construction of sanitary sewers in Vine and Perry sts., and Rockhill ave., is contemplated.

Hamilton, O.—Funds amounting to $14,-000 are available for the construction of sewers and sidewalks.

New Philadelphia, O.—G. E. Arnold has prepared plans for a sewerage system to cost about $100,000.

Springfield, O.—The construction of the Maiden Lane sewerage system to cost about $40,000 is contemplated.

Youngstown, O.—The construction of a sewer in Ohio st. is contemplated.

Portland, Ore.—The city engineer has prepared plans for the construction of 2 trunk sewer systems to be known as the East Stark St., sewer system number one and two.

Brackenridge, Pa.—Plans are being prepared for the improvement and extension of the sewerage system.

Ellwood City, Pa.—Plans are being prepared for constructing the Fifth st. sewer. Alex Main, boro engineer.

Harrisburg, Pa.—Samuel G. Dixon, state commissioner of health has approved of plans of the boroughs of Rankin and North Braddock to construct sewers and drains into the Monongahela river.

Meadville, Pa.—The construction of a new sewage disposal plant is being urged.

Nazareth, Pa.—A new sewer system, to cost $20,000 is contemplated.

Tarentum, Pa.—Finance Com. of city council has been authorized to borrow $14,-000 for extension of the sewer system.

Uniontown, Pa.—Samuel E. Dixon, state commissioner of health has approved plans for the construction of a disposal plant by the towns of Uniontown and S. Bethlehem, Pa.

Sioux Falls, S. D.—A $200,000 bond issue has been voted for installing an adequate sewerage system.

Austin, Tex.—Plans are being prepared by city engineer Iredell for a sewer on Comal st.

Calvert, Tex.—The Fountain-Shaw Co., Dallas, Tex., is preparing plans for the construction of a complete sewerage system.

Midland, Tex.—A company is being organized and will be incorporated for $50,000 for the purpose of constructing a sewerage system.

Terrell, Tex.—The city is contemplating the purchase of a sewerage system which is operated by a private corporation.

Rocky Mount, Va.—Installation of a sewerage and water works system is contemplated. J. L. Ludlow, of Winston-Salem, will make surveys.

Bellingham, Wash.—W. H. North, city engineer, has prepared estimates for a trunk sewer to cost about $12,000.

Cashmere, Wash.—Sewer construction to cost $17,500 is contemplated.

Barbourville, W. Va.—An $11,500 bond issue for sewer improvements has been voted.

WATER WORKS.

BIDS REQUESTED.

Savannah, Ill.—March 5, 8 p. m.—Furnishing and installing water works equipment including boilers, pumps, cast iron pipe, and etc. H. T. McKinney, clerk. A. T. Maltby, 803 Great Northern Bldg., Chicago.

Henderson, Ky.—March 2. Furnishing plans for a complete filtration plant. W. I. Thompson, mayor.

Baltimore, Md.—March 6, 11 a. m. Constructing masonry dam including the following: coffer dam, 35,000 cu. yds. rock and earth excavation, 4,600 cu. yds. excavation in cut-off, 38,000 cu. yds. concrete and rubble concrete, 21,000 lbs. steel reinforcing, 70,000 pounds steel bridge. Certified check, $20,000. Ezra B. Whitman, water engineer.

Cincinnati, O.—March 4, 12 m. Furnishing water works pumping equipment and 125,000 gal. elevated steel water tower for the village of Madisonville, O. Director of public service, city hall, Cincinnati.

Cincinnati, O.—March 4, 12 m. Furnishing water works pumping equipment for plant at Carthage, O. Certified check $500. Director of public service, city hall, Cincinnati, O.

Durand, Wisc.—March 1. Constructing 180,000 gal. concrete reservoir and 16,000 feet of mains for water works extensions. H. G. Gilman, Mondovi, Wisc., engineer.

Burnaby, B. C., Can.—March 11, 5 p. m. Supplying 35 miles of steel pipe from 3 to 10 inches in diameter. W. Griffith, clerk municipal council. Cleveland & Cameron, 506 Winch Bldg., Vancouver, B. C., engineer.

CONTRACTS AWARDED.

Macon, Ga.—Furnishing 2,500 tons of cast iron pipe, to the U. S. Cast Iron Pipe & Foundry Co., of Chattanooga, Tenn.

Anna, Ill.—Constructing a water distributing system, including 6,888 ft. of 8-in. cast iron pipe; 8,665 ft. of 6-in. cast iron pipe; 7,995 ft. of 4-in. c. i. pipe; 43 hydrants, 25 valves and valve boxes, to T. C. Brooks & Son, of Jackson, Mich.

New Athens, Ill.—Constructing a water works system, to the Hall Construction Co., East St. Louis, Ill., $17,039.

Henderson, Ky.—Constructing 10 wells for water works system, to E. S. Coudna, Madisonville, Ky.

Boston, Mass.—The following water works system and an electric light plant, ishing cast iron pipe to the United States Steel Cast Iron Pipe & Foundry Co., 2,900 tons at $20.95, and 25 tons of specials at $20.95; furnishing 750,000 pounds number one iron castings, and 250,000 pounds number 2 iron castings to the Roxbury Iron & Brass Foundry Co., Roxbury, Mass.

St. Charles, Mo.—Improving water works system, to Bull & Weberly, St. Charles, Mo., $20,144; constructing pipe line, to John Schulz, St. Charles, Mo., $8,803.

Charlotte, N. C.—Constructing a 65,000,000 gallon reservoir, to Johnson, Porter and Peck, Charlotte, N. C., $31,359; Gilbert C. White, Charlotte, N. C., engineer.

Hammon, Okla.—Constructing a water works system and an electric light plant, to Hunter & Hunter, of Oklahoma City, Okla., $16,943.

Porum, Okla.—Kennedy and Fleming, Oklahoma City, Okla., have been awarded the contract for the construction of a water works and electric light plant to cost $33,000.

Jacksonville, Ore.—Constructing water works system complete, to Jacobson-Bady Co., Portland, Ore., $27,000.

Chamberlain, S. D.—Installing water works system complete, to the Black Hawk Construction Co., Waterloo, Ia., $15,945.

Johnson City, Tenn.—The following water works contracts have been awarded: furnishing pipe, to the U. S. Cast Iron Company, Chattanooga, Tenn., $95,471; laying mains, to F. R. Stone & Co., Oklahoma City, Okla., $42,215; constructing reservoirs, to Oliver & Hill, of Marysville, Tenn., $16,177; constructing intake, to Flynn & Co., Chattanooga, Tenn., $1,000; constructing manholes, to the Central Construction Co., Lexington, Tenn., $235.

Norfolk, Va.—Constructing about 10 miles of pipe line including wooden and iron pipe from 16 inches to 24 inches in size, to Perry W. Ruth & Co., $110,000.

CONTEMPLATED WORK.

Fayetteville, Ala.—Plans are being prepared for the construction of a water works and sewerage system.

Nogales, Ariz.—The city has purchased and is contemplating extensions to the water works system. Purchase price, $60,000.

Argenta, Ark.—Extensive improvements to the water works system are contemplated.

Berryville, Ark.—The Will F. Plummer Co., of Springfield, Mo., has been retained to prepare plans and estimates for the construction of a complete water works system.

Fullerton, Cal.—Sloan & Robeson, San Francisco, Cal., are preparing plans for the construction of a municipal water works system and a complete sewerage system.

Wilmington, Del.—All bids received for the installation of the new turbine wheels and triplex pumps were rejected by the water commissioners and the chief engineer was instructed to prepare new plans and specifications.

Preston, Idaho.—C. H. Reed, Spokane, Wash., is preparing plans for a water works system to cost about $60,000. E. W. Patterson, city clerk.

Central City, Ia.—A bond issue for the construction of a water works plant and distribution system has been voted.

Laurel, Md.—The construction of a reservoir and dam to cost about $1,000,000 is contemplated by the government.

Brookline, Mass.—Constructing water works improvements as follows, is contemplated: 42-inch pipe line 8 miles in length, 2 concrete dams and 4,000 feet of tunnel. R. N. Clark, city engineer.

St. Joseph, Mo.—Extensive improvements at the pumping station of the water company, to cost approximately $178,000, are to be made soon. Chas. H. Taylor, superintendent.

St. Paul, Minn.—A $100,000 bond issue for water works improvements has been voted.

Wolfesboro, N. H.—Chas. H. Bartlett is preparing plans for a water works extension to cost about $13,000.

Collingswood, N. J.—The construction of a municipal water works plant is contemplated. A. B. Rogers, engineer.

Geneseo, N. Y.—A $10,000 bond issue for the construction of a concrete or steel reservoir has been voted. Geo. R. Meeker, superintendent of water works.

Schenectady, N. Y.—An appropriation of $30,000 will be made by the city to install water meters in residences. F. W. Bentley, water superintendent.

Syracuse, N. Y.—George H. Beebee, engineer, is preparing plans for water works extension.

Wolcott, N. Y.—The construction of a municipal water works system is contemplated. C. C. Hopkins, engineer, of Rochester, has been engaged.

Gastonia, N. C.—Water works extensions to cost about $17,500 are contemplated.

Byesville, O.—H. L. Maddocks, 504 Newark Trust Bldg., Newark, O., is preparing plans and estimates for the construction of a complete water supply system, to cost about $50,000.

Hubbard, O.—A $30,000 bond issue for the installation of a water works system has been voted.

Lisbon, O.—A resolution has been adopted for issuing of $10,000 in bonds for increasing the water supply. Mayor B. F. Hennacy.

Senecaville, O.—H. L. Maddocks, Newark, O., is preparing plans and estimates for a $40,000 water works system.

Steubenville, O.—The purchase of 6,000,000 gallon pump has been recommended by Director of Service Gavis.

Youngstown, O.—Reservoir construction to cost about $900,000 is contemplated for the coming season.

Coatesville, Penn.—Alexander Potter, New York City, has been retained to prepare plans and supervise the construction of a complete water supply system.

Pittsburgh, Pa.—Extensive improvements to the water works system have been recommended by director of public service Armstrong. Among the improvements are the following: pumping station improvements, $120,000; pipe line extensions, $543,000; filtration plant improvements, $175,000; additional meters, $60,000; reservoir improvements, $25,000.

Harlington, Tex.—A $21,500 bond issue for water works and electric lighting plants has been voted.

Franklin, Va.—The Phowan Water and Power Corporation has been incorporated for $50,000, by E. W. Cary, W. O. Bristow and G. C. Stephenson.

Kamloops, B. C., Can.—A $60,000 bond issue for water works extension has been voted.

Vancouver, B. C., Can.—Water works extensions to cost about $625,000 are contemplated.

Ottawa, Can.—The city engineer has been directed to prepare plans and estimates for a sand filtration system.

BRIDGES.

BIDS REQUESTED.

Washington, D. C.—March 6. Furnishing and erecting one 100 foot steel truss highway bridge for the Shoshone project, Wyoming. United States Reclamation Service, Washington, D. C.

Jacksonville, Fla.—March 1, 10 a. m. Furnishing and erecting two wooden bridges on the Fernandina road. Gail L. Barnard, county engineer.

Salem, Ind.—March 4, 1:30 p. m. Constructing one concrete bridge. Frank F. Munkle, auditor.

Warren, Minn.—March 2, 4 p. m. Constructing bridges as follows: 12 corrugated steel arched bridges; 40 corrugated steel culverts with concrete bulkheads; 40 small culverts without bulkheads. A. G. Lundgren, Marshall county auditor. J. H. Baugh, engineer.

Carthage, Mo.—March 7, 2 p. m. Bridge construction as follows: Number 1, the Purcell bridge and trestle approach; Number 2, the Moss Springs bridge; Number 3, the Johnson bridge. Certified check $300. William Kohlman, county engineer.

Delaware, Ohio.—March 11, 12 m. Constructing the super-structure of the Worline bridge. Certified check $200. W. H. Whittier, county surveyor.

Lisbon, Ohio.—March 4, 1 p. m. Constructing steel bridge Number 48 over Cherry Fork Creek. Certified check $200. H. B. McCamon, president board of Columbiana county commissioners.

Toledo, Ohio.—March 5, 10 a. m. Constructing complete floor system for a bridge across the Maumee river. Certified check $200. C. E. Stinebaugh, auditor of Wood county. Chas. A. Sanzenbacher, auditor of Lucas county.

Norristown, Pa.—March 12, 12 m. Removing wooden bridge and stone pier and constructing a steel girder highway bridge. Certified check $1,000. Robert C. Miller, clerk Montgomery county commissioners.

Milton, Ont., Can.—March 4, 12 m. Constructing 135-foot reinforced concrete arch and 340 feet of concrete viaduct approach on the Middle Road. Frank Barber, 57 Adelaide st. east, Toronto, engineer.

CONTRACTS AWARDED.

Jonesboro, Ark.—Constructing a steel bridge across St. Francis Lake, to the Vincennes Bridge Co., Vincennes, Ind.

Lake City, Ark.—Constructing steel bridge across St. Francis Lake, to the Vincennes Bridge Co., at $64,900.

Tucson, Ariz.—Constructing stone bridge, to Griffith and Pachao, about $20,000.

Grand Junction, Colo.—Constructing a bridge over the Grand river, to the Patterson Bridge Co., Denver, Colo., $67,215.

Marietta, Ga.—Constructing a bridge over Power street, to the Virginia Bridge and Iron Company, Atlanta, Ga.

Charleston, Ill.—Constructing a bridge across the Ryan ford, to Groggin & Company, Arcola, Ill.

Havanna, Ill.—Repairing a bridge across the Illinois river, to the Joliet Bridge and Iron Co., Joliet, Ill.

Newport, Ind.—Erecting two bridges in in Vermillion county, to the Central States Bridge Co., Indianapolis, $22,043.

Cedar Rapids, Ia.—Constructing three bridges, to the Clinton Bridge Company, Clinton, Ia., $8,250.

Coffeyville, Kan.—Constructing 32-ft. span reinforced concrete bridge over Turkey creek, to Nelson Bros.

New Orleans, La.—Erecting bascule bridge over the New Basin Canal at Hagan avenue, to Midland Bridge Co., $22,900.

Baltimore, Md.—Constructing steel bridge on South Monroe st., to McClintick-Marshall Construction Co., Philadelphia, Pa., $17,575.

St. Joseph, Mich.—Constructing a viaduct at First st., to the Elkhart Bridge and Iron Co., Elkhart, Ind.

Linneus, Mo.—Constructing 14 steel bridges, to the Monarch Engineering Company.

Marion, O.—Building super-structure of the Radnor pike bridge, to Horn Engineering & Contract Co., of Canton.

Portland, Ore.—Constructing Broadway bridge, to the Pennsylvania Steel Co.

Philadelphia, Pa.—Constructing roadway and bridge across Barnegat Bay, New Jersey, from Manahawken to Long Beach, to the General Contracting and Engineering Co., New York City, $75,000.

Aberdeen, S. D.—Constructing four steel concrete bridges and repairing two steel bridges in Brown county, to C. E. Gilbert. Improved Corrugated Culvert Co., Aberdeen, S. D., $12,971.

Chattanooga, Tenn.—Constructing bridges and culverts, to J. P. Nolan & E. F. Malone.

Olympia, Wash.—Constructing sub-structure of the Lewis river bridge, near Woodland, to the Jahn Construction Co., of Seattle, Wash., $16,565.

Olympia, Wash.—Constructing a bridge over the Skagit river, to D. M. Stevenson, Portland, Ore., $29,494.

Seattle, Wash.—Constructing the Patten Bridge, to C. J. McHugh, Seattle, Wash., $13,310.

Woodland, Wash.—Constructing the approaches and piers for bridge across the Lewis river, to the Jahn Construction Co., Seattle, Wash., $60,000.

CONTEMPLATED WORK.

Birmingham, Ala.—Plans for a viaduct on Twentieth st. have been informally submitted to President Exum, of the commission.

Ft. Smith, Ark.—A new bridge over the Arkansas river, connecting Ft. Smith and Oklahoma, is contemplated.

San Diego, Cal.—Constructing bridge over canyon at Nutmeg and Laurel sts., is contemplated. D. K. Adams, superintendent of streets.

Kissimee, Fla.—A $25,000 bond issue for curbing, grading and paving has been voted.

Danville, Ill.—The state highway commission is preparing plans for the construction of an 850-ft. reinforced concrete bridge. A. N. Johnson, state highway commissioner, Springfield, Ill.

Maywood, Ill.—Westcott and Ronneburg, 1107 Security building, Chicago, Ill., are preparing plans for a 200-ft. reinforced concrete arched bridge.

Moline, Ill.—The Henry county board of supervisors have decided to appropriate $30,000 for the erection of a bridge across the river at Colona.

Rock Island, Ill.—The county supervisors have appropriated $30,000 for constructing a new bridge across the Rock river at Colona.

Peru, Ind.—A $12,000 bond issue for bridge improvements has been voted.

Sioux City, Ia.—The construction of a bridge over the Missouri river is contemplated.

St. Joseph, Mo.—Plans and specifications for a system of concrete viaducts in Sixth, Mary and Monterey sts. and Mitchell ave. have been prepared by I. V. Cochrane.

Cranford, N. J.—The erection of a $12,000 bridge over the Rahway river at South ave. is contemplated.

Buffalo, N. Y.—The construction of a bridge across the canal at Ferry st. is contemplated.

Statesville, N. C.—A $400,000 bond issue for highway construction, including a number of steel highway bridges, has been voted. W. S. Fallis, county engineer.

Dayton, O.—E. C. Cummin, city engineer, has recommended the appropriation of $10,000 for the proposed Keowee st. bridge.

Youngstown, O.—F. M. Lillie, city engineer, has prepared plans for bridges to be constructed in Lincoln Park.

Pittsburg, Pa.—Bids will soon be asked for constructing a bridge on Atherton ave., over the P. R. R., at an estimated cost of $100,000.

Memphis, Tenn.—A new bridge across the Mississippi river at Memphis is contemplated.

Fort Worth, Tex.—A $1,600,000 bond issue for road and bridge improvements has been issued by the county commissioners.

Petersburg, Va.—A $212,000 bond issue for bridge construction and street improvement has been voted.

Spokane, Wash.—The construction of steel and concrete bridges to cost about $60,000 is contemplated, for the early spring.

Tacoma, Wash.—The construction of a steel bridge to cost $25,000 is contemplated by the municipal commission.

Milwaukee, Wis.—A $175,000 bond issue for a bridge at Buffalo st. has been voted.

STREET LIGHTING.

BIDS REQUESTED.

Helena, Mont.—March 4. Furnishing 127 one-lamp ornamental lighting posts. Chas. W. Helmick, city engineer.

Cincinnati, O.—March 4, 12 m. Furnishing electric generating machinery, etc., for the village of Madisonville, O. Director of public service, city hall.

Pittsburg, Pa.—Feb. 19, 10 a. m. Furnishing all material necessary to keep in good condition and light the streets, boulevards, alleys, parks, etc., of the city of Pittsburg for a term of five years. William A. Magee, mayor; Joseph G. Armstrong, director, department of public works.

CONTEMPLATED WORK.

Atlanta, Ga.—The J. B. McCrary Co. has been called upon to give advice relative to improving lighting conditions, including a new electrical power plant.

Chicago, Ill.—The Lincoln Park commissioners contemplate extending, boulevarding and illuminating Sheridan road for 30 miles north from Devon ave.

Peoria, Ill.—The city clerk has been instructed to advertise for bids for lighting the streets for a period of years. Lighting extension, including ornamental lights, is planned.

Burlington, Ia.—The Commercial Exchange is securing contracts for an ornamental lighting system.

Coggon, Ia.—A new municipal electric light plant is contemplated.

Manson, Ia.—H. R. Healy, Corpus Christi, Tex., has purchased the lighting plant.

Keokuk, Ia.—Plans are being prepared for installing a curb lighting system on Main st.

Atchison, Kan.—The construction of a municipal light plant is contemplated. C. B. Walker, mayor.

Cumberland, Md.—The construction of a municipal lighting plant is contemplated. Harry L. Smith, commissioner.

Fenton, Mich.—The construction of a municipal lighting plant is contemplated.

Grand Rapids, Mich.—Definite action has been taken and the Retail Merchants' Association is raising the necessary funds for the construction of an ornamental lighting system.

Kalamazoo, Mich.—The installation of an ornamental lighting system is being urged.

Tarkio, Mo.—The purchase of the electric light and water company's plant is contemplated.

Kearney, Neb.—The installation of a municipal lighting system in Kearney is contemplated. Geo. G. Ford, city clerk.

Millville, N. J.—A municipal electric lighting plant is contemplated.

Yonkers, N. Y.—The United Business Men's Association is agitating the question of ornamental street lighting. Kenneth G. MacKenzie, president.

Cincinnati, O.—The installation of a boulevard lighting system in the downtown district is contemplated.

Cleveland, O.—Fred W. Ballard is preparing plans for the new $2,000,000 electric lighting plant. Contracts for the machinery may be let in May. Mayor Baker.

Salem, O.—The Daily Engineering Co., of Alliance, O., is preparing plans for the construction of an electric lighting plant.

Youngstown, O.—The installation of an ornamental lighting system in Federal st. is contemplated.

Warren, O.—The installation of an electric lighting plant for the court house and jail is contemplated by the county authorities.

Porum, Okla.—Kennedy and Fleming, of Oklahoma City, Okla., have been awarded the contract for the construction of a water works and electric light plant to cost $33,000.

Irving, Ore.—The Oregon Power Co. has been asked to furnish electricity for street lighting purposes.

Amity, Pa.—The installation of a street lighting system is contemplated. Dr. W. L. Dodd.

Conneautville, Pa.—A franchise for furnishing electric lights and power has been granted to S. C. Eckels.

Harrisburg, Pa.—A rearrangement of the street lighting system is being urged by the Board of Trade.

McKeesport, Pa.—The installation of cluster lights in certain portions of the downtown streets is being urged.

New Brighton, Pa.—The construction of a municipal lighting plant is contemplated.

Philadelphia, Pa.—The Kensington Board of Trade desires information concerning an ornamental lighting system. A. B. Keeley, president, 2434 Kensington ave.

Uniontown, Pa.—The installation of an ornamental lighting system is contemplated. The Chamber of Commerce is interested.

Beaumont, Tex.—The Beaumont Electric Light & Power Company will construct an ornamental lighting system on Pearl st.

San Antonio, Tex.—The San Antonio Gas & Electric Co. will expend about $300,000 for new equipment and improvements during 1912.

Bellingham, Wash.—The purchase and installation of cluster lights on three streets is contemplated.

Luxemburg, Wis.—The installation of a street lighting system to cost about $4,000 is contemplated.

FIRE APPARATUS.

BIDS REQUESTED.

Iron River, Mich.—March 7, 7 p. m. Furnishing combination chemical and hose wagon. Certified check, $75. James B. Henley, clerk.

CONTEMPLATED WORK.

Los Angeles, Cal.—The purchase of three motor combination pumping engines has been recommended.

Washington, D. C.—An American consul in a foreign country states that cities in his district desire American fire apparatus. Address Bureau of Manufacturers, No. 8157.

The following members of the city council have been appointed to investigate motor fire apparatus: J. M. Vickery, W. E. Crawford and J. P. Edwards.

Southington, Conn.—The purchase of motor fire apparatus is contemplated.

Quitman, Ga.—A $12,000 bond issue for fire department improvement has been voted.

Waycross, Ga.—H. Hengeveld, of the fire and police committee, desires information on automobile fire apparatus.

Salina, Kan.—The purchase of motor fire apparatus is contemplated.

Benton, Ky.—Bids will be asked soon for an automobile fire engine.

Middleboro, Mass.—The purchase of motor fire apparatus is contemplated. Chas. M. Hutchison.

Rockland, Mass.—The purchase of an automobile truck is contemplated.

Wakefield, Mass.—A committee has been appointed to investigate motor fire apparatus with a view to purchase. W. E. Cade, chief and president of committee.

Flint, Mich.—The purchase of a motor-driven combination pump and hose wagon is contemplated.

Rochester, Minn.—The purchase of a triple combination automobile chemical and fire engine to cost about $9,000 is contemplated.

Dunkirk, N. Y.—The purchase of an automobile combination motor chemical and hose wagon is contemplated.

Ogdensburg, N. Y.—A $20,000 bond issue for the construction and equipment of a central fire station has been authorized.

Tuckahoe, N. Y.—The town of East Chester will purchase a fire engine; estimated cost, $8,000.

Scranton, Pa.—$41,000 has been appropriated by the council for the purchase of new equipment for the fire department.

Salem, Ore.—A committee has been appointed to investigate motor fire apparatus.

Saskatoon, Can.—A $94,000 bond issue for storm sewer construction has been voted. E. T. Clark, city engineer.

Nanaimo, B. C., Can.—The purchase of an automobile chemical engine, hose cart, automobile pumping engine, etc., has been recommended.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTRACTS AWARDED.

Aurora, Ill.—Constructing garbage crematory, to the Dixon Engineering and Contracting Co., Toledo, O., $9,316.

Boston, Mass.—Disposal of the city's refuse for ten years, to the Boston Development & Sanitary Co., $1,432,000.

Boston, Mass.—Collecting and removing ashes, etc., in the South Dorchester district to the S. S. and A. B. Gore Corporation, Boston, Mass., $1,540; collecting and removing ashes, etc., in North Dorchester district to the F. S. and A. B. Gore Corporation, $2,037; collecting and removing garbage in the Dorchester district, to the F. S. and A. B. Gore Corporation, $1,881; collectin and removing garbage in the east Boston district, to John E. Lane, $416; collecting and removing ashes, etc., in the Hyde Park district, to Thomas Corrigan, $350; collecting and removing ashes, etc., in the Brighton district, to John McNamara, $990; collecting and removing ashes in East Boston, to Antonio De Sano, $958.

CONTEMPLATED WORK.

Martins Ferry, O.—The city council is considering the construction of an incinerating plant for the disposal of garbage.

McKees Rocks, Pa.—A new garbage disposal plant is contemplated. Louis F. Kellerman, president council.

MUNICIPAL ENGINEERING

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APRIL, NINETEEN HUNDRED TWELVE

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

SAND-CLAY ROADS.

IN THIS and the following chapters we will be concerned chiefly with the construction of the several kinds of wearing surfaces, assuming that the drainage and foundation features have been cared for.

All road users are familiar with the effects of different climatic conditions upon roads of sand and of clay. While the former are at their best when wet and become practically impassable during the hot, dry months, the clay road is in best condition in the summer and is least serviceable in winter. For this reason an effort has been made to so combine these two materials that the resulting surface will give better service than when either is used alone. It has been found that if the intense hardness of the sand grains be used for wearing purposes and the stickiness of the clay be utilized for binding these sand grains together, the road thus formed is hard, smooth and resilient, and very inexpensive. The sand-clay road, then, is a combination of sand and clay in such proportions that every grain of sand is in contact with its neighbor, with the air spaces or voids in the sand just filled with a binder of clay. In order that these conditions may be fulfilled—

1. The sand must be clean and sharp and preferably coarse.
2. The clay must be free from sand and must possess the quality of binding.

It may be further noted that such a surface may be built under either of two conditions, namely:

1. On a sand foundation.
2. On a clay foundation.

Before explaining the different methods of construction it might be well to emphasize the following points: The sole object in building a sand-clay surface is to improve the condition of the road, causing it to more nearly serve the requirements of the traffic. It is therefore to the advantage of the community that the road be improved to the highest state of perfection possible with the materials at hand. And so far as a combination of sand and clay is concerned the whole success of the improvement depends upon the thorough mixing and compacting of the materials in the proper proportions. For this reason such methods will be outlined that will, with the exercise of some judgment, insure the best immediate results.

Sand-Clay on Sand.—under this head we may discuss two conditions: Construction on deep sand and on shallow sand. In the first case it is usually desirable to cover the deep sand with a layer of, say, 10 inches of clay, and then place a sand-clay surface on this in the same manner as on a clay foundation, using a thinner surface coat. A very satisfactory method to use on a shallow sand foundation is as follows:

Determine the width to be improved, say 15 feet. The road is then crowned slightly with a road machine, and shoulders are thrown up at the sides to confine the clay. The clay is hauled and spread carefully over the surface, 6 to 8 inches deep at the center and 3 to 4 inches deep at the sides. This binder is covered with a thin layer of sand. The whole mass is then thoroughly pulverized and mixed by plowing and harrowing. Note that in this case the amount of clay used (an average depth of 4 to 6 inches of loose material) should produce a total thickness of 8 to 10 inches. The materials having been mixed dry, they should be wet by sprinkling and again harrowed. If it is not possible to sprinkle the road, the puddling may wait until after a rain, when it should be carefully done. After this wet mixing the surface is shaped with a grader and thoroughly rolled. As has been noted, the value of the improvement depends upon the intimate mixing, puddling and compacting of the sand and clay.

Sand-Clay on Clay.—Under this condition, after the shoulders are formed as above, the clay is loosened to a depth of, say, 4 inches, and all clods and lumps broken with the harrow. Coarse, sharp sand is then spread to an average depth of 8 inches, spreading somewhat deeper in the center than at the sides. This mass is then mixed by plowing and harrowing, puddled, shaped and rolled.

Another method is to haul the sand when the weather is good, distributing it along the road and applying after a rain, but before the road is cut into ruts. In this manner some labor is saved, but it is questionable if the final results are as desirable, because of the non-uniformity of the mixture. The sand might be dumped upon deep mud and do no harm, but this operation is more costly.

It is to be remembered that the depth and width of improvement depends upon the volume of traffic to be cared for. Furthermore it will be found that the proportions selected are not absolutely correct, and that sand or clay must be added along the roadway to make the mixture uniform. In fact, the construction of a sand-clay road is rather a matter of experiment and development until the two ingredients have been supplied in just the proper proportions; then the construction ceases and the maintenance begins.

For estimating purposes it is customary to test the sand for voids in the following manner: Take two glasses or other measure of equal volume. Fill one with water and the other with the sand to be used. Pour water from the glass into the sand, stirring constantly, until the water is just flush with the top of the sand glass. By observing the water that remains we may estimate the quantity that has been removed, which is the measure of the voids in the sand. The percentage of voids varies with the sand and the moisture it contains.

Any excess of clay over that required to fill the voids in the sand is undesirable, and will mean the application of more sand. On this account and because it is difficult to measure these voids accurately and then thoroughly mix the materials, it is desirable that piles of suitable sand or clay be kept along the road for use when necessary.

The maintenance of a sand-clay road is conducted principally with the road drag, together with the addition of such material as may be required to keep the surface in a uniformly good condition.

Before selecting the clay to be used a careful investigation of all the available pits should be made, and that clay chosen which packs readily, and pulverizes slowly when dry, or softens slowly when wet. A few simple tests will suggest themselves for this determination. A ball of clay may be placed in a glass of water, and its behavior noted. The longer it holds its shape the better suited it is for the purpose. Immediate slaking may indicate the presence of sand, which is undesirable. Another ball of clay placed on a glass should not crumble readily when dry; and when mixed with the sand in the assumed proportions, should show few, if any, cracks.

It might be well to state here that when a sand-clay road shows cracks, these cracks must be immediately filled with sand. This may usually be done by using the drag. The supervisor must understand that in this, as well as in other highway improvement, the value of the result depends largely upon the exercise of judgment in adapting the method to the conditions and upon his patience, care and perseverance.

The crown of a sand-clay road should be approximately the same as for earth roads, ¾ or 1 inch per foot. The bottom of the side ditch must be at least 20 inches below the center of the roadway

The cost of this construction varies with the local conditions. These roads have been built for 10 cents to 17 cents per square yard. It is probable that an eight-inch, fifteen-foot surface, constructed as outlined above, may be built under average conditions for one thousand dollars ($1,000) per mile. These roads are always cheaper than macadam, and, except on a clay base where gravel may be had easily, are cheaper than gravel. In fact, many of the so-called cheap gravel roads are in reality expensive sand-clay roads, the gravel taking the place of the sand.

Combined Electric Light and Water Works Plant at St. Marys, Kansas.

By Frank C. Perkins, Buffalo, N. Y.

DURING the past year nearly forty municipal electric lighting plants have been installed in the state of Kansas, where a state law has been passed allowing the state school fund to purchase the municipal bonds required for the construction of these water works and electric light stations. In the state of Oklahoma an even greater number of municipal electric light plants and water works have been erected during 1909. The accompanying illustration shows the electrical end of a typical installation of this type at St. Marys, Kansas, using fuel oil in the boilers for generating the steam and doing away entirely with the inconvenience and expense of handling the coal. The electric plant consists of two direct connected high-speed engine generator sets with exciters belted to pulleys on the extended shafts of the alternators outside of the main bearings. The electric installation is in duplicate, the switchboard and electric generator set being mounted in a separate room from the pumping plant.

The street lighting of the town of St. Marys is equipped with series tungsten lamps which give a pure white light, instead of the yellow rays of the ordinary carbon filament lamp, and at one-third the operating cost of the latter.

The boilers are operated with great economy in labor on account of the use of fuel oil, which is supplied in carload lots at 1⅞ cents per gallon, delivered into the city's storage tank at the station, which has a capacity of two carloads of oil.

The pumping plant consists of two horizontal compound duplex pumps, located in a brick pump pit and connected with the main suction pipe, which is installed in a brick tunnel connecting the three wells, which are about 40 feet deep. The water supply is taken from these wells, which are away from the drainage of the city, west of St. Marys. Cast iron mains are used throughout the city for distribution, domestic and fire pressure being secured from an elevated storage tank or from direct pressure. This station is operated most economically, giving both electric lighting service and water service at minimum cost, on account of the combining of the service to the greatest advantage in low first cost of plant, and therefore reduced fixed charges, as well as low maintenance cost and operating expense, the same labor being utilized for attending the lighting and pumping installation.

ELECTRIC LIGHT AND WATER PLANT, ST. MARYS, KANSAS.
Electric Generators and Switchboard.

Proportioning Gravel Concrete.*

By Clifford Older, Springfield, Ill.

THE bridge work of the Illinois Highway Commission involves the use of concrete under the greatest variety of conditions imaginable. The quality of concrete required varies from that necessary in massive plain concrete abutments and retaining walls to that required for light, thin reinforced floors for steel bridges.

The conditions under which concrete is built vary throughout all seasons of the year, and the location of the work may be in a city with ample transportation facilities, or it may be 20 miles from a railroad with dirt roads and 10 per cent. grades intervening.

The quality of available aggregates may be the best of crushed limestone and coarse river sand, or it may be gravel of infinitely varied character. The quantity needed for the work may also be anything from a few cubic yards to several hundred or even thousand cubic yards.

Handling the construction of a large number of concrete structures under greatly varying conditions made it necessary to devise a set of specifications for concrete work which would provide for concrete of satisfactory quality under all conditions and yet be elastic enough to permit the use of a considerable variety of aggregate.

When the bridge is located comparatively near a railroad station, it is frequently possible to secure broken stone and sand at a reasonable cost. Many county highway bridges, however, are located perhaps 5, 10 or 15 miles from a railroad, in which case, if broken stone and sand were required, the cost of concrete structures would be beyond the reach of many communities.

Gravel.—The admission of gravel for aggregate permits the economical use of concrete in practically all Illinois townships, however remote from stone supply. Gravel as nature provides it has, however, an infinitely varied mixture of sand, pebbles and stone. Gravel as known to local highway officials and to most contractors may, in some cases, contain stone from 3 inches in diameter down, and in others it may be a material all of which will pass through a ⅜-inch or even a ¼-inch screen. It is all popularly known as gravel, and the standard mixture is 1 part of cement to 6 or 7 parts of gravel.

The abuse of gravel concrete in small country highway work is astonishing. One local contractor, who was building a small bridge, insisted that a proportion of one of cement to six of gravel meant one sack of cement to six wheelbarrows of gravel.

The specification adopted provides for the use of broken stone and sand when available by stating the number of parts by volume of each ingredient. Screened gravel is treated in the same way. Unscreened gravel is also permitted under certain conditions.

The clay or loam content is limited by the specifications to 2 per cent. of the sand. But few natural gravels will satisfy this requirement. Larger percentages are frequently allowed if the gravel is otherwise of good quality.

To secure the necessary strength, the cement is proportioned according to the amount of sand contained in the gravel, sand being defined as that part of the gravel which will pass through a ¼-inch screen. The only requirement as to the relative proportions of sand and stone in the gravel is that the volume of sand must not fall below six-tenths of the volume of stone. Any gravel, therefore, having a sand-to-stone ratio greater than 0.6 may be used without modification, but for gravel so used the cement-to-sand ratio must be constant for a given class of concrete.

This provision permits the use of practically all gravels composed of satisfactory material. The resulting proportions stated in the usual form may vary, for a certain class of concrete, from 1 part cement to 2¼ parts sand and 4 parts of stone to a mortar mixture of 1 part of cement to 2½ parts sand.

This method of proportioning is based on the assumption that if the sand and the stone are of satisfactory quality, and the ratio of sand to stone is equal to, or greater than 0.60, the strength of the concrete will be satisfactory, providing the ratio of cement to sand, or, in other words, the mortar is always maintained constant for a given class of concrete.

Specifications for broken stone and gravel concrete require for class X concrete 1 part cement, 2 parts sand and 3½ parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1-inch ring; for class A concrete 1 part cement, 2½ parts sand and 4 parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1-inch ring, and for class B concrete 1 part cement, 3 parts

*From a paper before the Illinois Society of Engineers and Surveyors.

sand and 5 parts rock broken to pieces which will be retained on a ¾-inch screen and which will pass a 2½-inch ring.

Gravel may be used in the place of broken stone and sand for concrete if it consists of clean, hard and sound stones, pebbles and sand, having a reasonably uniform gradation from the coarsest material allowable for the work specified to fine sand.

In proportioning gravel concrete, frequent tests are made to determine the proportion of sand to stone. For class X and class A gravel concrete all material which passes a ¼-inch screen and passes a 1-inch screen is considered stone. For class B gravel concrete all material which passed a ¼-inch screen is considered sand and all material which is retained on a ¼-inch screen and passes a 2½-inch screen is considered stone. For any of the classes of concrete, should the volume of sand so found be less than 60 per cent. of the volume of stone, sufficient sand must be added to bring up the proportion. Should the volume of sand be more than 60 per cent. of the volume of stone, stone must be added or sufficient cement so that the volume of cement to sand shall be for class X concrete as 1 to 2; for class A concrete as 1 to 2½; and for class B concrete as 1 to 3.

Pit-run gravel is defined as a mixture of sand and stone.

Sand is that part of pit-run gravel which will pass through a ¼-inch screen.

Stone is that part of pit-run gravel which will be retained on a ¼-inch screen and which will pass through a screen of the size indicated for the given class of concrete.

Sometimes it is convenient to proportion gravel concrete by relative volumes of cement and total aggregate. To determine this relation, first compute the number of sacks of cement per cubic yard of the aggregate as it is to be used in the mixture; then the volume in cubic feet of cement per cubic yard of aggregate equals 0.95 of the number of sacks and the proportion of cement to aggregate equals 27 divided by this quantity.

It is often cheaper to resort to screening in order to obtain the stone necessary to modify the gravel to the 0.60 ratio than it is to add cement or purchase broken stone.

With cement at $1 per barrel on the ground and 30 cents as the cost of screening 1 yard of gravel, assuming that the gravel is free at the pit or that it is necessary to purchase only the amount of gravel hauled away, it will be seen that screening is cheaper than adding cement up to where proportion of same is 0.90. With the cement on the ground at $1.50 per barrel and screening at 30 cents per yard; gravel being free at the pit or the material hauled away only being paid for, there is a very marked saving in cost by screening up to a proportion of sand of 0.93 over the method of adding cement.

With cement at $1.50 per barrel, screening at 30 cents and gravel at 40 cents, all gravel screened as well as that hauled being paid for at this rate, it is still cheaper to screen the gravel in order to find stone to add than it is to add cement up to values of sand ratio of 0.85.

With cement at $1.50 and broken stone at $2 per yard delivered at the bridge site, the adding of broken stone is cheaper than adding cement, cheaper than screening if all gravel handled must be paid for at the rate of 40 cents per cubic yard, and is cheaper than screenings alone for values of sand ratio larger than 0.8.

A Typical Example.—An example of a case where the method of adding cement proved the cheapest for proportioning follows:

A bridge located about nine miles from the nearest railroad station required about 350 cubic yards of class A concrete. Cement was delivered at the bridge site at cost of $1.35 per barrel. At the site of the bridge occurred a deposit of gravel containing but a small amount of stone, the sand, however, being of excellent quality. The gravel was had at the cost of shoveling it into wheelbarrows. Broken stone at the nearest railroad station would have cost $1.75 per cubic yard, and the haul on account of the grades would have cost $4 per cubic yard, making the cost of broken stone at the bridge site $5.75 per cubic yard. The gravel in the creek bed tested 0.93 sand and 0.12 stone.

Using the gravel as it occurred in the creek bed required the use of 2.60 barrels of cement per cubic yard of concrete, the cost at $1.35 per barrel being $3.51 per cubic yard. Had broken stone been added, it would have been necessary to purchase about 0.7 cubic yard per cubic yard of concrete. This would have cost at the bridge site $4.02. The cement necessary would have been reduced to 1.2 barrels and would have cost $1.62 per cubic yard of concrete. The cost of cement and stone per cubic yard of concrete would have been about $5.64. The saving per cubic yard of concrete effected by adding cement at the rate of 1 of cement to 2½ of the contained sand amounted to $2.13. As there were 350 cubic yards used, the total saving amounted in this case to $745. The resulting concrete appears to be excellent.

Screening was out of the question, as to obtain the stone required would have necessitated screening nearly 1,800 cubic yards of gravel, and the visible supply was much less than this.

In general the specification for gravel concrete herein described, which has been in use by the Illinois Highway Commission for several years, has resulted in satisfactory concrete, and made concrete structures available in many places where the cost would have been prohibitive had a fixed ratio of sand to stone been required in all cases.

Electric Wire Conduits at Westfield, Mass.

By Henry D. Jackson, C. E., Boston, Mass.

ON the 4th day of May, 1910, the town of Westfield, Mass., at a regular town meeting, elected a committee of nine men to serve as a committee on the repaving of Elm street and Park Square in the town of Westfield, Mass. This committee was also authorized to investigate, and if deemed advisable, install an underground system by means of which the wires of the municipal plant would be put under ground. Also to install an entire new lighting system for the district to be repaved. This district composed the main street of Westfield from the river to and including the streets around the park in and about the centre of the town. This required the placing underground of three arc circuits, two lighting circuits, and one power circuit, or the removal of at least 16 high tension wires from the main streets, as well as the secondaries and the transformers.

A careful investigation of the situation showed that the best method was the installation of a wire house or terminal house on the dyke at the southerly end of the bridge across the Westfield river, fairly close to the power station. From this terminal house a 12-duct conduit was carried in a southerly direction through Elm street to the junction of Main street. At this point it changed from 12-duct to 8-duct up Elm street to Court. The section down Main street was 12-ducts and Broad street was 8-ducts. At each street crossing, a manhole was located, with a section of conduit running down each street to a sufficient distance to keep the general neat appearance of the main street unobstructed. At various other locations distributing boxes and conduits were located in order to distribute the current from the main ducts to buildings, or alleyways which could not be dignified by the name of streets. At the end of each distributing duct a junction box was located, to enable the wires to be drawn from the ducts to the pole conduit.

The main line of conduit has entrance only at the manholes and terminal house. The distributing boxes are located with reference to the top four ducts, and have physical contact only with these ducts. The entire main conduit, and general line of distributing conduit, was made of standard section Camp tile, either 2, 4 or 6-duct, laid in concrete, and thoroughly protected in a 3-inch wall of concrete on either side, as well as on the top and bottom. The ducts for the arc light poles are of section round tile pipe 4 inches in diameter, as are also the ducts in the terminal boxes to the pole conduit.

The manholes are all standard dimensions, 5 x 5 square. All manholes, where feasible, are drained to the sewer. The distributing boxes are 30 inches square, and of varying depths, depending upon the number of ducts entering, the standard width being 4-ducts. The terminal boxes, where necessary, are round, 22 inches in diameter at the bottom and 26 inches in diameter at the top, being 12 inches deep inside. Both service boxes and manholes are provided with solid cast-iron covers.

The specifications covering this work were made as complete as possible in every detail, covering all precautionary sections usually covered in municipal work for the protection of the town, also for the protection of both contractor's employes and the townspeople. The specifications were carefully divided into sections of various characters of work done, each section being completely covered in its entirety with reference to the material used and the method of using it. The prices were obtained for each individual item, also as regards the total estimate of work to be done and unit prices per foot of duct, per terminal box or per manhole.

The contract for the installation was let to the Safety Insulated Wire and Cable Co., of New York, and was satis-

CONDUIT WORK IN WESTFIELD, MASS.
Terminal House with Pole for Distributing Lines.

factorily accomplished. The terminal house was not included in first contract.

During the time conduit was being installed, the committee investigated the different types and methods of street lighting at present in use; and finally decided to use the luminous arc or magnetite arc for the Main street, with a few series incandescent on the same circuit, current for these being supplied from tub transformer and mercury arc rectifier.

With the idea that it was good business to make the entire system as neat and attractive as possible, considerable attention was paid to the type of poles, and final decision was for the iron ornamental pole shown in the accompanying photograph cf Elm street after removal of wires. These poles are set in concrete at frequent intervals along the main street, park, etc. The lamps are carried at approximately 25 feet above the street, and with the number of lamps installed, Westfield should have a main street as well lighted as any city or town in the country.

The cable installation was under a second contract and specifications, and was also secured by the Safety Insulated Wire and Cable Co. This contract also included the installation of the pole ducts, and the setting and wiring of the arc light poles. The specifications drawn up for this work called for either varnished cambric or varnished paper insulation, alternative bids being requested. After a careful deliberation of the prices submitted, it was decided that the paper cable was for the price most satisfactory, and paper insulation was selected. The specifications were carefully divided into a large number of sections, in order to get accurate figures on not only the cost of the various materials, but the labor involved in its installation. In all there were some 26 items, including furnishing the different characters of cable, for installing the same, for making taps, all joints being included in the installing of the cable, for furnishing cutouts, for furnishing and installing castings for connecting the conduit to the arc light poles, for installing the various characters of service outlets, for furnishing and installing the pole terminal fittings, such as V V fittings and potheads, for furnishing and installing hangers in the manholes, for furnishing and installing the protecting listing on wire in manholes, terminal boxes and distributing boxes, and for furnishing the necessary transformers and instruments and making the test. These various items were carefully covered in the specifications, both as regards the quality of the material supplied, work done, and method of using material. Also all necessary clauses for protecting the town and contractor were

CONDUIT WORK IN WESTFIELD, MASS.
Installation of Wires to Street Lamp. Transition from Lead Cable to Rubber Covered Wire. End Bells will be Filled with Paraffine.

carefully inserted in accordance with the standard form of contract used by the town of Westfield.

The drawings in connection with these specifications were made as complete as possible, the location of each wire or cable being carefully indicated in each duct, also where the joints were to be made, and how the cables were to be drawn from the main line duct through to the distributing ducts to and up the poles. The power and light cables in the main section through Elm street to Main street are No. 0 wire. The laterals are No. 4 and No. 6. The circuit from Main to Court street is No. 4, down Main St. No. 2, and down Broad street No. 4. All of this cable is standard 3,000-volt paper insulated cable, with standard thickness lead sheath, and was tested for 4,800 volts for thirty minutes. All cable is of stranded wire and single conductor.

The arc light cable is No. 6, solid, 8,000-volt, standard cable, and was tested for 12,800 volts for thirty minutes.

The two cables composing one side of the two-phase circuit are pulled into the same duct, and the two wires composing an arc circuit are pulled in the same duct wherever feasible. The wires when leaving the terminal boxes for poles, are carried through fibre or iron bends, depending upon whether there is more than one wire in the conduit or not. Where more than one wire is used, iron pipe is installed. Where single wire is run, a fibre pipe is used. The iron pipes are carried from the terminal boxes up the poles to a height of at least 10 feet above the ground. From this point to just below the lower arm, the conduit is composed of Orangeburg fibre. At the top of all of these ducts is placed a V V fitting, from which the wire is carried by a smooth curve to a Davis pothead, which is fastened to the lower arm, the junction to the different circuits being made at this pothead. This construction makes a very neat and attractive appearance, and is thoroughly effective as regards the protection of the cable, besides allowing the ready removing of the line from the cable by taking off the pothead cap at any time.

The arc cables are carried from the conduit to a short circuit switch in the base of the pole, at which point cable sheath is grounded to the pole. The wiring in the pole itself is composed of a twin conductor solid No. 8 rubber-insulated wire, which is carried from the cutout switch to the cutout suspended with the lamp.

ELM STREET, WESTFIELD, MASS.
View After Installation of Conduit and Lamps and Removal of Overhead Wires.

In order to bring the wires from the power station to the cable, a terminal house was installed on the dyke near the Westfield river. In this terminal house are located the choke coils for protecting the cable, also fuses and switches, which will enable the cable to be cut out at any time without affecting the rest of the circuits. The illustrations show with more or less distinctness the construction of the cable house and its appearance after completion, with the terminal pole from which the wires run to the house. They also show the junction of the lead cable to the rubber-covered cable at the base of the arc light pole, as well as the appearance of the streets after the installation of underground service.

The entire layout of this work—both constructions, including plans, specifications and form of contract—was drawn up by Messrs. Sprague, Keyes and Jackson, engineers, 88 Broad street, Boston, who also supervised and inspected the work at frequent intervals. The general construction work was supervised by the town engineer, Mr. Oren E. Parks, and his assistants.

The Meadow Boulevard to Atlantic City, N. J.

Editorial Correspondence.

NEW JERSEY has a hard surface road which has been built upon a foundation as treacherous and unstable as the material known as "quicksand." This road, the "Meadow Boulevard," connects the sand-bar island, upon which Atlantic City is built, with the main land; taking a course across the salt marsh flats, where previous to that time there had been a toll road in service only under favorable conditions of wind and tide

The first railroad to Atlantic City, the Camden and Absecon, had a terminus at the edge of the meadows, or marshes. This was afterward extended over the more solid portions of the flats to the island. The railroad ties were laid without ballast upon stiff sod which floated on the mud beneath. Train schedules were uncertain as storm tides frequently interrupted travel for days. The increase in weight of locomotives and the uncertainty of operation finally caused the railroad to build a more permanent road bed, bringing sand from some distance to obtain a fill which would displace the soft mud until sufficient bearing surface was obtained to give the desired results.

A wagon toll road of the corduroy type had been constructed between Pleasantville and Atlantic City. This structure in reality floated on the mud of the meadows and occasionally the sinking of the entire surface made necessary the expensive hauling and placing of gravel from the mainland. The construction of a state road from Camden brought a great deal of traffic to the toll road and it became a paying investment, as will be understood from the fact that though the distance was less than 4 miles a charge of sixty cents per team for each round trip was made. When it was proposed to construct a state road across the marshes a great deal of opposition was made by the toll road interests, but the purchase of the road for use as a right of way by a trolley line finally disposed of this opposition.

A survey was accordingly made and a right of way, one hundred feet in width, was obtained and the actual construction work was undertaken in 1903 under the direction of Robert A. Meeker, state supervisor of roads, with J. J. Anderson, county engineer of Atlantic county, in charge. The length of the roadway constructed was 3.58 miles.

Soundings taken along the right of way showed that the semi-liquid mud varied in depth from six feet to twenty-eight feet and the surface was covered in most places with a salt marsh grass sod varying in depth from two to four feet in thickness. Below this was found a layer of hard pan which in a few places was only about four feet thick. Below this was a seemingly bottomless stratum of soft mud. This was particularly true at the points where it was decided to construct bridges to allow for the thoroughfares and bays from the ocean.

Pile bents were constructed to support the approaches to these bridges. These piles were put down by water jet and hammer combined. They were driven to a depth of about thirty feet as at about thirty-five feet all resistance to the hammer ceased and the piles sank indefinitely.

After the road was definitely located, sod banks were constructed, five feet six inches high, twelve feet wide at the base, and two at the top and with the growing grass side out. The inside edges of these banks were sixty feet apart and formed the outer boundaries of the roadway. The sod was taken from between the walls as it was found that as the fill was placed between them, the weight displaced the mud to such an extent that in a number of places the crust without the walls was raised.

After the walls were finished a mixture of sand with about 90 per cent. of water was pumped by hydraulic dredges for a distance of about one-half mile or more, and discharged between the sod walls. The sand settled and the water ran back into the bay. As this settlement continued the mud was displaced until the roadway rested upon the hardpan or until an equilibrium was established and the sand, spread to an umbrella-like cross section, formed a surface capable of supporting the fill and roadway. After the sand fill was completed to a height of about six feet above the level of the meadows, a coat of gravel was applied and the roadway was leveled and given the proper curvature. A substantial railing was erected at each side of the boulevard and the road was thrown open to traffic which has continued without interruption by the tide since 1903. The method of construction here used has since been adopted in a number of cases for shore road building.

The gravel which formed the top of the roadway was of excellent quality having sufficient clay to make a binder, causing it to form a closely knit surface which has required some maintenance each year, but which under the exceptionally heavy traffic has given very good service. The Meadow Boulevard forms the only roadway connecting the great seaside resort, Atlantic City, with the mainland. It is the last link in the great highway from Philadelphia to the sea; and by reason of the great numbers who come across the country to Atlantic City, it carries an automobile traffic alone of over a million and a half vehicles each year. In addition to this class of traffic there is a great market gardening business due to the number of hotels, and the market stuff is hauled in wagons which are horse drawn; so that the road has to withstand combined horse and automobile traffic of the most severe type.

By reason of the cost of maintenance due to the exceptionally heavy traffic, the county board of freeholders of Atlantic county decided to construct some more permanent surface for that portion of the boulevard adjacent to Atlantic City. Accordingly a contract was let for the resurfacing with Warrenite the portion near to Atlantic City, for a distance of 0.6 mile, and the roadway was constructed under the direction of E. D. Rightmire. Great care was taken in the construction, due to the width of the roadway, fifty-eight feet, and the small crown allowed. The accompanying photograph shows the excellent condition of the surface at the present time.

After the preparation of the subgrade a six-inch rolled layer of 2½-inch trap rock was spread and a binder course of stone screenings and gravel was added. Upon this foundation was placed a two-inch layer of Warrenite surface, which consists of graded stone mixed with Warrenite bituminous cement. This layer was thoroughly rolled and compacted and a flush coat was added. The addition of stone screenings and thorough rolling completed the roadway.

The resulting road is as hard and smooth as a city asphalt street and thanks to the careful supervision and attention to detail there is excellent drainage and no pockets are afforded in the comparatively flat surface for the retention of water.

MEADOW BOULEVARD ROAD, ATLANTIC CITY, N. J.

Water Meters, Mains and Service Pipes from the Financial Standpoint.*

By Willis J. Spaulding, Commissioner of Public Property, Springfield, Ill.

A YEAR ago next April our city passed an ordinance requiring all services to be metered within two years. On March 1st last we had about twenty-two hundred meters in use. March 1st, this year, we had about five thousand in use. Our daily pumpage has been steadily decreasing, and we have been able to supply the city from our wells regularly for the past six months. While we had to meet a good deal of prejudice in the start, I think it is safe to say that fully three-fourths of our consumers are satisfied, and more are being converted every day. I am told that in one large city the past season the supply to all residences was cut off at the curb key to save the water for fire protection. Later the installation of meters was begun. Had this city been on the meter system probably this drastic measure would not have been necessary.

It is only necessary to make the patrons understand that conservation means in the end lower rates and better service for them. The proposition is simple. For example, if ten million gallons are pumped through the mains, and only five millions devoted to legitimate use, the five millions of waste must be added into the bills of consumers the same as if they had used it. If those five millions which were wasted were sold, it is obvious that the rates could have been reduced fifty per cent. and the water department still have received the same gross income, less the cost of additional mains.

One matter that should not be overlooked with reference to the meter system is that a meter is a machine and will get out of order. A water system had better not be metered at all, at least from a revenue standpoint, if the meters are to be installed and then allowed to take care of themselves. I think it is a serious mistake for the consumer to own the meter. The water department should own, install, and take care of them, and so keep its records that it can know the history of every meter from the time it was installed down to date. Our experience is that meters seldom get fast, but continually become slow. In the past summer we started a test of all meters which had been in service more than two years. The test was made at the premises. These tests showed that about four meters out of five were from five per cent. to ninety per cent. slow. It should be explained, however, that these meters had been in for from two to twelve years. Most of them had been in service eight or ten years. To illustrate, we removed a meter which had been yielding seventy-five cents per month in revenue, and replaced it with an accurate one. The revenue at this place rose to thirteen dollars. Reference to the ledger showed the registration had been gradually falling off for several years. Of course, the consumer feel greatly aggrieved and assumed that he was being robbed, but was finally convinced that he was wasting a great deal of water and by a change of management cut his bill down to about four dollars per month, which in his case, might be considered normal. This is only one of many similar cases. I think it is safe to say that on all meters that had been in more than eight years we were losing forty per cent. in income on the average. Tests for accuracy should be made at regular intervals not more than two years apart. We expect to follow up the work of installing and complete it this summer.

In our city, as in many others, free water was given to various institutions from the beginning, and these were added to from time to time, until we had a great many such consumers. We have a park system which is provided for by State law. The revenue is provided for by a special tax levy. It is no more fair for the water department to furnish them water free than to pay for the park policemen. The water department is no more obliged to furnish the public schools free of charge than to pay their janitors. It is no more entitled to furnish the cemetery with water than to pay the grave digger. In our city we have put these and a number of other free consumers on the pay list. At one school building when the meter was first installed the consumption was at the rate of about seventy-five dollars per month. This, of course, was largely due to leakage.

In this matter of free water there is a question of equity which is often over-

*From a paper before the Illinois Sanitary and Water Supply Association.

looked in municipal management. It is assumed that a water plant should be self-sustaining, and on this point there is no argument. If the funds of the water department are diverted to other uses, it is obvious that in that case water consumers are being made an object of special taxation indirectly through the water rates. For instance, suppose that the water rates were placed high enough so that the revenue would not only support the water plant, but would pay the cost of maintaining the fire department also. Then a citizen would be taxed to support the fire department, not in proportion to the property owned, but in proportion to the water he used, and a substantial portion (say one-half of his water bill) would really be a charge for fire protection, and fire protection for the whole city would be paid for by water consumers, while nearly one-half the people enjoy the same protection and pay nothing. The furnishing of free water is only another method of diverting the funds of the water department away from their proper channel, and to that extent an unfair burden is being placed upon those who pay for water. On account of its importance from a sanitary standpoint, we can not fail to see the urgency for promoting the general use of a public water supply, and the most certain way to do this is by making it as cheap as possible. A city cannot be made beautiful or sanitary until every working man can enjoy the advantages of city water. In our city only a little more than half of the residents are water takers, and one of our problems is to increase the number.

The matter of water rates, however, is of no greater importance than the necessity of making the service easily available. That is to say, the distributing main must be accessible to the prospective consumer, and the installing of the service pipe should be made as easy and inexpensive as possible. Home builders can not take city water if there is no main within reach. At the same time any water department can easily bankrupt itself by draining its resources for water main extensions from which there is insufficient revenue. One of the problems now before our water department is the question of how best to provide revenue for extensions. In the past we have been meeting this expense from the revenues. In a prosperous and growing city the cost of water pipe extensions commonly amounts to about twenty-five per cent. of the gross income.

There are three ways in which this expense may be met: from water revenues, by bond issues, or by a special assessment against the frontage. In the first instance water consumers foot the bill directly; in the second it becomes a permanent interest bearing obligation against water patrons. By either of these two methods it must be provided for in the rates. By the third method it is paid once for all by the owners of the property benefited, and in that case the rates for water could be reduced approximately twenty-five per cent., and at the same time leave the department the same net income. In the past two years we have had some large additions laid out in the residence part of the city. These additions were not available as home sites without city water. Since there were no consumers immediately to be had the water department refused to make extensions. The owners of the additions concluded to lay the mains at their own expense, and the argument to justify the expenditure was as follows: Investment for water pipe in front of these lots would amount to about $14.00 for each forty-foot lot; for the expenditure of $14.00 on the lot its value was enhanced at least double that amount, so that as a matter of fact the investment in water pipe paid a profit of one hundred per cent. to the owner of the frontage. As the lots were sold the real estate dealer received the money he had invested in the pipe, together with one hundred per cent. profit on it, so that the water department surely could not be said to be in debt to him. Therefore, no refund was made. Now under the old method of paying for the water pipe from the water revenue the lot owners would have collected the value of the water pipe from the home builder just the same. The home builder who improved the lot by putting a house on it would probably proceed to pay for the water pipe in his water rates as soon as he had become a water consumer, notwithstanding that he had already paid for the pipe twice over when he bought his lot. This would seem to be a ridiculous inconsistency which penalizes the home builder in favor of the lot owner, and at least in the case of municipal ownership could just as well be avoided. The cost of sewers and of pavements is acknowledged as a legitimate charge against the frontage and is paid for accordingly. The value of a water main in front of a lot is much more certain and tangible than sewers or pavement, because there is scarcely any business or purpose for which the lot could be used that water would not be necessary or desirable. It is like bringing an ever-flowing spring, and flowing under pressure, within reach of the lot, and though a resident may use no water at all the fire protection means an annual saving in insurance. It is perfectly natural that a real estate owner should capitalize the value of a water main and charge it to the home builder who buys the lot, just as he would charge for a sewer, a pavement, or a boulevard. Therefore, what is more logical or fair than to require him to pay for the main in the beginning, since he gets the money back with perhaps one hundred per cent profit?

Charging water pipe to the frontage is not new in this state, and is quite general in Minnesota, but there they have a method of spreading the cost over a period of ten years, collecting the amount with the regular tax assessment, which makes the annual charge so small that it is scarcely noticed and makes the collection in a very inexpensive way.

The advantages to a city of some such method are far reaching. Under such a plan water pipe would be extended in all directions as new additions were laid out, instead of being held back until such time as there are enough consumers to make the extension profitable, thus avoiding the unfortunate necessity of compelling many home builders to provide themselves a well and outhouse on their lot. Finally when the main is extended, often a large number of residents have become settled and satisfied, and will not put in the service. Many persons in planning a new house will put in city water but the same persons would not rearrange an old house. This method accomplishes three things of vital importance: first, it makes the water available to those who want to use it; second, it reduces the cost of water in two ways, namely, by relieving the water department of the cost of extensions, and by greatly increasing the number of patrons; third, and above all, it is the most equitable plan yet devised.

A weak feature commonly found in the administration of public water works is that the installing of service pipes is done by the plumbers. In our city it has cost from thirty-five to fifty dollars to install a service pipe. This is about double what it would be if the department did the work at actual cost. A water plant should expect to earn its revenues from the sale of water, and should therefore be interested in making it as easy as possible for citizens to obtain the service. With that idea in mind our city council introduced an ordinance providing that all services shall be installed by the water department at cost, and by this means we are enabled to make a uniform charge which applies to both the long and short services alike so that the resident who happens to be on the long side of the street will have to pay no more than if he were on the short side.

Sewage Sludge Disposal.

By I. Batley, Late Superintendent of Sewage Works, Bradford, England.

THE disposal of sewage sludge in England is a problem which is now having serious attention by city engineers and others in charge of municipal sanitary arrangements. The writer's intention in this article is to give an outline of the methods adopted at various works in experiments made to dispose of sewage sludge economically. At the works at Frizinghall, which treat the sewage of the city of Bradford, the raw sewage is of a very complex nature, owing to the large quantity of waste water which comes from the various industries, comprising wool combing, dyeing, brewing and a host of other trades.

The dry weather flow is about 15,000,000 gallons daily. This passes over a series of tanks which collect all the heavy matter, and then through revolving screens, which collect all the waste paper, water closet refuse, etc. Sulphuric acid is then added in just sufficient quantity to "crack" the water, which passes over a series of fifteen precipitation tanks. The sludge with the grease in combination falls to the bottom and when the tank is full the water course is turned.

The resultant sludge, containing about 80 per cent. water, is then run by gravity into a large ram, where it is then pumped up into the presses, the grease and water running away all the time.

The cake, when it leaves the presses, contains about 30 per cent. moisture, and 15 per cent. grease left in. The calorific value compared with coal used on the works is about half. A number of experiments have been made to effectively deal with the quantity of cake made (about 40 tons per 24 hours), a few of which will be of interesting description. At one time the cake was crushed into small pieces and fed into a series of eight D-shaped retorts, heated underneath by a generating furnace. Superheated steam was blown through the cake as it was scraped slowly on by a chain belt with iron scrapers attached.

The fatty matter passed off at the top and was drawn through condensers and afterwards refined. The grease was of poor quality, owing to the quantity of tarry matters that also came over with it. The plant itself was not a success. Depreciation and repairs were expensive items, and eventually it was thrown on the junk heap.

Successfully to burn the cake, also to avoid using as much coal, with which it had to be mixed before burning, it was decided to gasify it in a twin gas producer and use the gas for firing a water tube boiler, with the ultimate idea of also recovering the nitrogen as ammonia.

Although the scheme had merits, the difficulties were numerous. Chief amongst these was the ash, which clung to the corners of the brickwork lining of the producer and gradually built up until it formed a solid mass in the chambers. The gas was of good value and was ignited under the boiler for generating steam. As the control over the gases was not effective, the pressure in the boiler was very erratic and could not be relied upon to supply the works with steam with regularity.

This plant was also passed as of no further use, but not before it was thoroughly demonstrated that it would not be of practical use.

The water tube boiler was then fitted with a chain-grate stoker. Sewage cake in proportion to coal was burnt here., three tons of cake to four tons of coal being used. This was fairly satisfactory, nevertheless the question of burning all pressed cake and no coal was never lost sight of, and to this end, with a view to removing the remaining moisture in the cake, a large rotary drying machine of American make was installed. This machine did its work well. The wet cake, partly crushed, was fed in at one end and left at the other in fine dry powder. A trial run in burning the powder on the chain-grate stoker which had been installed was sufficient to prove that there was no advantage in burning it, as the fine powder formed one solid mass of clinker, entirely preventing any air coming through the grate to oxidize the combustible products.

All this time a small quantity of the cake had been disposed of as a fertilizer base, about $1.50 per ton being obtained for it, when sent out in powder form. This demand grew to large proportions and the rotary drying machine, which turned out about 30 tons of dry product every 24 hours, was kept hard at work to keep up with the demand. The price of the dry powder was also gradually increased until $2.50 was obtained for it. The demand of course varies, but in the spring large quantities are sent away. The powder shows on analysis 2 to 2.5 per cent. ammonia.

At Leeds a small experimental plant has been erected for recovery of the ammonia from the pressed sewage cake. This plant was not at work when I saw it. Mr. Hart, the sewage engineer, spoke highly of it as far as his results had gone, and it certainly has merits. The previously dried sewage cake is fed into an iron retort at the top, which is built in a brick chamber leaving an annular space between the inner wall of furnace and outer shell of retort for heating purposes. Connected to this space is a small gas producer. The producer is started up and charged with ordinary coke and the gas ignited under the retort, which, when sufficiently heated drives off all combustible products from the sewage cake, leaving a fine ash at the bottom of retort. The gases are led from top of retort through a condenser, the ammoniacal liquors and a small portion of oil separates out, the combustible gas is led into the bottom of retort which serves in place of the gas producer, making the plant nearly self-supporting. The producer is used only when starting up the plant. No figures as to cost of production were yet available, but it appears to be an idea with vast possibilities.

At Tadcaster, a brewery town, in Yorkshire, of about 3,000 population, a rotary dryer is at present being installed of similar make to the one at Bradford. The sewage, which is chiefly composed of brewery waste, is treated with lime. About 300 tons of 90 per cent. sludge is made weekly. It is proposed to dry this by pumping it direct into a dehydrator, which will reduce it to 75 or 80 per cent. moisture, and then run directly into the dryer. The cost per ton for drying, including labor, fuel, capital outlay, etc., on plant, will be about $2.00 per ton of dry product, and as there is a good market for it at $5.00 per ton, sewage, instead of being drug, will prove of good value and a profitable industry as well.

At Huddersfield the sewage is pumped from the sedimentation tanks into some natural reservoir near, no efforts having yet been made to deal with it. Most towns press the sludge, the cake having 50 to 70 per cent. moisture left in. This is given away to farmers free for removing, sometimes 12 to 18 cents per ton also with it, depending on the location of the works and the manurial value of the sewage. Low lying land is also filled up, this being the method generally adopted.

Manchester, Salford, Glasgow, and other cities within easy reach of the coast take the sewage sludge out to sea in boats. This also applies to some portion of the sewage of Dublin, Ireland. Near to the Dublin works, Fertilizers, Ltd., a company formed to work the patent of Mr. A. Dickson for treating sewage sludge, are operating. The process consists of adding a certain amount of waste brewery yeast to the sewage sludge, fermentation taking place, the organic matter rising to the top and the heavy matter falling to the bottom. The organic sewage is dried and sells readily at $12.00 per ton. When I was at the works in May last, orders for over 1,000 tons were already booked. The cost of production is about $3.00 per ton, therefore, if the process works satisfactorily, the stockholders in the company will be well rewarded. The analysis of the dried manure is as high as 3 per cent. nitrogen. It yet remains to be seen as to the merits of it as a fertilizer. One obstacle in the way of the process being generally adopted would be the difficulty of obtaining the spent yeast in sufficient quantities. Only a small percentage is used however, and it was later found out that by leaving a small portion of the fermented sludge in the bottom of tanks it would start the fresh sludge.

At Norwich a separate company is also being formed to take the sludge for treatment after leaving the precipitation tanks. This sewage is very rich in nitrogen, and also contains about 30 per cent. oil when in the dry state. It is proposed to recover this, and dispose of the residue for fertilizer. As this plant is more of an experimental scheme and has not yet been demonstrated no definite opinion can be given at this point.

At Warrington, Lanc., the town is more on the pail system. The contents are collected, which contain 90 per cent. water. This is evaporated down to 60 per cent. in vacuum pans and then run into steam jacketed dryers to dry into powder form. The output is about 20 tons weekly. It is bagged up, and sold as "poudrette," $20 a ton being obtained for it.

Oldham, Lancashire, is at present erecting a plant, value $50,000, for recovering the grease, and making a dry product at the same time which will be sold as a fertilizer. The grease is sold to distillers, olein, stearine, and pitch being obtained from it. Similar attempts with plants of this kind have been made. Needless to say they have not yet proved successful.

Great strides are now being made in regards to the question of sewage sludge disposal. No general method can be adopted in dealing with it, as each case varies according to the different industries carried on.

Residential Sewage Disposal Plants.*

By R. Winthrop Pratt, Chief Engineer of State Board of Health, Columbus, Ohio.

ALTHOUGH a privy vault or cesspool might be in general classed as a residence sewage disposal plant, yet the true definition of such a plant would include only a scientifically designed apparatus capable of purifying or disposing of the sewage in a definite, sanitary and controllable manner.

The two chief principles upon which depends the successful operation of a house sewage disposal plant are:

First. The clarification of the sewage by causing the solid matter to settle to the bottom of a tank and there become partially liquefied, and by causing the grease and light suspended matter to rise to the top in the form of scum; and,

Second. The disposal of the clarified liquid either (a) in a specially prepared filter; (b) over the surface of the ground; or (c) into the soil beneath the surface.

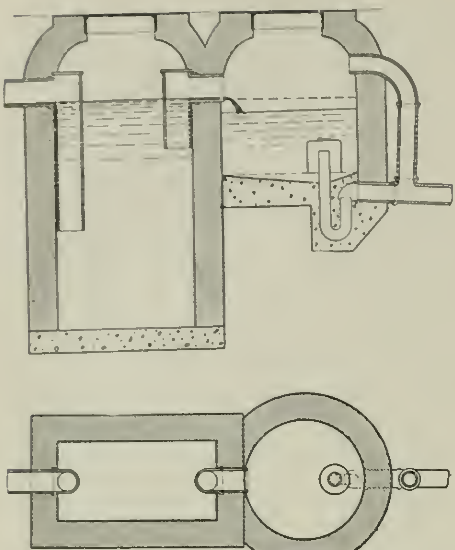
The process depends, aside from its mechanical workings, upon bacterial action; and without attempting to enter into a bacteriological discussion, it may be of interest to mention that the essential bacteria are of two general classes.

The first class of bacteria inhabit the tank and perform the function of partially changing the solid matter into liquids and gases. They are known as anaerobic (those working without oxygen) and facultative (those working either with or without oxygen). The bacteria are assisted in their work by worms and other animal organisms.

The second, or the aerobic, class of bacteria inhabit the filter or the ground used for the final purification of the clarified sewage. The function of this class is to transform the organic matter of the sewage into harmless and odorless mineral matter, thus causing or tending to cause the disappearance of the dangerous germs of the original sewage.

A plant designed according to the above mentioned principles may be described somewhat as follows: The outflowing sewage from the house is delivered into a settling basin of sufficient size and of suitable design to afford opportunity for the sedimentation of the solid matter and the rise of the grease.

*From a paper before a conference of boards of health.



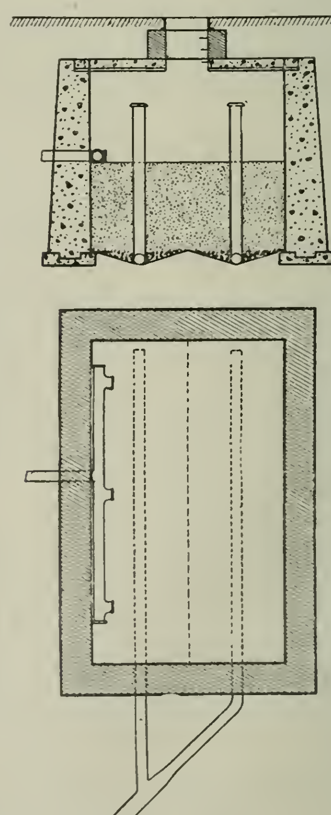
RESIDENTIAL SEWAGE DISPOSAL PLANT.
1. Vertical Section and Plan Showing Settling or Septic Tank and Dosing Chamber.

This basin or tank contains a constant volume which approximately should equal one or two days' flow of sewage. The inlets and outlets should be so arranged that neither the scum at the top nor the sludge at the bottom is disturbed as the sewage passes through it. The matter deposited in the bottom of the tank becomes partially reduced and passes away in the form of liquid or gas. There will be, however, a certain accumulation which must be cleaned out occasionally, probably not oftener than once a year. The tank should be ventilated through the main soil pipe of the house in the same way in which modern sanitary sewer systems are ventilated.

The clarified liquid overflowing from this tank passes into a second one adjacent thereto, called the dosing tank. Herein is placed an automatic siphon or other controlling device which holds back the flow until the sewage has reached a certain depth, at which time the entire contents of the dosing tank are discharged very rapidly. The discharge completed, the apparatus automatically prevents further outflow until the tank becomes again full. This tank serves to apply the sewage to the filter, sub-surface disposal system, or other means for final purification, to which the capacity or "dose" must bear a certain relation in order that the sewage be properly distributed.

Such distribution is essential for the reason that, if the sewage is allowed to pass on to the filter or into the "absorption system" in the same irregular way that it leaves the house, the filtering material will be constantly saturated in places and hence become clogged and foul. In other words, the filtering material must be kept clean by allowing the air to frequently penetrate it. (See Fig. 1.)

The disposal of the clarified sewage by open filters and by broad irrigation is identical in principle with the corresponding methods for city plants and need not be described here. Of course, these can be used only where ample land is available; and they are not suitable for built-up districts, but rather for isolated houses. In any case these methods involve exposing the unpurified sewage to the air and are, therefore, less desirable than a sub-surface system. If, however, one wishes to construct a filter bed in a concrete chamber beneath the ground, this can be satisfactorily done, though somewhat expensive, in close proximity to residences. (See Fig. 2.)



RESIDENTIAL SEWAGE DISPOSAL PLANT.
2. Vertical Section and Plan of Intermittent Sand Filter Underground.

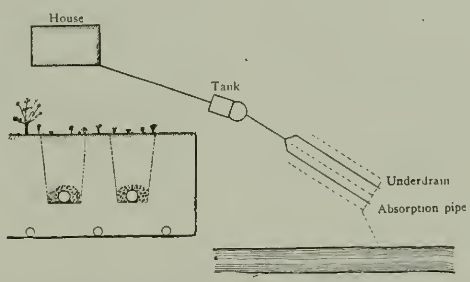
The sub-surface disposal system is composed of lines of three, four or six-inch agricultural drain tile or vitrified pipe with open joints, laid level or nearly so, within one or two feet of the surface of the ground. These are called absorption or distribution pipes. Their total length is determined primarily by the porosity of the soil in which they are placed and varies for a family of five or six, from 100 to 600 feet. In clayey soils it is necessary to thoroughly underdrain the land at a depth of three or four feet in order to render the soil dry enough to absorb the sewage, and in addition it is desirable to surround the tile with gravel, cinders or porous material. There should be, of course, no opportunity for sewage to pass directly from the absorption pipe into any of the underdrains. As mentioned above, the cubical contents of the absorption system should have a certain relation to the dosing tank in order that the sewage may be properly distributed. It is often convenient, furthermore, to divide the system into two or three portions in order that the flow may be changed from one to the other every few weeks.

There will doubtless be a certain accumulation of finely divided solid matter in the tile which may make necessary their relaying after a period of years. This, however, is a matter of small importance. The system can be placed at any convenient point and is often installed underneath the lawn or vegetable garden without in any way showing evidences of its existence, except by assisting in the growth of vegetation. (See Fig. 3.)

While the general principles of the design of municipal sewage purification plants apply also to residential plants, yet there are several practical differences which should be borne in mind.

In the first place the sewage from individual houses is extremely fresh and there is no opportunity for the mechanical breaking up of the larger suspended particles as is the case when sewage flows for miles in a city sewer. Then there are extreme fluctuations in the rate of flow in the case of the single house, as compared to the more regular discharge from a municipality. For instance, there is rarely any flow during the night, and the flow during the day comes in sudden rushes.

The small actual size of a house sewage tank, although it may be large from the standpoint of "hours of storage," may permit a sudden inrush of sewage to stir up the entire contents, thus carrying out some solid matter and causing the filters or the sub-surface system to clog. The above mentioned facts show the necessity of designing both tanks and finishing treatment on a more liberal per capita basis than is required with municipal plants.



RESIDENTIAL SEWAGE DISPOSAL PLANT.
3. Plan and Section of Sub-surface Absorption System and Under-drains to Remove Ground Water.

Finally, residential plants are intended to be more automatic than municipal plants, and rarely receive regular attention, and they must, of necessity, be located much nearer to dwellings than city plants. It is necessary, therefore, to exercise much more care in design in order that no work need be done on the plant oftener than once a year, although it should be inspected every few months. Also the design should be such that the plant will create no odors even though within a few feet of a residence.

Relative to the cost of building an efficient residential sewage disposal plant for a family of five or six, this will vary greatly according to the local cost of material and labor and the character of the ground in which it is to be placed. The usual tanks with sub-surface absorption system should be built in porous ground for $100 to $150; and in clay soil for $250 to $300. A plant including a covered sand filter may cost $500.

Wood Block Pavements from Construction Standpoint.*

By Day I. Okes, The Kettle River Co., Minneapolis, Minn.

I AM PRESENTING to the society a few observations made on the construction of creosoted block pavements noted from results of the material in place.

The foundation to be used under creosoted block pavements depends upon the sub-soil and the traffic strains to which the pavement is subjected. If there is good drainage of sub-soil, that is, if it is sandy or contains gravel, no provision needs to be made to allow for the effect of frost or heaving of the foundation. If the sub-soil is clay, or practically impervious to water, either sub-drainage has to be provided or an additional depth of concrete.

The effect of traffic on the depth of the concrete is proportional to the weight of the loads carried by the pavement surface. The strain on the foundation concrete is indirect compression, and the strength of the concrete mixture under compression determines the depth of foundation from this standpoint.

On almost all pavements it is necessary during the life of same to make openings or cuts for underground work or repairs. Unless this work is replaced in first-class shape there always results a deterioration of the pavement on the surface. In order, after cuts are made, to provide as strong a foundation as originally laid, it is advisable to reinforce over cuts or openings by an extra thickness of concrete or by steel reinforcements. Inasmuch as it is generally impossible to get the sub-soil in a trench replaced to its final compression the concrete foundation over the trench or cut would necessarily have no support in case the sub-soil took a shrinkage after the concrete was replaced. This would put the concrete foundation over the trench in tension, and the necessity of steel reinforcement is apparent.

As the success of a creosoted block street is dependent upon a continuous smooth surface, it is essential that the concrete foundation surface have as near the contour of the final pavement surface as possible. Where gravel concrete is used it is advisable to have the concrete foundation surface made by drawing a template over same. Where stone concrete foundation is used a template curve ought to be worked, too.

The cushion upon which concrete blocks are laid should never exceed 1 inch, and it should be less, either ¾ or ½ inch, where concrete is templated to an even surface; in fact, the use of the sand cushion under creosoted block streets is essential only in order to obtain a smooth wearing surface of creosoted block pavement.

Sand is now generally designated for the cushion material. Where there is vibration of pavement, as between car tracks, it is most advisable to use a mortar cushion. The manner of placing this cushion is to mix the sand and cement in proper proportions, dry, and pull same with template in a similar manner to pulling the sand cushion. The blocks are then placed and rolled to the final surface contour, then the pavement surface is flushed with water in order to dampen the mortar cushion, and leave same set up. After pavement becomes dry the filler can be applied.

It is my opinion that where the sand filler is now used with a creosoted block pavement under heavy traffic, the mortar cushion, such as above, would be very desirable in its place, inasmuch as the set in this mortar cushion would prevent any washing due to water leaking through the interstices of the blocks, and would also prevent any displacement of the block surface due to the pushing away or flowing of cushion, and the consequent rutting of the blocks under heavy loads.

The objection, of course, to this mortar cushion is the time necessary to wait for set before pavement can be used. However, it has the advantage of making possible the use of the sand filler on lighter traffic streets, inasmuch as it provides against the washing away of the cushion during the ironing out of the pavement and the sealing of the joints, and we who are somewhat familiar with the present creosote block construction know it is most advisable to do away with the kind of a bituminous filler which becomes sticky in hot weather.

This question of the kind of material to be used for the cushion and the kind of material to be used as a filler between the blocks, and the essential necessity of having a creosoted wood block pavement perfectly smooth under the various traffic and weather conditions brings us directly to the problem of the expansion of creosoted blocks and the necessity of providing against such expansion in order that the material will lay continuously as it is originally placed. On these premises we have two methods of meeting the problem of obtaining a practically smooth, continuous and permanent surface: First, to produce a block of

*A paper before the Wood Preservers' Association.

the kind of wood and the kind of oil, and with the required impregnation to allow a minimum percentage of absorption of moisture under conditions where the water or moisture surround entirely the creosoted block, or else to provide by construction a sealing of the creosoted blocks on the bottom by a mortar cushion, and on the four sides by means of a bituminous filler.

I do not wish to enter into the discussion of a satisfactory oil or treatment to be used for creosoted wood block paving, but I take up the problem from a contractor's standpoint. We are familiar, though, in a general way with the trouble that has been experienced during the use of a heavy or, as it is called, a "waterproofing" oil by the bleeding of the blocks. It is sometimes contended that this bleeding is due to the manner of treatment and to the action of the blocks expanding in the street. However, when the use of a lighter oil under 1.10 sp. gr. was prevalent, it is a fact that we did not experience trouble with the oil exuding and staying on top of the pavement, so that if we would use a straight run creosote oil and by our construction provide against absorption of moisture, and therefore against expansion by the use of a dry mortar cushion and a bituminous filler which would not cut back by the oil from the blocks or would not soften and run in the hot weather—that is to say, if an asphaltic base bituminous filler were used, we would have a minimum amount of expansion and movement of the blocks in the street, and therefore would provide a pavement which, if laid smooth, the original contour would remain in such condition under traffic and weather conditions.

As to the laying of creosoted blocks, it is now practically conceded by watching the action of same that it is necessary to place the blocks at an angle of 45 to 67½ degrees with the curb to provide against the wearing of the joints by the calks of the horses' shoes and also to get the action of any expansion of the blocks as near directly against the curb as possible.

There are many special problems of construction that arise in the laying of creosoted block pavement, those of properly caring for surface water, construction around manholes and intakes and street car work being the principal ones. As creosoted blocks are comparatively a high first cost pavement, it is essential that the proper study and care be given to the design, methods and workmanship, so that the resultant economy due to the long life of properly constructed creosoted block pavement will be attained.

Bitucrete Pavement.

By A. E. Schutte, Cambridge, Mass.

THE automobile and the astonishing demands its increasing use are making upon the paving engineer have rapidly come upon us, still there has been time at least to dispel two illusions which beset us at first. One of these was the insistent cry of the motor enthusiast who prophesied the immediate doom of the horse and his speedy elimination from our roads. We now know this to be a fallacy. We see traffic and business necessities so increasing with our greater population that there is work for all the horses and motors, too, that we have. It is not strictly the motor road which we must pave and keep paved, but it is a double purpose road which is required, and this brings us to the second fallacy that I mentioned, which is the ill-considered notion that horse traffic and motor traffic destroy a road surface in like manner, but in varying degrees, as was at first assumed.

An appreciation of the different forces of disintegration exercised by the horse and vehicle and by the automobile clearly shows why the old pavements cannot and will not stand either the automobile traffic or the mixed traffic. A horse going over the pavement and applying its hoofs upon the surface at first tends to compress the material below it and then by raising the hoof to kick some of it up, while the wheels tend to restore the whole to its original position by compression and by forcing some of the detritus back into the spaces or openings thus formed. A different force is exercised by the automobile. The fast going wheel first tends to throw the particles to either side of the tire and displace them, then the receding tire, forming a partial vacuum, draws the fine particles of the surrounding area, which are then forcibly thrown off by the centrifugal action of the wheel.

There are two different and distinct problems involved. Engineers have realized these facts for years and have found that they could construct a piece of roadway which would stand ordinary traffic, also that they could construct a piece of roadway which would reasonably well stand the action of the automobile, but the pavement which had to stand both kinds of traffic was a much more difficult thing to construct, and is still in its experimental stage.

The two main difficulties are to construct a roadway at reasonable cost which will prevent the automobile from drawing up and out the particles of material, of which the pavement is composed, and which at the same time will not suffer from the grinding, pounding and displacing action of the horse's hoofs.

Attempts to regulate the speed of traffic below the point injurious to the roads or to prohibit attachments to wheels which tended to hasten its disintegration were of no avail, for roads have to be built to resist the traffic no matter of what kind, and not traffic regulated to suit the road, which would retard progress in every sense of the word.

The first thought was to bind the particles, say of an ordinary macadam road, with a cementing material that had more cementing power than the ordinary detritus, by adding or pouring some more or less viscous material, and you all know the result achieved by any of the very numerous coatings which have been applied for five or six years upon the road surface and which, with occasional exceptions and under unusually favorable conditions last only a short time, this being principally due to the inability to incorporate the oils or viscous cement with the detritus in such a way that the resulting mixture will adhere to the stone, whose superficial voids the detritus is filling.

It is quite obvious why the road builder should turn to Portland cement as the material from which to construct his road, for in that cement he has the rigidity necessary to maintain the contour of the road and also the necessary cementing properties to hold the particles tightly together and thus prevent their dislodgement. Cement roadways, however, have proved unsuccessful on account of their hardness and lack of resiliency.

In 1906 the writer's attention was called to a compound which was placed on the market for the purpose of waterproofing Portland cement. It was composed of a very soft bituminous cement to which had been added some silicate of soda in order to harden the cement, whose strength was greatly reduced by the addition of the oil. A large number of experiments were made by the writer attempting to produce a combination of Portland cement with an oil suitable for roadways, but in each case it was found that the strength of the cement was reduced from 40 to 65 per cent. (depending on the oils used) and that a surface was produced which was weak; and slippery on account of the presence of the oil. After many trials this was abandoned, for if enough oil was added to make the surface slightly elastic the strength of the mixture was reduced below the utility point, and the resulting surface was exceedingly slippery and dangerous on this account to both the automobile and the horse. If only a small amount of oil was used the strength of the mixture was reduced without adding anything at all to the utility of the mixture as a roadway surface. The results and the knowledge gained through these experiments are, however, of much greater value to the water-proofing engineer than to the road builder.

The experiments in the mixture of oils and cement were abandoned and in 1906 and 1907 experiments were made to produce upon a rigid cement support an elastic, non-breaking surface, which should make it easier for horses, non-absorbent and silent. The experimental pieces, some of which proved successful, all showed in some places lack of adhesion between the Portland cement and the coating. This caused the material soon to be broken up and carried away. Numerous oils were tried for cementing the bituminous cement to the concrete but these experiments were accompanied by only partial success.

Late in 1906 a successful piece was laid, in which the surface of the Portland cement concrete, which was of the proportion 1-3-6, was carefully washed while still in its plastic condition so as to remove all the mortar between the upper and superficial stones and to produce between them spaces ranging from one-half to one inch, or thereabout. This was then flushcoated with the bituminous cement, which firmly stuck to the clean stone. This section of the roadway is still in existence today and is giving good results.

In experimenting with the latter, "protected concrete," as the writer termed it, a great difficuty was encountered in constructing this road in cold weather. It was almost impossible to make the bitumen stick to very cold stone and methods of heating the stone by means of surface heaters or burners were found to be too expensive for large areas. Solvents added to the bituminous cement helped but little.

The next advanced step was the production of the Bitucrete double bond roadway, to which I wish to especially call your attention.

The method of constructing this roadway is as follows:

Upon an ordinary sub-grade, of no matter what kind, whether an old macadam road, dirt road, excavated soil, sand, or in fact anything capable of supporting wet concrete, there is placed a layer of concrete from two to six inches. In cases of resurfacing old macadam roads, the roadway is scarified, the detritus washed off the stone by means of hose; a thin layer, say one inch to two inches of stone is laid on the top and the whole grouted to form the foundation. While this foundation is still plastic there is placed upon it the "bonding course" so called because it is firmly bonded to the foundation and because it holds or bonds the particles of stone as well as the filling bitumen in its spaces. This bonding course is preferably composed of a uniform sized stone about one inch in diameter (preferably of a size which will pass 1 inch and remain on ½ inch ring), which has been previously coated by any suitable and economic means with a Portland cement grout composed of preferably neat Portland cement and water or Portland cement containing a small addition of fine sand. Mixing has been found the best for this method, and this mixing can be done either by hand or by machinery.

It is quite possible to coat these stones by spraying or forcing grout upon and into them, the main object being to surround each inidividual particle of stone with this mortar or grout so as to produce around the stones a continuous layer of Portland cement which is somewhat heavier at the contacting points of the individual stones. Thus you can see there is formed a well of stone and Portland cement which keys all the stones together and at the same time leaves between the stone interstices or voids.

After this layer two or three days old, or has become sufficiently hard, there is poured upon and into it a tough bituminous compound which fills all the voids and leaves a layer on the surface into which there is then first incorporated some stone about one-half inch size which sink into the spaces between the projecting stones and then there is scattered over the top a thin layer of sharp gritty material which produces a non-slippery surface. For this top layer either coarse sand or crushed screenings is used.

Here we have each individual particle of stone first firmly secured, cemented and bound to the adjacent particle of stone and in turn to the foundation, making displacement of these stones very difficult, and here we also have a non-abrading bituminous surface which fills the voids between the stones, prevents the abrasion of the stone, and is prevented from being displaced by the stone (they taking all weight), and which produces with these stones a waterproof, non-absorbent, semi-elastic surface, which can be made as rough or as smooth as the conditions, or rather the engineer, may require. A pavement thus results which has enough bitumen to perpetually and continually coat the points or surfaces of such stones as may be exposed by wear and which also can be very easily repaired in case the necessity for cuts arises.

Another advantage is that it does not require special machinery for its laying, although like all important construction the work must be done carefully.

An ordinary concrete mixer, good cement and fairly hard stone, tough bitumen and reasonable care in construction is all that is necessary to produce a successful pavement of this kind. It is important to keep the surface as clean as practicable before the bitumen or filler is poured into the bonding course, for dirt, sand, etc., will prevent the bitumen from penetrating.

It has been found that in order to secure a proper setting of Portland cement and keep it clean, it is best to cover the area laid each day with canvas until the proper time for pouring has arrived, thus preventing the Portland cement from being dried before setting, and also preventing infiltration of dirt or detritus in case of rain.

A test piece was laid at Cambridge, Mass., over two years ago, over which about 118,000 tons of material, generally in loads of 2 to 3 tons, has been hauled. After the pavement stood this test a piece was laid for public use at Newton, Mass., and now some 18,000 yards are being laid at Morristown, N. J.

During the laying of the Morristown work the pavement had two rather severe tests, the first being the carting over it of a sand-stone column weighing about 14 tons, supported on a wagon with three-inch tires, and the second a 50-ton manganese steel vault on a twelve-ton truck weighing altogether about 62 tons, drawn by 24 horses, of which about 2,360 pounds per square inch was on the hind wheels. The load was drawn the entire length of the pavement when it was only ten or twelve days old and it stood these excessive tests without showing the slightest mark. At one stop the heavy load stood nearly one-half hour and the horses started the load without any special effort leaving absolutely no mark where the wheels had stood.

Paving and Care of Streets.*

By Edwin A. Fisher, City Engineer, Rochester, N. Y.

GUARANTY.

MUCH has been said and written upon the subject of pavement guarantees. A few years ago a long guaranty was thought to be the one thing needful in street paving. New York City laid many pavements under a fifteen-year guaranty period. Many other cities, unless prevented by charters, exacted ten years. Of late, however, a reaction has set in and many engineers and other municipal officers argue that the guaranty should be abolished entirely. I believe that some guaranty is essential, but that it should not cover an extended maintenance, but be limited generally to the material and workmanship.

Where a large amount of underground work is done, scattered, as is usual, over a considerable distance, it is absolutely impossible, with ordinary inspection, to know that the trenches are properly backfilled. The contractor should be responsible for this work.

We have fixed the guaranty period for standard pavements at five years, and for resurfaced streets and sidewalks at three years. I do not think a uniform length of guaranty of all kinds of pavements is right. It ought to be only long enough to detect defects of material and construction and should vary with the different kinds of pavements, and other conditions. I recently told a committee of citizens that any contractor who would sign a contract with a maintenance guaranty for a macadam pavement on a street of considerable traffic ought to be sent to a lunatic asylum.

CONTRACTS.

Two methods of letting contracts are practiced—the lump sum bid and the unit price bid. If the exact quantity and character of the work can be fully and clearly described, and changes are not probable, the lump sum is the most satisfactory. On the other hand, as is usual in the case of a permanent pavement, especially in the older portion of the city, where many of the quantities are not positively known, the unit price method is preferable. I have used this method altogether for pavements. What is wanted is a method that will eliminate the gambling element and enable the engineer to pay the contractor a fair price for satisfactory work. Care should be exercised, however, in making up the bidding sheets that the estimated quantities correspond as nearly as possible with the actual, else you will get unbalanced bids. I have found it better, in the case of items where the quantity was uncertain, to fix the price in advance, or leave it out altogether, and treat such items as extra work, rather than to put in estimated quantities which might vary materially from the actual, and thus tempt the contractors to make unbalanced bids.

LOWEST BIDDER.

The charter provision compelling the letting of all contracts for public work to the lowest bidder that will furnish adequate security results, in many cases, in turning over municipal work requiring special knowledge and skill to ignorant or inexperienced men, deficient in every quality required for the successful execution of the work. Nothing has so tended to bring the business of municipal contracting into disrepute as the lowest bidder. From a large experience in both public and private work, I am clearly of the opinion that the contracting board should have discretion to let contracts as in its judgment is for the best interests of the municipality. In nearly all cases the lowest bidder would get the work. Honesty, ability, intelligence and special knowledge would be recognized, and the business of the city contracting be placed on a higher plane. The work would also be better and more economically done.

For twenty-five years prior to the year 1900 municipal contracts for the city of Rochester were let by an elected board of three members having authority to award contracts as in its judgment was for the best interests of the city. While this board, on account of its large powers, was made the central figure in every municipal campaign, and all sorts of criticism and abuse heaped upon its members during the heat of a campaign, I do not recall that its acts, with respect to the letting of contracts, were ever questioned.

ASPHALT.

This pavement leads all others in amount laid in the larger cities. It possesses most of the qualities of an ideal pavement, and taken altogether, when properly built and maintained, and laid upon streets adapted to its use, is generally satisfactory. It is easily repaired, even when worn quite thin, and in this respect is in contrast with block pavement of any kind.

Many mistakes have been made in the

*From an address before the Williamsport, Pa., Board of Trade.

past in an endeavor to cheapen the cost of this kind of pavement.

BITULITHIC.

Mention may also be made of the bitulithic pavement that has come rapidly and extensively into use in the last ten years. This pavement is correct in theory, and its extensive and generally satisfactory use indicates that its theory is sustained by actual practice. It combines very many of the qualities of an ideal pavement. Its success, however, depends, more than any other kind, upon extreme care in the selection and grading of the materials, and in the proper execution of the work. It is therefore perhaps an actual advantage that its use is covered by broad patents, preventing its construction except under the skilled supervision of the patentees.

STREET RAILWAY TRACK.

The general railroad law, as interpreted by the Court of Appeals in the Conway case (a Rochester case), compels street surface railways to keep in repair the pavement between lines drawn two feet outside the outside rails of the tracks in any street, and also to make new pavements within the same space when required by the proper authorities, and within thirty days from the date of notice so to do.

The Rochester Railway Company has, since the court decision referred to, waived the thirty-day notice and permitted the city to let the contract in the railway portion with the remainder of the street. Our present charter permits the city to assess the cost of this work upon the property and franchises of the railway company.

Two methods of construction are followed: Wooden tie construction, consisting of a concrete foundation twelve inches thick, extending the entire width of the space, between lines drawn six inches outside the outside ends of the ties, put in at the same time and connected with the six-inch foundation outside. Wooden ties about two feet six inches centers are left imbedded in this concrete. This form is favored in streets where recent excavations have been made under the track space.

The other method, and one now practiced, is the use of steel ties of three inches depth, spaced four feet centers, imbedded in a twelve-inch Portland cement concrete foundation, extending entirely across the space between lines drawn six inches outside the ends of the ties and connected with the six-inch foundation under the pavement. Old rails have been used for ties in some streets.

Anchor Ice.*

By Linden C. Trow, Superintendent of Water Company, Lake Forest, Ill.

When a period of about six months has elapsed after a young man has paid his first ten dollars on a correspondence course in hydraulic engineering, and has secured a position with some water company, he signs his name John Smith, Hydraulic Engineer, spelling the last two words out in full; but having had some fifteen to fifty years of experience along these lines, he signs himself just plain John Smith, his eyes having been opened to so great an extent to what this field of engineering covers that he doesn't feel as though the ownership of the term is his sole property.

Two years ago, I sent word to this Association that I would deliver a paper upon the subject of Anchor Ice, but at the present meeting, I would rather simply ask the question, "What is Anchor Ice?"

The severe winters in the region of the Great Lakes have always affected the water supply to so great an extent that it has become a custom to couple the ice question with problems relating to an adequate water supply.

Of course, a shut down of one minute is an unpardonable occurrence in the eyes of the consumer, and keeping this point in mind, consider the effect of a five-hour shut down and a shortage of water at breakfast time.

In different countries, ice which causes a stoppage in the intake is known by different names. In Scotland it is called ground gru and lappered ice; the French Canadians call it moutone from its resemblance, after accumulation, to the wool on the back of a sheep; others call it spicular ice, but the name of frazil given by Mr. Murphy in his report to the Royal Society of Canada, is the one most generally used along the northern lakes. Anchor ice is the common expression in the United States and, although it is in reality misnamed, it is such a handy phrase that it will probably remain in spite of any efforts to credit frazil with the record it has made, and were you to tell a consumer that you had frazil, when he wanted to know why he couldn't get water, he would probably think that you

*A paper before the Illinois Sanitary and Water Supply Association.

had partaken too freely of some new breakfast food.

It is doubtless well at this point to state that men who have made a thorough study of ice formation, divide the ice into three classes, first sheet ice formed upon the surface; second, anchor ice formed upon the bottom; and frazil or ice formed below the surface and above the bottom. Anchor ice and frazil are both formed only when there is open water above. Along the west shore of the lake there are a few other features which are always stable; the wind must be in a westerly direction and the thermometer must be below freezing. Frazil or anchor ice is never formed when the sun is shining or when there is a cloudy sky at night, and the rising sun always heralds the fact that the accumulation of ice has ceased. The very slightest rise in water temperature relieves the situation and the ice will loosen its grip if the water is warmed to the thousandth part of one degree on the positive side of freezing.

Anchor ice is formed upon the bottom of rivers or bodies of water where the water is in motion; the growth of frazil is in the water itself, and the necessity of some object being present for it to attach itself to is eliminated, as the floating particles will adhere one to another. The growth of frazil must be accompanied by surface cooling through wind or rapid agitation and by radiation.

In questioning men of practical experience, it is very interesting to note the different theory which each one advances as to the cause of the ice which closes an intake and the theory of one man will possibly be an absurdity in the eyes of the next man as compared to his own. One engineer advanced the following: "It is a law of nature that warm water must rise, also a law of nature that objects lighter than water must rise, hence it stands to reason that water at the bottom of the lake is the coldest and that is the point where the ice is formed and from there having become lighter by the process of freezing, it floats to the surface unless drawn aside by some disturbance in the water such as an intake, whose suction causes the ice to adhere to the screen in the form of minute crystals until the screen is so thoroughly covered as to stop the passage of water." This theory is only handicapped by the fact that the rapid circulation of water ceases when the theormometer reaches 39 degrees F.

Another is this: "In 1836 Gay-Lussac observed that water, when placed in a vessel covered with oil, may be cooled to 10 degrees F., without freezing, but if the vessel is shaken, solidification ensues at once. During a west wind the water at the surface is always warmer than at the bottom, and this warm water upon the surface may act as a blanket in some such manner as the oil, and the water reach a point below freezing until disturbed by coming in contact with the intake."

In one city north of Chicago, I found a 42-inch intake with thirteen openings, some pointing up, some pointing down, and others pointing at different angles; for there is a theory that the way which the opening looks makes considerable difference; some of the openings are covered with iron screens and some with wooden screens, but in spite of all these precautions, this city's intake was closed by ice this winter to such an extent that it was necessary for them to send a diver down to make an opening. Some one connected with the welfare of this city, conceived the novel idea of placing a fan over an opening in the intake to be propelled by compressed air which would keep away the ice. The engineer and commissioner of public works spent a few peaceful nights in sleep after this installation was made, but one night the water ceased to come; the diver was hurried to the scene and lowered to the bottom to discover what had gone wrong with the fan, and there over the intake he found it churning away, completely housed for the winter in a dome of ice.

Of the theories advanced by practical men, or the man at the throttle, many will be seen to be very near the truth of the situation, but it still remains for such institutions as our State Universities and other organizations of research to get at the whole truth of the matter.

The usual method of procedure in a case of anchor ice is for the night engineer to call the superintendent out of bed about 12 o'clock and tell him that "there is a valve out of the pump." When asked over the 'phone "which end," his confused reply is that "there seems to be one out at each end, both sides." Crawling into his clothes the superintendent proceeds to the pump room to find the hand of the vacuum gauge reposing peacefully upon the pin. The valves in the well are closed and any pressure which may be left in the mains is thrown upon the intake through the bypass. At times we have been able to maintain a pressure of seventy-five pounds upon the intake for fifteen or twenty minutes before there would be any noticeable release. About one out of five times, this method, when tried before sunrise, has proved satisfactory, the other four times, more water was lost back-flushing than came back before the ice again closed the opening. The pumps usually get a full supply of water with the aid of nature's remedy, the heat of the sun, about as soon as the plant that labors with back-flushing and other contrivances.

A New Elevator Grader for Road Building.

By Frank C. Perkins, Buffalo, N. Y.

THE accompanying illustration shows the method employed in building roads in North Dakota, with an elevating grading and ditcher of an English design as constructed at Minneapolis, Minn.

The gasoline engine is utilized for handling the material, the elevating grader throwing a large furrow with four or six horses as a motive power. The photograph shows the machine in operation handling Red River Valley gumbo. It is moving more earth than could be handled with from 12 to 16 horses on a geared machine without the use of a gasoline engine, the latter in this case being covered by a metal casing. It is interesting to note the comparison in Fig. 2, of a rcad machine of the reversible type in service on street work at Los Angeles with the engine driven grader and ditcher noted in illustration Fig. 1.

The gasoline engine for running the carrier is compact and powerful and arranged to be speeded up to make the carrier belt run faster in elevating loose material. The grader is capable of moving 1,000 to 12,000 cubic feet of earth in 10 hours actual work, saving one-half the expense of other methods formerly employed.

This motor-driven elevating grader is

1. BUILDING ROADS IN NORTH DAKOTA WITH AN ELEVATING GRADER AND DITCHER.

2. REVERSIBLE ROAD MACHINE ON STREET WORK IN LOS ANGELES.

utilized extensively for building and repairing irrigation canals in the arid land of the West and for rice culture of the southern states, as well as for building drainage ditches throughout the Red River valley of the North.

The carrier or elevator consists of a belt of 36 inches wide which conveys the dirt from the plow by the gasoline motor, the machine and plow being hauled by horses, giving a combination which serves to reduce the expense very materially, as it will be admitted that about as much power is required to operate the carrier loaded with dirt as to haul the plow and machine in ordinary soil.

The advantages to be gained by hauling by animal power are that there are no drive wheels and the grader does not depend upon driver or bull wheels for power to convey the dirt. It is maintained that wet or loose ground will not prevent it from elevating and a small rain shower will not lay up the work, as it will elevate and do good work in wet or sandy soil as long as it is passable to the horses. When a carrier 18 feet long is utilized, an engine of from 8 to 10 horse-power is required, the motor being increased to 15 horse-power capacity when a 23-foot carrier is utilized. The latter may be reduced to 18 feet in length by removing a 5-foot section if desired.

The carrier is made sectional and can be made adjustable to various lengths, but when a carrier as long as 30 feet is required, an engine of 20 horse-power capacity must be used.

Maintenance of County Roads.*

By Robert E. Gibbons, County Engineer, Terre Haute, Ind.

I WISH to call the attention of our society to a condition regarding the maintenance of our improved county roads which is becoming a very serious factor in our county and no doubt in all other counties throughout the State.

These roads were originally built by the townships, subscription and in a few instances by the State and government, and some few were started as toll roads. These as a general rule were and are our most heavily traveled roads, and those which were in a somewhat respectable shape were taken over by the county several years ago and have been maintained by the county since being taken over.

This maintenance, as we all know, has never been what it should be, this being not so much the fault of the officers directly in charge as in the lack of available funds to carry on the repairs in an adequate manner, the custom being to appropriate sufficient money during the September meeting of the County Council to take care of the road repairs for the following year, and despite the pleas of the county commissioners these items have been shaved so close that as repair funds they are a joke. To my actual knowledge one of our later gravel roads this year had $8.00 per mile for maintenance.

These highways, as a general rule, were built in a fairly substantial manner, and from the fact that they stand the wear and tear which they are subjected to for from five to ten years, with practically no care nor maintenance, where originally constructed in a reasonable manner, clearly shows that the life of the road could have been easily doubled or tripled with intelligent care in the repairs and maintenance.

But the point I wish to make is the fact that the older roads are the heavier traveled, and with our present motor traffic and greatly increased freight tonnage, they do not answer the purpose, and, taking into consideration their maintenance, or so-called maintenance, they are not, as a general thing, a subject for repairs, but for rebuilding. Not alone the wearing surface, but the gradients are excessively heavy, and the subgrades, drainage, culverts and pavement should be thoroughly remodeled and the highway rebuilt to get the proper roadway for modern conditions.

In our county—and, I suppose, in others—our recently constructed roads are, as a general rule, crossroads and byways leading to the main highways, connected with the county seat and with other larger cities, comprising our markets and business centers. These roads are by far better constructed in all ways than the principal highways, the result being that the nearer the city the poorer the road; and as our motor business or traction and pleasure or joy riders usually travel from one large center to another, they do not touch the better roads, except in the lesser populated counties, where road construction is prac-

*From a paper before the Indiana Engineering Society.

tically new and traffic light, and as this class of citizens form our best reporters, the consequence is that the whole highway system of the larger populated counties is condemned.

There is absolutely no way to take care of these county roads, except under the old repair method, which means that the road is never kept in good shape and steadily deteriorates from year to year, until, as in this county, we have a large mileage of supposedly improved highway which is very little better, if any, than our dirt roads, being saddled in addition with very heavy gradients, poor drainage and culverts.

Now, the only way to handle these worn-out county roads is not to repair, but to rebuild them to meet modern conditions; and as we have no legal way to proceed, under the rulings of our county attorney, it will necessitate legislation upon this subject; and if it becomes possible to pass a law covering the rebuilding of worn-out county roads, the law should, I think, if possible, cover the method and procedure in which these roads are to be taken care of after construction, although the latter being a subject upon which there is considerable chance for argument and widely different opinions, need not be embodied at present if it has a tendency to wreck the whole, although I think it is important.

I am also of the opinion that the act should, in the rebuilding of these old county roads, make the State as well as the county a party to the construction, and that both should bear their parts in maintenance after construction, and that the engineering department having charge of the work, whether they be county or state engineers, should be taken care of in an intelligent manner as to their duties and remuneration, as—and I think you will all agree with me—from $2.50 to $3.50 per day is hardly an attractive figure for a real engineer to jump at, although the road-law makers seem to think so, and they cannot understand why they do not get the same class of engineers and the same class of work which private corporations get who pay salaries and fees that somewhere near compensate the engineer for his work.

The Capitol Avenue Bridge, Indianapolis, Ind.

Editorial Correspondence.

INDIANAPOLIS is fortunate in possessing a number of very attractive bridges, which have been constructed over White River and Fall Creek, two streams which flow through the residential and park districts of the city and along which pleasure drives have been constructed. The most recently constructed of these bridges, one which is in fact not yet completed, is the Capitol avenue bridge across Fall Creek. Capitol avenue is a boulevard limited to pleasure vehicle traffic and the new bridge is at the junction of this avenue with the Fall Creek boulevard. The approach walls and rails join the lines of these drives in curves and are tangent to the curb lines.

By reason of its location in this important relation to the parkway system, particular care was exercised to secure a graceful structure which would prove consistent with and an ornament to the landscape features of the boulevards mentioned; and the result seems to fulfill the hopes of the park authorities in every particular. It was paid for by the county and constructed under the supervision of the Indianapolis Park Board.

The type of arch chosen was a modification of the Melan type; a seven-centered arch which joins the springing line tangent to a vertical line. The concrete which forms the body of the bridge is in no place visible except on the intrados of the arch. A granite facing on each of the piers and abutments and a Bedford sawed stone facing on the spandrel wing and approach walls and in the railings and posts adds greatly to the pleasing effect and the result is a graceful structure thoroughly consistent in every detail.

The center arch is longer than the two end arches, giving a curve to the entire bridge. The two end arches are each of 48 feet span with 8 feet 9 inches rise, while the main arch is of 84 feet span and has a rise of 11 feet 6 inches. The center arch is twenty inches in thickness at the crown while the two smaller arches are 12 inches. The resultant curve imparted to the roadway is parallelled by the railings.

The steel bridge, a double Pratt truss, which formerly occupied almost the exact site of the new bridge was removed early in June, 1911, and the center pier was left standing. Construction work was started by the contractors, The Cleary-Kuert Co., Indianapolis, on July 12th.

Excavations for the piers and abutments were carried down by cofferdams to a depth of 10 feet below low water mark and piling was driven to a depth of from 15 to 20 feet into the solid gravel which underlies almost the entire city of Indianapolis and forms the bed material in the small streams in the locality. A seal coat of concrete was then deposited into which the piling extended about 4 feet. Centrifugal pumps were operated continuously to remove the water which seeped through the gravel beneath the cofferdam. The seal coat was carried to a depth of about 2 feet below low water mark, where the granite face was commenced and carried to the springing lines of the arches.

The arch centering was of the ordinary type, as will be noted from the accompanying photographs taken during construction. Pile bents were constructed and caps were set on these, then the adjusting wedges were placed and other caps superimposed. On these rested ribs spaced 45 inches on the large and 32 inches on the small arches. The lagging, accurately sawed from 2-inch lumber, was placed on these. In laying out the curves for the forms, a pattern was marked out on the asphalt of the boulevard by accurate transit points and the material was cut to conform. The surface of the forms was carefully dressed and oiled with paraffin so that the under surface of the concrete is smooth and shows few joints. It is interesting in connection with the form work to note that about three months after the concrete had been placed in the arches, in January, 1912, a flood and floating ice carried away part of the centering and loosened the wedges on some of the other so that the arches were all practically unsupported from that time.

A very efficient plant was installed for placing the concrete. In dredging out the creek bed at an earlier period, an amount of excellent fine gravel had been excavated and dropped on the north shore of the stream. The mixer plant was set up on the roadway at this end and an inclined trackway with switches at both ends was run down to this gravel bank. Cars operated by a drum integral with the mixer and operated by the same engine were put in service to bring the materials to the mixer. The cars were run down by gravity to the gravel pile, receiving on the way the portions of cobble stones or coarse gravel required, and the cement. Then after the addition of the finer stream gravel they were hauled back to the mixer and dumped into it. The mixer discharged into a dump bucket suspended from a derrick at the north end and from which it could be passed to a derrick located on the center pier of the old bridge and thence to a derrick on the south bank or could be placed intermediately. A temporary trackway was also constructed, by means of which cars could handle the concrete for the longer distances. The plant handled on the average about 21 cubic yards per hour. A ½ yard batch mixer was used. A 1-3-5 gravel concrete was used in the substructure, while the arches were built of a 1-2-4 broken stone mixture. About 5,200 barrels of cement were used and the last concrete was placed before the period of very cold weather. Provision was made whenever

CAPITOL AVENUE BRIDGE, INDIANAPOLIS, IND
North End, Showing Plant for Handling Concrete and Concrete Materials.

the temperature was below freezing, to heat all the materials, to use hot water, and the concrete was heated by steam pipes for a period after placing.

It will be interesting to note the success of the waterproofing materials used as a compound which was mixed with the cement was used on the south arch while the other two were coated with a mineral and oil mixture which was painted on the surface. La Farge cement was used where the concrete joined the stone facing, to prevent staining. It was also used in pointing up all the stone work.

The Bedford stone facing possesses many novel features of construction and the care exercised in dressing and preparing it was such that there was not the slightest trouble in putting it in place. The hollow panels which form the small railing posts, were formed by carefully drilling three holes in a vertical line, of the radius of the top and bottom curve. The intermediate portion was then sawed away, leaving the panels as shown. The posts were all slotted to the depth of about 6 inches and the panel blocks and railings were dropped into accurate position, the railings being mitered into the caps of the posts, with the result that there is a perfect alignment of the railing throughout; though the posts extend slightly beyond the railings and the main posts of the columns slightly beyond the line of the intermediate posts so that in no case is there an unbroken straight line of sight. The rail is at a distance of about 44 inches above the sidewalk line so that it will be easily possible for one to rest his elbows on the top while standing on the sidewalks. All the stone was handled by the system of derricks mentioned in connection with the concrete, with the one difference that the center derrick was placed on the newly completed middle arch, for the reason that the old bridge pier had been removed. The second photograph shows the placing of the stone.

The lamp standards shown are of special design prepared for this bridge. They are of heavy cast bronze construction and will support five ball globe lights placed erect.

The roadway over the bridge is forty feet in width and was to have been paved with wood blocks, but the decision of the Park Board to make the pavement material the same as the north extension of Capitol avenue, which will probably be of asphalt, makes a change probable. There are ten-foot walks on either side, which will be constructed of granitoid. Conduits will be placed on both sides with convenient manholes for the accommodation of all wire lines. The seepage water is taken care of by red tile lines placed between the arches and communicating with pipes in the piers which discharge at about two feet below low water.

The contract price of the structure was about $85,000, though a unit price clause will probably increase this amount to some extent. The construction work was under direction of the Park Board who were represented on the job by L. V. Sheridan. The design was made by George E. Kessler, who is consulting architect for the Park Board, for whom H. B. Boardwell acted as architect and R. C. Barnett as engineer in direct charge of the design.

CAPITOL AVENUE BRIDGE, INDIANAPOLIS, IND.
South End, Showing Centering and Completed Arches Without Parapet.

EDITORIAL COMMENT

California's Public Utilities Act. — The County Jungle.
Financing Road Building.

CALIFORNIA'S PUBLIC UTILITIES ACT.

The State of California has had the opportunity to prepare a law providing for the regulation of public utilities of all sorts, in such manner as to take advantage of the experience of all the other State commissions, and all the formal steps leading to the law which went into effect on March 23, 1912, were taken during 1911.

California has had a railroad commission for over twenty-two years, having power to fix rates and prescribe a uniform system of accounts for transportation companies. In March, 1911, the legislature voted to submit three constitutional amendments to the vote of the people which would make it possible to give the Railroad Commission more power and to extend this power over the other public utilities in the state. These amendments were adopted by vote of the people on October 10, 1911, the bills putting them into effect were introduced at an extraordinary session of the legislature on November 28, and they were duly passed by both houses and were signed by Governor Johnson on December 23, 1911.

The bills were drafted by the attorney for the Railroad Commission, Max Thelen, after several months' study of the actual working of some twelve of the leading commissions of the country and of the statutes governing them, and cover the constitution of the commission, its powers and duties, the modes of procedure before the commission and the courts, the relations between the commission and public service corporations, both private and municipal.

There are five commissioners with term of six years, appointed in three groups of one, two and two, and salaries of $6,000 a year. Separate hearings may be held by the individual commissioners but their findings must be approved by the commission as a body before they become effective. The office is in San Francisco, but hearings may be held anywhere in the state.

The commission is given power, among others—

(a) To fix all rates, fares, charges and classifications.

(b) To establish through routes and joint rates, fares and charges.

(c) To investigate all interstate rates, fares and charges affecting this state and to apply to the Interstate Commerce Commission or to any court of competent jurisdiction for relief.

(d) To prescribe just, reasonable, safe and proper service, equipment, facilities and methods.

(e) To prescribe additions, extensions, repairs and improvements.

(f) To direct that additional cars or trains be operated and that trains stop with greater frequency and at proper places.

(g) To direct connections in proper cases, between the tracks of railroad or street railroad corporations.

(h) To direct, in proper cases, that switch connections and spurs be installed.

(i) To direct that physical connections and joint rates over two or more telephone or telegraph lines be established in specified cases.

(j) To direct the use, in proper cases, by one public utility, of a part of the property of another utility, on, over or under any street or highway.

(k) To direct the installation of safety appliances and other devices to safeguard the health and safety of employees, patrons and the public.

(l) To regulate crossings of railroad tracks and streets or highways in specified cases.

(m) To investigate the cause of accidents and to take steps to prevent their recurrence.

(n) To provide demurrage rules and

rules for the collection and delivery of express packages and telephone and telegraph messages.

(o) To fix standards, classifications, measurements and practices of gas, electrical and water corporations.

(p) To ascertain the value of the property of every public utility.

(q) To establish uniform systems of accounts for each class of public utility.

(r) To permit or refuse to permit new street railroad, gas, electrical, telephone or water corporations to enter a field already served by an existing corporation of like kind.

(s) To permit or refuse to permit corporations mentioned in (r) to exercise rights under new franchises or permits.

(t) To regulate transfers of the property used in the public service, of public utilities except express corporations, wharfingers and warehousemen, and the acquisition by one public utility of stock in another utility.

(u) To regulate and control the issues of stocks, bonds and other evidences of indebtedness within the state.

Hearings are held without regard for the technical rules of evidence with a view of ascertaining the truth as speedily and simply as possible. Any one aggrieved by a decision must first ask the commission for a re-hearing, giving his reasons for the same, and if it is refused he may then appeal to the State Supreme Court for a review of the question on the evidence presented at the hearing by the commission, without new evidence, the findings of the commission as to questions of fact being considered final.

The provisions for bonds filed by petitioners for review to protect those who would be injured by delay if decision is in their favor, and for impounding excess rates and fares at interest until the question of their validity is finally decided, seem to be ample and also in such shape as to prevent long-drawn out legal proceedings and appeals on slight grounds simply to secure delay.

Most cities and towns in California now have power to fix rates and fares charged by public utilities within their borders and some of them can regulate service, equipment, etc. These powers are continued under the new law. Another act provides that the people of any city or town through its council or by petition of 10 per cent of the electors can hold an election and turn the control of any of its public utility corporations over to the Railroad Commission.

One of the constitutional amendments restricts the control of the Railroad Commission to private corporations, thus leaving the municipally owned plants without control. In this California follows Washington, Oregon, Nevada, Kansas, Ohio and New Hampshire, and departs from the practice of the states which have commissions under laws producing the most satisfactory results, i. e., New York, Wisconsin, Massachusetts and New Jersey. If one may judge the future results in California from those already obtained in Wisconsin, for example, the cities and towns in California which have municipally owned plants will soon be very jealous of the better results obtained in the municipalities with privately owned plants under commission control. And it is quite possible that they will also be envious of the better market for the securities of the private plants, although the price of municipal securities is affected by other factors than the management of the utility for whose benefit a special issue of bonds is made. It is quite possible that the differences in service and rates will be so noticeable that the people will ask later that their own public utilities be subject to the same expert control that the constitution now provides for the privately owned plants. This depends largely, of course, on the efficiency and honesty of the State Railroad Commission, particularly of the first one, which has just gone into service.

The city attorney of San Francisco, Percy V. Long, has made a careful study of the effect of the new constitutional provisions upon the control of privately owned public service corporations by the municipality and has written an opinion in which he shows the entire change of principle made by the change in the constitution and the consequences thereof so far as San Francisco, at least, is concerned.

He shows that under the old constitution the public service corporations were practically free from municipal control, and that such corporations organized prior to October 10, 1911, continue to enjoy the same freedom, so far as they had exercised their rights. He asserts that these privileges were revoked by the recent amendments and that no new corporation can do business except under the control provided for by these amendments, which is by the municipality or the railroad commission as above outlined. He also asserts that no old corporation can extend its operations in the municipality except under the control now provided for. His reasoning in this regard seems conclusive and if sustained by the courts will ultimately give the cities control over the older corporations, because their desire for the extension of their business into new districts will lead them to concede this control over all their business in return for the grant of the privilege of making the extensions. Cities can hasten this day by judicious treatment of each particular case.

Mr. Long differentiates very clearly in his opinion between conditions that may arise. Thus the distribution of power is not mentioned in the amendments to the constitution, but the distribution of light is covered. An electric light and power plant desiring to extend its lines in San Francisco could therefore extend them for the purpose of supplying power without other control than that of the physical structures under the police powers of the State, but could not extend them for the purpose of supplying light without accepting the municipal control of its operations which is granted by the new sections of the constitution and the acts of the legislature thereunder.

THE COUNTY JUNGLE.

This term is applied to the present form of county government in New York State, and a diagram, which attempts to show the relations of county officers to each other, to the state government and to the people of the county and state, gives rise to the term, for it has every appearance of a trackless jungle, or rather of one with a multitude of tracks with little or no relation to each other, such as would be made by wandering animals trying to get from one place to another without guidance or knowledge of direction or distance.

This showing is made in the February *Short Ballot Bulletin*, and is possible because of the headless nature of county government, the independence of the various elective officials and their consequent possible irresponsibility and lack of cooperation.

The National Short Ballot Organization is wedded to the commission form of government, and so it recommends a board of supervisors as the responsible head of the county government, which shall have the appointment of all the other county officers, and shall have both the tax-levying and revenue-expending functions.

One member of the organization, Richard S. Childs, recommends the appointment of county judges by the governor, they to appoint the officers of the court, such as clerk and sheriff; the appointment of the prosecuting attorney by the state attorney-general, who is made an appointee of the governor, he to appoint the coroner; and the appointment of the county clerk by the secretary of state.

This process certainly produces a short ballot, but it produces scarcely any other good result and wholly overturns present principles and methods. For example: At present the construction of the main roads in the state is in the hands of the state highway department, and it is quite necessary that the county and township work on the local roads be thoroughly co-ordinated with the work of the state commission. This is made possible by the laws, recently passed, which give the state commission close supervision over the county and township engineers and supervisors and over their qualifications and attention to their duties. While it is true that the county supplies funds for road construction and maintenance, and to that extent might make claim to a right to supervise these expenditures, it does not supply all the funds, and the knowledge by its board of supervisors of the subject of road making is limited and fragmentary. Far better results are therefore obtained through the expert supervision by the state commissioners. This is amply demonstrated already by results.

The principle of home rule does not suggest the proposed change in responsibility of supervision, for the next proposition is to abolish the office of county auditor and substitute for him a state examiner with power to investigate and criticise county management, but not to interfere therein. The great value of control of county and municipal accounting by a state board has been demonstrated in Ohio, and therefore the proposal of a state examiner is a good one, but the proposed method of operation of the system is distinctly vicious, and opens the way to a system of blackmail which would be difficult to control.

Likewise the appointment of judges, prosecuting attorneys and county clerks by the governor or by his direct appointees is vicious in that it makes these offices the direct appendages of the state political machine. In other words, the proposed plan, so far as politics is concerned, simply transfers the political control from the county machine to the state machine, and the last state will be worse than the first.

It is possible to work out a short ballot scheme for the county which will concentrate responsibility for financial matters and for efficiency of county officers in a few hands. It is possible to work out a system of expert state supervision of matters concerning which most local authorities are confessedly ignorant, quite to the extent that they do not know that they are ignorant. And it is possible to do these things without interfering with the real, though as yet imperfectly recognized right of home rule. But the plan proposed violates so many of the fundamental principles of good government, and ignores so much of the information as to success and failure of the methods proposed and condemned, that it is worthy only of so much consideration as may tend to show its defects and disabilities.

County government in most states is in almost as bad condition as it is in New York, and this discussion may apply almost equally well to any other state.

FINANCING ROAD BUILDING.

Modern road construction has proceeded far enough to begin to show the difficulties which may arise in financing maintenance, which, added to the financing of new construction, may call a halt upon construction in some States. Municipal Engineering has advocated, during all of the campaigns for new roads built by modern methods, that the character of road should be suited to the traffic to which it is to be subjected. This is economy both in construction and in maintenance, and a State which adheres to this conservative policy will make more uniform progress than one which goes wholesale into the construction of high-class roads without previous consideration of the resulting annual expenditures for interest on bonds, for retirement of bonds and for maintenance and repair of the new roads. Such States as Indiana, Ohio and Kentucky have now many miles of macadam and gravel roads, which are fully equal to the duties required of them, but they need proper maintenance to make them wholly efficient.

Mr. Gibbon's article on another page gives a clear statement of the difficulties in Indiana. The money for these repairs is now available if there were a proper system of expert supervision of the maintenance of roads, so that this problem is not one of new financing, but of improving the present method of expending the available money and converting the labor available into its cash equivalent.

There are, however, a good many miles of these roads in the statement of mileage, which are not equal to the duties required of them, and they should be eliminated from the tables for the reasons given by Mr. Gibbon. He also shows the difficulty of taking care of these roads under the present Indiana laws. Other States have similar difficulties, if not exactly the same. Here some expert financial help is needed. The main roads, as so clearly shown by Mr. Gibbon, are worn out by through traffic, much of which is automobile, because the original construction was not sufficient and because the appropriations for repair have not been adequate, until now the roads are worn out beyond hope of repair and must be reconstructed.

It is claimed by some that this repair should be paid for by those who have made it necessary, viz., the automobilists, or that the reconstruction should be paid for by them. In considerable degree this is true, but the rapid wear is due not alone to the automobile, nor to the horse-drawn traffic, but to the combination of the two. Repair for either one alone would be comparatively easy and inexpensive. It is the combination which makes the problem so serious.

Early in the history of automobiling it might have been said, and was, that the automobilists developed the new difficulties, and they were in a special class which it might have been proper to treat in a specially drastic manner, but now the use of the automobile is so general, by denizens of the country as well as of the city; the increase in their use for hauling crops and materials to and from the farm, as well as between towns, is so directly dependent upon the excellence of the roads that it is no longer possible to place the automobilists in a class by themselves.

Students of the problem are rapidly coming to a state of mind which calls for the construction of these main roads as a general charge upon state, county and township, with assessment of some portion thereof upon the property locally and directly benefited in proportion to such benefit. They are also coming to believe that the traffic over the road should pay for the maintenance of the road after it is constructed.

The difficulties and expense connected with the maintenance of toll gates are such that the next alternative, that of graduated vehicle taxes, is usually chosen. The Governor of Massachusetts and the chairman of the State Highway Commission have recommended an annual tax on automobiles of $1 per horsepower, on the argument that wear of roads is roughly proportional thereto, either on account of speed or on account of weight of loads on commercial vehicles. One of the bills presented to the Indiana Legislature last year went still further, and most properly, and extended the vehicle tax to include all vehicles using or likely to use the roads. Granted the principle, the application thereof is a matter of development. None of us know as yet the proportional wear of roads by horses, horse-drawn vehicles, narrow or wide tires, steel or rubber tires, automobiles of high speed, of heavy weight, alone or used as locomotives for wagons or cars behind, etc., and this question must be thoroughly studied before a thoroughly equitable vehicle tax law can be framed. Meanwhile the financial problem is pressing and we must put some plan in operation which will bring in the money, and must correct as they appear the injustices which will arise from any law framed in our present state of ignorance.

The financial problems will apparently be most easily solved if, therefore, we bear in mind—

1. That the character and quality of road building should suit the traffic expected over them, thus reducing cost of some roads, postponing indefinitely the reconstruction of some and materially increasing the cost of some.

2. That the cost of the new roads should be distributed over state, county, township and abutting property in equitable proportions, thus increasing, probably, the expenditures of no one of these classes except the State, but securing better results.

3. That the present available funds for road construction can be administered more efficiently and economically and that they should be supplemented by equitable assessment upon the direct users of the roads of a portion of the cost of maintaining them as nearly as possible in proportion to their wear of the roads or the possibility thereof.

Roads wear out rapidly, and even if they are maintained efficiently they must be reconstructed at intervals. Bonds issued to pay for roads, like every other bond for the construction of a public utility, should have terms not longer than the estimated life of the road built with their proceeds.

THE QUESTION DEPARTMENT

RMP

Legal Practice in Street Improvements in Illinois.

I am city attorney of this Illinois city, which contains a population of about three thousand. The city authorities propose to pave about one mile of the streets of this city, and with that end in view have directed me to prepare the necessary resolutions and recommendations of the board of local improvements, and also the proper ordinances or ordinance therefor.

I enclose you a plat of the proposed paving. This plat is not, however, drawn to a scale. Beginning at the east or right side thereof, the paving will run two blocks west at a proposed width of 24 feet, thence one block south at a proposed width of 30 feet, thence one block west at a proposed width of 24 feet, thence south one block, proposed width 24 feet; thence west two blocks, proposed width 24 feet; thence south four blocks at a proposed width of 36 feet, thence continuing south one block at a proposed width of 30 feet, thence continuing south five blocks at a proposed width of 27 feet, thence around the public square, the proposed paving on the north and south sides thereof to be 36 feet in width, and on the west side thereof to be 30 feet in width.

You will notice that the line of paving will be continuous and contiguous. All of the same is to be of the same material and of the same method of construction. It is proposed that the whole cost of the paving be assessed against the property owners, to be collected by special taxation.

I am undecided on the following propositions: First, as to whether or not the whole cost of this paving can be assessed and collected from the property owners, meaning in this regard whether or not the property owners can be made to pay for paving the intersections of the streets. Second, whether or not this can be considered as one improvement and all embraced in one ordinance and one assessment roll.

The puzzling part of this proposition is whether or not the different widths upon the different streets and upon parts of the same streets as heretofore indicated and as shown on the plat, will make any difference as to whether or not the same can be considered as one improvement.

I wish you would give me some information in this matter and answer the foregoing propositions. The reasons for the different widths briefly are about as follows: The 24-foot line is upon narrower streets and away from the business section of the city; the one block of 30-foot pavement indicated in the 24-foot line is upon an unusually wide street, and this is widened for appearances principally; the 36-foot pavement is upon wide streets in the business portion of the city; the 30-foot pavement on the west side of the square is on account of a narrow street, the street being too narrow for a 36-foot pavement; the 30-foot pavement on Main street, and from thence on the 27-foot pavement, is in the residence portion of the city, and it was considered this width would be sufficient, notwithstanding the street continues the same width; the one block of 30-foot pavement between the 27-foot and the 36-foot was deemed proper so as not to make too sudden a change in width, principally for appearances.

M. T. R., City Attorney, ———, Ill.

The local improvement laws of Illinois are so general and indefinite in their nature that the practice and the court decisions have not been uniform. About four years ago the National Paving Brick Manufacturers' Association made an effort to increase the uniformity in practice and prepared a set of forms for use in all the steps to be taken in making local improvements from the petition for the improvement to the warrant of the collector of delinquent assessments. This book can probably be obtained from the secretary of the association in Cleveland, Ohio, and should be of much assistance in such cases as that described above.

There seems to be nothing in the law or in these forms to prevent including all the streets described in the question in one proceeding, provided the form of procedure is selected which assesses the cost according to benefits and not according to frontage. The cost of intersections can be assessed upon the city or upon the property, as may be decided in framing the ordinance. If bids are received per square yard of paving, per linear foot of curb, etc., it will be a little easier to determine the cost of each particular street or portion of street than if the contract is let for a lump sum, but in either case the assessment board can determine without much trouble the proportionate benefit to all the property affected.

Whether there are any court decisions which would modify this interpretation of the statutes is not known to the writer.

Ordinances for Removal of Obstructions From Streets.

I am now at work on an ordinance to remove wires, poles, signs, etc., out of business street. What data have you on such ordinance.

W. B. J., City Solicitor, ———, O.

These ordinances vary in the form as well as in the nature of their provisions, according to the constitutional and statutory provisions in the various States. The following are provisions in the ordinances in Ohio cities which are probably applicable to the city in question, although it is much smaller than either of them:

Cleveland covers the question of signs in a section which reads as follows: "All signboards and billboards now or hereafter erected on any residence street within 200 feet of any park, park boulevard or driveway, except signboards not exceeding a one-sheet board in area, used for advertising the sale or renting of the property on which they are located, and all signs on buildings on any residence street within said 200 feet, except signs advertising the business within, or signs used to advertise the selling or renting of the property, are hereby declared to be public nuisances, and any such first described signboards or billboards now existing shall be removed by the owners thereof within 30 days after the passage of this ordinance, and upon failure thereof the same shall be torn down under the direction of the inspector of buildings." The building code gives full specifications for all kinds of signs and provides that "any existing sign now erected on the outer wall of any building or attached to a projection thereto, and in conflict with the provisions of this code, shall be removed when rotten or unsafe or when ordered to be removed by the inspector of buildings. There is a similar specification for poles and posts on public property and requiring permits from the Board of Public Service for their erection, and also providing that "no posts, poles or signs heretofore erected or placed in or upon any sidewalk or street or other public places within the city limits shall be permitted to remain, except as provided in this section."

To remove wires entirely from a portion of the city streets is a more difficult problem, as it requires provision for conduits to carry the wires. The ordinances for placing wires underground in certain named streets in Cleveland are good models, though perhaps a little more complicated than would be necessary in a small city.

The Dayton ordinance regarding removal of signs is very simple. It is a section of the ordinance prescribing the methods of regulating signs, and says: "Any sign which extends over any part of any public way shall be removed by the owner or owners or user or users thereof upon 30 days' notice from the Board of Public Service so to do, and upon failure so to remove same, it may be removed by said board."

Poles, wires and conduits are regulated in Dayton by the ordinances granting privileges to the various companies requiring them in their operations.

Mileage of Pavements in United States.

Can you furnish us the following information, or inform us where we can get it without writing to the separate cities?

Miles of pavement in the different cities in the United States of 25,000 population and over. O. L. E., Oklahoma City, Okla.

This information is given for cities of over 30,000 population in the periodical volume of "Statistics of Cities Having a Population of Over 30,000," the latest printed edition of which is for the year 1908 and was printed in 1910.

Street Areas in Large Cities.

We are anxious to obtain statistics either accurate or estimated as to the proportionate street areas as compared with the building areas in the business sections of the following cities, New York, Chicago, Boston, Philadelphia, London, Paris, Berlin, Brussels, and Rome.

If you can supply us with any portion of this information or can refer us to any other authority the courtesy will be highly appreciated.

H. C. B., New York City.

The usual proportion of street area to total area of city is stated to vary in cities of the United States from 20 to 40 per cent. with Washington an exception, having 54 per cent. of street area. The report on social statistics of cities in the United States at the census of 1890 gives some figures from which the following percentages of areas not available for buildings may be computed. There is but little detail of information given, but it may be assumed that this area not available for building includes streets, parks, public places, alleys, water and other public space. New York had 37.6 per cent of such open space, Berlin 66.1; Boston 17.1; Brussels 58.0. Elsewhere in the same report is a statement of lengths of streets and alleys and average width of streets. The mileage of alleys being small in the eastern cities it will not be a serious error to assume the average width of streets to be the average width of streets and alleys, and, with this assumption, New York is found to have 16.2 per cent of its area in streets, Chicago 16.0 per cent, Boston 8.2 per cent and Philadelphia 8.4 per cent. Again in the report of the U. S. Census Bureau for 1907 on statistics of cities the lengths of streets are given and widths of pavements. These widths check the assumed total widths of streets from the earlier census report and, using them, it is found that New York has 10.9 per cent of its land area in streets, Chicago has 30 per cent, Boston 9.4 per cent and Philadelphia 12.9 per cent. These areas do not include alleys. The large increase in Chicago seems to be due to a much larger increase in length of streets than in area between 1890 and 1907, even though the figures for the latter year do not include alleys, of which Chicago has many miles.

Garbage Disposal for Small City.

This is a city of the sixth class, a health resort, with population of 2,000. The garbage question has become very acute. Can you let me know:

First. The cost of an incinerator to dispose of four tons of garbage per day? We would not wish to utilize the residue.

Second. The cost of operating the same.

Third. The best method of disposing of garbage for a city of this size situated upon a level peninsula, without facilities for taking the same to sea.

PRESIDENT BOARD OF TRUSTEES,
———, Cal.

There are so many differences in local

conditions that definite answers to these questions cannot be given for any one locality without study of them upon the ground. Some general information can be given, however.

Small garbage destruction plants are manufactured by the following firms, concerning which, as well as others, reference may be made to the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the headings "Destructors," "Garbage Disposal Plants," "Incinerators," "Refuse Destructors," Buffalo Engine Company, Buffalo, N. Y.; City Wastes Disposal Company, 156 Fifth avenue, New York; The Destructor Company, 111 Broadway, New York; J. B. Harris, 210 Stahlman building, Nashville, Tenn.; Specialty Engineering Company, Houston, Tex.; J. G. Branch, St. Louis, Mo.; Griscom-Spencer Company, 90 West street, New York City; Morse-Boulger Company, 39 Cortlandt street, New York City.

Some of these plants have as small capacity as 50 or 60 pounds per hour. It would probably be best for a small city, especially if it has a fluctuating seasonal population as a health resort, to install a plant of larger size than would be actually necessary and then run the plant as many hours a day or as many days a week as might be found necessary according to the season. This is done with government plants at army posts, quarantine stations, etc., common capacities per 24 hours being 5, 8 and 12 tons, the maximum capacity being reached only under conditions of very exceptional crowding of accommodations. A few cities have plants of about the sizes named, such as Coalinga, Cal.; Oak Park, Ill.; Butte, Mont.; Easton, Pa.; Santa Clara, Cal.

The cost of the plants varies greatly. The reported costs of the government plants are possibly greater than would be the case for small city plants. Thus one three-ton plant ready for erection in building cost $700, and a five-ton plant, $1,059. Another three-ton plant, erected but not including building, cost $2,400, and five-ton plants, erected but not including building, cost from $1,200 to $3,985. Five-ton plants, with building, complete, cost from $2,740 to $4,000. Much of the variation in cost is due to location and differences in cost of labor, materials and freight. Small city plants of 10 to 20 tons capacity per 24 hours have cost $1,900 to $4,295, erected, without a building, and others have cost $3,000 to $4,650, including building.

Several garbage furnace builders can supply portable furnaces large enough for the duty specified, such as the Destructor Company, 111 Broadway, New York; Isaac D. Smead, 141 East Fourth street, Cincinnati, Ohio; possibly the Decarie Manufacturing Company, Minneapolis, Minn., and Griscom-Spencer Company, 90 West street, New York.

Much of the above information about cost of plants is taken from Morse's "The Collection and Disposal of Municipal Waste" ($5), which is a compendium of valuable information on all branches of the subject.

The cost of operating the plant is even more indefinite than the cost of the plant. If the collectors can take care of the burning as well as the collection of refuse, and all the combustible refuse as well as well-drained garbage is collected, it may be possible to burn it with no fuel aside from the combustible refuse collected, in which case there would be no additional cost for disposal beyond the repairs, interest and depreciation on the plant. But if the garbage alone is collected and it is very wet, and a ton of coal at $5, say, may be required for four tons of garbage, and one or two extra men are required to take care of the furnace, the cost might easily run to $1.50 or $2 per ton of garbage destroyed. The true state of affairs would lie between these limits, and that is about all that can be said except by one who devises a plan and is given authority to carry it out.

Perhaps more information can be gathered from MUNICIPAL ENGINEERING than from any other single source. In a succeeding article on "Information Concerning Garbage Collection and Disposal" will be found a list of articles in the later volumes of MUNICIPAL ENGINEERING on the subject. Other lists of articles in still earlier volumes are referred to therein.

A few notes may be given here concerning small plants not referred to in the articles in the list.

C. E. Moore, city engineer at Santa Clara, Cal., reports that he built a small plant for $900, including a small building over the front and a shed roof over the receiving platform. He reported about 75 cubic yards of garbage destroyed per month, with slab fuel, at a cost of $20 for attendance and $8 for fuel, or about 35 cents a cubic yard, possibly equivalent to 70 cents to $1 per ton. The operation is not continuous and probably three times as much garbage could be disposed of for very nearly the same total cost.

The garbage furnace at the Naval Training Station, Newport, R. I., cost $8,599 complete and will destroy 2,032 pounds of garbage per hour. Its regular operation is 8 hours a day and it uses 1 pound of coal to burn 16.1 pounds of garbage. Attendants cost $2 a day and coal costs $3.60 a ton. An average for several months showed 4.5 tons of garbage burned per day at a cost of 65 cents per ton.

The plant at Oak Park, Ill., having a capacity of 30 tons a day, burns 9 to 10 tons, with a consumption of 1,400 to 1,600 pounds of coal. The fuel charge is about 20 cents per ton at this low rate of operation and the labor charge perhaps 30 cents more.

List of Articles on Garbage and Refuse Collection and Disposal.

I note that from time to time you have published lists of references on various engineering subjects found in past numbers of your valuable magazine. These lists I have found very valuable, but it has occurred to me that it would be still more valuable if you could publish a list of such lists, i. e., list of pages and general subjects only, going back, say, not longer than five or six years. I am sure that many of your readers would find such a general list, referring them to volume and page where they could find such information, of great value to themselves. L. S. S., ———, Wis.

In response to the above suggestion and in further reply to a question from another correspondent, the following classified list of articles in recent volumes of MUNICIPAL ENGINEERING on garbage collection and disposal has been prepared. Lists on other subjects will be prepared on request, and a list of these lists will be printed occasionally.

The general principles to be followed in devising a system for collecting and disposing of municipal refuse are well stated in such articles as that on "Refuse Disposal in Cambridge, Mass., xlii, 101; "The Pittsburgh Garbage Problem," xli, 61; "Reduction of Garbage," xl, 36; "Garbage and Refuse Collection and Disposal," xl, 106; the series of articles on "Town Scavenging and Refuse Disposal," xxxvii, 287; xxxviii, 1, 73, 143, 229, 299, 381; xxxix, 1, 85; "City Refuse Collection," xxxix, 286; "Night Soil Removal," xxxviii, 37; "Boston Report on Collection and Disposal of Refuse," xxxviii, 209; "High Temperature Garbage and Refuse Destructors," xxxviii, 258; "Disposal of Municipal Refuse in the United States," xxxv, 377; "Refuse Destruction for the Borough of Richmond, New York City," xxxii, 39; "Garbage Incineration for St. Louis," xxx, 28; "Garbage Collection and Disposal in St. Louis," xxx, 214; "Sewage and Dye Waste Disposal," xxx, 276.

Various systems and plants for collecting and disposing of garbage and refuse are described more or less fully in: "Harris Combination Incinerator and Power Plant," xlii, p. 205: "A Municipal Garbage Incinerator and Steam Generator," xli, p. 405: "The Garbage Crematory at Houston, Texas," xl, 177; "The Municipal Garbage Reduction Plant at Columbus, Ohio," xl, 322; "Special Services to Rochester Citizens," xxxix, 24; "The Municipal Garbage Reduction Plant at Columbus, Ohio," xxxix, 135; "Specifications for New Incinerating Plants for San Francisco," xxxix, 226; "Garbage Collection and Disposal in Minneapolis, Minn.," xxxix, 275; "Garbage Cremation," xxxviii, 63; "Garbage Collection and Disposal Plans for New Orleans," xxxvii, 49; "A Combined Refuse Destructor and Generating Plant," xxxvi, 253; "Refuse Destruction in Richmond Borough, New York City," xxxv, 359; "English, German and Swiss Destructor Plants," xxxii, 371; "Westmount, Quebec, Garbage Destructor," xxxi, 50; "Disposal of Dye and Wool Finishing Waste," xxxi, 204; "Garbage Disposal by Reduction Methods," xxxi, 211; "Street Cleaning and Disposition of Sweepings," xxxi, 374; "Garbage Reduction," xxxi, 414; "Garbage Disposal in Detroit," xxxi, 436; "Test of the New Decarie Garbage Incinerator at Duluth," xxx, 235, 313.

Articles giving some figures of cost of construction and operation of plants and of collection include: "Bids for Garbage Plant at Paterson, N. J.," xli, 483; "The Milwaukee Refuse Incinerator," xli, 148; "Sewage nd Refuse Disposal in Memphis, Tenn.," xxxix, 4; "Garbage Disposal in Paris," xxxix, 224; "Refuse Disposal in Somerville, Mass.," xxxix, 319; "Sanitary Railroad Construction Camps on Cedar River Watershed, Seattle, Wash.," xxxvi, 146; "Garbage and Refuse as Fuel in Nottingham, England," xxxv, 394.

Statistical data on garbage collection and disposal will be found in "Garbage Collection and Disposal," xl, 281; "Garbage Disposal and Street Cleaning Details," xxx, 25.

Sanitary garbage carts are described in "German Garbage Carts," xlii, p. 106; "Refuse Disposal in Berlin, Germany," xli, 476; "Odorless Garbage and Refuse Carts," xxxvii, 129; "A Steel Sanitary Cart," xxxvi, 195.

Feeding of garbage to hogs is described in an article on "Garbage Disposal in Montclair, N. J.," xli, 147.

Regulations and ordinances governing garbage and refuse collection and disposal are given in "Regulations for Collecting Garbage at Householders' Expense," xl, 348; "Suggested Garbage Receptacle Ordinance for St. Louis," xl, 445; "Refuse Can Be Dumped in Lake Michigan Only Behind Breakwaters," xxxix, 55; "Garbage Ordinance," xxx, 34.

Legal decisions and opinions on phases of garbage and refuse disposal nuisances, contracts, etc., will be found in "Exclusive Privilege of Collecting Garbage," vol. xl, p. 137; "Maintenance of Noxious Garbage Dump by City and Liability for Nuisance," vol. xxxviii, p. 352; "Ohio Cities Can Not Restrict Garbage Collection," vol. xxxi, p. 120; Exclusive Garbage Contracts Can be Made, xxx, 28.

Reviews of Books on the subject: Morse's "The Collection and Disposal of Municipal Waste," vol. xl, p. 143; Parsons's "Disposal of Municipal Refuse," vol. xxxv, p. 48; Baker's "Notes on British Refuse Destruction," vol. xxxv, p. 325; Venable's "Garbage Crematories in America," vol. xxxiv, p. 44; Branch's "Heat and Light from Municipal and Other Waste," vol. xxxiv, p. 111.

Descriptive lists of articles, most of which are also included in this list, will be found in "Disposal of Sewage and Refuse," vol. xli, p. 289; "Information About Garbage Collection and Disposal," vol. xli, p. 291; "Information About Garbage Destruction," vol. xxxix, p. 39; "Garbage Collection in Small City," vol. xxxviii, p. 194; "Garbage

Disposal in America," vol. xxxviii, p. 422; "Collection and Disposal of Garbage in Small Cities," vol. xxxvii, p. 36; "Information on Refuse and Garbage Disposal," vol. xxxvi, p. 257; "Information on Street Cleaning and Garbage Collection and Disposal," vol. xxxv, p. 179; "Garbage Disposal," vol. xxxii, p. 95; "Disposal of Garbage in Small Towns," vol. xxxi, p. 454; "Power from Garbage Destructor," vol. xxx, p. 25.

Miscellaneous articles of less importance include: "To Exhibit Cleveland's Garbage Plant," vol. xli, p. 147; "Los Angeles' Refuse Disposal," vol. xli, p. 480; "Baltimore Collects Its Own Garbage and Refuse," vol. xl, p. 127; "Modern Municipal Sanitation in Cuba," vol. xl, p. 333; "Information About Garbage Plants," vol. xl, p. 350; "Cities Operating Garbage Incinerators," vol. xl, p. 427; "Manufacturers of Garbage Disposal Plants," vol. xl, p. 428; "Test of Decarie Garbage and Refuse Incinerator," vol. xl, p. 460; "Los Angeles Has a Garbage Nuisance," vol. xxxix, p. 54; "Garbage Reduction," vol. xxxix, p. 153; "Municipal Improvements in Richmond, Ind.," vol. xxxix, p. 194; "The Destructor Company," vol. xxxix, p. 415; "Municipalities Operating Garbage Reduction Plants," vol. xxxix, p. 471; "Garbage Disposal for Small City," vol. xxxviii, p. 267; "Municipal Garbage Collection Proposed for Washington, D. C.," vol. xxxviii, p. 431; "Garbage Disposal and Street Cleaning," vol. xxxiii, p. 236; "Pollution of Sea Beaches in New Jersey Must Stop," vol. xxxiii, p. 263; "Garbage for Fuel," vol. xxxii, p. 314; "Ashes Removed by Trolley Cars," vol. xxxii, p. 335; "Cost of Street Cleaning, Garbage and Light in Cleveland," vol. xxxi, p. 189; "Garbage and Refuse Disposal in Pittsburg," vol. xxxi, p. 210; "Hogs Proposed as Garbage Disposal Plant for Boston," vol. xxxi, p. 210; "New York Garbage on New Jersey Beaches," vol. xxxi, p. 211; "What Is the Best Method of Garbage Disposal?" vol. xxxi, p. 280; "Odorless Excavators," vol. xxxi, p. 280; "Detroit's Garbage Question Undecided," vol. xxx, p. 292; "Chicago's Garbage Problem Postponed," vol. xxx, p. 292.

The correlative subject of abattoir management is treated in "A European Abattoir," vol. xl, p. 490; "Municipal Abattoir," vol. xxxix, p. 33; "The Municipal Abattoir and Reduction Plant at Paris, Texas," vol. xxxix, p. 90; "Austin Contemplates a Municipal Abattoir," vol. xxxix, p. 479; "A Municipal Abattoir in South Africa," vol. xxxv, p. 224; "Municipal Slaughter Houses," vol. xxxiv, p. 237; "Purification of Slaughter House Refuse at Zerbst, Germany," vol. xxxi, p. 86.

Crematories for Human Bodies are named in vol. xxx, p. 199.

Records in a City Engineer's Office.

I would like to get the most modern method of keeping city records for a city enginer's office, giving the method in detail, such as water mains and service connection to same, sewers and their connections and all records that should be kept by a city engineer. Are there any books published that give the information?

U. M. E., City Engineer, ———, Minn.

There is no book which is of direct application to the problem stated. The books on accounting, recording and filing give principles which are applicable, and also many details of method, but laws, customs and other local conditions vary so much that no book could cover them all. The following articles in Municipal Engineering treat the subject from almost every viewpoint and will be of much assistance in working out a system. Some of them refer to other articles in still earlier numbers, as well as to books and other sources of information.

"Record of Water Fixtures and Meter Readings," vol. xlii, p. 121.

"Method of Keeping Record of Improvements to Established Water Works Plants," vol. xli, p. 13.

"Books on Accounting for Contractors," vol. xli, p. 129.

Review of Gillette and Dana's "Cost Keeping and Management Engineering," vol. xl, p. 446.

"Contracting Practice," vol. xl, pp. 393, 475; vol. xli, pp. 1, 93, 173, 252, 337, 421; vol. xlii, pp. 23, 104, 149.

"A Card Index of Catalogs," vol. xl, p. 536.

"Form of Grade Book for Small City," vol. xl, p. 210.

"Smoke Abatement Campaign Material," vol. xl, p. 354.

"Record of City Improvements," vol. xl, p. 222.

"Forms for Proposals and Estimates," vol. xl, p. 344.

"Water Rates and Records at Valparaiso, Ind.," vol. xxxix, p. 18.

"Forms of Receipts and Water Bills and Water Rates," vol. xxxix, p. 120; vol. xxxviii, pp. 184, 347, 423.

"The Card Index Applied to Fire Fighting," vol. xxxix, p. 130.

"The Classification and Filing of Technical Memoranda," vol. xxxix, p. 190.

"Card Index for Engineer's Office," vol. xxxviii, p. 113.

"Bookkeeping for Metered Water System," vol. xxxviii, p. 182.

Review of the annual report of the city engineer of Salt Lake City, Utah, for 1908, which gives detail as to classification and methods of keeping records and accounts by a system which is very complete and is doubtless efficient; vol. xxxviii, p. 56.

"Handling Day Labor in Holyoke, Mass.," vol. xxxviii, p. 202.

"Improved Municipal Accounting for Washington," vol. xxxviii, p. 208.

"Forms for Daily Force and Material Reports," vol. xxxviii, p. 270.

"Service Reports and Balance Sheets for City Law Departments," vol. xxxviii, p. 348.

"Model Form of Report for Water Works Department," vol. xxxviii, p. 350.

Review of Garrison's "Accounting Every Business Man Should Know," vol. xxxviii, p. 357.

"Forms of Meter Repair Records," vol. xxvii, p. 260.

"Control of Workmanship on Asphalt Pavements," vol. xxxvii, p. 301.

"Cost Keeping on Municipal Contract Work," vol. xxxvi, p. 1.

"A House Numbering System," vol. xxxvi, p. 38.

"A System in Municipal Accounting, vol. xxxv, p. 22.

"Water Rates and Rentals," vol. xxxv, p. 73.

"System of Accounts for Small City," vol. xxxv, pp. 177, 246.

"Municipal Accounting System of Atlantic City, N. J.," vol. xxxv, p. 298.

"The Ohio Law on Supervision of Accounts of Public Officials," vol. xxxiv, p. 90.

"State Supervision of Public Accounts Recommended for South Carolina," vol. xxxiv, p. 104.

"Books for Keeping Water and Light Plant Accounts," vol. xxxiv, p. 165.

"Books on Operation of Water and Light Plants," vol. xxxiv, p. 231.

"A Daily Report Form for Street Work," vol. xxxiv, p. 239.

"New Accounting System for Springfield, Ill.," vol. xxxiv, p. 245.

"A Few Experiences in the Examination of Water Works Accounts and Management," vol. xxxiii, p. 40.

"The Demand for Better Forms of Municipal Accounts and Reports," vol. xxxiii, p. 42.

"City Engineer's Office Records," giving references to a number of earlier articles on this subject, vol. xxxii, p. 18.

"Form of Pumping Station Records and Sinking Wells," vol. xxxii, p. 21.

"Establishing Street Grades and Water for Concrete," referring to a number of articles on procedure and records, vol. xxxii, p. 22.

Review of McCullough's "Engineering Work in Towns and Small Cities," vol. xxxii, p. 49.

Review of Mulhall's "Quasi-Public Corporation Accounting and Management," vol. xxxii, p. 188.

Review of Gillette's "Handbook of Cost Data for Contractors and Engineers," vol. xxxii, p. 189.

"A Method of Filing Notes, Sketches and Clippings," vol. xxxi, p. 41.

"Filing and Indexing City Engineers' Records," vol. xxx, p. 270.

"Loose Leaf System for Field Notes and Office Records," vol. xxx, p. 409.

Cost of Electric Current in Cities.

Our city is investigating the cost of electric current for lighting, heat and power purposes.

I presume you have this information easily accessible, as the question often arises. Therefore for the city and myself I request such information as you can furnish on the following questions:

In cities between 100,000 and 200,000 population in the United States—

1. What is the cost per arc light per annum?
2. What is the cost per incandescent lamp per annum?
3. What is the price to consumers for such electric current? The classes into which consumers are divided, and the price charged each?
4. The cost of production and transmission of such current in these cities?

J. L. Mayson, City Attorney, Atlanta, Ga.

1. The cost per arc light per annum for street lighting is as follows, all-night schedule:

Columbus, O.—Municipal plant.
Toledo, O.—2,000-c. p. magnetite arcs, $83.
Atlanta, Ga.—500-w. arcs, $60.
Oakland, Cal.—2,000-c. p. arcs, $75.60.
Worcester, Mass.—380-w. arcs, $91.25.
Syracuse, N. Y.—2,000-c. p. arcs, $68.
New Haven, Conn.—320-w. arcs, 20 cents per night, or about $73 a year.
Birmingham, Ala.—450-w. arcs, $70 a year. City also has small plant.
Memphis, Tenn.—1.5-amp. arcs, $75.
Scranton, Pa.—A. c. and d. c. arcs, 480-k. w., $72.
Richmond, Va.—Arcs, $54.75 and $57. Also has municipal plant, now using water power.
Paterson, N. J.—2,000-c. p. arcs, $77.50.
Omaha, Neb.—A. c. arcs, 6.6-amp., $60.
Fall River, Mass.—4-amp. magnetite arcs, $91.25.
Dayton, O.—465-w., d. c., series arcs, $66.
Grand Rapids, Mich.—Municipal plant, costing city, for 2,000-c. p. arcs, $57.24 a year.
Nashville, Tenn.—Municipal plant.
Lowell, Mass.—4,000-c. p. arcs, $100.
Cambridge, Mass.—450-w. arcs, $90.
Spokane, Wash.—7.5-amp., 2,000-c. p., series arcs, $58.
Bridgeport, Conn.—1,200-c. p. magnetite arcs, $73.
Albany, N. Y.—2,000-c. p. arcs, $98.55.

2. The cost per incandescent lamp per year for street lighting, all-night schedule, is as follows:

Atlanta, Ga.—75-c. p., $33.75.
Oakland, Cal.—16-c. p., $7.20.
Worcester, Mass.—50-w., tungsten, $18.
Syracuse, N. Y.—128-w. and 50-w., $24 to $20.
New Haven, Conn.—8 to 100-c. p., 11 cents per k. w.
Scranton, Pa.—40-w., series tungstens, $15.
Paterson, N. J.—$15 to 20.
Omaha, Neb.—50-w. tungstens, $15.80.
Fall River, Mass.—40 and 75-w. tungstens, $20 and $25.
Dayton, O.—60-c. p., 6.6-amp. tungstens, $24.
Lowell, Mass.—25 and 40-c. p., $18 and $22.50.
Cambridge, Mass.—40-c. p. tungstens, $25.
Spokane, Wash.—100-w. tungstens, $18.
Bridgeport, Conn.—75-w., series arc, $27.
Albany, N. Y.—40-c. p. Mazda, $20.

3. But few prices to consumers are at hand. They are as follows:

Toledo, O.—9 cents per kw. hr., 10 per cent discount.
Oakland City, Cal.—10 cents per kw. hr., 5 to 65 per cent discount for light; 5 to 12 cents per kw. hr. for power.
Syracuse, N. Y.—8 cents per kw. hr., 10 to 40 per cent discount for light; 8 to 1.75 cents for power.
Birmingham, Ala.—12 cents per kw. hr. for light and 7 cents for power, with discounts.
Memphis, Tenn.—11 cents per kw. hr., 1 cent discount for light; 10 cents, with discounts, for power.
Paterson, N. J.—10 cents per kw. hr., with discounts for quantity, for light, and for quantity and demand for power.
Nashville, Tenn.—For commercial incandescents and 500 to 2,000-c. p. arcs, 12 cents per kw. hr. is charged by private company furnishing them.
Lowell, Mass.—Commercial arcs and 16-c. p. incandescents cost 11 cents per kw. hr.

4. The cost of production and transmission is not available. One item of importance is the cost of coal, which is reported as follows, per ton:

Columbus, O., $1.29.
Toledo, O., $1.50 to $1.65.
Atlanta, Ga., $2.
Oakland, Cal., oil, 2.3 cents per gallon.
Worcester, Mass., $4.40.
New Haven, Conn., $4.
Birmingham, Ala., $1.55 at city plant, $1.50 at private plant, delivered.
Memphis, Tenn., $1.45 to $1.65.
Scranton, Pa., $1.25.
Richmond, Va., $3 to $2.63.
Omaha, Neb., $2.40.
Fall River, Mass., $3.40.
Dayton, O., $2.25 to $2.18.
Grand Rapids, Mich., $2.94.
Nashville, Tenn., $2.80.
Lowell, Mass., $5 to $4.53.
Cambridge, Mass., $4.
Spokane, Wash., water power.
Bridgeport, Conn., $3.85.
Albany, N. Y., slack, $3.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. Never mind style of composition, the fact is what is wanted.

Thorough Study of Smoke Problem in Progress.

To the Editor of MUNICIPAL ENGINEERING:

Sir—It may be of interest for you to know that we are entering upon a study of the smoke problem in the broadest possible manner.

We are taking the following as our chief lines of investigation: The effect of smoke on health, plant life and buildings. We are also considering the increased cost of living due to damage and dirt caused by smoke, and the legal as well as the engineering side of the question. Each of these investigations will be carried out by one or more men, each a specialist in his line.

It is hoped that by co-ordinating these various researches it will be possible to obtain some valuable technical as well as scientific data. We will at least be able to establish the status of the problem, as a whole, on a scientific basis.

I am writing at this time to see if you will not aid us in this undertaking by making mention of the work we are doing in the pages of MUNICIPAL ENGINEERING. We should like to get in touch with people interested for the purpose of co-operation, information and suggestions.

Thanking you in advance for any aid that you may see fit to render us, I beg to remain,

Very truly yours,

R. C. BENNER,

Department of Industrial Research, University of Pittsburg, Pa.

Water Tight Sewer Joints.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Seeing the mention of "Jointite" in your February issue I thought perhaps you might be interested in knowing may experience with same on sewer work at Summit, of which place I am city engineer, so I am enclosing an outline of its use and a few details of cost and my reasons for making water-tight joints which I thought might be on interest to some of your readers.

JOHN S. STIGER,

City Engineer, Summit, N. J.

Experiments were made by the writer during the winter of 1909-10 on waterproofing sewers. These experiments resulted in getting a flexible water-tight joint material that would remain water-tight under pressure when deflected to a very great degree. This property is of great value not only in lessening the liability to injury of the joint when constructing the sewer but later when settlement is so apt to occur. This material, known as Jointite, manufactured by the Marbleoid Co. of New York City, is heated to a temperature of 400 degrees or more and poured into joints in similar manner to lead and can be safely handled in all kinds of weather without danger of cracking tile or of poor results.

One of the peculiarities of the material, which is of great value, is that it adheres to a wet pipe, apparently dispelling moisture in the form of vapor produced by the heat of the mixture. I have often in my work at Summit poured joints in from 4 to 6 ins. of water with apparently the same good results as if poured on dry pipe. Lines so run stood both an outside and inside water test. However, I do not of course advise pouring joints in water where it is practical to pump, which is usually the case, and in fact almost always necessary in order to handle the excavation economically. On 8 in. deep and wide socket tile pipe I specify 3 lbs. of compound to a joint and as the cost of the material is $105 per ton or 5½ centts per poundd it would make the cost of these water-tight joints, including labor of running, about 7 cents per foot, or slightly less than $370 per mile. Engineers differ as to the cost of cement joints but I think all will agree with me that $100 per mile would be a very low estimate. This makes the additional cost of $270 per mile for sewers that will remain water-tight under all conditions, as I have proven during the past two years on over twelve miles of sewers laid throughout the city of Summit.

As half the sewerage in Summit has to be pumped, I estimate that the saving in cost of pumping alone would pay the additional cost of water-tight joints in less than five years. Based on the average infiltration of 140 miles of sewers throughout the small towns in Massachusets as reported by Mr. Kenneth Allen, of 40,000 gals. per mile daily, the cost of pumping this infiltration would amount to as much in one year and two months as the additional cost of making tight joints. Summit's infiltration is much less than most towns owing to the hilly or rolling surface and porous sub-soil, therefore it would be less important to make water-tight sewers here than in most towns, were it not, as I have already stated, that we have to pump half our sewage and are also limited to capacity in joint trunk sewer. However, nearly all towns are either simiilarly situated or have purification plants which make it equally important to prevent infiltration owing to the additional cost of treating.

I would further state as my experience that in quicksand work or in any ground where much water is encountered, it is not only better, but cheaper to use Jointite than cement if only sufficiently tight joints are desired to prevent quicksand entering through them. In all work at Summit I specify Jointite whether in wet ground or dry, as I consider it as important to prevent the sewage from getting out and polluting the subsoil, as to keep ground water from coming into the sewer.

Managing a Clay Bottom in a Tunnel.

Tunnel work for sewers, being usually near the surface, often encounters very troublesome obstacles in a combination of different materials, and sometimes in clays which seem to leave no foundation fit, or possible, to work on.

An interesting example from a piece of tunnel work in connection with the new sewerage work in Louisville, Ky., is given in the report of the chief engineer, J. B. F. Breed, and Harrison P. Eddy, of Boston, consulting engineer.

This was a tunnel nearly 1,300 feet long, the driving of which was made difficult, among other causes, by the variation in the depth of rock. In some places the headings were entirely in rock; in others entirely earth, while for about one-fourth of the distance the roof was in earth and the lower part of the tunnel was in rock. The method of construction adopted by the contractor was to first drive the entire length of tunnel between two shafts, then to start the concrete in the center of the drift, working in each direction toward the shafts. In the headings, which were wholly in earth, the wet, blue clay encountered was rendered soft and unstable by the continual disturbance caused by working upon it and by the passage of men and cars over it. This condition was avoided by building a sub-invert of concrete five inches in thickness as fast as the tunnel was driven and upon and over which the employes could work and pass back and forth without causing any softening of the material underneath.

In some places the clay was found to be particularly soft, so that the upward pressure of the clay in the floor of the tunnel, due to the weight of the surrounding material, caused some trouble in placing the concrete sub-invert. In such places a three-inch oak platform was placed on the clay bottom and on this the sewer was built. Under Mellwood avenue similar conditions were encountered and much trouble was experienced in attempting to drive a tunnel. The attempt to tunnel was finally abandoned and this portion was built in open cut, by which method no difficulty was experienced, apparently because of the reduced amount of walking over the clay bottom. In the open trench the clay was removed to a depth of twelve inches below grade, this excavation being refilled with gravel, which provided a satisfactory foundation for the concrete structure.

Sewer Construction in Lagrange, Ill.

The village of Lagrange, Ill., is just completing 6,500 feet of combined monolithic concrete and vitrified pipe sewer. The former of these is 6½ feet in diameter and will take care of storm water, while the smaller pipe, 15 inches in diameter, will carry sewage to the filter beds. These sewers parallel each other in the same trench, with their centers on practically the same plane.

The concrete sewer has walls 8 inches in thickness, and the concrete is extended to cover the pipe sewer to a thickness of 6 inches. This is done because the flow through this pipe is at a considerable head at some points.

The excavation is made with a 45-ton Bucyrus shovel, while a Vulcan traction shovel makes the back fill.

Concrete is mixed directly over the trench on a platform resting on rollers. The mixer outfit comprises an engine, a boiler and a Drake continuous mixer discharging through a swinging pipe directly into the forms. Concrete materials are distributed in piles at convenient intervals along the trench either in the street or on private property. From here it is delivered by wheel-barrows directly into the mixer.

About 130 feet of the sewer invert extending up on the sides to within a foot of the center line is poured before any attempt is made to place the arch. The platform is pulled ahead by a crab on the engine. Forms are then set up and the platform returned to pour the concrete into the arch. These forms consist of 2x6-inch lagging placed over ¾x3-inch steel half rings, which have their turned-in ends bolted together at the sides of the sewer. To facilitate removal, wedges were placed between the ends of the half rings. The lagging is 16 feet long and the rings are spaced 4 foot centers. A steel band 1-16x4 inches in cross-section, bent to the half circle with the ends turned in and back to hold the first plank secures the lagging in place at each side. The last piece placed at the top forms a key which is so wedged against the adjoining pieces that it can be removed quickly. Forms are left in from thirty to forty-eight hours. The contractor has sufficient lumber to set up about 500 feet of forms. From 130 to 160 feet of completed sewer constitutes an average day's work, except where a medium hard limestone ledge, varying in depth from 0 to 6.5 feet was encountered. Two men only are required to remove the forms and carry the material forward. Two other men erect the inner forms for the arch and also place the boards used on the haunches on the outside.

The invert of the sewer is given a plaster finish ¾ to 1 inch thick, applied as soon as the comparatively dry concrete has been placed. The arch is smoothed up with plaster where necessary as soon as the forms are removed.

The concrete used in constructing the sewer is mixed in the proportions of one part Universal Portland cement to three parts torpedo sand and five parts of 1½-inch broken limestone obtained from quarries about one and one-half miles from the work.

The Ewing & Stone Company, of Chicago, are the engineers on the job, with Mr. Edwin Hancock, of that company, in active charge.

The Youngstown Slag Road.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I note in the February issue of "MUNICIPAL ENGINEERING," on page 98, an article published as Editorial Correspondence and entitled "The Youngstown Slag Road." Taken as a whole, your correspondent gives a good review to date of the slag experiments conducted by this office in co-operation with the Carnegie Steel Company, but there is one erroneous statement to which I take occasion to call your attention in order that it may be corrected through your pages. I refer to your representative's report of an inspection of Section 40, on page 100, where he says:

The binding material, a crude coke-oven tar, seems to possess valuable properties for use in this connection, superior by far to most crude tars which have come to the writer's attention.

Then follows an analysis of a sample of the crude material with our recommendations as to the proper method of refining it to produce a satisfactory road binder.

For your correct information I am sending you herewith a copy of our circular describing the Youngstown experiments, and on page 9 you will find an analysis of the tar actually used with a brief statement showing that it was made from the crude material by following our recommendations. It was a refined product and your correspondent has evidently been misinformed; but since the wide circulation which this paragraph may have is apt to mislead your readers into attempting construction work with crude tars, and, moreover, places us in the position of recommending such tars for that class of work, I have to request that you make such prompt and public correction of the statement as you conventiently can. L. W. PAGE,

Director, Office of Public Roads,

Washington, D. C.

The analysis to which Mr. Page refers is as follows:

This tar was obtained from a by-product coke-oven plant at Sharon, Pa., where it was also refined by distilling off about 17 per cent. of the lighter oils and water. Its characteristics are shown in the following table:

ANALYSIS OF REFINED COKE OVEN TAR.

Specific gravity 25°/25° C. 1.217

Float test at 32° C(time) ....1 min. 25 sec.

Per cent. of free carbon (insoluble in CS2, aid tem.) 13.11

Distillation:	Per cent. by vol.	Per cent. by wt.
Water	0.0	0.0
First light oils to 110° C...	.0	.0
Second light oils 110°-170° C	b3.8	3.2
Dead oils 170°-270° C......	c26.6	23.4
Pitch residue	d69.6	73.4
	100.0	100.0

b. Distillate practically solid when cold.
c. Distillate showed about one-third its volume precipitated solids when cold.
d. Pitch residue, hard, brittle, fairly lustrous.

The Mechanical Action of Calcium Chloride.

To the Editor of MUNICIPAL ENGINEERING:

Sir—A companion piece to your very valuable article in the February issue on "The Germicidal Value of Calcium Chloride," from Prof. M. L. Trowbridge, will, I trust, be found in a brief description of my observation of the mechanical action of this chemical, which I have found very different from the accepted belief, in the four years of experimental work I have just completed.

I started my labors under the prevailing supposition that calcium chloride was a soluble salt which would dissolve completely in water and so become lost through this process of dissolution. But a close observation soon led me to doubt this theory. The fact that this chemical is considerably heavier than water would seem, on the lines of gravity, to make it impossible for the heavier substance, chloride, to lift and flow with the lighter substance, water. The fact that the chemical, once properly incorporated in a road, did not seem to wash or lose its moisture-gathering and giving properties, soon confirmed the belief that the chemical was not moved by a flow of water unless this flow was strong enough to lift and carry away bodily the road substance and surface to which it was attached. With this discovery, I began to question the theory of dilution and to substitute that of saturation. This I found fitted my experience more nearly, and so I took a sample of the chemical to Prof. John Matthews, the chemist in one of the high schools of this city, and arranged with him to test out this sponge theory as against the old one of dilution. At first he was inclined to ridicule my beliefs and was doubtful of results, but on hearing the actual results, which I had observed in over a year's use of the chemical in road treatment, he agreed to make the tests for me. He, very much to his surprise, found my contentions correct and has recently made affidavit to this effect for presentation to the Commissioner of Patents in support of my contentions before that office.

Now, with the chemical heavier than water, and having the sponge property of absorption and evaporation, rather than that of dilution and dissolution, you can see that the chemical, once properly and thoroughly incorporated in the top surface of a roadway, becomes practically indestructible. As Prof. Trowbridge shows in his able paper, once such an incorporation is a fact, the roadway becomes sterile, and if you allow this chemical sponge to dry out and the surface of your roadway to become dry and dusty, still you will have a relatively harmless dust, one carrying few, if any, disease germs.

I think I have also made still another discovery. In the chemical action of this chemical is a leech-like action of attachment by which it will attach itself to any substance it may fall upon in a liquid state, or on which it may dissolve and liquefy if put on in a granular form, and that, once attached, its removal is almost impossible. I first noted this in the saturation or liquefaction by air-moisture absorption of these granules in a steel-shell wheelbarrow from which we did our spreading in my first year's operation. The shell of this barrow became coated with the chemical to a thickness of over one-fourth of an inch, and this coating could only be removed with some sharp cutting tool, with a blow or pressure. This feature also adds greatly to the life and service of the chemical after application.

It must be apparent that with all these staying qualities, added to the disease destroying action shown to exist (with a proper treatment) in the paper quoted above, you have in the deliquescent chlorides (calcium, magnesium and sodium chlorides being in this same class, with magnesium chloride a greater moisture absorbent than calcium), a substance for road treatment that has no equal. Owing to these lasting, or non-wasting properties, you have a system of road treatment, repair, and construction that insures a constant improvement in same, with a rapidly decreasing cost, going almost to the vanishing point, and one that will stand any kind or condition of traffic, in fact, the heavier and harder, the better, as weight simply means a more solid compacting, and rubber auto tires simply iron down a damp surface.

There is still another feature of this chemical action that promises much comfort to the dweller on a treated roadway during the hot, sultry summer months, and that is the promise of a nice, cool air through the night after a light wetting in the evening, as the chemical, once saturated, will carry the moisture all night, and long into the next day, no matter how hot and dry it may be, and if there is moisture in the air to draw from, it will not dry out at all.

These actions are largely contrary to the generally accepted belief, but are hinted at by Prof. Trowbridge in his statement that the chemical, though subjected to an excessive dilution during a long or hard drain, will again concentrate on evaporation and so regain or recover its original strength. As I understand it, a substance that is subject to a large dilution, unless absolutely confined (which is impossible on a roadway), could hardly recover its original strength or properties, but if, as under my contention, it is not diluted but simply saturated, the water saturation may and will dry out and leave the body of chemical intact ready for repeated actions. Prof. Matthews does not think it loses its absorption powers in any great degree by this repeated action.

S. G. Howe,
Manager the Howe Chemical Road Co.,
Detroit, Mich.

Schedule of Professional Charges.

A schedule of charges for professional services of consulting and construction engineers has been prepared by a number of representative St. Louis engineers and endorsed by the Engineers' Club of St. Louis. The schedule follows:

The following schedule of charges is intended as a guide to engineers and their clients. It is adopted as representing fair and proper compensation for engineering services under the conditions stated, and is believed to conform to the established practice of the leading American engineers. We recognize the propriety of a per diem or percentage charge varying in amount according to the magnitude or importance of the work involved, or the experience and reputation of the engineer. We reserve the right to depart from the schedule at any time, if such action seems to us wise and proper.

1. For preliminary study and report upon a project, or examination of a project prepared by another engineer and report on same:

(a) Charges, \$50 to \$100 per day for the first two to ten days and \$25 to \$50 per day thereafter, plus all expenses, including salaries paid assistants, with an allowance of 25 per cent of such salaries for general office expenses.

(b) In lieu of the above, at the option of the engineer, a percentage charge varying from 1 to 2½ per cent.

2. For preliminary study, report and final detail drawings and specifications:

Charges same as under paragraph 1 (a), or, at the option of the engineer, a charge of 3½ per cent.

3. For preliminary study and report, preparing detail drawings and specifications, awarding contracts and acting in a general supervisory capacity during construction, including office consultation, but not including continuous supervision, inspection, testing or management—work costing \$10,000 or more, 5 per cent.

For work costing less than \$10,000 it is proper to charge a fee in excess of 5 per cent.

4. For full professional services and management, including preliminary studies, detail drawings and specifications, awarding contracts, active and continuous supervision, testing and inspection, work costing \$10,000 or more, 10 per cent.

For work costing less than \$10,000 it is proper to charge a fee in excess of 10 per cent.

5. For investigations and reports involving questions in dispute and intended for use in connection with expert testimony:

Charges, a minimum fee or retainer of $100 to $500, or such larger amount as may be commensurate with the financial importance of the case or the labor involved, with per diem and expense charges as per paragraph No. 1 (a).

6. Where a per diem charge is made six hours of actual work shall be considered one day. While absent from the home city, however, or while attending court, each day of twenty-four hours or part of a day shall be considered one day, irrespective of the actual hours of time devoted to the case.

7. When charges are based on a percentage of the cost, the commissions as above are to be computed on the entire cost of the completed work, or on the estimated cost pending execution or completion. Payments shall be made to the engineer from time to time in proportion to the amount of work he has done.

8. Traveling expenses, as well as any expenses involved in the collection of the data necessary for the proper designing or planning of the structure or project, such as borings, soundings or other tests, and excepting only ordinary measurements and surveys, are to be paid by the client in addition to the commissions herein provided for.

9. When alterations or additions are made to contracts, drawings or specifications, or when services are required in connection with legal proceedings, failure of contractors, franchises or right-of-way a charge based upon the time and trouble involved shall be made for same, in addition to the commission herein provided for.

10. Drawings and specifications are to be considered the property of the engineer, but the client is entitled to receive one complete record copy of same upon payment of actual cost of making copies if no duplicate set is on hand.

Cost of Tar Binding and Water Binding of Roads.

Having received a few inquiries as to the treatment of roads with "Tarvia" binding and "tar" binding, and as to the cost over the ordinary water-bound system, I thought it would perhaps be useful to embody the particulars in a short paper for the information of other surveyors in various parts of the country. In doing this I take into consideration that at this period of the year the estimates are being prepared for road work to be carried out during the forthcoming season, and the question to consider is the advisability of adopting more up-to-date methods in the repairing and remetalling of road surfaces, and whether surveyors are to advise their councils to use a tar binder or still adhere to the old water-bound system. There are various materials on the market from which to choose, such as ordinary gasworks tar, distilled tar, Tarvia and other patent tar preparations. In these short notes I shall only treat upon two—that is, ordinary gasworks tar, with an addition of pitch, and Tarvia. I append the approximate cost for the treatment of roads with these two materials, and also by the water-bound system as carried out by me during the past season. Of course, the cost of the various materials and work will vary in different districts according to distance from quarries, station or wharf to the road to be remetalled, and the cost of manual labor, etc. The amount paid by me for men averages about 3s. 2d. per day of nine hours. Another point to be taken into consideration in estimating the cost is the thickness of metal applied, whether one ton of metal is to cover ten or twenty square yards, and also the size of metal used, whether 1¾ inch or upwards to 2½ inch gauge.

The method adopted by me in the treatment of the roads is as follows: The dry metal is evenly spread over the surface of the road to the required contour, and then lightly rolled with a 12-ton roller to press the stones into their position; the Tarvia or other binder is then applied evenly over the surface by means of a 2-gallon water can or spreader, so as to cover every stone. After this has been done, ½-inch chippings are spread over the surface to fill up the interstices (allowing about 15 tons to 100 tons of metal); 10 tons are applied after application of binder. The whole is then thoroughly well rolled and brought to a good surface, after which the remaining 5 tons of chippings are spread to fill up any small holes which may still be showing, and left for the traffic to grind in. It is needless to remark that fine, warm weather is essential to carry out the work successfully and at a minimum cost. I find it necessary to have three 40-gallon tar boilers to keep properly going, otherwise the roller is standing idle, and the men have no binder to go on with, or are waiting for it to boil. Tarvia needs heating to a temperature of about 180 degrees Fahrenheit, and it is essential that it should reach about this temperature, otherwise it will not cover the area estimated (which should be at least one square yard to one gallon of material), and the work will take longer. When using Tarvia, which is very viscid, and difficult to get out of the barrel through the bunghole, especially if the weather is cold, it will be found necessary to take out the head of the barrel. The way to do this, causing least damage to the cask, is to knock off the chine and second hoops, tap the staves outwards with a hammer, remove the head, replace the second hoop and tighten up by driving it on, then empty the contents. The barrel will, of course, have been placed on the platform (mentioned later) before removing the head. The tools required are a cooper's drift and and two cooper's gimlets. A platform should be erected at a convenient point by placing two or more barrels on end and laying strong planks on them, and the barrels may be unloaded on to the platform or on to the ground and rolled up as required on two strong planks.

Two pieces of iron should be placed on top of each tar boiler and the barrels upended on them. The platforms should be placed in a position so that in removing once each day the material will only have to be carried a convenient distance.

The section of roadway treated with Tarvia has been a complete success so far this winter, it being practically free from mud and dirt, except a little brought on by wheels of carts from adjoining fields. The cost, as shown, works out at about 1s. 6¾d. per yard, but I consider it can be done for 1s. 4d., given favorable weather. In carrying out my work I was handicapped by wet weather and by only having two tar boilers for half the time the work was in progress, but I hope next season to show that Tarvia binding can be carried out at the price mentioned.

In considering the cost, the question of scavenging and cleansing requires to be taken into account, as the amount spent this winter on the section treated as been practically nil, which would not have been the case with a water-bound road.

I experimented on a small area of about 366 square yards with ordinary gasworks tar, with an addition of pitch. This has been fairly satisfactory, and would, I believe, have been a complete success, but I found the men were not using enough pitch, and were not allowing the mixture to boil. It is very evident enough pitch must be used, and the mixture brought to boiling point. As an experiment I consider it satisfactory, and believe it possible to produce good results if the above precautions are taken. The costs of the various systems will be noted from the appended particulars. I hope in making these remarks something may be done to assist in bringing about a better form of road surface.

PARTICULARS OF TARVIA BINDING.

	£	s.	d.
Quantity of metal used, 402 tons 6 cwt.; 322 tons, 11 cwt. of 2½-inch granite	148	15	7
79 tons 17 cwt. of 3-inch rejections (making up sides)	27	5	8
53 tons 8 cwt. ½-inch granite chips	20	13	10
Steam roller hire, 15 days	14	13	0
Manual labor, 8 men 15 days	19	8	8
Carting all materials (approx.)	35	18	8
3,813 gal. Tarvia "B" at 4¼d.	67	10	6
Use of 95 barrels at 6d	2	7	6
Return carriage on barrels	3	6	11
Fuel for tar boiler	1	12	6
Fuel for roller	4	1	3
Allow for tools and use of boilers	1	5	0
	£346	19	1

Length treated, 825 linear yards.
Area treated, 4,400 square yards.
Square yards per ton of metal, 10.90.
Approximate cost per square yard, 1s. 6¾d., or 38 cents.

APPROXIMATE COST OF TAR BINDING.

	£	s.	d.
23 tons (approximate) 2½-inch broken granite	11	8	1
3 tons ½-inch chippings	1	3	3
1½ days steam roller	1	2	6
Manual labor	1	10	0
280 gallons tar	2	6	8
3½ cwts. pitch		14	0
Fuel		10	0
Tools, etc.		2	0
Team labor	2	10	2
	£21	6	8

Area treated, 366 yards (approximate).
Cost per yard, 1s. 2d., nearly, or 28 1-3 cents.
Square yards per ton of metal, 16 yards.
The above figures are the maximum, as actual figures and particulars were not noted at the time, and I believe the actual cost to be less than this.

WATER-BOUND ROADS (ACTUAL FIGURES).

	£	s.	d.
80 tons 7 cwt. 2½-inch broken granite	39	16	10
21 tons 12 cwt. 3-in. rejections	9	12	7
6 tons ½-inch chippings	2	6	6
Binding		16	0
Manual labor, 4 days	4	6	11
Team labor and horse for water cart	8	4	7½
4 days steam roller	3	12	0
	£68	15	5½

Area treated, 1,372 yards.
Cost per square yard, 1s., or 24 1-3 cents.
Square yards per ton of metal, 13.5.

—G. BENSON CHILVERS, Engineer and Surveyor to the Oundle Urban District Council, in *The Surveyor and Municipal and County Engineer.*

Snow Removal in Indianapolis.

An exceptional winter was that of 1911-1912, is the concurrent opinion of the weather authorities, both of the goosebone school and of the government weather bureau. Municipalities have realized this fact and their various departments have been kept busy correcting the troubles caused by the extreme cold and snow. Waterworks departments report troubles with anchor ice at the intakes, frozen service pipes and mains; and in some few cases even sanitary sewers were blocked with solid ice. Fire departments have been called upon to contend with snow drifts which were impassable to the old type of fire apparatus and impeded even the high-powered auto trucks. Frozen hydrants have added to their troubles. The street cleaning departments have had their problems to contend with, which have thoroughly tested abilities.

In Indianapolis repeated snow falls through January and February have taxed the patience of the street cleaning department and have proved a drain upon the department's appropriation by reason of the extra force required to handle the snow on the downtown streets.

The government weather bureau records show a snow fall each week through January until the last week of the month, when the customary January thaw allowed the street department a slight breathing spell. For the first two weeks in February there was snow every day, ranging from a trace to 1.4 inches. Then on February 21st, came a storm which will make the winter remarkable as the year of the big snow. It started with a sleet on the night of the 20th, which quickly changed to a damp snow driven by a 36-mile wind. The snow was drifted badly throughout the city. The government records show a snowfall of 10 inches on the 21st, one of the heaviest ever recorded by the local bureau.

The result was a blockading of almost all forms of traffic. Street cars were kept in operation over a few lines during the morning and an effort was made to keep the tracks clear. An antiquated form of snow plow with a revolving brush which threw the topmost layer of snow to one side, was operated up and down a few of the main lines in an effort to keep them in operation, while the less important ones were abandoned. By early evening there were only two car lines in service, and except for an automobile bus line which operates regularly on Meridian street and a few privately owned automobiles and motor trucks which were being driven for hire, there was no traffic between the downtown and residence districts.

During the entire day the street cleaning department had been working with a force of 260 men endeavoring to keep the downtown streets in a passable condition. The heavy snowfall which had drifted to a depth of three or more feet at some points, was made worse by that which was thrown by the sweepers from the double tracks of the car lines, directly upon the portion allotted to vehicular traffic. Owing to the excessive and continued snowfall it was found impossible to extend the operations of the snow removal beyond the limits of the business and wholesale districts; but it is to the credit of the department that this district was not blockaded and that all of the snow was removed within three days from about 22,000 linear feet of 60 to 80-foot pavements.

The method of removal, while not by any means new, presents many points of merit. It was necessary, owing to the dampness and weight of the snow, to loosen it from the street surface and to place it in ridge piles for removal, so two graders, each drawn by six horses, were employed. The graders were driven close to the curb and the snow was piled towards the center, where, with that which had been thrown from the car tracks, it formed continuous mounds which were easy of access for loading. It was then loaded into dump wagons, enough men being employed so that there was little waiting for a load, and the driver in each case assisted in loading. A short haul of never more than a block was then made and the wagon was dumped directly over a manhole into a sewer, and that portion of the snow which did not fall directly into the manhole was shoveled into it. The three photographs accompanying show the different stages of the work.

I. SNOW REMOVAL IN INDIANAPOLIS.
Scraping and Loosening Snow.

There were a few minor details of handling the men and wagons which are perhaps open to criticism, but in the main the work was very efficient. It was evident that there was congestion at some points where 8 or more wagons were at work in one block as shown in photograph 1. They interfered with one another to some extent and it was noted that as they were driven to the manhole to be dumped, there were at times two or more wagons waiting their turn, while at other times the four or five men who were shoveling into the sewer would be left idle while they waited for a wagon. But with so large an unskilled organization gathered on such short notice, the work was creditably handled.

The regular barn force of the street clean-

II. SNOW REMOVAL IN INDIANAPOLIS.
Loading into Wagons.

ing department includes about 12 or 13 men, including the drivers, repair men, etc. The department owns about 45 wagons, of which number about 28 were available for the snow removal. The uniform scale of 20 cents per hour was paid to the regular and the extra men employed by the department. The following payrolls for January and February, furnished by J. C. Egger, of the street cleaning department, show the expense of snow removal during those months, for but little other work was done at that time:

January 3rd to 10th	$1,415
January 10th to 17th	1,900
January 17th to 24th	681
January 24th to 31st	552
January 31st to February 7th	849
February 7th to 14th	625
February 14th to 21st	891
February 21st to 28th	1,596
Total	$8,509

The total quantity of snow removed in January was 20,049 cubic yards, and in February was 24,339 cubic yards.

III. SNOW REMOVAL IN INDIANAPOLIS.
Shoveling into Sewer.

STREET · LIGHTING

Ornamental Luminous Arc Lamp.—Poughkeepsie's Lighting.—Dearborn Street Lights.—Ornamental Lighting.

The Luminous Arc Lamp in Ornamental Street Lighting.

The development of the magnetite or luminous arc lamp has been practically simultaneous with the growth and spread of ornamental street lighting. The fact that no attempt had been made, except for a very few exceptions, to render the arc light standards attractive, has caused the incandescent lamp to be adopted in the more modern examples of street lighting. A committee of the National Electric Light Association commented on this fact in a report to the association. Their comment was, briefly:

As regards arc lighting, there is very little which should properly be classified as ornamental. The fixtures employed are rather better than has been common in this country, but neither the fixtures nor the illumination would strike a visiting foreigner familiar with street lighting in continental cities as implying anything more than a workmanlike attempt to furnish adequate illumination in streets deserving it. They are indeed very few arc installations in this country which should properly be classified as ornamental lighting save in isolated spots. We may, therefore,, pass by the arc lighting matter as simply embodying vigorous efforts in the right direction without in any sense entering the field of decorative lighting.

The steadily increasing demand for a street lighting unit which is attractive in appearance by day as well as when lighted has led to the designing of an arc lamp, globe and standard which satisfies this demand. This unit is described in the General Electric Review, by C. A. B. Halvorson, Jr.

Photograph 1 is as illustration of the lamp mounted on one of these ornamental poles such as may be obtained from the various manufacturers. The lamp casing constitutes the capital of the supporting post or column, and is so designed that by releasing a latch it may be lowered to give free access to the lamp mechanism as readily as a similar operation is accomplished on an ordinary arc lamp.

As the lamp is designed to be operated from a series rectifier outfit, it is necessary to provide proper insulation from lamp to ground, as well as adequate protection for the trimmer.

With this end in view the lamp is placed on a high voltage strain insulator which is fastened to the pole by three deeply recessed screws placed 120 degrees apart; the lamp being held to the insulator by three other recessed screws permanently secured to the insulation. The changing of the lamps for any purpose is easily accomplished by removing three nuts, the studs projecting upward and being held in place ready for the installation of the new lamp. The details of the installation are shown in photograph 2.

Within the base of the pole an absolute cut out is placed so that the trimmer may disconnect the lamp from the line before starting to work on it.

The ornamental cover of the chimney is also highly insulated from current carrying parts, and it is practically impossible for any ground to take place here. The insulator acts also as the globe seat.

In operation and design the mechanism is essentially the same as that of the standard mechanism of the direct current series luminous arc lamps. The arc is struck between a stationary non-consumable copper upper electrode and a movable magnetite lower electrode, 9-16 inch in diameter and 18 inches long, burning under normal updraft conditions The lower electrode is carried on a rod (photograph 3) actuated by the standard type of shoe clutch mechanism. The current is carried to the electrode by means of a flexible spiral connection contained in tube which is telescoped by the electrode rod. A single side rod, telescoping the supporting tube, supports and carries the electrode, fume dome and chimney so that no shadows on the globe are visible when the lamp is properly placed, with the side rod toward the sidewalk.

The lamp is equipped with a diffusing globe that is unique in design in that it is perfectly filled with light and no circular shadows are cast upon it by the electrodes. It is equipped with an attaching ring fitted

1. ORNAMENTAL LUMINOUS ARC LIGHT.

with bayonet slots, which are arranged so that by turning the globe on its axis it may be removed without disturbing the alignment of the electrodes. If, on the other hand, it is desired to raise the globe for cleaning, without removing it from the lamp, this may be accomplished by raising the globe and turning it on the axis of the supporting rod; the electrode box and globe being handled as a unit and supported in position by a locking arrangement located within the tube. A large ash pan is provided, which is easily removable.

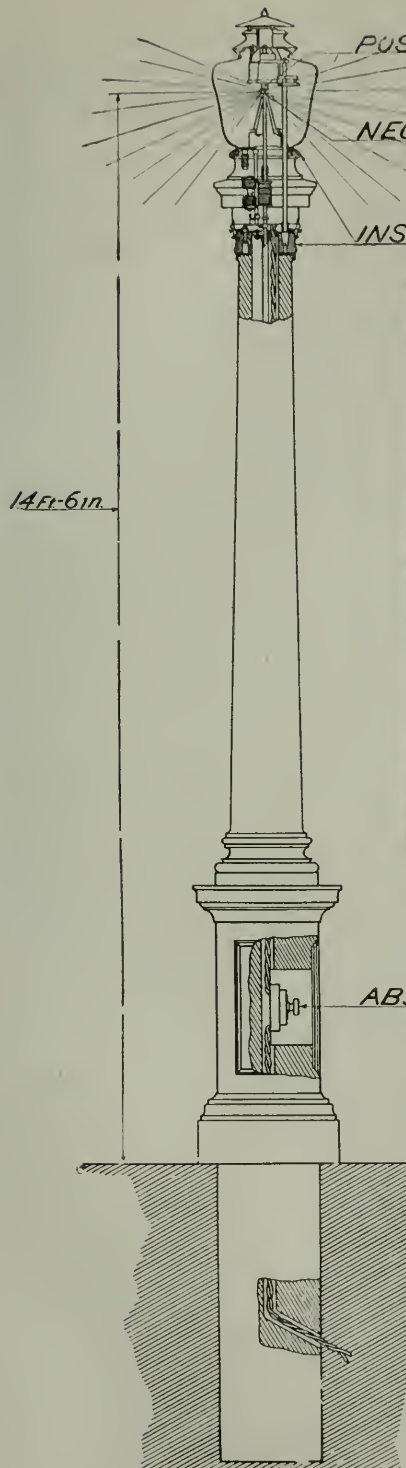
The operation may be stated as follows: The current enters a terminal, passing through the starting resistance, starting magnets, and the cutout contacts to the negative terminal. The starting coils are thus energized and the lower electrode is brought into contact with the positive, establishing the arc and the circuit through the series cutout coil; this coil, on becoming energized, separates the contacts and opens the circuit through the starting coils, thus allowing the lower electrode to fall back to its normal position, retarded by air dashpots. The electrodes remain in this position until for some reason the voltage at the arc momentarily reaches a point sufficiently high to actuate the shunt magnet, when the contacts are once more closed and the cycle of operation is repeated.

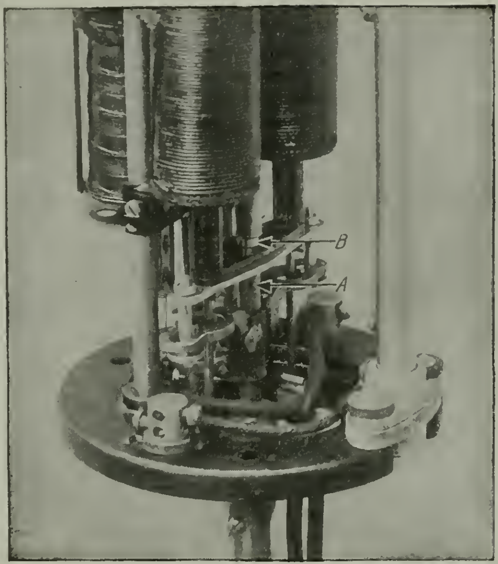
When operating at standard adjustments, the life of the lower, or magnetite, electrode is from 150 to 175 hours, and that of the upper, or copper electrode from 3,000 to 4,000 hours. The electrodes used being of the same composition as those used in the standard series luminous lamps, the illuminating efficiency at the arc should be the same; as, however, the lamp carries no reflector, a certain amount of light is directed upward and passes through the globe. The upward rays tend to obliterate finely-defined shadows, and are of great value to ornamental street lighting.

The first installation of this type of lamp was made in New Haven, Conn., and has been recently been put in service. The units are placed alternately and are spaced 87 feet apart. The first installation included 75 lamps which were located on the principal business streets. The wiring is all placed underground and each lamp is connected separately to a man-hole so as to provide for easy access for repairs.

The poles are of the design shown in photograph 1. Special provision is made to guard against grounding as noted in the previous description.

The new unit gives a light of a pure white color, so diffused as to give a minimum of glare. It is pleasing in appearance, efficient and particularly adapted to park and boulevard lighting.





3. ORNAMENTAL LUMINOUS ARC LIGHT.
Clutch Mechanism and Method of Connecting to Circuit.

2. ORNAMENTAL LUMINOUS ARC LIGHT.
Details of Installation.

Chemical Fire Extinguisher.—Lawton Water Works.—Motor Fire Engine.

Chemical Fire Extinguisher.

BY CHARLES H. MEIGS.

The extinguishing of large fires by means of water is a matter that has been fully developed. Steam pumps, motor-driven pumps and high-pressure systems may be further improved, but however the means and methods may be improved in fighting fire with water, the principle must always be the same and the endeavor must always be the same as at present—that is, to get an adequate volume of water in the proper place in the shortest possible time. It is absolutely true that if it were possible to get non-injurious fire-extinguishing chemical solutions in practically unlimited quantities and at not a prohibitive expense, the same as we now get water, plain water would never be used on fires. The impossibility of our doing this is the real reason and the only reason why all large fires are handled with plain water, for in these enlightened days we have every facility for knowing positively that chemical solutions are many times more efficient than plain water for fighting fire. And I wish to call your attention to another point that is not recognized by many, and that is that large fires are seldom extinguished by water. It is creditable if, by the use of water, we are able only to confine large fires to their place of origin. Large fires are never put out. They burn out, or nearly so, until they are small fires, and then are easily controlled by water. Even today reliable statistics prove that less than 20 per cent. of all fires are extinguished by means of water, over 80 per cent. being handled solely by chemical fire apparatus. Therefore we are well warranted, in considering fire extinguishing, in giving our attention to the subject of chemical fire apparatus; for it is only in chemical fire apparatus that any real improvement in the science of fire-fighting has been, or can be, made.

To be able to fight fire to the best advantage and to understand why one method of fighting fire is better than another we must know what fire is. "Fire," said Lavoisier in 1786, "is the combination of a substance with oxygen." To have fire, therefore, oxygen must be present with the material with which it is combining, and not only must they both be present—this oxygen and this material—but they must be present at a temperature above the burning point. So, then, two conditions are absolutely necessary before we can have fire. The burning point varies greatly in different substances. But all fire, whether it be the slow process of rust or the quicker process of a conflagration, when a building, a block, or a whole city, is a mass of flames, is simply the combination of some substance with oxygen.

As there are only two conditions that are requisite in order to have fire, it follows that there can be only two ways in which to extinguish fire. If it were practical in every instance the best and quickest way to extinguish any fire would be to separate the oxygen from the substance with which it is combining. They must be together and combine in order to produce fire; therefore, to separate them and to interfere with their combining is to extinguish the fire. That is the first way. The second way is to reduce the temperature below the burning point.

Water extinguishes fire because it reduces the temperature below the burning point by taking the heat of the fire and using it to change the water into steam; and it also, both by means of the steam and by itself, tends to form a blanket or covering over the burning material, thus separating it and shutting it off from the air (that is, from the oxygen in the air) and in that way extinguishing the fire.

The stream from chemical fire apparatus is much more efficient for fire-extinguishing purposes than is plain water because, first of all, this stream is water, and that fact is not changed because chemicals are carried in the solution. Therefore, the chemical stream does everything that the water stream does, exactly in the same way and for the same reason that water does it; and it does something that the water stream cannot do—that is, it forms a blanket of gases which are heavier than air, and which are non-supporters of combustion, and thus more effectively shuts off any access of air (oxygen) to the fire. You will note that something more is necessary than that these gases shall be heavier than air and thus act as a smothering blanket. They must also be non-supporters of combustion.

In the ordinary chemical fire apparatus

with which everybody is more or less familiar, known as the "soda-and-acid" type, a solution of bi-carbonate of soda is used, into which sulphuric acid is dumped. The heat of the resultant chemical action transforms the solution partially into carbonic acid gas (carbon dioxid, CO_2), and this gas is the fire-extinguishing principle—it being heavier than air and a non-supporter of combustion. The tank must be at least from one-fifth to one-seventh empty, to provide space for the collection of this gas which forms in larger volume than the space permits, and thus compresses itself, and in that way forms the pressure which forces the stream out of the chemical tank, through the hose and on the fire.

The practical and successful application of compressed air to chemical fire apparatus has marked an epoch in fire-fighting. There is no device in which the use of compressed air is so desirable and valuable, and to which it is so adaptable as chemical fire apparatus.

By this compressed air system the expense and handling of the sulphuric acid are entirely avoided. The pressure is powerful, always ready, reliable, uniform, entirely independent of any chemical action, and always the same under all conditions. This pressure, compressed air, is carried in separate, interchangeable air cylinders, connected to the chemical tank through an automatic pressure-reducing valve, which regulates and controls the pressure on the chemical tank, keeping it uniformly at whatever pressure is desired. As no gas space is required, the chemical tank can be filled to its capacity, As the pressure is not dependent upon any chemical action, the apparatus is not limited to any specific chemical solution, because the compressed air will, of course, force plain water, or any desired solution, out of the tank. This permits the addition of other chemicals that give increased fire-extinguishing and fireproofing qualities. The heat of the fire creates all the carbonic acid gas and other gases than can possibly be made from the full strength of all the chemicals, and all these gases are made on the fire. If only a portion of the contents of the chemical tank is used the remaining portion does not have to be wasted.

Its solution, having extinguished the fire, then fireproofs the material, so that it cannot readily catch fire again.

Public competitive tests of this apparatus have been given before firemen and others in such places as Wilkes-Barre, Pa.; Delmar, N. Y.; Washington, D. C.; Mt. Vernon, N. Y.; Boston, Mass.; Charleston, W. Va., and many other cities, and have demonstrated its reliability and efficiency.

The Water Supply System of Lawton, Okla.

The town of Lawton, Okla., was established and started by the United States government. The federal government platted the town, conducted the auction sale for the disposal of town lots, and expended the amount realized, nearly half a million dollars, for city and country improvements. This money paid for water mains, sanitary and storm sewer systems, school houses and running expenses of the city for a year. Court house, jail and many other improvements were provided, and thus was the young city able to start on its voyage unincumbered by bonded indebtedness.

Lawton's water supply is at present the most important feature. About fourteen miles northwest of the city is a high range of the Wichita mountains. The mountain heights culminate at the top of Mt. Scott, 3,400 feet above sea level. In early ages these mountains formed a complete circle, but the constant wash of water as it overflowed at a particular point made an outlet.

An early move of the city was to build a dam across this outlet. Ground was purchased and now that the dam is completed to a height of 50 feet, the city is assured of an abundance of water. The water is such as is found in mountain districts. More than 600 acres are now covered with water and the gauge shows that water is 34 feet deep. When the water reaches the top of the dam the lake will cover 1.500 acres.

The dam is a reinforced concrete structure, the base being 55 feet in width, the height is 50 feet and the length 325 feet. The dam in its present state cost $120,000; the pipe line into the city, $175,000, and the 2,300 acres which the city purchased to maintain the reservoir, $65,000.

In order that the supply of water would always remain in its present undefiled condition, Senator Thomas, of Lawton, was successful in getting through the State Legislature a bill giving the city of Lawton power to police sufficient country in that vicinity to control any drainage that would flow to the city lake.

The dam is 177 feet above the highest point in the city and 14 miles from the source of supply. This gravity system obviates the necessity of pumping station and steam engines. The power will later be utilized for commercial purposes.

New York's Powerful Motor Fire Engine.

What is said to be the most powerful fire-fighting machine in the world has just been placed in commission in connection with many changes inaugurated to perfect New York's fire defense system. The engine is of 26 h.p., gasoline automobile type and travels at the rate of 35 miles an hour. Pumps 744 gallons a minute. It is the expectation of the city authorities to have 150 motor-driven fire apparatus by the end of 1912. The weight of the engine is 13,000 pounds.

MUNICIPAL IMPROVEMENTS 1911-1912

CONSTRUCTION REPORTS FROM CITIES AND TOWNS

Streets, Sidewalks, Curb and gutter, Sewers, Sewage Disposal, Water Works, Electric Light, Gas, Garbage, Fire Apparatus and Buildings.

The promptness with which city officials have responded to our requests for information for this spring announcement of the work in prospect for the year 1912 enables us to give quite a full statement of the work of the past year as well as of the year to come, which can but be encouraging as an evidence of the prospects of prosperity in the near future and of plenty of work for every one interested in municipal developments. Perhaps the presidential election year has lost some of its terrors, perhaps the dangers of a change this year are not considered so serious as they have been sometimes, perhaps activity in municipal matters requiring many assistants is a convenience in campaign times. Whatever the reason there is plenty of work in sight, and the following pages give a good idea of what it is and where it is. The record of 1911 is given to indicate the increase or diminution in activity in the various cities and thus give additional light on the situation.

This special construction number is one month later this year than last because it is possible to make so much fuller report of the proposed work for the year than on any earlier date. The general form of the tables is similar to that used last year, with such changes as the changes in details of information supplied seem to require. They are arranged in the following order:

Street pavements.
Sidewalks,
Curb and gutter.
Sewers,
Sewage disposal.
Water distribution.
Water supply.
Electric light.
Gas light.
Garbage collection and disposal.
Street signs.
Fire department.

Nearly all city departments have responded to calls for information, but particularly city clerks, city engineers, boards of public works, water works, electric and gas lighting superintendents, and our acknowledgment of their courtesies is hearty and sincere.

The short time which can be devoted to the collection of these statistics that they may be both fresh and as inclusive of the prospects of the coming year as possible makes it impossible to get reports from every city, but the cities from which reports have been received are well distributed and are representative of all.

The usual department of "Improvement and Contracting News" is reduced to the statement of dates for receipt of bids and such general items as are not included in the larger tables and lists.

In all the tables and lists the cities are arranged alphabetically under their respective States, also arranged alphabetically.

In the line 1911 of the table is given the number of linear feet or the number of each class of work done or material furnished during the year 1911.

In the line 1912 is given like information regarding prospects for 1912. This line is printed in bold-faced type so that it can be readily distinguished, and at the same time can be easily compared with the line for 1911.

STREET IMPROVEMENTS.

Official Reports of Street Improvements Made to *Municipal Engineering* by Municipal Officials of America.

The data in the reports have been reduced to the same unit, linear feet of street, for ease in comparison. In case the data were given in square yards or square feet it is assumed that the average width of street is 30 feet. In cities which have been paving many alleys this average is probably a little too large, as the ordinary alley pavement is not more than 15 feet wide. In a very few of the larger cities this would result in the report of length of brick and concrete pavements being a little less than the actual fact.

Under "Asphalt' are included the few reports of block asphalt as well as the sheet asphalt. Under "Granite" are included Belgian block, the ordinary granite block, sandstone and limestone blocks. Under "Concrete" are included Blome concrete, granitoid, Hassam and trappoid pavements. Under "Wood" are included wooden block and plank, most of those reported being creosoted blocks. Under "Bituminous Macadam" are included asphaltic concrete, asphaltic macadam, bitumen, bituminous macadam, filbertine, Ford macadam, gravel and oil, mineral rubber asphalt or concrete or Sarco mineral rubber, oileroid, oiled macadam, petrolithic, silicamma, slag tar macadam, surface oil with and without surface coat of gravel, tar macadam, tarvia, westrumite and doubtless others whose trade names were not given in the reports.

Under "Others" will be found in the "1912" lines the total amount to be improved in 1912, in case the nature of the paving material to be used has not yet been decided upon. Where the other pavements in the city are classified, in either the 1911 or the 1912 lines, the figure under "Others" usually represents gravel.

ALABAMA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Birmingham—									
1911.....	....	18,992	15,151	12,121	....	....	....	....	....
Corey—									
1911.....	....	158	....	....	....	....	....	....	....
Decatur—									
1911.....	....	....	3,500	....	....	....	....	....	....
1912.....	....	....	**1,200**	....	....	....	....	....	....
Dothan—									
1911.....	....	....	....	5,416	....	....	....	....	....
Florence—									
1911.....	....	....	....	....	....	5,280	....	....	....
Gadsden—									
1912.....	....	....	**6,000**	....	....	**15,840**	....	....	....
Huntsville—									
1911.....	1,360	....	19,800	10,560	15,840	79,000	....	....	....
1912.....	**10,560**	....	....	....	....	....	....	....	....
Jasper—									
1911.....	....	....	....	....	....	....	....	....	15,800
Mobile—									
1911.....	....	....	....	....	....	....	....	9,900	....
Montgomery—									
1911.....	....	....	....	....	....	....	....	9,900	....
New Decatur—									
1911.....	....	....	15,000	....	....	....	....	....	....
1912.....	....	....	**32,000**	....	....	....	....	....	....
Selma—									
1911.....	....	....	....	....	....	....	....	....	....
1912.....	....	....	....	....	....	....	....	....	**5,000**

ARIZONA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Phoenix—									
1911.....	....	6,847	....	....	....	....	....	....	....

ARKANSAS.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Fayetteville—									
1911.....	....	....	....	....	....	....	....	....	10,500
Ft. Smith—									
1911.....	....	....	....	52,800	....	....	....	....	....
Helena—									
1912.....	....	....	**1,000**	**9,000**	....	....	....	....	....
Little Rock—									
1911.....	....	....	....	....	....	....	....	15,840	....
Pine Bluff—									
1912.....	....	....	....	....	....	....	....	....	**8,000**

CALIFORNIA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Alameda—									
1912.....	....	....	....	....	....	**5,000**	....	....	....
Alhambra—									
1911.....	....	....	53,900 oiled	...	....	....	....	....	....
1912.....	....	....	**52,450 oiled**	...	....	....	....	....	....
Berkeley—									
1911.....	4,200	....	....	....	....	21,900	....	....	....
1912.....	**50,000**	**36,500**	**22,500**	....	....	**12,500**	....	....	....
Chico—									
1912.....	**13,500**	....	....	....	....	....	....	....	....
Fresno—									
1911.....	....	....	3,330	....	....	....	....	....	....
1912.....	....	....	**6,000**	....	....	....	....	....	....
Grass Valley—									
1911.....	....	....	5,280	....	....	3,900	....	....	....
Los Angeles—									
1911.....	67,000	....	10,000	....	....	....	5,000	....	115,000
1912.....	....	**10,000**	....	....	....	....	....	....	**117,000**
Marysville—									
1911.....	4,200	....	....	....	....	....	....	....	....
1912.....	**11,000**	....	....	....	....	....	....	....	....

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Modesto—									
1911	25,000								
1912	30,000								
Pasadena—									
1911		13,800							
Riverside—									
1911	70					531			
Sacramento—									
1911		15,500	57,700						
1912	15,840		57,700						
San Bernardino—									
1911	2,640		13,200						31,680
1912	2,640		21,120						31,680
San Francisco—									
1911	30,965		54,050			29,900	7,557		1,132
1912									5,000
San Jose—									
1911	8,500		1,600						
1912	26,400								
San Mateo—									
1912	5,000					52,800			
San Rafael—									
1911						30,000			
1912			12,400						
Santa Barbara—									
1911	1,060		2,640						
1912	10,560								
Santa Cruz—									
1911						2,640			
1912			6,000						
Selma—									
1912	10,000								
Stockton—									
1911			16,460		1,720	16,290			600
1912	400		39,700		2,400				
Vallejo—									
1911	7,500		5,000						
1912	20,000		20,000						
COLORADO.									
Boulder—									
1911			2,260						7,200
1912					2,640				
Florence—									
1912									2,640
Golden—									
1912					650				
Grand Junction—									
1911					5,200				
1912					7,500				
CONNECTICUT.									
Ansonia—									
1911						1,200			
1912		435				2,000	600		9,600
East Hartford—									
1911						8,000			
1912						2,400			
Greenwich—									
1912		5,200						510	
Hartford—									
1911	2,640		7,100			15,000		200	
1912	2,640					20,000			
Meriden—									
1911			400						
New Britain—									
1911									5,400
New Haven—									
1911								3,900	
New London—									
1911			8,300	1,600					
Norwalk—									
1911								6,000	
Norwich—									
1911			1,080	900		5,200	2,000		7,500
1912				900		1,890			50,000
Simsbury—									
1911						2,000			
1912						2,000			
Southington—									
1911						800			
Stanford—									
1911								600	
Torrington—									
1911			1,100			24,000			
1912			1,935				40		2,460

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Wallingford—									
1911			2,640						
1912			4,500	1,500		4,500		1,500	
Waterbury—									
1911				4,214		6,769	422	736	
DELAWARE.									
Milford—									
1911					600				
1912					600				
Wilmington—									
1911		1,900	6,870		1,120		730		
1912									52,800
DISTRICT OF COLUMBIA.									
Washington—									
1911	6,912					13,032			
1912	8,700		7,500			7,500			
FLORIDA.									
Gainesville—									
1911			5,900						
1912				10,000					
Live Oak—									
1912				5,000					
Palatka—									
1911				12,000					
1912				3,000					6,150
Pensacola—									
1911								21,000	
1912				22,500	10,500			21,000	
St. Augustine—									
1912				5,000					
St. Petersburg—									
1911				58,000					15,840
1912				26,400					5,280
GEORGIA.									
Albany—									
1912			6,000						
Americus—									
1911				720				10,800	
1912									9,000
Atlanta—									
1911		17,900						10,500	
Columbus—									
1911			27,552	22,305					
1912			3,500	30,000					
Dublin—									
1911				10,000					
Newman—									
1911								4,000	
Rome—									
1911			3,500	1,600				3,900	
1912			2,600					1,700	
Waycross—									
1911									21,120
1912				1,200					
IDAHO.									
Boise—									
1911	7,480		8,300		3,765				
Lewiston—									
1912									5,000
Moscow—									
1912									10,000
Payette—									
1912						26,400			
Pocatello—									
1912		9,600							
ILLINOIS.									
Aledo—									
1912			24,090		24,090				
Alton—									
1911				12,840					
1912				19,200					
Aurora—									
1912									16,000
Belvidere—									
1911						8,000			
1912						some			
Bloomington—									
1912				10,560					
Cairo—									
1912				some					

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Canton—									
1911				4,500					
1912				**5,000**					
Carlinville—									
1912				**300**	**1,140**				
Centralia—									
1912			**6,000**	**6,000**					
Chicago—									
1911	288,000		21,000	141,000	2,800	74,000	40,000	71,000	
1912	**285,000**		**12,000**	**141,000**	**3,000**	**75,000**	**40,000**	**72,000**	
Chicago Heights—									
1911			10,560	15,840		13,200			
Chrisman—									
1912				**4,000**					
Collinsville—									
1911			6,600						
Danville—									
1911		2,900		3,000					
1912				**15,000**					
Decatur—									
1911				7,920					
1912				**3,600**					
Dekalb—									
1911									1,600
East Moline—									
1912				**4,000**					
East St. Louis—									
1911				64,500					
Edwardsville—									
1911				5,280					
1912				**7,700**	**4,100**				
Elgin—									
1911				306					
1912			**9,942**	**4,671**					
Eureka—									
1911				2,640					
Evanston—									
1911			2,200	2,200	800	2,000			
1912			**1,700**	**1,400**	**2,000**				
Forest Park—									
1911				4,100					
1912				**24,760**					
Freeport—									
1911						7,010			
1912				**8,340**					
Galesburg—									
1911				3,500					
1912									**20,000**
Galva—									
1912				**2,700**					
Granite City—									
1911				3,500					
Greenville—									
1911					2,550	9,240			
1912					**2,340**				
Harrisburg—									
1912					**5,000**				
Harvard—									
1912				**7,800**					
Harvey—									
1911				5,700					
Highland Park—									
1911			8,400			1,170			
1912					**6,900**				
Hillsboro—									
1912				**6,000**					
Jacksonville—									
1911	13,200								
Jerseyville—									
1912				**9,000**					
Joliet—									
1911						2,700			
1912								**4,000**	
Lake Forest—									
1911			5,400						
1912			**4,500**		**7,340**				
Lewiston—									
1912									**10,000**
Lincoln—									
1912				**11,880**					
Marengo—									
1912									**Some**
Marion—									
1911			262	2,112					
1912			**3,180**						
Marshall—									
1912				**4,000**					

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Mattoon—									
1911.....				5,300	1,800				
1912.....				**15,000**					
Maywood—									
1911.....				17,650					
1912.....				**2,640**					
Melrose Park—									
1912.....				**2,640**					
Mendota—									
1912.....				**3,400**					
Moline—									
1911.....				13,800					
1912.....	**9,300**			**12,600**					
Monmouth—									
1912.....				**6,120**					
Morris—									
1912.....	**2,640**			**2,985**					
Morrison—									
1911.....	6,253			3,900					
Mt. Carmel—									
1911.....				6,700					
1912.....				**18,700**		**3,500**			
Normal—									
1911.....				8,100					
1912.....				**5,100**					
Oak Park—									
1911.....			4,794	738		6,567			
1912.....			**9,300**	**8,000**		**2,600**			
Ottawa—									
1912.....				**8,000**					
Paris—									
1911.....				2,410					
1912.....				**3,400**					
Pekin—									
1911.....			4,500	4,000					
1912.....				**18,000**					
Peoria—									
1911.....								1,500	
Pontiac—									
1911.....				3,000					
1912.....				**3,000**		**1,950**		**1,350**	
Proviso—									
1911.....						2,650			
Quincy—									
1912.....									**20,000**
River Forest—									
1911.....			6,760						
1912.....			**4,650**	**4,770**					
Robinson—									
1911.....				3,500					
1912.....			**6,000**						
Rochelle—									
1911.....				15,000					
1912.....				**9,495**					
Rockford—									
1911.....			17,000	4,600					
1912.....				**14,000**					
Rock Island—									
1912.....	**7,500**			**4,800**					
Springfield—									
1911.....	660			17,700					
1912.....	**4,500**			**19,500**	**300**			**4,000**	
Spring Valley—									
1912.....				**10,500**					
Sterling—									
1912.....				**2,400**					
Streator—									
1911.....				6,900					
1912.....				**6,900**					
Taylorville—									
1911.....				4,224					
1912.....									**10,000**
Urbana—									
1912.....									**15,000**
Vandalia—									
1912.....				**5,200**					
Waukegan—									
1911.....			6,900	465		5,300			
1912.....			**1,000**	**7,200**			**3,000**		
Wheaton—									
1912.....			**10,560**						
Woodland—									
1912.....									**Some**

INDIANA.

Anderson—									
1911.....			1,725	6,315					938

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Attica—									
1912				**3,900**					
Auburn—									
1911				300					
Bedford—									
1911				2,400					
1912									**5,280**
Bloomington—									
1911				3,000		3,000			
1912				**7,500**		**1,500**			
Bourbon—									
1912				**10,000**					
Butler—									
1911									700
Clinton—									
1912				**6,000**		**6,000**			
Columbus—									
1911				25,100					
Crawfordsville—									
1911				4,000					
Delphi—									
1911			6,120	1,658					
1912			**15,000**						
E. Chicago—									
1911			19,220	5,800		1,200			
Elkhart—									
1912	**1,000**			**10,000**					
Evansville—									
1911									14,000
Ft. Wayne—									
1911	10,237		7,759	12,301					565
1912	**13,000**		**2,000**	**14,000**					
Goshen—									
1912				**10,000**					
Greencastle—									
1911						3,000			
Huntington—									
1911			2,400		450				
1912	**4,200**				**1,800**				
Indianapolis—									
1911	31,667		3,681	10,040				420	
1912	**40,000**								
Kokomo—									
1911	3,565		4,340	3,500		2,200			
1912	**3,800**		**11,690**	**8,000**					
Lebanon—									
1911				966					2,640
Ligonier—									
1911				5,280					
1912				**2,640**					
Linton—									
1911				1,500					
1912				**7,920**					
Logansport—									
1911	16,873			2,200					5,400
1912				**6,000**					**6,000**
Marion—									
1911				1,504		148			585
Martinsville—									
1911				10,560					
Mishawaka—									
1911	670	6,340		5,280					
1912	**670**	**6,340**		**5,480**					
Mt. Vernon—									
1912	**600**			**600**					
Muncie—									
1911				10,292	3,213	4,500			
1912				**4,500**					
New Albany—									
1911				280					
1912				**1,950**					
Newcastle—									
1911				7,500					
1912				**14,768**					
Noblesville—									
1911				9,900					30,000
N. Vernon—									
1911						10,560			
Peru—									
1911				4,000		6,000			
Portland—									
1912						**1,500**			**3,000**
Princeton—									
1912				**10,000**					
Remington—									
1911						52,800			
Richmond—									
1911				3,964	3,091	10,000			1,916
1912				**8,000**		**10,000**			

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Rushville—									
1911				4,300					
Seymour—									
1911					600				
1912				1,000	5,000				
Shelbyville—									
1912				9,500					
South Bend—									
1911			5,280	1,700					
1912	2,280			17,000					
South Whitley—									
1912				6,000					
Veedersburg—									
1911				2,000		15,840			
Wabash—									
1911	8,051			1,000		2,800			
1912	2,000								
Warsaw—									
1911	5,280								
Washington—									
1911						1,740			1,440
W. Lafayette—									
1912			3,000						
Whiting—									
1911	4,611		580			565			
1912			12,000						

IOWA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Ames—									
1911								2,000	
Belle Plaine—									
1911									9,600
Burlington—									
1911			500	972	1,203				
Carroll—									
1911				4,500					
1912				7,200					
Cedar Falls—									
1912	4,800				17,200				
Cedar Rapids—									
1911				15,000	650			2,200	
Chariton—									
1911			360	5,700					
Charles City—									
1912	6,336	6,336	or	6,336	6,336	or		6,336	
Clarinda—									
1911					4,500				
Clinton—									
1912	5,000	or		5,000	5,000	or		5,000	
Corning—									
1912				4,160	140				
Council Bluffs—									
1911				20,114					
1912				20,100					
Creston—									
1912			21,120		1,000				
Davenport—									
1912				20,000					
Des Moines—									
1912	5,000								
Dubuque—									
1911			4,200	1,400	100	12,400			
Eldora—									
1911					3,200				
Fairfield—									
1912				4,500				1,600	
Ft. Dodge—									
1911	3,600				5,400			1,350	
1912					4,500				
Harlan—									
1911					4,200				
1912					6,000				
Independence—									
1911				5,640					
1912				720					
Iowa City—									
1911		6,000							
1912		1,000							
Iowa Falls—									
1912					10,500				
Knoxville—									
1911					3,000				
Lake City—									
1911									300
1912									300
Maquoketa—									
1911								870	

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Manchester—									
1911		2,400			250				
1912		3,000							
Marshalltown—									
1911					2,100				
1912					18,480				
Mason City—									
1911				3,600	12,000			100	
1912					15,000				
Muscatine—									
1911		5,280							
1912			6,600	3,000	1,000				
Newton—									
1912					5,280				
Oelwein—									
1912		9,000			4,200				
Ottumwa—									
1911				960					
1912				9,000				840	
Pella—									
1911				7,920					
Red Oak—									
1911									9,000
Sheldon—									
1912			15,000	or	15.000				
Shenandoah—									
1911			13,000						
Sioux City—									
1911				2,500	21,000				
1912					40,000				
Villisca—									
1911				5,100					
Waterloo—									
1911	20,000					1,500		540	
1912	15,000				2,700				
Webster City—									
1911				12,000					
1912				14,000					
Winterset—									
1911	2,100								
1912									10,000
KANSAS.									
Abilene—									
1912				15,000					
Arkansas City—									
1911	2,640			10,600	1,220			5,000	
Atchison									
1911				5,280					
1912				900	3,000				
Clay Center—									
1911				975					
Coffeyville—									
1911				4,064					
1912				13,926					
Eldorado—									
1912					528	240			
Emporia—									
1911	10,560			10,200					
1912									11,880
Ft. Scott—									
1911				15,000		1,880			
1912				15,000		8,400			
Great Bend—									
1912				7,500	3,000				45,000
Hutchinson—									
1911				15,000				1,200	
Independence—									
1911				11,616					
1912				5,280					
Kansas City—									
1911	10,085	12,408		14,045	8,131	2,006			
Lawrence—									
1911				18,800					
1912				6,000					
Leavenworth—									
1911			5,770	5,000					
1912				10,560					
Manhattan—									
1911			17,400	3,600					
1912			12,000	3,600					
McPherson—									
1911				2,992					
1912				2,231					
Newton—									
1911				2,000					
Olathe—									
1912				4,000	4,000				

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Osawatomie—									
1911.....	....	....	....	....	....	....	....	....	10,560
Ottawa—									
1911.....	....	....	8,060	5,502	459	3,090	....	....	....
Parsons—									
1912.....	....	....	....	**11,000**	....	**2,800**	....	....	....
Pittsburg—									
1911.....	....	....	....	3,382	....	....	....	....	....
1912.....	....	....	....	**9,300**	....	....	....	....	**3,900**
Rosedale—									
1911.....	....	7,000	....	....	....	....	....	....	....
Salina—									
1911.....	....	....	12,830	....	1,400	....	....	....	....
1912.....	....	....	**3,280**	....	....	....	....	....	....
Topeka—									
1911.....	....	....	....	16,000	....	....	....	....	....
1912.....	....	....	**9,900**	**22,500**	....	....	....	....	....
Wichita—									
1911.....	8,200	9,500	1,300	65,800	21,000	....	....	190	....
1912.....	**2,640**	....	....	**21,120**	**9,240**	....	....	**2,640**	....
KENTUCKY.									
Cattlettsburg—									
1911.....	....	....	....	7,200	....	....	....	....	....
Dayton—									
1911.....	....	....	....	....	....	3,000	....	....	....
1912.....	....	....	....	**3,200**	....	**3,500**	....	....	....
Lexington—									
1911.....	12,300	....	....	15,000	....	7,000	....	....	....
1912.....	**8,500**	....	**2,000**	**2,100**	....	**1,500**	....	....	....
Louisville—									
1911.....	28,596	....	....	17,796	....	....	....	....	300
1912.....	**30,000**	....	....	**18,000**	....	....	....	....	....
Ludlow—									
1911.....	....	....	....	400	....	....	....	....	....
1912.....	....	....	**1,000**	**4,000**	....	....	....	....	....
Mt. Sterling—									
1912.....	....	....	....	**10,000**	....	....	....	....	....
Owensboro—									
1911.....	....	....	3,400	....	....	1,300	....	....	....
1912.....	....	....	**4,500**	....	....	....	....	....	....
Paducah—									
1911.....	....	....	12,600	22,000	....	....	....	....	....
Pineville—									
1911.....	....	....	....	....	6,000	....	....	....	....
1912.....	....	....	....	....	**6,000**	....	....	....	....
LOUISIANA.									
Alexandria—									
1911.....	....	1,700	....	....	....	....	....	....	....
1912.....	....	....	....	....	....	....	....	....	**1,650**
Crowley—									
1912.....	....	....	....	**3,500**	....	....	....	....	....
Lake Charles—									
1912.....	**12,000**	....	....	**1,000**	....	....	....	**18,000**	....
New Orleans—									
1911.....	14,000	5,800	1,600	....	3,500	....	....	3,000	560
Shreveport—									
1911.....	....	3,800	....	....	....	....	....	15,300	....
MAINE.									
Lewiston—									
1911.....	....	....	3,780	....	....	....	....	....	....
Portland—									
1911.....	....	....	....	....	4,800	....	380	....	....
Rockland—									
1911.....	....	....	....	....	....	2,700	2,085	....	270
1912.....	....	....	**750**	....	....	....	**750**	....	**2,700**
Skowhegan—									
1911.....	....	....	....	....	....	3,500	....	....	....
1912.....	....	....	....	....	....	**3,000**	....	....	....
MARYLAND.									
Annapolis—									
1911.....	....	....	1,100	....	....	....	....	....	....
1912.....	....	....	**900**	....	....	....	....	....	....
Baltimore—									
1911.....	....	....	....	....	....	....	....	550	....
1912.....	**52,000**	....	....	....	....	....	....	....	**28,000**
Brunswick—									
1912.....	....	....	....	....	....	**6,600**	....	....	....
Cambridge—									
1911.....	....	....	....	6,000	....	....	....	....	....
1912.....	....	....	....	....	....	....	....	....	....
Cumberland—									
1911.....	....	....	....	3,000	....	....	....	....	....
1912.....	....	....	....	**6,300**	....	....	....	....	....
Westminster—									
1911.....	....	....	3,500	....	....	....	....	....	240
1912.....	**50**	....	....	....	**100**	**700**	....	....	....

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
MASSACHUSETTS.									
Agawam—									
1911.....						2,500			
1912.....						**4,000**			
Attleboro—									
1911.....						5,640			10,000
Cambridge—									
1911.....		6,800							
East Hampton—									
1911.....						2,500			
1912.....						**1,000**			
Everett—									
1911.....			3,180				2,900		
Greenfield—									
1911.....						1,170			4,000
Haverhill—									
1911.....			11,100		2,300	4,400	1,400		600
Lawrence—									
1911.....	3,200					2,400	3,185		
Lowell—									
1911.....						6,600	7,000		2,700
1912.....						**6,600**	**7,500**		**2,700**
Lynn—									
1911.....					6,400	30,000	2,000		
1912.....					**6,000**	**30,000**	**2,250**		
Medford—									
1911.....			935			2,000			
New Bedford—									
1911.....		9,000				23,430	5,900		
1912.....		**7,500**				**24,000**	**3,000**		
North Attleboro—									
1911.....			2,500			60,000			
1912.....			**3,000**			**10,560**			
Quincy—									
1911.....								300	
Somerville—									
1911.....			6,300	2,200			1,100		
1912.....									**10,000**
Southbridge—									
1911.....				3,000		1,200			
1912.....				**300**		**1,950**			
Springfield—									
1911.....		2,871				21,200		1,312	2,100
1912.....							**900**		
Westfield—									
1911.....			1,663			1,644	2,659		
Worcester—									
1911.....			3,000	200	4,300	25,700	12,900		1,620
MICHIGAN.									
Albion—									
1911.....			6,844	3,960					
1912.....			**5,280**						
Allegan—									
1911.....				5,280					
1912.....				**4,000**					
Alpena—									
1911.....					3,900				
1912.....					3,600				
Ann Arbor—									
1911.....			19,227						
1912.....			**10,000**						
Battle Creek—									
1911.....				4,200					
1912.....				**6,600**					
Benton Harbor—									
1911.....				1,000		360			
Bessemer—									
1911.....						6,720			
1912.....						13,200			
Cadillac—									
1911.....						6,330			
1912.....						**8,450**			
Cheboygan—									
1911.....			1,320			900			
1912.....			**900**						
Detroit—									
1911.....	60,900			3,000	1,000			11,900	
1912.....	**5,280**			**3,000**				**600**	
Dowagiac—									
1911.....					3,000				
1912.....					**2,500**				
Escanaba—									
1911.....			800		3,600				
1912.....					**6,000**	**300**			
Flint—									
1911.....				1,700					
1912.....	**5,000**								

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Grand Ledge—									
1911				750	900				
1912									**480**
Grand Rapids—									
1911			3,200	15,900	360				14,400
Gladwin—									
1911						3,000			
Greenville—									
1911				4,000					
Hastings—									
1912				**5,000**					
Hillsdale—									
1911				3,300					
1912			**3,000**						
Holland—									
1911			7,500						
1912			**6,600**						
Jackson—									
1911				2,800	3,200				
1912				**3,000**	**3,000**				
Kalamazoo—									
1911				3,000					
1912			**12,000**	**4,500**		**12,000**			
Lansing—									
1911					3,000				
1912					**18,000**				
Lapeer—									
1911						2,500			
1912						**4,000**			
Menominee—									
1912					**216**	**1,890**			
Milan—									
1912				**5,000**					
Monroe—									
1911					5,000				
1912					**15,600**				
Mt. Clemens—									
1911	700			400					
1912	**3,000**			**300**					
Norway—									
1911			2,000						
Owosso—									
1911				420		225			
1912				**1,950**	**750**	**2,880**			
Pontiac—									
1911	2,640			1,500					
1912						**5,280**			
Port Huron—									
1911			1,300	1,000					
1912			**6,500**						
Saginaw—									
1911	14,500								
St. Johns—									
1911				1,350	365				
1912				**280**	**3,785**				
St. Joseph—									
1911				2,294			1,800		
Sault Ste Marie—									
1911			1,000						
1912			**8,000**						
Whitehall—									
1911						3,960			
Wyandotte—									
1911				3,000					

MINNESOTA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Albert Lea—									
1911								9,500	
Bemidji—									
1911					5,846				
1912					**2,338**				
Cloquet—									
1912						**3,000**			
Crookston—									
1911	5,600		6,480			6,300	600		
1912	**4,300**		**1,960**						
Faribault—									
1912			**11,500**						**18,300**
Mankato—									
1911	5,600		1,890	203		4,350		6,320	31,680
1912			**some**	**some**				**some**	
Minneapolis—									
1911			8,700	5,280			4,500	52,800	
1912								**10,000**	
New Ulm—									
1911									2,640
Red Wing—									
1911						2,820			

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Rochester—									
1911								2,200	
St. Cloud—									
1911			1,500						
St. Paul—									
1911				1,500					
1912				15,000					
Two Harbors—									
1911						1,036			
Virginia—									
1911		9,600						4,400	
Winona—									
1911				3,300					
1912				1,600					

MISSISSIPPI.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Columbus—									
1912			36,000						
Grenada—									
1912								18,000	
Jackson—									
1911	6,500	5,100	1,500					8,300	
1912				6,600					
Meridian—									
1912		1,500							
Port Gibson—									
1912									3,300
Tupelo—									
1911									5,200
1912			15,000						
Vicksburg—									
1911				9,000					
1912				6,600					
West Point—									
1912						3,300			

MISSOURI.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Aurora—									
1911									200
Bethany—									
1911					465				
1912					5,280				
Boonville—									
1912									some
Brookfield—									
1911				15,000					
1912				12,000					
Butler—									
1912				5,280					
Cape Girardeau—									
1911				1,400					
1912								930	
Carrollton—									
1911				18,000					
1912				9,000					
Caruthersville—									
1911									1,500
1912									1,500
Clinton—									
1911		some							
Columbia—									
1911				10,000					
1912				9,600					
DeSoto—									
1912						4,000			
Eldorado Springs—									
1911				1,500					
1912					3,700				
Fulton—									
1911				2,700		5,000			
1912			660	300					
Hannibal—									
1911				15,000		52,800			10,000
1912			9,000	12,000	3,000				
Independence—									
1911		2,400			9,000				
Jerseyville—									
1912									7,000
Joplin—									
1911								6,900	
Kansas City—									
1911	31,960		2,000	7,000	35,278		4,912	6,112	67,520
1912	34,000			8,000	45,000		5,000	8,400	68,000
Kirksville—									
1911				1,500	600				
1912				3,500	1,800				
Lexington—									
1912			5,000						

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Liberty—									
1911				1,000	5,000				
1912					5,000				
Libertyville—									
1911				9,000					
Macon—									
1911				27,000					
Mexico—									
1911				100					
1912				3,000					
Moberly—									
1911				1,800					
1912				6,300					
Nevada—									
1912			3,000	3,000	6,000				
Oregon—									
1911									2,640
Poplar Bluff—									
1912							9,000		
St. Charles—									
1911						750			600
1912			2,700		5,400				
St. Joseph—									
1912	2,500		5,000		7,500				
St. Louis—									
1911		22,100						12,900	
Sedalia—									
1911				5,280					
1912				13,200					
Springfield—									
1911								1,800	
Tarkio—									
1911					2,400				
Webb City—									
1911			9,123	1,758					

MONTANA.

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Billings—									
1911					600				
1912				6,000	1,300			19,000	
Bozeman—									
1911					8,100				
1912					6,000				
Butte—									
1911				3,000		2,400			
Great Falls—									
1911								540	
1912					12,800				
Helena—									
1911				6,900				9,600	
1912				4,500					
Kalispel—									
1911		2,500	7,200			10,560			45,000
Missoula—									
1911		480				3,600			12,300
1912				7,200					

NEBRASKA.

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Chadron—									
1911									3,500
Fremont—									
1911				2,640					
1912				5,280	600				
Hastings—									
1911				15,840					
Lincoln—									
1911	9,645	175		11,100	650	785			
1912	9,000	3,000		3,000					
Norfolk—									
1911				2,900					
1912			13,200						
Omaha—									
1911	18,860		9,900	20,328	1,350		3,900	4,000	
South Omaha—									
1911			12,668	12,735	4,924				
1912			11,440	22,880	3,150				
University Place—									
1911				1,600					
York—									
1911				15,840					

NEW HAMPSHIRE.

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Concord—									
1911			2,000			2,000			
1912			Some			Some			
Dover—									
1911		720				11,880	480		18,500
1912						10,560	3,600		21,120

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Keene—									
1911			1,100			1,200	900		
Laconia—									
1911			6,600						
1912			**6,000**						
Littleton—									
1911					200				3,600
NEW JERSEY.									
Atlantic City—									
1911		6,600							
Bayonne—									
1911	8,200			3,800					
Beach Haven—									
1911									50,000
Bloomfield—									
1911						143,100			
1912		**2,640**				**15,280**	**15,840**		
Burlington—									
1912		**3,960**							
Camden—									
1911	6,900			1,300		990	120		
Dover—									
1911				1,500					
Elizabeth—									
1911			1,566	5,090			824		
1912			**1,000**	**9,777**			**6,535**		
Glen Ridge—									
1911						1,651			
1912						**901**			
Harrison—									
1911		900							
Hoboken—									
1911								4,500	
Jersey City—									
1911	7,498		2,700	13,464		9,018	845	1,320	
1912	750		**1,000**	**1,600**			3,900		
Kearney—									
1911		5,100							
Montclair—									
1911			3,600						
1912						79,200			
Newark—									
1911	1,768	28,882		30,801			21,410		
1912		35,000		22,000			30,000		
Ocean City—									
1911									5,000
1912									**6,000**
Paterson—									
1911								4,500	
Perth Amboy—									
1911		3,300							
Phillipsburg—									
1912						**300**			
Plainfield—									
1911						5,000			
Rahway—									
1911				15,000					
Rutherford—									
1911			2,100			8,700			
1912			**7,920**	**9,000**		**7,920**			
South Amboy—									
1912		**3,750**							
Summit—									
1911			840	1,320		2,000			
1912				**7,350**		**3,000**			
Trenton—									
1911	6,836		14,516	740	847	1,478			
1912	1,050		**10,000**	**3,000**	**550**				
Westfield—									
1911			7,300			13,500			
1912			**3,000**			**4,500**			
West New York—									
1911	1,500			1,900					
1912							**6,000**		
NEW MEXICO.									
Albuquerque—									
1912		**7,500**							
Las Vegas—									
1912									**some**
NEW YORK.									
Albany—									
1911				10,560			1,100		
1912			**900**	**12,000**	**1,200**		**1,500**		
Amsterdam—									
1911				2,100					

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Auburn—									
1911				4,335		29,215	975		
1912	**2,800**			**6,565**		**30,000**	**600**		
Binghamton—									
1911				4,604					
1912			**4,500**	**4,342**	**507**	**5,000**		**2,208**	
Buffalo—									
1911	31,877			11,418			6,973		
1912	**15,000**				**5,000**				
Canajoharie—									
1911				1,260					
Canastota—									
1912				**5,400**					
Carthage—									
1911			330			330			
1912			**9,900**	**2,250**					
Corning—									
1911				2,960					
Cortland—									
1912	**3,000**		**1,800**						
Dobbs Ferry—									
1911	540		31,680	4,500		5,280			10,560
1912				**6,000**		**6,000**			
Dunkirk—									
1911	6,300			2,350					
1912	**6,000**			**7,000**					
Elmira—									
1911				900					
1912				**5,400**					
Fulton—									
1912			**5,100**	**9,300**					
Geneseo—									
1911			2,250						
1912				**180**		**8,660**	**900**		
Herkimer—									
1911		2,000	5,500	1,100					
1912		**4,300**							
Hoosick Falls—									
1911			3,500						
Hornell—									
1911			700	330					
Hudson—									
1911			1,000	4,200		1,500			
1912			**1,500**	**2,700**	**500**	**180**			
Hudson Falls—									
1911				420					
Ithaca—									
1911			1,320	79,200		10,560	3,960		10,560
Jamestown—									
1911				15,800					
1912				**15,000**					
Kingston—									
1911			2,400	4,300		6,000			
1912			**3,000**	**1,500**		**6,000**	**1,500**		
Larchmont—									
1912						**15,840**			
Lestershire—									
1912				4,800					
Little Falls—									
1911		1,800	900			1,000	300		
1912			**5,000**	**900**					**2,500**
Little Valley—									
1912				**5,000**					
Lockport—									
1911								600	
Lowville—									
1912			**5,280**						
Middletown—									
1911			3,000	2,700		10,560			10,560
1912				**3,000**					
Moravia—									
1912				**2,000**					
Newark—									
1911				3,000					
NEW YORK CITY—									
Bronx—									
1911	58,000		2,700			1,000	12,000	2,000	
1912						329,000			
Brooklyn—									
1911	128,000					210	2,700		
1912	**266,000**	**6,000**				**6,000**	**58,000**	**17,000**	
Manhattan—									
1911	127,000						68,000	31,000	
1912	**187,000**						**90,000**	**40,500**	*

*Appropriation for repairing with sheet asphalt, granite and wood block is $3,500,000 for 1912.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Richmond—									
1911			41,000	18,000	210		4,000	7,000	1,500

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Niagara Falls—									
1911	4,900			2,500	5,500				
1912									12,000
N. Tonawanda—									
1911						3,000			
1912									4,000
Norwich—									
1911			900	5,700					
1912				3,800					
Ogdensburg—									
1912				12,000					
Olean—									
1911				5,000					
Oneida—									
1911				1,600					
Penn Yan—									
1912				2,500					
Plattsburg—									
1911	2,000			1,400		6,920			
1912			10,000		3,000				
Poughkeepsie—									
1911			800	6,700		5,100		600	
1912				7,900					
Rochester—									
1911	29,700		4,800	37,500			900	400	
Salamanca—									
1911				800					
1912				3,300					
Schenectady—									
1911	18,000		3,000	500					
Solvay—									
1911						5,000			
Syracuse—									
1911	4,963			2,057		2,587			
1912									26,400
Troy—									
1911		1,300							
Utica—									
1911	7,000	1,000		5,200			3,900		
1912	6,000	3,000		3,000					
Warsaw—									
1912				14,520					
Watertown—									
1911			1,500	900		7,500			
1912			2,700	3,600	330	7,500			
White Plains—									
1911			3,240						
1912			900	300	150				
Whitesboro—									
1911		2,100							

NORTH CAROLINA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Asheville—									
1911		2,700							
Burlington—									sand clay
1911									52,800
Greenville—									sand clay
1912									15,800
Goldsboro—									
1911									1,500
1912			3,000						
Greensboro—									
1911			390						
1912			4,500			1,400			
Monroe—									
1911			6,000			6,000			1,500
1912			12,000						12,000
Raleigh—									gravel
1912									45,000
Wilson—									
1911		2,000							
1912		2,000							

NORTH DAKOTA.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Fargo—									
1911								1,380	
Grand Forks—									granitoid
1911			2,500		666				10,600

OHIO.

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Ashland—									
1911				1,800					
1912				2,400					

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Barberton—									
1911				909					
1912				**5,400**					
Bowling Green—									
1911						4,698			
1912						**8,800**			
Bryan—									
1912				**12,000**					
Bucyrus—									
1911				1,434					
Canton—									
1911				15,000					
1912				**38,000**					
Chillicothe—									
1911				1,650					
Circleville—									
1911				12,500					
1912				**3,500**					
Cincinnati—									
1911	10,500	1,000	10,500	7,500		196,000	12,000		45,000
Cleveland—									
1911				64,000			17,400		1,200
1912			**3,900**	**105,000**			10,100		
Columbus—									
1911	12,000			66,000			1,300		1,300
1912	**13,500**			**71,000**					
Conneaut—									
1912				**5,280**					
Coshocton—									
1911	1,894			120					
Dayton—									
1911	8,100			43,500					
1912	**5,000**			**50,000**					
Fostoria—									
1911				6,300					
1912				**10,500**					
Galion—									
1911	3,200			3,519					
1912	**6,600**			**750**					**6,000**
Greenville—									
1911				2,650					
Hamilton—									**gravel**
1911	2,300		1,200						
1912	**15,000**								**3,600**
Lancaster—									
1911				6,000					
1912				**9,000**					
Lorain—									
1911	4,800		2,850	5,400					
1912									**15,000**
Marion—									
1911	800		905	1,290				840	
1912	**2,900**		**870**	**3,500**	**1,100**	**1,890**			
Massillon—									
1911				15,000					
1912				**6,800**					**15,000**
Millersburg—									
1911				4,100					
1912				**16,000**					
Miamisburg—									
1912						**4,500**			
Monroeville—									
1911				2,400					
Mount Vernon—									
1911				900					
1912				**4,500**	**4,500**				
Mt. Gilead—									
1911			5,000			1,250			
Newark—									
1911						600			
1912				**9,000**					
Newburgh City—									
1912				**7,200**					
New Lexington—									
1911				2,395					
1912				**1,700**					
Pomeroy—									
1911				6,000					
1912				**1,800**					
Port Clinton—									
1911				900					
1912				**2,400**					
Piqua—									
1911				4,500					
Ravenna—									
1911				3,800					
1912				**4,000**					

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Sandusky—									
1911.....	4,000			400					
Toledo—									
1911.....		4,200							
Van Wert—									
1911.....				3,100		3,960			
1912.....				**3,960**					
Wapakoneta—									
1911.....				5,280					
Warren—									
1911.....	18,000			22,500		18,300	15,000		
Zanesville—									
1911.....				5,100					
1912.....				**5,100**					
				OKLAHOMA.					
Altus—									
1911.....		56,000							
1912.....		**49,000**							
Alva—									
1911.....	7,600		3,960		3,960				
1912.....			**2,640**	**1,760**					
Bartlesville—									
1911.....		770		5,180					
1912.....		**8,600**		**3,540**					
Chickasha—									
1911.....				675					
Clinton—									
1912.....	**30,000**								
Durant—									
1911.....	2,700			5,800					
1912.....	**3,300**								
Frederick—									
1912.....					**10,560**				
Muskogee—									
1911.....	60,000		5,100	3,000		3,600			
1912.....	**30,000**		**13,500**	**4,500**					
Oklahoma City—									
1911.....	82,600			2,400		3,000			
Sapulpa—									
1912.....	**10,500**			**6,000**					
				OREGON.					
Albany—									
1911.....		7,500							
1912.....		**22,000**							
Ashland—									
1911.....		30,000							
Astoria—									
1911.....					900	8,400			
1912.....		**4,500**			**900**	**900**		**900**	
Grant's Pass—									
1911.....		3,300				1,500			
1912.....		**5,400**	**4,500**			**6,600**			
Hillsboro—									
1911.....		3,600							
La Grande—									
1911.....		12,000							
Oregon City—									
1911.....			13,500						
1912.....	**7,500**		**3,600**						
Portland—									Hassam
1911.....	161,937	22,869			9,821	8,448	17,741	1,531	117,058
1912.....	**291,000 feet of all kinds.**								
Roseburg—									
1911.....	18,670		1,873						
1912.....	**10,000**								
Salem—									
1911.....		16,500	12,000		25,500				
1912.....		**16,500**	**12,000**		**25,500**				
The Dalles—									
1911.....		13,200							
Twin Falls—									
1911.....		9,300							
Pendleton—									**Hard surface**
1912.....						**6,900**			**12,600**
				PENNSYLVANIA.					
Allentown—									
1911.....	6,000			300		3,000			
1912.....	**12,000**								
Altoona—									
1911.....		5,900							
Bethlehem—									
1911.....			1,000						
1912.....			**1,800**						
Bloomsburg—									
1911.....				360					

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
1912				360					
Bradford—									
1911				700					
1912				900					
Carbondale—									
1911			2,250	18,000					
1912				15,000					
Carlisle—									
1911			3,000	400	200	7,000			
1912			1,000	2,100		3,000			
Catasauqua—									
1911						9,100			
Claysville—									
1912				2,165					
Clearfield—									
1912			1,200	1,200		3,600			
Chester—									
1911								12,000	
Du Bois—									
1911				2,700					
1912				3,300					
Easton—									
1912				900					
East Stroudsburg—									
1912				5,280		3,000			
Edwardsville—									
1911				2,100					
Erie—									
1911	9,588			1,500					
Franklin—									
1911				9,000					
1912				6,000					
Harrisburg—									
1911	50,000			900					
1912	45,000								
Hollidayburg—									
1911		3,600		2,400					
1912				600					
Indiana—									
1911				10,560					
1912				6,000					
Kingston—									
1911			900	5,600				450	
1912				1,500					
Lancaster—									
1911	6,000		6,000	30,000		22,400	9,000		
Latrobe—									
1911				2,500					
McKeesport—									
1911				5,400			300		
1912				15,000					
Mechanicsburg—									
1911				2,400		3,600			
1912				3,600					
Media—									
1911			110,000						
Meadville—									
1911				1,800					
Miners' Mills—									
1912				2,500					
Northumberland—									
1911				900					
1912				1,800					
Philadelphia—									
1911								9,000	
Pittsburg—									
1911	6,000			6,600			15,000		
Oil City—							Wood, bituminous or brick		
1911				8,398					
1912				2,130					8,140
Punxsutawney—									
1911				2,480					
1912				2,400					
Rankin—									
1911				10,500			1,050		
1912				2,100					
Ridgway—									
1911				2,500					
Sayre—									
1911				2,000					
1912				1,500		3,000			
Scranton—									
1911	17,890						330		
1912	3,380								
S. Bethlehem—									
1911			1,500						
1912		5,400	6,600						

City	Asphalt	Bitu-lithic	Bitum-inous	Brick	Con-crete	Ma-cadam	Granite	Wood	Others
Swissvale—									
1911.....				3,570					
1912.....				**15,000**					
Warren—									
1911.....				3,000					
Westchester—									
1911.....						7,500			
Wilkes Barre—									
1911.....	32,222			30,996					
1912.....	**15,350**			**15,350**					
Wilkinsburg—									
1911.....				35,600					
1912.....				**5,400**					
Williamsport—									
1911.....				1,500					
1912.....				**5,400**					
				RHODE ISLAND.					
Cranston—									
1911.....						10,560	500		
1912.....						**10,560**			
E. Providence.									
1911.....						4,440	1,920		
Newport—									
1911.....						6,557			
Providence—									
1911.....						17,750	3,240		
1912.....						**15,000**	**3,000**		
				SOUTH CAROLINA.					
Charleston—									
1911.....				5,100			1,000		
Columbia—									
1911.....		7,960	443					1,772	
1912.....	**5,280**	**2,640**		**2,600**					
Greenville—									
1911.....	15,680				1,000	300			
1912.....			**4,500**						
Orangeburg—									
1912.....				**1,320**					
				SOUTH DAKOTA.					
Aberdeen—									
1912.....				**1,800**					
Mitchell—									
1912.....					**9,000**				
Rapid City—									
1912.....						**12,600**			
				TENNESSEE.					
Clarksville—									
1911.....						5,700			
1912.....						**4,000**			
Columbia—									
1911.....						1,000			
1912.....			**5,280**						
Harriman—									
1911.....						3,250			
Knoxville—									
1911.....	11,940				1,000				
Memphis—									
1911.....								6,300	
McKenzie—									Gravel
1912.....									15,000
				TEXAS.					
Abilene—									
1911.....		7,200							
Austin—									
1911.....		10,000						720	
1912.....		**7,000**			**1,000**			**2,100**	
Beaumont—									
1911.....		1,900		45,000				3,000	
1912.....	**9,000**		**9,000**					**9,000**	
Cuero—								Gravel and clay	
1911.....									10,000
1912.....									**10,000**
Dallas—									
1911.....		22,000	6,200	4,800				17,400	
Ft. Worth—									
1911.....		33,600							
Greenville—									
1911.....		19,400			900			7,200	
Paris—									
1911.....	9,900								
1912.....	**6,900**		**1,500**						
San Angelo—									
1911.....								6,900	
1912.....			**12,000**					**7,500**	

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
San Antonio—									
1911			18,000						66,000
Terrell—									Undecided
1911									2,400
Waxahachie—									
1912						110,000			
UTAH.									
Logan—									
1912		10,800							
Salt Lake City—									
1911	10,812								
VERMONT.									
Barre—									
1911						1,825	566		
Brattleboro—									
1911									2,500
1912									3,000
St. Albans—									
1911			3,000			2,400			
1912			2,400			600			
VIRGINIA.									
Covington—									
1912				450					
Danville—									
1912				2,700					
E. Radford—									
1912			2,640						
Fredericksburg—									
1911							900		
1912						3,900			
Newport News—									
1911						2,490			
Norfolk—									
1911								4,500	
Portsmouth—									
1911		20,069							
Richmond—									
1911								600	
WASHINGTON.									
Aberdeen—									
1911	22,000								
Bellingham—									Gravel
1911	6,336			800				2,024	4,710
1912	21,310		2,250	640					
Centralia—									
1911		4,200							
Colfax—									
1911		10,400							
Dayton—									
1911		7,500							
Everett—									
1911	19,300			1,500	900			3,000	
Hoquiam—									
1911	1,191	2,114							
1912		3,800							
Kelso—									
1911		7,790							
Kent—									
1911					2,500				
1912					3,000				
N. Yakima—									
1911	2,400	14,000		2,330					
1912				3,000					3,900
Pasco—									
1911		17,600							
Puyallup—									
1911		4,800			4,500				
Port Angeles—									
1912									4,000
Seattle—									Sandstone
1911	79,674			38,702			2,482	59,136	9,979
1912	49,900			24,400			1,500		2,500
Snohomish—									
1911				1,344					
Spokane—									
1911	49,368		264	28,618	23,390	10,243			
Tacoma—									
1911	4,940			6,650	3,700		4,200		
Walla Walla—									
1912	6,000					5,600			
WEST VIRGINIA.									
Follansbee—									
1911				3,600					
1912				900					

City	Asphalt	Bitulithic	Bituminous	Brick	Concrete	Macadam	Granite	Wood	Others
Moundsville—									
1912				5,280					
Parkersburg—									
1911				2,500					
1912				4,000					
WISCONSIN.									
Antigo—									
1911			1,500			900			
1912						1,200			
Appleton—									
1911	7,500				750				
1912	3,000								
Baraboo—									
1912						2,400			
Burlington—									
1911				1,000	6,300				
1912				2,700	400				
Columbus—									
1911	1,500								
1912	3,500								
Delavan—									
1912			1,800						
De Pere—									
1912					2,900				
Fond du Lac—									
1911				2,124	3,715				
1912					2,640				
Janesville—									
1911				576					
1912				1,254	400				
Kenosha—									
1911			4,200	37,500		2,400			
1912	7,500			12,000					
La Crosse—									
1912			1,950	510		1,920			
Madison—									
1911								750	
Marinette—									Gravel
1911				18,600		73,000			4,600
Neenah									
1912									5,200
Oshkosh—									
1911	2,500			1,640		1,080			
1912	2,580		1,400		1,500			900	
Sheboygan—									
1911			3,050	7,805	5,420	840		360	
1912			1,240	3,730	12,860	1,195		440	
Superior—									Undecided
1911	3,265			2,664	1,700	5,500		2,050	
1912	1,950								15,000
Waukesha—									
1911			1,380						
1912			9,800	570					
Waupaca—									Gravel
1911						2,750			7,050
1912						3,400			

SIDEWALK IMPROVEMENTS.

Official Report of Sidewalk Improvements Made to *Municipal Engineering* by the Municipal Officials of America.

The reports have been reduced to the same unit of linear feet. When the area of sidewalks was given in square feet or square yards it has been reduced to linear feet by assuming the average width of sidewalks as 5.5 feet.

The column headed "Cement" includes cement walks laid in place, concrete flags and concrete blocks.

The column headed "Others" has an explanatory word inserted immediately above the item to which it refers whenever possible.

City	Cement	Stone	Wood	Others
ALABAMA.				
Birmingham—				
1911	22,500			
Dothan—				
1911	63,500			
New Decatur—				
1911	158,200			

City	Cement	Stone	Wood	Others
ARIZONA.				
Jerome—				
1911	1,000			
ARKANSAS.				
Ft. Smith—				
1911	31,400			

City	Cement	Stone	Wood	Others
Pine Bluff—				
1911.....	21,052	....	......	....
1912.....	**20,000**	....	......	....
CALIFORNIA.				
Alameda—				
1911.....	15,800	....	......	....
Alhambra—				
1911.....	3,000	....	......	....
1912.....	**35,100**	....	......	....
East San Jose—				
1911.....	10,560	....	......	....
Oakland				
1911.....	185,000	....	......	....
Palo Alto—				
1911.....	10,000	....	......	....
Pasadena—				
1911.....	10,560	....	......	....
Portersville—				
1911.....	26,400	....	......	....
Riverside—				
1911.....	501	....	......	....
San Francisco—				
1911.....	71,753	9,035	......	....
San Mateo—				
1911.....	5,000	....	......	....
1912.....	**10,000**	....	......	....
Selma—				
1911.....	15,800	....	......	....
Vallejo—				
1911.....	5,000	....	......	....
1912.....	**10,000**	....	......	....
Watsonville—				
1911.....	10,000	....	......	....
DISTRICT OF COLUMBIA				
Washington—				brick
1911.....	96,000	....	......	1,140
COLORADO.				
Golden—				
1911.....	3,000	....	......	....
Salida—				
1911.....	1,500	....	......	....
1912.....	**10,560**	....	......	....
CONNECTICUT.				
New Britain—				
1911.....	15,800	....	......	....
Southington—				
1912.....	**1,000**	....	......	....
Waterbury—				
1911.....	2,350	....	......	....
FLORIDA.				
Gainesville—				
1911.....	5,000	....	......	....
1912.....	**6,000**	....	......	....
Pensacola—				
1911.....	238,000	....	......	....
GEORGIA.				
Americus—				
1911.....	18,000	....	......	....
1912.....	**12,600**	....	......	....
Atlanta—				
1911.....	184,800	....	......	....
Brunswick—				tile
1911.....	......	....	......	5,280
Columbus—				
1911.....	5,261	....	......	....
1912.....	**7,800**	....	......	....
Rome—				
1912.....	**20,000**	....	......	....
IDAHO.				
Boise City—				
1911.....	12,446	....	......	....
Payette—				
1911.....	10,560	....	......	....
1912.....	**21,120**	....	......	....
Rexburg—				gravel
1911.....	7,800	....	......	7,500
1912.....	**8,000**	....	......	4,000
ILLINOIS.				
Anna—				
1911.....	1,500	....	......	....
Belvidere—				
1911.....	35,000	....	......	....
1912.....	**25,000**	....	......	....
Canton—				brick
1911.....	2,000	....	......	3,000
Centralia—				
1912.....	**32,000**	....	......	....
Chicago Heights—				
1911.....	36,900	....	......	....
Collinsville—				
1911.....	4,550	....	......	....
Danville—				
1911.....	26,400	....	......	....
Edwardsville—				
1911.....	2,000	....	......	....
1912.....	**20,000**	....	......	....
Elgin—				
1911.....	20,116	....	......	....
Elmhurst—				
1912.....	**1,320**	....	......	....
Freeport—				
1911.....	5,000	....	......	....
1912.....	**5,000**	....	......	....
Forest Park—				
1911.....	17,177	....	......	....
Galena—				
1911.....	3,960	....	......	....
Jerseyville—				
1912.....	**25,000**	....	......	....
Joliet—				
1911.....	26,300	....	......	....
Lake Forest—				
1911.....	5,000	....	......	....
Lincoln—				
1911.....	10,560	....	......	....
Marengo—				
1911.....	2,640	....	......	....
Mattoon—				
1911.....	7,000	....	......	....
1912.....	**10,000**	....	......	....
Moline—				
1911.....	15,800	....	......	....
Mt. Pulaski—				brick
1911.....	1,200	....	......	5,280
Oak Park—				
1911.....	55,804	....	......	....
Paris—				
1911.....	850	....	......	....
1912.....	**2,500**	....	......	....
Pekin—				
1912.....	**10,000**	....	......	....
Peoria—				
1911.....	105,600	....	......	....
Robinson—				
1911.....	2,000	....	......	....
Rock Island—				
1911.....	8,700	....	......	....
Taylorville—				
1911.....	43,200	....	......	....
Waukegan—				
1911.....	5,000	....	......	....
1912.....	**5,000**	....	......	....
Wheaton—				
1911.....	7,000	....	......	....
INDIANA.				
Anderson—				
1911.....	29,060	....	......	....
Brazil—				
1911.....	10.560	....	......	....
Columbus—				
1911.....	1,320	....	......	....
Crawfordsville—				
1911.....	2,500	....	......	....
Ft. Wayne—				
1911.....	79,200	....	......	....
1912.....	**52,800**	....	......	....
Indianapolis—				
1911.....	72,746	....	......	....
1912.....	**96,948**	....	......	....
Kokomo—				
1911.....	27,300	....	......	....
1912.....	**33,300**	....	......	....
Lebanon—				
1911.....	5,280	....	......	....

City	Cement	Stone	Wood	Others
Ligonier—				
1911	15,800	....	......	....
1912	**10,560**	....	......	....
Logansport—				
1911	3,000	....	......	....
Marion—				
1911	1,670	....	......	....
Martinsville—				
1911	5,280	....	......	....
Mishawaka—				
1911	10,450	....	......	....
Mt. Vernon—				
1911	1,800	....	......	....
1912	**3,000**	....	......	....
Muncie—				
1911	4,080	....	......	....
New Castle—				
1911	20,000	....	......	....
1912	**25,000**	....	......	....
N. Vernon—				
1911	50,000	....	......	....
Peru—				
1911	3,000	....	......	....
Portland—				
1911	5,280	....	......	....
Richmond—				
1911	52,800	....	......	....
1912	**40,000**	....	......	....
Rushville—				
1911	6,000	....	......	....
Seymour—				
1911	2,000	....	......	....
1912	**1,500**	....	......	....
Sullivan—				
1911	7,920	....	......	....
Veedersburg—				
1911	6,000	....	......	....
Wabash—				
1911	6,432	....	......	....
1912	**4,000**	....	......	....
Whiting—				
1911	7,255	....	......	....
Wolcottville—				
1911	1,500	....	......	....

IOWA.

City	Cement	Stone	Wood	Others
Burlington—				
1911	26,400	....	......	....
Carroll—				
1912	**1,000**	....	......	....
Cedar Falls—				
1912	**6,000**	....	......	....
Centerville—				
1911	5,280	....	......	....
Council Bluffs—				
1911	29,600	....	......	....
1912	**23,200**	....	......	....
Decorah—				
1911	4,100	....	......	....
Des Moines—				brick
1911	5,900	....	......	7,900
Fairfield—				
1911	15,840	....	......	....
1912	**10,500**	....	......	....
Indianola—				
1911	5,280	....	......	....
Manchester—				
1911	40,000	....	......	....
Mason City—				
1911	1,500	....	......	....
1912	**2,000**	....	......	....
Newton—				
1911	10,560	....	......	....
1912	**10,560**	....	......	....
Sioux City—				
1911	10,000	....	......	....
Waterloo—				
1911	36,400	....	......	....
1912	**40,000**	....	......	....

KANSAS.

City	Cement	Stone	Wood	Others
Abilene—				
1911	52,800	....	......	....
Arkansas City—				
1911	45,500	....	......	....
Coffeyville—				
1911	......	....	22,000	....
1912	......	....	**30,000**	....
Emporia—				
1911	7,920	....	......	....
1912	**11,700**	....	......	....
Hutchinson—				
1911	52,800	....	......	....
Manhattan—				
1911	15,800	....	......	....
Ottawa—				
1911	25,000	....	......	....
Parsons—				brick
1911	4,000	....	......	5,000
1912	**2,000**	....	......	5,000
Salina—				brick
1911	2,000	....	......	5,000

KENTUCKY.

City	Cement	Stone	Wood	Others
Ashland—				
1911	21,100	....	......	....
Dayton—				
1911	2,000	....	......	....
1912	**2,000**	....	......	....
Lexington—				
1911	20,000	....	......	....
1912	**15,000**	....	......	....
Louisville—				brick
1911	32,867	....	......	2,984
1912	**33,000**	....	......	**3,000**
Ludlow—				
1911	800	....	......	....
1912	**8,000**	....	......	....
Maysville—				
1911	5,280	....	......	....
Pineville—				
1911	200	....	......	....

LOUISIANA.

City	Cement	Stone	Wood	Others
Morgan City—				
1911	10,560	....	......	....
Opelousas—				
1911	23,500	....	......	....

MAINE.

City	Cement	Stone	Wood	Others
Gorham—				
1911	3,000	....	......	....
Skowhegan—				
1911	800	....	......	....
1912	**800**	....	......	....

MASSACHUSETTS.

City	Cement	Stone	Wood	Others
Easthampton—				tar
1911	......	....	......	2,500
1912	**2,600**	....	......	....
Greenfield—				
1911	5,000	....	......	....
Lawrence—				tar
1911	8,245	853	......	25,907
New Bedford—				
1911	14,000	....	......	....
North Adams—				
1911	3,948	....	......	8,909
North Attleboro—				
1911	2,640	....	......	....
Somerville—				brick
1911	18,570	....	......	7,417
1912	**$30,000 appropriated for granolithic and others.**			
Springfield—				brick
1911	3,973	....	......	5,133
1911	......	....	......	823
Westfield—				tar
1911	2,910	5,360	......	3,190

MICHIGAN.

City	Cement	Stone	Wood	Others
Allegan City—				
1911	5,000	....	......	....
Battle Creek—				
1911	7,300	....	......	....
Cadillac—				
1911	1,400	....	......	....
Gladwin—				
1911	5,000	....	......	....
Holland—				
1911	10,560	....	......	....
1912	**10,560**	....	......	....
Jackson—				
1911	29,000	....	......	....
Kalamazoo—				
1911	10,560	....	......	....
1912	**10,560**	....	......	....

City	Cement	Stone	Wood	Others
Lapeer—				
1911	7,200			
1912	**5,000**			
Marine City—				
1911	3,000			
Menominee—				
1911	11,700			
Monroe—				
1911	8,800			
1912	**8,000**			
Mt. Clemens—				
1911	3,000			
Pontiac—				cross-walks
1911	105,900			3,600
1912	**180,000**			7,200
Port Huron—				
1911	5,280			
St. Clair—				
1911	15,000			
St. Johns—				
1911	1,800			
St. Joseph—				
1911	10,600			
1912	**9,000**			

MINNESOTA.

City	Cement	Stone	Wood	Others
Albert Lea—				
1911	4,000			
1912	**1,000**			
Bemidji—				
1911	$8,798			
1912	**$2,000**			
Cloquet—				
1911	9,000			
Crookston—				
1911	11,400			
Eveleth—				
1911	18,000		18,149	
Faribault—				
1911	900			
1912	**900**			
Fairmont—				
1911	6,000			
Mankato—				
1911	6,000			
1912	**2,000**			
Montevideo—				
1911	1,990			
1912	**1,800**			
Red Wing—				
1912	**5,000**			
Stillwater—				
1911	7,920			
Two Harbors—				
1911	31,440			

MISSISSIPPI.

City	Cement	Stone	Wood	Others
Clarksdale—				
1911	5,800			
Columbus—				
1911	6,000			
1912	**1,500**			
Itta Bena—				
1911	5,280			
Jackson—				
1912	**8,000**			
Vicksburg—				
1911	10,560			
1912	**10,560**			

MISSOURI.

City	Cement	Stone	Wood	Others
Bethany—				
1911	4,000			
Boonville—				
1911	7,550			
Caruthersville—				
1911	3,000			
1912	**3,000**			
Kansas City—				
1911	$74,246			
1912	**$95,000**			
Lexington—				
1911	1,800			
Liberty—				
1911	27,000			
Moberly—				
1911	15,800			
Nevada—				
1911	20,000			
Oregon—				
1911	1,500			
St. Joseph—				
1911	1,300			
Sedalia—				
1911	42,250			
1912	**52,600**			
Springfield—				
1912	**40,000**			
Webb City—				
1911	24,500			

MONTANA.

City	Cement	Stone	Wood	Others
Billings—				
1911	50,000			
Bozeman—				
1911	45,000			
Glasgow—				
1911	9,100			
Helena—				
1911	20,900			
Laurel—				
1911			21,120	
Lewiston—				
1911	10,500			

NEBRASKA.

City	Cement	Stone	Wood	Others
Chadron—				
1911	1,900			
Lincoln—				brick
1911	32,183			2,276
Norfolk—				
1911	24,200			
1912	**20,000**			

NEW HAMPSHIRE.

City	Cement	Stone	Wood	Others
Keene—				
1912	**$2,000 appropriated for cement or art stone.**			
Laconia—				tar
1911				1,000
1912	**1,000**			

NEW JERSEY.

City	Cement	Stone	Wood	Others
Bayonne—				
1911		3,160		
Bloomfield—				
1911	15,840			
Egg Harbor—				
1911	4,500			
Glen Ridge—				
1912	**1,500**			
Irvington—				
1911		10,900		
Millville—				
1911	21,150			
Newark—				
1911	21,748	147,839		
Ocean City—				
1911	5,000			
1912	**5,000**	**2,500**		
Plainfield—				
1911	20,000			
Rutherford—				
1911	10,560	13,200		
Trenton—				
1911	40,000			

NEW MEXICO.

City	Cement	Stone	Wood	Others
Las Vegas—				
1911	1,500			
1912	**1,000**			

NEW YORK.

City	Cement	Stone	Wood	Others
Auburn—				
1911	37,000			
1912	**40,000**			
Batavia—				
1911	2,500			
1912	**5,000**			
Binghamton—				
1911	28,964	297		
1912	**30,000**	**300**		
Buffalo—				
1911	301,000		5,280	

City	Cement	Stone	Wood	Others
Corning—				
1911.....	10,560			
Dunkirk—				
1911.....	47,500			
1912.....	26,400			
Elmira—				
1911.....	25,000			
Geneseo—				
1911.....	21,500			
1912.....	18,080			
Hoosick Falls—				
1911.....	6,400			
Little Falls—				
1911.....	75,000			
1912.....	75,000			
North Tonawanda—				
1911.....	10,000			
1912.....	10,000			
Niagara Falls—				
1911.....	2,850			
Oneida—				
1911.....	2,640			
Plattsburg—				
1911.....	32,500			
Poughkeepsie—				
1911.....	35,000			
Rochester—				
1911.....	59,000			
Salamanca—				
1911.....	10,500			
Schenectady—				
1911.....	13,285			
Solvay—				
1911.....	42,200			
Syracuse—				
1911.....	49,100			
1912.....	50,000			
Warsaw—				
1912.....	660			
Watertown—				
1911.....	23,800			
White Plains—				
1911.....	10,000			

NORTH CAROLINA.

City	Cement	Stone	Wood	Others
Burlington—				
1911.....	10,560			
1912.....	42,200			
Greenville—				
1911.....	5,000			
1912.....	5,280			
Greensboro—				
1911.....	1,250			
Monroe—				gravel
1911.....	......			6,000
Rocky Mount—				
1911.....	2,500			
1912.....	25,312			
Statesville—				
1911.....	31,680			
1912.....	20,000			

NORTH DAKOTA.

City	Cement	Stone	Wood	Others
Grand Forks—				
1911.....	8,220			
Jamestown—				
1911.....	7,920			
1912.....	2,640			
Valley City—				
1911.....	3,960			
1912.....	3,960			
Williston—				
1911.....	18,762			
1912.....	15,000			

OHIO.

City	Cement	Stone	Wood	Others
Akron—				
1911.....	30,000			
Barberton—				
1911.....	1,000			
1912.....	2,000			
Bellefontaine—				
1911.....	36,960			
Bowling Green—				
1911.....	10,560 Cement, stone and wood.			
Bucyrus—				
1911.....	2,945	17,114		
Cambridge—				
1911.....	6,000			
Canton—				brick
1911.....	500	1,000		200
1912.....	500	1,500		300
Chillicothe—				
1911.....	9,300			
1912.....	4,800			
Cincinnati—				
1911.....	159,800			
Conneaut—				
1912.....	7,920			
Cleveland Hts.—				
1911.....	2,640	13,200		
Dayton—				
1911.....	2,600			
Dennison—				
1911.....	3,500			
1912.....	4,000			
Euclid—				
1911.....	......	2,640		
Findlay—				
1911.....	7,920			
Fostoria—				
1911.....	8,000			
Galion—				
1911.....	5,280			
1912.....	16,800			
Greenville—				
1911.....	8,000			
1912.....	4,000			
Leetonia—				
1911.....	2,000	3,000		
Lorain—				
1911.....	600	18,800		
1912.....	......	20,000		
Marion—				
1911.....	17,592			
1912.....	1,200			
Massillon—				
1911.....	4,000			
Millersburg—				
1911.....	1,000			
1912.....	3,000			
Mt. Gilead—				
1911.....	1,000	800		
Mt. Vernon—				
1911.....	4,000			
Newburg City—				
1912.....	10,800			
Newark—				
1911.....	13,000			
Niles—				
1911.....	8,000	12,000		
Norwood—				
1911.....	5,280			
Oberlin—				
1911.....	......	1,820		
Piqua—				
1912.....	200			
Port Clinton—				
1911.....	2,000			
Ravenna—				
1912.....	1,000			
Sandusky—				
1911.....	16,000			
Steubenville—				
1911.....	15,800			
Wadsworth—				
1911.....	......	15,800		
Wapakoneta—				
1911.....	2,640			
Warren—				
1911.....	2,640	2,640		

OKLAHOMA.

City	Cement	Stone	Wood	Others
Altus—				
1911.....	500			
1912.....	1,000			
Alva—				
1912.....	1,320			
Bartlesville—				
1911.....	2,500			
Chandler—				
1911.....	2,300		600	
Clinton—				
1912.....	6,000			
Durant—				
1912.....	15,800			

City	Cement	Stone	Wood	Others
El Reno—				
1911.....	10,560	....	......	....
Frederick—				
1912.....	**26,400**	....	......	....
Sapulpa—				
1911.....	15,000	....	......	....
Tulsa—				
1911.....	14,000	....	......	....
Vinita—				
1911.....	26,400	....	......	....
OREGON.				
Astoria—				
1911.....	5,600	....	......	....
Baker City—				
1911.....	9,197	....	......	....
Cloquille—				
1911.....	2,000	....	......	....
The Dalles—				
1911.....	26,400	....	......	....
Marshfield—				
1911.....	10,560	....	......	....
Portland—				
1911..	1,284,201	....	18,566	....
Salem—				
1911.....	15,800	....	......	....
PENNSYLVANIA.				
Allentown—				
1911.....	12,000	....	......	....
Bellewood—				
1911.....	2,000	....	......	....
Bradford—				brick
1911.....	......	....	......	12,000
1912.....	......	....	......	**15,000**
Carbondale—				
1911.....	......	7,000	......	....
Carlisle—				
1911.....	1,900	....	......	....
1912.....	**2,000**	....	......	....
Catasauqua—				
1911.....	2,420	....	......	....
East Stroudsburg—				
1911.....	500	....	......	....
Gallitzin—				
1911.....	1,000	....	......	....
1912.....	**2,000**	....	......	....
Indiana—				
1911.....	7,920	....	......	....
1912.....	**5,280**	....	......	....
McKees Rock				
1911.....	20,000	....	......	....
McKeesport—				
1911.....	6,540	....	......	....
Media—				brick
1911.....	2,000	....	......	150
Meadville—				
1911.....	4,000	....	......	....
Mercer—				
1911.....	......	1,200	......	....
Miners Mills—				
1912.....	**5,000**	....	......	....
Northumberland—				
1911.....	3,300	....	......	....
Oil City—				
1911.....	37,860	....	......	....
1912.....	**12,600**	....	......	....
Punxsutawney—				
1911.....	2,600	....	......	....
Warren—				
1911.....	17,500	400	......	....
Wilkes Barre—				
1911.....	2,000	14,000	......	....
York—				
1911.....	10,000	....	......	....
RHODE ISLAND.				
Charleston—				
1911.....	9,900	2,800	......	....
East Providence—				tar
1911.....	......	....	......	12,000
Newport—				
1911.....	10,925	....	......	....
Providence—				tar
1911.....	......	....	......	8,785

City	Cement	Stone	Wood	Others
Woonsocket—				tar
1911.....	......	....	......	1,900
1912.....	......	....	......	**300**
SOUTH CAROLINA.				
Chester—				
1911.....	1,000	....	......	....
Greenville—				
1911.....	4,000	....	......	....
Orangeburg—				
1912.....	**2,640**	....	......	....
Union—				
1911.....	21,120	....	......	....
SOUTH DAKOTA.				
Aberdeen—				
1911.....	13,300	....	......	....
1912.....	**8,500**	....	......	....
Hot Springs—				
1911.....	7,600	1,320	......	....
1912.....	**52,800**	....	......	....
Madison—				
1911.....	12,300	....	......	....
Mitchell—				
1911.....	7,580	....	......	....
Pierre—				
1911.....	5,000	....	......	....
Sioux Falls—				
1911.....	12,000	....	......	....
1912.....	**10,000**	....	......	....
Yankton—				
1911.....	1,000	....	......	....
1912.....	**3,000**	....	......	....
TENNESSEE.				
Columbia—				
1911.....	10,000	....	......	....
Clarksville—				brick
1911.....	3,025	....	......	....
1912.....	**5,500**	....	......	**5,400**
Knoxville—				
1911.....	21,300	....	......	....
Maryville—				
1911.....	2,000	....	......	....
1912.....	**5,280**	....	......	....
Memphis—				
1911.....	52,800	....	......	....
Rockwood—				
1911.....	10,560	....	......	....
TEXAS.				
Austin—				
1911.....	22,700	....	......	....
Dallas—				
1911.....	25,000	....	......	....
Cuero—				
1911.....	1,700	....	......	....
1912.....	**1,000**	....	......	....
Paris—				
1911.....	26,400	....	......	....
San Angelo—				
1911.....	7,000	....	......	....
Terrell—				
1912.....	**31,600**	....	......	....
UTAH.				
Ogden—				
1911.....	25,257	....	......	....
Provo—				
1911.....	3,055	....	......	....
Salt Lake City—				
1911....	194,300	....	......	....
VERMONT.				
Barre—				
1911.....	162	....	......	....
Brattleboro—				
1911.....	5,000	....	......	....
1912.....	**36,000**	....	......	....
Enosburg Falls—				
1912.....	**200**	....	......	....
St. Albans—				
1911.....	3,330	400	......	....
VIRGINIA.				
Chatham—				
1911.....	2,640	....	......	....

City	Cement	Stone	Wood	Others
Danville—				
1911.....	11,200	....	......	....
East Radford—				
1912.....	**5,000**	....	......	....
Fredericksburg—				
1911.....	2,000	....	......	....
Newport News—				
1911.....	5,200	....	......	....
Portsmouth—				
1911.....	1,420	....	......	....
WASHINGTON.				
Aberdeen—				
1911.....	52,000	....	......	....
Bellingham—				
1911.....	34,175	....	3,049	....
1912.....	**11,390**	....	......	....
Dayton—				
1911.....	6,480	....	......	....
Everett—				
1911.....	72,900	....	......	....
Hoquiam—				
1911.....	4,000	....	......	....
1912.....	**7,400**	....	......	....
Kent—				
1911.....	3,000	....	2,000	....
1912.....	**2,000**	....	**1,200**	....
Seattle—				
1911....	344,150	....	8,712	....
1912....	**275,000**	....	**15,000**	....
Snohomish—				
1911.....	10,000	....	......	....
1912.....	**10,000**	....	......	....
Spokane—				
1911....	447,834	....	......	....
Tacoma—				
1911....	106,174	....	......	....
Walla Walla—				
1911.....	29,925	....	......	....
1912....	**100,000**	....	......	....
WEST VIRGINIA.				
Moundsville—				
1911.....	26,400	....	......	....
Point Pleasant—				
1911.....	8,000	....	......	....

City	Cement	Stone	Wood	Others
WISCONSIN.				
Antigo—				
1911.....	6,700	....	......	....
Appleton—				
1911.....	46,500	....	......	....
Beloit—				
1911.....	15,800	....	......	....
Burlington—				
1911.....	9,500	....	......	....
Columbus—				
1911.....	2,600	....	......	....
Delavan—				
1911.....	15,800	....	......	....
1912.....	**15,800**	....	......	....
Depere—				
1911.....	23,000	....	......	....
1912.....	**18,500**	....	......	....
Fond du Lac—				
1911.....	52,800	....	......	....
1912.....	**52,800**	....	......	....
Janesville—				
1911.....	20,000	....	......	....
Marinette—				
1911.....	15,800	....	......	....
La Crosse—				
1911.....	13,146	....	......	....
Oconto—				
1911.....	10,280	....	......	....
Superior—				
1911.....	59,583	....	4,750	....
1912.....	**50,000**	....	......	....
Waupaca—				
1911.....	1,200	....	......	....
Waupun—				
1911.....	8,146	....	......	....
WYOMING.				
Cheyenne—				
1911.....	10,370	....	......	....
1912.....	**10,000**	....	......	....
Greybull—				
1911.....	21,120*	....	......	....
Laramie—				
1911.....	42,250	....	......	....
Sheridan—				
1911.....	10,560*	....	......	....
1911.....	2,000**	....	......	....
1911.....	28,000¶	....	......	....

CURB AND GUTTER.

Official Report of Curb and Gutter Improvements Made to *Municipal Engineering* by the Municipal Officials of America.

Many cities set curbs and lay gutters, separately or combined, on streets which do not receive permanent pavements. These are reported in the following table. There has been no attempt to separate them into curb, gutter and combined curb and gutter, as in many of the reports no data are given on which to base this separation. The figures given represent the total length of the improvement, which may be either curb or gutter or combined curb and gutter.

City	Concrete	Limestone	Granite	Others
ALABAMA.				
Decatur—				
1911.....	4,000	....	....	....
1912.....	**4,000**	....	....	....
Dothan—				
1911.....	6,400	....	....	....
Florence—				
1911.....	4,200	....	....	....
Gadsden—				
1911.....	2,600	....	....	....
ARKANSAS.				
Fayetteville—				
1911.....	10,000	....	....	....
Helena—				
1912.....	**20,000**	....	....	....
Pine Bluff—				
1911.....	3,410	....	....	....
1912.....	**30,000**	....	....	....
CALIFORNIA.				
Alameda—				
1911.....	10,560	....	....	5,280
Alhambra—				
1911.....	36,600	....	....	....
1912.....	**104,900**	....	....	....
Fresno—				
1911.....	14,000	....	....	....

City	Concrete	Lime-stone	Granite	Others
Los Angeles—				
1911.....	303,000			
Riverside—				
1911.....	1,783			
Sacramento—				
1911.....	115,708			
San Bernardino—				
1911.....	25,000			
San Francisco—				
1911.....			6,935	3,812
San Mateo—				
1911.....	100,000			
1912.....	**10,000**			
COLORADO.				
Florence—				
1911.....	500			
Grand Junction—				
1911.....	6,000			
Golden—				
1911.....	400			
Salida—				
1911.....	2,000			
1912.....	**4,000**			
CONNECTICUT.				
Ansonia—				
1911.....	1,500		4,000	
1912.....	**1,500**		**6,000**	
East Hartford—				
1911.....	500			
Hartford—				Grading
1911.....	8,000		20,000	5,000
1912.....	**8,000**		**30,000**	
Norwich—				
1911.....	500			
Southington—				
1912.....	**500**			
Waterbury—				
1911.....	15,056			
DISTRICT OF COLUMBIA.				
Washington—				
1911.....			40,916	
FLORIDA.				
Gainesville—				Grading
1911.....	5,000			3,000
1912.....	**15,000**			**10,000**
GEORGIA.				
Americus—				
1911.....	15,000			
1912.....	**10,000**			
Columbus—				
1911.....			12,090	
1912.....			**10,500**	
Dublin—				
1911.....			400	
Rome—				
1911.....			12,600	
1912.....	**5,300**		**1,300**	
IDAHO.				
Boise City—				
1911.....	9,022			
Pocatello—				
1911.....	11,700			
ILLINOIS.				
Alton—				
1911.....	24,710			
Belvidere—				
1911.....	8,000			
Bloomington—				
1911.....	15,000			
Canton—				Sandstone
1911.....	2,300			2,200
1912.....	**10,000**			
Centralia—				Sandstone
1912.....				**40,000**
Danville—				Sandstone
1911.....				18,000
Edwardsville—				
1912.....	**20,000**	**3,600**		
Elgin—				
1912.....	**5,476**			
Freeport—				Sandstone
1911.....	15,000			
1912.....				**17,000**
Highland Park—				
1911.....	27,600	Concrete and sandstone		
Jerseyville—				
1912.....	**20,000**			
Morris—				
1912.....	**14,460**			
Morrison—				Sandstone
1911.....	17,500			625
Mt. Carmel—				
1911.....	12,000			
1912.....	**28,000**			
Oak Park—				
1911.....	33,598			
1912.....	**25,900**			
Rochelle—				
1911.....	4,700			
Waukegan—				
1911.....	1,000			
1912.....	**15,000**			
INDIANA.				
Anderson—				
1911.....	4,406			
Bloomington—				
1911.....	4,000			
Clinton—				
1912.....	**7,200**			
Crawfordsville—				
1911.....	4,590			
East Chicago—				
1911.....	57,000			
Ft. Wayne—				
1911.....	2,000			
Indianapolis—				
1911.....		89,533	3,491	
1912.....		**120,000**	**5,000**	
Kokomo—				
1911.....	19,700			
1912.....	**28,000**			
Logansport—				
1911.....	1,000			
Mishawaka—				Grading
1911.....	8,566			2,500
Mt. Vernon—				
1912.....	**1,200**			
Muncie—				
1911.....	9,324			
New Castle—				
1911.....	15,000			
1912.....	**10,000**			
Noblesville—				
1911.....	2,920			
North Vernon—				
1911.....	11,000			
Peru—				
1911.....	2,000			
Richmond—				
1911.....	30,000			
1912.....	**20,000**			
Seymour—				Grading
1911.....	5,000			15,000
1912.....	**5,000**			**10,000**
Wabash—				
1911.....				1,500
Washington—				
1911.....	6,800			
Whiting—				
1911.....	5,200			
IOWA.				
Ames—				
1911.....	4,038			
Carroll—				
1912.....	**8,500**			
Cedar Falls—				
1912.....	**21,000**			
Cedar Rapids—				
1912.....	**36,000**			
Council Bluffs—				
1911.....	11,009			
1912.....	**13,132**			
Creston—				
1912.....	**42,000**			
Dubuque—				
1911.....	29,153			
Fairfield—				
1912.....	**12,000**			

City	Concrete	Lime-stone	Granite	Others
Fort Dodge—				
1911.....	9,000	....	....	....
Harlan—				
1911.....	8,400	....	....	....
1912.....	**12,000**	....	....	....
Manchester—				
1911.....	14,000	....	....	....
1912.....	**2,000**	....	....	....
Marshalltown—				
1911.....	2,400	....	....	....
Muscatine—				
1911.....	10,386	....	....	....
Newton—				
1912.....	**5,280**	....	....	....
Sioux City—				Grading
1911.....	65,000	....	....	10,000
Waterloo—				
1911.....	8,000	....	....	....
Webster City—				
1911.....	17,000	....	....	....
1912.....	**27,000**	....	....	....
Winterset—				
1911.....	2,100	....	....	....
KANSAS.				
Atchison—				
1911.....	12,187	....	....	....
Coffeyville—				
1911.....	9,000	....	....	....
1912.....	**28,000**	....	....	....
Council Grove—				
1912.....	**1,500**	....	....	....
El Dorado—				
1911.....	3,000	....	....	....
Emporia—				
1911.....	19,800	....	....	....
1912.....	**22,000**	....	....	....
Fort Scott—				
1911.....	21,640	....	....	....
Great Bend—				
1911.....	5,000	....	....	....
Hutchinson—				
1911.....	52,800	....	....	....
Leavenworth—				
1911.....	4,697	....	....	....
Lyons—				
1911.....	1,200	....	....	....
McPherson—				
1911.....	6,400	....	....	....
1912.....	**4,400**	....	....	....
Olathe—				
1912.....	**8,000**	....	....	....
Ottawa—				Grading
1911.....	22,253	....	....	30,000
Parsons—				
1911.....	3,000	....	....	....
1912.....	**2,600**	....	....	....
Salina—				
1911.....	25,000	....	....	....
Topeka—				
1911.....	89,378	....	....	....
Wichita—				
1911.....	117,975	....	....	....
KENTUCKY.				
Dayton—				
1911.....	2,000	....	....	....
1912.....	**6,400**	....	....	....
Lexington—				
1911.....	15,000	2,000	....	....
1912.....	**12,000**	**4,000**	**6,000**	....
Louisville—				Grading
1911.....	87,273	....	....	14,221
1912.....	**85,000**	....	....	....
Ludlow—				
1911.....	800	....	....	....
1912.....	**8,000**	....	....	....
LOUISIANA.				
Lake Charles—				
1911.....	80,000	....	....	....
MAINE.				
Portland—				
1911.....	....	....	6,783	....
MARYLAND.				
Annapolis—				
1911.....	4,711	....	....	....
MASSACHUSETTS.				
East Hampton—				
1911.....	....	....	2,500	....
1912.....	**2,600**	....	....	....
Everett—				
1911.....	10,000	....	....	....
Haverhill—				
1911.....	6,495	....	....	....
Lawrence—				
1911.....	3,134	....	15,783	....
Medford—				
1911.....	....	....	6,485	....
New Bedford—				
1911.....	21,401	....	....	....
North Attleboro—				
1911.....	....	....	2,000	....
1912.....	....	....	**2,000**	....
Somerville—				
1911.....	....	....	15,957	....
Springfield—				
1911.....	4,551	....	6,558	....
Westfield—				
1911.....	2,686	....	1,495	....
Worcester—				
1911.....	....	....	34,473	....
MICHIGAN.				
Albion—				
1911.....	10,480	....	....	....
Allegan City—				
1911.....	4,000	....	....	....
Battle Creek—				
1911.....	15,895	....	....	....
Cadillac—				Grading
1911.....	20,000	....	....	7,100
1912.....	**15,000**	....	....	**3,200**
Dowagiac—				
1911.....	6,000	....	....	....
1912.....	**5,000**	....	....	....
Escanaba—				
1911.....	7,270	....	....	....
Flint—				
1911.....	3,493	....	....	....
Hillsdale—				
1911.....	6,700	....	....	....
Holland—				
1911.....	6,600	....	....	....
1912.....	**15,000**	....	....	....
Jackson—				
1911.....	42,000	....	....	....
Kalamazoo—				
1911.....	20,000	....	....	....
1912.....	**14,000**	....	....	....
Lapeer—				
1911.....	5,000	.....	....	....
1912.....	**14,000**	....	....	....
Menominee—				
1912.....	**720**	....	....	....
. Monroe—				
1911.....	3,500	....	....	....
1912.....	**5,000**	....	....	....
Mt. Clemens—				
1911.....	2,100	....	....	....
1912.....	**10,000**	....	....	....
Pontiac—				
1911.....	5,280	....	....	14,000
1912.....	**5,280**	....	....	**20,000**
Port Huron—				Grading
1911.....	20,000	....	....	10,000
St. Johns—				
1911.....	2,923	....	....	3,019
1912.....	**7,000**	....	....	....
St. Joseph—				
1911.....	3,725	....	....	....
MINNESOTA.				
Albert Lea—				
1911.....	15,500	....	....	....
1912.....	**2,000**	....	....	....
Cloquet—				
1911.....	500	....	....	....
Crookston—				
1911.....	8,828	....	....	....

City	Concrete	Lime-stone	Granite	Others
Eveleth—				
1911.....	20,389	....	....	....
Faribault—				
1912.....	**6,100**	....	**4,900**	....
Fergus Falls—				
1911.....	1,500	....	....	....
Mankato—				
1911.....	18,500	....	....	....
Minneapolis—				
1911.....	401,784	....	....	....
Red Wing—				
1911.....	15,028	....	....	....
1912.....	**20,000**	....	....	....
Stillwater—				
1912.....	**5,280**	....	....	....
Winona—				
1911.....	2,375	....	....	....

MISSISSIPPI.

City	Concrete	Lime-stone	Granite	Others
Clarksdale—				
1911.....	3,000	....	....	....
Columbia—				
1911.....	6,600	....	....	....
Itta Bena—				Grading
1911.....	....	....	....	11,000
Jackson—				
1911.....	9,000	....	....	....
1912.....	**20,000**	....	....	....

MISSOURI.

City	Concrete	Lime-stone	Granite	Others
Bethany—				
1911.....	780	....	....	....
Carrollton—				
1911.....	20,000	....	....	....
Hannibal—				
1911.....	5,000	....	....	....
Kansas City—				
1911.....	135,000	....	....	....
1912.....	**63,000**	....	....	....
Liberty—				
1911.....	10,000	....	....	....
1912.....	**10,000**	....	....	....
Macon—				
1911.....	5,200	....	....	....
Poplar Bluff—				
1911.....	2,000	....	....	....
Sedalia—				Grading
1911.....	10,560	....	....	7,920
1912.....	**15,800**	....	....	**15,000**
Springfield—				
1912.....	**81,571**	**9,005**	....	....
Webb City—				
1911.....	26,170	384	....	....

MONTANA.

City	Concrete	Lime-stone	Granite	Others
Billings—				Grading
1911.....	45,000	....	....	2,500
Bozeman—				
1911.....	10,600	....	....	....
Helena—				
1911.....	23,265	....	....	....

NEBRASKA.

City	Concrete	Lime-stone	Granite	Others
Chadron—				
1911.....	10,400	....	....	....
Lincoln—				
1911.....	19,079	....	....	....
Norfolk—				Grading
1911.....	5,600	....	....	10,000
1912.....	**24,000**	....	....	**15,000**
Omaha—				Sandstone
1911.....	....	....	....	84,044
South Omaha—				
1911.....	61,260	....	....	....

NEW HAMPSHIRE.

City	Concrete	Lime-stone	Granite	Others
Concord—				
1911.....	1,000	....	....	....
Dover—				
1911.....	450	....	....	....
Laconia—				
1911.....	....	....	500	....
1912.....	....	....	**2,000**	....

NEW JERSEY.

City	Concrete	Lime-stone	Granite	Others
Bayonne—				
1911.....	18,160	....	....	....
Bloomfield—				
1911.....	26,265	....	....	....
Egg Harbor—				
1911.....	1,900	....	....	....
Millville—				
1911.....	1,000	....	....	....
Ocean City—				Bluestone
1911.....	5,000	....	....	....
1912.....	**5,000**	....	....	**2,500**
Rutherford—				
1911.....	3,000	....	....	....
Summit—				
1911.....	8,000	....	....	....
Trenton—				Grading
1911.....	40,000	....	....	1,350
Westfield—				
1911.....	17,662 concrete & bluestone			

NEW MEXICO.

City	Concrete	Lime-stone	Granite	Others
Las Vegas—				
1911.....	2,000	....	....	....

NEW YORK.

City	Concrete	Lime-stone	Granite	Others
Albany—				
1911.....	2,000 Concrete or granite			
Auburn—				Sandstone
1911.....	6,445	....	....	8,655
1912.....	**15,000**	....	....	**9,600**
Batavia—				
1911.....	1,500	....	....	....
1912.....	**1,500**	....	....	....
Binghamton—				
1911.....	6,556	....	....	....
1912.....	**7,000**	....	....	....
Buffalo—				
1911.....	1,208	....	....	28,768
1912.....	....	....	....	**19,090**
Cortland—				
1911.....	5,300	....	....	....
Elmira—				
1911.....	1,987	....	....	....
Geneseo—				
1912.....	**1,824**	....	....	....
Herkimer—				
1911.....	4,388	....	....	....
Jamestown—				
1911.....	500	....	....	....
Kingston—				
1911.....	3,181	....	....	....
Lestershire—				
1911.....	5,600	....	....	....
Little Falls—				Sandstone
1911.....	2,000	1,600	....	4,000
1912.....	....	....	....	**5,000**
Middletown—				
1911.....	2,000	....	....	....
NEW YORK CITY—				
Manhattan—				
1911.....	217,966 Granite and Bluestone			
Brooklyn—				
1911.....	425,000 Concrete and Bluestone			
Richmond—				
1911.....	64,559	....	....	....
Norwich—				
1911.....	11,400	....	....	....
1912.....	**3,800**	....	....	....
Poughkeepsie—				
1911.....	14,747 Bluestone nad Sandstone			
Plattsburg—				
1911.....	9,350	....	....	....
1912.....	**10,000**	....	....	....
Salamanca—				
1911.....	1,600	....	....	....
Schenectady—				
1911.....	....	....	....	9,190
Watertown—				
1911.....	8,350	....	....	....

NORTH CAROLINA.

City	Concrete	Lime-stone	Granite	Others
Greenville—				
1912.....	**1,000**	....	....	....
Monroe—				
1911.....	2,640	....	....	....
Rocky Mount—				
1911.....	3,000	....	....	....
1912.....	**17,376**	....	....	....

City	Concrete	Lime-stone	Granite	Others
NORTH DAKOTA.				
Grand Forks—				
1911	8,000			
Jamestown—				Grading
1911				10,560
1912				**10,560**
Valley City—				
1911	600			
1912	**1,000**			
Williston—				Grading
1911	11,611			5,386
1912	**18,000**			**5,000**
OHIO.				
Barberton—				
1911	2,932			
1912	**8,000**			
Bowling Green—				
1911	9,395			
1912	**4,400**			
Bucyrus —				Sandstone
1911	660			2,300
Canton—				Brick gutter
1911				2,000
1912				**3,000**
Chillicothe—				
1911	9,600			
1912	**5,000**			
Circleville—				
1911	3,000	16,000		
Conneaut—				
1912	**10,560**			
Dayton—				
1911	7,800			
Fostoria—				
1911	16,000			
1912	**20,000**			
Greenville—				Grading
1912	**1,620**			**1,620**
Lorain—				Sandstone
1911				15,600
Marion—				
1911	9,580			
1912	**14,400**	**Concrete or Sandstone**		
Miamisburg—				
1911	5,000			
1912	**3,000**			
Millersburg—				
1911	2,600			
1912	**10,000**			
Mt. Gilead—				Sandstone
1911	500			2,600
Newburgh City—				
1912	**1,900**	**Concrete or Sandstone**		
Newark—				
1911	1,600			
Norwood—				
1911	5,000			
Piqua—				Grading
1911				1,600
1912				**1,600**
Ravenna—				
1911	7,600			
1912	**8,000**			
Sandusky—				
1911	10,000			
Springfield—				
1911	36,000			
Wapakoneta—				Sandstone
1911	1,500			3,000
Youngstown—				
1911	105,468	Concrete or Stone		
OKLAHOMA.				
Altus—				Grading
1911	16,000			4,000
1912	**18,400**			**5,000**
Alva—				
1911	26,400			
1912	**7,400**			
Bartlesville—				
1911	14,600			
1912	**16,000**			
Chickasha—				
1911	600			
Clinton—				Grading
1911	25,000			50,000

City	Concrete	Lime-stone	Granite	Others
Muskogee—				
1911	150,000			
OREGON.				
Astoria—				
1911	6,405			
Baker City—				
1911	34,390			
Oregon City—				
1911	42,000			
Portland—				Wood
1911	1,384,252			18,566
				Grading
1911				420,394
Roseburg—				
1911	41,266			
1912	**20,000**			
PENNSYLVANIA.				
Allentown—				
1911	12,000			
Bloomsburg—				
1911	700			
Bradford—				
1911		1,000		
1912		**3,000**		
Carbondale—				
1911	7,000			
Carlisle—				
1911	2,280			
1912	**2,000**			
Catasauqua—				
1911	2,220			
East Stroudsburg—				
1912	**5,280**			
Erie—				
1911	15,000			
Franklin—				Sandstone
1911				3,000
Latrobe—				
1911	5,000			
Media—				
1911			1,500	
Miners Mills—				
1911				1,000
1912	**2,500**			3,000
Northumberland—				
1911	300			
Oil City—				
1911	5,509	Concrete or Sandstone		
1912				**20,350**
Pittsburgh—				
1911	97,800			
Rankin—				
1911	3,500			
Sayre—				
1911	4,000			
1912	**3,000**			
Scranton—				
1911	39,120			
Swissvale—				
1911	6,348			
1912	**28,000**			
Warren—				
1911	6,000			
West Chester—			Brick	Gutter
1911			2,500	3,000
Wilkes Barre—				Red Stone
1911	6,463			32,109
				Grading
1912				**30,690**
RHODE ISLAND.				
Cranston—				Grading
1911				26,040
1912			**2,000**	
Newport—				
1911			4,480	
Providence—				
1911			34,906	
Woonsocket—				
1912			**5,280**	
SOUTH CAROLINA.				
Charleston—				
1911	14,987			
Orangeburg—				
1912	**13,020**			

City	Concrete	Lime-stone	Granite	Others
	SOUTH DAKOTA.			
Aberdeen—				
1911.....	1,603	....	....	....
1912.....	**3,000**	....	....	....
Pierre—				
1911.....	1,000	....	....	....
Sioux Falls—				Grading
1911.....	12,000	....	....	15,000
1912.....	**8,000**	....	....	**15,000**
Yankton—				
1911.....	600	....	....	....
	TENNESSEE.			
Clarksville—				
1911.....	3,300	....	....	....
1912.....	**5,500**	....	....	....
Harriman—				
1911.....	2,507	....	....	....
Knoxville—				
1911.....	43,970 concrete or limestone.			
Maryville—				
1911.....	2,000	....	....	....
	TEXAS.			
Austin—				
1911.....	23,100	....	....	....
Dallas—				
1911.....	213,000	....	....	....
San Angelo—				
1911.....	9,000	....	....	....
	UTAH.			
Ogden—				
1911.....	19,462	....	....	....
Salt Lake City—				
1911.....	7,384	....	....	....
	VERMONT.			
Barre—				
1911.....	....	....	565	....
Brattleboro—				
1911.....	5,000	....	....	....
1912.....	**10,000**	....	....	....
St. Albans—				
1911.....	3,300	....	400	....
	VIRGINIA.			
Covington—				
1911.....	900	....	....	....
East Radford—				
1912.....	**2,000**	....	....	....
Portsmouth—				
1911.....	....	....	3,284	....

City	Concrete	Lime-stone	Granite	Others
	WASHINGTON.			
Aberdeen—				
1911.....	31,900	....	....	....
Bellingham—				Wood
1911.....	15,512	....	1,326	7,500
1912.....	**19,753**	....	....	....
Hoquiam—				
1911.....	6,432	....	....	2,114
				grading
1912.....	....	....	....	3,800
Kent—				grading
1912.....	....	....	....	**2,000**
Seattle—				gutter
1911.....	187,427	....	44,422	596,575
1912.....	**125,000**	....	**26,000**	**450,000**
Snohomish—				
1912.....	**8,000**	....	....	....
Spokane—				
1911.....	446,160	....	....	....
Walla Walla—				grading
1912.....	**20,000**	....	....	**5,000**
	WEST VIRGINIA.			
Parkersburg—				
1911.....	2,500	5,000	....	....
	WISCONSIN.			
Antigo—				
1911.....	5,400	....	....	....
Burlington—				
1911.....	8,800	....	....	....
Delavan—				
1911.....	500	....	....	....
1912....	**360**	....	....	....
De Pere—				
1912.....	**6,050**	....	....	....
Fond du Lac—				
1911.....	11,524	....	....	....
1912.....	**5,290**	....	....	....
Janesville—				
1911.....	21,926	....	....	....
Marinette—				
1911.....	3,800	....	....	....
Neenah—				
1911.....	3,276	....	....	....
1912.....	**7,684**	....	....	....
Waukesha—				grading
1911.....	3,993	....	....	1,500
1912.....	**21,980**	....	....	**4,000**

SEWER IMPROVEMENTS.

Official Report of Sewer Improvements Made to *Municipal Engineering* by the Municipal Officials of America.

City	Brick	Con-crete	Rein-forced Con-crete	Vitri-fied Pipe
		ALABAMA.		
Decatur—				
1912......	....	....	....	**900**
New Decatur—				
1911......	....	....	....	274,300
		ARIZONA.		
Jerome—				
1911......	....	....	....	15,850
		ARKANSAS.		
Pine Bluff—				
1911......	....	....	....	4,200
1912......	....	....	....	**20,000**

City	Brick	Con-crete	Rein-forced Con-crete	Vitri-fied Pipe
		CALIFORNIA.		
Alameda—				
1911......	....	....	....	4,000
Jackson—				
1912......	....	....	....	**Carload**
San Francisco—				
1911......	....	....	....	99,705
San Mateo—				
1911......	....	....	....	21,400
Vallejo—				
1911......	....	4,500	....	....
1912......	....	**10,000**	....	....
		COLORADO.		
Golden—				
1911......	....	....	....	22,500

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
CONNECTICUT.				
Ansonia—				
1911	....	....	....	32,000
1912	....	....	....	25,000
Hartford—				
1911	....	3,673	....	9,255
Stonington—				
1912	**900**	....	....	....
Waterbury*—				
1911	....	....	....	7,083
*3,727 feet open drain constructed in 1911.				
DISTRICT OF COLUMBIA.				
1911	16,061	....	....	100,850
FLORIDA.				
Gainesville—				
1911	1,300	....	....	....
1912	**1,000**	....	....	....
GEORGIA.				
Americus—				
1912	....	....	....	**62,800**
Columbus—				
1911	....	....	....	4,006
1912	....	....	....	**3,500**
Rome—				
1911	....	....	....	8,000
1912	....	....	....	**60,000**
IDAHO.				
Boise City—				
1911	....	....	....	15,430
1912	....	**25,000**	....	**25,000**
Payette—				
1911	....	....	....	26,390
ILLINOIS.				
Anna—				
1911	....	....	....	22,000
Aurora—				
1911	....	2,640	....	42,300
Belvidere—				
1912 Complete system to be installed in 1912.				
Canton—				
1911	....	....	....	2,600
1912	....	....	....	**5,000**
Centralia—				
1912	....	....	....	**4,000**
Chicago Heights—				
1912	....	....	**52,800**	**13,200**
Collinsville—				
1911	....	....	....	13,200
Danville—				
1911	....	....	....	52,800
Edwardsville—				
1912	....	....	....	**4,500**
Elgin*—				
1911	....	2,792	....	39,675
1912	....	....	....	**72,846**
*500 feet cast iron pipe laid in 1911; 175 feet to be laid in 1912.				
Evanston—				
1911	....	....	....	7,100
1912	....	....	....	**7,500**
Freeport—				
1911	....	400	....	39,600
1912	....	**800**	....	**10,560**
Jerseyville—				
1912	....	....	....	**5,000**
Joliet—				
1911	....	....	....	5,000
Maywood—				
1911	....	....	....	1,000
Marengo—				
1911	....	....	....	4,860
Mattoon—				
1912	....	**1,800**	....	**15,800**
Mt. Carmel—				
1911	....	....	....	3,000
1912	....	....	....	**5,700**
Normal—				
1911	....	....	....	3,000
Oak Park—				
1911	334	....	....	13,341
Paris—				
1911	....	....	3,850	....
Pekin—				
1911	15,000	....	....	63,400
Peoria—				
1911	....	....	....	3,860
Rockford—				
1911	....	....	....	5,700
Robinson—				
1911	....	400	....	4,000
Rochelle—				
1912	....	....	....	**5,350**
Taylorville—				
1911	....	....	....	600
Waukegan—				
1911	....	....	....	26,400
1912	....	....	....	**7,920**
Wheaton—				
1912	....	**2,890**	....	....
INDIANA.				
Anderson—				
1911	....	....	....	3,600
Columbia City—				
1911	....	....	....	3,500
1912	....	....	....	**1,000**
Crawfordsville—				
1911	....	....	....	5,120
Delphi—				
1911	....	....	....	2,800
Evansville—				
1911	....	....	....	20,000
Ft. Wayne—				
1911	....	....	....	7,915
1912	....	....	....	**15,800**
Indianapolis—				
1911	....	....	....	*78,897
1912	....	....	....	**75,000**
*Includes some concrete.				
Kokomo—				
1911	....	....	6,800	8,700
1912	....	**7,000**	....	**8,300**
Ligonier—				
1911	....	....	....	2,640
Logansport—				
1911	....	....	....	1,000
Marion—				
1911	....	....	....	1,964
Mishawaka—				
1911	....	....	....	4,000
Mt. Vernon—				
1911	....	....	....	1,500
1912	....	....	....	**3,600**
Muncie—				
1911	....	....	....	2,610
New Albany—				
1912	....	....	....	**$800**
New Castle—				
1911	....	....	....	28,000
1912	....	....	....	**10,000**
North Vernon—				
1911	....	....	....	5,500
1912	....	....	....	**1,500**
Peru—				
1911	....	....	....	10,000
Remington—				
1911	....	....	....	3,000
Richmond—				
1911	....	....	....	3,500
1912	....	....	....	**7,000**
Rushville—				
1912 $55,000 contract for vitrified pipe has been let.				
Seymour—				
1911	....	....	....	4,000
1912	....	....	....	**1,500**
Wabash—				
1911	....	....	....	4,610
1912	....	....	....	**2,500**
Whiting—				
1911	....	....	....	2,500

IOWA.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Burlington—				
1911	....	....	....	5,043
1912	....	....	....	**9,000**
Carroll—				
1912	....	....	....	**6,000**
Cedar Falls—				
1912	....	....	....	**3,000**
Council Bluffs—				
1911	....	....	....	174,520
Creston—				
1912	....	....	....	**2,600**
Eldora—				
1911	....	....	....	1,500
Fairfield—				
1912	....	....	....	**84,500**
Fort Dodge—				
1911	....	....	....	10,560
Harlan—				
1911	....	....	....	8,000
Indianola*—				
1912	....	....	....	**23,780**
*Contract let for $21,749.				
Mason City—				
1911	....	....	....	5,280
Manchester—				
1911	....	....	....	1,000
1912	....	....	....	**2,000**
Newton—				
1911	....	....	....	23,680
Shenandoah—				
1912	....	....	....	**13,400**
Sioux City—				
1911*	....	300	....	26,600
1912	....	**1,600**	....	**40,000**
*400 feet of tunnel.				
Waterloo—				
1911	....	....	....	18,700
1912	....	....	....	**20,000**
Waukon—				
1911	....	....	....	26,855
Webster City—				
1911	....	....	....	3,960
1912	....	....	....	**12,000**
Winterset—				
1911	....	....	....	400

KANSAS.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Argentine—				
1911	5,280	....	....	5,280
Arkansas City—				
1911	....	....	3,980	....
Coffeyville—				
1911	....	....	....	3,000
1912	....	....	....	**25,000**
Emporia—				
1911	....	....	....	5,400
1912	....	....	....	**12,000**
Hutchinson—				
1911	10,560	....	....	....
Lawrence—				
1911	....	....	....	10,560
McPherson—				
1912	....	....	....	**37,000**
Olathe—				
1912	....	....	....	**3,500**
Ottawa—				
1911	....	....	322	1,500
Parsons—				
1911	....	....	....	8,000
1912	....	....	....	**26,000**
Pittsburg—				
1911	....	....	....	1,120
1912	....	....	....	**3,600**
Salina—				
1911	....	....	....	8,000

KENTUCKY.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Ashland—				
1911	....	....	....	1,000
Dayton—				
1911	....	....	....	3,000
1912	....	....	....	**1,500**
Lexington—				
1911	....	600	....	8,000
1912	....	**300**	....	**5,000**
Louisville				
1911	....	....	....	49,000
1912	....	....	....	**49,000**
Ludlow—				
1912	....	....	....	**3,000**

MAINE.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Lewistown—				
1911	....	....	....	4,000
Skowhegan—				
1911	....	....	....	600

MASSACHUSETTS.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Agawam—				
1912	....	....	....	**3,000**
Easthampton—				
1911	....	....	....	3,000
1912	....	....	....	**5,000**
Greenfield—				
1911	....	....	....	10,000
Lawrence*—				
1911	....	....	....	6,136
*865 feet concrete invert with brick arch.				
New Bedford—				
1911	....	....	....	10,560
North Adams—				
1911	....	....	....	3,017
North Attleboro—				
1911	....	....	1,000	84,500
Quincy—				
1911	....	....	....	24,000
Somerville—				
1911	....	....	....	4,645
1912 $15,000 has been appropriated for extensions.				
Springfield—				
1911	....	1,382	....	19,241
Westfield—				
1911	....	....	....	8,434

MICHIGAN.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Allegan City—				
1911	....	....	....	5,280
Ann Arbor—				
1911	....	....	....	6.655
Bessemer—				
1911	....	....	820	5,492
Cadillac—				
1911	....	....	....	2,500
1912	....	....	....	**4,000**
Dowagiac—				
1911	....	....	....	6,000
1912	....	....	....	**5,000**
Gladwin—				
1911	....	....	....	1,000
Holland—				
1911	....	....	....	16,000
1912	....	....	....	**7,000**
Jackson—				
1911	....	....	5,000	19,000
1912	....	....	**5,000**	**19,000**
Kalamazoo—				
1911	....	....	....	15,000
Lapeer—				
1911	....	....	....	3,000
1912	....	....	....	**4,000**
Marine City—				
1911	....	3,000	....	....
Marshall—				
1911	....	....	....	3,500
Menominee—				
1911	....	....	....	1,200
Monroe—				
1911	....	....	....	1,300
1912	....	....	....	**2,500**
Mt. Clemens—				
1911	....	....	....	900
1912	....	....	....	**1,200**
Norway—				
1911	....	....	....	2,000

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Pontiac*—				
1911				20,450
1912				**40,000**
*6,000 feet open drains constructed in 1911; 12,000 feet for 1912.				
Port Huron—				
1911				3,500
St. Clair—				
1911				3,000
St. Johns—				
1911				840
1912				**3,400**
St. Joseph—				
1911				4,150
1912				**1,300**
Sturgis—				
1912				**35,000**

MINNESOTA.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Albert Lea—				
1911				18,676
1912				**15,000**
Bemidji—				
1911				$3,526
1912				**$1,400**
Cloquet—				
1911				10,000
Faribault—				
1911			363	5,120
1912				**4,000**
Fairmount—				
1911				7,200
Mankato—				
1911				4,000
1912				**10,000**
Montevideo—				
1911				5,300
Red Wing—				
1912			**600**	**8,000**
Stillwater—				
1911				2,500
1912				**4,000**
St. Paul—				
1911			5,280	40,000
Winona—				
1911				2,000

MISSISSIPPI.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Itta Bena—				
1911				2,000
Jackson—				
1912				**9,000**
Vicksburg—				
1912				**7,500**

MISSOURI.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Bethany—				
1911			85	
Brookfield—				
1911				2,640
Boonville—				
1911				1,684
Kansas City*—				
1911	$500,000			
1912	**$750,000**			
*Includes concrete, reinforced concrete, vitrified pipe and tunnel work.				
Liberty—				
1911				500
Moberly—				
1911			21,000	
Sedalia—				
1911				26,400
1912	**7,960**			**52,800**
Webb City—				
1911				2,135
1912 A $17,000 bond issue has been voted.				

MONTANA.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Billings—				
1911				7,000
Laurel—				
1911				10,560

NEBRASKA.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Chadron—				
1911				4,000
Hastings—				
1911				7,940
Lincoln—				
1911				14,000
Norfolk*—				
1911			320	7,260
1912				**5,000**
*620 feet galvanized culvert constructed in 1911; 1,000 feet for 1912.				
South Omaha—				
1911	1,328	18,530	513	10,655
1912				**15,000**

NEW HAMPSHIRE.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Concord—				
1911				1,397
1912	**400**	**600**		
Keene—				
1912				**$2,600**
Laconia—				
1911				2,000
1912				**5,000**
Littleton—				
1911				1,100

NEW JERSEY.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Bloomfield—				
1911				10,560
Elizabeth—				
1911				8,011
1912	**3,000**			**7,000**
Glen Ridge—				
1912				**6,000**
Jersey City*—				
1911	4,100		2,640	3,590
*5,800 feet steel.				
Newark—				
1911	2,200		3,250	20,600
Ocean City—				
1911				20,000
1912				**10,000**
Rahway—				
1912				**5,500**
South Amboy—				
Second section of sanitary sewerage system completed in 1911.				
Trenton—				
1911		1,700		31,700
1912		**6,000**		**25,000**

NEW MEXICO.

East Las Vegas—
A sanitary sewerage system costing $40,000 was completed in 1911.

Las Vegas—
A sewerage system covering one-half of the city was completed in 1911.

NEW YORK.

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Auburn—				
1911				400
1912				**9,200**
Binghamton—				
1911			1,722	25,257
1912				**20,577**
Buffalo—				
1911	1,296			33,757
1912	**5,422**	**443**		**36,760**
Corning—				
1911				5,280
Dunkirk—				
1911				2,640
1912				**5,280**
Elmira—				
1911				4,000
Geneseo—				
1911				1,200
Kingston—				
1911				4,000
North Tonawanda—				
1911				10,500
1912				**12,500**
Norwich—				
1911				1,445
1912				**1,200**

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Olean—				
1911				15,000
Oneida—				
1911				3,960
Plattsburg—				
1911				2,000
1912				**3,000**
Schenectady—				
1911				15,000
Sidney—				
1911				700
Syracuse—				
1911				19,285
1912				**20,000**
Watertown—				
1911				7,940
NORTH CAROLINA.				
Burlington—				
1911				10,560
1912				**42,250**
Greenville—				
1912				**1,000**
Hendersonville—				
1911				5,280
Wilson—				
1911				2,000
1912				**5,000**
NORTH DAKOTA.				
Grand Forks—				
1911				2,019
Jamestown—				
1911				1,320
1912				**660**
Valley City—				
1911				825
1912			**2,980**	**8,800**
Williston—				
1911				3,642
1912				**5,000**
OHIO.				
Alliance—				
1911				2,000
Ashtabula—				
1911				2,160
Barberton—				
1912				**52,800**
Bellefontaine—				
1911				122,000
Bowling Green—				
1911				5,422
1912				**6,000**
Bucyrus*—				
1911				4,940
1912				**5,000**
*1,000 feet vitrified segment laid in 1911; 4,000 feet for 1912.				
Canal Dover—				
1911				10,560
Canton—				
1911				3,000
1912				**4,500**
Chillicothe—				
1911				2,450
1912				**6,000**
Cincinnati—				
1911				15,500
1912				**13,700**
Circleville—				
1911				10,000
1912				**5,000**
Conneaut—				
1911				8,000
1912				**4,000**
Coshocton—				
1911				490
Dayton—				
1911		2,243		62,812
1912		**10,000**		**50,000**
Delaware—				
1911				6,000
Dennison—				
1912				**1,000**
East Liverpool—				
1911				2,640
Euclid—				
1911				2,640
Findlay—				
1911				5,280
Fostoria—				
1911				5,200
1912				**6,000**
Galion—				
1911				90,000
1912				**3,000**
Greenville—				
1911				2,180
Ironton—				
1911		6,200		600
Lorain—				
1911	3,902			18,274
1912	**3,000**			**13,000**
Louisville—				
1911				400
Marion—				
1911				5,070
1912				**3,500**
Miamisburg—				
1911		2,640		
1912				**2,000**
Millersburg—				
1912				**5,600**
Mingo Junction—				
1912				**500**
Mt. Gilead—				
1911				6,100
Newburg City—				
1911	11,000			
1912				**4,500**
Niles—				
1911				15,800
Piqua—				
1911	2,650			9,200
1912				**7,300**
Ravenna—				
1911				4,500
1912				**4,500**
Salem—				
1911				3,000
Sandusky—				
1911				5,000
Steubenville—				
1911	5,280			15,000
Warren—				
1911				18,500
Wapakoneta—				
1911				1,000
Zanesville—				
1911				3,000
OKLAHOMA.				
Altus—				
1911				21,800
1912				**10,560**
Alva—				
1911	5,280			17,960
Bartlesville—				
1911				1,000
1912				**20,000**
Chandler—				
1911				35,000
Clinton—				
1911				36,000
Durant—				
1912 Complete sanitary system to be constructed.				
El Reno—				
1911				30,000
Lawton—				
1911		4,000		
Muskogee*—				
*An outfall sewer costing $250,000 is being constructed.				
Norman—				
1911		1,000		15,000
Tulsa—				
1911				35,000

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
Vinita—				
1911				6,000
OREGON.				
Albany—				
1911				6,000
Baker City—				
1911				14,014
Marshfield—				
1911				7,920
Portland*—				
1911			20,042	213,853
1912			**40,000**	**400,000**
*152,664 feet cement pipe laid in 1911; 300,000 feet for 1912.				
Roseburg—				
1911				48,000
1912				**2,900**
Salem—				
1911 $50,000 concrete and reinforced sewers constructed.				
The Dalles—				
1911				10,560
PENNSYLVANIA.				
Bradford—				
1911				1,000
1912				**5,500**
Carlisle—				
1912 Complete sewerage costing $60,000 to be constructed.				
Chester—				
1911				13,600
Corry—				
1911				850
Erie—				
1911		800		8,907
Gallitzin—				
1912				**3,000**
Harrisburg—				
1911	915			8,852
Indiana—				
1911				4,000
1912				**2,000**
Johnstown—				
1911				9,118
Latrobe—				
1911				3,500
McKees Rock—				
1911				2,000
Miners Mills—				
1911				500
1912				**1,800**
New Castle—				
1911				5,280
Norristown—				
1911				2,500
Oil City—				
1911				4,847
1912				**7,000**
Port Allegheny—				
1911				2,000
Ridgway—				
1912				**5,000**
Sayre—				
1912				**2,000**
Scottdale—				
1911				10,560
Sharpsville—				
1911				10,560
Swissdale—				
1911				687
Warren—				
1911				2,500
Westchester—				
1911				900
Wilkes Barre—				
1911	1,390			9,003
RHODE ISLAND.				
Newport—				
1911				15,184
Providence—				
1911	10,000			15,800
Woonsocket—				
1911				7,920
SOUTH CAROLINA.				
Charleston*				
1911				7,338
*An entire new sewer system was constructed in 1910 and 1911.				
Columbia—				
1911		3,500		7,920
1912		**2,000**		**10,560**
Greenville—				
1911				18,500
Orangeburg—				
1912				**1,320**
Union—				
1911				1,000
SOUTH DAKOTA.				
Aberdeen—				
1911				10,128
1912				**12,000**
Faulkton—				
1911				1,500
Lead—				
1911				3,000
Lennox—				
1911			5,000	
Madison—				
1911				31,600
Mitchell—				
1911				10,560
Sioux Falls—				
1911				1,300
1912		**7,000**		**92,000**
*600 feet of tunntel to be constructed during 1912.				
Yankton—				
1912				**2,000**
TENNESSEE.				
Clarksville—				
1911				150
1912				**800**
Columbia—				
1911				1,000
1912				**5,280**
Harriman—				
1911				1,000
TEXAS.				
Cuero—				
Sewer construction to the amount of $25,000 is contemplated.				
Dennison—				
1911				10,000
El Paso—				
1911		1,600		
Terrell—				
The purchase of the privately owned system is being effected.				
UTAH.				
Ogden—				
1911		21,100		
Provo—				
1911				51,831
Salt Lake City*—				
1911				27,963
*2,450 feet steel constructed during 1911.				
VERMONT.				
Barre—				
1911				9,554
Brattleboro—				
1911				5,000
Enosburg Falls—				
1911				1,120
St. Albans—				
1911				700
VIRGINIA.				
East Bradford—				
1911				2,000
1912				**2,640**

City	Brick	Concrete	Reinforced Concrete	Vitrified Pipe
WASHINGTON.				
Aberdeen—				
1911				10,560
Bellingham*—				
1911		2,348		
1912		**6,500**	**750**	
*23,247 feet drain tile laid in 1911; 6,087 for 1912.				
Everett—				
1911	7,798		2,971	25,454
Hoquiam—				
1911				4,409
1912				**7,300**
Kent—				
1912				**6,000**
Pullman—				
1911				5,000
Seattle—				
1911	3,680	41,325		189,421
1912	**5,500**	**25,000**		**112,000**
Snohomish—				
1911				6,437
1912				**5,200**
Spokane—				
1911				47,483
Tacoma—				
1911		6,072	8,712	19,000
Walla Walla—				
1912		**23,000**		
WEST VIRGINIA.				
Fairmont—				
1911				2,640
Middlebourne—				
1911				3,000
Moundsville—				
1912				**147,840**
Parkersburg—				
1911				4,560
WISCONSIN.				
Ashland—				
1911				6,220
1912				**10,000**
Beloit—				
1911				10,560
1912				**10,560**
Burlington—				
1911				4,300
Columbus—				
1911	2,000			
1912	**1,500**			
Delavan—				
1911				5,000
Depere—				
1911				2,000
1912				**15,000**
Fond du Lac—				
1911				5,800
1912				**5,000**
Janesville—				
1911	10,500			
1912	**5,540**			
La Crosse—				
1911				2,330
1912				**23,750**
Milwaukee—				
1911	26,400			36,960
Neenah—				
1911				1,581
Portage—				
1911				47,500
Racine—				
1911				1,600
Sheboygan—				
1911				11,986
1912				**3,000**
Superior—				
1911				5,369
Waupaca—				
1911				7,721
Waukesha—				
1911				9,489
WYOMING.				
Cheyenne—				
1911				2,765
1912				**2,000**
Cowley—				
1912	**System under construction.**			
Thermopolis—				
1912.	**System under construction.**			

SEWAGE DISPOSAL AND PUMPING PLANTS.

ARKANSAS.

Pine Bluff—The city will purchase 9 flush tanks and 9 flush tank regulators.

CALIFORNIA.

San Mateo—The city constructed a disposal system including pumps, pump pits and a septic tank at a cost of $25,000.

CONNECTICUT.

Southington—The construction of a sand filter system is contemplated. T. N. and S. N. McKenney, engineers.

IDAHO.

Payette—The city will construct a sewage pumping plant.

ILLINOIS.

Anna—The construction of a septic tank is contemplated.

Freeport—The city constructed a pumping plant of 800-gal. per minute capacity and installed 4 flush tanks during 1911.

INDIANA.

North Vernon—Four flush tanks were installed in 1911 and 2 more will be purchased in 1912.

IOWA.

Fairfield—The installation of a complete sewage disposal system to cost about $16,000 is contemplated.

Newton—The construction of a septic tank is contemplated.

KANSAS.

Coffeyville—A sewage treatment plant to cost about $5,000 is contemplated.

Council Grove—A construction of a complete sewerage system and disposal plant to cost $25,000 is contemplated.

Hutchinson—A construction of a sewage pumping plant of 1,000,000-gal. per day capacity is contemplated.

Parsons—During 1911 a sewage pumping plant and concrete septic tanks costing $25,000 were constructed.

MASSACHUSETTS.

North Attleboro—A complete sewage disposal plant including the following was constructed during 1911: 1 settling tank, 2 units; 2 electrically driven pumps; 1 flush tank and 16 sludge beds 125x150 ft.

MICHIGAN.

Cadillac—Two 6-in. pumping units with a capacity of 1,500,000-gal. per day and costing $9,000 were constructed during 1911.

Port Huron—A small sewage pumping plant will be constructed in 1912.

St. Johns—A new feeder system for the sewage farm will be constructed during 1912.

MINNESOTA.

Bemidji—Septic tanks costing about $1,000 were installed during 1911.

Montevideo—Two flush tanks were installed in 1911.

MISSISSIPPI.

Jackson—Four flush tanks were installed during 1911.

MISSOURI.

Kansas City—A pumping plant costing $1,800 was built in 1911 and $43,000 is available for sewage disposal pumps for 1912.

Sedalia—During 1911 the city constructed 4 sections each 50x70 ft. of a septic tank and 4 crushed stone filters at a cost of $11,000. One septic tank and 6 contact beds costing $15,000 will be constructed in 1912.

NEW JERSEY.

Ocean City—The city constructed a sewage disinfection plant costing $20,000 in 1912.

Trenton—A construction of an experimental sewage plant is contemplated.

NEW MEXICO.

Las Vegas—Sewage disposal by irrigation to cost $10,000 is contemplated.

NEW YORK.

North Tonawanda—A centrifugal electrically driven pumping plant was installed in 1911.

NORTH CAROLINA.

Rocky Mount—Sewage disposal plant finished in 1911, sewage being treated with hypochlorite of lime. Tanks, chemical house and pipe lines cost $7,000.

Statesville—A sewage disposal plant costing $3,800 was constructed in 1911.

OHIO.

Circleville—A pumping plant and 3 flush tanks were installed in 1911.

Conneaut—A sewage pumping plant was constructed in 1911.

Galion—A sewage disposal plant including the following items and costing $30,000 was constructed in 1911: 3 settling tanks, 5 contact beds, 88 flush tanks, 1 sludge bed and 1 sludge pump.

Mt. Gilead—A filter bed was constructed at the sewage plant in 1911.

Ravenna—Two settling tanks will be constructed in 1913 and a sewage pumping plant will be installed in 1912.

OKLAHOMA.

Altus—Two sand filters 50x50 ft., and a septic tank 80ft.x50x6 and costing $6,000 was installed in 1911.

Chandler—A 12-chamber septic tank, 28 ft. by 38 ft. by 9 ft. deep and costing $3,500 was constructed in 1911.

Durant—Construction of a complete sewage disposal plant is contemplated.

PENNSYLVANIA.

Bradford—Plans for a complete sewage disposal plant have been submitted to the state board of health.

Carlisle—A sewage disposal plant costing $40,000 is contemplated.

Indiana—Sewage disposal plant completed May 1, 1911, consists of 2 sludge tanks, dosing chamber, 1 sprinkling filter and 2 secondary settling tanks designed to treat a maximum flow of 1,000,000 gal. Operation very satisfactory.

Westchester—A sewage disposal plant costing $60,000 is under consideration.

RHODE ISLAND.

Newport—A sewage pumping plant costing $9,500 is in the process of construction.

SOUTH DAKOTA.

Aberdeen—A $200,000 bond issue for the construction of a sewage disposal plant has been sold.

Madison—The contract for the construction of a sewage disposal plant has been let for $9,908.

UTAH.

Provo—Twenty-five flush tanks were installed in 1911.

Salt Lake City—The city installed 42 flush tanks during 1911.

VERMONT.

St. Albans—The construction of a sewage disposal plant is contemplated for 1912.

WASHINGTON.

Bellingham—The city installed 1 flush tank, 3 manholes and 9 catch basins and inlets in 1911.

WISCONSIN.

Beloit—Plans have been accepted for the construction of a sewage disposal plant.

Waupaca—One flush tank was purchased in 1911.

WATER WORKS IMPROVEMENTS.

Official Reports of Water Works Improvements Made to *Municipal Engineering* by the Managers of the Water Works Plants of America.

City	Pipe	Hydrants	Valves	Meters
ALABAMA.				
Sheffield—				
1911.....	16*	....	......	....
Talladega—				
1911.....	18,000*	....	......	....
ARKANSAS.				
Pine Bluff—				
1911.....	7,188*	3	6	600
1912.....	....	....	......	**800**
CALIFORNIA.				
Vallejo—				
1911.....	15,000*	25	......	....
1912.....	**10,000***	**25**	......	**500**
COLORADO.				
Salida—				
1911.....	3,585*	6	......	2
1912.....	**14,000†**	**6**	**20**	....
CONNECTICUT.				
Southington—				
1912.....	**25,000***	....	......	....
1912.....	**10,000‡**	....	......	....
Waterbury—				
1911.....	21,605*	33	33	59
Wallingford—				
1911.....	1,500*	....	......	....
DISTRICT OF COLUMBIA.				
Washington—				
1911.....	152,066*	157	847	3,060
1912.....	**5,280¶**	....	......	**150**

City	Pipe	Hydrants	Valves	Meters
FLORIDA.				
Gainesville—				
1912.....	**$40,000 for mains and machinery.**			
GEORGIA.				
Americus—				
1911.....	15,800*	20	40	65
Atlanta—				
1911.....	158,400*	....	......	....
Eastman—				
1911.....	13,200*	....	......	....
1911.....	10,560¶	....	......	....
Rome—				
1911.....	13,906*	23	25	72
1912.....	**20,000***	40	......	....
IDAHO.				
Lewiston—				
1911.....	10,560	....	......	....
Payette—				
1911.....	21,860¶	30	......	100
1912.....	**5,280¶**	....	......	....
Rexburg—				
1911.....	3,000*	....	......	....
1912.....	**3,000***	**6**	......	**100**
ILLINOIS.				
Anna—				
1912.....	**21,000***	....	......	....
Canton—				
1911.....	5,600*	....	......	....
1912.....	**4,000***	....	......	....
Evanston—				
1911.....	4,500*	....	......	....
Flora—				
1912.....	**15,800***	....	......	....
Highland Park—				
1911.....	3,000*	....	......	....
1912.....	**3,200***	....	......	....
Jerseyville—				
1912.....	**4,200***	....	......	....
Joliet—				
1911.....	4,000*	....	......	....
Mattoon—				
1911.....	2,700*	....	......	....
1912.....	**5,280***	**10**	......	....
Maywood—				
1912.....	**4,890**	....	......	....
Oak Park—				
1911.....	6,107*	23	9	324
1912.....	**7,643***	**19**	**10**	....
Paris—				
1911.....	2,760*	....	......	....
1912.....	**1,000***	....	......	....
River Forest—				
1911.....	1,260	....	......	....
1912.....	**9,650**	....	......	....
Rochelle—				
1912.....	**2,400***	....	......	....
Rockford—				
1911.....	50,000*	....	......	....
Rock Island—				
1911.....	4,400*	....	......	....
Waukegan—				
1911.....	1,500*	....	......	....
1912.....	**1,000***	....	**100**	....
INDIANA.				
Bloomington—				
1911.....	10,560*	....	......	....
Brazil—				
1911.....	1,500*	....	......	....
Butler—				
1911.....	1,000*	....	......	....
Clinton—				
1911.....	10,560v	4	......	....
Delphi—				
1911.....	....	....	......	50
1912.....	**1,500***	....	......	**50**
Ft. Wayne—				
1911.....	608,709*	854	1,005	74,093
1912.....	......	**30**	**50**	**6,000**
Hammond—				
1911.....	3,600*	....	......	....
Indianapolis—				
1911.....	50,000*	....	......	....
1912.....	**75,000***	....	......	....
Ligonier—				
1911.....	5,280*	....	......	....
Logansport—				
1911.....	$9,000	....	......	....
Mishawaka—				
1911.....	12,000*	3	15	25
1911.....	367**	....	......	....
1912.....	**8,000***	....	**25**	....
New Castle—				
1912.....	**10,000***	....	......	....
North Vernon—				
1911.....	1,500*	....	......	....
Peru—				
1911.....	14,000*	....	......	....
Portland—				
1911.....	30 ton*	5	4	2
Rushville—				
1911.....	1,400*	....	......	....
1912.....	**26,400¶**	....	......	....
1912.....	**4,600***	....	**4**	**50**
Seymour—				
1911.....	2,000*	....	......	....
Whiting—				
1911.....	4,200*	....	......	....
1912.....	**3,000***	....	......	....
IOWA.				
Burlington—				
1911.....	10,560*	....	......	....
Cedar Falls—				
1912.....	**4,000***	....	......	**100**
Charles City—				
1911.....	10,560*	....	......	....
Cherokee—				
1911.....	1,600*	1	4	....
Council Bluffs—				
1911.....	50,000*	46	55	1,000
Decorah—				
1911.....	......	....	......	30
Eldora—				
1911.....	1,000*	....	......	....
Fairfield—				
1911.....	1,000*	....	......	....
1912.....	**2,500***	**4**	......	....
Harlan—				
1911.....	300*	....	......	....
1912.....	**4,000***	....	......	....
Iowa City—				
1911.....	12,000*	....	......	....
Manchester—				
1911.....	2,500*	....	......	....
Mason City—				
1911.....	10,560*	....	......	....
Muscatine—				
1911.....	15,800*	....	......	....
Newton—				
1911.....	5,280*	....	......	....
1912.....	**5,280***	....	......	....
Shenandoah—				
1912.....	**2,000***	....	......	....
Sioux City—				
1911.....	30,000*	....	......	....
1911.....	30,000‡	....	......	....
Waterloo—				
1911.....	15,000*	....	......	....
1912.....	**20,000***	....	......	....
Webster City—				
1911.....	10,000*	....	......	....
KANSAS.				
Abilene—				
1911.....	1,000*	....	......	....
1911.....	1,000**	....	......	....
1912.....	**1,000***	....	......	....
Arkansas City—				
1911.....	79,100*	....	......	....
Burlington—				
1911.....	33,000*	....	......	....
Cherryvale—				
1911.....	36,900*	....	......	....
Coffeyville—				
1912.....	**$59,665 appropriated for distribution system.**			
Emporia—				
1911.....	4,000*	....	......	....
Newton—				
1911.....	7,000*	....	......	....

City	Pipe	Hydrants	Valves	Meters
Olathe—				
1912....	5,000*	....	......	....
Ottawa—				
1911.....	2,000*	....	......	....
Pittsburg—				
1912....	$40,000 appropriation for distribution system.			
LOUISIANA.				
Monroe—				
1912	Cast Iron Water Mains to be laid.			
Opelousas—				
1911.....	2,630*	....	......	....
MAINE.				
Augusta—				
1911.....	2,500*	....	......	....
1911.....	1,500**	....	......	....
MARYLAND.				
Brunswick—				
1911.....	5,000*	....	......	....
MASSACHUSETTS.				
Attleboro—				
1911.....	10,000*	....	......	....
Easthampton—				
1911.....	3,000k	....	......	....
1911.....	20,000*	50	25	....
Lawrence—				
1911.....	17,185*	....	......	....
1911.....	6,771§	42	112	197
New Bedford—				
1911.....	67,584*	....	......	....
1912.....	10,560*	....	......	....
Newton—				
1911.....	8,476	2	10	....
Revere—				
1911.....	7,920*	....	......	....
Somerville—				
1912.....	$17,000 appropriated for new work and $30,000 for maintenance.			
Springfield—				
1911.....	30,000*	59	284	792
1912.....	30,000*	59	284	792
Westfield—				
1911.....	12,301*	16	24	2
MICHIGAN.				
Alma—				
1911.....	15,800*	....	......	....
1911.....	10,560¶	....	......	....
Battle Creek—				
1911.....	15,800*	....	......	....
Cadillac—				
1911.....	7,575*	4	8	12
1912.....	5,450*	20	10	100
Detroit—				
1911.....	225,871	258	507	886
Jackson—				
1911.....	21,000*	39	75	1,800
1912.....	21,000*	39	75	1,800
Kalamazoo—				
1911.....	40,000**	....	......	....
1912.....	15,000**	....	......	....
Lapeer—				
1911.....	3,500*	....	......	....
1911.....	1,600**	2	......	....
Marine City—				
1911.....	300*	....	......	....
Pontiac—				
1911.....	15,000*	....	......	....
1911.....	452‖	....	......	376
1912.....	10,000*	....	......	500
1912.....	700‖	....	......	....
Port Huron—				
1911.....	13,500*	....	......	....
1912.....	5,000*	....	......	....
St. Joseph—				
1911.....	1,000*	....	......	100
1911.....	40‖	....	......	....
Sturgis—				
1911.....	3,000*	....	......	....
1912.....	2,000*	....	......	....
Ypsilanti—				
1911.....	360*	....	......	....
MINNESOTA.				
Albert Lea—				
1911.....	6,000*	....	......	....
1912.....	6,000*	....	......	....
Bemidji—				
1911.....	$1,500*	$175	$80	$500
1912.....	......	....	......	$500
Cloquet—				
1911.....	12,000*	17	27	110
Eveleth—				
1911.....	1,067*	3	19	6
Faribault—				
1911.....	289*	3	13	77
1912.....	2,500*	....	......	....
Mankato—				
1911.....	400*	....	......	....
Montevideo—				
1911.....	1,835*	....	......	....
1912	400*	....	......	....
Red Wing—				
1912.....	8,000*	....	......	....
Stillwater—				
1911.....	4,000*	3	3	....
1912.....	3,000*	6	4	....
MISSISSIPPI.				
Clarksdale—				
1911.....	44,000*	....	......	....
Greenville—				
1911.....	500*	....	......	....
1912.....	5,000*	....	......	....
Itta Bena—				
1911.....	10,000‡	....	......	....
Vicksburg—				
1912.....	8,020*	....	......	....
MISSOURI.				
Bethany—				
1912.....	5,000**	2	......	....
Caruthersville—				
1911.....	3,000*	....	......	6
1912.....	3,000*	....	......	....
Kansas City—				
1911....	$294,941	....	......	....
1912....	$325,000	....	......	....
Lexington—				
1912.....	Connections.			
Liberty—				
1911.....	2,700*	....	......	....
NEBRASKA.				
Norfolk—				
1911.....	......	....	......	100
NEW HAMPSHIRE.				
Concord—				
1911.....	3,713*	13	22	....
Littleton—				
1911.....	300*	....	......	....
1911.....	2,000**	....	......	....
NEW JERSEY.				
Jersey City—				
1911.....	16,900*	8	22	....
Ocean City—				
1911.....	300‖	....	......	....
1911.....	14,000*	20	100	300
1912.....	300‖	....	......	....
1912.....	10,000*	20	50	300
Trenton—				
1911.....	38,000*	....	......	....
1912.....	40,000*	....	......	....
NEW YORK.				
Auburn—				
1911.....	5,600*	7	19	....
Batavia—				
1911....	12,000*	14	9	....
1912.....	12,600*	15	10	....
Binghamton—				
1911.....	9,757*	12	......	404
Buffalo—				
1911.....	40,960*	....	......	....
1911.....	1,635‖	75	313	204
1912.....	25,000*	....	......	....
1912.....	1,500‖	100	300	200

City	Pipe	Hydrants	Valves	Meters
East Aurora—				
1911.....	5,000*			
1911.....	800¶			
Liberty—				
1911.....	2,000*			
1912.....	**2,000***			
Little Falls—				
1911.....	15‖	2	5	50
1912.....	**2,500***			
1912.....	**20‖**	**2**	**10**	**50**
Newburg—				
1911.....	3,168	7	17	
North Tonawanda—				
1911.....	1,000*			
1912.....	**3,000***			
Norwich—				
1911.....	8,020*			
Plattsburg—				
1911.....	14,100*	23	50	14
1912.....	**2,000***			
Rochester—				
1911.....	115,000*			
1912.....	**105,800***			
Solvay—				
1911.....	1,000*			
1912.....	**3,000***			
Syracuse—				
1911.....	21,800*	40	30	1,200
1911.....	20,000‖			
1912.....	**21,800***			
1912.....	**20,000‖**	**40**	**30**	**1,200**
NORTH CAROLINA.				
Greenville—				
1912.....	**2,000***			
Rocky Mount—				
1911.....	1,000*			
1912.....	**6,500***			
Statesville—				
1911.....	......	15		90
NORTH DAKOTA.				
Grand Forks—				
1911.....	2,340†			
1911.....	11,578*	12	15	
Jamestown—				
1911.....	10,560*			
1912.....	**5,280***			
Valley City—				
1911.....	4,500*	9	10	30
1912.....	**2,000***	6	8	30
Williston—				
1911.....	4,260*	4		
1912.....	**27,450***	**35**		
OHIO.				
Alliance—				
1911.....	10,000*			
1911.....	500**			
1911.....	4,000c			
1912.....	**8,000***			
1912.....	**4,000***	**36 to 42 in. conduits.**		
Barberton—				
1911.....	1,500*			
1912.....	**17,000***			
Cambridge—				
1911.....	$1,200*			
1912.....	**$1,200***			
Canton—				
1911.....	2,000*			
1912.....	**5,000***			
Conneaut—				
1911.....	1,500*	3		
1912.....	**1,000***	**2**		
Coshocton—				
1911.....	1,800*	1	6	
Dayton—				
1911.....	1,387*			
1911.....	2,325‖	50	73	1,541
1912.....	**2,600 tons***			
1912.....	**2,000‖**	**50**	**100**	**1,600**
Fostoria—				
1911.....	2,000*			
1912.....	**1,500***			
Greenville—				
1911.....	680**			
1911.....	1,300*			
Lorain—				
1911.....	2,800*			

City	Pipe	Hydrants	Valves	Meters
Miamisburg—				
1911.....	600‡			
Newburgh City—				
1911.....	25,450*			800
1912.....	**25,450***			**800**
Port Clinton—				
1911.....	1,500*			
Ravenna—				
1911.....	3,000*	5	4	
1912.....	**1,500**	**6**	**6**	**4**
Sandusky—				
1911.....	10,600*	16	24	500
1911.....	500‖			
Van Wert—				
1911.....	55 tons*			
OKLAHOMA.				
Altus—				
1912.....	**5,280***			
Alva—				
1911.....	686,000*			
1911.....	502‖	89	26	476
1912.....	**21,800***			
Chandler—				
1911.....	1,500‡			$250
1912.....	**6,000‡**			**$1,500**
Clinton—				
1911.....	5,000*	12		
1912.....	**5,000***			
Durant—				
1911.....	21,800*			25
OREGON.				
Baker City—				
1911.....	1,282	4	2	
Portland—				
1911.....	378,418*	623	1,483	429
1912.....	**400,000***			
PENNSYLVANIA.				
Catasauqua—				
1911.....	752‖			
1911.....	36,059*	78	73	
East Stroudsburg—				
1911.....	2,000*			
1912.....	**3,000***			
Media—				
1911.....	2,700*	4	10	
1912.....	**2,500***			
West Chester—				
1911.....	2,650*	7	6	21
SOUTH CAROLINA.				
Orangeburg—				
1911.....	660*	2		40
1912.....	**1,320***			**40**
SOUTH DAKOTA.				
Aberdeen—				
1911.....	9,514*			
1912.....	**13,200***			
Mitchell—				
1911.....	7,300*			
1912.....	**7,000***			
Sioux Falls—				
1911.....	100 tons*			
1911.....	210‡	6		2,000
1912.....	**600 tons***	**10**		**300**
Vermillion—				
1911.....	700*		3	
Yankton—				
1911.....	1,200*			
1912.....	**30,000* to replace wood.**			
TENNESSEE.				
Clarksville—				
1911.....	125*			
1912.....	**1,500***			**200**
Harriman—				
1911.....	......	5		
TEXAS.				
Cuero—				
1911.....	1,200*	5		
1912.....	**2,400***			
Denison—				
1911.....	21,800*			
Hillsboro—				
1911.....	5,280*			

City	Pipe	Hydrants	Valves	Meters
UTAH.				
American Fork—				
1911.....	1,320*	....	......	....
1911.....	28,100¶	....	......	....
Provo—				
1911.....	858¶	....	17	29
1911.....	18,193c	....	......	....
1912.....	**2,450†**	....	......	....
Salt Lake City—				
1911.....	34,183*	52	139	....
VERMONT.				
Barre—				
1911.....	518‡	5	......	....
1911.....	2,832*	....	......	....
St. Albans—				
1911.....	180*	....	......	....
1911.....	2,100¶	....	......	....
1912.....	**10,000***	**12**	**12**	**1,000**
1912.....	**10,000**	**Vitrified tile.**		
WASHINGTON.				
Bellingham—				
1911.....	17,000¶	15	......	....
1911.....	333‖	....	......	....
1912.....	**4,510***	**10**	**16**	....
Kent—				
1912.....	**10,000¶**	....	......	....
Seattle—				
1911.....	156,333*	....	......	....
1911.....	16,064†	313	304	....
1911.....	1,185¶	....	......	....
1912.....	**46,500***	....	......	....
1912.....	**18,250†**	**130**	**150**	....
Snohomish—				
1911.....	17-mile system installed.			
Spokane—				
1911.....	43,936*	....	......	....
1911.....	89,979k	238	276	2,312
1911.....	16,078†	....	......	....
1911.....	690‡	....	......	....
1911.....	1,876‖	....	......	....
1912.....	**26,400†**	....	......	....
WEST VIRGINIA.				
Parkersburg—				
1911.....	6,000*	30	35	275
WISCONSIN.				
Columbus—				
1911.....	1,500*	....	......	....
1912.....	**1,500***	....	......	....
Delavan—				
1911.....	6,000*	....	......	....
Depere—				
1911.....	2,000‖	....	......	100
1912.....	**15,000‖**	....	......	**200**
La Crosse—				
1911.....	15,978*	14	64	....
1912.....	**10,000***	**15**	**75**	....
Waupaca—				
1911.....	1,000*	....	......	....
1911.....	540†	....	......	....
1911.....	30‖	1	4	4
1912.....	**2,000***	....	......	....
WYOMING.				
Cheyenne—				
1911.....	3,685*	....	......	....
Sheridan—				
1911.....	21,800¶	....	......	....

WATER SUPPLIES.

ALABAMA.

Dothan—The city constructed a 1,000,000-gal. reinforced concrete reservoir during 1911.

Talladega—The city constructed coal sheds, tool houses and a scales during 1911.

ARKANSAS.

Batesville—A filtration plant was constructed in 1911.

CALIFORNIA.

Alameda—A district has been formed with Oakland to obtain water from the mountain.

Portersville—A 500,000-gal. reservoir was constructed in 1911.

San Bernardino—A reservoir, the third to be constructed, was built in 1911.

San Francisco—$817,000 of contracts for fire protection water supply were completed in fiscal year ending in 1911, and $900,000 remained to complete during current year. filter plant. A high service pumping station was completed in 1911 and an entirely new low service plant is proposed for construction in 1912.

Vallejo—A 15,000,000-gal. reservoir of reinforced concrete construction was built in 1911.

Visalia—An electrically-driven 500,000-gal. centrifugal pump was installed in 1911.

COLORADO.

Golden—The earth and concrete reservoir was enlarged in 1911.

Rocky Ford—A pumping station and filtration plant was constructed in 1911.

CONNECTICUT.

Perryville—The impounding system was enlarged in 1911.

Wallingford—A 100,000,000-gal. reservoir was constructed in 1911.

FLORIDA.

Jacksonville—A 3,000,000-gal. covered reinforced concrete reservoir was constructed in 1911.

Gainesville—An appropriation of $40,000 for the purchase of machinery and the extension of the distribution system has been voted.

GEORGIA.

Americus—A 225,000-gal. concrete reservoir costing $5,000; a 1,500,000-gal. crank and fly wheel engine; a 200-h.p. return tubular boiler; and one 12-in. well were added to the supply system during 1911.

Ft. Valley—A reservoir and air compressor pumping station was constructed in 1911.

Rome—The installation of a 4,000,000-gal. steam or 2,500,000-gal. electric pumping unit and the construction of a 500,000 filter unit are contemplated for 1912.

Waynesboro—One 12x12x12 Myer air compressor has been installed.

IDAHO.

Ilo—An $11,000 bond issue for a water works system has been voted.

Payette—The construction of a pumping station and a filtration plant are contemplated for 1912.

ILLINOIS.

Anna—The construction of a 100,000-gal. tank and tower is contemplated for 1912.

Canton—A pumping station was constructed and one $2,000,000 pump, and two 150-h.p. boilers were installed in 1911. A 2,000,000-gal. pump will be installed in 1912.

Centralia—The city completed a water supply system in 1911, submerging 250 acres to an average depth of 10 ft. by the construction of an earth dam. The cost of the work was $150,000.

Downers Grove—A stand pipe was constructed in 1911.

Eureka—A 270-gallon per minute pump was purchased and a 10-in. well driven in 1911.

Fairbury—A steel tank and tower will be erected and forty meters purchased in 1912.

Mattoon—The installation of a filtration plant is contemplated by the city water works system.
Morrison—An additional artesian well is being constructed.
Mt. Carmel—The installation of a filtration unit is contemplated.
Normal—The construction of a concrete reservoir, and a brick pumping station, one deep well and the installation of 2 steam pumps is contemplated. Bids will be requested soon.
Oak Park—A pumping unit costing $11,000 was purchased in 1911.
Paris—The purchase of an additional unit is contemplated.
Quincy—A special committee has reported on local water works conditions recommending the immediate use of hypochlorite of lime, and the early construction of a complete filter plant.
San Jose—The installation of a water works system including reservoir and an air lift pumping station is contemplated.
Waukegan—The construction of a hypochlorite plant is contemplated in 1912.
Wheaton—A Nash gas producer gas engine replacing steam units was installed and additions were made to the pumping station during 1911.

INDIANA.

Bedford—The installation of two boilers and a steam driven pumping unit is contemplated for 1912.
Clinton—Two pumps and one boiler were purchased in 1911.
Ft. Wayne—Four pumps and four boilers, one air compressor and one electric pumping unit were purchased in 1911, and one pump, and one air compressor will be needed in 1912.
Hobart—The extension of the water works system is contemplated.
Indianapolis—A new pumping station and complete boiler plant will be installed by the Indianapolis Water Co. during 1912.
Logansport—A dam costing $12,000, a pump house extension, costing $2,000 and pumps costing $15,200, were added to the water works system in 1911.
Mishawaka—The purchase of two boilers and one pump to cost about $70,000 is contemplated.
New Castle—A deep well will be driven and an additional pumping unit purchased in 1912.
North Vernon—A concrete dam 15 ft. high and 150 ft. long was constructed in 1911 and in 1912 an electric pumping unit will be purchased and settling basins and filters of 1,000,000-gal. capacity will be added.
Remington—A filtration plant was built in 1911.
Rushville—Extensions to the water works system as follows are contemplated for 1912: One brick and concrete pumping station, three pumps, two motors and 5 miles of transmission line and one 14-in. well.

IOWA.

Cedar Falls—The purchase of a 2,000,000-gal. pump and the construction of a deep well is contemplated for 1912.
Cherokee—The construction of a concrete reservoir and the re-construction of a receiving reservoir, and one well were completed in 1911.
Council Bluffs—Water works extensions as follows are contemplated for 1912: A brick boiler room, one 8,000,000-gal. high duty, and 2 14,000,000-gal. centrifugal pumps, 1 air compressor, 1 steel air compressor tank and 2 100-h.p. motors.
Fairfield—The installation of a filter unit to cost about $16,000 is contemplated.
Glenwood Park—A $4,000 bond issue for water works extension has been voted.
Newton—A 100,000-gal. steel tank was completed and one Dean compound duplex steam pump was purchased in 191.
Shenandoah—The purchase of 1 Gould pump and the construction of a deep well is contemplated for 1912.
Sioux City—The following water works improvements were completed in 1911: 1 120,000-gal. steel tank, 1,000 ft. of 5-ft.x5-ft. tunnel, 2 small pumping stations and 6 16-in. wells.
Sigourney—A filtration plant was completed during 1911.
Waterloo—Two pumps were purchased, and 1 settling basin and 1 deep well were constructed during 1911.

KANSAS.

Arkansas City—A water works system costing about $100,000 and including a dam, pumping station and filtration plant was completed in 1911.
Clay Center—A 1,000,000-gal. pump was purchased in 1911.
Coffeyville—The following water works improvements are contemplated for 1912: Boilers, $11,300; filters, $32,000; settling basins, $14,800.
Emporia—Electric pumping apparatus costing $13,000 was purchased in 1911 and additional apparatus costing $4,000 is contemplated for 1912.
Lynden—J. W. Mavity is preparing plans and estimates for a water supply system for the city.
Manhattan—A 2-stage 5-in. vertical motor driven turbine pump was installed in 1911.
Newton—Water works improvements costing $3,000 were installed during 1911. They were an additional pump house, 1 pumping engine, 2 deep wells, and 3 deep well pumps.
Ottawa—Improvements to the dam and intake costing about $1,000 were completed in 1911.

KENTUCKY.

Earlington—A 150,000-gal. reservoir is completed.
Owensboro—A water softening plant was installed in 1911.

LOUISIANA.

Baton Rouge—The Baton Rouge Water Co. will require the following material for reservoir construction this fall: 130 lbs. hydrated lime, 1292 bbls. cement, 725 cu. yds. crushed stone, 263 cu. yds. sand, reinforcing bars, valves, cast iron pipe and castings.
Morgan City—A water works system was constructed in 1911.
Monroe—The construction of a dam is contemplated for 1912.

MAINE.

Augusta—Reservoir extensions were completed in 1911.

MARYLAND.

Brunswick—A 350,000-gallon concrete reservoir was completed in 1911.
Laurel—The construction of a reservoir and dam to cost about $1,000,000 is contemplated.
Myersville—The construction of a water works system is contemplated.

MASSACHUSETTS.

East Hampton—The installation of an electric indicator and 10,000 ft. of transmission line is contemplated for 1912.
Greenfield—A storage reservoir was completed in 1911.
Summerville—An appropriation of $17,000 for water works extensions and $30,000 for maintenance has been made.
Springfield—The additional cost of recent new water supply from the Little River including land damages, etc., was $78,000.

MICHIGAN.

Bessemer—Two 250-ft. wells were constructed in 1911 and 3 300-ft. wells will be constructed in 1912.

Dowagiac—A 1,500,000-gal. Canton-Hughes pump was purchased in 1911.

Grand Haven—A $60,000 bond issue for water works extension has been voted.

Hancock—An electric pumping station was constructed in 1911.

Jackson—The installation of 2 125-h.p. boilers is contemplated for 1912.

Kalamazoo—The purchase of 2 steel standpipes or tanks and towers is contemplated for 1912.

Mt. Clemens—An additional well was constructed in 1911.

Pontiac—One 2,000,000-gal. concrete reservoir was constructed in 1911.

St. Johns—A 1,000,000-gal. pumping engine was purchased in 1911.

MINNESOTA.

Cloquet—A centrifugal pump and a 90-h.p. motor were purchased in 1911, and an entire new pumping station will be added in 1912.

Duluth—A 5,000,000-gal. reservoir was constructed in 1911.

Faribault—A 12-in. artesian well, 1,385 ft. in depth was completed in 1911.

Jordan—A $7,000 bond issue for water works extension has been voted.

Mankato—A 50-000-gal. tank and tower was constructed in 1911, and the following equipment was installed: 1 125-h.p. boiler, and 1 electrically driven centrifugal pump.

Montevedio—A gravity pipe line about one-half mile in length was installed in 1911.

New Prague—A $7,000 bond issue for water works extension has been voted.

St. Peter—A concrete reservoir was constructed in 1911.

Two Harbors—One compound Nordberg pump was purchased in 1911.

MISSISSIPPI.

Clarksdale—Two pumps were purchased and an air compressor installed in 1911, and in 1912 1 250-h.p. water tube boiler will be added.

Columbus—A 200,000-gal. elevated tank and tower costing $8,500 was added in 1911.

Greenville—A Babcock and Wilcox boiler was installed during 1911.

Itta Bena—One well was constructed in 1911.

Jackson—A pumping station with 2 pumps and 2 boilers was constructed in 1911.

Vicksburg—A bond issue for a municipally owned water works system has been voted.

Yazoo City—A $30,000 bond issue for water works improvements has been voted.

MISSOURI.

Bethany—The construction of a power plant and the installation of a pumping unit is contemplated for 1912.

Boonville—A concrete reservoir was constructed in 1911, and 2 additional reservoirs will be built in 1912. The reservoir is divided into sections, a unit of which is constructed at a time.

Kansas City—A 30,000,000-gal. pumping engine at Quindaro, and a high pressure pump at Turkey Creek and other pumping equipment costing $359,427, was constructed in 1911. Additional power house improvements to cost $150,000 are contemplated for 1912.

Lexington—Additional pumping units and reservoir extensions were added in 1911.

Liberty—A 100,00-gal. steel tank is contemplated for 1912.

Mound City—A $15,000 bond issue for water works extensions has been voted.

Oregon—Pumps and boilers costing $11,500 were added in 1911.

MONTANA.

Bozeman—Extensive reservoir improvements were made in 1911.

Great Falls—The reservoirs, a filtration plant and electric pumping units were added in 1911.

NEBRASKA.

Alliance—Water works construction as follows will be completed about May 1st, 1912: Power plant, 100 ft. by 60 ft., 2 165-h.p. boilers, 1 engine direct connected to 100-k.w. Ft. Wayne generator and 1 engine direct connected to a 250-k.w. generator.

Chadron—A dam was constructed in 1911.

Lincoln—Two 1,500,000-gal. centrifugal pumps will be purchased in 1912, and 2 deep wells will be constructed.

Mason City—A $3,000 bond issue for the erection of a standpipe and the extension of water mains has been voted.

Marquette—A $9,100 bond issue for water works construction has been voted.

Norfolk—An electric pumping sub-station will be constructed in 1912.

North Platte—A $100,000 bond issue for water construction has been voted.

Tecumseh—A 125,000-gal. tank and tower was purchased in 1911.

Wymore—A pumping station was installed in 1911.

NEW JERSEY.

Beech Haven—A filtration plant was constructed in 1911.

Burlington—A mechanical filtration plant will be installed in 1912.

Millville—The purchase of the Peoples Water Co. plant and its operation by the city is contemplated.

New Brunswick—A $100,000 bond issue for water works construction has been voted.

Ocean City—An air compressor system and 1 well were added in 1911 and an additional well will be driven in 1912.

Plainfield—New wells and pumping equipment were installed in 1911.

South Amboy—A steel standpipe will be constructed in 1912.

Trenton—The city proposes to construct a mechanical filtration plant to cost about $450,000.

NEW YORK.

Batavia—A concrete reservoir containing about 600 cu. yds. was constructed, and 1 5,000,000-gal. pump was purchased during 1911. A 150-ft. brick chimney will be constructed in 1912.

Binghamton—A 5,000,000-gal. reservoir is being constructed.

Buffalo—A new pumping station containing 2 30,000,000-gal. pumps is under construction, and the purchase of 5 30,000,000-gal. pumps and 8 750-h.p. boilers is contemplated.

Cortland—The reservoir is to be enlarged and lined during 1912.

East Aurora—The reservoir was repaired and the pumping station was overhauled during 1911.

Elmira—A 5,000,000-gal. reservoir was constructed in 1911.

Frankfort—A 20,000,000-gal. reservoir was constructed during 1911.

Geneseo—An appropriation of $10,000 for the construction of a reservoir and the purchase of a steel tank has been made.

Granville—The construction of a new reservoir and water main extensions to cost $15,000 is contemplated for 1912.

Huntington—A 25,000-gal. tank was constructed during 1911.

Jamestown—Chester & Flemming, Union Bank Bldg., Pittsburgh, Pa., have been retained to prepare plans for the construction of a reinforced concrete reservoir.

Liberty—The purchase of 50 water meters is contemplated by the city.

Millerton—A filtration plant was constructed during 1911.

Mt. Morris—A $140,000 bond issue for water works construction has been voted.

Norwich—A 2,000,000-gal. centrifugal pump electrically driven was purchased in 1911.

Oneida—The installation of a water softener plant to cost about $25,000 is contemplated.

Plattsburg—An earth dam with concrete corewall costing $24,000 was completed in 1911. Additional reservoir improvements are contemplated for 1912.

NORTH CAROLINA.

Greensboro—A 2,000,000-gal. pump steam turbine driven was purchased during 1911.

NORTH DAKOTA.

Grand Forks—A 2,000,000-gal. rapid sand filter was completed in 1911.

Jamestown—An additional pumping unit was purchased in 1911.

Mandan—Three reservoirs were constructed and a filter plant completed during 1911.

Valley City—A concrete block pumping station, 2 stories in height, was completed and 2 Deming pumps direct connected to motors and having a capacity of 300 gal. per minute, were installed.

Williston—The construction of a 215,000-gal. steel tank, a 1,000,000-gal. filter and 2 pumps is contemplated for 1912.

OHIO.

Alliance—The construction of a 300,000,000-gal. reservoir and a 5,000,000-gal. standpipe is contemplated for 1912. During 1911 the following equipment was installed: 2 250-h.p. boilers, 1 feed water pump, 1 500 cu. ft. air compressor.

Bucyrus—A 3,000,000-gal. pump and 2 125-h.p. boilers were installed during 1911.

Cambridge—The construction of a water purification plant is contemplated.

Canton—A steel tank and tower and 1 pump were purchased during 1911, and 2 standpipes, 2 pumps and 15 or 20 wells will be added during 1912.

Cincinnati—General Supt. Baldwin of the water works has recommended water works improvements to the amount of $199,500.

Cleveland—Two 25,000,000-gal. pumping engines were installed during 1911, and during a part of the winter season a temporary hypochlorite plant was in use.

Coshocton—Three wells were constructed during 1911.

Crooksville—Consulting Engineer Maddox, Newark, O., has been retained to prepare plans for a complete water works system. A joint system with Roseville is contemplated.

Dayton—The following work was completed by the city water works during 1911, a steel dam, 3,000,000-gal. reinforced reservoir, 1 steel standpipe, 1 pumping station, 3 3,500,000-gal. per minute pumps, 1 vacuum pump, 3 50-h.p. motors and 40 8-in. wells.

Dennison—All steam apparatus was replaced by electric motors during 1911.

East Liverpool—A pumping station was constructed during 1911.

Junction City—The installation of a water works system is contemplated.

Lisbon—A $10,000 bond issue for water works improvements has been voted.

Lorrain—An engine room and 2 settling basins were completed in 1911. In 1912 an engine will be purchased and a pump house and 2 settling basins will be constructed at a cost of about $52,000.

Mingo Junction—The purchase of a private water works system which has been in operation for about 15 years is contemplated by the village. Estimated cost, $65,000.

Port Clinton—A filtration plant costing $17,000 was completed in 1911. The construction of a new intake is contemplated for 1912.

Portsmouth—J. F. Witmer, Buffalo, N. Y., has been retained to prepare plans and superintend the construction of a water works plant. Estimated cost, $300,000.

Ravenna—The construction of a pump and boiler house and the installation of 1 3,000,000-gal. pump and 150-h.p. boiler is contemplated for 1912.

Sandusky—Extensive repairs to the filtration plant are contemplated for 1912.

Toledo—A 60,000,000-gal. clear water basin, additional pumping units, filters and a high pressure main system were constructed during 1911.

West Carrolton—A reservoir and dam were constructed in 1911.

Youngstown—An addition to the filter plant on Northwest ave. is to be built during the coming summer.

OKLAHOMA.

Ainsworth—A $21,000 bond issue for water works construction has been voted.

Altus—The following water works construction was completed in 1911: steel standpipe, $7,000; pump house, $1,000; 2 1,000,000-gal. pumps; 2 40-h.p. motors; and 2 wells 28 ft. in diameter and 28 ft. deep. For 1912 the following work is contemplated: Dam to cost $7,000; reservoir to cost $1,000 and a 9-mile canal.

Alva—the following water works improvements were completed during 1911: 1 66,000-gal. reservoir, 1 300,000-gal. and 1 65,000-gal. steel standpipe, 5 triplex pumps and 2 wells.

Chandler—Wells costing $2,500 were constructed during 1911. During 1912 a deep well costing $10,000 and deep well pumps will be purchased.

Clinton—The city will purchase 1 air compressor and will construct a deep well during 1912.

Durant—A filter plant, settling basins and wells costing $18,000 were constructed during 1911.

El Reno—Three reservoirs, a dam, pumping station and filtration plant were constructed during 1911.

Kenefic—A $15,000 bond issue for water works improvements has been voted.

Muskogee—The city is now constructing improvements which will cost $650,000, including a reservoir at the cost of about $49,000, a tunnel across the Arkansas River at the expenditure of $90,000, a purification plant and settling basin, also various new pipe lines from 24-in. down.

Prior Creek—The Benham Engineering Co., Oklahoma City, Okla., is preparing plans for the construction of a new water works system.

OREGON.

Cornelius—A $27,000 bond issue for the purpose of constructing a gravity water system from Rhoderick Creek including 5 miles of pipe line, is contemplated.

Portland—The following improvements were made during 1911: 125,000,000-gal. reservoir, 200,000-gal. standpipe, 10 miles of 52-in. and 14 miles of 44-in. conduits with a capacity of 45,000,000 gal.

Union—Water works extensions to cost $20,000 are contemplated. Wood or steel pipe will be used.

PENNSYLVANIA.

Bellwood—City constructed a reservoir in 1911.

Bradford—The work of enlarging the reservoir is in progress. Earth dam with core wall is under construction and will give a reservoir capacity of 200,000,000 gal. Estimated cost, $80,000.

Catasauqua—The following water works improvements were completed during 1911: a reservoir, 72 ft. in diameter and 15 ft. deep; a steel standpipe 15 x 80 ft.; a pumping station equipped with 2 pumps, 2 boilers and 2 air compressors.

Coatesville—Samuel Q. Dixon, state commissioner of health has ordered the installation of a filter and water sterilizing plant.

East Stroudsburg—The water works co. will drill an 8-in. well.

Erie—A sterilization plant was completed during 1911.

Franklin—A boiler and pump were purchased during 1911.

Ligonier—A concrete reservoir was constructed during 1911.

McKeesport—Leo Hudson, Haverstraw, N. Y., has prepared plans for water works extension.

Media—The Borough has purchased the property of the Nether Providence Water Co. at a cost of $10,050. Extensions are contemplated.

Port Alleghany—The reservoir was enlarged during 1911.

Phoenixville—The construction of a 3,000,000-gal. mechanical filtration plant is contemplated.

Somerset—A 500,000-gal. reservoir and pumping station were completed during 1911.

SOUTH CAROLINA.

Columbus—Water works extensions to cost about $15,000 are contemplated.

Orangeburg—An air compressor was added to the water works equipment during 1911.

Rock Hill—The water works system was rebuilt during 1911 at a cost of about $500,000.

SOUTH DAKOTA.

Aberdeen—Artesian wells costing $11,127 were constructed during 1911 and in 1912 the construction of 1 reservoir and 1 pumping station is contemplated.

Madison—The city will purchase 1 400 and 1 600-gal. per minute pumps.

Mitchell—The installation of a water softening plant is contemplated.

Pierre—A $5,000 addition to the pumping station was completed during 1911.

Sioux Falls—A concrete well 50 ft. in diameter, 30 ft. deep and costing $11,200 was completed in 1911.

Vermillion—The contract for the following construction was let in October, 1911: The plant which includes the following will be in operation about April 1st: a 100,000-gal. tank on a 110-ft. tower; 24 x 30 ft. brick and concrete pump house; 2 8¼ x 10 in. triplex Gould pumps: 2 40-h.p. Fairbanks-Morse oil engines with starting apparatus; 32 ft. x 15 ft. brick and concrete settling basin; and 2 65 ft. wells 10 ft. in diameter with 8-ft. Johnson screens.

Yankton—The purchase of a steel standpipe is contemplated for 1912.

TENNESSEE.

Clarksville—A complete water works plant costing $60,000 is now under construction.

Harriman—The city has purchased 2 200-h.p. internally fired boilers for the water and light plant.

Knoxville—A 12,000,000-gal. filtration plant was constructed in 1911.

TEXAS.

Belton—A 250,000-gal. reinforced standpipe was completed in 1911.

Cuero—Two wells were completed in 1911 and 2 will be constructed in 1912.

Dallas—J. H. Fuertes, New York City, is preparing plans for a 15,000,000-gal. water filtration plant.

Denison—A pumping station of 2,000,000-gal. capacity and 4 wells were completed in 1911. The construction of a filtration plant is contemplated for 1912.

Greenville—A 450,000-gal. reservoir was completed in 1911.

Houston—The installation of a water purification plant to cost about $200,000 is contemplated.

Sherman—Extensions to the water works system are contemplated.

Terrell—The construction of a reservoir and the drilling of new wells is contemplated.

Texas City—A reservoir and dam were constructed in 1911.

UTAH.

American Fork—A reservoir and dam were constructed during 1911.

Ogden—A filtration plant was constructed during 1911.

Provo—Concrete conduit 18,193 ft. in length and costing $31,831 was constructed during 1911. A concrete swimming pool 60 x 30 x 7 ft. will be constructed during 1912.

VERMONT.

St. Albans—The construction of an earthen reservoir of 128,000,000-gal. capacity is contemplated for 1912.

VIRGINIA.

Gordonville—A $10,000 bond issue for water works construction has been voted.

Richmond—Water works extensions to cost about $70,000 are contemplated by the city of Richmond.

WASHINGTON.

Centralia—Frank C. Kelsey has been retained to prepare plans and estimates for the construction of 14.2 miles of 16-in. pipe line to deliver 3,000,000 gal. per day and cost about $112,115.

Grand View—W. H. Dunbar, city engineer, has prepared plans for water works extension to cost about $18,000.

Kent—A construction of a reservoir to cost about $2,000 is contemplated.

Seattle—The following water works construction was completed during 1911, lining reservoirs with concrete, $292,218; steel water tower, $14,880; gatehouse, $7,375; pumping station, $14,256.

Spokane—The following water works construction was completed in 1911: 4 350,000-gal. concrete standpipes; the Lincoln Heights pumping station; 1 3,000,000-gal. and 1 12,500,000-gal. pumps; electric motors to drive the above mentioned pumps; 1 well, 26 ft. in diameter and 40 ft. deep. During 1912 a 20,000,000-gal. reservoir with earth banks concrete lined, will be constructed; 200 ft. of tunnel will be built; meter testing apparatus and a 100-cu. ft. air compressor will be purchased.

Spokane—A 12,500,000-gal. pumping station and 2 standpipes were completed during 1911. The construction of a 28-in. force main to cost $130,000 is contemplated for 1912.

Walla Walla—A concrete reservoir 300 ft. x 400 ft. 20 ft. deep and costing $80,000 was completed in 1911. The purchase of 3,500 ft. of steel pipe for water mains is contemplated for 1912.

WEST VIRGINIA.

Fairmont—A pumping station was constructed in 1911.

Milton—A $10,500 bond issue for water works construction has been voted.

Parkersburg—A construction of a concrete reservoir is contemplated.

Romney—A 150,000-gal. reservoir and pumping station were completed in 1911.

Sistersville—The city completed a fireproof buff brick water station costing $4,500.

WISCONSIN.

Antigo—Additional pumping units were purchased during 1911.

Appleton—The installation of a filtration plant is being discussed.

Burlington—A concrete retaining wall around the standpipe was constructed.

LaCrosse—The construction of a water plant including about 3 miles of mains at an estimated cost of about $300,000, is contemplated.

Milwaukee—A 12,000,000-gal. pumping unit was installed.

WYOMING.

Cheyenne—The following water works construction was completed in 1911: 4 diversion dams, $55,700; 2 storage reservoirs, $166,000; and 2 concrete reservoirs, $30.000.

Greybull—Completed 4 mi. c. i. pipe line, tower and tank in 1911.

ELECTRIC LIGHT IMPROVEMENTS.

The following table gives a summary of the reports of additions to electric lighting plants made in 1911 and to be made in 1912. The first column gives the number of feet of street wiring done or proposed, the second the number of poles, the third the number of feet of underground conduits and the fourth the number of street lamps.

As nearly as may be, the kind of street lamps is explained in a note under each town installing them. The number of kinds of lamps is now so great that this information is in general only as to class of lamp, and not always so definite as that.

ALABAMA.

Sheffield—The electric lighting plant owned by a private corporation includes 1 building, 3 engines, 5 boilers and 2 generators.

ARKANSAS.

Pine Bluff—The city installed a 108-light tungsten lighting system in the business district.

CALIFORNIA.

Alhambra—An ornamental lighting system with concrete mission and Moorish standards has been completed on 7 streets. Lights spaced 100 ft. apart and 48 watts tungstens are used. Length of wire in system is 18,700 feet.

Lodi—The city installed 20 ornamental lights in 1911.

Salida—An ornamental lighting system with 14 standards was completed in 1911.

CONNECTICUT.

Hartford—The city is lighted by contract and the system includes at present 580 magnetite and 1,500 125-watt tungstens.

Waterbury—The city installed 73 arc lights and 19 incandescents in 1911.

DISTRICT OF COLUMBIA.

Washington—New lamps were established during fiscal year ending in 1911 as follows: 2,090 incandescents of 40 to 100 c.p., 47 arcs. wear comes directly on them and the sand or special fittings for putting the frames to- or ten or fifty of them on a moment's notice. swers call. The operation of all patrol boxes it at switchboard or not.

FLORIDA.

Gainesville—A $50,000 bond issue for a municipal light plant has been voted.

Jacksonville—A lighting system is now being constructed and it will include the following: 8 miles of wire, 450 poles, 12,000 ft. of conduit and 200 street lamps.

GEORGIA.

Cuthbert—A generator, an engine and 2 boilers were installed in 1911.

Waynesboro—The city installed 30 lighting poles and 12 lights in 1911 and will add 30 poles and some lights in 1912.

IDAHO.

Rexburg—A lighting system was completed in 1911 and includes the following: 26,000 ft. of wire, 200 poles, 12,000 ft. of conduits, 29 100-watt and 140 40-watt tungstens.

ILLINOIS.

Champaign—Contract for constructing a new street lighting system of the ornamental type, to James R. Cravath, $35,000.

Mattoon—The city purchased 1 generator and 70 magnetite arc lights for the municipal lighting plant during 1911.

Oak Park—The city purchased 19 arc lights in 1911.

Pekin—The Citizens Gas and Electric Co. will purchase several thousand ft. of wire in 1912.

Rochelle—One 150-k.w. generator will be purchased in 1912.

Streator—The question of constructing a municipal lighting plant to cost about $51,000 is being agitated. A bond election has been called.

INDIANA.

Clinton—One arc light and 3 incandescent units were installed in 1911.

Columbia City—The city extended its lighting system by 10,000 ft. of wire, 100 poles, 75 arc lights, 500 incandescents, 200 tungstens, 1 engine and 2 generators in 1911. The purchase of 5,000 ft. of wire, 100 poles, 500 tungstens, and the construction of 5,000 ft. of conduit is contemplated for 1912.

Ft. Wayne—The following improvements were completed in 1911: 239,860 ft. of wire, 415 poles, 10,000 ft. of conduit, 590 arc lights, 50 tungstens, 90 5-light ornamental posts, 1 building, 3 engines, 4 boilers and 3 generators. The following improvements are contemplated for 1912: 250,000 ft. of wire, 400 poles, 500 ft. of conduit, 50 arc lights, 25 tungstens, 500 ornamental posts, a new power station and 2 boilers.

Garrett—A steam engine driven generator will be installed about July 1st.

Indianapolis—The city installed 96 arc lights and 165 tungstens in 1911.

Linton—One Allis-Chalmers engine and generator unit was installed in 1911.

Logansport—Arc lights and a distribution system costing $2,800, a building at $12,300 and boilers at $13,575 were completed in 1911.

Portland—The city completed the following improvements in 1911: 7 miles of wire, 70 poles, 2 arc lights, 2 tungstens and 1 ornamental standard. In 1912 10 miles of wire, 100 poles, 12 arcs and 12 tungstens will be purchased.

Richmond—The installation of an ornamental lighting system is contemplated.

Seymour—The following additions were completed in 1911: 19 arc lights, 300 tungstens, 2 ornamental standards, 2 engines, 2 boilers and 2 generators.

IOWA.

Fairfield—An ornamental lighting system including 125 Mazda lamps, 20 poles, and 10,000 ft. of wire was completed in 1911. Lighting extensions as follows have been contracted for: 175 Mazda lamps, 100 poles and 20,000 ft. of wire.

Manchester—The city installed a 5-light ornamental lighting system including 30 standards and 1,800 ft. of wire.

Marshalltown—A franchise has been granted to Tubbs and Hamer, for lighting the streets with electricity.

Shenandoah—The contract has been let for installing 25 arcs and 160 tungstens.

Waterloo—An ornamental lighting system including 135 poles and 675 tungstens was installed in 1911.

Webster City—A new $40,000 municipal lighting plant was completed in 1911.

Woodward—The Woodward Heat & Lighting Co. has been incorporated for $10,000.

KANSAS.

Ottawa—Thirty street lamps were installed in 1911, 25 are now being put in place and 25 will be added in 1912.

Salina—A private lighting corporation installed 50 arc lights in 1911.

KENTUCKY.

Paris—The construction of a municipal lighting plant is contemplated.

MAINE.

Skowhegan—One arc light and 2 incandescent units will be purchased in 1912.

MARYLAND.

Baltimore—The installation of an ornamental lighting system in the downtown district is contemplated.

Cumberland—The Merchants and Mfgrs. Assn. proposes to convert the water works system power plant into a municipal lighting plant.

Myersville—The construction of an electric light plant is contemplated.

MICHIGAN.

Cadillac—The following improvements were added in 1911: 75 poles, 90 arc lights and 5 incandescents. The following is contemplated for 1912: A 200-k. w. generator, 100 poles, 10 arc lights and 50 incandescents.

Dowagiac—A lighting system was completed in 1911 and includes the following: 5 miles of No. 8 wire, 200 poles, 300 Fostoria lamps, and 150 center suspension tungstens.

Fenton—The construction of a municipal lighting plant is contemplated.

Kalamazoo—The city will vote on a $140,000 bond issue to remodel a municipal lighting plant.

Monroe—During 1911 40 poles and 3,500 ft. of wire were added to the distribution system, and in 1912 50 poles and 3,000 ft. of wire will be needed. It is the intention to purchase a boiler during 1912.

St. Johns—A 3-phase generator was purchased in 1911, and in 1912 20 5-arc light ornamental standards will be installed.

St. Joseph—The city purchased 30 arc lamps in 1911.

Ypsilanti—The following improvements were installed in 1911: 2,300 ft. of wire, 100 poles and 25 lamps.

MINNESOTA.

Eveleth—The city installed 15 arc lamps and 51 ornamental posts in 1911.

Fairmont—The present lighting system includes 2 engines, 3 generators and a distribution system of 80 poles, 70,000 ft. of wire and 1,200 tungstens.

Two Harbors—Two boilers were purchased for the combined electric light and water plant during 1911.

Valley City—The installation of an ornamental lighting system is being discussed by the Commercial club.

MISSISSIPPI.

Clarksdale—The following improvements were completed in 1911: 3,800 ft. of wire, 40 poles and 72 tungsten lamps. In 1912 60 tungsten lamps will be added.

MISSOURI.

Bethany—The city will purchase a boiler, 1½ miles of wire and 175 poles.

Oregon—The city installed a 600-light ornamental lighting system in 1911.

MONTANA.

Billings—The city purchased 197 5-light ornamental lighting standards in 1911.

Chinook—The contract for constructing an ornamental light post has been awarded to the Two Miracle Co., of Kalispell, Mont.

Lewiston—The Lewistown power company has been incorporated for $200,000 to furnish the city with light and power.

NEBRASKA.

Alliance—The city extended its transmission line by 80 poles and 1 mile of wire in 1911.

Marquette—A $2,800 bond issue for electric light extensions has been voted.

Norfolk—The city will purchase 32 5-light ornamental standards and will construct 5,000 ft. of conduit in 1912.

Omaha—The installation of ornamental lights on the park boulevards is contemplated.

NEW HAMPSHIRE.

Littleton—Lighting extensions costing about $3,000 were constructed in 1811.

NEW JERSEY.

Camden—Chief Electrical Engineer John Kelly, Jr., and City Engineer Levi Farnham have been instructed to prepare plans for street lighting system which will include about 12,000 arc lamps and 2,500 incandescent lamps.

Jersey City—The present lighting system includes 1,806 arc lamps.

Ocean City—Lighting extensions as follows were completed in 1911: 10,000 ft. of wire, 100 poles, 50 arc lamps and 1,000 tungstens. In 1912 the city will purchase an engine and a generator, 500 incandescent lamps, 40 arcs, 50 poles and 12,000 ft. of wire.

NEW MEXICO.

Las Vegas—The city will purchase 100 tungsten lighting units in 1912.

NEW YORK.

Buffalo—The privately owned electric company completed the following extensions in 1911: 35,565 ft. of underground cable, 881,534 ft. of wire, 669 poles, 80216 ft. of conduit, 247 arcs and 37 ornamental lights.

Cortland—The city contemplates the construction of a conduit system in 1912.

Middletown—The installation of an ornamental lighting system is contemplated.

Niagara Falls—A merchants' committee has been appointed to arrange for extensions to the ornamental lighting system.

Solvay—Electric light extensions as follows were completed in 1911: 1 mile of wire, 100 poles and 50 street lamps. In 1912 25 street lamps, 40 poles and 3,000 ft. of wire will be added.

Syracuse—The present system includes 1,741 arc lamps and to this number 100 will be added in 1912.

Weedsport—The construction of a municipal electric lighting plant is contemplated.

Yonkers—The United Business Men's Assn. is agitating the question of ornamental street lighting.

NORTH CAROLINA.

Rocky Mount—The city added 4 arc lights, 60 poles and 20,000 ft. of wire to the system in 1911.

Statesville—The city extended the transmission line by 6,000 ft. of wire during 1911.

NORTH DAKOTA.

Jamestown—An entire new lighting system is to be installed in the place of an obsolete system. The work will be completed in 1912 and will cost about $20,000.

Valley City—The city extended the transmission line by 3,000 ft. of wire and 100 poles and installed 10 arc lamps and incandescents costing $1,200. In 1912 3,000 ft. of wire will be added and incandescents purchased to an amount of $1,200.

Williston—The transmission line was extended by 3,000 ft. of wire in 1911 and in 1912 an ornamental lighting system including 18,000 ft. of wire, 3,000 poles and 36 ornamental standards will be installed.

OHIO.

Bowling Green—The installation of an ornamental lighting system is contemplated.

Cincinnati—The installation of boulevard lights on Pike St., 12th St., Central Ave. and 4th Ave., is contemplated.

Dayton—The privately owned lighting corporation installed 800 arc lamps and 369 ornamental lighting standards in 1911.

Galion—The construction of an ornamental lighting system including 182 5-light standards and the addition of 100 arc lamps is contemplated.

Lucasville—The installation of an ornamental street lighting system is contemplated.

Mansfield—E. A. Merkel has prepared plans and estimates for a municipal electric lighting plant at Mansfield, O., including 200 ornamental lights. Estimated cost lighting system, $74,750; power house, $58,200.

Mineral Ridge—The installation of a municipal lighting plant is contemplated.

Newburgh City—A private lighting company furnishes 80 arc lamps under contract.

Salem—The Bailey Engineering Co., Alliance, O., has been retained to prepare plans for the tungsten street lighting system.

Springfield—Extensions to the lighting system are contemplated.

Youngstown—The installation of an ornamental lighting system in the downtown district is contemplated.

OKLAHOMA.

Altus—The present lighting system includes 30 miles of wire, 1,000 poles, 29 arc lamps and a power system, which includes 2 engines, 3 boilers and 2 generators direct connected. About 2 miles of wire and 75 poles will be added in 1912.

Clinton—The following extensions are contemplated for 1912: 2 miles of wire, 75 poles and 12 arcs.

Durant—The power for the 42 arc lamps which comprise the lighting system is furnished by 2 boilers, 2 engines and 2 generators. Extensions to cost about $5,000 are contemplated in 1912.

PENNSYLVANIA.

Conneautville—A franchise has been granted the Peoples Light Co., of Meadville, Pa., to furnish electricity for lighting purposes.

Duquesne—A council committee is investigating the question of ornamental street lights.

Media—The following improvements were constructed in 1911: 1 engine, 1 boiler, 1 generator, 98 arcs and 200 tungstens.

New Castle—The construction of a municipal lighting plant is being urged.

Pittsburg—The Allegheny County Light Co. has been given a contract for lighting the city for a period of 5 years.

Titusville—The installation of an ornamental lighting plant is contemplated.

RHODE ISLAND.

Cranston—The following improvements were completed in 1911: 2,000 ft. of wire, 15 poles and 20 incandescents. In 1912 2,000 ft. of wire, 20 poles and 20 incandescents will be purchased.

SOUTH CAROLINA.

Orangeburg—The lighting system includes the following: 1,000 ft. of wire, 50 poles and 22 tungstens and 1 engine and generator set direct connected.

SOUTH DAKOTA.

Mitchell—The installation of a 48-light tungsten system, including 6,700 ft. of galvanized conduit, is contemplated for 1912.

TEXAS.

Beaumont—The Beaumont Electric Light & Power Co. will construct an ornamental lighting system on Pearl St.

Hearne—An entire new electric light plant will be constructed in 1912.

UTAH.

American Fork—The present lighting system includes 100 street lamps.

Provo—The city paid $2,817 in 1911 for 207 32-candle power lamps. The construction of a municipal lighting plant is being agitated.

WASHINGTON.

Ellensburg—The contract for erecting 124 cluster lights has been awarded to Evans Dickson and Co., Tacoma, Wash.

Port Angeles—The city is contemplating the purchase of 180,000 ft. of wire, 300 poles, 10 arc lights and 250 incandescents. The current is supplied by the Olympic Power Co.

WEST VIRGINIA.

Parkersburg—The installation of an ornamental lighting system on a number of streets is contemplated. Light is furnished by a private corporation.

WYOMING.

Cowley—Will build three miles of pole line in 1912.

CANADA.

Vancouver, B. C.—The installation of 200 additional arc lights and a large number of ornamental lights is contemplated.

Winnipeg, Man.—The J. P. Morgan interests, New York, N. Y., have purchased the Winnipeg Street Railway line and the light, heat and power plant for the sum of $30,000,000. The purchasers announce that $15,000,000 will be expended in extensions.

GAS LIGHTING IMPROVEMENTS.

ALABAMA.

Talladega—The city purchased 5,000 ft. of 4-in. cast iron pipe in 1911 and will purchase 2,000 ft. in 1912.

ARKANSAS.

Pine Bluff—The present gas lighting system includes the following: 1 high pressure and 3 low pressure stations, 66,997 ft. of 4-in., 4,400 ft. of 3-in., 31,630 ft. of 6-in., 7,000 ft. of 10-in. and 3,400 ft. of 12-in. main and 20,000 ft. of service pipe.

INDIANA.

Indianapolis—The city installed 13 gas lamps in 1911.

IOWA.

Carroll—The city will construct a gas plant including about 5 miles of distribution mains.

Newton—The city constructed a new gas plant, including 1¼ miles of mains during 1911.

MICHIGAN.

Cadillac—The city constructed the following gas plant improvements during 1911: 1,063 ft. of pipe, 3 lamps, 3,339 ft. of services and plant additions costing $1,200.

MONTANA.

Billings—The city will construct 5 miles of gas mains during 1912.

NEW JERSEY.

Ocean City—The city constructed 5,000 ft. of gas mains in 1911 and wil construct 12,000 ft. in 1912.

NEW YORK.

Buffalo—The privately owned gas company constructed 22.25 miles of natural gas mains and 4.78 miles of artificial gas main and installed 554 lamps during 1911.

Solvay—About 4 miles of gas mains were constructed in 1911 and 2 miles will be completed in 1912.

OHIO.

Dayton—The Dayton Gas Co. operates the gas plant and will install 1,646 incandescent lights as needed.

GARBAGE COLLECTION AND DISPOSAL.

ALABAMA.

Sheffield—Garbage is dumped on the common, and the collection system comprises 2 horse-drawn wagons and 50 cans.

ARIZONA.

Jerome—The collection system includes 1 wagon and 2 horses and the garbage is dumped.

Pine Bluff—The city purchased the following for the garbage department during 1911: 7 wagons, 3 horses and 30 cans; and they will purchase 12 wagons, 6 horses and 24 cans during 1912.

CALIFORNIA.

Alameda—The garbage is hauled by wagons and dumped on a salt marsh 2 miles south of the city.

CONNECTICUT.

Hartford—The garbage is disposed of by contract.

Waterbury—During 1911 the garbage was fed to hogs. Contract has been given for collection and disposal.

GEORGIA.

Columbus—The city purchased 12 garbage carts, 12 mules, and 200 tin cans during 1911.

Rome—The city will purchase 6 garbage carts during 1912.

ILLINOIS.

Freeport—The present garbage disposal system includes 3 wagons, and 8 horses. The garbage is dumped upon the ground.

INDIANA.

Ft. Wayne—The city purchased 10 garbage wagons and 24 horses during 1911, and constructed a disposal plant. In 1912 2 wagons and 30 horses will be purchased and an addition to the disposal plant will be built.

Indianapolis—A contract for the disposal of garbage for a period of 6 years from 1911 was let for $48,000 per year.

New Albany—The city purchased 2 garbage dump wagons during 1911.

Seymour—One garbage wagon is operated by the city and 1 by contract for the disposal of refuse.

IOWA.

Iowa City—The city hauls the garbage in 2 wagons and disposes of it by feeding.

Newton—The city purchased 20 garbage cans in 1911.

KANSAS.

Ottawa—The city will construct an incinerator plant and will purchase 2 garbage wagons and 3,000 cans in 1912.

KENTUCKY.

Dayton—The city purchased 3 garbage carts and 6 horses in 1911, and will purchase the same in 1912.

Lexington—The city crematory is operated by contract at $11,000 per year. During 1911 6 wagons and 9 horses were purchased and a like number will be purchased in 1912.

MASSACHUSETTS.

East Hampton—The garbage is disposed of by contract.

Newton—Bids are now being received for disposal of garbage by contract.

Springfield—The garbage collection system includes 10 wagons, 8 sleighs, 14 horses and 2 mules.

MICHIGAN.

Menominee—The garbage is disposed of by dumping upon the ground.

MINNESOTA.

Mankato—Garbage is collected by 1 wagon and is dumped upon the ground.

Red Wing—The collection and disposal is made by contract.

MISSISSIPPI.

Clarksdale—The garbage collection system includes 1 wagon, 1 cart and 3 horses.

Greenville—The garbage is hauled and dumped into the river. A garbage scow was constructed in 1911 at a cost of $2,500.

Jackson—The garbage disposal system includes 1 incinerator, 10 wagons and 15 horses.

MISSOURI.

Kansas City—Garbage is disposed of by contract.

MONTANA.

Billings—The garbage collection system consists of 3 wagons and 7 horses.

NEW HAMPSHIRE.

Laconia—Garbage is collected by 2 horse-drawn wagons and hauled to a public dump.

NEW JERSEY.

Ocean City—The city purchased 3 garbage wagons and 6 horses in 1911 and will purchase 2 wagons and 4 horses in 1912.

NEW YORK.

Buffalo—The disposal of garbage and ashes is by contract. The city maintains a Heenan-Froude furnace, which was completed before 1911, and additional furnace was built in 1911, and in 1912 an elevated entrance, storage bins, picking belts and mixing floors will be completed.

Syracuse—A reducing plant was constructed, 15 wagons and 36 cans were purchased in 1911.

NORTH CAROLINA.

Greenville—The city will purchase 2 garbage wagons or carts and 50 cans in 1912.

Rocky Mount—The city purchased 4 garbage carts and 4 mules in 1911.

Statesville—The city purchased 1 garbage wagon and 2 horses in 1912.

NORTH DAKOTA.

The garbage is hauled in two wagons and dumped upon the ground.

OHIO.

Bucyrus—The city purchased 2 garbage wagons and 4 horses in 1911.

Dayton—The city constructed a disposal plant and purchased 15 garbage wagons in 1911.

Greenville—The city purchased 2 garbage carts in 1911.

Newburgh City—The garbage is hauled by 1 wagon to a garbage plant at Cleveland, O.

OKLAHOMA.

Durant—The city expects to install an incinerating plant.

Frederick—The construction of a garbage incinerator is contemplated.

Muskogee—A garbage plant was erected in 1911 at a cost of $21,000, which, with horses, wagons, etc., amounted to $30,000.

OREGON.

The sum of $75,000 has been appropriated for a collection system, which will be put in operation early in 1912.

PENNSYLVANIA.

Bradford—A garbage collection system is in prospect.

Erie—A disposal plant will be built and outfit of horses, wagons, cans, etc., for municipal collection, in 1912.

Media—The garbage is disposed of by contract.

Swissvale—A contract has been let for the disposal of garbage to the American Reduction Co., at $360 per month.

Westchester—The garbage collection system includes 3 horses and 3 carts.

RHODE ISLAND.

Cranston—The garbage is collected in 4 carts and is fed to swine.

SOUTH DAKOTA.

Hot Springs—A garbage collection system was introduced in 1911 and several additions are planned for 1912.

TENNESSEE.

Columbia—The garbage collection system includes 2 wagons, 3 carts and 7 mules.

UTAH.

Provo City—Garbage is collected in 1 wagon and hauled to a public dump.

WEST VIRGINIA.

Parkersburg—Garbage is disposed of by contract.

WISCONSIN.

Janesville—Garbage is disposed of by private contract.

Superior—The garbage collection system includes 4 wagons, 8 horses and 200 cans.

STREET SIGNS.

CALIFORNIA.

Alameda—The city uses the lettered lamp post street sign.

Jackson—The city purchased street signs at a cost of $100 in 1911.

CONNECTICUT.

Ansonia—The city purchased 300 enamel street signs in 1911 and will purchase 100 in 1912.

Hartford—All metal signs are being renewed.

Southington—The city has ordered 100 enamel signs.

IDAHO.

Boise City—The city will purchase 175 wood street signs in 1912.

ILLINOIS.

Canton—The city purchased 200 enamel street signs in 1911.

Freeport—A system of metal street signs has been recently installed.

Peoria—The sum of $250 has been appropriated for the purchase of street signs.

INDIANA.

Ft. Wayne—The city purchased 10,000 enamel and 3,000 sidewalk signs in 1911, and will purchase 6,000 enamel and 1,000 sidewalk signs in 1912.

Ligonier—The city purchased 200 enamel signs in 1911.

Seymour—The city purchased 300 metal signs in 1911.

IOWA.

Carroll—The purchase of metal street signs is contemplated.

Webster City—Wooden signs were installed throughout the city during 1911.

KANSAS.

Ottawa—The city purchased 60 sidewalk signs in 1911 and in 1912 will purchase 1,200 enamel signs and 50 sidewalk signs.

KENTUCKY.

Lexington—The system of street signs includes enamel markers for houses and posts and metal signs in the sidewalks.

MAINE.

Skowhegan—The city will purchase 100 wooden signs in 1912.

MARYLAND.

Brunswick—The purchase of street signs is being discussed.

MASSACHUSETTS.

North Attleboro—The 'system includes a number of wooden signs which are repainted each year.

Springfield—Approximately 200 enamel signs were purchased in 1911, and 1,000 will be needed in 1912.

Westfield—The city purchased 50 enamel signs in 1911.

MICHIGAN.

Menominee—The street names are stamped in the cement sidewalks.

Monroe—The city will purchase 450 wood signs in 1912.

MISSISSIPPI.

Jackson—The present system includes 400 enamel signs and 50 tile signs.

MISSOURI.

Kansas City—All street signs are placed in the sidewalks.

NEW HAMPSHIRE.

Laconia—The city purchased 50 wood signs in 1911 and will need 100 in 1912.

NEW JERSEY.

Ocean City—The city purchased 50 metal signs in 1911 and will purchase 20 in 1912.

Trenton—The city will purchase 1,000 enamel signs in 1912.

NEW YORK.

Auburn—About 60 wood and 80 metal signs were purchased in 1911 and 50 wood signs will be needed in 1912.

Buffalo—The city installed 57 enamel signs and 128 cast iron plate signs in 1911 and will purchase 50 enamel and 100 cast iron signs in 1912.

Plattsburg—About 200 enamel signs were installed in 1911.

Syracuse—About 5,000 enamel and metal signs were purchased in 1911.

NORTH CAROLINA.

Greenville—The city will need 200 street signs, kind not stated, in 1912.

OHIO.

Canton—The city will purchase 5,000 cast iron sign posts in 1912.

Dayton—About 200 enamel signs were placed in 1911.

Fostoria—The city installed 550 enamel signs in 1911.

OKLAHOMA.

Bartlesville—The city purchased 50 metal signs in 1911.

Frederick—The installation of a complete system of street signs is contemplated.

PENNSYLVANIA.

Bradford—The city will purchase 200 enamel signs in 1912.

East Stroudsburg—The city purchased 100 enamel signs in 1911.

Media—The city purchased 500 enamel signs in 1911.

Miners Mills—The borough purchased 105 enamel signs in 1911.

Ridgway—The city purchased 300 enamel signs in 1911 and will need 50 of the same in 1912.

Swissvale—The street signs are placed on the light globes at all street intersections.

RHODE ISLAND.

Cranston—About 50 street signs were installed in 1911.

SOUTH DAKOTA.

Hot Springs—A complete system of street signs was placed in 1911.

TENNESSEE.

Maryville—The purchase of street signs for the entire city is contemplated.

TEXAS.

Terrell—About 25 enamel street signs will be needed in 1912.

WASHINGTON.

Bellingham—Street names put in concrete walks at all street intersections.

WISCONSIN.

Janesville—The city purchased 910 enamel signs in 1911.

FIRE DEPARTMENT IMPROVEMENTS.

ALABAMA.

Decatur—The city purchased 1 horse-drawn hose cart, 1 combination hose and ladder truck, and 1,500 ft. of hose during 1911.

Sheffield—The present fire department comprises 1 building, 2 hose carts, horse-drawn, 1 ladder truck, a Gamewell fire alarm system comprising 10 boxes and about 3,000 ft. of hose.

ARIZONA.

Jerome—The fire department equipment includes 3 buildings, 3 hand hose carts and 1 chemical cart and 3,000 ft. of hose.

ARKANSAS.

Fort Smith—The city constructed a fire station and purchased 2 engines, 1 combination chemical and hose wagon and 7,000 ft. of hose.

Helena—The city constructed a two-story brick building and bought 1 hose cart, 1 ladder truck and 2,500 feet of hose in 1911. It will purchase 2 horses and 1,000 feet of hose in 1912.

Pine Bluff—The city will purchase 1,000 ft. of hose and 3 horses.

CALIFORNIA.

Alameda—The fire department equipment includes 8 buildings, 8 hose carts, 2 automobile propelled.

Antioch—The city purchased a combination automobile fire engine during 1911.

San Mateo—The city completed 4 hose cart buildings, installed a high pressure fire system and purchased 1 automobile fire engine at a total cost of $26,000 during 1911.

COLORADO.

Golden—The city purchased 300 ft. of hose and 2 bell towers during 1911.

Salida—The city will purchase an automobile fire engine and a hose wagon and chemical combination during 1912.

CONNECTICUT.

Ansonia—The city constructed a fire hall and purchased a hose cart during 1911.

Hartford—During 1911 the city purchased 1 automobile hose cart and rebuilt 2 horse-drawn fire engines, purchased 2 horse-drawn ladder trucks and 1 chief's car. Extensions to the fire alarm system, including 5 boxes, 50,000 ft. of wire were purchased and 3,100 ft. of hose were contracted for. During 1912 the following equipment will be purchased: 3 automobile hose carts, 1 horse-drawn fire engine, 1 tractor-drawn fire engine, 2 chief's cars, 5,000 ft. of hose, 10 fire alarm boxes and 60,000 ft. of wire.

Simsbury—The installation and equipping of a fire station is contemplated.

Southington—The purchase of an automobile chemical engine is contemplated.

Waterbury—During 1911 an automobile fire engine, and automobile chief's car and 2,350 ft. of hose were purchased.

GEORGIA.

Americus—The city purchased an automobile combination chemical and hose wagon in 1911.

Columbus—During 1911 the following equipment was purchased: 1 automobile hose cart, 1 automobile fire engine and 1,000 ft. of hose. During 1912 the city will build a station and will purchase 1 automobile hose cart and 1,000 ft. of hose.

Rome—The city purchased an automob'e fire engine in 1911 and will purchase another in 1912.

IDAHO.

Boise City—The city built 3 fire stations and purchased the following equipment during 1911: 1 fire alarm system, including 90,000 ft. of wire and 60 boxes, and 3,000 ft. of hose. In 1912 1 station will be built, and 10,000 ft. of wire, 6 boxes and 2,000 ft. of hose will be purchased.

Payette—The city will construct a station house, will purchase 1 ladder truck and 250 ft. of hose during 1912.

Rexburg—The city will purchase a complete fire alarm system during 1912.

ILLINOIS.

Belvidere—The purchase of a combination chemical and'hook and ladder truck is contemplated.

Freeport—The city constructed 3 department buildings and purchased the following equipment during 1911: 3 host carts and 1 horse-drawn ladder truck.

Mattoon—The city will purchase 1,500 ft. of hose during 1912.

Morris—The city purchased 500 ft. of hose during 1911, and in 1912 will increase the police alarm system.

Oak Park—The city has appropriated $10,000 for buildings and equipment.

Paris—The city purchased 1 horse-drawn hose cart in 1911 and will purchase 1,000 ft. of hose in 1912.

Pekin—The city is contemplating the purchase of an automobile combination chemical and hose wagon.

Rochelle—The city purchased one combination chemical and hose wagon and 1,000 ft. of hose during 1911.

Waukegan—During 1911 the city purchased an automobile fire engine costing $4,500, 1,000 ft. of hose and erected a $17,000 fire station. A $20,000 fire station will be built in 1912.

INDIANA.

Clinton—The city purchased 500 ft. of hose in 1911.

Columbia City—The city purchased a ladder truck and 1,000 ft. of hose in 1911.

Covington—A chemical engine horse-drawn has been purchased.

Ft. Wayne—The present equipment of the fire department includes 8 hose carts, 16 horses, 8 fire engines with 17 horses, 3 ladder trucks with 7 horses, 2 supply wagons with 4 horses, 2 chemical engines, 1 automobile-drawn, a Gamewell fire alarm system and 13,000 ft. of hose, all housed in 8 department stations. During 1912 2 stations will be built, 1 automobile chemical engine and 1,000 ft. of hose will be purchased.

Logansport—The city purchased 1,000 ft. of hose in 1911.

Mishawaka—An automobile chemical engine costing $5,500 and 2,000 ft. of hose were purchased in 1911.

Muncie—Purchased 1,000 feet of hose in 1911.

New Albany—The city has constructed a new fire station and will need 1 horse-drawn hose wagon and a new reel house.

New Castle—The city constructed 1 fire station during 1911 and in 1912 will purchase an automobile hose cart.

Richmond—The city will purchase an automobile chemical engine, for which the contract has been let.

Seymour—The present fire system comprises 1 horse-drawn hose cart, 1 horse-drawn fire engine, 1 horse-drawn ladder truck, 1 horse-drawn chemical engine and a complete fire alarm system.

Whiting—The city will purchase an automobile ladder truck.

IOWA.

Cherokee—The city purchased 500 ft. of hose in 1911.

Decorah—The city purchased 600 ft. of hose in 1911.

Harlan—A horse-drawn chemical engine and 200 ft. of hose were purchased in 1911.

Iowa City—The present fire system which is housed in 2 buildings includes 2 hose carts, horse-drawn, 1 horse-drawn ladder truck, a 15-box fire alarm system, with 20,000 ft. of wire.

Manchester—The city has purchased 600 ft. of hose.

Sioux City—The purchase of an automobile fire engine is contemplated.

Waterloo—An automobile hose cart was purchased in 1911.

Winterset—A combination hose and ladder truck, horse-drawn, was purchased in 1911.

KANSAS.

Hutchinson—One automobile combination ladder truck and pumping engine and 2 automobile fire engines were purchased in 1911.

Ottawa—The city will purchase a combination hose and ladder truck and pumping engine apparatus and 500 ft. of hose in 1912.

Pittsburg—The city purchased 1,000 ft. of hose in 1911 and will duplicate the order in 1912.

Salina—The city has purchased a combination hose and ladder truck and an automobile ladder truck.

KENTUCKY.

Dayton—The following fire equipment was purchased during 1911: 1 horse-drawn hose cart, 1 ladder truck and extinguishers.

Pineville—The city will purchase 1,000 ft. of 4-in. hose.

LOUISIANA.

Monroe—The present fire system includes 2 stations, 1 automobile and 1 horse-drawn combination chemical engines. The installation of a fire alarm system is contemplated for 1912.

MAINE.

Skowhegan—The city will purchase 1,500 ft. of hose in 1912.

MASSACHUSETTS.

East Hampton—The fire alarm system was changed from a one to a four circuit system and 500 ft. of hose was purchased during 1911.

Lawrence—The fire system comprises the following: 9 stations, 4 horse-drawn hose carts, 4 horse-drawn fire engines, 4 horse-drawn ladder trucks, 9 supply wagons, two horse-drawn chemical engines, 2 wagon guns, 4 combination hose and chemical wagons, 1 water tower, 19,500 ft. of hose and a Gamewell fire alarm system, including 123 boxes, 38 miles of wire underground and 52 miles of wire overhead.

Westfield—An automobile combination chemical engine was purchased in 1911.

MICHIGAN.

Allegan City—Five hundred ft. of hose was purchased in 1911.

Jackson—One automobile chemical engine was purchased in 1911 and 2 will be purchased in 1912.

Menominee—The fire system which is contained in 3 station houses includes 3 hose carts, 1 fire engine, 1 ladder truck and 1 supply wagon, all horse-drawn, 2,000 ft. of hose, and a Gamewell fire alarm system including 68 boxes.

Monroe—The city purchased 1,500 ft. of hose in 1911 and will need 1,000 ft. in 1912.

Pontiac—One LaFrance automobile chemical engine and 1,000 ft. of hose were purchased in 1911.

Port Huron—One fire station was constructed and 500 ft. of hose was purchased in 1911. In 1912 an automobile hose cart and 500 ft. of hose will be needed.

MINNESOTA.

Albert Lea—Five hundred ft. of hose was purchased in 1911.

Cloquet—The city purchased a 50,000-gal. chemical wagon in 1911.

Eveleth—Contracts have been let for the installation of a 10-box fire alarm system and the purchase of 3,300 ft. of hose.

Faribault—The city purchased 500 ft. of hose in 1911.

MISSISSIPPI.

Greenville—The fire system includes 1 ladder truck, 1 chemical engine and 2,100 ft. of hose. Will purchase 1,500 ft. of fire hose and 600 ft. of chemical hose in 1912.

Jackson—The city possesses 4 brick fire stations and the following equipment: 2 hose carts, 2 fire engines, 2 ladder trucks, 2 combination hose and chemical wagons, all horse-drawn, 6,600 ft. of hose, 1 chief's buggy, and a fire alarm system of the Gamewell type, including 45 miles of wire and 32 boxes. The city will purchase an automobile combination hose and chemical wagon in 1912.

MISSOURI.

Bethany—About 600 ft. of hose was purchased in 1911.

Sedalia—The purchase of a chief's automobile is contemplated.

Webb City—A combination hose and chemical wagon, automobile propelled and costing $5,000 was purchased in 1911.

MONTANA.

Billings—A fire station costing $20,000 was built, an automobile hose cart, a Gamewell fire alarm system, and 1,000 ft. of hose were purchased in 1911.

NEBRASKA.

Lincoln—The city purchased an automobile fire engine, an automobile hose cart, and 3,000 ft. of hose in 1911.

South Omaha—Two buildings were constructed and 2 horse-drawn hose wagons were purchased in 1911.

NEW HAMPSHIRE.

Keene—The installation of a battery fire alarm system is contemplated.

Laconia—The fire system comprises 3 buildings, 3 hose carts, 1 fire engine, 3 ladder trucks, 1 supply wagon, and 2 chemical engines, all horse-drawn, and a Gamewell fire alarm system.

NEW JERSEY.

Egg Harbor City—The purchase of a horse-drawn chemical engine and the installation of a fire alarm system are contemplated.

Elizabeth—Two fire stations will be constructed and an automobile fire engine and an automobile ladder truck will be purchased in 1912.

Glen Ridge—The city purchased a combination chemical and hose apparatus, 770 ft. of hose and 2,000 ft. of wire during 1911. About 700 ft. of wire, 1 fire alarm box and 300 ft. of hose will be purchased in 1912.

Ocean City—The city purchased an automobile chemical engine and 2,000 ft. of hose in 1911, and the purchase of 2,000 ft. of hose and the extension of the fire alarm system is contemplated for 1912.

South Amboy—The purchase of a Seagrave combination hook and ladder truck is contemplated.

NEW MEXICO.

Las Vegas—About 1,000 ft. of hose was purchased in 1911.

NEW YORK.

Auburn—The following equipment was purchased in 1911: 1 automobile chemical wagon and 1 fire alarm box. The construction of a fire station, the purchase of 2 tractors and 2 fire alarm boxes is contemplated for 1912.

Binghamton—A combination automobile hose cart and a horse drawn aerial ladder truck was purchased in 1911.

Buffalo—A national police and fire alarm system including 20 miles of wire and 16 boxes was installed in 1911 and 6,000 ft. of hose were purchased. A fire station will be constructed and a combination pumping engine and chemical truck automobile propelled will be purchased.

Geneseo—The purchase of 900 ft. of hose is contemplated for 1912.

Little Falls—The city purchased 1,000 ft. of hose in 1911 and will purchase a like amount in 1912.

Plattsburg—The city purchased 2,000 ft. of hose in 1911 and will purchase 1,000 ft. in 1912.

Syracuse—One station was constructed, a fire alarm system installed and 2,500 ft. of hose was purchased in 1911. The purchase of 1 combination hose and chemical apparatus, automobile propelled, a chief's automobile and 2,000 ft. of hose and the erection of a fire station is contemplated for 1912.

Utica—A small fire station will be constructed in 1912.

NORTH CAROLINA.

Rocky Mount—The following apparatus was purchased in 1911: 2 horse-drawn hose carts, 1 horse-drawn fire engine, and 1 horse-drawn ladder truck. The installation of a 20-box fire alarm system with 10 miles of line is contemplated for 1912.

Statesville—A horse-drawn ladder truck costing $5,500 was purchased in 1911.

NORTH DAKOTA.

Grand Forks—A city hall building and fire station costing $80,000 has been completed.

OHIO.

Barberton—The city purchased 1 triple combination 90-h.p. Webb automobile fire engine, 2 combination hose and chemical engines, 5 Garle fire alarm boxes and 1,000 ft. of hose during 1911. The purchase of a triple combination automobile pumping engine 1½ miles of wire and 8 fire alarm boxes is contemplated for 1912.

Bucyrus—A chemical engine, automobile propelled, and 2 fire alarm boxes were purchased in 1911.

Canton—The city will purchase 2 or 3 automobile fire engines, 1 automobile fire truck, 1 automobile supply wagon, 1 automobile chemical engine and 7,800 ft. of hose and will construct a fire station during 1912.

Circleville—The purchase of an automobile combination pumping engine and hose wagon is contemplated.

Conneaut—The city will purchase a hose drying tower.

Dayton—The present fire system which is contained in 16 stations includes 3 hose carts, 9 fire engines, 5 ladder trucks, 3 supply wagons, 13 combination hose and chemical wagons, all horse-drawn, 32,000 ft. of hose and a Gamewell fire alarm system of 262 boxes, 81 miles of overhead and 24,900 ft. of underground wire. The city will construct a fire station and will purchase 3 automobile combination hose and chemical wagons and a chief's automobile during 1912.

Galion—The purchase of 500 ft. of hose is contemplated.

Lorain—An automobile hose cart, an automobile ladder truck, and 3,000 ft. of hose were purchased during 1911 and a fire station costing $40,000 was erected.

Marion—The city will construct a central fire station and will purchase 2 automobile hose wagons in 1912.

Newburgh City—The fire system includes 1 hose cart and 1,100 ft. of hose.

Piqua—The purchase of 1,000 ft. of hose is contemplated.

Sandusky—The construction of a fire station is contemplated.

Wapakoneta—The city purchased 500 ft. of hose in 1911.

OKLAHOMA.

Altus—The city purchased an automobile combination hose cart in 1911.

Alva—A fire station was constructed and the following equipment was purchased: 2 hose carts and 1 combination hose and chemical engine horse-drawn, and 2,000 ft. of hose.

Bartlesville—A fire station was constructed and the following equipment purchased during 1911: 1 automobile hose cart, 1 hose cart, 1 fire engine, and 1 ladder truck, all horse-drawn, and 1 combination chemical engine, automobile propelled.

Chandler—The city will purchase 1,000 ft. of hose in 1912.

Clinton—The city will purchase an automobile hose cart in 1912.

Frederick—The city constructed a fire station and purchased 2,000 ft. of hose in 1911. The equipment comprises an automobile chemical engine and a horse-drawn hose cart.

OREGON.

Portland—Three stations were built and the following equipment was purchased during 1911: 2 combined chemical and hose wagons, automobile propelled, 1 automobile supply wagon, 2 automobile runabouts, a fire boat, 14,750 ft. of hose, 15 fire alarm boxes and 34,300 ft. of wire. During 1912 7 stations will be built and the following apparatus purchased: 8 combined chemical and hose wagons, automobile propelled, 1 automobile fire engine, 1 automobile ladder truck, 1 supply wagon, 1 fire boat, 2 automobile runabouts, 16,100 ft. of hose, 60 fire alarm boxes and 58,100 ft. of wire.

PENNSYLVANIA.

Bradford—A brick fire station will be constructed in 1912 and an automobile chemical engine and 1,500 ft. of hose will be purchased.

Carlisle—The purchase of an automobile pumping engine or chemical wagon is contemplated for 1912.

Catasauqua—The fire system comprises 2 stations, 4 hose carts, 2 fire engines and 2 ladder trucks.

Claysville—The fire system comprises 1 hose cart and 800 ft. of hose.

Indiana—The construction of a municipal building and fire station combined, to cost $17,000, is contemplated. Contract will be let April 20.

Latrobe—The fire system which is contained in 6 stations includes 5 hand hose carts, 1 horse-drawn ladder truck and 1,500 ft. of hose.

Media—The fire system includes 1 station, 1 horse-drawn hose cart, 1 engine, 1 ladder truck, 1 chemical engine, all horse-drawn, and 500 ft. of hose.

Ridgway—The city will purchase a horse-drawn hose cart and 500 ft. of hose in 1912.

Sayre—The purchase of 500 ft. of hose is contemplated.

Swissvale—The fire system includes 1 station, 3 hand hose carts, 1 horse-drawn hose cart, 1 horse-drawn ladder truck, 2,300 ft. of hose and a Gamewell fire alarm system of 14 boxes and 39,700 ft. of wire. The city will purchase an automobile hose cart in 1912.

Westchester—The city purchased 1,500 ft. of hose in 1911.

RHODE ISLAND.

Cranston—The city purchased 6 hose carts, 1 automobile propelled, 1 fire engine, 6 ladder trucks, 1 automobile propelled, 6 supply wagons, 5,000 ft. of hose, 25 fire alarm boxes and 5 miles of wire. The purchase of 2,000 ft. of hose is contemplated.

Woonsocket—A fire station to cost about $14,000 is contemplated.

SOUTH CAROLINA.

Orangeburg—One horse-drawn hose cart was purchased in 1911 and the purchase of an American LaFrance combination chemical engine and 1,000 ft. of hose is contemplated for 1912.

SOUTH DAKOTA.

Hot Springs—The fire system which is contained in 3 stations includes the following: 3 hose carts, 1 ladder truck and an 18-box fire alarm system with 3½ miles of wire.

Yankton—The city purchased 500 ft. of hose in 1911.

TENNESSEE.

Columbia—The fire equipment comprises 1 combination chemical and hose wagon.

TEXAS.

Cuero—The city purchased a fire alarm system costing $1,500 and 500 ft. of hose. The purchase of 1,000 ft. of hose and 2 automobile hose carts, for which the contracts have been let, is contemplated for 1912.

Terrell—The purchase of an automobile fire engine to cost about $7,500 is contemplated.

UTAH.

Provo City—One horse-drawn hose cart was purchased in 1911.

VERMONT.

Enosburg Falls—The fire system comprises 4 hose carts and 2,000 ft. of hose.

St. Albans—The city purchased a horse-drawn ladder truck in 1911 and will purchase 1,000 ft. of hose in 1912.

WASHINGTON.

Bellingham—The city installed a Gamewell system and bought 4,000 feet of hose in 1911. It will buy a combination auto truck in 1912.

Hoquiam—The fire system includes 3 buildings, 1 fire engine, 2 horse-drawn fire engines, 1 hand ladder truck, 3 horse-drawn combination chemical engines, 6,200 ft. of hose, and a Gamewell fire alarm system including 27 boxes and 15 miles of wire.

Port Angeles—The construction of a fire station and the purchase of the following equipment is contemplated for 1912: 1 horse drawn fire engine, one horse-drawn ladder truck, 2 automobile supply wagons, and 1,200 ft. of hose.

Spokane—One automobile hose cart, 2 horse-drawn fire engines, 1 automobile chemical engine, 1 chief's auto, 3,000 ft. of hose, 25 fire alarm boxes and 10 miles of wire were purchased during 1911.

WEST VIRGINIA.

Moundsville—The city will purchase 1 automobile fire truck and 2 ladder trucks in 1912.

Parkersburg—2,000 ft. of hose was purchased in 1911.

WISCONSIN.

Ashland—One horse-drawn hose cart was purchased in 1911 and 2 horse-drawn hose carts and 1,000 ft. of hose will be needed in 1912.

DePere—The city purchased 500 ft. of hose in 1911 and will purchase 700 ft. in 1912.

Janesville—An automobile hose cart was purchased in 1911 and 6 fire alarm boxes will be needed in 1912.

Waupaca—The city purchased 1,000 ft. of hose during 1911.

WYOMING.

Cheyenne—The present fire system includes 2 stations, 2 horse-drawn hose wagons, 1 automobile combination chemical and hose wagon, 1 horse-drawn aerial truck, 2 30-gal. chemical engines and 1 45-gal. automobile chemical engine, 5,000 ft. of hose, 1 chief's buggy and a 36-box Gamewell fire alarm system with 6 miles of overhead wire and 4 miles of underground wire. In 1912 the city will construct a pumping station and will purchase 1 2-horse hose cart, 1 mile of wire, 3 fire alarm boxes, chief's automobile and 11 ft. of hose, the latter of which has been contracted for.

ROADS AND PAVEMENTS

Progress in Good Roads.—Houston Public Improvement Law.

Recent Progress in the Good Roads Cause.

(Continued from Page 197, March Number.)

SOUTH CAROLINA.

The state of South Carolina at present has no laws giving the state any control over road construction, gives no state aid and has no state highway officials. The South Carolina Geological Survey, M. W. Twitchell. State Geologist, collects data regarding road work as opportunity offers, but has no duties in this respect and no special funds to pay expenses. The State Commissioner of Agriculture also collects some road statistics.

The state has 32,075 miles of road, although a detailed estimate of road mileage made in 1904 gave nearly 10,000 miles more length than the last report. Of the roads 3,535 miles, or 11.02 per cent have been improved, largely as sand-clay roads, of which there are 3,218 miles. Of the better surfaces there are 154 miles of macadam, 131 miles of gravel and 32 miles of shell roads.

The mileage of improved roads varies from zero in six counties to 450 in one, or from zero to 64.35 per cent of all the roads in the county. However, the county with the highest mileage of improved roads has but 2½ miles of macadam, all the rest being sand-clay. One county has 20 miles of macadam and 45 miles of gravel road in a total of 1,000 miles, and no other county has as many miles of the harder surface roads.

In the 23 counties reporting cost of building roads the average cost of sand-clay roads is computed as $415 a mile; of gravel roads $1,133 and of macadam roads $3,252, the latter average being brought up from about $2,500 a mile by the influence of one county, which reports a cost of $7,000 a mile for macadam roads. Another report states that sand-clay roads can be built 30 feet wide for $450 a mile and maintained by monthly attention from a gang of 5 convicts at about $10 a mile a year.

There are several county and district good roads associations and a state association which are agitating the issuance of county bonds for road building and a state highway organization. It is estimated that more than $1,000,000 will be spent on new road construction in the state during 1911.

In most of the counties of the state boards of three county commissioners have charge of the county roads. A few counties have boards which consist of the chairmen of the township boards. Each county has a supervisor. Each township in a county is a road district and a road overseer is appointed for each, who takes charge of the work on the roads.

South Carolina has a population of 1,515,400, which is increasing 10 or 15 per cent each decade. Its 43 counties range in population from 17,000 to 89,000.

SOUTH DAKOTA.

South Dakota has a highway commission appointed under the first state highway law, which was passed in 1911. The law carried no direct appropriation, but the commission has charge of the construction at state expense of certain roads on state lands. John Parmley, Ipswich, is the chairman of the commission and Samuel H. Lea, Pierre, is state engineer.

The state engineer has made a reconnaissance for the South Dakota part, from White Rock to Yankton, of what is called the Meridian road, which is to run from Winnipeg, Canada, to Galveston, Tex. The length of this part is 275 miles.

The state now has 56,354 miles of road, of which only 286 are improved, or 0.5 of one per cent. Of the improved roads 147 miles are gravel, 10 are macadam and 129 are sand-clay. One county has 75 miles of gravel road, which is 5 per cent of its total mileage. No other county has as much, and 50 counties have no improved roads.

County roads are in charge of boards of three county commissioners. Counties not divided into townships are divided into one or more road districts with a supervisor for each. County supervisors divide their townships into suitable road districts and appoint an overseer for each district.

South Dakota has a population of 583,888, which is increasing over 45 per cent per decade. Its 68 counties range in population from 100 to 30,000.

TENNESSEE.

Tennessee has no state road department and the state does not aid in road building. Many counties have bonded themselves heavily for good roads and there is at present a strong effort to complete a highway from end to end of the state, Memphis to Bristol, to be built by the counties through which it passes. A general specification for this road has been prepared. The engineer of Madison County has described the work in his county which results in a cost of $5,300 per mile, of which 75 per cent is the cost of the novaculite used, hauling, and putting it down, and the other 25 per cent is for grading and draining; and in sand-clay roads costing $1,500 a mile, and maintained with the road-drag at a cost of $5 a year. It is estimated that the counties of Tennessee will spend nearly $4,000,000 on new construction in 1912.

There are 45,913 miles of road in the state, of which 5,353.5 miles have been improved, or 11.66 per cent. Of the improved roads 2,684 miles are macadam, 2,542.5 miles are gravel and 127 miles are sand-clay. The mileage of improved roads varies from zero in 31 counties to 600 in one county or 24 per cent. Two counties have 55 and 58 per cent of their roads improved.

The average cost of macadam roads in the 24 counties reporting is $2,727 a mile; of gravel roads is $1,697, 16 counties reporting; and of sand-clay roads is $1.050, 3 counties reporting.

The county roads are in charge of the county court which appoints 3 superintendents, of which the chairman or judge is one, to see that turnpike and toll roads are maintained. The county is divided into districts and a road commissioner is appointed for each district who, in turn appoints an overseer for each 5 miles or less of road in his district.

Tennessee has a population of 2,184,789, which is increasing about 10 per cent per decade. Its 96 counties range in population from 3,000 to 191,000, all but four being below 42,000.

TEXAS.

Texas has no state road department and does not appropriate state funds in aid of road building. A number of counties in the more thickly settled districts have bonded themselves heavily for road construction in recent years. These bond issues have been from $150,000 to $1,600,000 per county, ten counties having voted $4,550,000 of bonds in 1911, and 49 counties having voted $8,915,000. Much of this amount is available for construction in 1912.

The state has 128,971 miles of road, of which 4,896 or 3.8 per cent have been improved. The improved roads consist of 365¼ miles of stone, 2,126 miles of gravel, 2,253¾ of sand-clay, 126 miles of shell and 25 miles of macadam with shell top.

The sand-clay roads are new within the past five years, and the gravel and broken stone roads have each increased about 200 miles in that time, and the shell roads about 100 miles. The stone roads are all in 10 counties and nearly all in four, those in which Beaumont, Austin, Taylor and Decatur are located. The shell roads are in six counties in the vicinity of Galveston, Houston and Corpus Christi.

One county has improved 54.11 per cent of its roads, nearly all with sand-clay and all those which have improved over 20 per cent of their roads have used sand-clay or gravel, according to local conditions, except Aransas county which has paved 10 miles of its 44 with shell, and Comal county which also has 20 miles of macadam.

The average cost of road construction in the counties reporting is $168 a mile for earth roads, $593 for sand-clay, $3,083 for shell, $1,708 for gravel and $2,160 for macadam.

The county roads are in charge of commissioners' courts of 4 members each. They divide their counties into road precincts and appoint an overseer for each.

Texas has a population of 3,896,542, which is increasing about 30 per cent per decade. Its 145 counties range in population from 65 to 136,000.

Houston's New Public Improvement Law.

The citizens of Houston have adopted an amendment to the city charter which opens the way to greatly improved conditions in the street paving of the city.

According to the terms of the amendment, whenever two-thirds of the owners of the front feet of property abutting on any highway, proposed to be improved, shall petition the city council to make improvements thereon, and designate the nature of the proposed improvements, and the limits within which they are to be constructed, the kind of pavement and the materials to be used, agreeing to pay the whole cost of constructing curbs (if any) and two-thirds of the cost of other improvements in front of the property of the owners abutting upon the highway to be improved, exclusive of the portion payable by the owners of railroads and street railways, the city council shall receive such petition and cause the same to be filed.

The petition shall remain on file with council not less than five days before the date fixed by it for acting upon the petition. On that date the city council shall consider the petition and hear any objections thereto which may be made by any owner of property abutting the improvement, or any party interested therein, and if the said petition is found to be in due form, and the owners of at least two-thirds of the front feet of property abutting upon the improvement have signed the same, the council shall, by resolution, order the making of such improvements, and the passage of such resolution shall be conclusive of the regularity and legality of such petition, and the public necessity and general benefit of such improvements.

The petitioners have the right to direct the construction of the kind of pavement specified in the petition, and of the other improvements described, and the use of the materials designated and to stipulate the maximum cost per cubic or square yard of improvements, or front foot of abutting property, at which the work of constructing the improvements shall be let, and no contract shall be let for a greater cost than is stipulated.

The council may only refuse to grant petition for the reason that there are no funds legally available out of which the city's portion of the cost of the proposed improvements can be appropriated.

Discharge of Ohio River.

In volume of water the Ohio river is the main tributary of the Mississippi. Its mean discharge, according to the records of the United States Geological Survey, is about 300,000 cubic feet per second, which is much more than the discharge of the St. Lawrence river at Ogdensburg, N. Y., although the drainage area of the St. Lawrence is nearly twice that of the Ohio. The maximum flow of the Ohio is approximately 1,500,000 cubic feet per second—about thirty times the low-water flow.

A comparison of records of flow of the Ohio river with those of the Upper Mississippi and Missouri shows that although its drainage area is but one-third that of the combined Mississippi and Missouri its mean and low-water flow is 1.3 times as great as their combined flow, and its maximum flow is 1.5 times as great. This fact is accounted for by the greater rainfall in the Ohio basin and by the general character of the region.

The Ohio basin affords many opportunities for storage, especially on the southern tributaries. From topographic maps of the Geological Survey covering part of the drainage area of the Ohio, a large number of reservoir sites have been located, some of them of enormous capacity. Careful surveys would undoubtedly show many suitable sites for dams that would impound large reservoirs.

Automobile Garbage Trucks in Cleveland.

To enable Director of Public Service Springborn to work out a new system of garbage collection which will require the establishment of four stations and the services of auto trucks for long hauls to the central station on Canal road, the council committees on finance and appropriations of Cleveland, O., have voted to allow the garbage department $150,000 instead of the $133,000 originally asked for. The establishment of the four sub-stations will reduce the present long haul, and the use of the automobile garbage trucks will greatly increase the efficiency of the collection service. Ten-ton automobile trucks, each drawing four trailers, will be used.

Vincennes' Rented Sewer System.

After months of re-arranging of contracts, the city council has at last arrived at a proper contract with the Vincennes Sewer Association for the construction of a complete sanitary sewer system. The contract specifies that the city pays an annual rental for twenty-five years. The cost will be near a half million dollars.

The Lighting of Dearborn Street, Chicago.

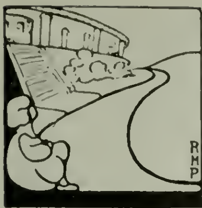
Plans of the Dearborn Street Improvement Association for an auxiliary lighting system that will increase the illumination of the street, between Lake and Polk streets, were announced recently by President John C. Roth. As was originally planned, the current for the new lighting system will be furnished by the Sanitary District.

Contracts for 100 brackets, each to support four Tungsten electric lamps of 200 watt power, have been let and the apparatus will be installed within the next two months. The cost is estimated at $10,000 and will be borne by business men and property owners of the thoroughfare in the downtown districts. The Chicago Railways Company has granted the use of its trolley poles, and the first 100 lamps will be supported by them by means of brackets.

Responsibility for the maintenance and support of the added lighting system, which will be independent of the regular city service, will fall upon the improvement association, although the officers hope to interest the city in a plan for sharing in the operating expenses. Plans for the new ligthing system have been under consideration by the improvement association for several months. Should the project prove a success other streets will be provided for similarly by the abutting property owners, it is predicted.

The Engineering Directory.

The 1912 "Engineering Directory," published by the Crawford Publishing Co., Chicago, Ill., is a complete directory of the plumbing, heating, power plant and mill supply industries in the United States. Among the lists a trifle outside the exact lines of the above description are those of the purchasing agents of the principal railways, the leading architects, the electric lighting and power plants, gas companies, water works companies and trade associations. The lists are thoroughly classified so that they are convenient for reference for any usual purpose. The price of the 1,500-page book is $5.



ORGANIZATIONS & INDIVIDUALS

Manitoba Good Roads.—Good Roads Year Book.—National Association of Cement Users.—Technical Associations.—Calendar.—Technical Schools.— D. D. Drummond.—Personal Notes.

Activity of the Manitoba Good Roads Association.

The Manitoba Good Roads Association has prepared a bill for the consideration of the legislature during the present session, which will be presented by a big delegation composed of the Good Roads Association, the Union of Manitoba Municipalities, the Winnipeg Automobile Club, the Winnipeg Motor Trades Association and other associations. One of the principal clauses of the bill is that which provides for the guarantee of municipal bonds for road work by the government. The government is prepared to set apart a sum of $200,000 for highway improvements during 1912, and in addition to make a grant equal to one-third of the total cost toward any permanent road work carried out by the municipalities.

The Good Roads Year Book.

Announcement is made of the forthcoming Good Roads Year Book, to be issued by American Association for Highway Improvement. The book will contain matter of interest to public road officials, contractors and engineers. The following are among the subjects covered.

A directory of international, national, interstate, state and local organizations which deal with the subject of road improvement, giving names of associations, the names, titles and addresses of their offcers and a brief statement of purposes.

All available information relating to appropriations by the national and state governments and by counties and townships for road improvement.

Information concerning bonds issued, authorized and contemplated by states and their subdivisions for road improvement.

A concise biography on roads.

A description of the types of bridges and culverts most in use, illustrated by drawings.

A list containing names and addresses of road contractors.

Dust preventives, definitions and methods.

A directory of national and state highway officials.

A list of educational institutions giving instruction in highway engineering and a condensed description of the courses given.

A condensed digest of the road laws of each state to January 1, 1912.

A table showing total mileage of all roads in each state and the mileage of improved roads of each type in the respecive states.

A short chapter on the various systems of maintenance now in effect.

A directory of manufacturers of road material and machinery, giving names, addresses and the kind of material or equipment manufactured.

A list of periodicals which devote attention to road improvement, with addresses, subscription price and name of publishers.

Brief definition of each type of road and methods of construction—bituminous macadam roads, brick roads, concrete roads, earth roads, gravel roads, macadam roads, sand clay roads, telford roads.

Further information may be obtained from the American Association for Highway Improvement, J. E. Pennybacker, Jr., Colorado Building, Washington, D. C.

The National Association of Cement Users.

The eighth annual convention of the National Association of Cement Users convened in Kansas City March 11 to 16.

Following the formal addresses of welcome and reply, Dr. W. M. Cross read the first technical paper on "The Use of Reinforced Concrete in Hypochlorite Water Purification Works." He was followed by George E. Tebbetts, engineer, Kansas City Terminal Railroad Co., who spoke on "The Use of Concrete in the New Union Station."

The session on Tuesday forenoon was devoted to the consideration of aggregates for concrete and to committee reports. W. M. Kinney, assistant inspecting engineer of the Universal Portland Cement Company, presented a paper entitled "Discussion on Aggregates for Concrete."

H. V. Schreiber, engineer, Sellers & Rippey, Philadelphia, then described and showed lantern slides of the design and construction of a hollow reinforced concrete dam of the Portland Railway, Light and Power Company at Estacada, Ore., on the Clackamas river.

The annual address of President Richard L. Humphrey at this session was interesting, as showing the development of the application of concrete in Europe.

Wednesday forenoon tests on reinforced concrete buildings under load were described by Prof. Talbot and Mr. Slater, of the University of Illinois. The method of making the tests was described in detail. W. S. Gearhart, state highway engineer, Kansas, gave an illustrated talk on highway bridges in his state, calling special attention to the necessity for good foundations and the fallacy of believing cheap first cost meant a cheap bridge. A paper on Concrete Bridges was also presented by Daniel B. Luten, of Indianapolis.

Concrete pavements were discussed in papers by F. P. Wilson, city engineer, Mason City, Ia., and E. W. Groves, city engineer, Ann Arbor, Mich. Following these papers the proposed revised specifications on concrete road and street pavements were read by C. W. Boynton, chairman of the committee.

A very good paper on "The Manufacture and Use of Concrete Drain Tile" was presented by C. E. Sims, secretary of the Interstate Cement Tile Manufacturers' Association. Gustave Kaufman, chief engineer of the Wilson & Baillie Manufacturing Co., of Brooklyn, N. Y., presented a paper on the advantages and durability of cement sewer pipe, based on the application of this material in sewer building in Brooklyn.

At the business meeting on March 13 the following officers were elected: President, Richard L. Humphrey, of Philadelphia; first vice-president, E. D. Boyer, Catasaqua, Pa.; second vice-president, Professor A. N. Talbot, Urbana, Ill.; third vice-president, E. S. Larned, Boston, and fourth vice-president, Professor Ira H. Woolson, New York.

Technical Associations.

At a meeting in Burlington, Vt., March 7, the Association of Vermont Engineers was formed and the following officers elected: President, F. O. Sinclair, of Burlington; vice-presidents, D. Williams, of St. Johnsbury, and J. E. Helyar, of Brattleboro; secretary, G. A. Read, of Barre; treasurer, A. E. Winslow, of Norwich.

At the fifth annual meeting of the Highway Engineers' Association of Missouri, held in Kansas City March 13-14, the following officers were elected: President, L. M. Stallard, St. Joseph, Mo.; vice-president, Alfred Riske, St. Charles, Mo.; secretary, J. E. Warner; treasurer, P. S. Quinn.

The Pacific Association of Consulting Engineers was recently organized at San Francisco and the following officers were elected: President, A. L. Adams; vice-president, C. D. Marx; secretary-treasurer, C. Derleth, Jr., University of California, Berkeley, Cal.

The Wyoming Society of Civil Engineers was recently organized at Basin, Wyo., to raise the engineering standard of the state and to promote public confidence in the irrigation and development of the state. The following officers were elected: President, C. W. Atherly, Basin; vice-president, H. T. Nowell, Basin; secretary-treasurer, M. D. Woolery, Thermopolis.

The second annual New York Architecture and Engineering Exhibition, which was to be held from March 25th to 30th, has been merged with and will be held in conjunction with the Fire Exposition, October 2d to 12th, constituting a department of fireproof construction and safety building equipment.

On the invitation of His Majesty's Government it has been decided to hold the Third International Road Congress in London, England, in June, 1913, to continue the studies already undertaken regarding the construction and maintenance of roads and bridges in view of modern methods of locomotion. The leading foreign governments have intimated their intention of sending delegates, and it is anticipated that there will be a large attendance of the representatives of many local authorities, engineering and other societies, and of road users, both at home and abroad.

In accordance with the terms of a statement from the president of the United States which assigns to the secretary of the department of commerce and labor the duty to initiate a movement for the establishment of a national organization representative of the commercial interests of the whole country, by calling a meeting of representative commercial and industrial associations of the Nnited States for the purpose of considering the question and outlining the principles by which such an organization should be governed, a conference is to be held in Washington, D. C., on April 15, 1912.

Calendar of Technical Meetings.

National Drainage Congress. Annual meeting at New Orleans, La., April 10-13. Vice-president, E. T. Perkins, First National Bank Bldg., Chicago.

Tri-State Water and Light Association of the Carolinas and Georgia. Annual meeting Salisbury, N. C., April 16-17. J. W. Neave, secretary, Salisbury, N. C.

American Electrochemical Society. Annual meeting Boston, Mass., April 18-20. J. W. Richards, secretary, Lehigh University, South Bethlehem, Pa.

American Water Works Association. Annual convention Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River st., Troy, N. Y.

Mayors Conference of New York. Third annual meeting Utica, June 10-12. Mayor C. C. Duryee, president, Schenectady, N. Y. C. C. Capes, secretary, New York.

Fire Marshals' Association of North America. Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

National Municipal League. Annual meeting Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American Bldg., Philadelphia, Pa.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment. Seventy-first Regiment armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway, New York, N. Y.

Technical Schools.

The University of Illinois announces the second competition for the award of the Francis J. Flym fellowship in architecture. The value of the fellowship is $1,000. It provides for a year of travel in Europe for the study of architecture.

Bulletin No. 425 of the University of Wisconsin contains 192 pages of a discussion of "The Flow of Streams and the Factors That Modify It, with Special Reference to Wisconsin Conditions," by Prof. Daniel W. Mead of the chair of hydraulic and sanitary engineering, which is a notable and valuable contribution to the knowledge of facts and theories on this important subject.

Prof. W. K. Hatt, of Purdue University, delivered an exchange lecture before the students and faculty of the College of Engineering of the University of Illinois March 6 on "Timber Preservation." He also gave an address before the freshmen of the college on "Mountain Railways."

Among the special lectures which have been given before the highway department of Columbia University during March are the following: Sand-Clay Roads and Oil-Cement-Concrete Pavements, by Logan W. Page, director United States Office of Public Roads, Washington; Mixing Plants for Bituminous Pavements, by Francis P. Smith, chemical and consulting paving engineer, New York City; Comparison of Pavements, by George W. Tillson, consulting engineer to the president of the Borough of Brooklyn, New York City; The Construction and Maintenance of Park Roads, by John R. Rablin, Massachusetts Metropolitan Park Commission, Boston; The Organization of the State Highway Department of New York, by John A. Bensel, New York state engineer, Albany.

Dr. Henry Wilson Spangler, professor of mechanical engineering and head of the mechanical engineering department of the University of Pennsylvania for twenty years, died in Philadelphia on March 18. He was an officer of the United States navy at one time and was a consulting engineer of the United States government. Prof. Spangler graduated from the United States Naval Academy in 1878. After serving for eleven years in the navy he accepted a position as assistant professor of mechanical engineering in the University of Pennsylvania.

David D. Drummond.

David D. Drummond died at his home in Chicago on March 8. Mr. Drummond was one of the early cement manufacturers in the middle west, his connection with the Chicago Portland Cement Company, of which he was later vice-president and manager, dating back thirteen years.

Mr. Drummond was a prominent figure at the meetings of the Association of American Portland Cement Manufacturers and during

D. D. DRUMMOND.

his entire lifetime he was actively interested in the work of the National Association of Cement Users and kindred bodies.

Mr. Drummond was born in Scotland, but lived in this country since boyhood. He died in his fifty-second year and is survived by a widow and three sons, Douglas, Ralph and Kenneth.

Motor Turntable Fire Escape.

The British Trade Journal contains a description of a motor turntable ladder truck, which is said to have given great satisfaction at its trial in a suburb of London.

The machine in question consists of a standard chassis, fitted with a 50 h.p. gasoline motor, carrying a ladder constructed in four sections, and arranged to lie in a horizontal position when traveling. The ladders can be raised to a vertical position or to any intermediate angle by means of hand winches. The fulcrum is at the rear of the chassis upon a base ring or turntable, which permits of the ladders being slewed round to any desired position. They are extended telescopically to the required height by means of a small engine or by hand winches. The operation of lowering the ladders is controlled by the same engine, the cylinders of which act as air cushions in taking the weight. The lowering of the ladders can be arrested at any moment by closing a small cock. Additional stability is given to the machine by feet or standards, which are screwed firmly down when the ladders are in use, these taking the weight off the springs and giving a rigid base to the whole. The ladders can be extended to a height of eighty to ninety feet in the small period of half a minute. When traveling to the scene of a fire this motor escape can attain a speed of about thirty miles an hour on the level, and it will take gradients heavier than any to be found near London. To insure safe working at night the appliance is fitted with a number of special devices.

Table of Water Equivalents.

The United States Geological Survey prints in many of its Water-Supply Papers a list of convenient equivalents for use in hydraulic computations.

The following is the most useful portion of the list:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot for one day covers 1 square mile 0.03719 inch deep.

1 second-foot for one day equals 1.983 acre-feet.

1 second-foot for one 28-day month equals 55.54 acre-feet.

1 second-foot for one 29-day month equals 57.52 acre-feet.

1 second-foot for one 30-day month equals 59.50 acre-feet.

1 second-foot for one 31-day month equals 61.49 acre-feet.

100 California miner's inches equals 18.7 United States gallons per second.

100 California miner's inches for one day equals 4.96 acre-feet.

100 Colorado miner's inches equals 2.60 second-feet.

100 Colorado miner's inches equals 19.5 United States gallons per second.

100 Colorado miner's inches for one day equals 5.17 acre-feet.

1,000,000 United States gallons per day equals 1.55 second-feet.

1,000,000 United States gallons equals 3.07 acre-feet.

1,000,000 cubic feet equals 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.

1 cubic foot equals 7.48 gallons.

1 cubic foot of water weighs 62.5 pounds.

1 horsepower equals 1 second-foot falling 8.80 feet.

To calculate water power quickly:

$$\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11} = \text{net horse power on}$$

water wheel realizing 80 per cent. of theoretical power.

Personal Notes.

Harry C. Hill has resigned as state engineer of New Hampshire.

W. G. Kirkpatrick has been appointed chief engineer of the city of Birmingham, Ala.

James W. Barrett has been appointed superintendent of water works at Portsmouth, N. H.

Henry Richmond, formerly city engineer of Nashua, N. H., died on February 21 at the age of 88 years.

C. L. James, city engineer of Mattoon, Ill., has been appointed city engineer of Oakland, Ill., by the city council of that place.

R. H. Thomson, for many years city engineer of Seattle, Wash., and for the last few months engineer of the port, has resigned.

George H. Herrold, who has been engaged in private practice in St. Paul, Minn., has been appointed assistant city engineer of that city.

Richard L. Saunders, formerly on the engineering staff of the Board of Water Supply of the City of New York, has become assistant city engineer of Bridgeport, Conn.

Frederick L. Ford, M. Am. Soc. C. E., of the firm of Ford, Buck & Sheldon, of Hartford, Conn., has been appointed city engineer of New Haven, Conn.

W. W. Chaffin has resigned as engineer in charge of track elevation of the Pennsylvania lines at Ft. Wayne, Ind., to become assistant city engineer of Ft. Wayne.

George R. Brown, assistant division engineer with the Massachusets state highway commission at Pittsfield, has resigned to take a position with the California state highway department.

Walter N. Frickstad has been appointed assistant city engineer of Oakland, Cal., succeeding Walter C. Howe, who resigned to become district engineer with the California state highway commission.

H. H. Quimby, M. Am. Soc. C. E., assistant engineer of the bridge division of the Bureau of Surveys of Philadelphia, Pa., has resigned to enter private practice with John G. Brown, Assoc. Am. Soc. C. E., as consulting engineer.

Albert H. Brosius, who has been principal assistant to Sewerage Engineer Hendrick, of Baltimore, Md., since the beginning of the new sewerage system, has accepted a position as chief engineer of sewerage and paving in Havana, Cuba.

Harold C. Stevens has resigned the position of assistant engineer, designer, board of water supply, New York City, and is associated with Johnson & Fuller, consulting engineers and sanitary experts, 150 Nassau street, New York City.

John Wilson has been appointed city engineer of Duluth, Minn. He was connected with the Minnesota state board of health and later was city engineer for Mankato, Minn., for three years, and recently special assistant engineer of Duluth.

MACHINERY AND TRADE

A One-Car Asphalt Plant.

Following is a description of the Merriman one-car asphalt plant, which is manufactured by the East Iron and Machine Co., of Lima, O.

The first essential should be strength to withstand the hard usage to which this class of machinery is subject. The first plant of this type has been in use eight seasons and has laid between 700,000 and 800,000 yds. of finished work—yet it is doing just as good and as large an amount in a season as any new plant.

The asphalt is heated with steam, precluding the possibility of coking or burning the material. There should not be to exceed 360 to 375 degrees of heat used when melting down the material. This degree of heat cannot be controlled by direct heat. With steam heat it can be absolutely controlled. More bad streets have resulted from the use of direct heat in melting down the asphalt than from any other one cause. It is a well known fact that if asphalt is burned or scorched (which can be done very easily with direct heat) it goes into the street apparently all right and it is not known otherwise until such time as the material begins to disintegrate and the contractor wonders why it should do so when he has used the proper amount and mixed it properly.

The steam for melting the asphalt and running the machinery is furnished from a 125-h. p. marine-type return-flue boiler tested at 250 lbs. cold water test, upon which 165 lbs. of steam is carried when necessary. In the first days of portable plants steam heat was employed for melting the asphalt and was not satisfactory, due to the fact that in putting together the pipe coils it was necessary to use connections which would leak inside the tank causing trouble. After the advent of electric welding this method was used in making the pipe coils, making each and every coil continuous from end to end and making it possible to make all connections on the outside of the tank, thus making the coils absolutely proof against leakage. Each tank has four of these coils, containing 1,130 lineal ft. of 1¼-inch double strength pipe so that with steam heat a tank of asphalt can be melted down in four or five hours.

The plant has two tanks, each having a melting capacity of 712 cu. ft., or a combined capacity of 1424 cu. ft.; either tank will hold sufficient A. C. for a day's run. The asphalt pipes for conducting the asphalt to the weigh-box mixer are all steam jacketed, making it possible to run in extremely cold weather without the possibility of the A. C. becoming cold in the supply pipes. One tank can be filled during the day while running from the other, melted down at night and used from the next day, in this way alternating from day to day, making it convenient without any of the annoyance where small kettles are used.

There are four engines on the machine, including the hoisting engine. These are all connected with steel gears and are independent each of the other, making it possible to run any one part independent of the other. The cold sand and stone elevators have clutch pulleys, making it possible to throw them in or out without stopping the machinery.

The condensed steam from A. C. tanks returns to boiler by means of a hot water pump working automatically. The sand drum is 28 ft. long, 5 ft. 6 in. in diameter; this is a return heat drum, the heat passing under and over and returning through same. It is a strong, substantial drum and has a capacity in excess of any possible requirement. It is very economical from a fuel standpoint, owing to its large heating surface.

The hot sand tank, screen, mixer and mixer engine, hoist and elevator engines are all on a sliding carriage on one end of plant which when in use is slid out in position to drive under by means of two large screws. The hot sand bin is raised and lowered by four right and left hand screws, one on each corner, raised when in operation and lowered when ready for the road and saves removing bin from car when being transported. It is a strictly one-car plant, as all parts are carried on the one car. The A. C. tanks are piped for either air or steam agitation. The best of materials of their respective kinds are used throughout and the best of workmen are used in the fabrication; and to quote the words of a practical man on his first examination of one of the plants in operation he said: First, he had never seen as large a piece of machinery so near mechanically perfect; Second, it is built strong in every part without an apparent pound of surplus material.

It has a capacity of 1800 sq. yds. of 2-inch top or 4000 yds. of 1-inch binder in ten hours. One plant last fall, under ordinary working conditions in 24 working days laid 28,000 yds. of 3-inch finished work. Another plant in 1907 laid 114,000 sq. yds. of finished work; traveled 1185 miles; was set up and taken down 7 times and lost four weeks waiting on materials. Another year 162,000 yds. was laid by one plant, which traveled 1,260 miles. These results were attained, not with any idea of making a record, but simply during the paving season without any effort to make a showing.

The Oshkosh Contractors' Pumps.

The Oshkosh Manufacturing Co., Oshkosh, Wis., have a complete line of contractors' pumps suited to various conditions of work. Among these are both centrifugal and diaphragm pumps.

The portable centrifugal type includes both gasoline engine driven and motor driven pumps. The former range in capacity from 125 to 1,100 gallons per minute, while the latter are made to include sizes from 265 to 1,100 gallons per minute.

The gasoline engine pump is driven by a valveless type engine, direct connected.

The advantage of this type of engine to this outfit is its ability to furnish the power needed at the minimum weight, the portable feature being a great advantage in transporting same to different places. The outfit is complete with batteries, spark plug, switch, etc.

The Oshkosh centrifugal pumping outfits with motors are connected by means of gears, one steel and one cloth gear. This cloth gear will wear and stand the weather and it also eliminates the noise which would come from two steel gears.

The portable diaphragm pump is designed to do away with expensive hand pumping. The pump is of latest design, guaranteed as to its represented capacity and can be furnished with either side or bottom suction. The engine is of the four-cycle type, guaranteed to develop two horsepower, and which at every stroke of the pump lever develops a lift of 1,000 pounds. The power is transmitted from the engine to the pump by means of a gear wheel and crank shaft. The idea of the crank shaft is to do away with all side motion and balance the complete outfit. This outfit may be had in capacities from 3,600 to 7,200 gallons per hour.

The Sieben Machine Cleans Water Mains.

The efficiency of the Sieben sewer cleaning machine on sewer work has been previously noted in these pages, and recent tests have opened a new field of usefulness for a new machine on the same general principles.

The efficiency of the 36-inch flow lines from the Quindaro pumping station to the Kaw river in Kansas City, Mo., had been reduced to about 40 per cent. by reason of the accumulation of foreign material. A contracting firm offered to clear the 18,000 feet of pipe in question for the sum of $7,200. The Sieben System of Sanitation Co., of Kansas City asked to be allowed to demonstrate by test that the pipe cleaning machine before mentioned, could cheaply and efficiently remove the obstructions. Accordingly the experiment was made on January 25th.

The main chosen for the test was a 20-inch pipe which had been in the ground and had not been cleaned for twenty-four years. It was badly crusted with from ¼ to ½-inch of tubercular and rust accumulation before the clearing commenced. The machine operated in a thorough and satisfying manner, leaving the pipe clean and smooth and entirely free from deposit. The pipe-cleaning machine consists of a tube about 22 inches long and 4 inches in diameter with a system of tubes to direct the water over a water turbine perfected and patented by the company for use for sewer cleaning purposes. The improvement for water main cleaning is a system of arms connected to the turbine with a roller cutting wheels attached to the arms that are thrown in and out by centrifugal action.

The turbine and cutters are mounted on runners carrying the machine in the center of the pipe admitting of the same pressure on the interior of the pipe all the way around the inside. This system does not miss a fraction of the pipe in its operation.

The Cobb Face Down Block Machine.

The Cobb adjustable face down concrete block machine is adaptable to making various sizes of concrete blocks of either the hollow or veneer types. It is very simple in construction, being free from springs, levers, etc., and the change in size of the form is made by merely changing the pallets. The cores for the formation of hollow blocks are interchangeable. Blocks on this machine can be made with a rich facing on the front and can also be faced on the back, and the end doors swing back out of the way, so as not to interfere with the block when being carried away.

Among the face designs furnished with the Cobb machine are broken ashlar, plain rock divided into two 4-inch blocks, rock divided into one 8-inch and two 4-inch blocks, tool edge, bush hammered, and panel.

The machine is manufactured by the Wm. Cobb Foundry, 209 Clinton street, Jackson, Mich. The company also has a complete line of municipal castings.

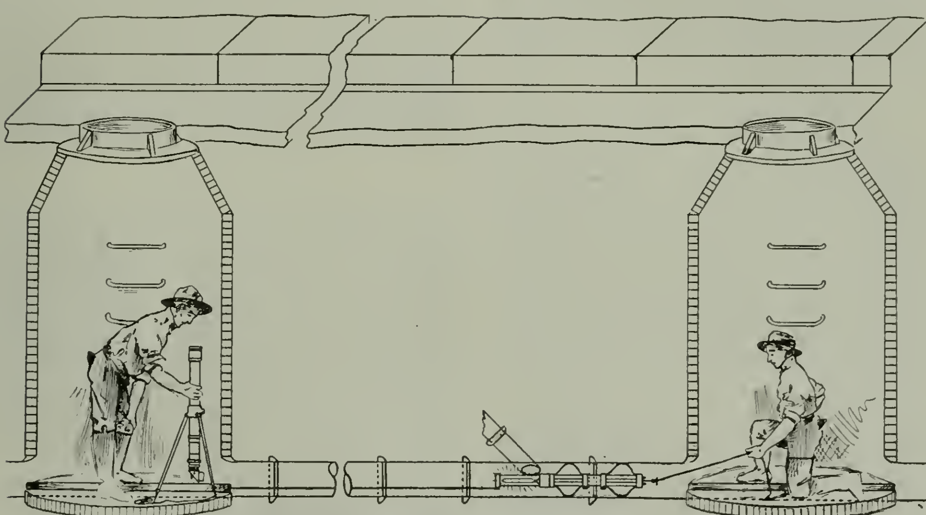
A Device for Inspecting Sewers.

Scientific men within the last few years have devoted a great deal of thought to the important question of sanitation. In our boasted supremacy as to education, cities have for years been laying sewers under our streets and the engineer who has designed them has pointed with pride to the details in the placing and construction.

The contract is let, the work completed at great expense and we glorify ourselves in that we have protected ourselves and the future generations from the ravages of disease that would have occurred had we not prepared this our perfect system of sanitation. In a few years we are forced to investigate and we find that our perfect system of sewerage is a myth, and our water supply is charged with disease due to the faulty construction of the sewer. There are numerous instances that can be cited to prove the above statement. Investigation at great expense shows broken pipe, open joints, disintegration of the sewer and many other conditions that bring upon the community sickness due to the pollution of the soil. Custom has proven that a sewer built of small diameter more readily adapts itself to the principles of sanitation from the possibility of the flow flushing it and keeping it in proper condition. But in building these small sewers what guarantee has the engineer or the city that is paying for same that this sewer is well constructed?

Inspection after the sewer line is laid shows a line of 6-inch, 8-inch, 10-inch and 12-inch pipe, which, if examined before back-fill has commenced, seems to be laid in perfect alignment and perfectly jointed. A further inspection by use of light at one manhole and mirror at next manhole shows merely a hole through the ground. Sewers laid and inspected as above have been tested by interior water pressure by plugging sewer pipe at the lower end of a grade and with fire hose filling line from upper end with the result in many cases of inability to fill the line, showing a leak at some point between.

The necessity of locating the weak points in sewers caused W. W. Dixon to have made a telescope mounted on a tripod, the telescope having an object glass and a right-angle prism. An electric torch of 8 candle power is suspended in the center of the sewer pipe by a series of springs adjustable to various sizes of pipe. A string is passed through the pipe line by either float or sewer rods and the torch attached and drawn through the sewer. At the end of the torch towards the operator with the telescope, is attached a graduated tag line. As the torch is drawn through the sewer the light illuminates the entire interior of the sewer for a distance of about 18 to 24 linear inches. The operator with the telescope then focuses on this illuminated point and is enabled to locate cracks, breaks, house branches and leaky joints; and by the use of the tape locates to a very close degree the distance of these defects from the manhole.



THE G-K SEWER INSPECTION SYSTEM.

The accompanying sketch shows the manner of use. This instrument is patented and is known as the G-K Sewer Inspection Device, owned by the Union Clay Products Co., 40 Church St., New York.

The Sycamore Maul.

"A maul that is a maul" is the descriptive phrase with which the Sycamore Maul Co., of Syracuse, Ill., describe their product. So small a detail of the contractor's equipment as a maul often is allowed to shift for itself, and it is customary to send a workman to the nearest source of supply with an order to "get a maul" when, as frequently happens, the one in use goes to pieces. With attention given to the workmen's slightest movement, so as to secure efficiency and avoid waste, with all available material carefully saved, the contractor uses simply any maul.

For certain classes of work, such as trench sheeting, etc., a wooden maul is desirable and the Sycamore maul possesses particular merit. The head is made of the best seasoned hard wood, selected and carefully prepared. The handle is of straight grained hickory and is carefully fitted and keyed into the head. Iron bands are placed around both faces of the head, and these are held firmly in place by a stay rod, which is fitted in a groove along the side of the maul head and bent over both of the bands while hot. This latter feature makes it impossible for the bands to become loosened and come off. It may be obtained from the Sycamore Maul Co., Sycamore, Ill.

Steel Playground Apparatus.

Park boards, playground officials and school authorities cannot but be impressed at this season with the weather's destructive effect upon most of their playground apparatus. The winter's rain, snow, sleet and wind has played havoc with the swings and teeters which were purchased perhaps no longer ago than last spring. The stout ropes are now shreds of hemp, the teeters are warped and cracked, and all of the apparatus which has been in occasional use during the few bright days of winter has been rendered unfit by the action of the elements.

The Medart Steel Playground Apparatus, made by the Fred Medart Manufacturing Co., Dekalb and President streets, St. Louis, Mo., is made to withstand these destructive agencies. The Medart apparatus is built entirely of steel and then galvanized, and will positively resist the elements of the weather under constant exposure and it is practically indestructible even under the severe use and abuse it is subjected to in the average public playground. It is free of any attempt at elaborateness.

A very complete catalog by this company illustrates a wide variety of swings, horizontal bars, flying and traveling rings, slides, etc., all constructed of steel. Four gymnastic outfits are illustrated in this catalog to permit of a selection for the average purpose, or these standard outfits can be modified to suit peculiar requirements. If necessary the company will draw plans for special outfits of this character, although standard outfits can be sold at comparatively lower prices. A complete playground equipment ordinarily consists of a gymnastic outfit, swing outfit, seesaws, circle swing and slide. In more complete equipments baby swings, revolving parallels, horses, bucks, etc., are also included.

The pipe for the swing frames, etc., can often be bought in local markets at a saving to the purchaser. The Medart Co. quotes the pipe independent of the apparatus and special fittings, so that a comparison of prices can be made with the prices of local supply houses. They invariably recommend the use or specitl fittings for putting the frames together, as they very greatly facilitate erection. These special fittings are not threaded and their use makes possible the erection of the frame with ordinary workmen. Complete instructions for each detail of the work are furnished and no item from digging the holes to attaching the apparatus is left unmentioned.

The fact that constant exposure and use under the most severe conditions necessarily make durability the essential consideration was recognized almost from the very beginning and careful observation of the apparatus in use resulted in continual improvement, but as playground work became more effective, the use of the apparatus became more excessive, and nearly fifteen years' time was consumed in perfecting the present construction. The principle of this construction is the elimination of practically all wooden parts and this idea was originated by Mr. Fred Medart.

"Pozite" Joint Cement.

F. H. Hough, 17 Battery Place, New York, N. Y., has invented and is manufacturing a pipe joint cement which he particularly recommends for pipe which is laid in wet trenches. The material which is sold under the trade name of "Pozite" is a fine powder, containing an intimate mixture of sulphur and specially prepared and combined in such proportion as to melt readily at about 240 degrees Fahrenheit, a little over the temperature of boiling water. The process of using the material is briefly as follows.

The joints should first be thoroughly caulked with jute packing well rammed down. Any form of joint runner is then fastened around the pipe closing the mouth of the bell, and the annular space between the bell and spigot is filled with molten "Pozite," which is poured in the same way that lead is poured in laying cast iron water pipe. The joint runner should be damp to prevent adhesion of cement, and a little moist clay should be used to prevent overflow at the top of joint. In practice, with small pipes up to 10 or 12 inches, it is found most convenient to join two or three lengths of pipe on a cradle on the surface of the ground, so that but one joint out of every three or four need to be made in the trench. The joined sections can be freely handled and lowered into the trench within a few minutes after pouring. When there is water in the trench, it must be kept down, of course, while the joint is being made, but only for the few minutes required to pour, and the water can be allowed to rise immediately afterward.

In laying pipes in wet trenches, the ditch should be excavated about six inches below the bottom of the pipe, which should be blocked up to grade. The water is thus more readily kept away from the bells. After the water has been reduced the bell must be wiped dry and care must be taken to see that no water enters the bell before the joint is poured. It is well to provide a wooden plug to close the free end of the pipe. In the case of large pipes, 15 or 24 inches in diameter, a proper bed should be made, of course, to support the pipe.

The table below gives the approximate quantity required per joint:

Pipe.	Lbs. Per Joint.
24 inch	10.0
22 inch	9.0
20 inch	8.0
18 inch	7.0
15 inch	5.0
12 inch	4.2
10 inch	3.3
8 inch	2.5

The Water Works System of Centralia, Mo.

The Des Moines Bridge and Iron Co., Des Moines, Iowa, have recently completed the construction of a complete water works system for Centralia, Mo., which is very complete and a most efficient small town plant.

WATER WORKS PLANT AT CENTRALIA, MO.

Centralia has a population of 2,500. A. Bishop Chance is mayor and J. C. Stewart is clerk.

The water supply for the system is secured from a 10-inch drilled well 700 feet deep tapping a quantity of water of an excellent quality. It is pumped from the well into a clear water reservoir shown in the foreground of the accompanying photograph. This reservoir is of concrete 45 feet in diameter and 6 feet deep. From here it is pumped into the hemispherical bottomed steel tank of 70,000 gallons capacity supported on a tower so that the top of the tank is at a height of 125 feet above the ground.

The power machinery is contained in a 48x59 foot brick pump house, with a brick chimney. The boiler equipment includes two 60-inch by 16-foot boilers, and the power machinery consists of one 125 h. p. engine, two 75 k. w. generators and one 500 gallon per minute duplex pump and one 300 gallon per minute triplex motor driven pump.

The distribution system serves 57 fire hydrants through 35,000 feet of cast iron mains. The total cost of the plant including power equipment and distribution system was $55,000. Burns and McDonnell, Kansas City, Mo., were engineers.

The Des Moines Bridge and Iron Co. construct a great many complete water works systems. Among those which they have recently completed are water works plants for the cities of Winterset, Iowa; Adair, Iowa; Farmington, Minn.; Onida, S. Dak.; Chappel, Neb.; and Highmore, S. Dak., and they have under construction water works plants for Prescott, Wis.; Shelbina, Mo., and Waterville, Kan., also Rushville, Ill. These plants range from $15,000 to $65,000 each.

The Two-Car Asphalt Paving Plant.

The first railway asphalt paving plant consisted of two cars, one being known as the dryer car and the other as the melting car. For nine years or more this was the only type of railway plant known; its invention originated with Hetherington & Berner, Indianapolis, Ind., as was decided by the United States Patent Office in a case in which the validity of the Hetherington patent was contested by the greatest company in the asphalt paving business at that time. The great success of the Hetherington two-car railway plant is now a part of the history of the asphalt paving business in this country and marks the beginning of that period of vast expansion in the use of asphalt as a paving material which has seen it come into general use in even the smaller towns, a thing not thought possible before the advent of the railway plant.

Improvements in the design, construction and capacity of the first plant took place very rapidly, until the Hetherington two-car railway plant achieved the capacity for turning out material for 2,000 square yards of finished 2-inch topping per day.

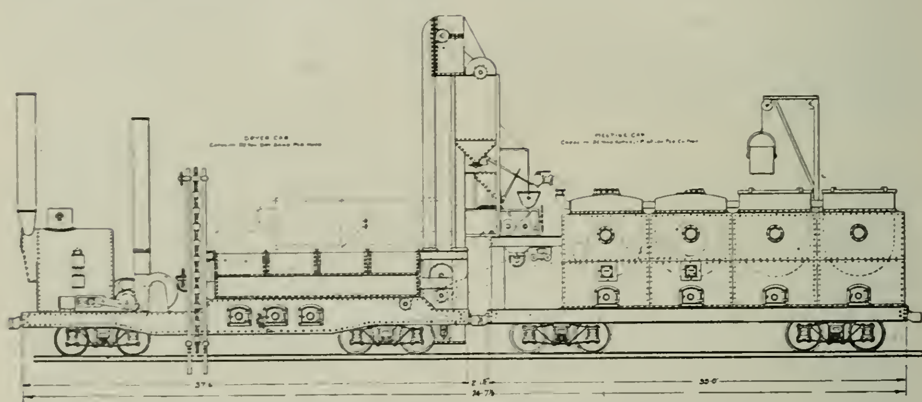
Then came a demand for a plant of less capacity. One of the leading paving contractors, who had been operating very successfully with the two-car plants, came to the conclusion that it would be a better business proposition to own two plants of about 1,000 square yards capacity rather than one plant of 2,000 yards capacity; this for the reason that after several years experience he had found that paving jobs of from 10,000 yards to 30,000 were plentiful, and that for jobs of such size a smaller plant would be more economical, while jobs of such size as to demand the capacity of the two-car plant were not so frequent and when he secured one of the larger ones he could operate both of the one-car plants upon it, with but one superintendent and one foreman. When not operating conjointly on a large contract then the smaller plants could work separately; thus enabling him to keep several jobs going at the same time. It was because of this sound reasoning that Hetherington & Berner brought out their celebrated one-car railway plant. But there were yet other paving contractors who still desired a plant of large capacity.

The principal features requiring consideration and investigation in the solution of this question were, first, the traveling weight of the outfit itself, taken in connection with the length of car which would be required and the distribution of that weight upon a car of that length; second, the relation of such an abnormally long and heavy car to the curves over which it might have to pass during its travels; third, the relation of such a car to the various tunnels that might be met with on the road, and, fourth, the distribution and arrangement of the machinery of the plant itself in order that each part or mechanism might be in such position that it could be readily gotten at for the purposes of operation and making repairs.

It is to meet the requirements set forth in the foregoing that Hetherington & Berner advocate the use of the two-car railway asphalt paving plant where capacities greater than 1,000 square yards per day are required, rather than a one-car plant.

The two-car railway asphalt paving plant which is illustrated herewith represents a plant that is even more mobile than the one-car plant, while at the same time it can be furnished of any capacity up to and even more than 2,000 square yards of 2-inch thick asphalt topping per day. In the design of this new plant have been incorporated most of the features of the old Hetherington two-car plant, and added to these features are those of particular excellence which have hitherto pertained only to the Hetherington one-car plant, the principal ones being the fold-down hot sand bin, the fold-down hot sand elevator and the helicoid conveyor mixer delivery apparatus which, while discharging the contents of the mixer to the waiting wagon, gives a secondary or double mix to the material, so that not the slightest quantity of unmixed sand can be found in it.

From an examination of the illustration it will be seen that neither one of the two cars which combine to make the plant complete is of extraordinary length; in fact both of them are somewhat under the length of the ordinary gondola or flat car of common use. Separately or coupled together these cars are able to negotiate any railway curve, any tunnel, any bridge and can be weighed upon any ordinary railway scales, and the combined length of the two cars is but little greater, if any, than that of certain one-car plants that have been offered to the trade. It will also be noted from the illustration that there is no part of the machinery of this plant that projects below the body of the car and hangs in dangerous proximity to the tracks.



THE HETHERINGTON & BERNER TWO-CAR ASPHALT PLANT.

The new style two-car Hetherington railway asphalt paving plant may be had in two sizes, one having capacity for 1,500 square yards per day and the other for 2,000 square yards per day.

In the design of this plant have been embodied the features of mechanical agitation and melting by direct heat, two features of absolute importance to a first-class asphalt paving plant, whether railway or stationary. It is altogether probable that the time is not far distant when the use of mechanical agitation will be made mandatory by all cities issuing specifications for that kind of pavements; the reasons for this, and also the reasons for the use of direct heat for melting, instead of steam heat, are fully set forth in a pamphlet entitled "Pointers for Plant Purchasers," which may be had of Hetherington & Berner.

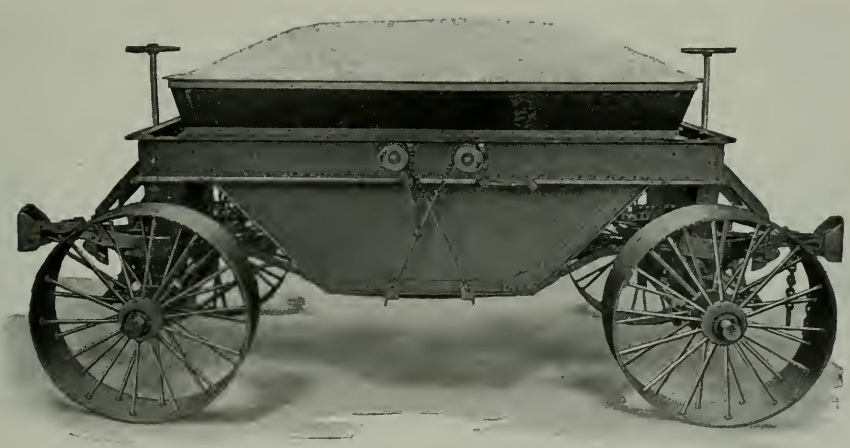
A New Reversible Spreading Dump Car.

The Port Huron Engine & Thresher Company, Port Huron, Mich., have just placed on the market something entirely new in the way of a spreading dump car. It differs from all others in having a hand steering device at each end, and is designed especially for use on narrow or crooked roads.

Each end is provided with a bumper or tongue, which can be made rigid by inserting a lock pin, or may be made flexible by its removal. It can be pushed or pulled to any desired location. Like their regular spreading car it is made of all steel and iron and is exceptionally staunch and durable.

The advantages of this car will appeal to road builders who have had experience on narrow roads where there was insufficient room to get alongside with engine or roller.

With a train of these cars, when spreading stone on a narrow road, to avoid running up onto stone already spread, they can be pulled to one side of the road and dropped about 15 feet apart. This will allow sufficient room for the engine to get back alongside and by use of the steering device cars can be pulled from almost any angle and dropped just where wanted. When so placed they can be coupled together, the engine hitched onto the last car and stone spread while leaving for the next road. With the steering device where roads are crooked or narrow, cars can be handled one at a time much quicker than could the whole train.



THE PORT HURON REVERSIBLE DUMP CAR.

The Staley Power Tamping Machine is Successful.

Recent tests conducted by a number of cities and private corporations have demonstrated the value of the Staley Power Tamping Machine, manufactured by R. H. Staley, Box 229, Springfield, Ill. The necessity of proper tamping of back filling is becoming more recognized and both municipalities and private contracting firms are finding it to their advantage to properly refill trenches.

Alexander J. Taylor, chief engineer of the city of Wilmington, Del., commends the machine and states: "We have had it for about six months now, during which time it has run smoothly and there has been no trouble with the mechanism. We have not, at hand, any data as to the cost of the work but it seems to effectively do the ramming for about six shovelers. We are well pleased with the machine and have not had any settlements in the ditches rammed by it. In some cases where the pipe installed was not over 10 inches in diameter all the earth excavated from the ditch has been replaced and none hauled away."

F. C. Shepard, superintendent of the Minneapolis Gas Co., Minneapolis, Minn., states that the company has used the machine extensively and says regarding it:

"It worked very successfully last summer and was able to do the work of ten men with two; in other words, it replaced eight men in tamping on all our pavement and railroad yard work, and we feel that it was a very good investment for the company. The cost of operation is very slight, both as regards maintenance and gasoline."

The machine, a gasoline engine driven tamper mounted upon wheels so as to be easily pushed along over the trench, has been fully described in these pages.

A New Concrete Lighting Standard.

The use of concrete as a material for the making of ornamental lighting standards is by no means new, as it has found favor in this field for a number of years. It has been proven to be a medium which allows the display of a wide variety of taste in design and execution, and is, of course, durable and economical. These latter facts have been shown to be true by the installation of concrete ornamental posts in a number of the large parks and boulevards throughout the country, notably in Lincoln park and drives, in Chicago.

The National Mixer Co., Mercantile Building, Rochester, N. Y., have perfected a form for the manufacture of a very attractive single light standard known as the Zem-Art standard which possesses the merits of being light and strong in construction and so fitted and finished as to assure of a smooth and well-formed product. The National Mixer Co. furnish the mold and an extra pallet complete and promise an output of one standard a day for each form.

ZEM-ART CONCRETE LIGHT STANDARDS IN ROCHESTER, N. Y.

The lighting company of Rochester installed about 200 of the standards during 1911 and it is stated will double this amount during 1912. The company has expressed its entire satisfaction with the standard both as regards its artistic design and by reason of the fact that it requires no painting nor repairs, can be easily cleaned and washed, and that it improves rather than deteriorates with age.

The Blome Concrete Pavements.

The Blome granitoid and granocrete pavements are not a creation, but are a development of types of a concrete pavement arising from experiments extending over a number of years. That the granitoid pavement, the first of the above mentioned types, has been successful is testified by the fact that they have been constructed under practically every condition of climate, upon grades and over a wide variety of foundations and many of the cities which first tried it have adopted it repeatedly in after years. The methods of constructing both the granitoid and granocrete pavements are patented by Rudolph S. Blome Co., City Hall Square Building, Chicago, Ill.

In the granitoid pavement a 5 or 6-inch concrete base is prepared as in the case of a brick pavement. Upon this is deposited a granitoid blocking 1¾ inches thick and containing one part of Portland cement to one and one-half parts of crushed granite or trap rock of the following composition: 50 per cent. of the granite of ¼-inch size, 30 per cent. of the ⅛-inch size and 20 per cent. of the 1-16-inch size. This material is thoroughly mixed and deposited on the concrete base after wetting. It is then worked into brick shapes of approximately 4½x9 inches, by means of special grooving apparatus. Expansion joints are provided for as needed.

The granitoid pavement has proven sanitary in that it is easily kept clean, it is not slippery and has stood up exceptionally well under traffic.

Granocrete pavement is a further development evolved through experiments tending to develop a less expensive concrete wearing surface. Granocrete provides a pavement which is especially adaptable for streets and boulevards of lighter traffic and for highways, a pavement which does not become slippery or dusty, and furthermore one that can be constructed at a low cost and minimum outlay for maintenance.

The surfacing of granocrete pavement is prepared with accuracy as to formula of composition and is based upon completely filling the spaces between the particles of crushed stone with a mixture of sand and cement in such a manner to reduce the voids to a minimum. The mixture of this surfacing is such that all portions of the stone are completely encased, the particles of stone are so placed in the wearing surface that all the wear comes directly on thel and the sand and cement merely act as a binder of the surfacing material.

More detailed information regarding these two types of pavement may be obtained from Rudolph S. Blome, City Hall Square, Chicago, Illinois.

Creosoted Yellow Pine for Pavements.

J. C. Dionne, editor of *Southwest* at Houston, Tex., makes a few telling statements at the close of an article on wooden blocks for paving Houston streets which are worth repeating. They are as follows:

The lumber men are going to prove to the citizens of Houston—not that the yellow pine block pavement is the best paving to be had —but that it is the only thoroughly successful and satisfactory pavement of modern times. The experiences of the many cities of the United States, Canada and Europe that have tried this pavement all demonstrate the truth of this saying. There is not a dissenting vote where the block pavement has been used; that is, the yellow pine block pavement.

The writer has recited previously the experience of Philadelphia, which sent a deputation of citizens accompanied by an engineer all over the world to decide what is the best modern pavement, and the commission voted unanimously for creosoted yellow pine blocks.

The United States government is conducting a wood block pavement experiment in Minneapolis, as recently noted in *The Chronicle,* and their recent report on the yellow pine blocks broke the world's paving records. The report shows that the wear was entirely smooth and uniform, that it amounted to one-sixteenth of an inch after six years' use under heavy traffic, which means that it would take ninety-six years to wear off an inch of this pavement, and that it would wear smoothly, at that.

The best paved streets in America and Europe are creosoted block pavements. Houston is full of citizens who have ridden on Michigan avenue in Chicago and commented on that magnificently paved boulevard, and the chances are a hundred to one they never dreamed they were riding over a common Texas wood paving block. Others who have enjoyed a spin on Fifth avenue, New York, would probably be surprised to know that it is paved with yellow pine.

And so on with a score of our large cities. Their first-class pavements are yellow pine blocks.

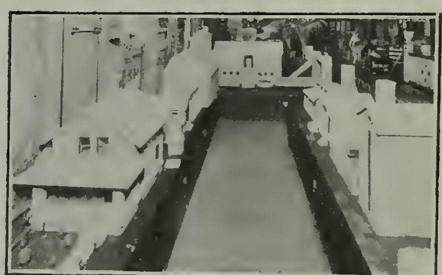
They are sending from the North for millions upon millions of feet of yellow pine for their main streets, and are praising these pavements to the skies; yet Houston, the leading yellow pine block selling city of the world, has never laid a foot of block pavements, except the old round block pavements without foundation, that were on eyesore for years.

The lumbermen are going to urge their fellow-citizens to pave Houston with "the perfect pavement," and have streets to be proud of. They are going to detail the value of creosoted blocks set on a concrete foundation and laid almost exactly like a brick pavement. They are going to indorse and guarantee it, and when they have finished their campaign the Houston people will have had full opportunity to know the full value of the yellow pine block.

Concrete Models of Farm Buildings.

At the recent Chicago Cement Show the Chicago Portland Cement Company appropriately installed an exhibit consisting of no less than thirty all-concrete models of farm buildings and miscellaneous structures on the farm, photograph of which is here reproduced. The visitor who inspected this exhibit was quick to grasp the wonderful utility of cement on the farm. It was an original, convincing display.

Located on the main aisle of the Coliseum Building, this exhibit occupied approximately 400 square feet. The idea was to exhibit only such concrete work as could be successfully accomplished on the farm, and to demonstrate it in the simplest manner possible. Wall construction was shown by a reinforced concrete wall of plain design, four feet high, which enclosed part of the exhibit, a space



CONCRETE MODEL FARM BUILDINGS.

10x12 feet. Concrete urns cast from an ordinary metal wash basin, such as is found in every farm home, were placed at intervals along the top of the wall, while a metal cuspidor served as the mold for the base of these urns. The use of concrete blocks was shown in a wall 3½ feet high which intersected the exhibit, while the widely discussed concrete furniture, comprising two tables, four chairs, one bench and two small milking stools, was also exhibited at this booth.

All of the models were built to the scale of one inch to the foot, the residence as shown in the picture being 22 inches wide, 36 inches deep and 28 inches high. It is a two-story, seven-room structure; was decorated interiorly, completely furnished, telephone equipment and other modern farm conveniences, and electrically illuminated throughout. Fronting the house was a long stretch of concrete roadway, concrete curb, sidewalk, stepping block, hitching post, and on the lawn was a concrete roller. To the rear of the residence were located the following models, all in concrete, in the order named: Cistern, well house and windmill, dog house, smoke house, ice house, garage, carriage and wagon shed, horse and hay barn with watering trough adjoining, dairy, cow barn with silo and elevated water tank, circular watering trough and machinery base adjoining, the concrete approach to the second story of the barn being utilized as a root cellar, a concrete feeding floor with manure pit extending between the cow barn and the hog house, corn crib and granary; and lastly, a chicken house. The miscellaneous models include concrete steps, drain tile and culvert.

Frank A. Caldwell, concrete contractor, 4723 Halsted street, Chicago, built the entire exhibit.

The Motor Fire Engine of Navesink, N. J.

The accompanying photograph shows a very interesting piece of motor fire apparatus manufactured especially for the village of Navesink, N. J. It is a special adaptation of a heavy touring car chassis to fire service and the combination was made at a very reasonable expense to the village.

The car is a fifty to sixty horsepower Thomas car with an overall length of seventeen feet with a Goulds bronze fitted rotary pump, manufactured by the Goulds Manufacturing Co., 131 West Falls street, Seneca Falls, N. Y. The weight of the apparatus complete is 4,000 pounds. The cost complete was only $2,800.

The pump runs at a speed of 350 revolutions, supplying 350 to 400 gallons per minute. It has 5-inch suction and 2½-inch discharge.

MOTOR FIRE ENGINE, NAVESINK. N. J.

With a pressure of 140 pounds at the hydrant the pump will throw a stream 100 feet and will throw a solid stream eighty-five feet straight up through 750 feet of discharge hose.

The Kalamazoo Trench Braces.

The Kalamazoo Foundry & Machine Co., 576 East Main street, Kalamazoo, Mich, make a special line of trenching braces which embody features of construction of particular merit. Among the types shown in their descriptive leaflet are the regular forms of trench braces, ranging in length when extended from one foot to four feet ten inches, heavy braces from three feet to six feet six inches, and ball and socket braces from one foot to six feet eight inches.

The Kalamazoo timber brace fittings are suitable for use in any width trench except the narrowest. They are especially useful in wide excavations. The screws are of stiff steel, and the bracing of the caps in the larger sizes make these braces most desirable for heavy and severe service. Cutting thread in cap makes these so that they may be safely extended within two inches of length of thread on screw.

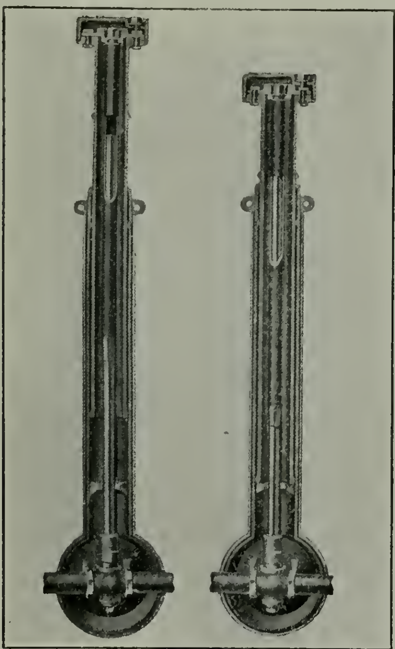
The "Perfect" Curb Box.

With the ordinary curb box, which has remained standard through the developing and perfecting of other water works equipment, trouble is often experienced, due to "freeze-ups" and the accumulation of dirt about the service cock. The E. T. Valve and Hydrant Company, 50 Church street, New York City, has given its attention to the bettering of the old standard, and the "Perfect" curb box is the result.

As will be noted from an examination of the accompanying photograph, the bottom of the box is completely enclosed, so that it is impossible for dirt or gravel to force up from beneath and obstruct the service cock. A support is provided upon which the valve rests in such a manner that it is maintained in its position.

The extension type shaft provides for the adjustment to different depths as needed, and as all frost upheaval tends to raise the lateral or bottom of the ordinary curb box, the extension provision will allow for this action and leave the service line undisturbed.

Style 1 is provided with a telescoping valve rod which adjusts itself to correspond to the adjusted length of the box. It fits any style valve. This valve rod eliminates



STYLE I, "PERFECT" CURB BOX.
Showing adjustment allowed in length.

the long, solid wrench and renders removal of the outside cover unnecessary. Style 2 is exactly the same as style 1, except for the valve rod. A special inside cover is furnished for style 2 that is locked in position or removed by a quarter turn of the key, the same key being used for both covers. When the inside cover is removed the wrench may be lowered to the valve. A division plate is placed immediately above the valve, so that if the wrench should drop it will not strike the valve. The plate is provided with an opening corresponding to the opening of the inside cover and to the shape of the head of the wrench. Style 2 curb box can be changed to style 1 by inserting the telescoping rod. The double top is of advantage in case the upper cover becomes broken, as it frequently does; as in that event the lower cover still remains to protect the box and exclude all dirt and debris. This double cap, the practically double-side casings and the enclosed bottom make the box a good protection against freezing.

The prices of the "Perfect" curb box are somewhat higher than the ordinary box, but the difference is not sufficiently great to cut any figure as against added convenience and elimination of possible consequental damage.

Road Exhibit at the Chicago Cement Show.

The Universal Portland Cement Company, of Chicago and Pittsburgh, devoted the larger part of its exhibition space at the Fifth Annual Chicago Cement Show to a display demonstrating the use of concrete as a paving material.

The engineer found the exhibit both educational and interesting. The types of pavement that were shown brought out the idea that permanency in pavement is essential to satisfactory country road construction, just as it is to city street building. In the first of the five booths a two-coat concrete pavement was shown. This was composed of a wearing surface of 1 part cement, 1½ parts of a mixture of 3 parts ¼-in. to ½-in. granito and 2 parts granite screenings. The base consisted of 1 part cement, 3 parts torpedo sand and 5 parts limestone. The expansion joints were protected by Baker steel plates.

In the second booth a brick wearing surface was laid after the recommendation of the National Paving Brick Manufacturers Association upon a standard concrete base, such as should be used under all permananet pavements. The base was composed of 1 part cement, 3 parts torpedo sand and 6 parts limestone.

In the third booth a concrete pavement with a wearing surface of bitumen and sand, such as is used at Ann Arbor, Mich., was laid upon a base composed of 1 part cement, 2 parts torpedo sand and 4 parts screened gravel.

The fourth booth was a representation of a type of pavement that covers thirty-three miles of road in Wayne county (Detroit), Michigan. This single-coat concrete pavement is composed of 1 part cement, 1½ parts torpedo sand and 3 parts screened gravel. The expansion joints were placed twenty-five feet apart and protected by Baker steel plates. This exhibit proved especially attractive to engineers and highway commissioners generally. The Wayne county pavements have excited country-wide interest among good roads men.

The fifth booth showed a pavement with a wearing surface of 1 part cement, 1½ parts of a mixture of 3 parts ¼-in. to ½-in. gravel and 2 parts torpedo sand. The base consisted of 1 part cement, 3 parts torpedo sand and 5 parts gravel. The expansion joints in this case were protected by 2x2½x3-16-in. angle iron. The reinforcing material used was No. 7 triangle mesh.

Concrete pavements with concrete wearing surfaces may be laid at a cost of from $1.00 to $1.50 per yard varying with local conditions, and upon the concrete base shown various wearing surfaces may be laid which will make the road structure permanent, but which will increase the cost of construction.

Steel Dump Cars in Street Excavation Work.

An example is shown in the accompanying illustration of the efficiency of steel dump cars for the economical handling of earth and material for filling. The photograph was taken in New Castle, a town in Western Pennsylvania, where a number of steep hills provide difficulties in street construction.

In making a street extension in New Castle, recently, 35,000 yards of earth had to be hauled a distance of 3500 feet to make a fill 40 ft. in depth, 50 feet wide at the top, and 150 feet at the bottom. Running across the bottom of the fill was a five foot concrete sewer 150 feet in length.

The big problem was the transportation of the material to make the fill, but the contractors, Wards and Golden Construction company of New Castle, solved it quickly, efficiently and economically, using a complete portable railway, consisting of 3500 ft. of 24 gauge portable track with switches, and 15 Koppel "V" shaped steel dump cars, each of 36 cu. ft. capacity. These were hauled by horses.

And the haul of the loaded cars was practically all down hill, the greater part of a 3 per cent. grade, but for a short distance a 10 per cent. grade was encountered. Down the 3 per cent. grade the cars were held in check with a pole used as a brake, with a heavyweight block on the end, and on the 10 per cent. grade, a hoist was used to raise and lower the cars.

The portable railway and cars were built by the Oronstein-Arthur Koppel company in their works at Koppel, Pa.

All material was hauled by these Koppel cars, and the work done at a cost of from 24 to 30 cents per cubic yard. This included every item of expense. This is remarkably low, and especially so when the distance of the haul is considered and the difficult grades encountered.

STREET EXCAVATION IN NEWCASTLE, PA.

Some Novel Features in Fireproof Construction.

BY W. H. RADCLIFFE.

The Vanderbilt Hotel, at Park avenue, Thirty-third and Thirty-fourth streets, New York City, shown in the accompanying photograph, is the last word in fireproof hotel construction.

If a fire should start in any part of this building it would simply consume the inflammable contents confined at the point of the fire's origin. Owing to the fireproof, hollow-drawn-steel and asbestos-filled construction of the doors and all interior trimming, coupled with the stone and metal construction of the elevator shafts, doors and stairways, a fire could not spread, because it could not eat its way from room to room, or from floor to floor. That this is an actual fact and not a theory was demonstrated by a fire that started in the corridor on the third floor three days after the official opening, and which was controlled with ease.

Each guest chamber, or suite, is virtually a building in itself, and although a fire may start in a dozen of them at the same time and on various floors, the safety of the hotel is not affected.

The insulation of the garbage room and of the servants' dining room presented an unusually difficult problem. It had to be of the highest efficiency, not so much on account of preventing fire, as to prevent the heat from the boilers spreading and raising the temperature in the room above.

Unlike most hotels, the servants' quarters, instead of being on the top floor, are on the third floor. This innovation was partly due to the top floor being considered the most desirable in the building on account of the extensive view afforded to the north, south and east. The Vanderbilt apartments, comprising nine rooms, are located on the top floor. The servants' quarters being on the third floor allow this floor to be used as a distribution center for the electric cables running up through the building and all piping of mechanical equipment. Thorough fireproof and soundproof insulation in the form of J-M asbestos plaster is used in the walls of the servants' rooms.

Guided by the report of the United States Geological Survey that 60 per cent. of the fire danger to buildings comes from exterior fires, unusual care was taken by the architects to insure an absolutely fireproof roofing for the hotel. The entire top of the building was therefore covered with J-M asbestos roofing. Over this a layer of vitrified tile was laid. A pent house on the roof is also covered with the same roofing.

Fireproof construction has been carefully followed in the foyer and halls, which are built largely of marble and Caen stone. The lighting has been especially well handled in the foyer, where J-M linolite electric lamps, screened with attractive reflectors, give a soft, pleasing effect, and amber frosted lamp bulbs in brackets and cut-glass chandeliers add to the attractiveness.

THE NEW FIRE-PROOF VANDERBILT HOTEL, NEW YORK CITY.

With the exception of the pictures, the marble and some of the bronzes, which were imported, the Vanderbilt Hotel represents throughout the work of local manufacturers, architects and builders. So far as the J-M fireproof materials described in this article are concerned, the H. W. Johns-Manville Company, New York, was the manufacturer. The Ajev Company was the general contractor, and Warren & Wetmore were the architects.

The Casey-Hedges Ornamental Standards for Street Lighting.

Ornamental lighting, by reason of the many different street plans, the variations in height and kind of buildings, the width of roadway and its relation to sidewalk and parking area, lends itself to a display of taste and originality in the choice of lighting standards. With a view to supplying designs to suit the different conditions, the Casey-Hedges Co., Chattanooga, Tenn., have a great number of patterns, some of which are particularly deserving of mention.

The "Colonial" standard is characterized by its broad, generous lines, extreme simplicity and dignity. It consists of a square base and column but slightly more ornate ports on its capital another short column section which supports the center globe erect and four pendant globes upon cross-arms of consistently plain design.

The "Doric" standard, is similar as to base and column but slightly more ornate as regards the cross-arms, the four erect side globes and the urn which supports the center globe at a well proportioned distance above the others. The length of the cross-arms gives a distance between the side lamps which is six inches greater than in the ordinary type of standard. Its weight is approximately 1300 pounds.

There are eight designs shown in the circulars issued by the company, and they are of such character as to allow of a wide range of choice in selection.

A Mineral Waterproofing.

Ironite, a product manufactured by the Ironite company, 716 Oxford Bld'g., Chicago, Ill., is a metallic waterproofing for all sorts of cement products, brick, stone and other porous substances. The material is in the form of an exceedingly fine metallic powder being strictly a mineral substance and having no oil, paraffine, asphalt or other similar substances in it.

In applying it, Ironite may be mixed with water to about the consistency of ordinary whitewash, and spread upon the desired surface with a brush, or similiar method. The water will carry the particles into any cavity that moisture will penetrate. Its value as a water-proofing is due to the fact that when thus introduced into the voids of concrete, brick work, etc., the particles oxidize, expand and form both a mechanical and a chemical union with the concrete, and become an inseparable part and parcel of same. It cannot be removed except with strong mechanical force, as "hammer and chisel;" and then only by taking a part of the concrete with it. Ironite can be applied either to a wet or a dry surface, and to a structure in course of erection, or to one many years old. It may be applied either to the inside or the outside of a structure, and against waterpressure.

Ironite is shipped in metal cans containing 8, 25, 50 and 100 pounds, respectively. It may be purchased by the consumer, and used according to the instructions, or if preferred, the work may be done by one of the contracting companies. In the latter case, if desired, the work will be guaranteed.

Recent Tests of Jointite.

Thomas B. Stillman, chemical engineer, connected with the Stevens Institute of Technology, Hoboken, N. J., and Edwin J. Fort have recently completed tests of the properties of "Jointite," a pipe jointing compound manufactured by the Marbleloid Co., 1328 Broadway, New York, N. Y. Mr. Stillman's report was, briefly, as follows:

This compound has great adhesiveness and pliability at normal temperatures and does not lose these properties after being frozen (10 degrees F.), and then thawed thirty times. It is somewhat brittle at 20 degrees F., but this is not a temperature existing in your working conditions. It is water-proof and it retains its elasticity underground.

It is a non-conductor of electricity and should be a protection against electrolysis.

Mr. Fort's tests, made upon 6-inch and 12-inch pipe under hydrostatic pressure, showed no leakage under twenty-five pounds for ten minutes; a slight percolation on one 6-inch section under thirty-five pounds for ten minutes, and a slight one in only two out of sixteen sections under forty-five pounds. The highest pressure obtained without leakage was ninety pounds, while only thirty-three pounds was required.

The Anti-Rust Paint.

Rust has always been the chief argument propounded against steel structures. To combat this rust or oxidation of the steel, structural shapes are painted in the fabricating shops before being sent to the work, then again immediately upon erection, and this is followed in the case the metal is exposed to the elements by repeated painting at very short intervals.

A practical rust preventing paint has been in use for a number of years and has met with favor on this class of work. This paint, Gardiner's anti-rust paint, has been used by the United States Government for the last twenty years on all its battleships.

Briefly, the important points of Gardiner's anti-rust are as follows:

It contains no linseed oil.

Linseed oil paint dries by oxidation, consequently it is impossible to shut out the oxygen from the steel by its use.

Gardiner's anti-rust is made from a base that is a natural insulator. It thus affords protection from electrolysis.

A special feature is that it is unaffected by acids or alkali, consequently in cement or concrete construction a coating of paint applied to the steel imbedded therein will fully protect it against these destructive agencies.

Robert W. Hunt & Co., engineers, of New York City, comment upon a series of tests which they made relative to Gardiner's anti-rust paint:

We hereby certify that in the light of a series of tests to which specimens of paint made by the Gardiner Paint Company of New York City have just been exhaustively subjected, we find said samples to be proof against rust or corrosion, although each specimen was rigidly submitted to the action respectively of sulphur dioxide, carbonic acid, sulphuretted hydrogen and moist air. Further, we are also prepared to certify to the efficiency of the same paint in its resistance to electrical assault, and this conviction is born of another set of tests for electrical resistance, sufficient of which are now so far completed as to justify our belief that an unusual measure of insulation attributes are contained in the paint mixture in question.

The paint is manufactured by the Gardiner Paint Co., 15 William street, New York City, and is sold throughout the west by Mansfield A. Pakas Co., Minneapolis, Minn.

The Russell Sewage Disposal System.

The Russell Sewage Disposal Company, which was located in Burlington, Iowa, for a number of years, has removed to 607 Marquette building, Chicago, Ill. The company manufactures a number of types of plants for the disposal of sewage from cities and towns, and from public buildings, school buildings and residences.

The disposal of sewage for cities, towns, school houses, summer cottages and country homes where there is no sewer, has been a problem for a number of years. C. W. Russell has discovered, and received patents and copyrights on a system that will dispose of 99 per cent. of the sewage, and discharge harmless water without odor. The Russell system, all parts, is made of the same material that sewer pipe is made of, hard burned glazed clay. It is entirely underground and may be placed in the front yard, or in the cellar. There is no opening to the top of the ground. It liquefies the sewage and discharges a very small amount of clear water which will seep away by laying about 5 feet of 4-inch open joint farm tile.

The first of the Russell sewage disposal systems were installed in 1905. These are still in use and more have been installed in the same towns and cities. A diagram of the system and an estimate of the cost of installation in any individual case will be sent upon application to the Russell Sewage Disposal Company.

Trade Publications.

The Blaw Steel Centering Company, Westinghouse Building, Pittsburg, Pa., offers prizes for the best plans and specifications for small concrete residences of $100, $75, $50 and $25 respectively, the designs for which must be in their hands by May the 15th, 1912.

The Koehring Machine Co., Milwaukee, Wis., have a monthly publication, "The Mixer," devoted to concrete and other mixers. Among those described in the current issue are the Koehring hot mixer, for road paving materials, and some of their standard mixers.

A suitable specification for stucco has been a much-mooted subject and when the metal lath manufacturers of the United States associated themselves for the purpose of working out the problems of the metal lath industry, stucco construction was one of the first things taken up. After over six months of consulting with authorities and conferring with architects, contractors and manufacturers, a typical specification to offer to architects was finally decided upon and has been issued by the Associated Metal Lath Manufacturers, 812 Wick Building, Youngstown, O.

The National Concrete Co., 806 Traction Building, Indianapolis, Ind., have a booklet on the Luten truss, which, in addition to giving examples of its use, has some interesting and valuable data on the design of highway bridges.

Charles J. Williamson, 702 Tenth street, Washington, D. C., has issued a pamphlet covering reinforced concrete patents, their scope and the legal questions involved. Particular mention is made of the Turner "mushroom" patents.

The March issue of the monthly publication of the Universal Portland Cement Co., Chicago, which is devoted to their dealers' interests, contains some valuable advertising data for the retail dealer. The March Bulletin of this company contains an interesting description of factory made concrete curbing, and descriptions of concrete pavements, dwellings, factories and office buildings.

About fifteen attractive designs of ornamental lighting standards are shown in a booklet on "Street Lighting" by the Davenport Machine & Foundry Co., Davenport, Ia. The company manufactures structural iron work and municipal castings.

The Lehigh, the monthly publication of the Lehigh Portland Cement Co., Peoples Gas Building, Chicago, Ill., contains some matter of interest to the sales force, the dealers, the contractors and the engineers who use Lehigh. A description of the Galveston causeway is of particular interest to the engineer.

The Arnold-Creager Co., New London, C., have a catalog of brick machine molds, brick barrows, sewer pipe barrows and trucks, clay conveyors, dump cars, disintegrators and other brick and tile manufacturing machinery.

The Chain Belt Co., Milwaukee, Wis., have a monthly publication, known as "Chain Belt," devoted to concrete construction in general and mixers in particular. Among the matters treated in the February number are the Black Hawk concrete statue, a number of concrete buildings shown by photographs and a method of figuring the quantities of materials in a cubic yard of concrete

A cloth bound booklet has been issued by the Metropolitan Paving Brick Co., Canton, Ohio, for the convenience of contractors. It comprises a number of tables of weights, measures and in addition a number of pages conveniently ruled for the recording of abstracts of bids.

The National Bridge Co., Indianapolis, Ind. have issued an illustrated leaflet setting forth the decrees on the Luten patents.

The Kurtztown Foundry and Machine Co., 116 N. Broad St., Philadelphia, Pa., have a publication which will be issued occasionally in the interest of education along the lines of garbage disposal. The first issue of this publication, "Garbage," contains a general article on the proper disposal of refuse and a description of the collection of New York City's garbage. Irvin Bain is editor of the publication.

The 1912 catalogue of the "Port Huron Line," appears in the folder form and is very complete as to detail. All machine parts are illustrated and described and their very extensive line of road building machinery is noted in the last portion of the catalog. A copy may be obtained from the Port Huron Engine and Thresher Co., Port Huron, Mich.

The Wheeler Condenser and Engine Co., Carteret, N. J., have a handbook "Steam Tables for Condenser Work." Three tables are especially notable. No. 1 with vacuum referred to a 30-inch barometer as the independent variable, No. 2 with temperature as the independent variable, and No. 3 a table of properties of steam above atmospheric pressure, with gauge pressure as the independent variable. None of these tables have been published before and were calculated especially for this book. In the remainder of the hand book the subject of vacuum measurements and the correction of vacuum gauge and barometer readings is discussed at more or less length.

The February issue of the Universal Portland Cement Co., 72 W. Adams St. Chicago, Ill., contains among other articles a discussion of an unusual type of water storage reservoir, a concrete block chimney, concrete guard rails in New York state, and a number of examples of building construction.

Trade Notes.

ASPHALT.

The Shelby Downard Asphalt Co., owner of natural asphalt mines at Ardmore, Oklahoma, have contracted for a plant at Chanute, Kas., for the purpose of refining Oklahoma asphalts, the location being selected because of its geographical center to the territory of the company's activity. Paving cements will be manufactured there for the use of the company in its paving business, and for sale to paving contractors generally. The general offices of the company will remain at Ardmore, Okla.

CEMENT.

The Sandusky Portland Cement Co., Sandusky, O., has just received an order for 100,000 pounds of Medusa waterproofing for use in the New York Dock Company's job at Atlantic Basin, Brooklyn; 5,000 barrels Medusa wateproofed white Portland cement for use in the Woolworth Building, New York City; 25,000 barrels of Medusa gray cement for use in the Central High School building, Minneapolis, and 3,000 barrels of Medusa white Portland cement for use in the same building.

MACHINERY.

Hollywood, Cal.—Special: The Beesemyer Contracting Co., 201 Cugue Bldg., desire prices on one second-hand twenty-five-ton standard revolving steam shovel.

Oak Park, Ill.—Special: H. G. Goelitz, general contractor, 451 North boulevard, desires to purchase the following machinery, either new or second-hand: One portable asphalt plant on cars; tools and complete asphalt paving equipment; two-wheel, seven-ton roller; six dump wagons lined with asbestos and steel, and one street concrete mixer.

Evansville, Ind.: Bedford & Nugent desire to purchase an eight-ton second-hand road roller.

Alliance, O.—Special: C. A. Childers, 113 Twelfth street, desires to purchase a small size concrete mixer for sidewalk work, and also steel sidewalk forms.

East Brady, Pa.—Special: Peter Meyer, general contractor and acting city engineer, desires information with a view to purchasing a concrete tile machine.

Philadelphia, Pa.: Field, Baker & Underwood, Inc., 718 Arcade Bldg., will purchase reinforcing bars, buckets, contractors' supplies, ditching machinery, dump wagons, excavating machinery, hoisting machinery, hose, iron and steel pipe, shovels, wheelbarrows and water-proofing.

Brooklyn, N. Y.: M. V. Woods, 371 Fulton street, will purchase one one-third cubic yard dredge.

Glens Falls, N. Y.—Special: The Matchless Street Cleaner Company, of Glens Falls, N. Y., sole manufacturers of the Matchless sanitary horse sweeping machine and hand cleaning machine, has reorganized and the plant moved to Troy, N. Y. Albert E. Davis, for many years sales manager of the Covert Manufacturing Company, is the new president and L. A. Jones secretary and treasurer of the company.

New York, N. Y.: The city of Huddersfield, Yorkshire, England, has placed the order with the London representative of the Ruggles-Coles Engineering Co., 50 Church street, New York, for two of their Class A-10 dryers for drying sewage cake.

Wausau, Wis.: R. H. Brown, Unity, Wis., county commissioner, desires to purchase road rollers, graders and a complete stone churshing outfit.

MISCELLANEOUS.

Walter B. Snow, publicity engineer, 170 Summer street, Boston, has increased his organization by the addition of Mr. Charles L. Mulligan, late of the editorial staff of the Brooklyn Standard Union, and for a considerable period associated with the publicity department of the Western Electric Co.

Vicente Saucedo, Assoc. M. Am. Soc. C. E., has resigned as chief engineer of the Monterey Water Works and Sewer Co. and of the Monterey Railway, Light and Power Co., and has opened offices for the general practice of engineering in the Banco Mercantile Building, Monterey, N. L., Mexico.

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MAY, NINETEEN HUNDRED TWELVE

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

GRAVEL ROADS.

IT may be asked, "When shall a road be graveled or macadamized?" This is a difficult question to answer. The worth or value of an improvement may be measured in terms of decreased cost of hauling, increased land values, better social and educational advantages, etc. The increase in land values will probably make the improvement profitable, if the land is at all productive and the present road conditions are bad. In the Illinois Highway Commission report for 1907, A. N. Johnson, state highway engineer, has estimated this value by arbitrarily fixing a charge per mile per vehicle. Assuming this charge at one cent, which is certainly reasonable, and an average of 100 vehicles per day, it is shown that the road would be worth $313 per mile per year, excluding Sundays. Further assuming the cost of maintaining the road at $100 per mile per year, it is evident that even with less traffic than assumed the investment for such improvement would be profitable. Any person, by estimating what a trip is worth to him in cash, may determine this matter for himself, remembering, however, that only a portion of the value of a good road can be measured in dollars and cents.

Before taking up the methods of surfacing with gravel or broken stone, the writer wishes again to call the attention of supervisors to the advisability of investigating for relocation. A hard surfaced road wears excessively on steep grades, and it is desirable that these grades do not exceed 6 per cent. It is usually economical to avoid the hill rather than to reduce the grade by excavation. In any event, no metal should be placed on an old road without carefully considering this feature.

There is practically no difference between a well-built gravel and a macadam road, except as to the materials used. The proper methods of doing the work are identical. It is true that crude ways of placing the gravel are sometimes adopted, but such methods are not so inexpensive as they seem. A road surfaced with crushed gravel is a macadam road, and may, in fact, give better service than were local crushed stone used in the work. Gravel roads do not cost as much as macadam, because usually less care is exercised in selecting, preparing and placing the materials; and for this reason they are not so serviceable. The construction of any hard-surfaced road is the same and includes:

1. Laying out the work, grading, etc.
2. Selecting the materials.
3. Preparing the subgrade.
4. Placing and compacting the materials.

PRELIMINARY.

The work should always be laid out by an engineer; that is, levels should be run on the old roadbed, a suitable grade established, culverts of proper size located, etc. All excavation and grader work must be staked out as previously noted. Temporary culverts and bridges should be removed and replaced by structures of a permanent nature. It is not possible to state just what the cost of engineering and inspection should be, as this item varies with the size of the job and local conditions. It is essential, however, that the work be carefully planned, staked out and inspected. The supervisor may be, and often is, the inspector, in which case his time should be so charged.

SELECTING THE MATERIALS.

As a general thing, bank gravel is preferable to stream gravel, as it is likely to bind better. This is probably more noticeable when the material is to be used without crushing; and we will assume for this consideration that the gravel is not to be crushed. If the material in its natural state contains more than 40 per cent. of sand, and it probably will, it should be screened, and the sand applied separately in the proper amount as a binder. The gravel is placed on the road in two courses, the largest stone used in the first course being three inches. This foundation course need not be screened, but the large stones should be removed by forking. The wearing surface, or second course, consists of stones varying in size from ½ inch to 1½ inch, all sand having been removed, as stated above. That gravel which stands perpendicular in the bank is very satisfactory for this type of road.

PREPARING THE SUBGRADE.

Particular attention must be given the preparation of the subgrade before any material is placed. It is not good practice, neither is it economical, to place the gravel without forming earth shoulders for its retention. The road must be properly drained and sub-drains constructed where necessary. If the roadway is low, and it is thought desirable to raise the grade, the shoulders may be formed by bringing the earth in from the side ditches, using the grader for this purpose. Otherwise, the earth in the driveway may be excavated, leaving a sort of wide, flat trench to receive the stone, and using the excavated earth for shoulders to hold it in place. Stakes for this work are to be set as explained previously.

Inasmuch as it is necessary to have a firm and solid foundation for the gravel, it may be well not to disturb the old roadbed, except to bring it to the proper cross-section. The earth subgrade is given a crown of one-half inch per foot. In any case the earth must be made true to grade and the surface thoroughly rolled. All soft or spongy earth must be removed and replaced by good, firm material tamped into place. The width between shoulders will be determined to suit the conditions but should be not less than 8 feet for a single track, nor less than 14 feet for a double track road. No stone should be placed on the subgrade until it has been compacted. Filling depressions with stone is costly, and any thin place in the surface is a point of weakness. If the earth be dry, it should be sprinkled before rolling.

In rolling the subgrade, if the earth is seen to creep or crawl ahead of the roller, a layer of straw or light brush spread over the surface will often relieve the difficulty, or a sprinkling of sand may be found helpful. It might be necessary to spread some gravel over the earth which will roll into the subgrade and add stability. These points are mentioned to bring out the necessity of having a firm and compact subgrade. Before placing the gravel blind drains are built at intervals along the road, extending through the shoulders into the side ditch. These drains are 6 or 8 inches wide, and may be placed at all low points and every 100 or 150 feet in clay soils. They are made by digging a trench from the subgrade through the shoulder into the side ditch and filling with coarse gravel. This serves to keep the subgrade dry by removing any water that may collect in the subgrade during construction, or percolate through the gravel surface.

PLACING.

The gravel is placed on the road in two courses, ordinarily a little thicker in the center than at the sides. The thickness of metal required will vary with conditions; but certain it is that many hard-surfaced roads are too thick. There can be little need for a surface deeper than 8 inches at the center and 5 or 6 inches at the sides, which will be adequate for most severe conditions of traffic. Often, and perhaps in most cases, a total depth of 6 inches at the center and 4 inches at the sides will give good service. The following table shows the quantities of loose material required per mile for roadways of different widths and thicknesses:

GRAVEL AND MACADAM ROADS. LOOSE MATERIAL REQUIRED.

(Approximate.)

Width of Metal.	Thickness in Inches.				Cubic Yards Material Screened ½ in to 3 ins.		Binder ½ in. and under.
	Loose		Compact				
Feet.	Center	Side	Center	Side	Per lin. ft.	Per mile	Per mile.
8	10	10	8	8	0.25	1,320	330
9	10	10	8	8	0.28	1,480	370
15	10	7	8	5½	0.39	2,060	515
16	10	7	8	5½	0.42	2,220	555
8	8	8	6	6	0.20	1,060	265
9	8	8	6	6	0.22	1,160	290
15	8	5½	6	4	0.32	1,690	425
16	8	5½	6	4	0.34	1,800	450

The writer believes that quite often 8 feet of metal, with the remainder of the driveway made of sand clay, will give sufficiently good service. Unless there is a heavy traffic in both directions at the same time, the community might make its money go practically twice as far by building single, instead of double, track roads.

If the total thickness of gravel is to be 8 inches and 5½ inches, as shown in the table, each course will be 5 inches thick in the center and 3½ inches thick at the sides, loose measurement. The first or foundation course is spread, using rakes or potato hooks for the purpose. Small blocks of wood of the proper size may be placed on the subgrade to aid in securing the correct thickness and a proper distribution of material. The gravel so placed should be harrowed, reshaped, sprinkled and thoroughly rolled. If the sand has been removed from this course, it will be applied at this time in the proper amount as a binder, and the rolling continued until the gravel will take up no more sand.

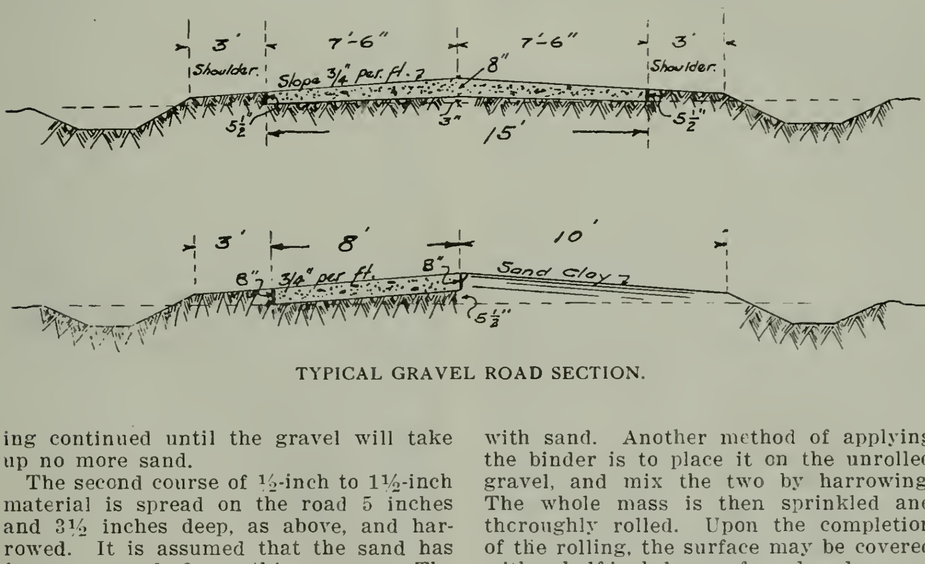
The second course of ½-inch to 1½-inch material is spread on the road 5 inches and 3½ inches deep, as above, and harrowed. It is assumed that the sand has been removed from this course. The gravel is then partially compacted by rolling and the binder of sand added.

At the time of the final rolling of the gravel the earth shoulders shall be compacted, and the entire surface left in a smooth and uniformly good condition. The completed surface shall have a slope from the center to the sides of approximately three-fourths inch per foot, as shown in the figure. A heavy macadam roller should not be used on gravel; a weight of five tons is sufficient. Useless attempts have been made to roll uncrushed gravel with a ten-ton roller. The lighter roller gives good results.

BINDER.

For the binder sand will ordinarily be used, as may also a mixture of sand and clay, in which case the amount of clay should not exceed 40 per cent. of the amount of sand used. It must be noted the binder is ineffective until water is added; and, if this water is not added during construction, the actual binding will be postponed until the required moisture is supplied by nature in the form of rain. The amount of binder required varies with the voids in the gravel, but will probably average 30 per cent. of the screened material. Spread the sand evenly over the surface by shoveling from the wagon, or from piles along the road. If dump wagons are used, it may be distributed in small piles on the gravel, and the spreading completed with rakes. The sand should be sprinkled and rolled into the gravel, the rolling to continue until no more binder will be taken up. If any depressions appear they should be filled with regular top-course stone, and not with sand. Another method of applying the binder is to place it on the unrolled gravel, and mix the two by harrowing. The whole mass is then sprinkled and thoroughly rolled. Upon the completion of the rolling, the surface may be covered with a half-inch layer of sand and opened to traffic.

Perhaps some road officials will consider the above method too costly. The cost of an improvement, however, is not determined by the first outlay alone, but by the life of the road, the expense of maintenance, etc. Certainly the more carefully the surface is constructed the better service it will give, the longer it will last and the less it will cost; not by the mile, but by the year. If it is necessary to avoid the expense of building the shoulders, screening, sprinkling and rolling the stone, it may be done with the understanding that a less permanent and



TYPICAL GRAVEL ROAD SECTION.

satisfactory road will result. Furthermore, by the time the road is made really serviceable it will have cost as much as, or more than, it would have if built as outlined above.

MAINTENANCE.

Conduct the general maintenance by means of the split log drag, removing such large stones as may appear on the surface. Piles of suitable surfacing material should be kept in a convenient location for use when the road begins to rut. By watching the roadway carefully, and making the repairs just before they are really needed, the road may be kept smooth and the result will be less expensive and more desirable. Before placing any repair gravel the old surface should be loosened so as to enable the materials to bond. When the road begins to ravel and go to pieces, a little sand sprinkled over the surface will usually result in improved conditions.

The Testing of Wood Paving Blocks.

By F. Kleeberg, Chief Chemist, Department of Public Works, Manhattan Borough, New York City.

WOOD block pavements where the conditions are suitable approach the ideal, since such pavements combine to a high degree durability, smoothness, noiselessness under traffic, resiliency, and, at the same time, are easily maintained, easily cleaned, and are therefore sanitary.

Of the above qualities, durability is the most important. That the blocks should be durable, demands, other things being equal, that they shall have been properly impregnated with a preserving material.

Without entering into the controversy whether the impregnating material should be a distilled creosote oil of light gfiravity, a coal tar product of heavy gravity, a water-gas tar product, or perchance, a paraffin residuum or an asphaltic oil, it appears to the writer there ought to be no question that any material which through volatilization or through lixiviation becomes dissipated is a material unsuitable to permanently preserve pavement blocks.

All authorities are agreed that the impregnating material shall have waterproofing qualities. It is also assumed that since in treating cross-ties, crossarms, poles and pilings, it is necessary that the material shall have antiseptic qualities, the same must be true in treating blocks intended for pavement purposes. There are, however, no figures available as to how active the antiseptic must be; that is, what its carbolic acid co-efficient shall be in order to inhibit parasitic growth. Fungi undoubtedly show greater resistance to antiseptics than bacteria. The latter, however, are of no interest as far as wood blocks are concerned, since as yet no wood destroying bacteria have been isolated, and, in fact, bacteria are unable to penetrate into solid wood and thus have little chance to act on it, until, owing to the attacks of fungi, it has reached the last stages of destruction. It is admitted that if timber be kept perfectly dry it will resist decay for an indefinite period. The term dry rot is a misnomer, for the fungus causing this decay, the Merulius lacrimans, occurs only in damp timber, and thrives in a damp atmosphere. Since decay is dependent upon moisture, and since in the process of manufacture the blocks are sterilized as a pdeliminary step, it is more important that the blocks should be made permanently aseptic rather than antiseptic; and an aseptic condition could be maintained if it were possible to make the blocks impervious to water. The writer has seen an abundant fungus growth, superficial it is true, on blocks treated with an oil derived from coal tar, and this has been observed both on blocks stored in the open and on blocks tightly enclosed in the hold of the vessel on which the blocks were shipped, where, if one would judge from the intense aromatic odor, the atmosphere was surcharged with antiseptics. If then a block previously sterilized could be made absolutely and permanently water-proof, without injuring the wood fibres, such a block would be the ideal pavement block, entirely independent of the nature of the water-proofing material, and consideration of the antiseptic qualities of the impregnating material would be of secondary importance. In lieu of complete water-proofing, a minimum water absorption requirements appears justified. This is particularly true because the strength of the timber is likewise maintained by preventing or minimizing the absorption of water. Most important, however, are the facts (1) that such a requirement eliminates expansion of the blocks with the concomitant swelling and buckling of the pavement, which when it occurs subjects it to abrasion at points, which under normal conditions would be protected, and (2) minimizes if it does not prevent the bleeding of the blocks.

The most important test, therefore, to which the blocks can be subjected after they have been delivered to the line of work, is the amount of water which they will absorb, and to George W. Tillson, Consulting Engineer, Bureau of Highways, Borough, of Brooklyn, New York City, is due the credit for having suggested incorporating this valuable test as part of the specifications.

Engineers are frequently at a loss as regards reliable information and unbiased data in connection with this test, and as regards the qualities which properly-treated wood blocks shall possess. Many erroneous statements are repeatedly made relative to the influence of the temperature at which the blocks are maintained during the preliminary heating to which they are subjected in this test; relative to the rapidity with which deterioration takes place; relative to the influence of the sun's rays and to weather conditions In general; also, in regard to the method of collecting the samples, whether these be taken from the interior or exterior of a pile; whether blocks, which have a specific gravity greater than one or less than one, are to be preferred, etc.; and data concerning these points are presented in the subjoined tables. It has also erroneously been claimed that the amount of water absorbed depends simply upon the condition of the original wood before treatment, whether this was green or dry. The writer has at present under observation several courses of blocks laid on one of the main thoroughfares. Half of these blocks were semi-green before treatment; the others, dry. Both series contained approximately twenty pounds of oil per cubic foot. The semi-green blocks, after treatment, averaged ten pounds more in weight per cubic foot than the dry blocks, yet both series absorbed approximately 3 per cent. of water, proving that the condition of the wood in the untreated blocks is not the factor controlling the absorption of water.

The Borough of Manhattan, of the city of New York, is practically the only city whose specifications require that a water absorption test be made on the blocks after they have been delivered to the line of work. The objection to this procedure is a delay of forty-eight hours, the time for making the test. The benefit derived, however, far outweighs this objection.

Wood blocks of the modern type, consisting of treated long-leaf yellow pine, were first laid in the Borough of Manhattan in the year 1904. The specific requirements, as regards the treated blocks, demanded that these should show such waterproofing qualities that, after being dried in an open oven at a temperature of 120 degrees F. for a period of forty-eight hours, weighed, and then immersed in water for a period of forty-eight hours and reweighed, the gain in weight should not be greater than 3 per cent. In 1906 the specifications were revised, and the clause relating to the testing of the treated blocks stated that the blocks should be dried in an open oven at a temperature of 120 degrees F. for a period of twenty-four hours, weighed and then immersed in water for a period of twenty-four hours, the gain in weight not to be greater than 3 per cent. In 1907 the amount of water which the blocks were allowed to absorb was increased to 3½ per cent., but the temperature, time of preliminary heating and time of immersion remained the same. In 1908 the amount of water which black gum blocks were allowed to absorb was 4½ per cent., the requirement for long-leaf yellow pine remaining at 3½ per cent.; and no change being made as regards time, heating and immersion. Since 1908 no further change has been made.

The specifications of the majority of cities have no water-absorption requirement whatever. A number of cities have such a requirement; but it is customary for these to have the test made after treatment at the plant, or within forty-eight hours. To test blocks immediately or soon after they have been removed from the cylinders, when they are reeking with oil and covered with a superficial protecting film, is of no value whatever, as it gives erroneous results. It is during the first few weeks of the life of a block that the greatest deterioration occurs as regards water absorption. After this the deterioration curve shows only a very gradual rise. Blocks made under the observation of and tested by the writer at the plant of the manufacturer showed 100 per cent. increase in water absorption when the same shipment was retested a few weeks later, on the line of work. Shipments of blocks have repeatedly been rejected on account of high water absorption which showed low water absorption, according to the inspector's test at the plant.

The specifications of the Borough of Manhattan require that the timber from which the blocks are cut shall be inspected by an inspector, appointed by the borough president. Moreover, it is the duty of this inspector to collect samples of oil which it is intended to use in impregnating blocks, which samples are sent to New York for analysis; and treatment is not begun until the quality of the oil has been passed upon by the laboratory of this borough. The specifications require that the oil should be a stable, antiseptic, waterproofing oil of a definite specific gravity, both as regards the oil itself and the fraction boiling between 255 and 315 degrees C.; and a typical analysis of the oil used in impregnating Manhattan Borough blocks is as follows:

Distillate.	Per Cent.	Consistency.
To 220°C.	3.1	Solid
220°—255°C.	15.8	Solid
255°—285°C.	9.5	Fluid
285°—315°C.	5.6	Semi-Fluid
315°—345°C.	8.4	Solid
345°—370°C.	8.9	Solid
Residue	48.7	
Total to 315°C.	34.0	
Specific gravity of 225°—315°C., fraction at 60° F.	1.041	
Specific gravity, original oil, at 38°C.	1.135	

The specifications require, further, that long-leaf yellow pine blocks shall contain not less than twenty pounds of oil, and that black gum blocks shall contain not less than twenty-two pounds after treatment.

It is a question whether anything is gained by requiring a twenty-pound treatment. Many blocks have been tested by the writer which did not contain more than fourteen to sixteen pounds of oil, and yet had a high degree of resistance to the absorption of water. A single block from Paris, presumably a typical block, was also tested, in which the amount of oil injected was exceedingly small; yet this block absorbed only 2.1 per cent. of water and weighed 57.3 pounds per cubic foot.

If the manufacturer can make his blocks waterproof, or nearly so, by using less than twenty pounds of oil, he should certainly be permitted to do so. Several years ago the manufacturers, in order to meet the water-absorption test, were obliged to inject twenty-five or more pounds of oil. Since that time improved methods in the treatment have resulted in reducing the amount of oil injected without decreasing the resistance to water absorption.

The following tests and experiments were made on blocks delivered to the line of work on regular contracts; and in no case were these blocks specially treated or selected. The timber, however, had been carefully inspected at the plant, as indicated above; and the oil was of a proper quality. The method of making the water-absorption test adopted by the laboratory of the Borough of Manhattan is to heat the blocks in a ventilated incubator, equipped with a maximum and minimum thermometer, to a temperature of 100 degrees F. for twenty-four hours. The blocks are then allowed to cool and are weighed, then immersed in water of a temperature of 70 degrees to 80 degrees F. for twenty-four hours, removed, allowed to drain for a few moments, dried between blotting papers to remove superficial water, and reweighed at once. The question has repeatedly arisen as to the number of blocks which ought to be tested in accepting or rejecting a shipment. It is obviously impracticable to test each individual block, although several years ago in Brooklyn the entire shipment was immersed in water with satisfactory results, those blocks which sunk being accepted; those which floated, rejected. We know, however that the fact, that the block has a specific gravity greater than one, is no assurance that such a block has a high-grade resistance to the absorption of water; or, conversely, that blocks which float absorb water readily; any more than that the weight of the block is necessarily an indication of the amount of oil it contains. We have tested shipments which practically all floated, which, nevertheless, contained the required twenty pounds of oil, and met our water-absorption requirement. In the hundreds of shipments of blocks tested, such shipments consisting of from 1,000 to 12,000 square yards, it has been the writer's experience that twelve blocks collected from the line of work, after the blocks have been piled along the street, will give an accurate indication of the quality of the entire shipment. Of course, the same care, judgment and fairness must be exercised in collecting these twelve blocks as would be exercised in taking a sample of coal from several carloads, a sample of sand from a barge or a sample of cement from a bin. A municipality can well afford to accept a shipment on a single test of one dozen blocks properly collected; and, if the contractor knows that his shipment will be tested in this manner, he will exercise the necessary care to have his shipment treated uniformly, which is entirely practicable.

The question will arise whether shipments ought to be accepted, providing the average of the test meets the water-absorption requirement, or whether each individual block must meet this requirement; or, again, would it be satisfactory if from seventy-five to eighty-five blocks passed the test? It may not be strictly true that a wood block pavement is no more durable than the weakest block forming part of it; but the analogy to a chain is close enough to condemn any system of averaging. The block which absorbs much water is the block which expands; and this not only forces itself, but its properly treated neighbor, out of position. Therefore, such blocks should be rigidly excluded. It will occur that some blocks in a cylinder escape their full share of treatment; but this percentage, with care, need be but very small, so that it is no hardship on the manufacturer to insist that practically all the blocks must pass the required water-absorption test.

Engineers are wont to place reliance on the degree of penetration as determined by the so-called hatchet test, that is, by simply splitting the blocks and observing the degree or depth of penetration. While this test is of some value, it is a fact that frequently the block which shows the best penetration, as witness, a block containing any considerable amount of sap wood, gives the highest water-absorption test. Such a block requires more oil than its close-grained or pitchy neighbor, and should not have been treated at the same time or under the same conditions. This is a matter which must be looked after and corrected at the plant by proper inspection.

In the subjoined tables, Table No. 1 shows with what uniformity blocks of proper quality meet the water-absorption requirement.

Table No. 2 shows how even prolonged preliminary exposure to heat caused but slight deterioration in blocks of good quality.

Table No. 3 shows that blocks of proper quality can be exposed to summer or winter weather conditions without serious deterioration.

Table No. 4 shows the influence of dipping blocks in oil which did not meet the requirements. If these blocks had been cooled reasonably in oil during the process of manufacture, this would have been equivalent to dipping.

In testing wood blocks and the oil used for impregnation, it may be of interest to the manufacturer and to the chemist to know the properties and nature of the oil used; but to the municipality the only questions of importance are, whether the blocks are durable, whether they will resist decay and show a minimum tendency to bleed and to expand; and these points are answered by the water-absorption test, when carried out at the proper time. Requirements as regards specific gravity, solubility, coke residue, fractionating tests, etc., are of relatively small importance.

The question to be considered is, whether it will be possible to obtain as good a grade of long-leaf yellow pine at a reasonable cost in the future as in the past. If this is the case, and timber with a minimum proportion of sap wood can be procured, then a rigid water-absorption test, rigidly enforced, will give positive assurance of obtaining the best blocks for pavement purposes; and whether or not such blocks are obtained will depend entirely upon the municipalities, and not upon the manufacturers.

TABLE NO. 1.

Showing the Uniformity With Which Blocks of Proper Quality Meet the Water-Absorption Requirements. The Shipment Consisted of 3,000 Square Yards. Samples From Each 300 Square Yards Tested.

Variety of wood, long-leaf yellow pine; dimensions, approximately 4x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Thirty-five per cent. of these blocks have a specific gravity of less than one.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test. Per Cent Gain in Weight.
K-7801	63.1	3.2
K-7802	70.1	1.3
K-7803	64.5	1.6
K-7804	64.2	1.4
K-7807	60.5	1.4
K-7808	63.1	0.7
K-7809	64.8	1.4
K-7810	60.3	2.1
K-7842	62.9	2.0
K-7843	68.9	1.8
K-7844	70.8	1.6
K-7845	61.0	1.6
K-7846	63.1	1.2
K-7847	63.8	2.2
K-7848	62.7	2.6
K-7849	61.1	1.9
K-7888	63.6	1.0
K-7889	66.5	0.9
K-7890	51.8	2.6
K-7891	63.5	0.8
K-7892	59.2	1.4
K-7893	68.9	3.2
K-7894	62.1	1.6
K-7895	64.8	1.2
K-7896	65.1	1.6
K-7897	63.4	1.2
K-7898	65.6	1.1
K-7899	61.2	1.8
K-7900	56.2	3.2
K-7901	63.0	1.7
K-7902	64.0	2.1
K-7903	61.3	1.7
K-7904	65.4	2.1
K-7905	60.7	1.9
K-7908	63.9	1.0
K-7909	65.0	1.1
K-7910	61.6	0.9

TABLE NO. 2.

Influence of Prolonged Preliminary Exposure to Heating.

Variety of wood, long-leaf yellow pine; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Blocks maintained at 100 degrees F. for seven days before immersion.

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
66.9	5.8	2.3
64.2	4.9	1.6
61.1	3.5	1.6
70.7	2.6	1.3
63.6	5.5	1.4
57.3	5.4	5.8

Blocks maintained at 140 to 185 deg. F. for seven days before immersion. During this period the temperature fell below 150 degrees F. and rose above 160 degrees F. for only a comparatively short period. A number of these blocks were quite badly warped and checked after this exposure.

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
73.5	5.8	1.3
59.2	9.2	1.9
57.8	12.2	2.5
64.2	10.8	2.4
68.3	5.8	2.8
62.2	9.7	2.2

Blocks from this same shipment, tested under the usual twenty-four-hour preliminary heating, gave the following results:

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
65.7	0.9	1.0
68.1	1.5	3.3
67.1	0.5	0.9
69.4	0.9	1.7
66.6	1.0	1.9
63.6	0.8	1.1

Blocks first maintained at 100 degrees F. for twenty-four hours and tested; allowed to dry at room temperature for three days, then maintained at 150 degrees to 160 degrees F. for seven days and retested.

Weight per Cubic Foot lbs.	24 Hours at 100°F. Water Absorption Test, Gain in Weight, Per cent.	7 Days at 150°—160°F. Loss in Weight during this period, Per cent.	7 Days at 150°—160°F. Water Absorption Test, Gain in Weight, Per cent.
67.3	2.1	8.9	2.4
63.5	3.4	14.7	3.9
69.5	1.9	12.8	3.2
63.2	2.6	11.5	2.7

TABLE NO. 3.

Influence of Prolonged Exposure to Winter and Summer Weather Conditions.

The blocks were exposed first from November to April, in such a manner that the sun, rain and snow had free play around each individual block. They were then subjected to the usual test. The same blocks were then exposed from May to November, as before, so that the sun and rain could strike each individual block. The blocks were occasionally turned to expose different surfaces. Variety of wood, long-leaf yellow pine: dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight.

Blocks exposed to the elements from November to April.

Laboratory Test No.	Weight Per Cubic Foot. Pounds	Water Absorption Test. Gain in Weight, Per Cent.
K-1292	61.3	1.3
K-1293	57.0	1.7
K-1294	63.5	3.8
K-1295	64.6	1.4
K-1296	71.4	0.9
K-1297	69.4	0.9

Blocks exposed to the elements from May to October.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test. Gain in Weight, Per Cent.
K-1292	60.9	1.7
K-1293	56.8	2.3
K-1294	62.7	4.8
K-1295	64.3	1.5
K-1296	70.6	1.0
K-1297	68.5	1.0

TABLE NO. 4.

Influence of Dipping Previously Treated Blocks in Oil. First Series.

Laboratory Test No.	Weight per Cubic Foot. Pounds.	Water Absorption Test—Gain in Weight, per cent. Original Blocks	Water Absorption Test—Gain in Weight, per cent. After dip'ng & exposure
K-9792	54.2	3.9	2.3
K-9793	69.7	4.6	2.7
K-9794	70.4	3.7	2.6
K-9795	65.6	4.4	2.7
K-9796	62.7	6.2	3.9
K-9797	67.3	4.2	1.9
K-9799	55.6	4.6	2.4
K-9800	72.4	3.4	2.2
K-9801	65.8	6.0	3.7
K-9803	65.8	4.3	2.0
K-9805	70.6	5.2	3.7
K-9809	51.5	4.4	1.8

Variety of wood, long-leaf yellow pine; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Blocks which gave an average water absorption of 4.6 per cent. were dipped in heavy oil, then exposed for six weeks to the elements and retested under usual conditions.

Second Series.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test—Gain in wt Per Cent.
K-4377	62.1	1.2
K-4378	69.7	4.0
K-4379	62.5	2.4
K-4380	66.2	1.2
K-4381	64.8	2.1
K-4382	67.0	1.1
K-4383	71.0	1.7
K-4384	71.9	2.2
K-4385	68.2	1.7
K-4386	75.2	1.3
K-4387	63.2	2.3
K-4388	72.2	2.1

Variety of wood, black gum; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculting cubic-foot weight. These series, before being dipped, averaged 3.9 per cent. water absorption; after dipping the blocks were heated for twenty-four hours to 100 degrees F., then exposed for seven days to the direct rays of the sun, in an exceptionally hot summer spell, during which several short but severe rain storms occurred. The blocks were then placed in an incubator at 100 degrees for twenty-four hours, and tested as usual.

The Monroe Street Bridge, Spokane, Wash.

THE Monroe street bridge, Spokane, Wash., which is shown in the photograph here reproduced, is remarkable for a number of features. It has one of the largest monolithic concrete arches in the world; it was constructed in record time by the city and under the day labor system, and it possesses a beauty of design seldom found in the larger bridges.

In 1907 the plans for the proposed bridge were prepared by Charles McIntyre, who was then city engineer, but construction was started under direction of City Engineer J. C. Ralston. The structure which this bridge replaced was a steel bridge, which became so weakened under traffic that it was found necessary to remove the street railway tracks before the bridge was finally abandoned. All the plans and drawings were made in the city engineer's office, and great credit is due to that department for the choice and execution of the design.

All the preliminary work upon the bridge was done under direction of Mr. Ralston, but owing to the fact that other bridge work interfered, the actual construction was not begun until Morton Macartney became city engineer. Mr. Macartney had been first assistant under Mr. Ralston. Professor Wm. H. Burr, instructor in civil engineering at Columbia University, checked the plans before construction work started.

The main arch of the bridge is of monolithic concrete, 281 feet in length, and the over-all length is 784 feet. A wooden trestle approach, shown at the right of the photograph, will later be replaced by an earth fill. With the trestle approach, the entire length is 965 feet.

The clear height above the water is 130 feet; the width over all is 68 feet, carrying two 9-foot sidewalks and a 50-foot roadway. The sidewalks are supported on cantilevers capable of supporting a dead load of 500,000 pounds at the center of the arch. The floor system is of steel, incased in concrete. About 25,000 cubic yards of concrete were used in the job.

The main arch is of the turn-ribbed segmental style. The rise of the intrados is 113 feet 9 inches, and the width of the ribs at the crown 16 feet, flaring to 19 feet 9 inches at the haunches. The thickness at the crown is 6 feet 9 inches. The smaller arches are constructed of two segmental spans, 120 feet long, with four ribs, each 6 feet wide by 3 feet 3 inches thick at the crown, and are connected in pairs by a 6-inch soffit wall. The spandrel and north arches are semicircular, with spans 17 to 17 feet 6 inches, with spandrel columns 3 feet 6 inches thick.

The roadway is handsomely finished by a decorative railing and by archways which are placed over the sidewalk on both sides, at the two piers. These arched stations are attached to the walls of the stations on the sidewalk side, and on the roadway sides are modeled concrete buffalo skulls. Ornamental lighting standards are placed along the roadway on both sides, spaced 8 feet apart. These poles support white ball globes and tungsten lamps. The driveway is paved with wood blocks treated with carbolineum.

As was stated, the bridge was constructed under the day labor system. Owing to the fact that the cost of labor in all lines was greatly increased shortly after the start of the job, the estimate fell far short of the actual cost of the bridge. The labor cost alone was $220,723, the greater part of which was paid for carpenters upon the form work. When the different classes of labor raised their prices, the carpenters increased theirs from $3.50 to $5, so that some idea may be gained of the difference which was made between the estimate and the cost, due to the increased scale.

The preliminary construction was carried on by means of aerial tramways, and later a wooden trestle was constructed. The collapse of this trestle, and the consequent injury to a number of workmen, led to the planning and construction of a steel false work, by means of which the main arch was completed.

MONROE STREET BRIDGE, SPOKANE, WASH.

The cost of this steel trestle was about $40,000, but as it may be used in constructing future bridges, its price was not a total loss. A unique feature of the construction was the method adopted of separately completing each segment in the arches before putting them in place, which is a departure from the customary method of building the molds and then filling in the concrete.

The net cost of the bridge, after credits have been made for machinery and supplies on hand, is $487,000, and the gross cost was $535,000. The time of construction, excluding delays, was twenty-three months.

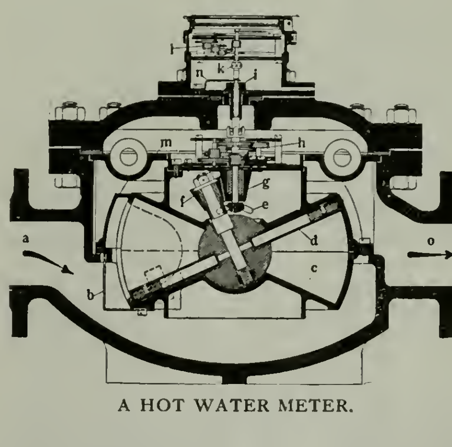
A Hot Water Meter.

By Dr. Robert Grimshaw, Dresden, Germany.

THE average water meter reminds me of the darkey's sermon, which he commenced by saying, "Dere am two ways, breddren; er broad en narrer way dat leads ter distraction en er narrer en broad way dat leads ter perdiction," to which the comment of one of his hearers was, "Ef dat's de case, dis nigger takes ter de woods!"

The particular reason why the average water meter reminds me of this sermon is that there are two principal kinds—one that, under higher pressure than ordinary, registers too much, and one that, at low pressure, shows too little; so that the only way to use them is to couple one of each kind tandem, weigh or measure the water after it reaches the meter, and not bother about the latter at all. Some stick open with grit, and some stick shut with soft dirt. The ones with hard rubber disks bulge out when they are used with warm water; the ones with brass pistons wear and leak when there is sand in the water. Altogether, one is "between the devil and the deep sea" in the matter. Of course, the difference of temperature of the water between summer and winter makes a difference in volume that is appreciable when it comes to exact work. Be this as it may, as a rule we rely on volume meters. They are a good deal better than guesswork.

One which is used in great quantities in Germany is that here illustrated, made by the Siemens & Halské Company, of Nonnendamm, near Berlin, and is used for hot water. A hollow metal disk, resting on a ball joint, is inclosed in a housing, the form of which corresponds to the peculiar oscillating movement of the disk. The latter moves about the spherical surfaces, and its periphery or outer edge describes a spherical curve corresponding to that of the housing, always dividing into two parts, an upper and a lower, the chamber which this housing incloses. The inlet and the outlet opening are beside each other, but separated from each other by the vertical partition wall tending towards the center of the disk chamber, and which fits in a slot in the brass disk, preventing the latter from turning about its vertical axis and hindering the water from passing through the meter without oscillating the disk. Passing through the disk chamber, the water has prescribed for it a definite path, by means of which it brings the disk into oscillation, and the result is that with each oscillation of the disk a quantity of water flows from the disk chamber, corresponding to its net volume. The



A HOT WATER METER.

result is in effect that of a piston pump in which one to-and-fro movement of the piston drives out an amount of fluid corresponding to the piston displacement.

Referring to the sectional view: The water enters at (a) and passes through a sieve (b) into the measuring chamber proper (c). The movement of the disk (d) is transmitted by the roller (f) and the dog (e) to the wheelwork (h). The measuring disk or oscillating piston is guided by the cones (g) and (f), so that there is always close contact between it and the walls of the chamber inclosing it. Each revolution of the dog (e) corresponds to the full oscillation of the disk. The water escapes by the opening (o).

The reason why temperature changes do not affect the readings is that all the interior parts of the meter are equally passed over by the water, so that there is no unequal expansion. The slow movement of the disk, of course, tends to keep down wear. The bearings and all other rubbing parts are of a special anti-friction graphite compound, so that oiling is unnecessary.

One peculiarity of this meter is that it is reversible, measuring equally accurately, whether the water flows in or out of the so-called inlet opening. It is recommended, however, to attach the meter under pressure, instead of under suction, unless the latter amounts to about 6 feet of water head. It will work up to 125 pounds pressure per square inch. The moving parts are ready of access. To clean it without disturbing the feed it should be furnished with a by-pass.

The manufacturers arrange the meter also for electric registry at a distance, in connection with a clockwork and paper drum.

Underground Electric Distribution.

By Wm. B. Ligon.

THE history and development of underground systems of distribution, while extending over a comparatively short period of time, is filled with interesting changes, not only in methods of construction, but also in materials entering into the work. No attempt, however, will be made here to cover the many points involved, and the object of this paper is to present a comparison between the two more important types of conduit on the market to-day, namely, tile and fiber conduit, respectively.

The first underground system of distribution was undertaken in 1886, and during the twenty-five years which have elapsed many changes and improvements have been made, and to-day subway systems have come into general favor because of the permanency of construction, assurance against interruption to the service and low maintenance and depreciation charges. Aside from these advantages, the streets and thoroughfares are improved by the removal of poles and wires, which detract greatly from the general appearance of city and country. The remedying of such conditions heretofore has been slow, and, in a measure, was due to the lack of sufficient cost data in the hands of telephone, telegraph, railroad and central station officials. The appreciation, therefore, of subway distribution to both community and company has been slowly recognized; and, as the advantages have become better understood, the agitation against aerial lines has turned into a co-operative movement whereby the benefits are well appreciated, resulting in the rapid adoption of the subway distribution of electrical currents wherever possible.

Like everything else in the electrical field, many improvements have been made in conduit materials, as well as in cables, to meet the more severe conditions of service resulting in changes in the types first employed. It may also be interesting to name the conduits first used, as follows:

1. The "Edison tube system," consisting of iron pipe about 18 feet in length, through which the cables were drawn and the tubes filled with an insulating compound.
2. "Troughing," constructed of planks nailed together, in which the cables were laid and protected by an insulating compound, in the same manner as in the Edison tube system.
3. "Cast iron multiple trough," which was simply a substitute for the wood troughing named above.
4. Wrought iron pipe inclosed in concrete.
5. "Pump log," made from soft wood, machined out to the proper dimensions and then creosoted.
6. Single and multiple duct tile, formed from clay in 18-inch and 36-inch lengths, respectively.
7. Fiber conduit, made from wood pulp, in 54-inch and 60-inch lengths, and indurated with a bituminous compound.

The introduction of high voltage circuits and their protection has had a marked influence in eliminating the older types of ducts. The disadvantages of the older types are numerous, and, aside from rendering little protection to the cables, were expensive in first cost and did not possess lasting qualities, thus increasing the depreciation and maintenance charges to an unreasonable degree. The latest and most important development in the art is the introduction of fiber conduit, which was brought about as a result of the exacting conditions of present practice and the necessity of absolute protection of circuits from the dangerous effects of electrolitic action.

Multiple and single duct tile has been in use for about twenty-five years, and is manufactured from vitrified clay in single duct, and multiples of two, three, four and six ducts, in either round or square bore. The ducts are laid end to end, with dowel pins to hold in alignment, and usually surrounded with an envelope of concrete about 3 inches in thickness, as protection and reinforcement to the entire structure. Joints are staggered and wrapped with either burlap or iron and cemented with mortar.

This material, if properly vitrified and glazed, will last indefinitely; when free from iron it possesses high insulating properties, and costs less per duct foot, f. o. b. factory, than any other conduit on the market to-day. It also possesses

Table Showing Cost to Construct Single Duct Tile Conduit in Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	6	8	12	16	20	25
Excavation, Refilling, Paving and Removing Surplus Earth	$ .259	$ .353	$ .494	$ .430	$ .536	$ .722	$ .788	$ .858	$ .996	$1.072
Concrete	.105	.145	.185	.192	.239	.287	.348	.412	.474	.540
Cost Tile Delivered	.054	.108	.162	.216	.324	.432	.648	.864	1.080	1.350
Laying Tile	.030	.060	.090	.120	.180	.240	.360	.480	.600	.750
Cleaning Ducts	.005	.010	.015	.020	.030	.040	.060	.080	.100	.125
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.062
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.062
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.037
Supervision, Inspection and Time-Keeping	.036	.053	.073	.076	.102	.134	.171	.210	.253	.299
Total per Trench Foot	.514	.756	1.049	1.088	1.463	1.920	2.453	3.008	3.633	4.297

Table Showing Costs of Constructing Multiple Duct Tile Conduit in Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	6	8	12	16	20	24
Excavating, Refilling, Paving and Disposal of Dirt	$ .230	$ .361	$ .546	$ .397	$ .559	$ .590	$ .637	$ .791	$ .867	$ .939
Concrete	.104	.131	.152	.160	.192	.243	.269	.333	.368	.384
Cost Tile Delivered	.053	.106	.159	.212	.318	.424	.636	.848	1.060	1.272
Laying Tile	.030	.040	.060	.080	.120	.160	.240	.320	.400	.480
Cleaning Ducts	.005	.010	.015	.020	.030	.040	.060	.080	.100	.120
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.060
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.060
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.036
Supervision, Inspection and Time-Keeping	.036	.052	.072	.072	.095	.114	.192	.247	.292	.339
Total per Trench Foot	.483	.727	1.034	.975	1.366	1.636	2.112	2.723	3.217	3.690

Table Showing Cost to Construct Fibre Pipe Conduit in Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	5	8	12	16	20	25
Excavation, Refilling, Paving and Removing Surplus Earth	$ .230	$ .343	$ .431	$ .381	$ .481	$ .601	$ .655	$ .716	$ .848	$ .919
Concrete	.090	.126	.163	.175	.224	.273	.344	.417	.490	.572
Cost Fibre Pipe Delivered	.051	.102	.153	.204	.306	.408	.612	.816	1.020	1.275
Laying Fibre Pipe	.010	.020	.030	.040	.060	.080	.120	.160	.200	.250
Proving Ducts	.003	.005	.007	.010	.015	.020	.030	.040	.050	.062
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.062
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.062
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.037
Supervision, Inspection and Time-Keeping	.031	.047	.061	.063	.085	.101	.138	.169	.205	.243
Total per Trench Foot	.440	.670	.875	.907	1.223	1.548	1.977	2.422	2.943	3.482

great mechanical strength and shows an average puncture test of 25,000 volts dry and 21,000 volts after immersion in water for 150 hours.

While the dielectric strength of tile is very high, the insulation of a system is greatly lowered in consequence of the large number of joints to be closed with cement or other moisture-absorbing material, and instead of the entire system testing out at 21,000 volts, it will be found, when taking the joints into consideration, an installation will rarely show a dielectric strength greater than 5,000 volts, depending, however, on the general characteristics of the earth surrounding the ducts. In making the joints in multiple duct tile, it is impossible to prevent communication between the ducts, and, due to this condition, multiple duct affords the lowest protection to the cables, and the action of electrolysis is more liable to occur than in single duct installations.

The weight of 3½-inch tile is approximately eight pounds per duct foot, and the heavy weight, therefore, increases the cost of freight, handling, carrying and laying, and in propositions involving the use of tile the question of breakage is also an important item of consideration, and may often amount to as much as one-tenth of the total shipment.

Due to offsets, seams and roughness at the joints, extreme care must be exercised in pulling through the cables, to prevent abrasion to the sheath, and if cables are not installed properly, short circuits and cable troubles will be encountered. Few manufacturers of vitrified clay recommend the use of tile bends in subway distribution, due to the roughness of the interior, and it therefore becomes necessary to replace with manholes or handholes. It has been demonstrated by experience that the cost of subway installation where tile is used for conveying the cables is considerably higher than the same installation with the newer type of material, due to the necessity of employing a higher class of labor, and the large percentage of duct which is furnished without true ends, and with seams, offsets, blowholes and improper glaze, and from these causes, as well as others mentioned above, the new class of material (fiber conduit) has rapidly come into general favor.

Fiber conduit is the most recent addition in materials for subway distribution systems that has been developed to meet the new conditions of service. It has been in use about eight years, and is formed in cylindrical shape from fiber or wood pulp under pressure. The wood pulp is thoroughly saturated with a bituminous compound, and any vegetable matter or bacteria which would tend to promote decay is killed by the presence of about 6 per cent. of creosote salts in solution. There are at the present time two types in general use, known as straight joint and bell and spigot joint conduit, made in four styles of joint to meet the general conditions of service, namely, socket (mortise and tenon) joint, sleeve joint, drive joint and screw joint, furnished in 1-inch, 1½-inch, 2-inch, $2\frac{1}{2}$-inch, 3-inch, $3\frac{1}{2}$-inch and 4-inch sizes. It has been shown that fiber conduit will stand an average puncture test of 32,000 volts dry and 24,000 volts after immersion in water for 200 hours.

In the introduction of this material on the market there were objections to be overcome, the most serious being as to the life compared with the older styles of conduit which had been tried out, and during the eight years of development this point has been one of greatest discussion and observation, resulting in numerous laboratory and service tests. Samples recently excavated from the first installations show no deterioration, either mechanically or electrically, and while it is safe to say that fiber conduit will last indefinitely, no one is in position to tell whether impregnated fiber will last for more than fifty years, and in basing our calculations on the future, the only thing to do is to cite cases which are as similar as possible.

It is a well-known fact that objects have been disinterred and found to be wrapped in cloth saturated in asphalt, evidently having been buried for hundreds of years, the asphalt in the cloth showing no deterioration except to have gotten hard. Coal tar pitch and alleged wool felt, which is usually a combination of old rags, wood pulp, straw refuse, cotton and jute, was taken out of the subway which was built by the New York Central & Hudson River Railroad, approximately thirty-five to forty years ago, and found to be in perfect condition. However, there is no cause to wonder at this performance, simply because these bituminous substances preserve this material indefinitely when oxygen and the actinic rays of the sun are not a factor and destroying agent, and this is the case when a piece of conduit is buried in the ground. Furthermore, the creosote salts positively fumigate the material and stop mold and rot. There are roofs of buildings that have been subjected to oxygen and the actinic rays of the sun, made of bituminous compounds similar to that which is used for impregnating fiber conduit, that have given good service for more than thirty years. It is also a well-known fact that railroad ties treated with an oil in which creosote occurs in sufficient quantity are immune to rot and decay, and their life has not been determined, inasmuch as ties are now in service that were treated with carbolineum more than twenty-five years ago, and carbolineum is nothing more than creosote oil.

It has been found that about 90 per cent. of all cable troubles are directly traceable to some injury to the lead casing when being drawn into the duct, due to the roughness of the walls, and the cement which has seeped through the joint and formed cutting edges after hardening. Cable troubles are also due to high currents leaking through the joints, as a result of improper installation. These objections, however, are eliminated by the use of fiber conduit, due to the smooth interior and water-tight joints. The connection made with fiber conduit is ideal, affording perfect alignment without the use of mandrels or dowel pins, and not having to use cement, mortar or burlap at the joints.

It is also true that fiber conduit is impervious to moisture, gases, acids or other corrosive elements; thus water, gas and stray currents cannot reach the cable protected by this material. It is known that a pressure of five volts will destroy a water pipe or cable in about nine years, and there are few railways, light and power companies who have not been troubled with electrolysis. In the event of short circuit the wall immediately surrounding the arc may char, but the fire will not spread.

In figuring on subway installations it has been fully demonstrated by experience that on account of the lightness in weight, large savings can be effected in freight, trucking, excavating, handling, laying, and the amount of concrete necessary. In shipping and handling fiber conduit, breakage is practically nothing, due to the great tensile strength of the wall and the shock-resisting properties of the material.

Samples of conduit which were placed in an oven and the temperature greatly raised show that at 135 degrees Fahr. softening of the compound began, and that at 205 degrees the compound became very soft, but the mechanical strength of the material was such that the samples retained their shape, and the effect was on the impregnating compound only.

Fiber conduit has been known to withstand temperatures of 330 degrees satisfactorily. However, in actual service, the high temperatures named are not likely to occur, as the cable insulation would give way, and in giving these temperatures it is to illustrate the heat-resisting qualities of fiber conduit under conditions other than normal.

The question of mechanical strength of fiber or tile when laid in concrete is of little importance, as the best concrete to-day will stand a compression test of about 3,000 pounds to the square inch, which is ample to meet the most exacting conditions of service.

The tables given herewith show the costs of constructing the multiple duct and the single duct tile conduit and the fiber conduit in streets paved with granite or similar material.

Instructions to Ohio Inspectors on Road Construction.

FOLLOWING upon the reconstruction of the Ohio state highway department, which took place last fall, the commissioner has issued a very comprehensive set of special instructions to inspectors employed upon road construction. The duties of the inspector in relation to his work are clearly outlined and a set of general principles laid down for his guidance.

The first portion of the instructions set forth in a general way the duties of the inspector. He is informed that, being placed upon the work to keep the department informed as to the progress of the job and the manner of its execution and to call the attention of the contractor to any infringement of the plans or specifications, he is not authorized to accept or approve any part of the work. The inspector's duties are divided under three heads, namely:

1. The inspection of methods used in construction, including quality of workmanship.
2. The inspection of both quality and quantity of material used.
3. The keeping of a daily record of the progress and condition of the work.

The inspector must report the progress of each day's work, and at the end of the week mail the reports of that week's work to the office of the state highway department. He must also keep a small diary, in which he will jot down the principal events of the day; also, the record of the work done on each day as given in his daily reports. This diary will be of great value in settling controversies, disputes, etc.

A thorough acquaintance with the specifications of the job is required, and any points of doubt are to be referred to the engineer in charge.

Fairness in the inspection and tests of materials is asked, but at the same time the inspector is required to carefully examine all materials used and reject those which do not comply with the requirements

The inspector is the representative upon the job of the resident engineer, and he is required to accept the orders of the resident engineer in all cases where such orders do not conflict with the specifications. In event of a difference of opinion on this point, the inspector is directed to stop work on the portion under dispute and communicate the matter to the department office.

Special rules are laid down for the guidance of the inspector upon various classes of road work, as an example of which the following detailed instructions on macadam and asphalt macadam are taken:

In the construction of a macadam road the points to be observed are:

1. The thorough consolidation and specified crown of the sub-grade or earth bed.
2. Cleanliness of the stone; it must be free from clay and loam.
3. Size of the stone as given in the specifications. Long, flakey pieces or "tailings" must be excluded; they will never compact, no matter how much they are rolled.
4. An excessive quantity of binding must not be used. The proportion should be about equal to the voids in the broken stone. By using a larger quantity than this the amount of rolling is lessened, but at the expense of durability.

The pieces of stone should be as nearly cubical as possible and be clean and free from dust, dirt and screenings, for the reason that it is impossible to prevent the dust and screenings from being deposited in bunches and producing weak places in the road. All excess of dust and screenings on the finished road is to be avoided, as it ruts easily and produces a soft surface. The watering of the finishing layer shall be thorough and the watering and rolling continued until water flushes over the whole surface and the passage of the roller will bring moisture to the partially dry surface, as in the case of concrete when it is tamped. If the material sticks to the roller it is clear evidence that there is not sufficient water being used.

No screenings shall be dumped on either layer, but they should be deposited in piles on the shoulder or at one side of the road. The material should be evenly applied to the road with a spreading motion of the shovel. It is also desirable that there shall be no displacement of the rolled stone before the spreading of the screenings, but should this occur the roller shall be brought to use again immediately before the spreading of screenings has begun. The caulks of horseshoes and wheels of vehicles driven over the surface of the rolled stone will tend to loosen and displace the stone, leaving pockets that will be filled with screenings, making weak spots in the road. The intention of the specifications is that the stone shall be closely packed together and held in place until the interstices have been completely filled with screenings. The rolling on each course should be continued until the stones are brought firmly together and do not move ahead of the roller or when walked over. Any hollows or depressions in either layer that develop during the process of rolling shall be filled with the same size of stone that has been used in the layer and brought to a true grade when rerolled.

Heavy loads of material will not be permitted on the surface of an unfinished road, nor after the finishing, until the surface has completely dried.

The inspector must not permit material of any kind to be placed upon the sub-grade when it is in a soft or muddy condition or when the ground is full of frost. He must see that trenches are cut that will thoroughly drain the sub-grade during wet weather, and while construction is under way. After the road has been completed there will be no necessity for sub-drainage, as the finished surface will act as a roof, completely shedding water from the sub-grade.

The inspector should keep a record of the depth of stone used on each course on each 100-foot section.

Tar or asphalt binders should be applied only in warm, dry weather. The conditions which should be particularly observed by the inspector are as follows:

1. The stone for the upper course should be clean and free from dust at the time of applying the binder. If the stone should be coated with dust or other fine material, the binder would not penetrate and would soon peel off, resulting in a raveling of the surface.

2. The stone should be dry. Moisture will prevent the proper penetration of the binder.

3. The binder should be applied during warm weather. Cold weather has a tendency to chill and stiffen the binder before it has had time to penetrate, and unsatisfactory work will result.

The inspector should keep an exact record of the number of barrels of tar or asphalt binder that is used on each 100-foot section of roadway, so that it may be ascertained whether the contractor is using the specified amount of material per square yard of surface.

Upon all brick roads the inspector is directed to procure samples of the brick as delivered on the road and to send twenty-four of these samples to the department for test. Further than this, the specifications are given as a guide, with no elaboration on their instructions. The same is true of the instructions relative to curb work, preparation of the foundation, and laying.

After the brick have been laid, the inspector is directed to carefully examine them, to mark those to be removed with an X and those to be turned with an I, and to see that the brick thus marked are turned or replaced, as directed.

Cement grout filler only is mentioned in the instructions, as the Ohio brick road specifications all call for this class of material to be used in filling. The inspector is directed to see that the sand is of the fineness desired, that it is thoroughly mixed with the cement before water is added, and that it is mixed in small quantities at a time. The first pouring of grout is specified as being as thin as water, and the second only as thick as cream. A careful study of the various conditions attendant upon the grouting is recommended, as it is stated that the application of the filler is the most particular work on laying brick pavement except the judging of the brick. The final inspection of the work is given to some member of the department.

A number of specific "Don'ts" which govern the general attitude of the inspector towards the contractor and the public, and which are general in their character, complete the instructions. They are:

Don't under any circumstances make any agreement with the contractor for the furnishing of material, teams or labor, nor derive any profit from anything used in the construction of the road.

Don't quarrel with the contractor or foreman. If possible, keep on good terms with them, but at all times be firm in holding them to the terms of the contract.

Don't give orders to workmen. If work is not being done properly, notify the foreman or person in charge of the work.

Don't do work on the road. You are paid to see that the work is done properly, not to do it yourself.

Don't accept favors from the contractor or try to be a "good fellow."

Don't be intimidated or "bluffed" by the contractor or any of his employes, and report any or all threats, if any be made.

Don't take orders or follow out suggestions from the contractor or from outside parties concerning the manner of doing work. Complaints and suggestions by residents along the road may be considered and reported, but orders must be followed as given by the department, and plans and specifications carried out, unless written consent to a change is secured from the department.

Don't let the contractor deposit stone or other material within the lines of the road at any point until after grading and rolling has been properly completed.

The Southern Outfall of the Louisville, Ky., Sewerage System.

AMONG the very large sewers of this country the southern outfall of the new Louisville, Ky., sewerage system is of interest because of the very peculiar conditions which had to be met in the design and construction of its outlet structure upon a very steep and unstable bank of the Ohio river. The details here presented are drawn from the report of J. B. F. Breed, chief engineer, and Harrison P. Eddy, of Boston, consulting engineer.

It is worth while to point out, before taking up the details of the outlet structure, that the question of hydraulic grades that had to be settled involved some nice judgment on the extent to which it was necessary and possible to build a system that should take care of any storm flow, no matter how extreme the conditions. The situation of Louisville with regard to the extreme high-water level in the Ohio river is such that at this highest level it is nearly impossible to prevent a flooding of the sewerage system by the back-up of the water from the river. In the case of the outlet of the southern outfall, a hydraulic grade was assumed from the top of the sewer at the upper end of the drop chamber to the surface of the water in the river when at elevation 415. This elevation is exceeded during freshets in the winter, but only very rarely between the 1st of May and the 1st of January. In the month of June, for example, the height of the water has exceeded this elevation only twice in thirty-five years, and on those occasions the river remained above this elevation only for a very short period of time.

Storms of great intensity are not frequent in Louisville except during the months of June, July and August, and are very infrequent during the winter months. The possibility of the occurrence of rainfalls of such high intensity as to tax the capacity of the sewer, occurring at a time when the river is above elevation 415, appears to be very remote, and for this reason it was believed to be safe to base the design of the drop and outlet structures upon the hydraulic grade assumed. The outlet structure will generally be submerged by water in the river, and occasionally, at times of extreme floods, the entire drop chamber, and even the southern outfall itself, will be submerged for its entire length. Had this sewer been in existence it would have been thus flooded on three occasions—in 1883, 1884 and 1907. Obviously it is impossible to provide for the adequate drainage of the city during storms of great severity occurring at a time when the river is at an extreme flood stage. All of the sewers of the city, as well as Beargrass creek, will then be flooded, due to the height of water in the river alone, and a cloudburst occurring at such a time must be construed as an "act of Providence" for which the city cannot provide.

The invert of the main sewer, where it reaches the top of the river bank, is at elevation 404.69, sea level datum. From this point down the river bank there is a drop chamber 93 feet long, with its invert at the lower end, at elevation 370.48, making a slope rather steeper than one in three. From the lower end of the drop chamber the outlet structure extends 56 feet into the river, with an invert grade of 1 per cent. The crown of the sewer at its outlet is at elevation 378, and will be below the surface of the water in the river at all times after the proposed 9-foot stage is established. Before that time there may be occasions when the mouth of the sewer will be partially exposed during periods of extreme low water, although the river is not likely to fall as low as the bottom of the sewer. The maximum recorded flood level of the river at this point is about elevation 448, or 70 feet above the crown at the mouth of the sewer.

There have been indications of a strong tendency of the river bank to move towards the river after the falling of the water in the late spring or summer. The bank is composed largely of a deposit of silt, which becomes saturated when the river is high, and when wet it is very heavy and has little stability. Underlying the silt is a bed of coarse sand and gravel, through which large quantities of water are continually flowing toward the river. The action of this water at the surface of the gravel probably tends to assist the sliding action of the silt above. In anticipation of any such action and consequent effect upon the sewer at its outlet, the foundation was carried down to bedrock. For a short distance, 15 feet, the rock was excavated for a depth of 4 or 5 feet and the foundation carried to this depth, thus forming a key to further guard against any movement.

The drop chamber was built upon piles to assist in resisting any possible movement, as well as to support the structure in case by any chance it should be undermined by the action of the river. These piles extend to the rock, where it was within 20 feet below the masonry, and 20 feet into the ground farther up the bank, in all cases penetrating a long distance into the gravel underlying the silt.

The outlet structure is 8 feet in width and 8 feet high, having a semi-circular arch, vertical side walls, nearly 3 feet in height, and a comparatively flat, but curved, invert. At the end of this structure two wing walls were built, projecting out into the river, each making an angle of 45 degrees with the axis of the sewer. The drop chamber is provided with arch, short side walls and invert of the same dimensions as those of the outlet structure. In the center of the invert, however, there is a channel 3 feet wide and 2 feet 10 inches deep, the bottom of which is lined with half-round vitrified sewer pipe. This channel is provided for the dry-weather flow, which will have a very high velocity. The vitrified pipe lining was used rather than vitrified brick because of the absence of longitudinal joints, at which sewer inverts on steep grades usually show the greatest amount of erosion, and for its great wearing qualities. The berm on each side of this channel will make inspections of the structure practicable. On account of the velocity which will be obtained during the lower stages of the river, both of these portions have been lined with vitrified brick as high as the top of the side walls.

The outlet structure was built within a cofferdam constructed of "U. S." steel sheet piling, 30 feet long, driven to rock. When the excavation for the outlet structure was complete, including a key cut into the rock, concreting was begun and continued night and day until it was completed to the elevation of the invert, thus forming a solid monolithic mass of concrete to serve as an anchor for the drop and outlet structures.

Some difficulty was experienced in placing the concrete in the drop chamber, on account of the steep slope—about 30 degrees—but this was overcome by careful handling of a comparatively dry mixture. To construct the pile foundation 10-inch wrought iron pipes were sunk and rested upon bedrock where this was within 20 feet of sub-grade. The inside core of earth was removed by means of a sand bucket, after which a small amount of concrete was placed in the bottom as a seal to prevent the upward flow of water. As soon as sealed the water standing above the concrete was pumped out and the pipes filled with concrete, reinforced with twisted rods.

The Contractors' Side of Road Building.*

By D. L. Hough, United Engineering and Contracting Co., New York City.

THE writer has had the privilege to work as a contractor under some very able engineers, and has fulfilled many contracts without a voice being raised, and completed the jobs with the feeling that his company has been treated with absolute fairness, and with the acknowledgment on the part of the principals that the work had been done by this company (the lowest bidder) well, honestly and without friction.

On the other hand, he has done considerable work for concerns whose policy seemed to be based upon the belief that, if the contractor was not losing money, there must be something wrong; that the work was not being well done, or he was not doing much; and has worked under engineers whose desire to return full value to their employers led them to be a little unreasonable, without their ability to understand that that very attitude was indirectly opposed to the interests of their principals.

Taking up at first some general thoughts, later to be applied to road specifications in particular:

The principle of the contract is the actual foundation of all social, business and professional relations and economies.

The very essence of a contract is mutuality; and the more this most important principle of a contract is kept before our minds, the more faithfully will the contract be carried out and the less will be the friction developed. If the mutuality of a contract is kept always before us, and it is understood that when a contract is once signed the parties thereto have equal rights thereunder, are on an equal footing, and that there is nothing in contractual relations that places the party who pays with his money on a higher plane than the party who pays with his materials and services, or vice versa, and if the engineer considers himself a nonpartisan arbitrator, there is nothing left to be desired.

*From a paper before the American Association for Highway Improvement.

The original contract was verbal, and the original contracts were carried out at the moment of their making, whether it was a matter of barter with the exchange of commodities on the part of both parties thereto, or a consideration for a service rendered.

As time went on the mortality of the human being and the frailty of the human memory required that a record be made of a contract, which at present requires that it be reduced to writing; but every contract, written or otherwise, must have in it at least the implication of that essential consideration, without which it is no contract—the mutuality thereof—whether it be the price mark upon a tin whistle or the elaborate agreements drawn between two great institutions by profound students of the law.

The less a contract has in it, provided it covers the points at issue, the safer it is for both parties. It would be a very excellent thing if all those who draw contracts might realize that the more they go into detail and the tighter they make a contract in certain points, the weaker it is with regard to those considerations that may develop that are not covered in detail. If a contract were drawn to lay down one or two general principles as to the relations to exist between the principal and the contractor, and then state that all matters that may arise are to be adjudicated upon those principles; and then if it could be understood that the engineer, made the arbitrator under the terms of the contract was actually as such the agent of both the parties thereto, most of the difficulties that arise and the friction that develops would be eliminated.

What are the circumstances that lead to the drawing of a contract? An individual or a group of men want something manufactured or constructed that they neither have the knowledge nor experience nor the equipment to manufacture or construct for themselves; they retain an engineer chosen as an expert in such matters; they outline to him what they want; he studies the physical conditions, if it be a matter of construction with which we have most to do, draws a plan setting forth the limits of the structure and prepares a specification as to the qualities of the materials, methods of workmanship; and a contract is drawn setting forth the terms under which his clients are willing to pay as the consideration for the construction.

This is then submitted to contractors for them to make their offers, and right here develops one of the great disadvantages of the present practice. Instead of permitting the contractor to make suggestions as to modifications of the plans or qualities of materials or methods of construction in advance, so that he may make a better price or give better satisfaction because of his experience and the nature of his equipment, too often the contractor will not be heard, and he must make his proposal absolutely under the terms of the plans and specifications; and after signing the contract it is too late. Discussion usually results in friction.

Ultimately the contractor is selected, a contract is signed, sealed and delivered; the principal appoints an engineer to look after his interests during the construction; and insofar as he lays out, directs and inspects the character of materials and workmanship, the engineer is properly the representative of the contractor; but under the terms of those clauses where he is made the arbitrator, interpreter and estimator, he is the representative of both parties and should be absolutely non-partisian.

The suggestion has often been made that the engineer is in the employ of and paid by the principal, and should, therefore, serve his interests first. This is not the case. If he were employed by both concerns, that is, if his fees were paid partly by the principal and partly by the contractor, that portion borne by the contractor would be added to the contractor's estimated cost and would be in the contract price. If the principal prefers to pay this portion of the engineer's salary direct, then the contractor leaves this sum out of his costs.

The broader an engineer interprets a contract the bigger he is, and if the records of the big men in the engineering profession are studied, it will be found that those at the head of the profession are those who have been the fairest in the adjudication of contracts.

It has been frequently said, and the writer has had it said to him, "You know, of course, if you think I am unfair, you have the right to appeal to the courts." This, naturally, is true in connection with every sort of contract, except those with the government or the state. But what is the result? One must wait three or four years for the case to come to trial, then become the victim of the relative cleverness of counsel and the lack of understanding or bias of the jury.

For this very reason an engineer ought to be scrupulously fair to the contractor and keep him out of the courts, rather than a little unfair on the ground that he wants the justification of the court's decree before he gives up to the contractor something for which he may fear criticism. There is possibly some slight excuse for this in the cast of a public servant who is always the target for criticism and investigation; but still there is a little weakness present in even the public servant when he does a wrong, no matter how slight, for the benefit of his personal security.

To turn to the contractor: There are bad contractors as well as good contractors, and this is true of every trade and profession. There are contractors of whom it is said that as soon as they sign a contract they look over it to find the weak spots developed by the very presence of clauses that are too stringent, who study where it may be beaten; and it is the justification of most engineers that admittedly unfair clauses are included in contracts to protect them against the unfair contractor, and if they meet a fair contractor these will not be enforced. If the average man sat in arbitration upon a contract of this sort, the evident unfairness of the contract should cause him to be more careful in seeing that fairness be done, even to a contractor of unfavorable reputation.

The writer has sometimes wondered how much of the tradition that the old-fashioned government and municipal contractor was a rascal grew out of the fact that the old-fashioned contractor was usually not an educated engineer and had to depend upon some man of alleged training to make his estimate, and, finding that he had been led into a ruinous agreement, tried to pull through as best he could.

But today contracting has become a business in which organizations have been built up of quite as high a character as in any other line of industrial effort. In recent years there have been brought into its conduct integrity and intelligence equal to that found in any other line of activity. There are two reasons for this:

First, the fact that our technical schools are turning out each year such a vast number of young men trained, not as engineers, but prepared to receive the training of engineers. These young men, entering the field of engineering, soon find the market for employment oversupplied, and, securing a job, find the opportunity for advancement limited; while anybody can take his chance at securing a contract, and the alleged greater independence of the contractor appeals to his ambition.

Second, the character of contract work now offered is of a much higher grade than the elementary work from which it grew. It takes just as good a man acting as managing engineer for the contractor to carry out the work as it does to design and lay out the work.

There must be two sides to a contract, as is implied by the very definition of the work, and the presence of and the surveillance by the inspectors of the one side are a benefit to the other. It is but human nature for a contractor's foreman when he has made a mistake to try to hide it or to make the best of it. The scrutiny of an inspector often prevents the harm that might result to the contractor because of the failure of that part of the work where the error was made, or its detection at a time when the expense of replacement would be embarrassing.

It is almost the universal experience in contracts that include deep excavation that the character of the excavated material, not having been developed by previous work in the same locality, is found to differ from that expected, no matter how carefully exploration and investigation may be made. The samples from a boring in many cases cannot show the condition of the soil as it exists in its original position.

The advantages of a clause under which the unexpected conditions might be considered and a price arrived at by the rule of three, based upon the price named for the material as it was indicated, are so evident that it is a surprise that such a clause is so infrequently found.

There has appeared in recent contracts drawn by lawyers of national reputation a clause calling upon the contractor to guarantee the efficiency and sufficiency of the design. This clause could not have been drawn by an engineer. The engineer who would frame such a clause would seemingly have a very poor opinion of his own qualification and very little courage as to his own convictions. Consider for a moment a clause. The contractor is called upon to make a bid to build something of a certain character, of certain materials and in a certain way; no matter what the conditions that he meets may be, no matter what the inefficiency or the insufficiency of the original design, he must make good without any change in price, and he cannot have the work unless he accepts this condition.

Could anything be more unfair? The party of the one part goes on record that he considers that his design is efficient and sufficient. If he does not believe it, the contract is dishonest. If he does believe it, then why should not the contractor who lacks the information and the experience believe it; and, if things turn out differently, why is not the contractee as much mistaken as the contractor?

There is another clause that may well be in every contract, particularly with state and city governments, one that will set forth that the contract is based upon the prevailing rate of wages and the prevailing hours of work at the time the contract is signed. Then if those who control our destinies through the legislature find it advisable to limit the hours of work or to pass legislation that shall affect the prevailing rate of wages, an equivalent increase shall be made in

Turning to the standard road specifications of the various states, as furnished by Mr. Page, it is found that the work of road building presents but few items. The mere construction of a road is quite elementary. Specifications may be made so brief that there seems but little opportunity to discuss them, and the plant required to construct a road is so simple that it would seem to put road construction into the hands of any man who may buy picks and shovels, a few carts and a roller and sprinkler.

But as one studies a little more carefully one sees that it is not the actual construction that presents the difficulties; it is more a matter of organization and transportation. There is so little work in any one locality that proportionately vast amounts of money may be lost by momentary delays or the breaking up of the organization by breaking up the sequence of the work, and in the securing of materials the plant required instead of being almost negligible as a percentage of the total cost of the work may become a very important percentage.

For this reason the engineer should be most careful to point out the difficulties to be encountered when he prepares his schedule of information to be furnished prospective bidders; and in this particular the writer finds the road specifications of none of the states adequate.

They should point out to contractors what rock they are willing to use and where it may be found; what sand they are willing to use and where that may be found, either along the line or within accessible distance; the stations of the railroads most accessible to the sources of supply of material, and the highways by which access may be given. Such information would result in lower prices in many cases, and would prevent the presentation of bids at too low a price because of a lack of information, with the result that the contractor fails, and the work must be relet with the delay and additional expense that must ensue.

The location of the highway should be studied at every point from end to end, and the desired treatment set forth in detail; and there should be a general clause outlining a basis for the adjustment of prices to meet any conditions that may reasonably develop.

Organization and uninterrupted procedure with the work is the most important consideration of all. Where the contractor must produce his own materials and deliver them with his own facilities, a road-building contract becomes practically a manufacturing and transportation proposition, and it takes an unusual order of ability and much versatility on the part of the contractor to do good work.

Turning to the actual construction, the writer finds in most of the specifications but one item for excavation, and in this is included the more or less immaterial item of grubbing and clearing. The specifications generally set forth that a stump must be excavated to such a depth as the engineer may direct, and the excavation be filled with such material as the engineer may approve. There should be a separate item for this character of excavation. The amount of this work cannot be determined in advance, nor can the individual preference of the individual engineer be known to all the bidders. It is true, however, that within the limits of the most exacting the cost of this character of excavation is about the same, shovelful for shovelful; but it is very different from the general excavation of the road in preparation for the road metal, and as it may vary so widely, it would seem to be but fair to the contractor to have this in a separate item.

Then as to the material of backfill, the engineer for his own protection and comfort should accurately describe the character of material he will require, and should point out where it may be obtained, unless he is willing to take the material from the excavation.

It would be perhaps a benefit in securing proper prices and avoiding discussion later, if a separate item were made for the excavation for drains, foundations and culverts. In some instances the specifications call for a separate price upon this, and this is particularly important where it is left to the engineer to determine the width and depth of the drains as the work progresses.

In the matter of borrow, appropriate borrow pits should be located by the engineer and their location pointed out to the prospective bidders; and to insure fair play between all bidders, the royalties to be paid should be negotiated in advance and the costs set forth in the information given.

Rock excavation seems fairly treated, but the information to bidders should clearly set forth whether or not this rock may be used in the road construction; and if it is a question that can only be determined as the work progresses, then there should be two prices, one when rock from the excavation may be used and one when the excavation rock must be spoiled and the road metal obtained from special quarries.

The details of pipe, open drains. culverts and similar items seem to be sufficiently treated.

The restrictions as to the character of labor and superintendence and the cleaning up after completion are in every case usual and reasonable.

There is one elemtn, however, that ought to be gone into, either as a separate item of the contract setting forth just what the limitaticns may be, or else be outlined in the information given to the bidders; namely, that where the road passes through communities where there is control by special legislation or ordinances, terms of these ordinances, or at least their existence, be pointed out, and in the latter case the contractor be informed where he is to go to determine what their effect may be upon the cost of his work.

In none of the contracts is there any provision made in the event of delay on the part of the communities in the sale of their bonds, or fcr other reasons not securing the funds with which to pay the contractor.

The only consideration given the contractor by the contractee is his pay. The terms of the pay are already set forth and the times at which the contractor may expect it.

It is only fair and reasonable that if there is any delay in making payments to the contractor he should be given interest from and after the date at which the payments are made due by the contract.

As an alternative to this suggestion, but a disadvantageous one to the contractor, would be his right to suspend work until he received his pay, in which case all reasonable costs during suspension should be estimated to him by the engineer. These should include not only the actual maintenance cost of plant, materials and watchman but the cost of disorganization and reorganization. If these cannot be determined by actual vouchers, then it should be arranged that they may be agreed upon, possibly by arbitration.

There should be a clause covering delays due to failure to secure right-of-way or to injunctions imposed through no fault of the contractor, and remuneration should be arranged.

In road building the most important general consideration is the sequence of the work. This should be definitely set forth in a clause of the specifications or in the information to bidders, so that the contractor may properly plan his job and properly organize it. The ideal arrangement is to start at strategic points and proceed as an army marches, one process following the other at the right interval of distance, so that the operations may be kept as close to each other as possible for the purpcse of supervision, and so that any excess or deficiency of materials may be corrected with the least possible transportation cost.

Any interruption or modification of the sequence of the work not in accord with this ideal procedure should be pointed out in advance, or a clause should be drawn that will give the contractor a reasonable return, perhaps in cost only without profit, for unexpected interruptions, either in time or sequence.

The contractor should not be made subject to the individual preference, and one may perhaps say fancy, of the directing engineer or some irrational property holder along the route, without facilities for his proper safe-guarding in unusual costs.

It would seem valuable, also, to incorporate a clause which permitted substitutions to be made if, during the progress of the work, these were found to be of value.

If something different from that set forth in the specifications is substituted in the way of materials, the owner should naturally have the benefit. If there is a reduction in the cost of transportation or otherwise, due to the ingenuity of the contractor, it should go to him; and in this way again the mutuality of the contract would be fulfilled.

It may be said that the suggestions which have been made are visionary, and, to say the least, Utopian. The best defense of them, however, may be seen in the specifications that have recently been drawn for the carrying out of one of the two or three most important enterprises now under construction.

To close, I would urge upon the engineers to draw their specifications so that they are fair and reasonable, to always assume the attitude of a non-partisan when arbitrating those classes where they make themselves the final court of appeal; to try to consider that the contractor is an honest man, and to work with him on that basis until he proves himself otherwise.

The Value of Pure Water.*

By Chas. B. Burdick, Hydraulic and Sanitary Engineer, Chicago, Ill.

It is the object of this paper to present to you briefly some observations upon the value of a pure water. The subject has been so ably handled recently by George C. Whipple, in his two books, "The Value of Pure Water" and "Typhoid Fever," that there is little to present in the way of additional statistics, except such as have been obtained in the last four years since these works were published. These data are being constantly supplemented by the numerous statistics of our health departments and sanitary associations, all of which data are available to a large part of the membership of this association. It is believed, however, that a brief review of these matters to date will be of some value.

The term "pure water" is herein given its usual significance, as understood by those engaged in the supply of public water. It must be healthful, clear, tasteless, odorless, and reasonably soft, the importance of these requisites being, roughly, in the order stated.

It is an impossible task to value a vital necessity. Water is generally considered to be worth its cost in any particular locality. The larger part of the thickly populated area of this country is blessed with an abundant rainfall, and local circumstances are such that supplies for all purposes can be obtained for moderate expenditures. With the spread in population, regions are now being settled in which the rainfall is less abundant, and these newer communities are cheerfully facing and making expenditures for water that very greatly exceed the necessities in the Eastern and Central States. Upon the Pacific coast there is no dispute as to the inherent value of a water right, developed or undeveloped. Such values are obvious to the California citizen.

According to the United States Census Bureau for the year 1907, the investment in public water supplies in cities of over 30,000 population amounted to $638,000,000, or $32.60 per capita. The approximate value of these properties was estimated at $619,000,000, or $31.60 per capita. The annual operating expenses of these 105 cities, with 19.6 millions of population, supplying 1,010 billion gallons per year, or 142 gallons per capita daily, amounted to $29,000,000, including taxes at 1 1-3 per cent. on the present value. If we allow 5 per cent. on the present worth as the value to the people of the money invested, and 2 per cent. to cover depreciation, the cost of this water will average $71.50 per million gallons, or $3.68 per capita per year.

To the figures named must be added the cost of the improvements on the premises of the consumer, aggregating a very considerable figure, and probably bringing the average cost of water up to $100 per million, or $5 per capita.

These figures include all supplies, good and bad, and probably represent, roughly, the average cost of water as it is supplied to-day.

It is the sentiment of the best people in this country to place the value of human life above price, and the public is constantly making expenditures to promote safety, under circumstances where it would be difficult or impossible to show a direct and certain monetary return. Such is not the case with water. Very conservative estimates show that where a pure supply replaces one that is polluted, the monetary return to the community is tremendously in excess of the expenditures necessary to bring about the improvement.

It is well known that, where a public water supply is turbid, or otherwise objectionable to sight or smell, large expenditures are made by citizens, able to afford it, for bottled waters. Estimates are presented by Whipple which seem to indicate that these expenditures are sufficient in many cases to purify the entire public supply. The expenditures for a suitable table water are doubtless considerably augmented under circumstances where the supply is publicly believed to be unhealthful, but it is probable that the expenditures for table waters are most largely brought about by the bad appearance of the public water supply covered by the requisites of clearness, taste and odor.

Hardness of water, in the popular mind, is a very general term, the significance of which varies largely with the locality. The Eastern waters generally are very soft, compared to the waters of the Middle West, and the latter are soft, compared to waters of the Western plateau country generally. For drinking purposes most people become quickly acclimated to a hardness of 200 parts per million, and many drinking waters considerably higher in hardness are highly prized. The ground waters, as a general rule, run about the same in hardness as the low water flow of the rivers, but average possibly 50 per cent. higher. There are in the Middle West many beautiful

*From a paper before the Indiana Sanitary and Water Supply Association.

ground waters whose hardness runs into very high figures.

As the cities develop, the needs of a soft water in the household and the factory are better appreciated, and while water softening has been practiced in the industries for a considerable time, it is only recently that the municipalities have turned their attention in this direction, and only a very few municipal plants have been built. The financial benefit of a soft water in the household is not difficult to estimate. Experiments and figures by Whipple on the basis of one gallon per capita used for purposes requiring soap, with soap at 5 cents a pound, indicate a value of $10 per million gallons for each 100 parts per million reduction in hardness. There are other household economies brought about by soft water, such as the maintenance of plumbing and heating systems, the saving in the wear of clothing in washing, and in manufacturing cities very considerable economies in steam plants and the mechanical arts in which water is used. There seems to be no doubt but that the large majority of the water supplied in the Middle West could be softened with great profit.

As water softening is practiced to-day it is practicable to so construct the municipal filtration plant that the water may be softened without material addition to the plant investment. In such plants, therefore, the question of softening is an operating question, and in places where the waters are excessively hard at certain periods of the year only, it is practicable to incur the rather high operating costs only at such times as the softening appears to be of financial benefit.

At Columbus, O., for the year 1910, the operating cost of the filtration and softening plant is stated as $19.42 per million gallons, of which probably $12 to $15 represents the cost of softening. This plant reduced the incrustants from 111 to 35, an average reduction of 76 parts per million, and the total hardness from 270 to 85, a reduction of 185 parts per million. Where alkalinity or temporary hardness only is reduced the cost is much less. Thus, at New Orleans, for the year 1910, the alkalinity was reduced from 99 to 39 parts per million, with a total operating cost for filtration and softening of $6.60 per million.

It is from the standpoint of health that pure water brings its largest financial return.

The most important of the water-borne diseases are Asiatic cholera and typhoid fever. The former has been practically eradicated in the most enlightened communities. Great strides have been made in the reduction of the typhoid death rate, but this disease is still prevalent throughout all civilized communities, and very much remains to be done in America. M. O. Leighton estimates the average value per life taken by typhoid at $4,635. Five thousand dollars is very commonly considered to be the value of a life. There are from ten to twenty cases of typhoid for each death. It is very difficult to estimate the cost per case, but statistics available seem to indicate actual expenditures of about $2,200 for each death.

Mr. Allen Hazen has presented figures on five cities where purification works have been introduced that appear to indicate that for each typhoid death saved, three additional lives have been saved from other causes. The pure water has evidently a very beneficial effect upon diseases diarrhoeal in nature, and probably also engenders an increased vitality that assists in the resistance to other diseases not water-borne.

After considering all these figures, Whipple concludes that $10,000 per typhoid death saved is a conservative estimate of the saving secured through the purification of a polluted supply. Upon this basis a saving of 10 per 100,000 living is equivalent to $1 per capita per annum (a convenient figure for estimating purposes), and he estimates the value of the purified water at $9.50 per capita per annum at Lawrence, Mass., $4.75 at Albany, N. Y., $3.80 at Binghamton, N. Y., and $4.75 at Watertown, N. Y.

The filtration works at Cincinnati, placed in operation in 1907, have apparently been effective in reducing the typhoid death rate per 100,000 from 80, 41 and 71, during the three years preceding the starting of the works, to 18, 13 and 6 for the three years following—an average reduction of 52, equivalent to $5.20 per capita. This, on the basis of the present population of 364,000, is equivalent to 1.9 million dollars per annum, which is 6 per cent. on $31,000,000. The filter plant and reservoirs cost about $1,750,000.

At Columbus, O., the saving based on two years following, compared with three years preceding the beginning of filtration operations, has been about 34 typhoid deaths per 100,000, worth to the citizens of Columbus $3.40 per capita, or $616,000 per annum. This is 6 per cent. upon 10.6 million dollars. The filtration works are reported to have cost about half a million dollars. Other statistics are available that show savings of from $3 to $7 per capita per annum through the benefit of pure water upon health.

The cost of filtration has been very generally estimated at $10 per million gallons of water filtered, including operation and fixed charges. In mechanical filtration the operating costs run from \$3.50 to \$7 per million, with fixed charges, including basins, of very nearly the same range. The writer has the figures upon about a dozen modern plants, large and small, that run from \$15,000 to \$25,000 per million gallons of filter capacity, including basins. The average is about \$17,500. Allowing 7 per cent. for fixed charges, the above figures of cost and operating cost produce annual charges of from \$7 to \$14, with \$10 as a mean.

This figure corresponds fairly well with estimates upon slow sand filtration plants, in which the principal item of cost lies in the fixed charges. They also handle waters materially different from the turbid waters handled by many of our Western mechanical filtration plants.

At \$10 per million gallons, and a consumption of 100 gallons per capita, the total cost of filtration is 36½ cents per inhabitant per year, and at 150 gallons per capita, which is nearer the average consumption for cities using river waters, 55 cents per capita per year.

Assuming the cost at 55 cents and the value of a life at \$10,000, including incidental losses, a saving of 5½ lives per hundred thousand will balance the cost of filtration. A reduction in the death rate of eleven will show a return double the net cost, and in all of the cities whose death rates have been cited above the indicated net return amounts to from six to twenty times the yearly cost of purification, including fixed charges.

Viewed as a business proposition, it can be conservatively stated that where a polluted water is effectively filtered, the net return in lives saved, after deducting operation costs and depreciation, will amount to from 50 to 200 per cent. per annum upon the investment in filtration works.

In the light of these figures, is there any better municipal investment than pure water?

Economy of Circular Reinforced Concrete Reservoirs.*

By Alexander Potter, Consulting Engineer, New York City.

THE economy in constructing water works service reservoirs, circular in shape, is not appreciated as fully as it should be. The circular shape for small reservoirs is not only the safest type of construction from a structural standpoint, but permits also a more economical use of the structural materials. Among the many, and unfortunately only too frequent, failures in reinforced concrete construction, it is rare to note failures of circular reinforced concrete tanks, other than those of badly leaking tanks, due either to poor workmanship, poor design, or both.

One of the greatest advantages possessed by the circular section, and not possessed by any other, is the ability to increase economically the capacity by simply increasing its depth. This is of great importance in the design of water works improvements. It enables the designer to keep down the first cost of construction by building a reservoir of a size sufficient for the immediate needs. As the water consumption increases, it is possible to increase economically the capacity, and at the same time raise the water level to counteract the increasing frictional losses in the distribution system.

The design of a circular reinforced concrete reservoir appears to be so very simple that the inexperienced designer is apt to create a structure of larger diameter than the application of the simple formula of tank design would seem to warrant. To him there appears to be no ostensible reason why a structure twice the size of one already built should not offer every evidence of strength and stability if designed in accordance with the formula for ring tension—a very misleading deduction. The secondary stresses, which in small structures are insignificant and consequently deemed of too little importance to have attention called to them, increase rapidly with the size of the structure, and only too often limit the size to which any particular type of construction can be adopted. In a circular reinforced concrete tank, the writer has in mind the varying tension from point to point in the steel reinforcement, due to the difficulty of obtaining a true circle in the field. In a small tank this is not so serious, as its effect upon the resultant stresses in the steel reinforcement is slight. To make this point clear, some computations have been made by the writer based on the assumption that in the construction of this type, even with the best of care taken in the field, a variation of a half inch in the middle ordinate of a 10-foot chord is likely to occur.

*From a paper before the New England Water Works Association.

Radius of Tank.	Variation in Radius of Curvature due to a variation of ½ in. in middle ordinate of a 10-ft. chord	Range of Tension in Steel Reinforcement. Average Unit Tension, 14,000 Lbs. per sq. in.
		Lbs. Lbs.
25 ft.	23.0— 27.2	12,850—16,200
50 ft.	42.8— 60.1	11,950—19,100
100 ft.	74.9—150.5	5,910—21,100
200 ft.	120.2—632.0	5,820—44,500

This table is not made to show accurately the variation in the tensile stresses of the steel reinforcement for the various diameters given. It does, however, give a fair idea of what may be expected in the variation of the ring tension in a circular structure. It points out the danger resulting from carelessness in constructing a circular reservoir more than 100 feet in diameter. For reservoirs of large diameter, however, the economy resulting from the use of a circular section does not obtain to the same extent, and consequently recourse to this type is not so frequent.

The writer's experience would tend to limit the working tension in the steel reinforcement to 14,000 lbs per sq. in. in a small tank, and to 12,000 lbs. per sq. in. for comparatively large tanks. A reduction in the allowable steel tension for large tanks is recommended, because of the greater range in the ring tension present in the larger structure. It may even be advisable to reduce the allowable unit stresses below 12,000 lbs. per sq. in. to keep within safe limits the excessive local stresses which cannot be avoided.

The variation in the tension of the steel reinforcement from point to point, due to the varying curvature of the shell, makes the use of a reinforcing bar with mechanical bond advisable. The reinforcing bars, for this reason, should also be of as small a size as it is possible to handle economically, in the field.

A high carbon steel, with an elastic limit of 50,000 lbs. per sq. in., can be used to great advantage.

Another difficulty to be considered in the design of a circular reservoir is the tendency to rupture along the line between the inside wall of the reservoir and the base, due to the expansion of the walls by internal water pressure and the consequent drawing away, as it were, from the base of the tank.

A good example of increasing the capacity of a circular reservoir is the enlargement of the distribution reservoir for the village of Suffern, N. Y. This village takes its water supply from Anthrim lake, formed by impounding a branch of the Ramapo river. The water is pumped from the lake to a distribution reservoir located on the side of a mountain to the north of the village, about 180 feet above the average datum of the village. This distribution reservoir, built a number of years ago, is a circular tank, 70 feet in diameter and 10 feet 6 inches deep, sunk entirely into the ground. The walls forming the sides of the tank are two feet thick, and both bottom and sides are constructed of plain concrete. This reservoir has a storage capacity of 266,000 gallons, and cost approximately $4,000.

The recent growth of the village has made it advisable to double the capacity of this distribution reservoir. The old structure, although massive, nevertheless leaked to a considerable extent, especially in the bottom. It was, therefore, decided to line the bottom of the tank at the same time that the sides were being raised. The reservoir as remodeled has an inside diameter of 69 feet and holds approximately 20 feet of water, giving a storage of 659,000 gallons. The side walls of the old tank are lined on the inside with 6 inches of reinforced concrete. Above the old work the width of the new work is 12 inches, tapering to 8 inches at the top.

The circumferential reinforcement consists of ⅝-in. square corrugated bars, possessing an elastic limit of 50,000 lbs. per sq. in. These bars are so spaced that the average unit tensile stress in them does not exceed 14,000 lbs. per sq. in.

In designing the lining for the old reservoir, it was assumed that the reinforcement would only have to take care of the increased tension due to the additional depth of 10 feet 6 inches. This is a constant quantity with a full reservoir, consequently the spacing and size of the steel in the lining of the old reservoir are uniform. The existing wall is relied upon to resist the hydrostatic pressure that it formerly did.

It is not very likely, because of the great daily fluctuation in the water level in this reservoir, that ice pressure will develop to such an extent as to overstress seriously the reinforced concrete shell, and consequently no provision has been made for such pressures.

The bottom lining is reinforced with ⅜-in. square corrugated bars, which have their ends hooked over the lowest reinforcing rings. Vertical ⅝-in. square bars, spaced 3-ft. centers, were used as vertical distributers. Each reinforcing ring is made up of six sections lapped 30 inches and wired. The rings were also wired to the vertical reinforcement at every intersection.

The forms consisted on the inside of vertical sheathing extending the full height of the reservoir, and of horizontal sheathing on the outside.

The thickness of the bottom lining

varies from 3 inches to 6 inches, so arranged as to offer better drainage than was obtained in the old tank.

The reservoir was completed October 12, 1911, and filled for the first time to its full depth on November 11, 1911. No leaks whatever have thus far appeared. The only precaution to render the reservoir watertight, other than that of using a fairly wet concrete which was mixed in the proportion of one part of cement to two parts of sand and four parts of ¾-in. broken trap rock, was to wash the inside of the tank with a semi-liquid cement.

The writer wishes to call attention to the comparatively low cost of this work. An increase in the storage capacity of 294,000 gallons was obtained at a cost of $2,500, the contract price for this work. The location of the reservoir on a steep mountain slope, about 180 feet above the street level, added considerable to the cost of hauling the structural material to the site, and consequently, to the contract price.

Stone and Gravel Roads.*

By W. A. McLean, Provincial Engineer of Highways of Ontario.

An ideal road-making material, possessing every desirable quality under all conditions, for service, durability and cost, continues to be used in Utopia, but so far as we can learn, in no other country. That such a material exists it is well to dream, but in more practical intervals it is not the part of wisdom to give up doing the things we can do because we want to do something we cannot do. Motor traffic has led to an important use of bituminous binders on main roads; but water-bound broken stone, substantially as advocated by Tresaguet, Telford and Macadam, is still the mainstay of road-building, while gravel is its useful ally.

There is a tendency to think of the trunk roads, the interurban roads, the roads of through traffic, as the all-important phase of the road problem. Without minimizing the usefulness of splendidly built main roads, it is only just to say that all roads are important, and that all deserve a type of construction and system of maintenance in keeping with the amount of traffic over them. In a consideration of construction, the classification of roads is a logical step, and while under any classifications one grade merges into another at the arbitrary dividing line, yet in every country of good roads a classification is necessarily adopted.

In Ontario, Canada, the roads are estimated to be 50,000 miles in total length. Careful consideration has shown that in view of local conditions, these might be classified approximately as follows:

Class 1—Interurban and trunk roads, 5 per cent.

Class 2—County or leading market roads, 15 per cent.

Class 3—(a) Main township roads, 50 per cent.; (b) secondary township roads, 30 per cent.

In the foregoing classification, Class No. 1, "interurban and trunk roads," includes such highways as would comprise a state or provincial system, and of which, because of heavy, constant through traffic, the proper construction and maintenance is an unfair charge upon local municipalities. These roads are of the type which should be built in the most permanent manner, using telford or other suitable foundation, and a strong broken stone covering, with bituminous binder.

Class No. 2 comprises the main arteries radiating from local market centers, and over which might ordinarily pass from 50 to 150 vehicles in a day. such roads, we believe, should have a broken stone covering, with bituminous binder.

Class No. 3 (a) comprises the concession or other roads of a township, on which numerous farms front, and which converge into and create the traffic of the county roads of Class No. 2. On such roads there may pass from five to fifty vehicles in a day. The more important of these deserve to be metaled with broken stone, if good gravel or other suitable material is not available.

Class No. 3 (b) includes little-traveled connecting or other roads, which should be graded and given such further treatment as circumstances may permit.

The relative importance of the several classes, from the builder's and administrator's standpoint, is a matter of cost, not so much the cost per mile as the total cost of each class. On that basis the trunk roads take a minor place, and the great body of roads under township councils ranks first in importance.

Gradients adopted, amount of camber

*A paper before the American Road Builders' Association.

or crown, width and depth of metal, foundation, if any, drainage, binding material and other details should, as suggested, be largely dictated by the degrees of traffic, in accordance with a suitable classification, of which that suggested may form a basis for the purposes of this paper. (Let me here suggest that a good road attracts and creates traffic, so that the improvement of any one road is very likely to raise it from one class to a higher grade, a matter which should not be lost sight of in planning construction.) A highway engineer should be an economist, for a design adapted to Class No. 1 should not be built where traffic requires only a road suitable for Class 2 or Class 3, or vice versa. Methods of construction should be as simple and direct as proper results will permit. There should be a well-adjusted average between maximum service and minimum cost. If this is studied with good judgment, the advocates of good roads need be less amenable to criticism respecting methods of finance.

CLASS NO. 1—TRUNK ROADS.

Broken stone roads of the best class have been reduced to a few well-defined types, through more than a century of experience in England, France, Germany and on this continent. The true macadam road has well-drained and crowned earth sub-grade, over which is spread a uniform coating of broken stone about 2½ inches in greatest dimension. The telford road has a foundation of flat quarry stone, placed by hand, on edge, the angular points being chipped off by hammer and wedged in the interstices; and over all is spread a coating of fine broken stone, in thickness about one-third of the total depth of the stone surface. The earth sub-grade is flat, and larger stones are used at the center of the road, with smaller at the sides, to give the desired camber. The roads built by Tresaguet, in France, were substantially the same as the telford road, and are usually included with it. In the French type the sub-grade was cambered and the foundation stones were of uniform depth. A distinct type of foundation is that developed in Mssachusetts, in which there is a slightly V-shaped subgrade, with a filling of cobble or field stone, a method which is claimed to give more effectively than other types the desirable underdrainage.

Experience has shown the superiority of roads with a foundation, such as the telford type, in reducing the cost of maintenance under heavy traffic. Settlement is more uniform, and defective drainage is less destructive. If the natural subsoil is strongly supporting, such as a dry, well-cemented gravel, the foundation may be omitted with saving of cost. Whether the telford or Massachusetts type of foundation be followed, the writer believes that local material suitable for either should largely govern.

The width of roadway between gutters or drains, and the width of stone, should be guided by the amount and character of traffic, and should ordinarily be less in strictly rural districts, increasing as roads converge into city streets. A minimum width of grade for trunk roads in the writer's experience should be 24 feet, with metal in the central 12 feet, and earth or gravel shoulders 6 feet wide on each side. Maintaining shoulders at 6 feet and a maximum width of metal at 18 feet, the maximum width of grade need not exceed 30 feet.

The camber on roads of heavy travel should be the least possible consistent with good surface drainage, factors to be considered being the quality of road metal, class of binder, and gradient of the road. As is well known, roads with a sharp crown encourage travel in one central line of wheel tracks, while a flatter surface permits more uniform wear.

A hard rock, such as trap, or a bituminous binder, requires less camber than do soft material and an inferior binder, while a steep grade requires an increased camber to drain the wheel tracks. Trunk roads of the best class may be given an average crown of one-third to one-half an inch per foot from center to gutter.

CLASS NO. 2—COUNTY OR MAIN MARKET ROADS.

Cost is always a factor, but in the case of county and township roads the problem is, more often than with trunk roads, one of limited outlay, or of obtaining the maximum results for a restricted expenditure. The general construction of stone roads of the best class, as briefly described, will form an introduction to roads of the more universal type.

Roads of Class No. 2 cannot as a rule follow closely English, French, German or other standards, but must be built with a view to the particular needs of this continent and of the locality. The need in most states and provinces is a long mileage, to be built as rapidly as possible through districts where population is comparatively sparse, where there may be little or no road-making material and the available expenditure necessarily is restricted by these and other conditions.

European engineers would undoubtedly, if it were possible to reconstruct many of their roads, lay them with foundations, but the cost is prohibitive. No more is it practicable on this continent to build any but the most heavily traveled roads with expensive foundations. Instead, it is necessary to depend on good drainage, carefully maintained, to keep the subsoil dry and streng enough to sustain the road surface.

Bridges have to be strong enough for the maximum load, and with waterway enough for the maximum freshet. So roadbeds should have sufficient drainage for the severest test, which in northern countries is a period of thaw in the early spring, lasting usually for two or three weeks. If subsoil drainage is sufficient for that test, no break-up of the road crust need be feared at other seasons.

Old specifications for roads built in Canada before the period of railway construction required open drains on each side of the road, with bottom at least 2 feet below the crown. In many places the drain was deeper, and hills or spouty places were underdrained by trenches filled with field stone. Such roads have stood the test of time, and may be accepted as the standard of drainage required for the north, except that tile underdrains are taking the place of open ditches where they would otherwise be dangerous, unsightly or difficult to maintain. Drains of porous farm tile keep the subsoil at its dryest, and prevent uneven settlement of the road crust into mud, which is as destructive to a road when below the surface as when on the surface. Some countries of Ontario are using tile drains the full length of all their roads. Others use them only on wet and spouty hills; on level land which is exceptionally wet and retentive; or where the open drain would otherwise have to be dangerously deep to give sufficient fall and outlet. In the last case the tile may carry some surface drainage, receiving it in catchbasins.

Closely associated with drainage is the grading of the road. Before a road is surfaced it should be brought to grades that insure permanence. Hills should be cut down, low places filled, and the earthwork brought to a substantial turnpike. The road surface will need renewal, but the grade, if properly made, will outlast even the bond issue. On roads of a secondary class elaborate surveys are unnecessary. A good foreman can obtain easy, flowing gradients by grading from point to point, and would probably disregard stakes and profiles, except in cases of extensive cuts and fills, new locations, tile drains, or doubtful surface drainage.

Road laid on an earth foundation should be given a higher crown when newly constructed than is desirable for perfect condition. Settlement will assuredly occur, and, unless the road is too high to begin with, it will become too flat. A road of Class No. 2, which in two or three years has settled to the desirable camber, will give the greatest degree of durability, with least expense for maintenance. One inch to the foot from center to gutter or edge of shoulder, for a completed, rolled road, will meet ordinary conditions. With a circular cross-section the greatest part of the fall is on the earth shoulders.

The cost of a road, unless earthwork and drainage is of an exceptional kind, will depend on the width and depth of broken stone used. Wide flat roads are desirable, but narrow roads, with a good camber, cost less to build, and much less to maintain, unless a highly organized system of maintenance is created. We have, for this class of road, found an earth grade 24 feet wide, shoulder to shoulder, to meet most conditions, which may be reduced to 18 or 20 feet for least traffic. With shoulder 6 feet wide, the stone is put on from 8 to 12 feet wide. The consolidated depth of metal on roads under the writer's supervision is based on 8 inches for a moderately strong clay or sand subsoil. This is modified according to the anticipated amount of traffic and quality of stone to resist wear, the maximum concentrated wheel loads, local tire width and wheel diameters, bond of road metal and consequent distributing effect of the metal crust, the supporting strength of the sub-grade and opportunity for drainage; all details of interest which cannot be dwelt upon within the limits of this paper.

Bituminous binders may be justified on heavily traveled suburban or motor roads of this class, but present practice in Canada tends to oiling as a preservative and dust preventive, owing to the less first cost of water-bound macadam.

CLASS NO. 3—TOWNSHIP ROADS.

Reduction of cost to meet township conditions requires that townships have as their ideal the cheaper class of roads adaptable for main county roads. Grading is cheap, and should be perfected before metal is applied. Neglect to provide easy flowing gradients and to sufficiently drain and turnpike are mistakes fatal to any road. Minor municipalities can make no mistake in placing the perfect earth road as their ideal base for such metal surfacing as their resources will permit. An earth grade from 18 to 24 feet, shoulder to shoulder, should be made, and a single track laid, 8 feet wide, of gravel or broken stone.

MATERIALS.

The durability of a road is largely dependent on the binder and the cementing qualities of the stone dust in producing a water-proof surface, if tar or other bituminous binder is not used. The writer is strongly in favor of the use of stone screenings as opposed to sand, and has very rarely found gravel or sand sufficiently clean, coarse and sharp satisfactorily to take the place of screenings as a binder. Wherever practicable, stone screenings are to be recommended, particularly the screenings of certain classes of limestone, the superior cementing qualities of which make it a better road metal than its degree of toughness would justify. Limestone screenings are exceedingly useful with water-washed gravel or with broken granite or trap.

A uniform grade of stone, rather fine, is desirable in finishing the surface of a road, and is necessary where a very hard stone, such as trap, is employed; but this may be sought at considerably increased cost, and is not always necessary to suitable results. It adds to the cost of a road to spread the stone in several layers. Municipalities using portable crushers, particularly, will find a rotary screen with two sizes of mesh very satisfactory. This will produce (1) "tailings," or the stone too large to pass through the screen; (2) the middle course, a uniform grade to form the main body of the road; and (4) "screenings" to bond and finish the surface. The tailings should be spread in the bottom of the road, and covered to the required depth with the uniform grade; and this, after rolling, may be lightly coated with screenings and rolled. If a very tough stone, such as trap, the screenings may be such as will pass a 1-inch mesh, or a 1½-inch mesh if limestone; and the uniform grade may be 2 inches for trap and 3 inches for limestone, with the screenings removed. Crushing and handling are cheapened by this system, and, for water-bound roads, a smooth surface results.

Trap or other tough rock brought from a distance by rail, in preference to the use of soft local material, may be justifiable for surfacing heavily traveled main roads; but it is a safe rule, if applied with discretion, that local material, if it exists, should be used. Much will depend on the teaming required, but for moderate wagon hauls up to two miles, on highways of the second and third classes, the writer has commonly found gravel roads being built for $100 per mile for each foot in width of metal; if local broken stone is used, the cost is, all things equal, about doubled, or $200 per foot, and, if imported by rail, about $300 per foot. Taking, then, a road not requiring much grading and with 8 feet of metal and 8 inches in consolidated depth, the cost might be stated, for cheap construction, at $800 a mile for a gravel road, $1,600 a mile for a road built of local crushed stone, and $2,400 per mile if the stone is brought in by rail.

Gravel in general is inferior to broken stone as a road material, but, if of a reasonable quality, is suitable for roads of the third class, township roads, and for many market roads of the second class; but, unless of exceptional quality, is deficient for heavy traffic. The rounded pebbles do not take the mechanical clasp that pertains to fragments of broken stone, while the sand which it usually contains is not equal to stone screenings as a binder. It may contain lime or iron, improving its bonding qualities, but as a rule it is not water-proof, and ruts readily in wet weather, especially if it contains sand, clay or loam in excess.

The best quality of gravel is of varying sized grain up to 2 inches in greatest dimension, with only sufficient fine material to fill the voids between pebbles. It should be clean and made up largely of a uniform grade of pebbles, qualities rarely found in natural pit gravel. Gravel pits containing a mass of large stones and boulders should be treated as rock, and put through a crusher. Gravel which is not coarse, but which is "dirty," should be screened to remove the excess of sand or clay. A rotary screen may be used, operated by steam power. The gravel can be drawn in wagons to an elevated platform, dumped into a hopper, from which it passes through the rotary screen, and from the screen to an elevated bin, from which the screened gravel is again loaded into wagons to be taken to the road. By means of the elevated bins the expense of shoveling into wagons is saved, the time of teams and teamsters is saved, and a well-arranged plant will, under favorable circumstances, pay for crushing and screening. This is particularly the case if a pit near the work can be used rather than to team better material a long distance.

METHODS OF CONSTRUCTION.

The methods of construction will largely determine the cost. Machine work is cheaper than manual labor. The cross-section adopted should therefore permit the maximum amount of machine construction. Particularly for the cheaper class of roads, the grading machine, in treating with old locations, should do most of the earthwork, supplemented with wheeled and drag scrapers. The cheapest and best plan in the writer's experience has been to make the earth subgrade, shoulder to shoulder between ditches, almost flat, or with a central rise of about 3 inches for a 24-foot grade. When this is rolled the stone is spread to the desired width in the center, then with the grading machine earth is drawn from the shoulders to support the stone, thus completing the camber. The stone is rolled dry to level the surface, the screenings are spread, sprinkled and rolled till consolidated. To grade the road and then excavate a central channel to receive the metal is a more expensive method, and is apt, for roads without a foundation, to place the stone too low for good drainage, producing what may be termed a "water-logged" road. Instead of the camber and turnpike being high enough to allow for settlement, it is apt to be made too low and flat.

As distinguished from earlier road-making, modern construction has been largely influenced by machinery, especially grading machines, rock crushers and road rollers. The smaller municipalities of Canada commonly use graders and crushers, but the purchase of a steam roller is too often delayed. It is to be pointed out that the cost of a roller is by no means an additional expense, since rolling effects economy in several ways. Coarser stone can be used in a road that is rolled, so that the cost of crushing is reduced. With coarser stone the road is stronger to resist wear, and is more securely bonded than if first rutted and mixed with mud. Less stone is required in a rolled road, as loose stone is largely forced down into the mud before the surface becomes water-proof, or is knocked to the ditches by traffic. Without rolling, roads demand attention for one or two years, to rake the stone to place from time to time; the earth shoulders have to be restored and leveled where cut up and destroyed by traffic; new material has to be added to fill hollows and ruts. By rolling the sub-grade, the wet or weak spots are developed, which can be drained or filled with earth and again rolled to produce a uniform foundation, thereby reducing the stone which the road would otherwise absorb. Long lines of loose stone left for traffic to consolidate are a most objectionable obstruction to travel, and bring road-building into disrepute. On the other hand, a road built with a heavy roller is a complete work, in perfect condition when finished. Rolled roads are a revelation to those who have been accustomed to and who expect only old-time methods and results. For economy, service, and to popularize the work, rolling should be regarded as essential for every class of gravel and stone roads.

EDITORIAL COMMENT

Conservation of National Resources.—Collection and Disposal of City Wastes.

CONSERVATION OF NATIONAL RESOURCES.

A recent paper by R. R. McCormick before the Western Society of Engineers, emphasizes the conflict between public and private interests in the development of improvements on a national scale, and opens up by implication a large field in which to view the ramifications of the contest between the old ideas of privilege, the right of discovery, the rights of those who have secured claims to great natural advantages by any means whatever, and the new ideas of public ownership of great natural gifts, whether developed under government ownership or by private enterprise under government control such that the people secure the benefits of these truly national possessions at the same time that the private developers and operators secure the benefits of their enterprise, their skill, and their courage in venturing upon the improvements in advance of certain knowledge as to the course of development in the district or of the industries involved.

The principle involved is the same as that behind state control of the natural monopolies operated as public service industries, local, state and national, and the only difference is in the methods by which the state and the nation can assume the control of them which, according to the modern ideas, belongs to them.

Mr. McCormick emphasizes particularly the case of incidental advantages to local owners of property and rights on account of improvements made by state or national government on other accounts. He cites as examples the water powers developed and to be developed along the line of the waterway from Lake Michigan to the Gulf of Mexico, and also the improvement in values of water front privileges on account of these improvements in navigation. For years these water powers have been of little or no value and the water front privileges have hardly paid the expense of maintaining and operating them. But now the United States government is deepening and straightening channels and making canals with locks, primarily for the purpose of improving navigation. The increase in value of water power sites and of water front privileges is none the less certain. This increase is produced by national activity; the local owner of water power or water front is in no way responsible for it; why should he receive as a gift the vast benefit which results? Under the old idea the private exploiter had a right to all the benefits that accrued to him from any source, accidental or intentional, no matter what the equities of the case might demand, and the early reports on the improvement of the Illinois river, for example, proceeded on the principle of interfering as little as possible with the private water privileges along the line. Under the new idea that the increment in value of natural monopolies due to the general development belongs to the public, and the extension of this idea to cover the increment in value of private properties due to construction of public improvements, the local owner of previously existing privileges is really the owner only of so much thereof as he has developed, and the public at large, represented by its government, national, state or municipal, as the case may be, is the owner of the increment. The question is regarding the method of assuming control of this increment of value, not as to the right to do so.

Mr. McCormick goes farther and takes

up the conflict between private and public rights which arises from proposed improvements. His example of this condition is the treatment of the Great Lakes. He states that the lakes have three general uses, as sources of water power, as routes of navigation, as sanitary agencies for the cities along their borders. He disposes of the developers of water power under the old idea of personal ownership, by claiming that the public use is paramount; and he contends that the public sanitary use of the lakes overshadows in value their use for navigation by private persons. His logic is not so convincing in these respects as it is in the case of the river improvements above mentioned, but there is a large amount of truth in his contention and where such conflicts of interest arise it is necessary to weigh the respective claims with great care and to make decisions which will produce the greatest good for the greatest number at the same time that they work the least possible injustice to those on the other side.

The conservation to the public of the increment in value on account of general development is taken care of in a few states, so far as public service industries are concerned, by the state public service commissions. A beginning has been made in national concerns through the Interstate Commerce Commission, and in local matters under national influence through such organizations as the Reclamation Service. The right of the private owner to only so much of a public supply as he develops and uses has been definitely fixed in most of the states with laws governing the application of water to irrigation. The principles upon which the new idea of public ownership of "unearned increments" of value is based are thus being applied successfully in a few cases. The application will be extended as we extend our recognition of its suitability and learn how to make it.

Too much of our national river and harbor work has been done under false pretenses to make it easy to apply the principles under discussion thereto. It is very doubtful whether the interests of navigation would ever have induced the expenditure of the vast sums which have been used in protecting the banks of the Mississippi river. The vast improvement in local conditions, the vast increase in local values of land and other property, tangible and intangible, has had fully as much to do with the appropriation of money for work on the Mississippi river as the improvement in navigation. The unearned increment in local values due to the work on the river is so wide-spread that the principle is lost sight of in the wide extent of this personal benefit, but it is none-the-less on a wrong basis.

The single-taxers carry the principle still farther and would conserve for the state all increments of value which are due to the development of the community.

But we must learn how to apply these principles in each particular field before we can make the advance successfully. The schemes of private interests are numerous and not easily discerned. This is shown by a recent development in a small section of the same field. The United States Department of Agriculture has for some time been spreading information about methods of improving the agriculture of the country and has sometimes overstepped the bounds of propriety in doing work for private owners for which service they should at least have paid full price, but when the reports of such work can be juggled and suppressed and again substituted and printed as public documents bearing the ostensible authority of the Department although published without its knowledge and approval, the ability of the United States government to organize and co-ordinate its work so that it shall be efficient and free from suspicion of private influence is called in very grave question. This is but one indication of the fact that we must learn how to make the desired application of the new ideas before we can hope for full success. It is of minor importance so far as magnitude is concerned, but it is of the utmost importance as showing the defects in our system of government which we must set about correcting before we can develop satisfactorily the desired improvements.

COLLECTION AND DISPOSAL OF CITY WASTES.

The State Board of Health of Ohio in 1909 and 1910 made a study of the methods of collection and disposal of city wastes in a number of the cities in the state and has printed a report of the investigation in a supplement to its 25th annual report. There is much of interest in the report, although there is not much which can be used as a guide to a satisfactory treatment of the problems involved. It is on the whole a report of the insufficiency of the methods employed, although there are many points of detail which are quite satisfactory.

The classification of city wastes which is used includes eight items, garbage, rubbish, ashes, street cleanings, dead animals, manure, night soil, and industrial wastes. The second item, rubbish, ought really to be subdivided into combustible and incombustible rubbish, although that used is apparently sufficient for the methods of collection and disposal observed.

The larger cities in the state, Cleveland, Columbus, Cincinnati, Dayton and Toledo, have garbage reduction plants, the first two under municipal ownership, and the smaller cities have developed the destruction of garbage as the most serious problem, leaving the other city wastes outside the system, so that they all collect garbage separately from the other wastes. The term garbage is held to cover wastes of a putrescible nature from household, hotel and restaurant kitchens, and similar wastes from markets, groceries and the like. The garbage from different sources is readily distinguishable by its appearance and is classified as (a) that from high-class residential districts averaging 23 per cent of the total from residences in the four largest cities, not including Toledo; (b) from medium class residences, 57 per cent; (c) from low class and tenement districts, 20 per cent. These are also (d) from hotels and restaurants, varying from 7 to 22 per cent and averaging 12 per cent of the total collection; and (e) from market, commission, and grocery houses, etc., varying from 1 to 16 per cent and averaging 6 per cent of the total collection in the four cities under observation.

Garbage weighs from 1,173 pounds per cubic yard in Columbus, to 1,475 pounds in Dayton, the latter on account of the excessive amount of water contained, owing to the method of collection.

The percentage of moisture in about 100 samples examined varies from a minimum of 72.7 in Cleveland to a maximum of 83.3 in Dayton. When this moisture is removed the ash in the remainder varies from 10.56 per cent. minimum in Columbus, to 20.35 maximum in Cincinnati; combustible matter from 39.66 per cent minimum in Cincinnati to 89.44 in Cleveland; calorific value from 7883 B. t. u., minimum in Cleveland, to 9186 maximum in Cincinnati..

The quantities of garbage collected are probably not as large in all the cities as they will be when systems of collection are fully developed. For 1909 they vary in the four larger cities from 164.5 pounds per inhabitant per annum in Cleveland, to 211 pounds in Dayton, the latter being perhaps 20 pounds higher on account of the higher percentage of moisture. The smaller cities included in the report evidently have very incomplete systems, for the amount of garbage collected per capita varies from about 8 to 120 pounds per year, in some cases doubtless because it is consumed on the premises or collected by private parties for individual use.

As to disposal of garbage, Columbus formerly buried it, several of the smaller cities fed it to hogs and others dumped it into large streams. Columbus and Cleveland now have reduction plants under municipal ownership, Cincinnati and Dayton have them under private ownership, and a Toledo company is building a reduction plant in that city. Canton and Mansfield have Dixon garbage crematories, Marion a Walker incinerator, Steubenville one built by Lewis and Kitchen, and Zanesville a Decarie plant.

The list of cities having any reasonable approach to a satisfactory disposal of garbage is very small for a state with as many cities as are located in Ohio, there being but two, Youngstown and East Liverpool, not included in the report and mentioned above. Ohio is doubtless as progressive in this matter as other states and this report is simply an indication of the backward condition of this line of sanitation in the United States.

Rubbish, ashes, street and catch basin cleanings are dumped on land in all the Ohio cities reported upon. The dumps are generally reported to be unsightly but not particularly unsanitary or otherwise objectionable except when the amount of combustible refuse is great enough to cause active or smoldering fires, producing odorous smoke and gases.

Manure and night soil are collected at private expense in all Ohio cities, in some under municipal supervision and in Cleveland the night soil by a municipal force. Night soil is dumped into sewers or buried. The disposal of dead animals is also not organized, private rendering companies taking care of them in all cities, although Columbus and Cleveland are prepared to take care of them.

There is room for much improvement in these matters and for considerable increase in the return from the disposal of all these classes of refuse, in addition to improvement in the sanitary conditions attending their collection and disposal.

The cost of collection and disposal is not easily obtained. A few cities keep incomplete data, from which incomplete and somewhat inaccurate reports have been made. Apparently garbage collection costs about $2.50 a ton in Cleveland, where accurate records are kept; $2.10 in Dayton; and $2.15 in Zanesville. Cleveland reports a net profit from its garbage reduction plant, which has increased each year from 16.7 cents per ton in 1905 to $1.92 in 1909, the latter going far to pay the cost of collection. Incineration costs about $2.60 a ton in Canton; $2.40 in Marion; $1.30 in Steubenville, and $2.55 in Zanesville.

The net cost per ton of garbage collection and disposal combined has diminished in Cleveland from $2 in 1905, to 87 cents in 1909; is about $2.65 in Cincinnati; $2.55 in Columbus; $2.10 in Dayton, and $4.70 in Zanesville.

The cost of rubbish and ash collection is more uniform, being about $1.20 in Cleveland; $1.32 in Cincinnati, and 80 cents in Dayton.

Street cleaning costs about $1.13 per cubic yard of dirt removed in Cleveland; $1.65 in Cincinnati, and $1.71 in Columbus.

It costs about 85 cents to clean a catch basin in Cleveland, and $1.75 in Cincinnati.

Detailed reports are given from each of the cities named, so far as observation and examination of records can give a basis for them. The systems are fragmentary and the data are meager, and, as suggested above, the report shows, by its lack of data, the unsatisfactory state of refuse collection and disposal. There is much information in the 290 pages of the report, in addition to that indicated by the preceding meager summary, and it is well worth reading by those interested in the subject.

THE QUESTION DEPARTMENT

Cost of Electric Current in Cities.

In further reply to the question regarding prices and cost of electric lighting in cities, which was answered in part in the April number, p. 254, the following data concerning New York and Massachusetts cities of 100,000 to 200,000 population have been collected from the reports of the state public service commissions having these matters in charge:

Two of the cities of populations between 100,000 and 200,000 are in New York; viz., Syracuse and Albany; and full reports of their operations are made to the public service commission. Abstracts therefrom are printed in the commission's annual reports. The following data are from the report for the year 1910, and give mainly the unit incomes and costs, as giving the most satisfactory figures for comparisons. Both the corporations operate both electric light and gas plants, and separations of costs are made in the reports, so that the figures given below are for electric light only.

The operating revenues for the Syracuse Lighting Company are $826,527 a year, and of the Municipal Gas Company of the city of Albany are $466,636.

After making deductions of electric operating expenses, the incomes from electric operations are $312,306 and $149,991, respectively. The bonded indebtedness of the Syracuse company is $6,497,000, on which about 5 per cent. interest is paid. The capital stock of the Syracuse company is $4,000,000, on which 5 per cent. dividends are paid. That of the Albany company is $2,000,000, on which 10 per cent. interest is paid. The capitalization includes both the electric light and gas plants.

Operating revenues in cents per kw. hr. are as follows:

	Syracuse.	Albany.
Municipal arc lights	4.95	4.87
Municipal inc. lights	12.45	2.80
Lighting city buildings	6.10	6.00
City heat and power	6.88	4.82
Commercial flat rate lighting	5.07	5.00
Commercial flat rate power	1.29	3.20
Commercial metered lighting	7.05	5.30
Commercial metered power	3.24	3.30
Other corporations, 3.15 and	3.75	....

Operating expenses are reported as follows, the cost being in cents per kw. hr., generated or purchased:

	Syracuse.	Albany.
Station superintendence and labor	1.229	3.794
Fuel for power	2.067	1.818
Other station supplies and expenses	.472	1.447
Repairs power plant buildings	.161	.932
Repairs steam equipment	.414	.302
Repairs power plant electric equipment	.138	.101
Miscellaneous station repairs	.001	.022
Electric energy purchased	.656	.886
Total production expenses	1.405	1.352
Total transmission expenses	.024	.....
Distribution office and superintendence	.042	.034
Moving meters and transformers	.030	.013
Distribution main repairs	.188	.053
Distribution services repairs	.021	.007
Transformer repairs	.006	.000
Meter operation and repairs	.026	.041
Total distribution expenses	.312	.149
Commercial arc operation	.007	.012
Commercial arc repairs	.000	.006
Commercial inc. operation	.092	.016
Consumers' installation expenses	.020	.002
Municipal street arc operation	.040	.164
Municipal street arc repairs	.032	.042
Municipal street inc. operation	.001	.000
Total utilization expenses	.191	.244
Commercial administration	.134	.064
Promotion expenses	.104	.011
Total commercial expenses	.238	.075
General administration	.055	.045
Insurance	.036	.013
General amortization	.229	1.035
Injuries to persons and property	.032	.004
Stationery and printing	....	.010
Store and stable expenses	....	.050
Miscellaneous adjustments, deduct	.071	.013
Total general and misc. expenses	.281	1.143
Total operating expenses	2.451	2.964

The low "production expense," as compared with the sum of the items preceding, is explained by the following figures, and shows that these companies generate current for themselves at a much higher cost than they purchase it for.

Total kw. hrs. generated	2,462,223	384,084
Total kw. hrs. purchased	24,047,356	11,566,571
Total kw. hrs. sold	19,082,822	9,970,603
Total kw. hrs. used by company	279,610	92,000
Lbs. coal consumed per kw. hr. generated	15.03	5.19
No. of consumers	10,588	3,776
Charges for installing services	100 ft. free	free
Minimum charge per mo., $1 lt. and	$1 pr. hp.	none
Charge for inc. installations	yes.	cost
Charge for inc. renewals	free carb. lts.	cost

STREET LIGHTING.

	Syracuse.	Albany.
Hours burned per year	4,000	4,000
Schedule	all nt.	all nt.
Arc lamps, no.	1,666	897
Arc lamps, wattage	325	450
Arc lamps, price pr. yr.	$68	$98.55
Incandescent lamps, no.	5	.....
Incandescent lamps, c.p.	32	.....
Incandescent lamps, price per year	$20	.....

Four of the cities between 100,000 and 200,000 population are in Massachusetts. The following data are taken from the report of the Board of Gas and Electric Light Commissioners of Massachusetts, and are for the year ending June 30, 1910:

COMMERCIAL RATES

	Worcester	Fall River	Lowell	Cambridge
Max. light rate—cents per kw. hr.	12*	12	13‡	12
Min. " " " " "	4	5	6	7
Min. monthly charge	$1 00 res. 10c pr. lp. bus.	$1.00	$1.00 res. $1.66 arc.	$1.00 inc. $2 00 arc. $2.00 to $5.00 motor.
Max. power rate—cents per kw hr.	6	10	11	10
Min. " " " " "	2	1½	3†	1¾
Discounts	......	10%	10%	Lt. 10%
Renewals	Free to stores	Carb free Tung. cost	Free to meter Cost to contr.	Carb. free. Tung. cost.

MUNICIPAL RATES

	Worcester		Fall River		Lowell		Cambridge		
Hours per year	2189		3940	3940		3940		3878	
Capacity, watts	50	75	400	75	375	75	500	50	75	450
Price	$18	$24	$91.25	$25.00	$91.25	$22.50	$100.00	$25.00	$90.00

*Arcs, 30 cents per lamp per night until 6 p. m.; 40 cents until 10 p. m., 50 cents until 12 p. m., 60 cents all night.

†For power 11 cents per kw. hr.; discounts 5 to 56 per cent.; monthly minimum $1.11 up to ½ hp., $1.66 up to 1 hp., $3.33 up to 2 hp., $5.55 over 2 hp.; minimum for large consumers $2 per mo. for 1st hp. of maximum demand, $1.25 for each additional hp.; 3 cents per kw. hr. for current consumed and 5 to 44 per cent. discount according to maximum demand, and 10 per cent. for prompt payment.

‡For arc lights, stores and factories, demand system, 13 cents per kw. hr. for first 50 hours' use of connected load; 6 cents for all over 50, 25 hours' use per month minimum; $1.66 per lamp per month, minimum.

DIVIDENDS AND COST OF CURRENT.

	Worcester.	Fall River.	Lowell.	Cambridge.
Capital	$800,000.00	$600,000.00	$1,023,000.00	$800,000.00
Dividends for year, per cent	10	8	8	20
Current, generated, kw. hrs.—				
For street lights	1,326,100	1,185,430	1,272,843	1,289,422
For commercial lighting	2,881,710	1,482,986	2,193,568	1,590,801
For commercial power	1,673,798	961,207	6,336,052	3,027,476
For other companies	....	....	....	236,387
Total	7,126,314	4,873,250	12,986,367	7,344,392
Cost—				
Operating expenses—				
Mfg. dist. manag., tax, inci	$193,340.04	$163,554.63	$253,345.68	$174,180.87
Depreciation or sinking fund	103,112.35	....	6,950.00	25,000.00
Reserve fund	....	21,200.00	24,264.26	35,000.00
Interest	2,331.86	17,366.35	10,223.52	1,073.33
Other items	....	....	981.43	601.91
Operating receipts	$380,585.88	$243,399.32	$395,297.91	$335,110.67
Dividend paid, cts. per. kw. hour	1.12	0.99	0.63	2.18
Operating expenses, cts. per kw. hour	2.71	3.36	1.95	2.37
Depreciation charge, cts. per kw. hour	1.45	....	0.05	0.35
Reserve charge, cts. per kw. hour	....	0.44	0.19	0.48
Interest charge, cts. per kw. hour	0.03	0.35	0.08	0.01
Other items, cts. per kw. hour	....	....	0.01	0.01
Total cost, cts. per kw. hour	4.19	4.15	2.28	3.22
Receipts for current generated, cts. per kw. hour	5.34	4.99	3.04	4.56

Fall River received permission during the year to increase its capital stock \$50,000, the stock to be sold at 150, and Worcester a like amount, to be sold at 200.

Charlestown reduced its net commercial rate from 13 1-3 to 12 cents per kw. hr. during the year.

Books on Gas Construction.

Would you kindly advise me of the titles of any books known to you, dealing with the construction and operation of a gas plant for towns of about 15,000 population? I should also like to know the names of firms which handle materials for this construction.

N. G. W., Rock Hill, S. C.

An American book on gas engineering is Latta's "Hand-Book of American Gas Engineering Practice" (\$4.50). Newbigging's "Hand-Book for Gas Engineering and Managers" (\$7) is an English book covering the field well. Webber's "Town Gas" is perhaps the book most directly applicable.

R. D. Wood & Co. and the United Gas Improvement Co., Philadelphia, and the Western Gas Construction Co., Ft. Wayne, Ind., are prominent makers of the apparatus required.

Floor for Highway Bridge.

This city is the owner of a wagon bridge across the Chippewa river at this place, which is built of steel, excepting the planking and joist on which the planking is laid. The joist are 4 in. by 14 in. by 20 ft. long, the ends of which rest on steel beams. The plank used for the roadway are of elm and are 3 inches thick, and the roadway is 18 feet wide, and the length of the bridge is 1,100 feet.

This bridge requires new planking every four years; and we are in the market for a dressing to put on top of the planking—if there is one in existence—that will protect and preserve the plank and make it wear longer, if there is one that can be had at a price that will make it practicable.

J. P. S., Chairman Bridge Committee,
Durand, Wis.

No data are given as to the strength of the bridge, so that it is not possible to recommend anything which would materially increase the weight of the floor system. Wood wears much better if the traffic is on the ends of the fibers, but this would require a wooden block pavement supported on a base which would materially increase the weight of the floor. If the life of the timber is affected by decay, it would be worth while to creosote it, although even this could not be done very completely without materially increasing the weight of the floor, for a treatment of 3-inch planks with 20 pounds of creosote per cubic foot would increase the weight of the floor 5 pounds per square foot.

The city of St. Louis has recently been treating its wooden block pavements with a sprinkling of oil, followed by a top dressing of sand (not too much) to be held in place by the bituminous coat. This is done to reduce the slipperiness of the wooden pavement, but it would also have some effect in reducing the abrasion of the wood if a sufficient quantity of sand is held by the oil. There is no report as to whether this treatment causes trouble by tracking the oil onto neighboring sidewalks and into neighboring houses.

Have our readers anything to suggest?

Best Filler for Brick Pavement—Slag for Concrete Base of Pavements.

What do you consider the best filler for brick pavements now on the market? While I am inclined to favor cement on level streets, I would like to gather other information on the subject.

I noticed an article in the Question Department, issue of February, 1912, in regard to slag for concrete. Do you know of any place where slag concrete is used for concrete base?

J. N. G., ———, O.

These questions are referred to our readers, with request that they give their opinions on the first and any information about the second which they may have.

There is much difference of opinion about the first question among the experts, and, perhaps, the most complete discussions of all sides of the subject have appeared in MUNICIPAL ENGINEERING, numerous adherents of cement fillers and of bituminous fillers having given their views in many numbers of the magazine during the past eight or ten years.

Who Shall Pay for Grade Crossing Elimination?

I have read intimations of a late decision of the Supreme Court of the United States, the purport of which is, that railroads may be compelled at their own expense to put in a subway or overhead crossing to avoid a grade crossing, where it is dangerous.

This decision, or series of decisions, was referred to in one article I read as the St. Paul grade crossing cases.

I would be greatly obliged if you could inform me where this decision is to be found, so that I can obtain a copy of it, or of them, if there are more than one.

J. M. B., ———, Ill.

This matter seems to be entirely in the hands of the state legislatures who may, as a public regulation for the public safety or under a power reserved to alter or amend a railroad charter, require the abolition of existing crossings at grades between streets or highways and railroads, or may authorize a municipality to require such change, and may require that the expense of such change be paid either by the railroad company or the county, township or municipality where the crossing is situated, or in part by both. Cities and counties can exercise only such powers in this respect as have been delegated to them by the legislature. The work may be done and the expense distributed by joint agreement between railroads, street railroads and municipalities interested.

That the entire expense may be placed on the railroad in Connecticut is affirmed in New York, etc., R. Co.'s Appeal, 62 Conn. 527, 26 Atl. 122; New York, etc., R. Co. v.

Bristol, 151 U. S. 556, 14 S. Ct. 437, 38 L. Ed. 269; Fairfield's Appeal, 57 Conn. 167, 17 Atl. 764.

Can our readers refer us to other decisions on the subject?

Terms of Telephone and Interurban Freight Franchises.

As we are now considering a telephone franchise ordinance in our city, will you kindly furnish me any information you have at hand as to the latest requirements and conditions of telephone franchise ordinances? I should also be glad to have information on freight carrying regulations of interurban lines through cities.

J. E. C., City Attorney,
———, Cal.

Telephone Ordinance. In the proceedings of the thirtieth convention of the Indiana Engineering Society, 1910 (50 cents), will be found a paper on "A Proposed Telephone Franchise," which covers most, if not all, of the points which have arisen in modern discussions of telephone franchises. This proposed form of franchise was prepared by a committee of the Commercial Club of a small city, and was accepted by one of the competing companies, but was not passed by the city council, and later business and political changes caused the matter to be dropped.

The principal difficulty which arises in fixing the terms of a franchise is the lack of information concerning cost of service and consequent rates to be adopted, and in change in cost of service as the plant increases in value and consequent provision for change in rates. This is taken care of in the proposed franchise by means of a commission which has control of the profits of operation, to the extent of making rebates to customers or of increasing rates if there is a deficit in operation which seriously affects a reserve fund, which is provided.

Provision is made for ample interest return upon the cash actually invested in the plant, for depreciation in the plant, and for operation expenses, before counting net profits; and these net profits are divided between the company and the commission, the latter using its share as above suggested, after paying its necessary expenses.

Efficiency of service is another important matter which must be provided for in a franchise, especially when there is no competing company. The commission has control over this matter, also, and can enforce its rulings, subject to the decision of a disinterested expert committee, in case either side thinks itself sufficiently aggrieved to appeal to it.

With these provisions carefully safeguarded, the question of rates at the beginning of the franchise is not so important, as the returns of the operation of the plant will soon demonstrate their nature.

Some of these proposed provisions have been used in franchises for other public service industries, and their practical application is shown in an article on "Some Provisions in Modern Franchises for Municipal Service Utilities," published in MUNICIPAL ENGINEERING, vol. xxxix, p. 456, in the cases of a gas company and a water company.

The city of Indianapolis is just now discussing the terms of a new telephone franchise, and has rejected one proposed by the companies as failing to safeguard sufficiently the questions of capital on which interest and dividends must be paid, inordinate swelling of expenses through the medium of royalties, subordinate construction and supply companies, etc., and increase in rates with increase in number of telephones, without sufficient knowledge of the rate of increase in cost of service with such increase in business.

The question of long-distance service and rates, where there is no competition, is of great importance. This has not yet been properly considered in any franchise, and thus far there is no standard to follow; but it must be worked out in accordance with local requirements.

Interurban Freight Ordinance. The following provisions in the franchises of the interurban railroads entering Indianapolis have been in successful operation for many years, and seem to cover the conditions completely. All companies have the same provisions, the latest without any changes from the earliest, except as to routes and other conditions peculiar to the particular lines.

5. Mail—Expressage—Freight. The said company, party of the second part, may at all times carry in its passenger cars, or in suitable compartments thereof, provided for such purpose, or in mail, express or freight cars of a style and pattern to be approved by the Board of Public Works, such baggage belonging to its passengers, being transported in such passenger cars, as is usually allowed to be carried by passengers in steam railroad companies' cars, and also the United States mail, and such express matter and merchandise as may be enclosed in boxes, crates and parcels, so as to be easily handled, and so as not to be unsightly in appearance or offensive to sight or smell, and also such packages and parcels as are usually carried and delivered by messenger service: Provided, That no live animals (except hunting dogs) shall be carried in any such cars or in any such compartment at any time; and Provided further, That all baggage (other than hand baggage), express matter, parcels and articles of merchandise carried as aforesaid shall be delivered at the station and terminals herein referred to, for distribution, and that in no case shall any such baggage (other than hand baggage) or any express matter, parcels or merchandise be loaded or unloaded in or upon any of the streets, alleys, avenues or public grounds of said city, except at said station or terminals. Provided, also, That fowls properly secured in boxes or coops, may be carried in said cars between the hours of 12:30 a. m. and 4:30 a. m.

6. Freight. The said company, party of the second part, shall not be permitted under any circumstances to transport in its cars through or over the streets, alleys or avenues of said city, live animals of any kind, other than hunting dogs. Said company, subject to the conditions hereinafter prescribed, shall be permitted to haul and handle

freight other than designated in section 5, when a station or terminal for the receipt and delivery of freight shall have been provided. After such terminal or station shall have been provided, the said company may deliver freight, other than live animals, not of a character offensive to sight or smell, into such station or terminal, where the same may be held for delivery to any part of said city, or for transfer to steam railroad lines, or to the lines of other suburban or interurban companies which may be able to transport the same under any ordinance regulating such transportation. Until such station or terminal for the receipt and delivery of freight shall have been provided, said company, for the purpose of loading and unloading its cars, shall have the right, by first securing the consent of the Indianapolis Railway Company and said Indianapolis Traction and Terminal Company, to stand said cars upon some line of "dead track" of said Indianapolis Street Railway Company or said Indianapolis Traction and Terminal Company: Provided, That the selection of such "dead track" shall be first approved by said Board of Public Works; and provided further, That such cars shall not be allowed to stand more than 15 minutes at any one time in loading or unloading.

The right is hereby expressly reserved by the Board of Public Works and Common Council of said city, to regulate by order or ordinance the carrying of freight, merchandise, or property of any kind described in sections 5 and 6 of this contract, through the streets, alleys and avenues of said city, and at any time during the term of this contract, to change the route of cars of said company, used exclusively for carrying mail, express or freight, over the lines and tracks of the Indianapolis Street Railway Company and the Indianapolis Traction and Terminal Company, but only on such a way that such route shall connect with the other part of the line on which said company enters the city, and at the same time connect with the station or terminal of the receipt and delivery of freight herein referred to.

7. Rates—Discriminations. The rates charged and collected by such company for the carriage of freight matter between Indianapolis and points on its lines shall not exceed those charged and collected for the carriage of like freight matter between the same points by other common carriers of freight; and the rates charged and collected by such company for the carriage of express matter between Indianapolis and points on its lines shall not exceed those charged and collected for the carriage of like express matter between the same points by other common carriers of express matter.

Provided, however, That such company shall never be compelled to charge or collect less than 80 per centum of the published rates now charged for the carriage between the same points of freight or express matter, as the case may be, by other common carriers of freight or express matter between such points.

Provided further, That the maximum rates which such company may charge hereunder shall not apply to freight or other classes than classes 1, 2, 3 and 4, as such classes are defined by the classification in use on January 1, 1902, by the railroad companies operating between Indianapolis and such other points, such classification being that known as "Official Classification No. 22," copyrighted in 1902 by C. E. Gill, chairman.

Compensation to the city is provided by a charge per round trip within the city limits against all passenger and freight cars in use.

The interurban freight station is provided for in a contract with the Indianapolis Traction and Terminal Company, which accounts for the above form of the provision regarding it.

Who is Damaged by Broken Water Mains—Can City Restrict Water Company to Service in City?

Where a private water company, supplying water to the inhabitants of a city, allows water to run from a break in its pipe in the street, to cave in a sidewalk at the side of the street in front of private property, is the city or the abutting property owner the party interested who should demand, and if necessary sue for, damages for same?

Also, would an ordinance stand in California, where the water company furnishing the city with water also furnishes water outside for irrigating purposes, making it the duty of the company first to supply the inhabitants of the city with water for domestic purposes, any surplus only to be sold for irrigation outside of city? The proposition is to bind the company by ordinance, if possible, to furnish a constant supply to the city where it has plenty of water to do so if not sold for irrigation purposes. Of course, if it gets too careless in its service, the company forfeits its franchise.

O., City Attorney,
———, Cal.

The first question depends for its answer upon the ownership of the damaged sidewalk. In some states the street and sidewalk belong to the abutting property, the public having the right of way only. In some states the sidewalk is specially considered as belonging to the abutting property, and the city steps in to improve it only when the property owner neglects his duties, and then does the work at the expense of the property benefited. In other states the property owner owns only his lot, and the street and sidewalk are public property, not subject to alienation of title, except under definitely formulated conditions.

If the property owner must pay the cost of repairing the street directly, he is the one to make the demand; but if the city must pay it, or if the city must repair the sidewalk, even if the property owner must pay for it, it would seem that the city should make the demand. In that case the property owner could probably force the city officials to act if they neglected their duty.

The writer is not familiar with California statutes, and so cannot make the direct application of these principles.

The second question is one for an attorney familiar with California laws. In some states water companies are restricted very closely to the districts they serve. In some cities they are so restricted by their contracts with the cities. Conditions are different in the states where water companies give service for irrigation as well as city water supplies.

The city's contract with the water company should provide for an adequate supply and for forfeiture of contract rights if there is a failure in supply. Quite possibly such a requirement could be imposed, if not already in the contract, as a matter of public necessity. This would probably depend upon the relative necessities of the various services the company is attempting to perform, priority of contract, etc.—questions which are purely local in their nature, but which may be of such nature as to determine the matter.

No long-distance opinion upon these questions can be of any value so far as details are concerned.

Information About Thawing Water Pipes.

Please advise me if any of the back numbers of MUNICIPAL ENGINEERING contain articles of practical value on thawing water service pipes by electricity.

If you can refer me to any other source of information, I would appreciate it very much.

C. H. W., Newark, O.

A brief article in vol. xlii, p. 39, gives the principles of the method of thawing service pipes by electricity, with references to other sources of information. A description of the method in detail is given in vol. xvi, p. 374, and a brief reference on p. 189. Other methods of thawing water pipes are briefly stated in vol. xv, p. 50, and vol. xxviii, p. 35.

Monuments and Maps for Locating Water Mains and Appurtenances.

I would like you to give form or information regarding maps for showing a water system in a town of about 2,500. Especially as to the best method of accurately locating valves, dead ends, etc., and of recording them. This city wishes a map made showing location of pipe lines, etc.

Now I can locate some valves by showing distance from cement walks, etc., but where no permanent monument exists near enough to a valve or cut-off to conveniently locate same, is it customary to drive an iron stake or erect some monument from which to locate such valves, etc.?

T. R. M., ———, Iowa.

Will our readers give statements of their practice and observation on this point?

The simplest method, where monuments are necessary, is to place two substantial concrete monuments in line, locating them so that they will not be in danger of destruction by vehicles and in as little danger as possible of displacement by subsequent improvement of street or sidewalk. If the line of the two monuments when produced will pass through the point to be located, but one measurement is necessary, otherwise a measurement along the line and at right angles to it or from the point to be located to each monument will be necessary. Iron pins may be used, but they are not as permanent as well placed and substantial concrete monuments. The iron pin may be placed directly over the point to be located, provided it is replaced every time the point is uncovered.

Books on Water and Its Utilization.

Please refer me to books on the subjects of concrete dam designs, water turbines, filtering of water and flood gates for dams.

J. H. M., North Vernon, Ind.

Design and construction of concrete dams is treated in more or less detail in such books as Reid's "Concrete and Reinforced Concrete Construction" ($5); Taylor and Thompson's "Treatise on Concrete, Plain and Reinforced," ($5); Buel and Hill's "Reinforced Concrete" ($5).

Wegmann's "Design and Construction of Dams" ($6) considers concrete dams briefly.

Wood's "Turbines" ($2.50) is one of the older books on the subject.

Blaine's "Hydraulic Machinery" ($5) gives descriptions of such machines.

Mead's "Water Power Engineering" ($6) treats among other subjects of the turbine, principles of construction and appendages to dams.

Beardsley's "Design and Construction of Hydro-Electric Plants" ($5) has a chapter on dams, penstocks, head gates, flash boards, etc.

Church's "Hydraulic Motors" ($2) discusses turbines with other hydraulic motors.

Frizell's "Water Power" ($5) covers dams, turbines and appurtenances.

Molitor's "Hydraulics of Rivers, Weirs and Sluices" ($2) may be of interest on the theory on which designs should be based.

Fuertes's "Water Filtration Works" ($2.50); Hazen's "Clean Water and How to Get It" ($1.50); Hazen's "Filtration of Public Water Supplies" ($3).

Turneaure and Russell's "Public Water Supplies" ($5) is the best book covering the whole of its subject.

Condemnation of Water Front for Municipal Ownership.

Have you anything on eminent domain? We are trying to condemn some water front.

J. L. B., ———, Fla.

The taking of land for a wharf, dock or pier is a taking for public use, as decided in the case of Jeffersonville v. Louisville, etc., Steam Ferry Company, 27 Ind. 100, 89 Am. Dec. 495, and the fact that a statute imposing on a city the duty of maintaining piers along its water front also gives it authority to give exclusive use to some piers for particular steamship lines does not make the use of such piers a private use; in re New York, 135 N. Y. 253, 31 N. E. 1043, 31 Am. St. Rep. 825, 18 N. Y. Suppl. 536; but a statute authorizing a city to license the erection of sheds by private persons on the public piers is void; People v. Baltimore, etc., R. Co., 117 N. Y. 150, 22 N. E. 1026, 23 N. E. 1144.

Land may be taken for the improvement of harbors and for furnishing better accommodations for the city's commercial interests; Moore v. Sanford, 151 Mass. 285, 24 N. E. 323, 7 L. R. A. 151.

Land may be taken for public parks; District of Columbia, U. S. v. Cooper, 20 D. C. 104; Kentucky, Rowan v. Portland, 8 B. Mon. 232; Missouri, St. Louis County Ct. v. Griswold, 58 Mo. 175; New Jersey, Albright v. Sussex County Lake, etc., Commission, 68 N. J. L. 523, 53 Atl. 612; New York, People v. Adirondack R. Co., 160 N. Y. 225, 54 N. E. 689, 176 U. S. 335, 20 S. Ct. 460, 44 L. Ed. 492; in re Rochester, 137 N. Y. 243, 33 N. E. 320, 20 N. Y. Suppl. 506; United States, Shoemaker v. U. S., 147 U. S. 282, 13 S. Ct. 361, 37 L. Ed. 170.

Private wharf property and land under water may be taken to provide a uniform system of wharves and piers in a city; in re New York, 18 N. Y. Suppl. 536.

Sewer Grades and Pipe Joints in Separate System.

What small cities or towns convenient to this location can you name having thorough-going separate sewer systems?

Have any examples of such separate systems been published in detail with sizes and grades of lines, recurrence of lamp and manholes, size and kinds of flush tanks, etc.? If so, what is the source of the information?

All authorities on sewering that I have seen treat thoroughly of the minimum grade for carrying the solids of sewage when flowing half full. What to do with too much grade on the other hand, and less than half flow seems to be left very much like Sam Weller's spelling of his name that he said was, he supposed, very much according to the taste and fancy of the speller. An obvious suggestion to my mind for the upper measures of the separate sewer is an egg shaped pipe of say 8-inch section and 3-inch bottom. Why not?

What joint material may be put in the hands of the ordinary workman with hope of better success than stuffing with cement which is notoriously not very successful in keeping out ground water?

C. E. V., ———, O.

Alliance, O., has sanitary sewers. Canton has sanitary and storm water sewers on the separate system. Glenville, now a part of Cleveland, has a separate system of sanitary and storm water sewers. Oberlin has sanitary sewers which apparently receive considerable storm water at times. Ashland has sanitary sewers with a few separate storm water drains. Geneva has sanitary sewers only. Shelby has the separate system, but there are many roof water connections to the sanitary sewers and there is much infiltration of ground water in wet seasons. Delaware has sanitary sewers with considerable infiltration of ground water and has a few storm water drains.

Lakewood formerly used the separate system, but recent construction has been on the combined system with overflows for storm water. London has a sanitary sewer system. Marion has a sanitary sewer system with a few miles of separate storm sewers. Plain City has a sanitary sewer system but has permitted many connections for roof water. Westerville has a separate system with considerable infiltration of ground water. East Cleveland has the separate system with storm sewers laid in the same trenches and apparently considerable leakage from the latter to the former.

Kenton has sanitary sewers in its north district. All of these cities and villages have sewage purification plants.

Staley and Pierson's "The Separate System of Sewerage,' ($3) contains the desired descriptions of systems. Moore's "Sanitary Engineering" ($14) also has them. Folwell's "Sewerage" ($3) also has a good discussion of the system and its details.

The treatment of small sewers on steep side hills has been left very largely to the preference of the engineer, since they give very little trouble in any case. If there is a large flow of water at a rapid rate, the erosion by the solid matters, particularly sand, gravel, and the like, which may get in from the streets or elsewhere, may result in rapid wear of the bottom, but sanitary sewers are seldom so troubled. There is more danger of the water running away from the larger solids, leaving them stranded to decay and produce odors. Even then there is usually little danger of stoppage for the occasional flushes from house discharges will move most materials at least a little way before the water runs by. One solution, where there is considerable water, is to run the sewer on as flat a grade as possible and put in drop manholes as often as are necessary to keep the sewer deep enough in the ground. This serves to concentrate the wear in the manhole or the drop pipe connected with it, which can be specially constructed to take the wear and to be repaired easily without digging up the sewer. Will our readers make suggestions? The egg-shaped pipe suggested would not be applicable in many places, although the concentration of the flow would aid on grades not too excessive.

Some excellent compounds for making water-tight sewer joints are now on the market, such as G-K sewer joint compound, jointite, pozite, the nature and use of which have been described recently in several articles in MUNICIPAL ENGINEERING. Information about them can also be obtained by writing to the firms named in the "Business Directory," published in each number, under the headings "Sewer Joint Compound," "Jointite."

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. Never mind style of composition, the fact is what is wanted.

Maine's Waste in Highway Construction.

BY GEORGE T. FILES.

Professor of German at Bowdoin College.

At least $300.000 of the $1,250,000 expended by the municipalities of Maine is being wasted annually in ignorant mismanagement of our local highway departments. The local commissioners are too frequently the centers of political factions who choose the officials and look for their reward. The commissioners themselves, when thus chosen, are quite commonly deficient in all necessary qualifications and rarely occupy their positions more than two years. As a result, we observe a pitiable lack of system in towns and cities, with the resultant loss of a large percentage of the money expended in the local highway departments. None of these shortcomings can be charged to our state highway department, however; the towns and cities are independent and sovereign communities, which control absolutely the funds that are thus raised for public purposes.

But there is a large amount of money which is annually expended by or under the direction of our state officials. These officials are trained men; and behind them there is a sovereign State which makes the laws which determine their actions. Why, then, do the main trunk highways of our State still remain notoriously wretched when, during the last eight years, a sum of money varying from $300.0d0 to $500,000 has been expended annually by the State in cooperation with the various towns and cities for the construction of our State highways? The aggregate joint fund during the last six years has exceeded the sum of $2,000,-000. It is the object of this paper to review in detail the reasons why our efforts as a State have as yet shown such slight visible results.

According to our report we have built 84.7 miles of various kinds of road. But where? Here, there and everywhere, all over the face of our State in patches of from 200 to 1,000 lineal feet. Some of these sections are well built; some are acceptable to the eyes of a modern road builder, but too many of them are mere patch work, the best efforts of local engineers and local constructors. With the exception of the beautiful Rockland-Rockport line and the six miles which the progressive town of Rumford has constructed, there are scarcely three consecutive miles of good modern road in the State of Maine.

Under such a system as this we are proposing to expend the sum of $600,000 or $700,000 during the next year. We are proposing to do more—we are looking earnestly forward to an amendment of our constitution which will permit us to borrow on the credit of the State, the sum of $2,000,000 with the intention of constructing the main trunk highway of our State.

The trouble does not lie with our highway department, for there you have conscientious men who are endeavoring to accomplish the largest possible results with the smallest possible expenditures of money. The real trouble lies in our system and in the laws of our State which underlie this system.

The chief causes of our waste are:

1. Our highway statutes established and now maintain a highway department at Augusta with a commissioner, who is an engineer, and a few clerks. Unfortunately, however, these same statutes robbed this same department of practically all its executive power and provided it scantily with means of accomplishing any tangible results. It is no exaggeration to state that, at the present time, the highway department of Maine has no power whatever except that of recommendation and perfunctory supervision by underpaid inspectors.

2. The selection of State and local highways is left in the hands of the local authorities and the county commissioners. In other words, we possess no impartial, central control for the development of local highways or of a State system.

3. When the joint fund is to be expended in a town or city, the State itself has no authority over construction. The work is laid out and completed by local engineering talent, oftentimes by men who have never enjoyed a day's engineering education. As a result we see in our State today some of

the most lamentable specimens of road construction that are to be found in the wide world; macadam roads rolled by traffic, roads properly ditched and drained but with no outlet for the water thus drained off, expensive bitulithic construction where gravel is abundant, poor dirt roads where the traffic demands a surface of the toughest carrying qualities, and other errors too numerous to mention.

4. During the construction of the joint-fund road, it is inspected, with more or less frequency, by the state inspectors, of whom there are twenty, receiving a salary of about $250 to $300 annually, and of which number not more than one or two have ever received a day's training in theoretical road building or practical engineering. Let it here be said that these men are all faithful and willing, excellent men of good sound common sense, but absolutely lacking in the technical training which is so necessary to such work.

5. Under the laws as they exist today, it is impossible to build a section of joint-fund road, on an average, longer than 1,000 to 1,200 feet of macadam or about twice that amount of gravel construction. In other words our State prescribes by law the most expensive method of construction that exists, namely, the piece-meal policy of a few feet at a time. As a result of this policy our macadam roads are costing us from $10,000 to $15,000 per mile, while in other States, where wholesale construction prevails, the cost is reduced from 30 per cent. to 40 per cent. from our own figures.

6. Our present laws prohibit the use of any of our State highway money for purposes of maintenance. This very necessary care of newly constructed roads is left in the hands of the town authorities after the road is completed, with no penalty for failure to maintain, or reward for good care. As a result many of the sections of State roads that have already been built in our State are in pitiable condition. Here we find one of the most unfortunate results of our local carelessness in selecting road commissioners, for it will be instantly seen that the new State roads, when once constructed, come under the jurisdiction of the local commissioner, for proper care and maintenance.

7. The last, and perhaps the most vicious means of wasting our State highway funds, is the provision, which our law now allows, that the cities of our State may expend their joint highway fund upon the city streets. During the past four years over $216,000 of our State highway funds has been expended in building the streets of our cities in Maine. It will long be held to the discredit of the city of Portland that the largest and richest municipality in our State succeeded, by force of influence and authority, in bringing this unfortunate condition about. Our law was properly framed in the beginning, but was changed by a later legislature after an urgent appeal on the part of the city government and certain citizens of Portland. No other State in New England permits such a waste of money as this.

These, then are the chief defects in the highway law of Maine as they exist today; they are vital defects, too, which are leading to an enormous waste of public money, and which are preventing us from realizing any adequate, tangible results from the amount of money which we are now expending upon the roads in our State. Therefore, we may naturally assume that the citizens of our State will never consent to any amendment to our constitution, carrying with it, as the proposed amendment does, an expenditure of $2,000,000, or more of money, until we, as a State, are satisfied that this vast sum of money will not be wasted. The writer believes in the proposed amendment to our constitution, for it will furnish our State with the necessary funds to undertake a comprehensive development of our State highway system. But this amendment should be authorized only after all the various interests of the State have been carefully safe-guarded, and when we know that the money thus raised will be wisely, equally, and economically expended.

It may not be out of place here, to state what assurances are asked in advance of any great expenditures, by the organizations of our State, whose interests are most vitally connected with the raising and expending of such a sum of money as is now proposed. Some of these preliminary steps are as follows:

1. The appointment of a commission, as is customary in other States of New England, with power to designate local and State lines, and to develop a system of highway improvement that will best serve all the varied interests of the State. This commission should be headed by our state engineer, and should be thoroughly representative in its character.

2. A code of highway laws modelled after the wise laws of our neighboring States, but adapted to the needs of our own conditions.

3. Such a code of laws would remove the defects which now exist in our system by

(a) Distinguishing as is done in other States, between State-aid roads and State roads, for the failure to distinguish properly between these two terms has already led to much confusion among us.

(b) Centralizing in our commission the authority over the roads to be constructed.

(c) Providing sufficient means for proper construction of our roads under trained engineers, possibly under the district plan as is the practice in New Hampshire and Massachusetts.

(d) Providing amply by funds and regulations for the proper maintenance of State-aid and State roads which have been and are to be constructed. This is one of the most vital considerations in the whole problem.

(e) Adjusting the proportion to be paid by the State and the towns in the construction of our State lines.

Such, in brief, is the plan which is proposed to remodel our present highway system, to prevent the economic waste which is now going on, and to provide for a wise and just expenditure of the funds that may be appropriated in the future.

Instruction to Sidewalk Inspectors.

Referring to question on page 190 of March MUNICIPAL ENGINEERING, concerning instructions to inspectors, I enclose herewith instructions to sidewalk inspectors which we are using. I intend preparing something along the same line for sewer and paving inspectors.

You are at liberty to publish the enclosed if you wish to do so.

EARLE R. WHITMORE,
City Engineer, Port Huron, Mich.

INSTRUCTIONS TO SIDEWALK INSPECTORS.

1. The inspector should keep with him a copy of the sidewalk specifications and should study same until he is thoroughly familiar with all their requirements.

He will be expected to enforce the specifications in every detail, and will be held responsible by the superintendent for such enforcement.

2. Inspector will be provided with blanks upon which he shall make a report to the city engineer at the end of each day's work of the number of lineal feet and location of walks built during the day, and amount of cement used, etc.

3. In case of any disagreement between the inspector and the foreman or men on the work as to the interpretation of the specifications, the matter shall immediately be reported to the superintendent or engineer.

Inspectors are expected to treat the contractor and his men courteously at all times, and to make every effort to avoid trouble or misunderstandings. But if any workman shall persistently fail to carry out the requirements of the specifications or shall prove unfaithful or incompetent, such facts must be at once reported. Anyone who is incompetent or willfully unfaithful or abusive will not be allowed to continue on the work.

4. Inspector must see that the materials comply with specifications. If any change is made in the brand of cement being used, the superintendent and engineer must be notified before making such change. No lumpy cement shall be used. Cement must be piled on a dry board or dry place where it will not absorb moisture from the ground, and if any is left on the street over night, it must be well covered with canvas. If cement shall seem not to work properly or to give unsatisfactory results in any way, the matter should be brought to the attention of the superintendent or engineer at once.

The inspector shall watch the gravel closely, and if it seems to contain too much or too little sand at any time shall immediately report the fact, and shall see that the sand used for mortar is of proper grade.

5. The inspector shall provide himself with a templet which can be laid across the forms to determine when the grade is the required 4½ inches below the finished surface, or the base the required ¾ inch below the finished surface.

6. See that sub-grade is quite wet when concrete is deposited. This not only prevents the ground from absorbing the moisture from the concrete, but as the moisture evaporates from the surface of the walk it will be replaced with moisture absorbed from the sub-grade. Concrete which is allowed to dry out too rapidly never attains its full strength.

7. Watch the proportioning and mixing continually.

If wheelbarrows of approximately uniform size are used, the gravel may be measured in wheelbarrows without the use of a measuring box. But the contractor shall be required to furnish and keep on the work at all times a box of definite size (say one cubic foot) with which the capacity of the wheelbarrows may be tested at any time. The specifications require that a 94-pound bag of cement shall be considered one cubic foot, and that the concrete for base shall be one part cement to five parts gravel. Thus if it is found that 1½ cubic feet of gravel is being handled to each wheelbarrow load, each barrow of gravel calls for 3-10 bag of cement and 20 barrows (30 cubic feet) of gravel require 6 bags of cement, which will make a convenient batch. (Care must be taken that batches are not so large that the wearing surface cannot be spread within the specified 50 minutes after mixing the base.) If barrows carry two cubic feet, 15 barrows (30 cubic feet) will require 6 bags of cement. If barrows carry 2½ cubic feet, 12 barrows (30 cubic feet) require 6 bags of cement and if barrows carry 3 cubic feet, 10 barrows (30) cubic feet) require 6 bags of cement.

Thorough mixing is fully as important as correct proportioning.

Concrete board should be carefully cleaned every night.

8. See that the finished walk is not exposed.

It must be covered with canvas or with sand without delay as soon as it is hard enough that the covering will not damage it, and the sand covering must be thoroughly moistened. If walk is covered temporarily with canvas, it must be covered with sand as soon as the canvas is removed.

9. See that proper and sufficient barricades and lights are provided, and finally, that

the work is properly and neatly cleaned up.

10. The above instructions are intended merely to explain and emphasize some portions of the specifications. Other requirements of the specifications are equally important, but do not require any special examination.

Some Methods of Preventing Dust on Macadam Streets.

BY JOHN F. ICKE, CITY ENGINEER, MADISON, WISCONSIN.

From a paper read at 1912 meeting of the Engineering Society of Wisconsin.

A macadam road as we all know, is made of crushed stone of varying sizes held in place by filling the interstices with smaller stone, stone dust, or other suitable material as a binder. In the ordinary water bound macadam a cementing action takes place between the crushed stone and the dust used as a binder, the degree of this cementing action depending upon the material used as crushed stone and the material used as a binder.

The harder the rock, the less able it is to absorb moisture, and the more difficult it is to bind. For this reason the granites are more difficult to bind than the limestones when used as a road material.

In order to keep macadam streets in good condition they must receive sufficient traffic to furnish more or less dust, and moisture must be provided to aid in keeping the stone cemented. If a sufficient amount of moisture is not present then the road will ravel and will be rapidly destroyed, especially if very much automobile traffic passes over the road.

In order to supply the necessary moisture the method of applying water with a sprinkling wagon has been used in the past. The water so applied furnishes the moisture which is absolutely necessary to keep the macadam well bound and also acts as a dust layer or dust preventive.

Many objections to the use of water as a dust preventive may, however, be urged. If the water is applied in just the right quantity to lay the dust but not in quantities enough to make the road surface unnecessarily muddy then the service may be considered fairly satisfactory. The difficulty lies, however, in the almost impossible task of having the water applied often enough and in quantities sufficient only to keep the surface moist.

For some years past engineers and others interested in road work have been experimenting with various materials and methods of application, designed as a substitute for water as a dust layer. The use of tar or asphaltic oil applied to the surface of the road, or of tar or asphalt as a binder for the upper two or three inches of the road surface is now good practice in many localities.

The application of tar or asphaltic oil on the surface of the road is generally spoken of as surface treatment. The writer's experience with the use of tar in the surface treatment of macadam streets dates back to the year 1908 when the first trial was made. The material used was a prepared tar known as Tarvia A made by the Barrett Manufacturing Co.

The street in question was one built of crushed limestone in 1897. The surface was in ideal condition with very few depressions or irregularities. The preliminary treatment of the road surface before applying the tar consisted in thoroughly sweeping the street surface to remove as much of the dust as possible. The consistency of the tar was such as to make it necessary to heat it before it could be applied. Application was by means of sprinkling cans with broadened nozzles. Approximately one-half gallon of tar was applied per square yard of surface. The surface of the tar was covered with a thin layer of coarse limestone screenings approximately one-quarter inch in diameter from which practically all the dust had been removed. The street was rolled with a fifteen-ton roller and was thrown open to traffic as soon as possible thereafter. After a short time and after the excess of screenings had been worn away the street resembled in many respects a sheet asphalt pavement. After the lapse of two years a second treatment was given similar in all respects to the first, except that the quantity of tar per square yard was about one-third of a gallon. This second treatment was given primarily to cover the individual stones which projected above the general surface of the pavement and were thus not thoroughly covered by the first treatment. Several excavations made in the street since the last treatment show that the tar penetrated the surface of the road from three-quarters of an inch to one inch and thoroughly bound the surface. How soon it will be necessary to again apply the tar it is impossible to tell; however, it is safe to say it will not be necessary to apply another treatment for at least three years and possibly not for five or six. The above mentioned treatment has practically eliminated the formation of dust caused by the breaking down of the stone under traffic. The street is, however, not dustless as more or less dust is brought upon it from traffic and other outside sources and it has been found advisable to give the street more or less sprinkling with water to keep down the small amount of dust which does accumulate on the street from the sources mentioned above. The street surface is so well bound that any ordinary rain will free the surface from dust as though it were an asphalt pavement. One objection to the above mentioned treatment is that it leaves the street slippery at those times when, due to weather conditions, other pavements like asphalt are also slippery.

The cost of the first treatment was 7 cents per square yard. In this cost are included all the items which should enter, namely, the cost of cleaning the street, the cost of the tar, of heating and applying it, the cost of the screenings and applying them, and the cost of rolling. The second treatment cost 4 cents per square yard as the quantity of tar applied per square yard was less.

In addition to applying the heavy tar mentioned above a lighter tar (Tarvia B) requiring no heating before applying has been used with considerable success. This tar is sufficiently fluid under ordinary temperatures to run freely from the tank cars in which it is shipped. Before applying the tar the road surface must be cleaned of all dirt so as to expose the stone surface. The cleaner the surface of the street the better will the result be in the end. If any cakes of dirt or screenings are allowed to remain on the surface then the tar will not penetrate into the macadam but will instead be absorbed by the layer of dirt or screenings. The first heavy rain will simply loosen the dirt layer and the street will in consequence become muddy. The street may be swept either with a rotary street sweeper or with push brooms. The former method is the more economical but is somewhat objectionable on the part of the public on account of the raising of dust while the sweeping is being done. The raising of a dust while sweeping may be lessened somewhat by sprinkling lightly with water previous to sweeping.

The tar is hauled from the tank cars to the street in wagons equipped with a sprinkling attachment to the rear of the wagon. Several such attachments are on the market the general principle of all being the same. Suitable regulating valves are provided on the attachment which makes it possible to gauge the quantity of tar to be applied. In practice about one-third of a gallon of tar is applied per square yard of street surface.

The tar, especially during warm weather, penetrates into the surface of the macadam sufficiently at the end of from six to twelve hours to enable the street to be thrown open to traffic. The efficiency of the tar as a dust preventive lies in the fact that it penetrates the surface of the street from one-fourth to one-half inch and firmly binds the stone in place.

Road Armoring With Setts.

Sir—The small sett, or "Durax" paving, roads with small setts. The method was fully described by Ernest Flagg, in the Feb- To the Editor of MUNICIPAL ENGINEERING: traffic, is best described as the armoring of which is now recognized as one of the very best for all kinds of roads and all classes of ruary issue of MUNICIPAL ENGINEERING.

The system, after exhaustive trials, is now being widely adopted, and hundreds of miles of streets and roads in England and Germany have been paved with small setts with great success and to the complete satisfaction of the engineers.

Although the most important application of this pavement is undoubtedly to the "armoring" of existing macadam roads, it is also being largely used on new roads with any suitable foundation, and also for replacing large setts.

The small setts are irregularly shaped cubes. The heads are preferably four-sided. The sides taper slightly so that the base is approximately two-thirds the area of the head.

The most important point, however, is the depth, which must not vary more than ½ inch at most. The two sizes in general use are the 3½-inch to 4-inch and the 4-inch to 4½-inch in depth, but for special purposes other sizes are made.

As in all roads, it is necessary that the foundations should be sound. Hence, before commencing to pave a macadam road with small setts, complete assurances on this point should be obtained. After removing as little as possible from the surface of the road it is leveled, correctly profiled and rolled, and the stones placed in position, sand being used sparingly and only for the purpose of bringing up the shallow stones to the level of those of full depth. It is most important that stones of unequal depth should not be placed together. It is therefore very necessary to sort the stones beforehand into three groups of similar depth and with reference to the shapes and angles.

When sorted, they are laid as follows: The smallest stones towards the abutments of the road, those of greatest depth at each side of the crown, and the medium size stone to form the crown. They are so arranged that they lie in concentric rings, so that the line joining the crowns of the rings is at right angles to the direction of the curb stone, and the axes of the outer rings or segments must coincide with the outer edge of the large setts which are used to form gutters. After the stones are in position they are rammed until firmly bedded on the foundation, when there must not be more than about ¼ inch of sand under the shallowest stone.

Before and during this process the road surface is freely watered and the space between the setts well filled up with a sharp river sand.

When complete, the whole surface is covered with sand to a depth of ¾ inch. This gradually works into the joints and consolidates. It has been found that sand is the best grouting for this paving. It enables the joints to be placed very close together and, when consolidated, effectually resists the scouring action of water and other destructive actions, whilst retaining its elastic nature.

Another method of laying the small setts can also be employed. Instead of placing the setts in concentric rings they are set in diagonal lines across the roads. This method tends to break the joints, and also to avoid gaps between setts which are sometimes unavoidable in the concentric ring method. Otherwise the process is identical as above described.

The roughness of the heads of the small setts wears off under the traffic, leaving a smooth and level surface over which the wheels pass as easily and as noiselessly as over asphalt.

The latest improvement of the "Durax Armouring" consists of the small granite cubes set in a foundation of bituminous concrete, with the joints grouted with a similar material. This gives an elastic, waterproof foundation, as resilient for all kinds of traffic as ordinary tar or pitch macadam. It has all the wearing qualities of an ordinary granite sett road, with none of its disadvantages, since it is comparatively noiseless, affords an excellent foothold, and does not become slippery or greasy in wet weather. This kind of road armouring is also suitable for all kinds of motor traffic.

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Kansas City's Sewer Specifications.

A "Public Improvements Committee," working with the Board of Public Works, started an investigation relative to proposed sewer specifications by writing a set of questions to some half dozen local engineering firms of good standing, whose answers were expected to show the amount of their experience with vitrified clay and concrete sewer pipes, their preference of the two, their criticism of concrete pipes (if any) and whether the new material was worthy of a place in the city specifications. They also addressed a circular letter to the plumbers of the city asking for their views. Most of the letters were readily replied to—some in person. Thus the committee immediately gained the co-operation of a great many local men with no extra expense whatever.

At this poin the clay pipe interests and the cement interests, through their co-operative publicity organizations, became keenly interested, extended the investigation all over the country, brought expert witnesses from far and near, affidavits, photographs and much other data, and appeared each side with an attorney and a court stenographer; so that the investigation soon assumed the aspects of a court proceeding.

Among the most interesting witnesses who appeared in behalf of concrete pipe were Prof. Erasmus Haworth of the University of Kansas; Prof. Heidenreich, author of the handbook of that name; R. T. Miller of the Pittsburgh Testing Laboratory, and J. E. Moore of Hunt & Co.'s Laboratory. Among those that appeared in favor of clay pipe were George W. Fuller, sanitary engineer; Prof. E. Orton, Jr., dean of ceramic engineering at the University of Ohio; Jas. L. Darnell and R. E. McDonnell, civil and sanitary engineers.

Professor Haworth advised that cement and concrete could be used for sewers when properly applied and stated that when there was an advantage in price in favor of concrete it should be used. Prof. Heidenreich's testimony as a whole did not bear directly on sewer pipe, but included very interesting results obtained by him as a pioneer in reinforced concrete. The testimony of R. T. Miller and J. E. Moore from the two testing laboratories was to the effect that after a great number of analyses of sewage they had found nothing which in their opinion would destroy concrete pipe when properly made. This qualification of "properly made" brought up the subject of methods and costs of inspection.

The clay interests introduced figures from L. R. Ash and Thos. McGeehan of the city's engineering department showing that the cost of sewer pipe was never more than one-fifth of the total cost of sewer contracts.

Prof. Orton's testimony was chiefly interesting as a clear description in plain language of the process of manufacturing vitrified clay pipe, of its chemical and physical characteristics, and its resistance to all agents of destruction. Mr. Fuller went into a detailed description of the action of bacteria upon sewage and sewer pipe and gave a clear account of the evolution of hydrogen sulfide from decomposition, the union of this gas under favorable conditions with air and moisture to form sulfuric acid, and the subsequent action of this acid upon concrete. Photos and reports from El Paso, Texas, and points in California and in England were introduced to bear out his theories.

The investigation was closed on the night of March 25th after four months' of thorough study on the part of the committee.

The conclusions of the committee were as follows:

First. That approved sanitary engineering requires that the best commercial product should be used in sanitary sewers, for the protection of health and life of the citizens of this community.

Second. That the best material to be used in the sewers of Kansas City is vitrified salt-glazed pipe. That it is the most sanitary, durable, and impervious; possesses the greatest strength and permanency, and presents the greatest resistance to deterioration and destruction of all the commercial products for sewer construction, now on the market.

Third. That bids for finished sewers, based on specifications, including both vitrified pipe and cement pipe, that have been submitted during the past few months, show that on an average the cost of the finished cement pipe sewer is greater than the finished vitrified pipe sewer. Taking into consideration these facts, and the legal opinion furnished us by the city counselor, in our judgment this is a matter that should be left entirely to the Board of Public Works, and we so recommend it. We also recommend that the pending ordinance do not pass.

MUNICIPAL MATTERS IN COURT

Higher Courts.—Bond Limit and Water Plant Purchase.—Sewage Disposal Veto.

Decisions of the Higher Courts of Interest to Municipalities.

City is Not Obliged to Light Streets.—A city is under no legal duty to light the streets of any particular locality and is not negligent in law for not doing so, though its failure to light a street might be considered in determining whether it was negligent in permitting an obstruction at that point.—Shreve v. City of Ft. Wayne (Ind.) 96 N. E. R. 7.

City Not Liable for Injury Due to Municipal Electric Current.—The lighting of streets is a governmental function, so as to make a city liable for injuries to a child by contact with a wire suspended from a pole supporting a street arc light, though the city's plant which supplied the street lights also supplied electricity to private dwellings and business houses.—Irvine v. Town of Greenwood et al. (S. C.) 72 S. E. R. 228.

City Must Maintain Municipal Lighting Poles in a Safe Condition—An Act permitting one injured through a defect in a street to recover damages therefor, requires the city to keep the street in such repair that it is reasonably safe for travel, so that it would be bound to keep an electric lighting pole placed in the street, together with the wires attached thereto, in a safe condition.—Irvine v. Town of Greenwood et al (S. C.) 72 S. E. R. 228.

Children Playing in the Street Is an Illegitimate Use Thereof.—The court cannot say, as a matter of law, that the playing of children in the street is an illegitimate use thereof, which the city is not required to anticipate in maintaining the street in a safe condition; the question being ordinarily for the jury.—Irvine v. Town of Greenwood (S. C.) 72 S. E. R. 228.

City Not Liable for Defect in Street Unless Notice Has Been Given to Make Repairs.—A city is not liable for injuries to a pedestrian by a defect in a street, unless it had notice of the defect, or of such facts and circumstances as would, by the exercise of reasonable diligence, lead a prudent person to such knowledge, whether the defect was caused by the act of a third person or by the failure of the city to make repairs.—Boender v. City of Harvey (Ill.) 95 N. E. R. 1087.

Duck Raising on City's Water Supply May be Enjoined.—A city using a pond for many years for supplying its inhabitants with water for drinking purposes is entitled to enjoin defendant from raising ducks on defendant's premises, unless defendant permits certain precautions to prevent the contamination of plaintiff's water supply by such use; defendant's business having been begun only some three years before action brought.—City of New York v. Blum (N. Y.) 131 N. Y. S. 87.

Assessments For Improvements May Be Made Even Though Cemetery Exemption Increases the Same.—Greater New York Charter authorizes the board of estimate and apportionment to determine how much of the cost of a local improvement shall be borne by the city, and requires the rest to be assessed on benefited property. Another section requires all moneys paid for the improvement, except the city's share, to be assessed proportionately as far as practicable upon the lands benefited. A law exempts cemetery property from assessments for local improvements. *Held*, that the Legislature had power to, and the statutes did, authorize the board of estimate and apportionment to assess he total cost of local improvements on land benefited, though cemetery land was exempted, so as to very largely increase the assessments on the other land; the assessment thereon not exceeding one-half the value of the land.—In re Starr Street in Borough of Queens (N. Y.) 131 N. Y. S. 71.

Sureties to a Contractor's Bond Are Not Liable For Additional Engineering Expense.—Increased sureties on the bond of a contractor who abandoned his contract with commissioners, while liable for any sum, in excess of the contract price, it cost to complate the work, are not liable for expense of any further engineering for the work after the abandonment of the contract; it not being shown any sum was paid out or debt incurred for engineering because of the abandonment of the contract.—Nick Peay Construction Co. et al. v. Miller et al. (Ark.) 139 S. W. R. 1107.

Sworn Statement To Sureties of a Contractor Is Not Essential to Holding Said Sureties to Account.—The notice of commissioners of a sewer district of a city to sureties on the bond of contractor for construction of a sewer merely that he had wholly abandoned his contract is enough, without more, and without being sworn to, though the bond provided that the sureties should be notified of any act of the contractor which might involve a loss for which they are responsible, with a verified statement of the facts in the case.—Nick Peay Construction Co. et al. v. Miller, et al. (Ark.) 139 S. W. R. 1107.

Citizen May Not Sue For Fire Loss Due to Insufficient Water Supply.—A private citizen, although a taxpayer of a municipality, cannot maintain an action against a waterworks company to recover damages for losses by fire sustained by him in consequence of the failure of the company to perform its contract with the municipality to furnish a supply of water for the extinguishing of fires, as there is a want of privity between the citizen and the company which prevents him from suing either for breach of the contract, or for the breach of duty growing out of the contract.—Lutz v. Talequah Water Co. (Okla.) 118 P. R. 128.

Water or Canal Co. Is Not Required to Construct Bridges Subsequent to Building Their Canal.—A law requiring every water or canal corporation to construct and keep in good repair all bridges across their canal that the board of supervisors of the county where such canal is situated may require, etc., does not require such companies to construct culverts to carry streets established subsequent to the construction of the canal over the same. the duty to construct such culverts being on the city.—South Yuba Water Co. v. City of Auburn (Cal.) 118 P. R. 1001.

City's Mandamus Right to Inspect Books of a Corporation Is Limited by Ability to Purchase Plant of the Company.—In preliminary mandamus proceedings by a city seeking to acquire the works and property of a water company, the paramount issue is the right of the city to have access to the company's books and records to secure data of the cost and maintenance of the company's plant and the dates and amounts of dividends, but, since mandamus will never issue for a vain or useless purpose or to satisfy a mere curiosity, the proceedings would also involve the issues of the financial ability of the city to purchase the plant, the assessed value of the city's real estate, and the amount of its indebtedness, and the cost of the waterworks plant, its maintenance, and the dividends declared.—City of Williamsport v. Citizens' Water & Gas Co. (Pa.) 81 A. R. 316.

Selectment Must Exhibit Map of Proposed Relocation of Street.—A law providing that, in a proceeding to re-establish the bounds of a street, the selectmen "may" cause a map showing existing conditions to be exhibited, and that notice as to when and where the may may be seen "shall" be given, the requirement for its exhibition is mandatory.—Hartford Trust Co. et al. v. Town of West Hartford (Conn.) 81 A. R. 277.

A Marked Copy of a Newspaper Does Not Constitute a Legal Notice of Intention.—In a proceeding to re-establish the bounds of a street, notice of the selectmen's decision given adjoining owners by mailing them marked copies of a newspaper containing an advertisement of the notice is insufficient. One cannot be charged with notice of what may be contained in the advertising columns of a newspaper, though the copy received by him be a marked copy.—Hartford Trust Co. et al. v. Town of West Hartford (Conn.) 81 A. R. 277.

Court May Not Direct Opening of a Dam to Give Future Relief From Shortage, even Though Present Conditions Warrant.—Where, at the suit of a water company in which it alleges a great scarcity of water, a preliminary injunction is granted compelling the opening of a dam so that the water of a lake may be released into the stream below to a certain amount, the court cannot in its final decree after the emergency requiring the preliminary injunction had passed direct that it stand in force to give similar relief whenever a similar emergency shall arise, especially where there is no prayer in the bill for such a decree.—North Mountain Water Supply Co. v. Troxell et al. (Pa.) 81 A. R. 157.

Renter May Demand Water Service Even Though It Be Refused to Landlord.—The lessee of part of a room is entitled to water service for his own use, or damages for refusal thereof, if he applies in good faith, though service formerly supplied to the landlord, he furnishing the lessee. water required by him, was discontinued for nonpayment of rentals by the landlord.—Ginnings v. Meridian Water Works Co. et al. (Miss.), 56 S. R. 450.

Bondsmen Liable for Cost of Repairs on Machinery Used in Work Bonded.—The bond of a contractor to construct sewers for a city, conditioned on the contractor paying for all labor performed and materials used in carrying out the contract, covers the cost of repairs of machinery used in the work, and the person making such repairs may sue the surety therefor. Fidelity & Deposit Co. of Maryland v. Charles Hegewald Co. (Ky.), 139 S. W. R. 975.

A Railroad Company is Classed as Part of "Public" in Water Contract.—An application for a writ of quo warranto challenging the right of a railroad company to purchase water from a water company in a territory within which such company is authorized to supply water to the public will be dismissed; the railroad company being a part of the public. Commonwealth ex rel. Todd, Atty. Gen., v.

Pennsylvania Railroad Co. (Pa.), 81 A. R. 196.

Mandamus May Force City Authorities to Allow Contractor Periodical Payments.—The Spokane city charter vested the board of public works with exclusive charge of the improvement and extension of streets and alleys, of all bridges and the erection and improvement thereof, and of all public works, not otherwise provided for. Ordinance No. A10 directs that the city engineer, in addition to his charter duties, shall perform such services as may be directed by the board of public works. The board of public works, on behalf of the city, executed a contract for a street improvement, which gave the board and the city engineer the supervision and control of the work, and provided for payment by warrants at specified intervals, based on estimates by the board and engineer of the work done. *Held*, that the duty of making estimates was not a contractual duty, though growing out of a contract, the board and engineer not being parties thereto, but was a duty imposed by law, and enforceable by mandamus. State ex rel. Warehouse & Realty Co. v. City of Spokane et al. (Wash.), 118 P. R. 321.

Authority to Levy Assessments for City Improvements Secure from Court Action in Most Cases.—Authority of a municipal corporation to levy assessments on abutting property for benefits conferred by street improvements being derived solely from the Legislature, the courts will not interfere with the exercise of the city's discretion in determining the extent of the benefit conferred, unless there is a want of power, or the method of assessment is so clearly inequitable as to offend a constitutional principle. Town of Tarboro v. Staton (N. C.), 72 S. E. R. 577.

Plans and Estimates Need Not Be Prepared by the Engineer in Person.—The estimate, plans and specifications for a public improvement need not be prepared by the city engineer in person, but may be prepared by a specially employed assistant, if the city engineer supervises the assistant's work to the best of his ability. Menefee v. Taubman et al. (Mo.), 140 S. W. R. 604.

Contract For Stipulated Price Per Year Does Not Come Under Limit of Indebtedness.—A contract of a municipal corporation, with a water works company, for a supply of water for public use, for a stipulated number of years, at a stipulated price per year, payable in quarter annual payments, is not void, by the statute limiting municipal indebtedness, because the aggregate of such payments, for the full term of the contract, with existing indebtedness, exceeds the amount for which such municipality, is by said statute, allowed to become indebted. The validity of such contract is tested by the aggregate quarterly payments for the first year. Allison et al. v. City of Chester et al. (W. Va.), 72 S. E. R. 472.

Bonded Limitation Interferes with Warren's Water Plant Purchase.

Following an agreement made between the city of Warren, Pa., and the Warren Water Company, and for the purpose of determining the value of the water plant, an appraisement of the water works plant and system was made early in 1903. This appraisement, it was determined, was to form the basis for the sale of the plant to the municipality.

The valuation of the plant was found at $390,000; and at this price the Warren Water Company agreed to sell and the borough in turn agreed to buy, issuing bonds to the Water Company in the full amount. These bonds were to be secured by the plant, and were to be paid solely out of the receipts and revenues derived from the water works system. An ordinance was accordingly passed which provided a sinking fund for this purpose as follows:

That to provide an adequate sinking fund from the receipts and revenues derived from said water works or system for the payment of the interest on said bonds and for their redemption there shall be set aside annually from said receipts and revenues the sum of $32,500 until and including the year 1921, and the sum of $26,000 until and including the year 1931, and the sum of $19,500, until and including the year 1941, during the existence of the bonds herein authorized and directed to be issued to provide for the payment of the interest and liquidation of the principal thereof. And the moneys arising from said receipts and revenues shall be applied at the periods stated in said bonds herein authorized and directed to be issued and to their redemption as per according to their terms and not otherwise.

The value of the taxable property of the borough was $4,692,545 and by the statute limiting the bonded indebtedness of a city of Pennsylvania only 7 per cent. of this amount could be pledged. The constitutional limit of indebtedness upon the consent of the voters was therefore only $338,478; so that with an existing indebtedness of $190,000, the proposed purchase, providing the purchase bonds came under the requirements of the limit of indebtedness, would cause an indebtedness in excess of the $328,478.

Suit was brought by Daniel E. Lesser, a taxpayer, to test the legality of the proposed purchase.

In commenting upon the case the judge held that there were four points involved, namely:

1st. The right of a taxpayer to maintain a bill;

2nd. The authority of the borough to own and operate its water plant;

3rd. The constitutionality of the act setting forth the method of determining a value and the procedure for purchase for such a plant;

4th. If the acts be unconstitutional, does the purchase of the water plant and the issuance of bonds in excess of the constitutional limitation as described constitute an indebtedness of the municipality.

The third and fourth points in question are of greatest interest in the case at hand, being those most frequently raised in this connection. Sections 5 and 6 of the acts in question have never been passed upon previously. These sections, which are as follows, were held to be constitutional under the Constitution of the State of Pennsylvania, and the issue was held to be narrowed to the single inquiry as to whether such a transaction as proposed would constitute an indebtedness:

Section 5. For the purpose of said purchase the municipality may issue bonds, which shall be secured solely by such waterworks, systems, and property, and the revenues thereof, and without other liability whatever of said municipality thereon, to an amount not exceeding the appraisement of the value fixed by said appraisers or the court. The proceeds of the sale of such bonds shall be used exclusively for the purpose of making payment for the property so acquired.

Section 6. The municipality shall provide an adequate sinking fund for the receipts and revenues derived from said water works or systems for the payment of the interest on such bonds and for their redemption. The bonds shall be payable within thirty years from the date of their issue, and shall be redeemable at such earlier periods as the municipality may by ordinance provide, and shall bear interest at a rate to be fixed by the municipality not exceeding six per centum per annum. The bonds shall be exempt from taxation for any purpose.

The purpose of the statute limiting the amount of the bonded indebtedness was analysed and shown to be in effect a safeguard on municipal extravagance in obtaining improvements on credit. A similar case in Corry, Pa., was cited in which the city of Corry had entered a contract with a corporation to construct a water plant which was to be paid for in twenty annual installments. The question of the modification of the indebtedness by the payment clause was here dealt with as follows:

What then is the nature and purpose of this contract? Is it a contract for supplying the city of Corry with water for public and private use for a term of years? If so, it does not create an addition to the municipal indebtedness; or is it a contract to supply the city a "system of water works," something to be furnished all at once, and not continuously through the whole term, covered by the contract? Is the consideration for the city's engagement 'received at once instead of being yielded in the future or at intervals?' If it is, unless the agreement that the installment shall be paid only from the current revenues modifies the liability, it creates a debt within the constitutional prohibition. It seems that by no reasonable construction can the contract be deemed one for the supplying the city with water, but it is one for furnishing it with a plant to be delivered to it at once, to be paid for by the city in installments.

Moreover, it is a debt by the payments that will have already been made, and equitable interest existing thereby in the city, will become forfeited upon default in paying the installments then due. It is a debt for the purchase money, and in principle analogous to the debt for purchase money for land, for which a mortgage has been given with no accompanying personal obligation, which is universally termed a "mortgage debt."

Numerous other cases were given by the judge in the Warren case, all of them tending to show that the acquisition of the plant constituted a definite debt of the municipality. It was therefore held that the transaction constituted an indebtedness of the defendant borough for an extraordinary undertaking in excess of the constitutional limit, and beyond its current revenues and present means of payment; that the acts of assembly relied upon to sustain this proceeding could not confer upon the borough of Warren any authority to contract such indebtedness in excess of the constitutional limitation.

The case is held to be of vital importance to not only Warren but to other municipalities, and it will in all probability be appealed.

Governor Wilson Vetoes Bill Against Sewage Disposal Plant.

During the latter part of March, Governor Wilson, of New Jersey, vetoed a bill the object of which was to prevent the establishment of a sewage disposal plant in Belleville and Bloomfield for the benefit of Montclair, East Orange and Orange. In considering the bill the fundamental principles underlying the settlement of such disputes, and the necessity of disregarding political or civil divisions in the interests of the public were the controlling elements in the veto.

The veto message was as follows:

A very careful consideration of this bill convinces me that it is based upon a most unsafe and unscientific principle.

The question of sewage affects whole sections of the State. It cannot be dealt with community by community, without regard to the topography of the country, the method and closeness of its settlement or the natural facilities for disposing of sewage.

Political divisions are in no sense natural divisions when this most difficult matter is to be handled. To adopt the principle of this bill would be to embarrass engineering undertakings connected with the public health in the most serious way, and in some instances might render them impossible.

Any careful consideration of the great urban areas of the northern part of the State would convince a careful student of this subject that those areas must be studied as wholes and dealt with as wholes, and that it is not safe to put the settlement of neighborhood questions with regard to drainage in the hands of any authorities having a smaller jurisdiction than that of the State itself.

It would seem that the present powers of the State Board of Health are sufficient to safeguard the several political divisions of the State against the deleterious influences resulting from the sewage disposal within their limits, and if the board has not now powers sufficiently comprehensive to accomplish this object, such powers should certainly be conferred upon it, rather than allow questions of drainage to be settled by neighborhood preferences and jealousies, instead of by the scientific rules of sanitary engineering.

I think the establishment of the principle involved in this bill would be a most unsafe experiment.

STREET · LIGHTING

Ornamental Street Lighting.—Five Dollar Gas.

Ornamental Street Lighting as a City Builder.

BY C. E. STEPHENS.

From a paper before the Pennsylvania Electric Association.

The growing and ever increasing use of our streets by night demands adequate street illumination. The best lighted streets attract the largest crowds. An increase of intensity of illumination increases traffic, and property values fluctuate with the density of the crowd. It is a noteworthy fact that, in many of our cities and boroughs, one street or section thereof, or perhaps one side of a particular street, is congested with traffic, while other sections in the immediate locality are practically deserted. In some cases this can be attributed to the character of the business houses, but in a large proportion of the cases, there is no doubt but that the illumination of the several sections is responsible for the condition.

Very little need be said to convince the average citizen of the positive value of well lighted streets. It remains, therefore, to profit by the experience of others with the various systems in use and to select the one which more nearly fulfills the requirements of local conditions.

The fundamental problem to consider in the illumination of any street is the intensity of the illumination required and its production at a minimum cost. The cost includes the expenditure of energy, cost of maintenance, and interest and depreciation for the lamps, plant and all auxiliary equipment.

The area to be lighted is a long and comparative narrow strip. The result to be obtained is an approximately uniform intensity of illumination along the street with a somewhat higher intensity at street intersections.

When considered from the standpoint of economy without regard for illumination and decorative requirements, if energy cost is low, large units at great distances apart are better, and if energy cost is high small units placed at frequent intervals are more economical.

The long period of insufficient and generally unsatisfactory illumination of the streets, is now being succeeded by a period in which central stations, civic organizations and merchants are making a gigantic effort to improve conditions. This effort has resulted in the installation of a large variety of lighting systems.

The ornamental lighting systems in general use may be classed under three general heads, as follows: Festoon, arc and post systems. We shall mention briefly the chief advantages and disadvantages of each, as given in various reports.

The arch system was perhaps the first one installed, which could be classed as an ornamental system. It consisted of incandescent lamps supported by arches extending from curb to curb. It gives an extremely spectacular appearance, and the large source of light eliminates sharply defined shadows. The experience with this system extends over a number of years, and the principal defects may be noted as follows:

The arches are long, comparatively heavy, and are difficult to support with sufficient rigidity to withstand high winds. The material used for the arch construction deteriorates very rapidly. The lamps are in such position that they are not readily accessible for replacement and cleaning. The distribution of candle power is such that bright bands of light are secured immediately under the arch and dark spots midway between arches. The individual position of each lamp makes it impractical to use any form of reflector for properly directing the light rays, and considerable light is wasted. The ends of the arches are necessarily low—and the lamps produce a glare in the eyes. The day light appearance is unsightly, and detracts from the architectural beauty of the buildings. This system is rarely installed at present and has been succeeded by the arc or post system or possibly a combination of the two.

In the arc system, use is made of the metallic flame style of lamp. The efficiency of the system is very high, and the maintenance cost low. The maximum candle power of this type of lamp is near the horizontal, and it is, therefore, possible to place the posts at great distance apart and at the same time secure a uniform intensity of illumination. This makes it possible to use a minimum number of poles—and possibly to make use of existing trolley or arc lamp posts. The lamps can be supported at great heights above the street, above the critical angle of the eyes. The small number of poles required for this system simplifies the installation of service wires, particularly in underground districts.

The principal defect noted in a large number of arc lamp systems, is the tendency to support the lamps too close to the ground. This is particularly objectionable on account of the fact that the glare effect produced by the bright light in the eye, causes a contraction of the pupil, which limits the amount of light entering the eye and no advantage is gained by a high intensity of illumination.

The ornamental post system is perhaps the most popular of the three systems classed as ornamental. There is a large number of post designs on the market, for from one to five light units. They are installed on both sides of the street, and comparatively close together. The lamps are supported in a pendant or inverted position, and are ordinarily supplied from an underground system. The lamps and globes are easy of access for renewals and cleaning. The maintenance cost is reasonably low, particularly where the series type of lamp is used. The illumination of the street, when units are properly spaced is quite uniform, and the required intensity is readily secured by a proper selection of lamp sizes. Since the lamp posts are on the curb lines, the resultant effect is a street of great width.

The first cost of installation varies with local conditions and the type of post adopted, and the available source of energy supply.

The principal objection to this system is the large number of posts required. This is a particularly objectionable feature in districts where there exists also a large number of trolley, telephone and other service poles.

Summing up the general situation, it appears that no one system can be adopted as the best for all installations. Local conditions very largely determine the best system to be installed.

One of the very first questions that arises in connection with an installation of an ornamental street lighting system is "Who is to pay for it?" The standing committee on ornamental street lighting of the National Electric Lamp Association received reports from sixty-five systems. The installation and maintenance costs were paid for as follows:

	Installation	Maintenance
City	26	8
Merchants	23	18
Central Station	5	14
Property Owners	6	19
City, Property Owners and Tenants	1	..
Property Owners and Merchants	1	3
City and Central Station	1	1
City and Property Owners	1	1
City and Merchants	1	1

Contracts have been made with so many parties and combinations of parties that it has been impractical to standardize on any particular scheme. Local conditions almost entirely determine the contracting parties, depending to a great extent on who agitates the movement for better street lighting.

Ordinarily it is quite unsatisfactory for the company to have a contract with the property owners, merchants or tenants, individually. This form of contract involves so many people that there is a constant source of annoyance when any one becomes dissatisfied, moves away or for other reasons desires to be released from his portion of the expense.

Perhaps one of the best methods of handling this class of business is to secure contract with the city for the service, and if necessary a special tax assessment on property holders and merchants in the affected district can be made.

Perhaps the most fertile field for immediate development is in a rearrangement of the present lighting system. It is possible to make enormous improvements in almost any system of street lighting by relocating the lamps; raising them higher from the street; removing useless, and replacing crooked, or decayed poles; and giving the lamps and fixtures sufficient attention to insure a pleasing appearance.

Mention may also be made of the possible improvements in caring for lamp glassware. Street lamps are subject to most severe weather conditions; dust and smoke will in a very short time have a deteriorating effect on the appearance of a lamp. A large proportion of industrial and manufacturing plants, stores, etc., have realized the advantages of keeping lamp globes and reflectors in good condition, and have had the maintenance department adopt a regular schedule for frequently washing and cleaning the fixtures. The results obtained have been highly satisfactory.

No doubt the companies have been greatly handicapped in their efforts to improve street lighting conditions by the vast amounts of unreliable data which are frequently published. We often read articles in local papers in which the rates for street lighting service in various cities and towns are compared. These articles appear quite frequently during the time when a new contract between the light company and city is pending, and are sometimes very inaccurate and misleading. The data are generally inaccurate, not in the information given, but in the lack of complete information.

It behooves the company manager, therefore, to keep thoroughly posted on the advantages and value of the various systems available; to explain these items to interested officials and citizens, and to continually insist on superior street illumination, previous to the time when the unsatisfactory street illumination has prompted action on the part of the city authorities, or civic organizations.

Ornamental Street Lighting.

Since the origin of the movement for better street lighting the attainment of which did not mean the unsightly obstruction of the streets by clumsy wooden poles and a tangle of rubber covered wires, there has been a uniform anad very rapid adavancement. At first it was set forth that the new ornamental lights would furnish a paying advertisement of the city, and such was the truth. The traveler on the night train was and will continue to be impressed, and his memory of the city with a decorative lighting system will be of material advantage.

But the growth and advancement of ornamental lighting has been such that the city without an adequate system of illumination will soon be the exception. The time is not far distant when the city without good street lighting will be the exception; and the night traveler will remember and advertise it after the fashion "Darkville, yes, I remember it well, it was a dreary little place, gloomy and unpleasant."

The advantages of good street lighting have become apparent and each month notes a great number of cities which have installed ornamental stret lights.

Bloomington, Ill., last year installed ornamental lights on Main street. The type of unit adopted was a five-light standard of very good design supporting four pendant 60-watt lamps and one 100-watt erect in the center. One of the big things which Bloomington will take up during the coming year and carry through, is the making of Washington street the "Great White Way" of the city, from one end to the other. In doing this, it would make a handsome street straight through the city, and connecting two of the railroad passenger stations located at opposite sides of the city. It has been suggested that such a project might well be carried through, partly at least, at general expense of the citizens. While the people living on the street, both east and west, would no doubt be willing to bear some of the expense of installing such a line of ornamental lamps, yet a portion of the cost might be raised, either by general taxation or by a public subscription to which any public spirited citizen could give a portion.

The Grand Rapids Gas Light Company, Grand Rapids, Mich., has just completed the erection of a number of street lamp posts on the corner on which the company's offices are located. From the two arms of each post are suspended two five-burner, white enameled inverted gas arc lamps with alabaster ball globes. The arms of the posts, instead of being at right angles, as generally installed, have been placed parallel with the curbs. The object of the installation was to furnish a lesson in ornamental illumination by gas lamps.

Wilmington, Del., recently made the dedication of a new "white way" the occasion of elaborate ceremonies. The new era of street lighting along Market street, the city's chief thoroughfare, was inaugurated under the auspices of the Board of Trade, the Mercantile Association, the Street and Sewer Department officials and other city officials and business interests. Promptly at 8 o'clock, Mayor Harrison W. Howell, standing on the steps of the city hall, opened a switch that shut off the 11 arc lights that had illuminated Market street from Front to Eleventh streets. He then closed another switch that turned on the current in the 172 tungsten lights that have been erected on ornamental poles along the same section of streets. The tungsten lights are scattered along the street so that the light is diffused and the street made uniformly bright. An automobile parade and speeches completed the celebration.

The boulevard system of lighting the streets has been installed in Monticello, Ia., by C. B. Nelson, of Ames, contractor. The electroliers consist of five lights, four 60-candle-power and one 100-candle-power. These are operated by a time switch, which turns off the 60's at midnight, the one 100-candle-power light giving all night service. The business men and property owners paid for the installation and the city furnishes the current.

Some time ago the wide-awake citizens of Hamilton, O., decided that it should keep pace with modern municipal improvements, the most conspicuous among which at the present time is decorative street lighting. The movement was supported by the Chamber of Commerce and the city council, and was largely aided by the Retail Merchants' Association. As a result of the agitation a handsome system of tungsten cluster lighting has been installed in the principal business center. Added interest is given to this installation for the reason that Hamilton is one of the few cities in this country having a municipal electric lighting plant. The installation was under the direction of the superintendent, James O'Toole, of the municipal electric light plant.

Anniston, Ala., has completed an installation of fifty-seven ornamental lighting units. The standard used weighs approximately 600 pounds. It is equipped for five lights, one in center, upright, and four on arms, inverted. The standard is 13½ feet high. Lamps used are 65-candle-power Mazda burning five in series on 115-volt circuit.

C. T. Wilson, city engineer of Waterloo, Ia., in his annual report of improvements, makes a very gratifying showing on the installation of "boulevard lights." Less than a year ago a movement was launched and in December, 1911, there had been installed 104 lamps on the business streets of Waterloo and 18 on Fifth street bridge.

In addition to the cities above noted, which have installed ornamental lighting systems a number have taken active steps to obtain more and better light.

Electric lighting for Columbus Junction, Ia., seems assured as the result of a special election held recently when by an almost unanimous vote the proposal to grant a franchise for the installation of an electric light system was endorsed.

Pontiac, Ill., has made a five-year contract with the Pontiac Light & Water Co., for the lighting of its streets. Additional ornamental lights will be installed.

McKeesport, Pa., is considering ornamental lights, as a result of a petition from the merchants of the city. It was estimated that the city would remove 30 arcs. The number of clusters asked for by the merchants was 175, and it was figured that there would be an additional cost of $5,700 in cost of light each year by this scheme, while the cost of installing the system would be about $10,800.

Plans are being developed for the illumination of Main street in Keokuk, Ia., which will make it most briliant and attractive. The plans are being prepared by the Stone & Webster Company and will be considered later by Mayor Elder and the commissioners. One plan that is being agitated and would no doubt meet with popular favor is the proposal to place four magnetite lights to each block in the center of the street. With the power of this light, as is displayed by the ones at the intersection, Main street would have a daylight appearance. If the center-street lighting system is adopted, a neutral strip would be necessary. This could be arranged by parking a small strip down the center protected by curbing and still allow about twenty-three feet on each side which would permit of three teams passing abreast. The intersections could be set back far enough to permit of ample room for turning at any of the intersections.

When Gas Was Five Dollars a Thousand.

Interesting documents of thirty years ago were brought to light recently when Assistant Postmaster J. G. Ludlam, of Lincoln, Neb., conducted a house-cleaning at the federal building. The document which attracted the greatest attention was a receipt for gas used in the federal building during the month of February, 1877.

The receipt is drawn to the "P. O. Office" and is signed by "Putman," on behalf of Walsh and Putman, who then operated the gas plant. It shows on its face that the postoffice consumed 3,700 cubic feet of gas and that its bill, less 10 per cent. reduction if paid within five days, was $18.75. This is at the rate of $5 per 1,000 cubic feet, just five times the rate which the city is now seeking to establish by ordinance.

The following notation, together with instructions for reading the meter appeared upon the face of the statement: The price of Gas shall be $5.00 per 1,000 cubic feet, with a reduction of 10 per cent. if paid within five days after due, and all bills shall be due and payable on the 1st day of each month. If not paid within 10 days after the presentation, the flow of gas to such defaulting consumer shall be stopped until all arrearages are paid in full. Bills payable at the office.

Formation of the San Gabriel, Cal., Sewerage Commission.

Fourteen cities of the San Gabriel valley, Los Angeles county, Cal., were represented at a meeting of the Inter-City Commission early in April at the City Hall of San Gabriel, to discuss ways and means to construct an outfall sewer to solve the sanitation problems which one by one they are all required to work out. The Inter-City Commission had sent invitations to the representatives of other cities who met in Covina previously, for the purpose of obtaining co-operation.

S. B. Olmstead, of Los Angeles, had been retained by that body for the purpose of making the preliminary reports, and at the close of the meeting it was agreed that one delegate from each of the cities should be named to form a committee to wait upon the Board of Supervisors and decide what legal steps would be necessary before starting the actual work of constructing the sewer. In this way there will be at least fourteen of the leading cities of Los Angeles county co-operating toward one end.

Mr. Olmstead has expressed the opinion that eventually it would be found necessary to build levees to define the course of the San Gabriel river, and that the sewer could be built in these levees.

Following is a list of the cities in the proposed sewerage system: Azusa, Alhambra, Covina, Compton, Claremont, Glendora, Lordsburg, Monrovia, Pomona, Pasadena, San Dimas, San Gabriel, Whittier and El Monte.

FIRE AND WATER

Water Filtration Cost.—Economical Fire Equipment.—Fire Semaphore.—Motor Fire Apparatus.—McKeesport Water Plant.

The Cost of Water Filtration.

The chief engineer of the State Board of Health, J. Winthrop Pratt, recently presented a paper before the Cleveland Engineering Society dealing with the question of water filtration. In this paper, Mr. Pratt presented some data and comparisons regarding the cost of water filtration as follows:

The cost of installing filter plants may range from $10,000 to $40,000 or even $50,000 per 1,000,000 gallons capacity. This unit cost varies with the size of the plant, the character of the water to be treated, the expense necessary to connect with the existing water system, and other local conditions. For example, the cost of installing the raw water pumps would be much less in places along the Great Lakes than it would be on the Ohio river, where the water level fluctuates 50 or 60 feet.

Studies by the Ohio State Board of Health of 11 filter plants in Ohio, namely, those at

	Cost per 1,000,000 gals.
Cincinnati	$49,830
Dennison	26,000
Elyria	10,000
Geneva	13,000
Lorain	12,000
Marietta	10,000
Rocky River	14,000
Upper Sandusky	15,000
Vermillion	8,000
Warren	13,000
Youngstown	13,000

have shown the average cost per 1,000,000 gallons capacity to be about $17,000. Excluding the Cincinnati plant, however, which cost $49,830 per 1,000,000 gallons capacity, the average cost of the remaining ten is only $13,000 per 1,000,000 gallons capacity. The average cost per capita (based on ultimate capacity of plant), excluding Cincinnati, was found to be about $1.50.

Slow sand filters are in general more costly to build, but cheaper to operate than mechanical filters. This statement is made with the assumption, of course, that the slow sand filters are installed only where the water is sufficiently clear to enable them to be operated with reasonable periods of service between cleanings.

Operating costs vary greatly with the quality of the raw water and the character of the treatment. Lake waters drawn from points removed from shore are cheapest to treat; while muddy river waters are most expensive.

Special treatment to remove color or odor add to the cost; and water softening may increase it two or three times. Under ordinary conditions filtered water may be obtained at a cost of $10 per 1,000,000 gallons, including interest and depreciation charges. The figure will vary from $5 to $20.

With slow sand filters the principal operating cost is the labor and maintenance of equipment used for washing the sand. With mechanical filtration, the cost of chemicals and of labor, which are about equal, constitute the largest items.

In Ohio it was found that the operating costs, excluding interest charges, ranged from $2.55 per 1,000,000 gallons at Elyria to $12.10 at Warren, with Youngstown second highest at $10.67. This great difference in cost is largely due to the superior quality of Lake Erie water taken from a point fairly remote from pollution over that of the turbid and polluted Mahoning river.

In considering the cost of maintaining a filter plant, attention should be directed to the comparatively small increase in the cost of supplying filtered water over that of supplying unfiltered water. This increase is rarely more than 25 or 30 per cent., and frequently only 10 or 15 per cent. In any case, the increase should not amount to more than 50 cents to $2 per person per year—a small price to pay for enjoying pure water and all of its benefits.

Economical Fire Equipment for Small Cities.

In response to a request from the Texas Association of Local Fire Insurance Agents, J. J. Hussy, who was until recently chief of the Texarkana, Ark.-Tex., fire department presented his opinions on the economy of motor fire apparatus for small cities. Texarkana is a city of about 10,000 population and Mr. Hussy's anaylsis is worthy of consideration from cities of that class. The text of his discussion is abstracted as follows:

There is one thing that I desire to call your attention to and that in my opinion is given very little thought as a general proposition both by fire insurance agents and chiefs of fire departments, and reasonably so, too, for the reason that it is fair to assume that every man or insurer of property is honest and I would dislike very much to think the contrary, but our experience teaches us that we are very often fooled in our conclusions. I, therefore, call your attention to the moral hazard of the insurance business and the fire-fighting ability of a fire department to a large degree fixes that hazard at the maximum or minimum. This hazard the motor driven apparatus has almost removed from our city by reason of the fact that the prompt response to an alarm of fire, such as can only be produced by motor driven apparatus fixes that fear of being discovered or the evidences of the crime being discovered to that degree this hazard is now reduced to a minimum in our city. I desire to call your attention to the fact that the records of this department show that the big triple combination motor driven machine at the first thirty-five fires after its installation in the service originating in this city arrived first thirty-three times, second one time and third one time.

The cost of operation has been reduced to a minimum. For instance, it costs $5,053.80 to operate one steam fire engine and one combination chemical engine and hose wagon, which represents the same amount of fire-fighting ability as is contained in one triple combination pumping engine, chemical engine and hose wagon, motor driven apparatus. You are required to have an engineer and driver for the steam fire engine and a driver of the hose wagon and four men to man the hose and nozzles, making a crew of seven men in all for the two pieces of apparatus; the driver of the steam fire engine and the engineer render service of a secondary nature, the driver doing the stoking and the engineer handling the engine and the driver of the hose wagon handling the team. This only leaves you at the fire four men to man the hose and nozzles, or a real fire-fighting force of four men. Now, take the motor driven triple combination such as is described in the above, manned by five men, one of whom handles the engine while pumping, and you have the same relative state of efficiency that you have with the seven men manning the horse drawn apparatus, and your action is decidedly quicker by reason of the fact that the motor driven apparatus is much easier placed at the hydrant and does not have to wait for steam, oiling and many little things that occur while getting into action that cause delay. Yet the motor driven apparatus, with the same efficiency, only costs this department $3,673.75 per year to operate, thus showing a net saving of operation of $1,380.05.

This only applies to one piece of motor driven apparatus against the same fire-fighting force that would be contained in two pieces of horse drawn apparatus, viz., one steam fire engine and one combination chemical engine and hose wagon. Now, make the same showing in a larger department of twenty pieces of apparatus of the horse drawn type as against ten pieces of the triple combination motor driven apparatus which would represent the same fire-fighting force and you will have reduced the cost of operation $13,800.50 per annum, or very near enough to buy two additional pieces of motor driven apparatus each year thereafter.

Referring to the question of first cost of motor driven apparatus as against the first cost of horse drawn apparatus, the following figures will be interesting:

One-third size steam engine, horse drawn	$5,250.00
One combination chemical engine and hose wagon, horse drawn..	1,600.00
Fire station and lot	7,000.00
Horses and harness	625.00
Total cost of installation	$14,475.00
One motor driven triple combination engine	$8,000.00
Fire station and lot, building only required to be half size	5,000.00
Total cost of installation	$13,000.00
Net saving	1,475.00

You will note from the foregoing that it takes a great deal less space to care for the motor driven apparatus than it does for the horse drawn. Therefore, you cut your investment in half. Now you can figure this investment in favor of the motor driven apparatus, and as a matter of fact as cities grow larger the desirable locations for fire stations grow accordingly higher in price and this is interminable, the saving on the investment in both the land and the station is a paying one forever, and you still have more efficiency in the service.

A Novel Fire Semaphore.

There has been recently installed in Boston a crossing signal by which it is proposed to halt traffic to allow the passing of the fire apparatus. The corner of Third Avenue, West and First Street was chosen for the first installation by reason of the fact that it has been considered one of the most dangerous crossings of the city.

The signal device is a semaphore, similar in appearance to those used in railroad work. It is about 12 feet in height with an arm similar to the railroad semaphore. It is connected with the fire headquarters in such a manner that when an alarm is received from the downtown section the semaphore arm, labeled fire, automatically drops, a red light is flashed and an alarm bell sounds. The common type of street alarm device consists of a bell which is tapped to signal to the traffic officer in charge from which direction the apparatus is to come. The semaphore device should prove useful on corners where traffic officers are not stationed.

The General Adoption of Motor Fire Apparatus.

A recent census by the Power Wagon showed that 301 cities and towns in the United States have 594 motor driven fire apparatus of all kinds already in service, each piece being worth anywhere from \$3,500 to \$10,000, the aggregate value being a trifle over three millions.

In no other branch of activity has the motor vehicle a more undisputed and proved superiority over the horse. The people whose property is insured by the motor apparatus against destruction by fire, the fire insurance companies, who are directly concerned in fire protection, and the fire chiefs and firemen whose business it is to put out fires—all these are a unit in declaring the efficiency of the motor from every standpoint, and its unquestioned superiority over the horse.

In the United States, according to the census of 1910, there are 6225 cities and towns with a population of 2,000 or over; there are 3553 with a population of 3,000 or over; there are 1858 with a population of 5000 or over; there are 842 cities with a population of 10,000 or over, there are 320 cities with a population of 25,000 or more; there are 131 cities with a population exceeding 50,000, and 43 cities have a population of 100,000 or over.

These, then, are the possibilities. Each of these cities and towns, on the average, needs two motor driven fire fighting machines. The whole country, according to this estimate, which is derived from present statistics, should have a total of 12,450 machines. There are only 594 of them already in service, which leaves a balance of 11,850 still wanted.

All the developments of the last few years are in favor of motor fire apparatus. Improved methods of intercommunication, notably the electric trolley and interurban lines, the telephone and the increasing radius of the delivery service (by motor wagons) of the great city department stores, have induced people to move out from the congested areas in the cities to the suburbs. The density of city population is decreasing, but the area is increasing enormously. Outlying districts are being built up and the people in them are isolated from fire protection facilities. The horse driven fire apparatus is thus automatically rendered obsolete, for it can not cover the distance in a reasonably short time The only alternative is motor apparatus. The people themselves realize this, for in numerous cases have fire motors been purchased by popular subscription, and in several cases even on the installment plan. A direct idea of the value to the public of motor fire apparatus is conveyed by the action of the insurance companies, which in numerous cases have voluntarily reduced their rates for fire insurance when motors have been installed. In several cases this reduction has amounted to over 50 per cent.

Municipal Water Plant at McKeesport, Pa.

McKeesport's water supply is the only public utility that the city owns and absolutely controls. It was established under the borough administration. The citizens authorized a bond issue sufficient to install it, and it constituted the largest single item of indebtedness that had been incurred up to that time. They were very evenly divided on the question when they voted on the bond issue, as the measure only carried by a majority of one vote.

The wisdom of the majority has been fully sustained by the results obtained, the department being self-supporting ever since and its revenues sufficient to maintain it, as well as paying for all improvements, extensions and betterments. In the first eight years of its existence the gross receipts were \$119,797; cost of maintenance, \$63,209. Expended for construction in that time, \$239,589, which includes the initial cost of plant and extensions to system, all covered by bond issues long since liquidated. The total revenues for the 21 years have been \$1,042,819; maintenance in that period, \$794,821; net revenue, \$247,998, and construction expenditures of \$713,496. The system is most unique in many ways. It supplies 7,000 patrons at rates that are lower than half of 355 public and private water companies in as many cities, towns and villages, besides furnishing free water in abundance for the washing and sprinkling of streets, public water troughs, park fountains, hospital, Y. M. C. A., all municipal buildings, such as police stations, fire stations, disposal plant, 500 fire hydrants, and in the summer season the largest public swimming pool in America, 1,500,000 gallons capacity.

Before the city installed its purification plant its water supply was a burden instead of a satisfaction. The city was a "plumbers' paradise," and the annual repair bill to the consumers was not less than \$200,000. The improvement cost the city \$279,000, and since its adoption three years ago it alone has paid for itself twice over in the total elimination of this extraordinary annual expense. As an asset the physical property represents \$750,000, which alone would meet all the outstanding indebtedness of the city if forced into liquidation. It has a revenue earning power of 16 per cent., with a maintenance cost of 7 per cent., leaving net 9 per cent.; has a bonded debt of \$279,000 less \$37,000 in sinking fund, \$242,000, and furnishes besides \$27,000 worth of water free per annum for the purposes previously mentioned.

There is, however, a more important phase of the subject than a mere commercial one, and that is the health of the community. Prior to the purifying of the water the city ranked second in the United States for typhoid fever mortality per hundred thousand population. This excessive death rate was not due to the unpurified city water directly, but indirectly, for the reason that the city supply was so highly acid and disagreeable that the people sought a more potable water and resorted to ground water from numerous unsanitary wells and springs throughout the city, which was responsible for the enormous typhoid death rate, between 50 and 60 cases annually. In so far as the origin of this malady due to the use of city water now is concerned, it has been totally eliminated, and the few cases recorded have been traced to the persistent use of well and spring water.

ROADS AND PAVEMENTS

**Molasses Road Binder.—Second New York Road Bond Issue.—
New Jersey Road Laws.—Stepless Street Car.**

Molasses as a Road Binder.

In connection with a series of experimental sections of road, which are under observation at Chevy Chase Circle, near Washington, D. C., the Government Road Department is carrying on some tests with a view to using a by-product from sugar refineries. This material, known as "blackstrap molasses," is the very lowest grade by-product from cane sugar and in the case of beet sugar it is absolutely uneatable.

The "blackstrap" from cane sugar was barreled and sold, but that from beet sugar was so offensive that the manufacturers could do nothing with it but burn it. Therefore when the experiment was tried in surfacing the stretch of road in Bradley lane, near Chevy Chase, cane sugar molasses was used. This mixed with lime water forms calcium sucrate, one of the stickiest substances known to chemistry. When it is put on the road it sinks in and is disagreeable feature is lost.

The small stretch of road on Bradley lane is the project of Logan Waller Page, the director of the office of public roads. The road is an ordinarily good macadam road, but the surface has been sprinkled with a road watering cart, in which a certain amount of the cheapest, low-grade molasses was mixed with lime water. This material, according to laboratory experiments, was found to have a peculiar binding effect with sand, so much so that its use as a road binder was indicated. Beet sugar "blackstrap" will be used in some future experiments.

New Jersey's New Road Laws.

A series of road bills signed by Governor Wilson during the latter part of April will give New Jersey eventually 1,500 miles of State highways and make radical changes in the method of dealing with these roads.

The establishment of the system of State highways is placed in the hands of the State Highway Commission, and by one of the bills the State Treasurer is added to this commission. It is now composed of Governor Wilson and State Road Commissioner Stevens and President Prince, of the Senate; Speaker McCran, of the Assembly, and State Treasurer Daniel S. Voorhees.

The most important of the measures provides that the State highway system shall include roads, or parts of them, as now are, or will form, main-traveled highways of reasonably direct route between the county seats, existing improved highways being chief lines of travel between seaside resorts and the large centers of population, other roads which naturally would be a part of a State system, the Ocean boulevard and the Delaware River drive.

The State road commissioner is to prepare and submit to the State Road Commission a map of the proposed highway system. After making necessary modifications the commission is to adopt the mapped road system as the State highway system.

The new law provides that in taking over any road as a part of the State system the commission shall be guided by the character and the amount of travel thereon, its consequent relative importance in the system and with due regard to the mileage of roads heretofore improved in each county and to the burden of maintenance and repair costs therein, which it is the intent of the act to relieve. The State system is not to exceed 1,500 miles of highways.

Whenever a road, or portion of a road, is taken over by the State its further improvement, maintenance and repair will be at the expense of the State.

There is a special provision that whenever the State shall take over a road occupied by any street railway or other corporation, which corporation is under agreement to repair or maintain any portion of the roadway, this agreement shall hold for the benefit of the State.

Important regulations for the use of the State roads are contained in the statute. No vehicle can be driven over the roads with a load of more than 30,000 pounds. Vehicles must be not more than twelve feet high or nine feet wide. No vehicle tire can be fitted with any blocks, hobs, studs or other projections. No person shall place any broken glass, pottery or sharp object or other substance on the roads injurious to their surfaces or to person, health or property of those using the roads. The penalty for violation of these provisions is a fine of from $10 to $20 and costs of prosecution.

No franchise or other grant affecting any State road shall be given for the construction of a street railway without the consent of the State Highway Commission.

Another of the new laws provides for the permanent improvement of non-State highways, the work to be done under the control of the boards of freeholders, and the State to pay forty per cent. of the cost. Under the old law the State paid only one-third the cost.

A Fifty-Million-Dollar Road Fund for New York.

A bill before the legislature of New York to provide for the submission to the people this fall of the question of approving another $50,000,000 bond issue for good roads, was passed by the Assembly by a vote of 82 to 29, Of this amount $30,000,000 will be used for county roads and $20,000,000 for State roads.

The New Type of New York Street Car.

The new "stepless car" of the New York Railways company went into practical operation recently on Broadway, New York City. The car was designed with a view to securing a maximum of safety and comfort to the passengers.

It is built with a low floor, which is at such a height that no step is required to assist in boarding or leaving it, and no side handles to encourage entering or alighting while the car is in motion.

The entrance and exit passages are at the center of the car, and are provided with side doors which cannot be opened until the car stops and the car cannot start until the doors are shut. When the car stops the conductor, who has a seat in the middle behind a desk, presses a button with his foot and a pneumatic device opens the door. Then the motorman, if the track is clear, sets his controller in the first notch for going-ahead. The conductor when the passengers are off and on, closes the door by releasing the button, and the instant the doors close the car starts. If the way is not clear the motorman does not throw his controller in but the closing of the doors flashes a light before him and he goes ahead. Security of passengers is thus obtained.

The new car is a marvel, for the load regulates the amount of air that is drawn in. If ten people are riding two ventilators are opened and the air is drawn in over heated coils and warmed for winter use; when the load is a hundred, all the ventilators are called into play. There are no straps in the car. Heavily enameled steel uprights take their places and they are cleaned every night with carbolic acid. The floor of the car is concrete and is cleaned by turning a hose onto it at night.

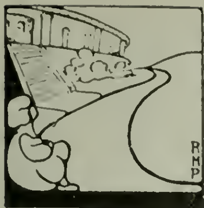
The seats are comfortably arranged in pairs and are all cross seats with the exception of the two ends, where semi-circular seats are installed. These are higher, as they are over the trucks. The motorman's place is directly over the large wheels of the truck and he is thus brought up to a position as high above the street as on the old style car, with the accompanying advantage of having a clear view of the street before him. The conductor has a comfortable seat in the middle, where he can control the movements of the passengers and has a full view of everybody getting on and off.

The cars are built throughout of steel with the exception of the floor, window posts and roof boards. It is lighter than any car of its capacity now in use.

Private Sewerage System Not Authorized by Pennsylvania.

The state commissioner of health cannot authorize private citizens to construct sewer systems and drain sewage into the public waters of the state, according to an opinion given recently to Commissioner Samuel G. Dixon by Attorney General John C. Bell. The commissioner stated that the borough of Nazareth has made application for approval of a sewer system and sewage disposal works with permission to discharge for a short time raw sewage into state waters, but had withdrawn the application and granted a franchise to private citizens, with the condition that the state should first approve the plans.

The attorney general holds that, if the borough desires to permit citizens to construct the works and discharge sewage, it must make application and must be held responsible for what private citizens do. This opinion will govern in a number of similar cases in both the eastern and western parts of the state.



ORGANIZATIONS & INDIVIDUALS

Technical Associations.—Calendar.—Technical Schools.—Youngest Mayor.—Personal Notes.

Technical Associations.

The Southern Engineering Society has been organized by the architects and engineers of Augusta, Ga., with an enrollment of about 50 members. The secretary is T. M. Campbell, 201 Terminal Bldg., Augusta, Ga.

A total of 573 papers has been definitely promised for presentation before the International Congress of Applied Chemistry, which will be held at Washington and New York on September 4-13. They will be divided among the sections of the congress according to the following classification: Analytical Chemistry; Inorganic Chemistry; Metallurgy and Mining; Silicate Industries; Organic Chemistry; Coal Tar Colors and Dye Stuffs; India Rubber and other Plastics; Fuels and Asphalt; Fats, Fatty Oils and Soaps; Paints, Drying Oils and Varnishes; Starch Cellulose and Paper Center; Agricultural Chemistry; Bromatology; Physiological Chemistry and Pharmacology, and Electro Chemistry. The secretary is Bernhard C. Hesse, 25 Broad St., New York City.

At the second annual convention of the Tennessee Health Officers Association held at Nashville, April 3-5, the following officers were elected: Dr. W. E. Hibbett, president, Nashville; Dr. J. F. Arnold, vice-president for East Tennessee, Washington County; Dr. C. T. Love, vice-president for West Tennessee, Crockett County; Dr T. O. Bratton, vice-president for Middle Tennessee, Wilson County; Dr. John Steele, secretary and treasurer, Chattanooga.

The fifth annual meeting of the Lake Michigan Sanitary Association was held at Hammond, Ind., on April 4. The following were elected officers for the ensuing year: President, Mayor A. J. Horlick, Racine, Wis.; first vice-president, Dr. G. B. Young, Health Commissioner, Chicago; second vice-president, Dr. F. A. Tucker, president Indiana State Board of Health; secretary, M. R. Humphrey, Industrial Commissioner, Association of Commerce, Chicago. The association (which is composed of health and other public officials, physicians, engineers and sanitarians) represents the states, municipalities, health boards, etc., interested in the use and protection of Lake Michigan as a source of public water supply.

The Arkansas Engineering Society was organized at a meeting of engineers of that State, held in Little Rock on March 15. Maj. W. H. Parks, of Pine Bluff, was elected president; D. A. MacCrea, of Little Rock, vice-president; T. B. Hill, of Little Rock, secretary.

The Atlanta Association of Members of the American Society of Civil Engineers was organized at a meeting held in Atlanta, Ga., on March 14. Arthur Pew was elected president, and W. A. Hansell, secretary.

At the 310th meeting of the New York Electrical Society, held in the Auditorium, Engineering Societies Building, 29 West 39th Street, Wednesday, April 17th, at 8 p. m., Guglielmo Marconi, LL.D., D.Sc., delivered an address on "The Progress of Wireless Telegraphy."

For the 1912 National Conference on City Planning, which will be held in Boston late in May, the Executive Committee has decided to consider the following subjects: The progress of city planning; How to finance city planning; Studies in the planning of specific areas; The German principle of "Zones" or differentiated building districts applied to the United States; Some aspects of the transit problem. Flavel Shurtleff, 19 Congress Street, Boston, Mass., is secretary.

At a regular meeting of the Municipal Engineers of the City of New York held on Weednesday, April 24, 1912, a paper entitled, "Progress on the City Tunnel of the Catskill Aqueduct, Board of Water Supply," was presented by Walter E. Spear, Department Engineer, Board of Water Supply, New York City.

At a meeting of the American Peat Society held in New York City on April 9, the following papers were presented: "Fuel Conservation," by Dr. Joseph A. Holmes, Director Bureau of Mines, Washington, D. C. "Agricultural Possibilities of Muck Lands," by Prof. Geo. W. Cavanaugh, of N. Y. State College of Agriculture at Cornell University, Ithaca, N. Y. "Peat Fuel a Success in Europe, Why not in America," Prof. Charles A. Davis, Peat Expert of Bureau of Mines, Washington, D. C., Julius Bordollo, Kingsbridge, New York City.

The Clay Products Show.

By reason of the amount of construction data which was submitted for the April issue of MUNICIPAL ENGINEERING, a number of articles were omitted in that number because of lack of space.

The first exhibition representative of the clay industry in this country was held in Chicago during an entire week in March. Other clay products exhibitions had been held in England, but the American manufacturers did not attempt a national exhibition previous to this time.

The entire Chicago Coliseum and Annex were utilized to contain the great numbers of exhibits which were provided by the different classes of manufacturers who comprise the motive force of the clay industry. A careful plan was followed by the exhibition officials, so that the different classes were grouped by their products. In this manner the manufacturers of ornamental brick, terra cotta, interior finish, face brick, etc., were given space together; while those who produced drain tile, paving brick, sanitary appliances, etc., were allotted to another section. At the south end, in the Coliseum Annex, was the municipal display, with drain tile, chimneys, flush tanks, all sorts of vitrified clay mains, and an automatic ditch digger for digging trenches, and by its own locomotion moving along the floor at various speeds.

A wide variety of exhibits were made and a careful consideration was shown for the purposes of the show, namely, to present to the buying public a comprehensive idea of the possibilities of clay as a consrtuction material. In addition to articles of a purely utilitarian nature, there were shown a large variety of artistic products, as well as some which from historical associations presented a "human interest" appeal. A brick from St. Peter's Cathedral, Rome, laid by Pope Leo XII in 1825, was a representative of this latter nature.

A few among the exhibits of interest to municipalities may be mentioned as follows:

The National Paving Brick Manufacturers' Association had an exceptionally well-conceived exhibit to represent their work. A full-sized street section was constructed, paved with brick laid on the standard concrete base and grout-filled. All the details of construction, such as vitrified clay culvert for a stream crossing, vitrified clay subdrains, curbs, gutters, etc., were built exactly as under actual service conditions. A carefully prepared background painting, drawn to true perspective, joined to the model mentioned, showed the appearance of a finished brick street.

The Clay Products Publicity Association had an exhibit of sewer pipe. A complete testing plant was in operation and sections of pipe were tested up to twenty-five tons external pressure.

W. S. Dickey had a complete exhibit of sewer pipe, chimney tops, hollow wall tile, fire brick, sewer sections and flue linings.

The W. E. Dee Clay Manufacturing Co. had a large space in which were shown sewer pipe, hollow tile sections, municipal castings, sanitary castings, and fittings, flue linings and drain tile.

N. A. Williams exhibited a line of sewer pipe, fire brick, etc.

The Austin Drainage Excavator Co. had set up and in operation a complete gasoline driven excavator, which is mentioned above.

The American Sewer Pipe Co. showed a 48-inch sewer section constructed of hollow vitrified sections, together with sewer pipe and clay conduits. The vitrified sections shown were of a new interlocking type.

The Edgar Allen American Manganese Steel Co. showed heavy brickmaking machinery and gears of their material.

The Blackmer & Post Pipe Co. exhibited large and small sewer pipe, vitrified clay syphons and specials.

The Dickey Clay Manufacturing Co. had a most complete line of sewer pipe and specials.

The National Fire-proofing Co., known for their "Natco" products, had an exhibit of all kinds of hollow tile shapes for every conceivable use in building construction.

The National Brick Co. had a very large exhibit, showing a model pavement, and, in addition to the various products of their company, a beautifully constructed floor laid under their own specifications.

The Woodland Clay Co. had a complete exhibit of drain tile.

The Pacific Flush Tank Co. exhibited a section of a bathroom, showing all the plumbing complete, house drainage, street drainage from curb to manhole, and a flush tank equipped with a Miller tank siphon. All of this was installed and under operation.

The Davenport Brick and Tile Co. showed a sewer section constructed of hollow vitrified tile.

The Dunn Wire-Cut-Lug Brick Co. furnished, in addition to an exhibit of their products, all the brick used in constructing the model paving section.

A. S. Rosing exhibited a very complete line of sewer pipe, acid jars, clay bibs, etc.

In addition to those above mentioned there were a number of other exhibits, showing all the classes of municipal work to which clay products are adaptable.

A very full attendance assured the success of the show and its repetition in the future. Passes were distributed by various manufacturers to those who were interested in the products shown. This feature assured that the attendance was of the class who made, advertised, sold, bought, ought to buy, or were interested in the products of clay.

Calendar of Technical Meetings.

National Fire Protection Association. Annual meeting, Chicago, Ill., May 14-17. F. H. Wentworth, Secretary, 87 Mill st., Boston, Mass.

International Navigation Congress. At Philadelphia, Pa., May 23-28. Secy. J. C. Sanford, 344 The Bourse, Philadelphia, Pa.

Fourth National Conference on City Planning. Meeting, Public Library, Boston, Mass., May 27-29. Flavel Shurtleff, Secretary, 19 Congress st., Boston, Mass.

American Water Works Association. Annual convention Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River st., Troy, N. Y.

Mayors Conference of New York. Third annual meeting Utica, June 10-12. Mayor C. C. Duryee, president, Schenectady, N. Y. C. C. Capes, secretary, New York.

National Electric Light Association. Annual meeting at Seattle, Wash., June 10-14. Secy. T. C. Martin, 29 West 39th st., New York.

Fire Marshals' Association of North America. Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

National Municipal League. Annual meeting Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American Bldg., Philadelphia, Pa.

Central States Water Works Association. Sixteenth annual convention, Detroit, Mich., September 24-26. R. P. Bricker, Secretary, Shelby, O.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment. Seventy-first Regiment armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway, New York, N. Y.

Technical Schools.

An investigation of the Value of Concrete as Reinforcement for Structural Steel Columns, by Arthur N. Talbot and Arthur R. Lord, has just been issued as Bulletin No. 56 of the Engineering Experiment Station of the University of Illinois. This bulletin gives an account of a series of tests to determine the strength of a structural steel column of considerable strength having a filling of concrete. The tests show that this type of column, if properly made, is a reliable and efficient structural member, and that nearly all the strength of both steel and concrete is developed. The tests also show that up to the point of failure of the column, the fireproofing shell of concrete adheres tightly to the remainder of the column.

The library of the late George E. Church has been placed in the college library of Brown University. These volumes contain rare ones covering the subject of engineering and large collections of publications on South American countries, believed to be of great historical value.

Ralph S. Tarr, professor of physical geography at Cornell University, and widely known for his work in that field and in geology, died at Ithaca, N. Y., on March 21. Professor Tarr was born in Gloucester, Mass., in 1864, and graduated from Harvard in 1891. From 1887 to 1889 he was also engaged in work for the U. S. Geological Survey and the Texas Geological Survey. In 1890 he took up the teaching of geology at Harvard, and in 1892 was made assistant professor of dynamic geology and physical geography at Cornell. Later he became professor, and in 1909, head of that department. He was the author of several books on geological and geographical subjects.

The April number of The Wisconsin Engineer, published by the students of Wisconsin University, includes among others the following articles: Student Life at the German Technical Schools, by Carl C. Thomas; Wood Preservation, by James D. Mac Lean; Special Method of Mining on Dangerous Ground on the Mesaba Range, Minnesota, by B. M. Concklin; and The Flow of Water Through a Porous Medium, by L. R. Balch.

Personal Notes.

Charles H. Baumgartner has been re-elected city engineer of Dubuque, Ia.

W. L. Lancaster has been retained by the city of Blacksburg, Va., to install a water and sewerage system.

D. F. McCarthy has been re-appointed city engineer and superintendent of streets, sewers and water for the city of St. Albans, Vt.

Rodney Swift has been elected city engineer of Auburn, Me., and F. E. Bisbee has been re-elected superintendent of water works.

Charles J. Jenner has been appointed superintendent of public works of Jamestown, N. Y., and Clyde G. Jones has been appointed city engineer.

J. G. Thorne, formerly Assistant Engineer and Superintendent for the Iowa Engineering Co., Iowa City, Iowa, has been elected City Engineer of Clinton, Iowa.

George A. Johnson, of Messrs. Johnson & Fuller, consulting sanitary engineers, New York, has been retained by the water committee of Wellsville, N. Y., on the question of water works improvement at that place.

J. W. Ledoux, consulting engineer, Philadelphia, Pa., has been retained by the city of Youngstown, Ohio, to advise on the construction of the proposed Milton dam and reservoir in that city.

E. J. McCaustland, M. Am. Soc. C. E., Professor of Municipal Engineering at the University of Washington, Seattle, Wash., has been appointed a member of the Washington State Board of Health.

J. Frederick Jackson has severed his connection with A. William Sperry, Inc., of New Haven, Conn., and has opened an office at 831 Chapel St., New Haven, for the general practice of civil engineering.

Alvord & Burdick, consulting engineers, Chicago, Ill., have been retained by La Crosse, Wis., to make an investigation of the feasibility of obtaining a ground-water supply in connection with the water works improvements contemplated.

John F. Sinnott, of Newark, N. J., has been appointed a member of the Passaic Valley Sewerage Commission by Governor Wilson. Elmer H. Geran has been appointed to the State Water Supply Commission and William W. Smalley member of Forest Park Reservation Commission.

Edlow W. Harrison has resigned as chief engineer of the Passaic Valley Sewerage Commission, Jersey City, N. J. He will be succeeded by William M. Brown, of Boston, Mass., who has been serving as chief engineer of the Metropolitan Sewerage Works in that city.

William H. Connell has been appointed chief engineer of the Bureau of Highways of Philadelphia. He has been serving as deputy commissioner of public works of the Borough of Bronx of New York City for two years past and has been engaged on public work in New York for twelve years.

E. L. Grimes, W. R. Headden and C. D. Calkins have formed a partnership under the firm name of Messrs. Grimes, Headden & Calkins, for the practice of general civil engineering, with offices in the National State Bank Building, Troy, N. Y. They will prepare plans and specifications for water supplies, filtration plants, water power developments, sewerage systems, sewage disposal plants, steam and electric railroads, paving and bridges.

MACHINERY AND TRADE

An Adaptable Gasoline Engine.

It may be said with equal force that the measure of a portable pumping engine's use is the measure of its adaptability. In these pages have appeared advertisements of the Atlantic diaphragm pumping engine, a feature of which is its adaptability to different classes of work.

A model of this engine designed especially for pumping out trenches, foundations for buildings, piers, etc., has recently been perfected. This type is strong, durable, compact, easily portable, and highly efficient. In its peculiar class of work it takes the place of one to two hand pumps at a saving of $8 to $13.75 for each eight hours where in operation. While the engine is guaranteed to be of the highest efficiency, yet its cost is so little that it pays for itself in a short time.

Since coming on the market it has been found that the Atlantic is readily adaptable to many other kinds of work. It can be attached to a sanitary (cesspool) diaphragm suction and force pump for use by health departments and corporations in cities and towns for the removal of sewage from cesspools and drains. It has 3-inch suction and 3-inch discharge and a capacity of 3,000 to 4,000 gallons per hour. It is non-chokable, no trouble is experienced in using it.

Attached to a diaphragm suction and force pump with 2-inch suction and 1½-inch discharge, the engine is particularly adapted for prospecting and mining work and for contractors' use in filling tanks, watering carts or for elevating water for any job where a small quantity of water is desired. Either this or the sanitary type will raise and force water containing sand, dirt or tailings without choking.

For road contractors use in filling water carts, furnishing water for boilers and pumping out drains and culverts and also in mining operations, the Atlantic is supplied, attached to a double acting suction and force pump, with 5-inch brass lined cylinder, 2-inch suction, 2-inch discharge.

The Atlantic diaphragm pumping engine is so designed that it can be attached to your hand diaphragm pumps, thus making even your hand pumping equipments come in handy and made to pay. Harold L. Bond Company, Boston, Mass., manufacture the engine mentioned, and will furnish information relative to its adaption to your needs.

Integrol Waterproofing.

The necessity of properly waterproofing concrete has been set forth at length in various accounts of structures which have proved unsatisfactory through not being impervious to water. Various water proofing compounds which have had a varying degree of success, have been placed on the market and at the present time few concrete jobs of importance are undertaken without the specifications including the use of some good waterproofing.

Two classes of compounds have been developed which differ in their use and each class includes a number of both powders, liquids, or pastes. The first of these classes includes those compounds which are applied to the surface of the concrete, forming an exterior shield against moisture. Those of the second class are used in what is known as the integral method and they include the compounds which are mixed with the concrete or mortar and form an integral part of the whole. This method was introduced by Myron H. Lewis, who developed "Integrol" under his own name and trade mark.

"Integrol" is a paste containing three elements, a water repellant, a crystallizing component and a fine material which fills the voids left in the mixture of cement and aggregate. The elements employed do not in any way affect the strength or appearance of the concrete, and they are not injurious to steel reinforcement. The imperviousness which is obtained in the concrete by the use of the waterproofing serves to guard against the chemical action of oil, gas, water and other corrosive influences.

In using the paste the operations involved are very simple. "Integrol" is furnished in two grades, the Number 1 which is provided to be mixed in the proportions of 1 gallon of paste to 25 gallons of water; and Number 2 which is much denser and may be mixed in the proportions of 1 gallon of the paste to 50 gallons of water. These mixtures may be used instead of water in making either a mortar coat or in the mass of the concrete itself. The directions given for the use of "Integrol" in the concrete provide for mixing as follows:

Run about 10 gallons of water into a barrel, and then throw in the contents of a 2-gallon can of "Integrol." Stir the mixture a few minutes, and then add water until barrel is full. Keep stirring while adding water. When once mixed only slight occasional stirring is required to prevent settlement. It does not separate from the water. Where a less quantity is desired, 1 gallon is first mixed with about 4 gallons of water, then 21 gallons additional water is added if same is to used for mortar, and 46 gallons of water if for concrete. More exact proportions are given in a table which may be had upon request.

The waterproofing is sold by the Wemlinger Steel Piling Co., 11 Broadway, N. Y., who are also agents for the "Lewis Specification" products which include liquid damp-proofing, water proof mastic, water proof concrete finishes, and form coatings.

The Kelly Rocking and Dumping Grate.

An improved feature of the rocking and dumping grate is here shown. It consists of a large rear dump grate, which is operated independently from the main grate surface. By means of the double capacity dump grate the larger clinker formation can be quickly and easily disposed of at the rear of the furnace where combustion terminates. The residue of combustion must be disposed of after the fuel has performed its heat producing function, and two ways only are available, namely, to dump into the ash pit or clean out through the fire doors. In modern furnace practice the dumping process is considered the better method.

There is a tremendous loss in furnace efficiency by the forward cleaning of the fires, because it disturbs combustion, and with the opening of the fire doors, the heat producing function of the furnace is destroyed, and the loss represents both fuel and labor in getting the combustion areas of the furnace back to a normal active state again. By referring to the photograph it can be seen how convenient it is to clean these grates, especially the rear portion which ordinarily receives the least attention, because it is out of reach of the fireman. But with this wide dump grate, it is really the easiest portion of the grate surface to clean; and can be done without extra exertion or exposure to heat and dirt.

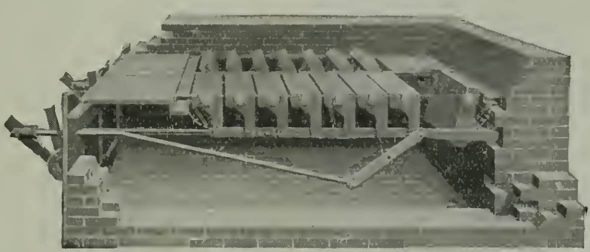
A combination of the rocking and dumping features entitles this grate to recognition as a modern device for coal burning furnaces and while it is a hand firing device it embodies three prominent features of a mechanically fed furnace, namely:

First. The agitation and breaking up of the fuel bed by the rocking movement.

Second. The tendency of the rocking motion to shift the fuel to the rear.

Third. The large dumping grate at the rear of the furnace which enables the operator to dump the accumulation of clinker and ash.

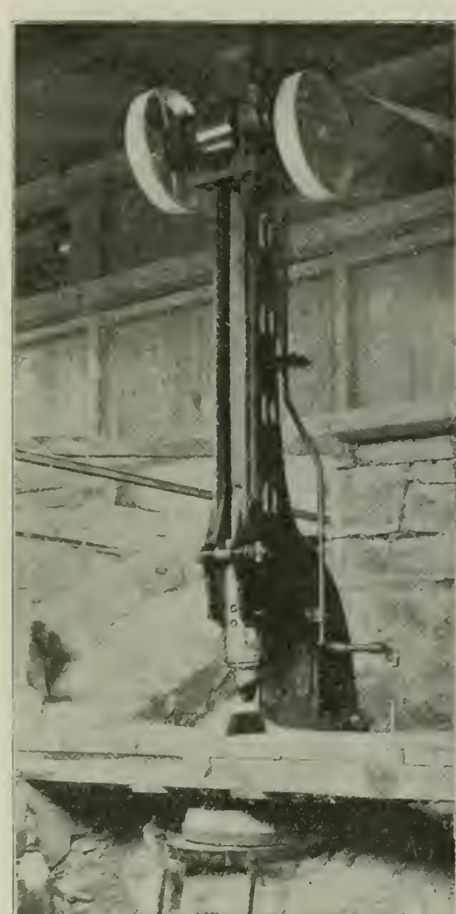
This grate is the product of the Kelly Foundry, of Goshen, Ind. It is made to fit any size furnace and with air space best adapted to the kind of fuel used. It is self-contained and does not require any alterations in the ordinary furnace to install.


THE KELLY ROCKING AND DUMPING GRATE.

The Sett Cutting Machine.

The sett-making machine, a machine for making small paving stones or setts, as will be seen from the illustration, is essentially a belt-driven friction drop-hammer, in which the monkey is attached to a lifting board, and is fitted with a special form of hammer-head. The anvil, on which the stone to be split is placed, consists of a long massive steel chisel, so fixed in the anvil-block that it is easily removable for sharpening. By merely pressing on the foot lever or releasing it, the monkey carrying the hammer-head is made to rise to or fall from any desired height; the operator has thus complete control over the strength of the blow. The machine or machines are erected in the quarry in such a way that the blocks can be delivered in the most direct manner possible down a shoot, and so on to a platform within easy reach of the operator. The blocks should not exceed 12 to 13 inches in depth, and should not be too large for the operator to handle easily. Experience has shown that labor spent in the quarry on roughly squaring the blocks amply repays itself in increased output of the machines, both in quantity and quality, and greatly diminished waste of stone.

The operation is as follows: The operator takes one of the blocks from the end of the bench where it has been delivered by the shoot and lifts it on to the chisel, arranging it in the place he wishes to split it. He then gives the block two or three light quick blows with the hammer so as to indent the stone and stun it along the de-



THE SETT CUTTING MACHINE.

sired line of cleavage. The monkey is then raised to the required height and a heavier blow is given to split the stone.

In this way the block is cut up into the required sizes, a single blow of the hammer being generally sufficient to split the smaller ones. When starting to cut up a block, the operator should begin splitting it along the line of its best cleavage. It is of course, most economical to make several different sizes at the same time so as to cut the blocks with least waste.

The whole operation is exceedingly simple, and an intelligent laborer should very soon be working the machine so as to give its maximum output, which is about 7 tons a day when making large setts only and about 4½ to 5 tons when making setts of mixed sizes in a 9-hour day, although it is impossible to give exact figures for the output, as so much depends on the kind of stone, on the quality of the blocks, and on the skill of the operator. Many of the setts are marketable as produced by the machine but for the best setts subsequent trimming is required.

The machine has been designed with due regard to the rough nature of the work pertaining in quarries; it is therefore exceedingly simple, working parts being reduced to a minimum, thus practically eliminating all risk of breakdowns.

The power required to drive the machine is only 1½ H. P. The transmission being by one open and one crossed belt.

There are over four hundreds of this machine in successful use in Europe. One concern in Sweden is operating 62 of them in their plants, manufacturing about 700,000 square yards of large and small setts. The American rights and sale of the machine in this country are controlled by A. E. Sylven, M. E., 29 Broadway, New York, N. Y.

Adjustable Steel Centering.

A form of steel centering which is adaptable to a wide variety of needs was patented during March of this year, by Henry H. Frick, Line Lexington, Pa. Previous to this time there has been nothing of this nature on the market to take the place of wood centers and forms for building sewer, bridge and culvert arches, walls, etc., with the exception of steel culvert forms.

The adjustable steel centering is made up of a number of units, hinged together at both ends. These units have drilled holes which may be brought to alignment, any one of a series of one unit being brought to conform with one of those on another unit, and fastened in position by means of a pin. The units have a freedom of movement with relation to each other which allows them to be revolved through an angle of about 180 degrees, and fastened in any relation to each other so as to give the desired contour. They may be used either as centering to hold forms apart, or as bonding, holding the forms together to give the required interior section for the casing.

The centering is widely adaptable to different sizes of sections, additional units being added as needed to increase the size. It may be used in place of wooden studding in building wall forms, one unit after another being added on either side, and the two lines of units being held together at the required distance by wires placed through the pin holes in the units of one side and carried to the other. These wired units may be left in place to support scaffolding from which the finishing may be carried on.

"Jointite" Under Service Test.

"Jointite," a pipe jointing compound, which has been described in these pages has recently been subjected to a severe service test. About 1,200 feet of 8-inch sanitary sewer was constructed in Summit, N. J., in August, 1911, by John J. McGrath. "Jointite" was used for the running joints.

This work was completed at the end of August and tested at the time of completion by water tests and the joints were all found to be absolutely water-tight. Inasmuch as the outlet for the sewer was not yet completed, the end of the sewer line was tightly plugged, and remained so until the early part of March of this year.

Meantime, the line being on low ground was covered with water for various periods throughout the winter. Upon opening the line this spring, it was found that no water due to infiltration was in the entire length of the line. In considering the amount of water in the soil during the past winter, the absence of water is a sure evidence of the efficiency of the compound.

Paterson, N. J., has an 1,800-foot sanitary sewer siphon line which has been in operation for about five months and has been found perfectly water-tight. The joints were constructed with "Jointite," which was run in a trench partly filled with water.

The material is manufactured by The Marbleloid Company, 1328 Broadway, New York, N. Y.

An Effective Weed Killer.

The "Target Brand" weed killer, manufactured by the Horticultural Chemical Co., 660 Bullitt Building, Philadelphia, Pa., is a preparation which has been widely used by street railway officials, street superintendents, park and cemetery caretakers, as well as owners of residence properties.

It is an effective combination of high grade chemicals which diluted in water at 1 to 40 destroys the roots as well as the tops of all weeds and vegetation to which it is applied. Its use prevents the unsightly growth of weeds and all forms of vegetation upon gravel, brick and cinder streets, between car tracks and along sidewalks. It is most effective in its operation, and is cheaper and is even more permanent in the prevention of weed growth than grubbing or hoeing. It is best to apply the preparation immediately following a rain.

One gallon of the Target Brand weed killer when diluted is sufficient to cover 50 to 100 square yards; and one or two applications are sufficient for an entire season. It does not injure marble, cement or road metal.

The Harold L. Bond Contractors' Equipment.

The Harold L. Bond Company, 383-391 M. Atlantic Ave., Boston, Mass., have issued a catalogue of contractors' equipments which includes everything from a cast iron washer to a derrick or a crane car. There are 318 pages in the catalogue, and all materials described are fully illustrated by photographs or drawings.

The tools and machinery shown are complete for every form of construction work carried on by contractors. The "Atlantic" line of contractors' pumping engines which have been described in these pages, including the types which have recently been put on the market, are shown, together with various other kinds of pumps and pumping engines. A convenient cross reference index, covering both the tool or machine desired and the trade names under which it is sold, makes the catalogue easy of reference.

Engines, drills, pumps, concrete mixers, derricks, graders, rock crushers, hoisting and conveying machinery, digging machinery, carts, windlasses, plows, scrapers, rollers, cars, steam cranes, and asphalt furnaces are among the heavier type of machines and equipments mentioned, in addition to hundreds of kinds of smaller tools and supplies. It would be easier to enumerate the one or two articles which might be mentioned for use by a contractor and are not mentioned in this catalogue than the numberless things which are listed and described. It is most complete.

A Booklet by the Des Moines Bridge and Iron Company.

The Des Moines Bridge and Iron Company, 912 Casey Building, Pittsburgh, Pa., has printed a booklet, for free distribution, which contains some interesting matter regarding steel water tanks, towers, stand pipes, etc. Illustrations are given of a great number of structures which the company has erected, together with data as to capacity and construction. Tables of capacities of cylinders and tank bottoms, friction of water in pipes, fire stream pressures and discharge are given.

The latter portion of the book contains matter relative to water works plants, several of which are mentioned as being built complete by the company. The order of procedure necessary to secure a water works plant is outlined.

Consumption of Cement in the United States.

The preliminary estimate of the production of Portland cement in the United States, made by the U. S. Geological Survey, shows about 77,877,236 barrels made in 1911, an increase of 1.7 per cent over that of 1910. An estimate of the consumption of cement can be made by combining with this statement the reports of imports and exports of foreign and domestic cements, made by the

U. S. Bureau of Statistics. According to these reports there were imported of all kinds of cement 172,044 barrels, of which 8,978 were re-exported, leaving the consumption of foreign cements 163,066 barrels. This neglects the slight variation in amount of cement remaining in warehouse at close of years 1910 and 1911. Exports of domestic cement in 1911 were 3,135,409 barrels. The report of trade with Panama is omitted from this year's volume, but it is probable that about half of the reported exports were sent to the Panama canal and might be considered as domestic consumption. If not so considered, the net domestic consumption is 74,904,893 barrels.

The value of domestic cement at the mills was 86.7 cents a barrel, that of the same cement as exported was $1.37 and the value of the imported foreign cement was nearly $1.50 a barrel.

Fuel Wastes.

The Combustion Appliances Co., Rogers Park, Chicago, Ill., are conducting an educational campaign, which, though its motive is probably to sell their equipment, yet is of such value that all users of steam power should be interested and being interested, they will be benefited. 'How to Stop Fuel Wastes" is the title of a small booklet, which is exceptionally well conceived and which cannot fail to make an appeal to power plant managers. It deals with the question, both from the standpoint of labor efficiency in firing and structural conditions of boilers, etc.

The analysis of fuel gases is taken as the method by which the best working conditions may be recognized in the furnace and a full description, not only of the apparatus to be used, but of the methods of its use and even the details of obtaining the greatest labor efficiency are outlined.

The Hays Gas Automatic Collector, the Hays Improved Gas Analysis Instrument and the Hays CO_2 and Draft Recorder are the instruments mentioned and described.

The Combustion Appliance Co. have a complete line of draft gauges, smoke recorders, gas calorimeters, damper regulators, soot blowers, recording gauges, thermometers and pyrometers.

Patents on Cleaning Water Mains Sustained.

The U. S. District Court for New Jersey on February 23, 1912, made a decision in the case of the National Water Main Cleaning Co. vs. Whitney Pipe Cleaning Co. and Geo. F. Whitney, which declares the validity of H. A. Greenan's patent, No. 934,520, for passing cables through water pipes, and that the defendants are infringers, who must account to the plaintiff for profits on sales of their devices and pay costs and disbursements in the suit. A perpetual injunction is also issued.

High Duty Pumping Engines.

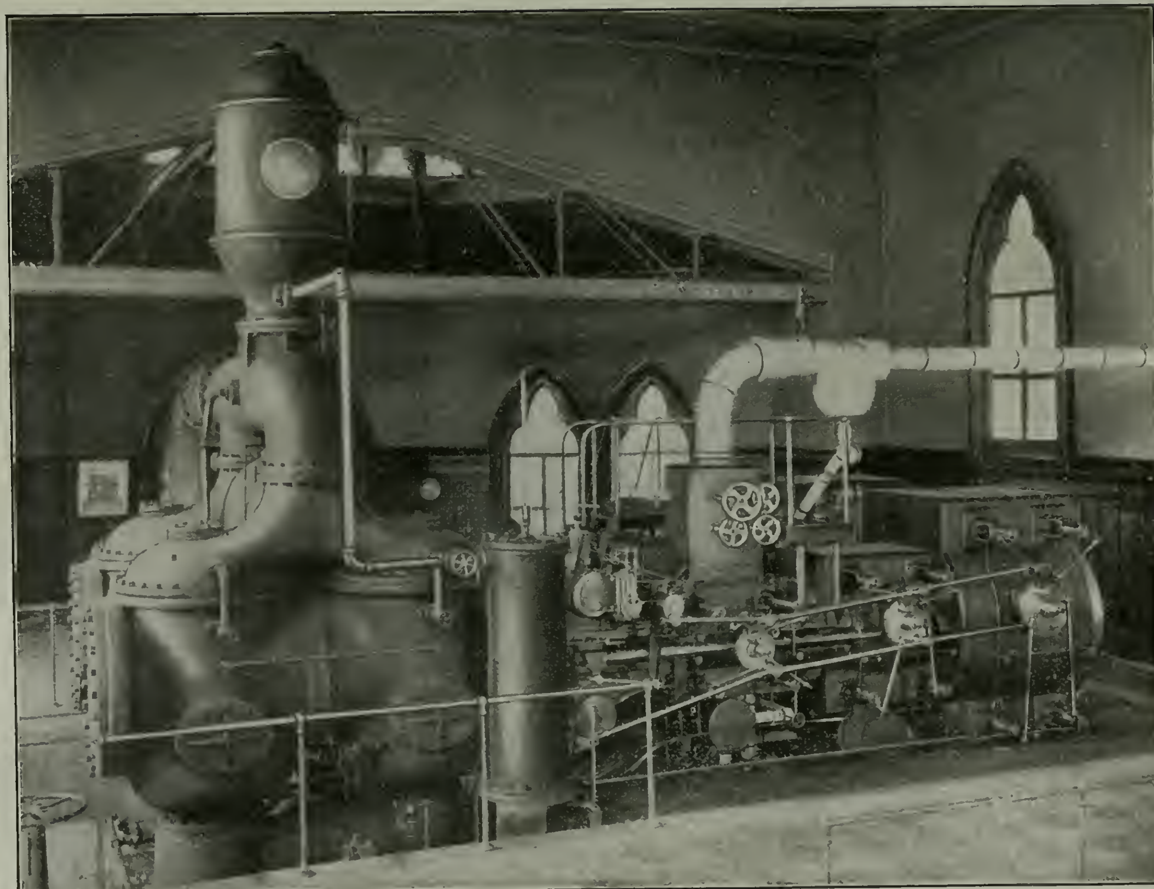
Henry R. Worthington, 115 Broadway, New York City, has just issued Bulletin W-188-63, giving an extended description of the Worthington horizontal, triple-expansion, high-duty dumping engine installed in the Hope Station of the Providence, R. I. water works. This engine has a capacity of 10,000,000 gallons per 24 hours against a head of 85 lbs. per square inch and its design represents the latest practice in pumping engines of this type. One of its interesting features is the high-duty attachment involving the use of compensating cylinders taking the place of a flywheel. The arrangement is preferable to a flywheel in that the power exerted increases in almost exact ratio with the decrease of the power of the expanding steam. The account of the duty trials shows that the guaranteed duty was excelled at full load by 4.5 percent. and at reduced capacity by 12.5 percent. The actual duty at full load was 149,500,000 foot-pounds per 1000-lb. of dry steam.

The bulletin also shows and describes a similar engine installed at Fall River, Mass. The bulletin will be especially interesting to municipalities facing the problem of securing adequate and economical pumping service.

Fall River, Mass., has a similar installation, and in a report by John W. Moran, chief engineer of water works, some interesting figures of economy are given. Commenting on this report, Mr. Moran states:

The high percentage of running time, 8599 out of a possible 8760 hours in the year, or 98.10 percent. and the yearly duty, "which includes every pound of coal burned at our station," of 90 2-3 million ft.-lbs. under our erratic pumping conditions (which with no reservoir means anything from an 11-million gal. per hour gait at certain hours of the day to a 3-½-million-gal. gait at others) demonstrates that the 10-million-gal. Worthington pumping engine installed at Fall River is both a highly efficient and economical pump. Under any kind of favorable pumping conditions, that is, running at about an 8 to 10-million-gal. gait regularly, it would sail close at all times to its guaranteed 135-million-ft. lbs. duty.

For the year 1910 I returned to the Water Board $2963.07 in coal, that is, I saved that much money in the amount of coal burned as compared to the best previous year in the history of the station. I have for the year just ended, 1911, shown a furthe saving of $504.70 over 1910, which means that in the two full years ending December 31, 1911, the Worthington pump has been running, I have saved the city of Fall River, in coal alone, over the best previous year with the old pumps, $6430.84, which means after paying the interest on the original investment, $43,000, that I can establish a sinking fund at 3 percent. with the remainder and retire the cost of the pump in about 18 years.



HIGH DUTY PUMPING ENGINE AT PROVIDENCE, R. I

The Studebaker Heater and Distributer for Heavy Road Binder.

During the past season the Studebaker heater and distributer found great favor in the eastern States as a most effective machine for applying heavy bituminous road materials. The machine is self contained in that it is independent of a steam roller for furnishing heat and the source of heat. A hydro-carbon gas generator is under direct control by the operator of the distributer.

The distributer consists of a rectangular steel tank, capacity 500 gallons, mounted on a platform spring running gear, adapted for two or three horse hitch. The tank is fitted with tubes placed vertically throughout the interior through which the heat passes from the burners which are located beneath the tank in an asbestos lined fire-box, the fire-box covering the full area of the bottom of the tank. The heat is thus driven directly through the mass of material in a most efficient manner. The burners are of special design, adapted for burning kerosene oil, are extremely simple in construction, non-carbonizing, and are controlled by needle valves affording instant and absolute control of the heat to practically any degree of temperature, as indicated by thermometer attached. Fuel oil is supplied to the burners under air pressure from a reservoir and air pump conveniently located. The delivery valves are placed inside the rear end of the fire-box where they are kept hot by the burners. Though using the heaviest material, the valves and spray tubes will not become clogged. Over the tubes on the top of the tank are placed removable hoods so that they can be readily cleaned.

The tank is provided with a simple device preventing all danger from accidental overflow of the material.

In operation the tank is filled in the usual way from the top and the filling cover tightly closed. The burners are then lighted and may be kept burning on the way from the car to the place of operation. If this is an average distance, the material will be sufficiently heated on arrival. The burners are then extinguished by closing the needle valves, the delivery valves are opened and the material distributed in an even and uniform spray in practically any volume desired from one-fourth to one gallon per square yard. Spraying tubes are removable and may be carried on the wagon when not in use.

The distributer is free from complicated mechanism; is practical, efficient and in every way up to date.

The accompanying photograph shows the distributer in use in Massachusetts.

It is manufactured by The Studebaker Corporation, South Bend, Ind.

THE STUDEBAKER HEATER AND DISTRIBUTER.

Hendricks' Commercial Register.

The 20th annual revised edition of Hendricks' Commercial Register of the United States for Buyers and Sellers just issued is the most complete work of its kind. Its aim is to furnish complete classified lists of manufacturers for the benefit of those who want to buy as well as for those who have something to sell. It covers every branch of the architectural, engineering, electrical, mechanical, and kindred trades and professions. It establishes a direct link between the buyer and seller. The index of the 20th edition requires one hundred and eight pages, or nine additional pages over last year, representing the manufacturers of over three thousand articles. The total number of classifications is over 45,000, each representing the manufacturers of or dealers in some machine, tool, specialty or material required in the industries named. The 20th edition numbers 1419 or 77 additional pages with a total of

124 pages of new matter, the whole representing upwards of 350,000 names and addresses. An important feature of the Commercial Register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. The trade names of all articles classified in the book as far as they can be secured appear in parenthesis between the names and addresses under the classifications where they appear. The book is revised, improved and issued annually. It is expressed to any part of the country on receipt of ten dollars by S. E. Hendricks Co., Publishers, 74 Lafayette street, New York.

Trade Publications.

The Barrett Manufacturing Company, New York City, has issued a handsomely illustrated booklet describing the use of Tarvia on roads and streets. About 30 excellent views of roadways constructed with Tarvia are shown and in addition there are photographs of the methods employed in applying the material. Full descriptive matter is given throughout.

A new sixteen-page illustrated publication called "Permanent Pavement" is being issued by the Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill. It covers the field of good roads and while the company is now especially interested in pavements using concrete it will cover all types. It is to arouse interest in road improvement and in bettering farming conditions through better transportation facilities.

The Atlas Portland Cement Co., 30 Broad St., New York, have a new publication called The Atlas Almanac, which will be issued periodically. It is devoted to cement progress and will serve in particular as an aid to the cement dealer and user, giving such items of interest and value to the cement field, as may arise. The details of new work will be observed and the points of interest and value will be recorded.

The American Asphaltum and Rubber Co., 600-619 Harvester Building, Chicago, Ill., have an illustrated folder entitled, "How You Can Make Better Sewer Joints." The "Pioneer" sewer joint asphalt and its use are described.

Five illustrated booklets are ready for distribution by The Studebaker Corporation, South Bend, Ind. The first describes the automatic pressure distributer for the application of materials for dust laying and road preservation. The record is devoted to the Studebaker line of dump wagons, with particular reference to the "New Ideal." The third is a supplement to catalogue number 723 and give details relative to their dump wagons. The fourth describes the patent combination heater and distributer for heavy bituminous materials. And the fifth called the Studebaker "Spokesman" is a publication giving various interesting facts, history and descriptions of various Studebaker products. All of the booklets are fully illustrated.

The Goulds Manufacturing Co., 131 W. Fall St., Seneca Falls, N. Y., have issued their Bulletin No. 110, devoted to single stage, double suction centrifugal pumps. Detailed descriptions, photographs, specifications and points with reference to the operation of the pumps are given.

The Keystone Driller Company, Beaver Falls, Pa., have for distribution their 1912 edition of catalogue No. 6. It is an 86 page book elaborately illustrated. To every well driller or engineer who has to do with pumping problems the book will be helpful and interesting; not only because of the information it contains upon a tried and approved system for elevating large quantities of water filters, contractors' lights, concrete account of the numerous tables of pressure, capacity, etc., which have been here collected.

The Roberts Filter Manufacturing Co., Darby, Philadelphia, Pa., has issued a catalogue of water filters of the pressure and gravity types and also complete filter appurtenances. In addition to the styles of filters shown the company constructs special filters to meet the particular needs of any case.

Trade Notes.

Eastman, Ga.—J. H. Hargrove & Sons will purchase reinforcing bars, cement, waterproofing, concrete mixers, concrete reinforcing, crushed stone, derricks, hoisting engines, water filters, contractors lights, concrete mixers, steel tapes, wire rope, and wood preservatives.

Chicago, Ill.—Universal Portland cement was sold last month to the Wayne County (Michigan) Road Commissioners for 40 miles of all-concrete pavement to be constructed this spring. This will take about 100,000 barrels in all and is the largest order for cement for concrete road construction on record.

Indianapolis, Ind.—The Fisher-Goory Coal Co., Indianapolis, has been incorporated for $25,000 by Wm. F. Fisher, pres.; Wm. P. Cosgrove, vice president; Wm. J. Goory, secretary and treasurer, and desire information on cement sewer pipe, lime, lath, roofing material and will take an agency for a line of concrete machinery and tools. Office, 708 S. Capitol Ave.

Indianapolis, Ind.—The Mansfield Engineering Co., 821 Board of Trade Bldg., will purchase a cableway concrete mixer and a conveyor system.

Buffalo, N. Y.—A $100,000 bond issue has been voted for playground extensions.

Beloit, Wis.—The city is in the market for low pressure sluice gates about 14 inches in diameter.

Milwaukee, Wis.—An $895,000 bond issue has been voted for recreational work in the schools.

Chicago, Ill.—The Weber Chimney Company, builders of reinforced concrete chimneys, have removed their offices from 209 South State Street, to 1452-1456 McCormick Building.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bedford, Ind.—May 7, 1 p. m. Constructing 10 gravel or macadamized roads. Ezra W. Edwards, auditor.

Bloomington, Ind.—May 7, 2 p. m. Constructing stone road in Salt Creek township. Horace Blakely, audt.

Brazil, Ind.—May 7, 11:30 a. m. Constructing road on line between Jackson and Washington townships. Edgar A. Staggs, auditor of Clay county.

Crown Point, Ind.—May 8, 12 m. Constructing 4 gravel roads in North township. J. Johnson, audt.

Fowler, Ind.—May 6, 1 p. m. Constructing 4 roads in Parish Grove township and 1 in Grant township. Lemuel Shipman, audt.

Fowler, Ind.—May 21, 11 a. m. Constructing a gravel road on line between Benton and Tippecanoe counties. Lemuel Shipman, auditor of Benton county.

Greensboro, Ind.—May 6, 1 p. m. Constructing macadamized road in Sand Creek township. Linton W. Sands, audt.

Hartford City, Ind.—May 6, 2 p. m. Constructing macadamized road in Washington township and on the line between Harrison and Jackson townships. James Cronan, Ja., audt.

Indianapolis, Ind.—May 2, 10 a. m. Furnishing 205 carloads of crushed stone for the highways of Marion county, and 200,000 gallons of road oil. W. T. Patton, auditor of Marion county.

Kentland, Ind.—May 6, 2 p. m. Constructing 2 macadamized roads in Lake township. E. R. Bringham, audt.

Kokomo, Ind.—May 7, 10 a. m. Constructing gravel road in Liberty township and 1 on line between Taylor and Center townships. A. B. Easterling, audt.

Logansport, Ind.—May 7, 10 a. m. Constructing road in Eel township. J. E. Wallace, auditor.

Logansport, Ind.—May 8, 10 a. m. Constructing a road on line between Cass and Pulaski county. J. E. Wallace, auditor of Cass county.

Madison, Ind.—May 7. Macadamizing a road in Republican township. A. M. Cass, audt.

Marion, Ind.—May 7, 2 p. m. Constructing gravel and stone road in Pleasant township. E. H. Kimball, audt.

Martinsville, Ind.—May 7, 12 m. Constructing gravel roads in Ashland and Washington townships. J. S. Whitaker, auditor.

Paoli, Ind.—May 7, 2 p. m. Constructing gravel road in North East township. Alvin B. Ham, audt.

Peru, Ind.—May 8, 12 m. Constructing roads in Peru and Jackson townships. Frank K. McElheny, audt.

Rushville, Ind.—May 6, 2 p. m. Constructing macadamized road in Rushville township. J. M. Stone, audt.

Salem, Ind.—May 6, 1:30 p. m. Constructing roads in Vernon and Howard townships. Frank S. Munkelt, audt.

Tipton, Ind.—May 6, 10 a. m. Constructing a gravel road in Cicero township. J. H. Tranbarger, audt.

Vernon, Ind.—May 6, 11 a. m. Constructing a macadamized road in Geneva township. N. W. Brogan, audt.

Vevay, Ind.—May 6, 1 p. m. Constructing highway in Pleasant township. Scott Culbertson, audt.

Vevay, Ind.—May 11, 10 a. m. Constructing gravel road in Jefferson township. Scott Culbertson, audt.

Vincennes, Ind.—May 7. Constructing 4 roads in Knox county. John T. Scott, audt.

Wabash, Ind.—May 7, 1 p. m. Constructing gravel road or macadam road in Chester township. Daniel Showalter, audt.

Kansas City, Mo.—May 6. Paving the Leeds-Raytown road with macadam and constructing concrete bridges and culverts at an estimated cost of $75,000. Cy. ct.

St. Louis, Mo.—May 3, 12 m. Paving construction as follows: Letting No. 10473 for constructing 393 ft. of vitrified brick pavement on Lloyd ave., certified check, $302; letting No. 10475 for constructing vitrified brick pavement on Utah st., certified check, $364; letting No. 10,476 for paving Byron pl., with Telford base macadam top and torpedo gravel and sand wearing surface, certified check, $182; letting No. 10477 for constructing roadway similar to letting No. 10476 on Esplanade st.; letting No. 10478 for constructing oiled macadam road on Manhattan ave., certified check, $343; letting No. 10479 for constructing oiled macadam roadway on Tennyson ave., certified check, $253; letting No. 10480 for constructing oiled macadam on Canterbury ave., certified check, $327; letting No. 10481 for constructing oiled macadam road on Oxford ave., certified check, $126; letting No. 10482 for constructing oiled macadam on Commonwealth ave., certified check, $377; letting No. 10483 for constructing oiled macadam, gravel surface roadway on Picadilly ave., certified check, $243; letting No. 10484 for constructing similar pavement on Ellendale ave., certified check, $376; letting No. 10485 for constructing similar pavement on Blow st., certified check, $450; letting No. 10,486 for constructing similar pavement on French ave., certified check, $313; letting No. 10487 for constructing similar pavement on another section of French ave., certified check, $303. Maxime Reber, pres. board of local improvements; William T. Findly, secy.

Akron, O.—May 7, 1 p. m. Constructing bituminous concrete roadway on the Ghent road. Length 12,546 ft., width 14 ft., estimated cost, $18,423. certified check, $300. Commissioners of Summit Co.; James R. Marker, Columbus, O., state highway com.

Chillicothe, O.—May 6, 12 m. Constructing bituminous concrete roadway on the Frankfort rd. Length 6,969 ft., width 16 ft., estimated cost, $12,877. Certified check, $300. Commissioners of Ross Co., James R. Marker, Columbus, O., state highway com.

Cincinnati, O.—May 3, 12 m. Widening the S. fork of the Taylor Creek rd. and building retaining wall under specification No. 241. Bond, $500. Albert Reinhardt, clk.

Lancaster, O.—May 4, 10 a. m. Constructing water bound macadam on the Lancaster-Newark rd. Length 22,616 ft., width 12 ft., estimated cost, $28,887. Certified check, $300. Commissioners of Fairfield Co.; James R. Marker, Columbus, O., state highway com.

Struthers, O.—May 2, 12 m. Constructing brick pavement on Space st. Certified check, $250. Ira Isenbraum, clk.

Troy, O.—May 3, 12 m. Constructing water bound macadam on the Piqua-Troy road section No. 1. Length, 9,800 ft., width 16 ft., estimated cost, $15,347; alternative bids will be considered for bituminous surface treated macadam at an estimted cost of $16,566. Certified check, $300. Commrs. of Miami Co.; James R. Marker, Columbus, O., state highway com.

Wilmington, O.—May 2, 12 m. Constructing macadam roadway on the Wilmington-Xenia rd. Length, 20,750 ft., width 14 ft., estimated cost, $23,141. Certified check, $300. Commrs. of Clinton Co.; James R. Marker, Columbus, O., state highway com.

Mitchell, S. D.—May 9, 8 p. m. Paving construction as follows: Main st., 2,969 lineal ft., including 19,252 sq. yds. of reinforced concrete; First ave., Second ave., Third ave., Fourth ave., and Fifth ave., including 284 ft. and 1,326 sq. yds. of reinforced concrete in each section. Certified check, 5 per cent. N. H. Jensen, cy. audt.

Paris, Tex.—May 21. Constructing 40 to 48 miles of macadam road and bridges for Prct. 1 in Lamar Co. W. S. Gill, secy. board of permant road commrs., M. Hannah, engr.

Colville, Wash.—May 8, 2 p. m. Clearing, grading, bridging and surfacing with gravel 3½ miles of the Addy-Gifford highway in Stevens Co. Certified check, 10 per cent. L. E. Jesseph, audt. of Stevens Co.

CONTRACTS AWARDED.

Montgomery, Ala.—Paving Jeff Davis ave., to the Southern Asphalt & Const. Co., $12,145; paving S. Court st., to the same.

Helena, Ark.—Paving Walnut st., to the Southern Bitulithic Co., Nashville, Tenn., $35,000.

Chicago Heights, Ill.—Constructing the first section of a $150,000 paving contract, to Wm. & Edw. McGavock, Beloit, Wis.

Mattoon, Ill.—Paving Pine ave., from 24th to 33rd st., to Thornton & Michaels, Mattoon, Ill., $15,974.

Monmouth, Ill.—Paving in the East 1st ave. district, to the Burlington Const. Co., Burlington, Ia., $26,689.

Pana, Ill.—Constructing 30 blocks of pavement, to John Cherry, Jacksonville, Ill.

Goshen, Ind.—Paving St. Joseph st., to the Northern Indiana Const. Co., Elkhart, Ind., concrete work sublet to Smith, Douglas and Witt, Goshen, Ind.

Indianapolis, Ind.—The following paving contracts have been awarded: Northern ave., to John Arnold, Concord st., gravelling roadway, to John Arnold; 30th st. grading, gravelling and curbing, to the American Const. Co., Grey st., grading, gravelling and curbing, to Abel Bros., constructing cement walks on Ritter ave., to Abel Bros., Hosbrook st, constructing walks, to Abel Bros.

Newcastle, Ind.—Paving Indiana ave., from 7th st. to 17th st., to James Garbey, $19,684; paving Grand ave. with brick, to McGrath & Clinton, Newcastle, Ind., $10,155.

South Whitley, Ind.—Constructing brick pavement, to W. W. Hatch, Goshen, Ind., about $30,000.

Creston, Ia.—Constructing 5 miles of pavement, to the Western Improv. Co., Racine, Wis., about $75,000.

Marshalltown, Ia.—Constructing 48,500 sq. yds. of concrete pavement, to Elzy & Carlson, Marshalltown, Ia., at $1.08 per sq. yd.

Muscatine, Ia.—The following paving contracts have been awarded to the August Korneman Co., Dist. 29, $21,324; Blk. 79, $617; Blk. 145, $623; 151, $645.

Newton, Ia.—Constructing 40,000 yds. of pavement, to G. Manieina, Florence, Neb., at $1.18 per sq. yd.

Mt. Clemens, Mich.—Paving construction, to W. W. Hatch & Co., Goshen, Ind., $10,000.

Canton, O.—Constructing 1.48 miles of road, to J. C. Devine Co., Alliance, O., $30,613.

Columbus, O.—The following road contracts have been awarded: The Cole rd., 2 miles to Vogelsburg & Walls, $9,981; the Kenny rd, 3.75 miles to Jewett and Keys, $26,677; the Scioto and Mudsock rd., to J. N. Snoufer, $29,030; the Hart rd, ½ mile, to W. O. Jewett, $3310.

Massillon, O.—Improving the Massillon-Millersburg rd., to Urban & Clements, Massillon, O., $28,870.

Massillon, O.—Improving the Massillon-Navarre rd., to A. F. Wendling, Massillon, O.

West Unity, O.—Paving streets to the amount of $24,000, to H. S. Encke, Lima, O.

Warren, O.—Constructing 2.5 miles of macadam road, to C. James Chinnouck, $13,887.

Salem, Ore.—Constructing concrete pavement, to E. W. Geiger Const. Co., $23,532.

Emsworth, Pa.—Paving the Beaver rd., to J. G. McGuire Co., New Brighton, Pa., $33,527.

Pittsburgh, Pa.—Work has been started on the "Hump" cut for which Booth & Flinn, received the contract at about $780,000. The James H. McQuade firm, which was the low bidder, has withdrawn.

Beaumont, Tex.—The following paving contracts have been awarded: to the Uvalde Rock Asphalt Co., 45,034 sq. yds., at $78,811; to the Creosoted Wood Block Paving Co., New Orleans, La., 24,490 sq. yds, at $61,456.

Olympia, Wash.—Paving 5 blocks of asphalt, to the Independent Asphalt Co., Seattle, Wash., $23,370.

Seattle, Wash.—The following paving contracts have been awarded: Harvard ave. to Xura Case, 1330 8th ave., $7,935; fourth ave., south to the Barber Asphalt Paving Co., Henry bldg., $28,141; concrete walks on 20th st., to Carl Isador & Co., Federal ave., $9,328; 25th ave., North, to Edgar C. Parks, 609 6th ave., north, $835; Newport ave., to C. H. Trachaven, $9,397.

Spokane, Wash.—Constructing the Apple Way rd., to the Spokane Paving & Const. Co., Spokane, Wash., $38,930.

Green Bay, Wis.—Constructing asphalt pavements, to the White Const. Co., Milwaukee, Wis., $13,500.

Neenah, Wis.—Paving E. Wisconsin ave., with tar macadam and concrete, to Chris Johnson, Oshkosh, Wis., $24,175.

Two Rivers, Wis.—Paving about 25 blks. to the Schuete Cement Const. Co., of Manitowoc, $30,000.

Waukesha, Wis.—Paving 7 streets, to Geo. Stanchfield, Fond du Lac, Wis.

CONTEMPLATED WORK.

Hillsboro, Cal.—A $130,000 bond issue for road construction has been voted.

Inglewood, Cal.—A $30,000 bond issue for street improvement has been voted.

San Francisco, Cal.—An $8,500,000 bond issue for the construction and improvement of civic centers has been voted.

Lewiston, Ida.—The paving improvements to cost about $200,000 are contemplated. D. C. Wrighter, engr.

Springfield, Ill.—The paving of about 6 miles of streets is contemplated for the coming season.

Clinton, Ia.—The council has passed a resolution fixing May 14 as a date for opening bids for the paving of 5th ave.

Crowley, La.—A committee composed of Mayor Wm. Egan, and Alderman J. G. McLenka, J. W. Cheney, and city engineer White, are inspecting pavements with a view to selecting material for a number of streets.

Bad Axe, Mich.—A $75,000 bond issue for road construction has been voted.

Bessemer, Mich.—A $150,000 bond issue for road construction has been voted by Gogebic county. W. I. Russell, deputy co. clk.

Beulah, Mich.—A $15,000 bond issue for the construction of roads has been voted.

Erie, Mich.—A $40,000 bond issue for road construction has been voted. G. W. Minnie, twp. clk.

Grand Haven, Mich.—A $600,000 bond issue for road construction has been voted. Jacob Glerune, co. clk.

Grand Rapids, Mich.—A $600,000 bond issue for road construction has been voted by Kent Co. R. A. Mosher, co. clk.

Monroe, Mich.—A $40,000 bond issue for the construction of 5½ miles of macadam highway has been voted.

Minneapolis, Minn.—Frank Haycock, co. surveyor, has been instructed to prepare plans and specifications for county roads to cost about $59,000.

Mt. Vernon, Mo.—A $50,000 bond issue for road construction has been voted.

Sedalia, Mo.—A $200,000 bond issue for road improvement has been voted.

Albany, N. Y.—A bill providing $50,000,000 for road improvement and maintenance has been passed by the legislature and signed by Gov. Dick. The bond issue will be voted on in the fall election.

Amsterdam, N. Y.—John A. Bensel, state highway engineer, has approved the plans to pave W. Main st., with brick. About 42,000 sq. yds. of brick pavement will be constructed at an estimated cost of about $100,000.

Cohocton, N. Y.—A $10,444 bond issue for the paving of Maple ave. with brick has been voted.

Tonawanda, N. Y.—A. P. Smith, city engineer, is preparing plans for paving Tremont st., and for constructing a sewer on Rumbold ave.

Bryan, O.—A $60,000 bond issue for paving purposes has been voted. Brick will be used in most of the work.

Cincinnati, O.—The repaving of Eastern ave., to cost about $252,000 is contemplated.

Lisbon, O.—A $250,000 bond issue has been voted by Columbiana county for the purpose of constructing roads.

Massillon, O.—Street improvements to cost about $50,000 including $38,788 for paving and $13,019 for sewer construction are contemplated.

Norwalk, O.—A $20,000 bond issue for road improvement has been voted. J. M. Bethtol, twp. clk.

Warren, O.—A $25,000 bond issue has been sold and bids will be requested for road construction.

Pittsburgh, Pa.—Ordinances have been presented providing for repaving work to the amount of $238,000. Jos. B. Armstrong, director of public service.

Chattanooga, Tenn.—A $250,000 bond issue for park improvement has been voted. P. C Thompson, mayor.

Halls, Tenn.—A $15,000 bond issue for sidewalk improvement has been voted.

Springfield, Tenn.—A $350,000 bond issue for road construction has been voted.

Carroll, Tex.—A $25,000 bond issue for street paving has been voted. H. Galbreth, board of bond trustees.

Corpus Christi, Tex.—A $150,000 bond issue for paving construction has been voted. Thomas B. Dunn, cy. engr.

Nacogdoches, Tex.—A $65,000 bond issue for an electric light plant, sewerage and paving improvements has been voted

Goldendale, Wash.—S. T. Lancaster, has been retained to supervise the construction of 52 blocks of paving.

North Yakima, Wash.—The county commissioners are contemplating the construction of 30 miles of gravel and macadam roadway.

Tacoma, Wash.—A $13,500 bond issue for paving construction has been voted. J. F. Meads, cy. contr.

Green Bay, Wis.—Paving 7 streets with asphalt, to the White Const. Co., of Milwaukee.

SEWERS.

BIDS REQUESTED.

Reinbeck, Ia.—May 13, 7:30 p. m. Constructing 6 miles of 8 to 15-in. sanitary sewers and a disposal plant. Certified check, $500. Bids accepted on 2 divisions. R. B. Ferguson, town clerk; Iowa Engineering Co., Clinton, Ia., engrs.

Mitchell, S. D.—May 9, 8 p. m. Sewer construction as follows: Branch P. sewer Dist. No. 3 including 1,508 ft. of 8-in. pipe; branch Q. sewer Dist. No. 2 including 595 ft. of 9-in. and 732 ft. of 10-in. pipe; branch W. sewer Dist. No. 2 and 3 including 410 ft. of 10-in. pipe; branch X sewer Dist. No. 4 including 732 ft. of 8-in. and 183 ft. of 10-in. pipe. Certified check, 5 per cent. N. H. Jensen, cy. audt.

Salt Lake City, Utah.—The Gilkerson Const. Co., 524 Newhouse bldg., will purchase 2 derricks, ditching machinery, hoisting engines, excavating machinery, flush tanks, vitrified pipe, and rock drills.

Goldendale, Wash., May 1, 3 p. m. Constructing storm sewers, curbing, parking and paving streets in improvement district No. 5. Certified check, 5 per cent. J. R. Putnam, town clerk.

CONTRACTS AWARDED.

Oakland, Cal.—The following sewer contracts have been awarded: Main outlet sewer, to H. F. Dahnke; East 12th street, to C. W. Cross; Market street, to the Ransome Crummey Company.

Mulvane, Kan.—Constructing 5 miles of sewer, to E. M. Eby, Wellington, Kan., about $10,000.

Wichita, Kan.—Constructing sewer on 3rd street, to McGuire & Stanton, Leavenworth, Kan., $58,419.

Marinette, Mich.—Constructing brick sewer on Bang street, to Johnson & Peander, Marinette, Mich., $11,901.

Petoskey, Mich.—Constructing the Lake street sewer, to King & Austin, Petoskey, Mich.

Pontiac, Mich.—Constructing 14 sewers, to Jno. Lennane, Detroit, Mich., $17,882.

California, Mo.—Constructing complete sewerage system, to Inman & Burras, Kansas City, Mo., $11,348.

St. Joseph, Mo.—Constructing the Whitehead sewer in Atchison street, to the Land Construction Co., $27,486.

Springfield, Mo.—Constructing 2 septic tanks for the sewage disposal system, to J. C. Likes, Des Moines, Ia, $69,315.

Binghamton, N. Y.—Constructing sewer on Cross street and Park avenue, to George Serafini, about $3,600.

Rochester, N. Y.—Constructing the outlet pipe for the sewage disposal system, to the P. A. Gillespie Company, New York, N. Y., $265,254.

Scranton, Pa.—Constructing the Old Forge Boro sewer, to M. Spitt, North Scranton, Pa., $35,000.

Seattle, Wash.—The following sewer contracts have been awarded: East 45th street, to Haydon & Son, $7,114; East 4th avenue, south, to Jenkins and Jones, Hinckley block, $4,650.

Spokane, Wash.—The following sewer contracts have been awarded: Alley of Block 7 and 8, to McMillan & Shaughnessy, $1,679; sewer in Lamont street, to J. L. Wood, $2,212.

CONTEMPLATED WORK.

Russelville, Ark.—E. A. Kingsley, Little Rock, Ark., has been retained to prepare plans and estimates for a complete sewerage system.

Bakersfield, Cal.—City Engineer Abbey has prepared estimates for the construction of a complete sewerage system to cost $20,788.

Rockford, Ill.—The construction of a sewerage system in the southeast portion of the city to cost about $95,000 is contemplated.

Princeton, Ind.—The city is contemplating the construction of a disposal plant of the septic tank type. Will R. Lamb, city clerk.

Arlington, Mass.—An $8,000 bond issue for sewer construction has been voted. Altion fire engine, chemical and hose wagon has been voted. Chief Pierce.

Escanaba, Mich.—An $80,000 bond issue for the purchase of an automobile combinabert J. Pepin, city clerk.

Springfield, Mo.—The city council has authorized issuance of $100,000 bond issue for sewer construction. J. H. Langston, city clerk.

Lewiston, Mont.—A $60,000 bond issue for sewer construction has been voted. S. T. Marshall, city clerk; C. W. Swearingen, Missoula, Mont., engineer.

Sidney, Neb.—A $23,000 bond issue for sewer construction has been voted. Leslie Neubauer, city clerk.

Columbus, O.—The following ordinances for sewer bond issues have been voted: Broad street, $28,000; Long street, $10,000; Arcadia avenue, $65,000; Markison avenue, $5,000.

Coshocton, O.—To comply with the Benz law, a sewage disposal plant and pumping station will be constructed at an estimated cost of $100,000.

Mt. Vernon, O.—A $10,000 bond issue for a sewer on Norton street and a $22,000 bond issue for a sewer in the first alley north of Sugar street has been ordered by the city council.

Port Clinton, O.—By the decision of the Supreme Court making the Benz act valid, the city is compelled to construct a new sewerage system and a disposal plant.

Steubenville, O.—Constructing sewers and improving Wallsley avenue is contemplated at an estimated cost of $15,000.

Eugene, Ore.—A $200,000 bond issue for the construction of a sewerage system has been voted.

Corry, Pa.—City Engineer Nevine R. Dixon is preparing plans for a sewage disposal system to cost about $50,000 in compliance with an order of the state board of health.

Somerset, Pa.—Clyde Potts, New York, N. Y., has been retained to prepare plans for a sewage disposal plant.

Cuero, Tex.—A $25,000 bond issue for a sewer system has been voted.

Dallas, Tex.—A $100,000 bond issue for sewerage construction has been voted.

Houston, Tex.—The construction of a filter bed at the city sewage disposal plant for an additional population of 60,000 is contemplated. City Engineer Dormant.

Pecos, Tex.—Application has been made by F. W. Johnston, president of the Pecos Land Company, for a 50-year franchise to construct and operate a sanitary sewage system.

Pomeroy, Wash.—Robert Dieck, Portland, Ore., has been retained as engineer on the construction of a new sewerage system.

WATER WORKS.

BIDS REQUESTED.

Titusville, Fla.—May 20. Constructing water works system complete, including pumping station, elevated reservoir, water main, hydrants, etc. Geo. M. Robbins, chairman.

Kalamazoo, Mich.—May 6, 12 m. Constructing 2 steel tanks, 36 feet in diameter and 70 feet high. Certified check, $600. C. L. Miller, city clerk.

Jamestown, N. Y.—May 2, 12 m. Furnishing 275 lengths of 24-inch and 235 lengths of 16-inch cast iron pipe, together with all specials, hauling and laying the same. Board of water commissioners, Chester & Fleming, Union Bank building, Pittsburgh, Pa., engineers.

Monmouth, Ore.—May 4, 3 p. m. Constructing pumping plant and water works system complete. Ira C. Powell, mayor; Lewis C. Kelsey, 404 Selling building, Portland, Ore., engineer.

Erie, Pa.—May 17, 2 p. m. Constructing filter plant, settling basin, piping, coagulant house, pumping station and furnishing low service pumping machinery, water proof boilers, filters and super-heaters. Certified check, 3 per cent. Geo. C. Gensheimer, secretary; Chester & Fleming, Union Bank building, Pittsburgh, Pa., engineers. J. C. Shafer has been appointed superintendent to take charge of the plant during and after construction.

Mitchell, S. D.—May 9, 8 p. m. Water works construction as follows: Furnishing and laying 2,410 feet of 4-inch, 3,850 feet of 6-inch and 1,510 feet of 10-inch water main, including all valves and hydrants; 37 4, 6 and 8-inch valves. Certified check, 5 per cent. N. H. Jensen, city auditor.

CONTRACTS AWARDED.

Boston, Mass.—Laying water pipe in various streets in Boston, Charlestown, South Boston, East Boston, Roxbury, Brighton, to Ferguson & Kelly, $10,110.

Oklahoma City, Okla.—Furnishing a 10,000,000-gallon pump for the water works plant, to the Snow Pump Manufacturing Company, $22,500.

Seattle, Wash.—Constructing water main on Dexter avenue, to the International Dredging Co., Seattle, Wash., $15,068.

Cheboygan, Wis.—Furnishing pump for the water works system, to the Prescott Steel Pump Co., Milwaukee, Wis.

CONTEMPLATED WORK.

Alabama City, Ala.—The city council has authorized the bond issue of $75,000 for water works construction.

Oxnard, Cal.—A $100,000 bond issue for water works improvement has been voted. J. R. Bellah, city clerk.

Sisson, Cal.—A $20,000 bond issue for water works construction has been voted.

De Beque, Colo.—A $20,000 bond issue for the water works improvement has been voted.

Fountain, Colo.—A $40,000 bond issue for water works construction has been voted. Geo. I. Phillips, city clerk.

Salida, Col.—The council has decided to issue bonds to the amount of $40,000 for the construction of a water works system.

Hartford, Conn.—A $50,000 bond issue for improvements for the water works pumping station has been voted.

Baldwin, Kan.—An $18,000 bond issue for water works extension has been voted.

Coffeyville, Kan.—A $130,000 bond issue for increasing the capacity of the city water works plant has been voted.

Independence, Kan.—A $100,000 bond issue for water works improvement has been voted.

Manchester, Mich.—A $27,000 bond issue for water works construction has been voted.

Yazoo City, Miss.—The issuance of $30,000 of bonds for the purchase of water meters is contemplated.

Shelby, Mont.—A $22,000 bond issue for water works improvement has been voted.

Glen Ridge, N. J.—A $44,000 bond issue for water works construction has been voted.

Middleport, N. Y.—The installation of a water works system, to cost about $50,000, is contemplated.

North Hempstead, N. Y.—A $140,000 bond issue has been sold and work will be started on a municipal water works plant in the Manhassett-Lakeville district.

Wolcott, N. Y.—A $45,000 bond issue for the construction of a water works system has been voted.

Dayton, O.—An ordinance has been passed to issue bonds for $120,000 for the improvement and extension of the water works plant.

Lorain, O.—C. Arthur Brown has prepared estimates for the construction of a filter basin at the water works station to cost $52,309.

Sandusky, O.—The city council has passed a $100,000 emergency bond issue to rebuild the filtration plant.

St. Bernard, O.—A bond issue of $10,000 to increase the capacity of the electric light and water works plant has been voted.

Alva, Okla.—A $55,000 bond issue for water works construction, including a gravity pipe line has been voted.

Mountain View, Okla.—A $15,000 bond issue for water works extensions has been voted.

Perkins, Okla.—A $25,000 bond issue for water works construction has been voted.

Bartlesville, Pa.—Geo. C. Priestly, of Warren, Pa., has purchased the Bartlesville Light & Water Company plant at a cost of $110,000. He will install a modern filtration plant.

Etna, Pa.—The sum of $25,000 for repairing the machinery and equipment of municipal water plant and in the purchase and installation of additional pumps, and the laying of new water mains has been appropriated. W. H. Miller, burgess.

Pecos, Tex.—The construction of a modern water works system to cost about $90,000 is contemplated.

Sulphur Springs, Tex.—A $30,000 bond issue for water works construction has been voted. T. W. Higgins, city clerk.

Waco, Tex.—A $400,000 bond issue for improvement of the water works plant has been voted.

Brigham, Utah.—A $35,000 bond issue for water works construction has been voted. Eliza Hanson, city treasurer.

Colonial Beach, Va.—A $17,000 bond issue for the installation of a water works plant has been voted.

Parkersburg, W. Va.—A $100,000 bond issue for the construction of a storage reservoir and for making improvements to the water works system has been voted.

Appleton, Wis.—Water main extensions to the amount of 16 or 17 miles are contemplated by the city council. Pipe from 4 to 16 inches in diameter will be needed.

Twin Rivers, Wis.—The council has appropriated $15,000 to enlarge the municipal water and light plant.

BRIDGES.

BIDS REQUESTED.

Brownstown, Ind.—May 7. Constructing 4 bridges. H W. Wacker, auditor.

Crown Point, Ind.—May 8, 12 m. Constructing bridges in East Chicago. C. A. Johnston, auditor.

Huntington, Ind.—May 30, 10 a. m. Constructing bridges over the Wabash and Salamonie rivers. Harold Guthrie, auditor.

Rensselaer, Ind.—May 6, 1 p. m. Constructing 2 bridges. Jos. P. Hammond, auditor.

Vevay, Ind.—May 11, 10 a. m. Repairing bridges on the Lower Indian creek. Scott Culbertson, auditor.

Vincennes, Ind.—May 7, 2 p. m. Constructing 9 bridges in Knox county. Jno. C. Scott, auditor.

Creston, Ia.—May 6, 4 p. m. Constructing a 40-ft. span, 24-ft. roadway, steel bridge on concrete substructure. Theo. S. Delay, county surveyor.

Cincinnati, O.—May 10, 12 m. Constructing concrete bridge and fill under Specification No. 304. Certified check, $500. Albert Reinhardt, clerk board Hamilton county commissioners.

Jefferson, O.—May 8, 1 p. m. Remodeling the substructure of bridge over Ashtabula creek under Engineer's Report No. 159. Certified check, $100. A. B. Hillyer, clerk.

Youngstown, O.—May 6, 11 a. m. Constructing a 75-ft. steel bridge over Mills creek. Certified check, $50. I. M. Hogg, county auditor.

Colville, Wash.—May 8, 2 p. m. Clearing, grading, bridging and surfacing with gravel 3½ miles of the Addy-Gifford highway in Stevens county. Certified check, 10 per cent. L. E. Joseph, auditor of Stevens county.

CONTRACTS AWARDED.

San Bernardino, Cal.—Constructing steel bridge over the Mojabe river, near Oro Grande, to the Joliet Bridge & Iron Co., Joliet, Ill.

Jacksonville, Fla.—Constructing steel and concrete bridge over Trout creek, to the Edwards Construction Co., Tampa, Fla., $19,757. W. C. Kiernan, of White Water, Wis., was the low bidder but did not comply with specifications.

St. Maries, Ida.—Constructing steel swing bridge across the St. Joe river at 4th street, to Carscallen Bros., Coeur d'Alene, Idaho.

Eldorado, Ill.—Constructing steel bridge across the Indian creek, to the Vincennes Bridge Co., Vincennes, Ind.

Freeport, Ill.—Constructing a bridge across the Pecatonica river at Pecatonica, to W. H. Shons, $14,000.

Keensburg, Ill.—Constructing 5 steel bridges, to the International Steel and Iron Construction Co., Evansville, Ind.

Perry, Ill.—Constructing steel bridge at the Lipcaman ford, to the Missouri Bridge and Iron Company, St. Louis, Mo.

East Chicago, Ind.—Constructing a bridge over the Canal at Forsythe avenue, to Geo. Owen Reed, Michigan City, nId.

Jasper, Ind.—Constructing a bridge across White river at Haysvile, between Dubois and Martin counties, to the Vincennes Bridge Co., Vincennes, Ind.

South Bend, Ind.—Macadamizing the Edwardsburg road, to Isaac M. Saples and Schuyler Ackerman, $13,480.

Miles City, Mont.—Constructing steel bridge over the Yellowstone river at Miles City, to the Security Bridge Co., Billings, Mont., $63,800.

Trenton, N. J.—Constructing steel and concrete bridge at East State street, to Brant & Stewart, Philadelphia, Pa.

Beatrice, Neb.—Constructing bridges in Sage county for the year, to the Standard Bridge Company, Omaha, Neb., to the Beatrice Iron Works and to the Massillon Bridge & Construction Co., Massillon, O.

Lancaster, N. Y.—Constructing a girder bridge over Cuyahoga creek and Aurora street, to the Corry Bridge Co., Corry, Pa., $11,495.

Grand Forks, N. D.—Constructing bridge over the Red river, to Waddell & Harrington, Kansas City, Mo., $18,500.

Norwalk, O.—Constructing substructure of the Kindling bridge, to Riley Pardo, Norwalk, O.

Bridgeport, Pa.—Constructing steel bridge over the canal, to the York Bridge Co., York, Pa., $9,670.

Milton, Pa.—Constructing a steel bridge across the Susquehana river to the Pennsylvania Steel Co, $65,000.

Norristown, Pa.—Constructing a bridge across the Schuylkill river, to Harry A. Bender, Harrisburg, Pa.

Floyersville, Tex.—Constructing 4 steel bridges, to the Missouri Valley Bridge and Iron Company, St. Louis, Mo., $17,444.

Port Arthur, Tex.—Constructing the bascule bridge over the Sabine-Nephew canal, to the Spence Howe Construction Co., $29,-300.

Seguin, Tex.—Constructing 173-ft span steel bridge across the Guadalupe river, to the Missouri Valley Bridge and Iron Co., $6,400.

Tacoma, Wash.—Constructing steel bridge over the Puyallup river, to the Washington Engineering Co., Tacoma, Wash., $9,250.

Oshkosh, Wis.—Furnishing plans and specifications and constructing a draw span over the Fox river at West Algoma street, to the Scherzer Rolling Lift Bridge Co., Chicago, Ill.

Shoshone, Wyo.—Constructing a 100-ft. steel bridge, to the Clinton Bridge Company, Clinton, Ia.

CONTEMPLATED WORK.

Lansing, Ia.—L. H. Markwardt is completing plans for the construction of a bridge to cost about $100,000.

New Hampton, Ia.—Bridge construction as follows is contemplated by the supervisor of Chickasaw county: 7 concrete bridges, $7,000; 3 steel bridges, about $5,000.

Sac City, Ia.—As a result of high water 5 bridges in Sac County will be rebuilt.

Albert Lea, Minn.—A $28,000 bond issue for bridge construction has been voted.

Sutherland, Neb.—The construction of a bridge across the North Platte river to cost about $30,000 is contemplated. A bond issue has been voted.

Akron, O.—An ordinance for the issue of bonds in the sum of $29,700 for the construction of a bridge over the B. & O. tracks at Kelley avenue has been voted.

Dayton, O.—Floods have made necessary the issuance of $15,000 emergency bridge bonds by the county commissioners.

Portland, Ore.—Ralph Modjeski, Chicago, Ill., has been retained to prepare plans and estimates for the Pacific highway bridge across the Columbia river, connecting Portland and Vancouver.

Sherman, Tex.—Twenty-five bridges, ranging in length from 10 to 50 ft. have been destroyed in Greyson county. New bridges will be constructed at a cost of $20,000.

Tacoma, Wash.—A $35,000 bond issue for bridge construction has been voted.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

BIDS REQUESTED.

Ottawa, Kan.—The city is in the market for a garbage disposal plant. Address Dr. W. L. Jacobus.

Monongahela, Pa.—The health and sanitation committee, composed of Frank A. Underwood, W. P. Gregg and A. L. McVickler, have advertised for bids for the construction of a garbage incinerating plant.

CONTRACTS AWARDED.

Newcastle, Ind.—Repairing the city garbage plant, to E. M. Sheridan, $1,680.

Tiffin, O.—Collecting and removing the city garbage, to Howard Grimes, $1,375.

CONTEMPLATED WORK.

Newark, N. J.—The construction of a garbage disposal plant and power plant combined is contemplated. Frederick O. Runyon, consulting engineer.

Sandusky, O.—The construction of a garbage disposal plant is contemplated. Chairman Frank Hammond, council committee on public health.

Homestead, Pa.—A $25,000 bond issue for the erection of a garbage disposal plant has been provided for by the city council.

Newcastle, Pa.—An ordinance has been prepared for the collecting and disposal of garbage by the city.

Pittsburgh, Pa.—Two ordinances for the disposal of garbage are before the city council.

Bastrop, Tex.—A $100,000 bond issue for road construction has been voted.

STREET LIGHTING.

BIDS REQUESTED.

Newcastle, Pa.—May 13, 12 m. Lighting the streets of the city with electric arc and tungsten lamps for a period of 1, 3 or 5 years. About 360 arc lamps and an indeterminate number of incandescents will be required. Certified check, $500. F. M. Hartman, city clerk.

CONTEMPLATED WORK.

Oxnard, Cal.—A $30,000 bond issue for electric lighting improvements has been voted. A. B Bellah, city clerk.

Vallejo, Cal.—A $100,000 bond issue for the construction of an electric light and power plant has been voted.

Hartford City, Ind.—The installation of an ornamental lighting system is contemplated.

Cedar Rapids, Ia.—W. G. Dows, John A. Reed, R. F. Cook and I. B. Smith, of Cedar Rapids, have secured an option on the Marshalltown gas, electric light and trolley plant, and will spend $200,000 on improvements if the sale is made.

Dubuque, Ia.—The Dubuque Industrial Corporation has completed a canvass for boulevard lights and bids will be accepted soon.

Laurens, Ia.—A $15,000 issue for electric light extensions has been voted. E. P. Lowry, town clerk.

Milo, Ia.—A $10,000 bond issue for electric light improvement has been voted. E. Burgess, city clerk.

Traverse City, Mich.—A $150,000 bond issue for electric lighting extension has been voted.

Minneapolis, Minn.—The extension of the lighting system to include about 300 additional arcs is contemplated.

Bryan, O.—A $5,000 bond issue for enlarging the municipal light and water plant has been voted.

Mineral Ridge, O.—The city council desires information on the cost of a complete municipal light plant for about 30 street lights and 150 residences.

Mt. Cory, O.—A $12.000 bond issue for electric light extension has been voted.

Sandusky, O.—E. G. Beckwith, Cleveland, O., has submitted an estimate of $158.000 as the cost of a municipal lighting plant in Sandusky.

St. Bernard, O.—A bond issue of $10,000 to increase the capacity of the electric light and water works plant has been voted.

Youngstown, O.—Stewart C. Coey, of the Youngstown Sheet & Tube Co., has been appointed to investigate with a view to installing a lighting plant and a municipal market house to furnish power for an ornamental lighting plant. Beedel Heasley, director of public service.

Durant, Okla.—A $5,000 bond issue for lighting improvements has been voted.

Florence, Ore.—A franchise has been granted to G. Bushman, Sheridan, Ore., to install and operate an electric lighting plant.

Bartlesville, Pa.—Geo. C. Priestly, of Warren, O., has purchased the Bartlesville Light & Water Company's plant at a cost of $110,000. He will install a modern filtration plant.

Marinette, Wis.—The installation of an ornamental lighting system on Dunlap square is contemeplated.

Twin Rivers, Wis.—The council has appropriated $15,000 to enlarge the municipal water and light plant.

FIRE APPARATUS.

BIDS REQUESTED.

Shreveport, La.—May 14. Furnishing the following fire equipment: One automobile combination chemical engine and hose wagon, 2 automobile combination pumping engines and hose wagons, 1 tractor to pull a 75-ft. Seagrave aerial truck, 1 chief's car and 2,000 ft. of 2½-in. rubber lined double jacket standard fire hose. L. H. Baker, secretary and treasurer.

Shelby, Mont.—May 1. Furnishing 4,000 ft. of hose. Superintendent water works.

Vancouver, B. C.—May 2. Furnishing 1 automobile gasoline pumping engine, 2 automobile hose wagons, 1 combination chemical engine, and hose wagon automobile propelled. City clerk.

CONTEMPLATED WORK.

Inglewood, Cal.—A $10,000 bond issue for the purchase of motor fire apparatus has been voted.

Longmont, Colo.—The purchase of an automobile fire wagon is contemplated. M. G. Rite, chief.

Trinidad, Colo.—The purchase of an automobile fire truck to cost about $5,000 is contemplated. Robert Dougherty, chief.

Hartford, Conn.—A $25,000 bond issue for the installation of a police and fire alarm system has been voted.

Oak Park, Ill.—A $20,000 bond issue for a new fire station and complete equipment has been voted.

Springfield, Ill.—The purchase of 2 pieces of motor fire apparatus is contemplated.

Evansville, Ind.—The purchase of a police patrol wagon and a motor fire engine is contemplated by the board of safety.

South Bend, Ind.—The complete motorization of the fire department at a cost of about $18,000 is contemplated. Wilford Grant, chief.

Arlington, Mass.—An appropriation of $8,000 for the purchase of an automobile triple combination fire pump, chemical and hose truck has been made.

Boston, Mass.—The following fire department equipment will be purchased: Seven automobile touring cars, 3 combination chemical and hose wagons, automobile propelled, 3 combination and ladder automobile trucks. Estimated cost, $48,000. Chas. H. Cole, fire commissioner.

Chelsea, Mass.—The purchase of 2 pieces of motor fire apparatus is contemplated. David M. Hudson, chief.

Marblehead, Mass.—The purchase of motor fire apparatus to the amount of $8,000 is contemplated.

St. Paul, Minn.—The purchase of a 120-h.p. fire engine automobile propelled, is contemplated.

Akron, O.—The issuance of $8,500 in bonds for the installation of automobile fire apparatus is contemplated by the city council.

Canton, O.—A $70,000 bond issue for the equipment of the fire department with automobile aparatus has been voted by the city council.

Cincinnati, O.—The sum of $250,000 has been appropriated for improving the fire system. Motor fire apparatus will be purchased.

Columbus, O.—A bond issue of $50,000 for the purchase of motor fire apparatus has been authorized by the city council.

Dayton, O.—About $25,000 will be appropriated for the purchase of 3 motor driven combination fire wagons, 1 automobile patrol and an automobile chief's wagon.

Oklahoma City, Okla.—The purchase of 2 motor combination hose and chemical wagons and 9,000 ft. of hose is contemplated. M. H. Kesler.

Buffalo, N. Y.—A $50,000 bond issue for extensions to the police and fire alarm system has been voted.

Erie, Pa.—The purchase of a new fire engine and 2,500 ft. of hose is contemplated.

Philadelphia, Pa.—Through the efforts of a committee on municipal affairs of the board of trade, the Philadelphia fire department will purchase several pieces of motor driven fire apparatus.

Pittsburgh, Pa.—An appropriation of $75,000 for the purchase of motor fire apparatus has been made. Bids are being asked on automobile combination chemical engines and hose wagons, 1 or more tractors, 5 police patrol wagons and 2 roadsters. Howard C. Owsley, director department of supplies.

Dallas, Tex.—Fire Chief H. Frank Magee is in St. Louis investigating the question of purchasing an automobile hook and ladder truck.

Aberdeen, Wash.—The city engineer has prepared plans and estimates for the paving of West Herron street at a cost of $24,000.

MUNICIPAL ENGINEERING

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Investigation of Municipal Lighting for Rockland, Mass.

THE town of Rockland, Mass., though having a population of only about 7,000, is thoroughly alive to the question of obtaining better lighting conditions at a lower cost. In compliance with a vote taken by the annual town meeting, held in 1911, William Plattner, a consulting engineer of North Attleboro, Mass., was retained to investigate the electric lighting service and to make recommendations for the betterment. The results of Mr. Plattner's investigations have recently been presented in a report to the voters of the town, and form an interesting commentary on the lighting conditions in similar towns in Massachusetts.

Electric current for Rockland has been and is at present furnished by the Electric Light & Power Co., of Abington and Rockland. The plant is located outside of the town of Rockland, so that the equipment which is appraised in the report and inventory is only that which is utilized in the distribution of the current. The current sold to the town as measured at the meters of the consumers is shown to be as follows:

	K.W. Hours.
Commercial lighting	155,582
Power	400,383
Street lighting	49,338
Total	605,303

For this current the following rates were charged:

Eighteen cents per kilowatt hour with a minimum charge of $12.00 per year and a 10 per cent. discount for bills paid before the 15th. Sixteen cents per kilowatt hour for the first 50 hours' use of the connected load per month, and 7 cents for all additional, with the same discount provision. The power rates varied from 9 cents to 3.4 cents, dependent on the amount of current used between the maximums of 175 and 3,500 k.w. hours. Installations of over 10 h. p. paid a service charge of $2.00 for the first kilowatt of maximum motor rating and $1.25 for each additional kilowatt plus a current charge of 3½ cents per kilowatt hour. Installations of 50 h. p. and over paid 3 cents per kilowatt, with discounts according to the capacity. A flat rate of $16.00 per lamp was made for each of the 310 40-watt street lamps.

In the appraisal made by Mr. Plattner, allowance was made only for depreciation due to wear and tear due to use and to natural decay, there being no material which was obsolete; and the market value of the materials at the time of inventory was assigned in each case. The estimated cost of the plant under these conditions was:

Pole lines, services, etc., together with labor of placing	$29,417.75
Street lamp fixtures and supplies, with labor	1,555.60
Transformers, meters, etc., in place	12,908.25
Motors with wiring, materials, etc., in place	6,651.00
Commercial incandescent lamps	1,200.00
Fan motors, arc lamps, holophane shades	615.00
Total	$52,347.60

As will be noted, there is no allowance for real estate such as would be necessary should current be purchased and distributed from a central distribution station by the city.

By reason of the dissatisfaction with the rates and service under the existing plant, there were two plans investigated by means of which the town could obtain its light under different conditions. The first of these plans was the construction of a municipal lighting plant, which might be operated by the city to give service both for street lighting and for private lighting and power purposes. The second plan involved merely the erection of a central distribution station from which current purchased from an outside corporation might be transformed and distributed for the purposes above noted.

In submitting an estimate of the cost of a plant for the town, Mr. Plattner assumed a day load of 250 k.w., 10 hours, with a duplication of machinery to take care of the "peak load." An additional unit of 100 k.w. capacity was also recommended to take care of the lighting from 1 a. m. until 6 a. m. This arrangement provides for no reserve unit for use in case of a breakdown. The estimated cost of the plant complete with two 300 k.w. units and one 100 k.w. unit, land, buildings, power house appurtenances and distribution lines was stated by Mr. Plattner at $123,073.

The plant as estimated was figured on the basis of steam turbine engines operating condensing. No consideration was given to gas or oil engines or to reciprocating engines. It was held that a larger initial investment would be required for the oil or gas engines and that as the load factor was very good in Rockland, no economy could be obtained by their use.

The cost of equipment required in case it should be decided to purchase current from an outside source, included only pole lines. transformers, meters, land and a transformer house. The amount stated by Mr. Plattner was $70,073, including $3,000 for engineering and working capital, which amount was also allowed for management in the plant installation.

In drawing comparisons between the two plans outlined and the existing conditions in Rockland, careful consideration was given to the matters of depreciation and repair items. In the former case, a depreciation of 5 per cent. was charged on both the completed plant and on the distribution station. The statutes of Massachusetts require only a 3 per cent. allowance for depreciation, but provide that the Board of Gas and Electric Light Commissioners may have the final decision in event that a larger or smaller amount is recommended. On the other hand, no provision is made for a fixed charge against the town for street lighting service, as the basis of computation for the plant is taken as the total of the kilowatt hours generated under the present conditions; the meter output having been taken and allowances made for all transmission and other losses. The gross income of the present electric company was $35,040 for last year. The two tables following give the operating expenses of the two propositions, as presented by Mr. Plattner:

OPERATING EXPENSE OF THE PROPOSED MUNICIPAL POWER PLANT.

Four per cent. interest on total cost, as estimated	$ 4,922.92
Five per cent. depreciation on plant and distributing lines	5,653.66
Coal, based on 721,000 k.w. hours, and station losses	6,500.00
Station wages	5,000.00
Insurance—Fire, liability and boiler	300.00
Supplies and repairs	1,500.00
Maintenance on distributing system	3,000.00
Management	3,000.00
Total operating expense	$29,876.58
Notes paid annually	$ 2,000.00
Amount paid into sinking fund	2,000.00
Total expense	$33,876.58
Present income from plant on basis of above noted output	$35,040.00
Operating expense of proposed plant	33,876.58
Unexpended balance	$ 1,163.42

OPERATING EXPENSE OF PROPOSED DISTRIBUTION PLANT FOR PURCHASED CURRENT.

Four per cent. interest in distribution system	$ 2,802.92
Five per cent. depreciation	3,178.66
721,000 k.w. hours, at $2\frac{1}{2}$ cents per kilowatt	18,025.00
Maintenance and repairs	3,000.00
Repair and care of street lamps	1,200.00
Management	3,000.00
Total	$31,206.58
Present income for light and power in Rockland	$35,040.00
Operating expenses of distributing plant	31,206.58
Unexpended balance	$ 3,833.92
Sinking fund	1,500.00
Amount saved on purchasing current as computed	$ 2,333.92

In making the above comparisons, Mr. Plattner states that there are a number of towns in the state which purchase current at the rate of from $0.023 to $0.04, so that he feels justified in setting the cost of current thus purchased at $2\frac{1}{2}$ cents.

There are several items in Mr. Plattner's comparison, as drawn, with which there might be a disagreement. There is no explanation of the item "Notes Paid Annually" in the statement regarding the complete plant, and which does not appear in the comparison of the distributing plant. The sinking funds in both cases might be larger, though the proportion observed is such that it is evident that the same basis of computation in each case was used. Ample allowance for repairs and depreciation, according to present practice seems to have been made.

In the latter portion of his report, Mr. Plattner gives some interesting tables with relation to the electric lighting situation in different towns in Massachusetts. From these tables, the following table is given to show the rates charged in various Massachusetts towns upon the same class of lighting unit as is used in Rockland:

MUNICIPALLY-OWNED PLANTS.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Reading	5,818	19	50	10.4	30.4	$ 4.53
Danvers	9,407	14	40	7.0	27.8	.40
Danvers	9,407	75	50	7.0	27.8	.50
Concord	6,421	863	50	9.3	30.4	4.98
North Attleboro	9,562	206	40	5.8	27.9	4.50
North Attleboro	9,562	506	50	5.8	27.9	5.62

MUNICIPALLY-OWNED DISTRIBUTION STATION FOR PURCHASED CURRENT.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Norwood	8,014	389	40	6.3	25.9	$ 1.43
Wellesley	5,413	72	40	8.6	29.3	3.48
Wellesley	5,413	221	50	8.6	29.3	4.35

PRIVATELY-OWNED PLANTS.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Amherst	5,112	165	50	5.2	27.5	$16.00
Palmer	8,610	175	40	5.8	26	15.00
Warren	4,188	150	40	5.8	26	15.00
Leominster	17,580	97	50	5.7	29.7	16.00
Everett	33,484	646	50	5.7	27.5	15.00
Northborough		111	50	6.7	27.5	16.00
Whitinsville		221	40	5.5	27.6	14.50
Dudley	4,267	125	50	5.4	30.4	13.30
ROCKLAND	6,928	310	40	5.4	28	16.00

TABLE OF QUANTITY AND COST OF STREET ILLUMINATION IN EIGHTEEN MASSACHUSETTS TOWNS.

Town.	Population.	Total C. P. of Street Lamps.	Total Cost Exclusive of Taxes.	C. P. Per Capita.	Cost Per Capita Exclusive of Taxes.
Belmont	5,542	35,920	$ 5,744.75	6.4	$1.03
Braintree	8,066	128,400	6,370.75	15.9	.59
Concord	6,421	42,520	4,787.37	6.6	.74
Danvers	9,407	174,398	1,401.52	18.5	.15
Hingham	4,965	26,760	3,745.27	5.5	.75
Hudson	6,743	33,020	1,021.04	4.9	.15
Hull	2,103	16,864	11,047.31	8.0	5.25
Ipswich	5,777	12,736	4,083.03	2.2	.76
Mansfield	5,183	18,232	6,509.57	3.5	1.25
Marblehead	7,338	185,345	10,396.20	25.2	1.41
Middleboro	8,214	37,267	5,218.78	4.5	.64
North Attleboro	9,562	26,792	4,493.34	2.8	.46
Norwood	8,014	25,828	1,518.24	3.2	.18
Peabody	15,721	151,664	18,078.55	9.6	1.14
Reading	5,818	167,620	6,447.45	28.8	1.10
Wakefield	11,404	74,080	11,729.97	6.4	1.02
Wellesley	5,413	31.409	5,074.54	5.8	.93
ROCKLAND	6,928	12,480	6,300.00	1.9	.88
Average of first 17		69,938		9.2	$1.42

Of the towns above noted only a very few use the tungsten 40-watt or 50-watt lamp exclusively, and in every case the municipally-owned plants use higher power tungsten and arc lamps. In 17 towns having their own lighting plants

Of the towns in first table above only a very few use the tungsten 40-watt or 50-watt lamp exclusively, and in every case the municipally-owned plants use higher total candlepower of street illumination in these 17 towns was shown to be 69,938, while in Rockland it is only 12,480. In conclusion, a table is given from which the data regarding candlepower of illumination, cost, and unit cost in the last table are taken. All of the first 17 towns given have municipally-owned plants, Rockland being the only exception in the table.

As may be noted from the above table, if Rockland received the same candlepower per capita of light upon the streets, and the rate remained the same, the cost per capita, exclusive of taxes, would be $4.04 instead of $0.88, as at the present time.

Some Considerations in the Choice of a Pavement.*

By Prof. Leonard S. Smith, University of Wisconsin, Madison, Wis.

WHAT is the best pavement? is a question which citizens, city officials and even some engineers are not infrequently guilty of asking, forgetful of the plain fact that such a question admits of no ready or simple answer. As well might it be asked what is the best bridge or the best house to build. It is a most hopeful sign that the past year has seen many papers read at engineering society meetings discussing this question of considerations affecting the choice of a pavement.

It cannot be too emphatically stated that in each case the best structure for a pavement depends upon the particular service required of it and also, too, upon the widely varying local conditions. These modifying factors naturally divide themselves into two general classes. The first of these govern the conditions to which the pavement will be subjected. Chief among these factors are the quality, nature and even the direction of the traffic, the character of the district served by the pavement, the grade of the street and the presence of car tracks.

On the other hand, the second class of factors which may determine the selection have reference to the character of the pavement itself, such as durability, smoothness, noiselessness, slipperiness, cost, etc.

The best pavement for some particular street, then, would be the one which would give the greatest and most needed service, using the word service in a broad way. The limits of this paper will not allow of a full discussion of this question, but my point can be most clearly explained by giving a few applications of the principle. For example, if the street had a steep grade, all such considerations as smoothness, noiselessness, cost, etc., must needs give way to the single governing quality of non-slipperiness. Again, if the street in question were on a moderate grade in a high-class residence district or in the office-building district of a large city, the factors of smoothness and noiselessness might properly determine the final selection. Such a selection, while involving a very expensive pavement, has repeatedly been shown to fully justify itself by the added value and earning capacity of the property. As a third example, considering the choice of a pavement in a wholesale district, subject to concentrated heavy traffic, the qualities of durability and non-slipperiness would here naturally receive the greatest consideration.

The above statements are so obviously based on common sense that it may seem to some useless to take up valuable time in their presentation. Repeated inspection of the pavements in a score of our largest cities has shown the writer that the choice of pavements has too frequently been left to chance or prejudice. Our growing vision of municipal efficiency discerns a much-needed reform in the choice of our pavements, a reform certain of realization.

But while there is great economic need that the best fitted pavement for each particular street should be thoughtfully and carefully chosen, it is at least of equal importance that all such paving improvements should proceed in accordance with some well-considered plan—some comprehensive system for future improvement of the entire city, ward or region. For example, pavement improvements should be so planned as to provide several parallel routes for through traffic. If this be not done, the single route becomes congested and the pavement is prematurely worn out. Again, pavements should be continuous, both for the convenience of traffic and for ease of maintenance.

In the case of country highways, it is necessary to construct disconnected stretches of pavement, but even here it is of prime importance that such construction should proceed in accordance with a systematic plan, so that disconnected stretches may eventually become a part

*A paper before the Engineering Society of Wisconsin.

of a complete system. For example, in our own State it would be easy to select a few trunk roads leading from the metropolis of the State to the adjoining cities, and still others connecting the largest city or county seat of each county, as being certain to attract the heaviest traffic. Portions of such trunk roads should be improved with reference to sustaining heavy traffic and also with a view of becoming a part of an intra-state system.

Unhappily, the city paving program is too often determined by the ward politician or the opposition or favor of short-sighted real estate owners. A few cities which have tried this plan of adopting a paving program extending over ten years will soon occupy an enviable position. Our cities cannot do better in this respect than to follow the example of the most successful railroad companies.

While future traffic conditions may render necessary here and there a change in the detail plan, the city is certain to gain largely in the end because of having a carefully prepared plan for all street improvements, including water, sewer and gas as well as pavements.

The charter of many American cities provides that the abutting property owners shall pay for the first pavement, while the city must pay for all repairs and renewals. As might be foreseen, this has resulted in the selection and construction of many cheap and inferior pavements, where much more permanent construction would have been justified. But this abuse has not stopped here. Long time bonds have been commonly issued to secure the payment of such temporary pavements, in many cases falling due twenty-five years or more after such pavement has utterly worn out.

Such a system of financing pavements cannot be characterized as anything short of dishonest. It simply transfers to the backs of our children the burdens we of right should bear ourselves. For the future will doubtless have sufficient burdens and problems of its own without being required to shoulder in addition those of today.

Already legislatures are considering corrective legislation. The writer knows of at least one eastern legislature which in 1910 passed a law prohibiting a city from paying for short-life pavements out of the proceeds of any bond sales. This principle of "pay as you go" deserves a wide adoption.

It is worthy of restatement that cheapness does not necessarily mean a cheap price of the pavement when laid; indeed, such a pavement may likely prove the most expensive in the end. The other governing elements which determine the actual cost of a pavement are the annual cost of repairs and the term of life of the pavement. Permanent pavements may properly be paid for out of the proceeds of bond issues payable during the life of the pavement. In such cases the public will eventually have to pay for the following items: Interest on the bonds, cost of repairs and annual sums for a sinking fund, which by the time the pavement is worn out will pay off the bonds. Such a plan may be shown by the following formula:

$$S + CI + \frac{R}{L} = \text{annual cost,}$$

where S = the yearly amount put in the sinking fund

C = first cost of the pavement

I = the rate of interest

L = the life of the pavement in years

R = the total cost of repairs.

Obviously, the cheapest pavement is the one involving the least annual cost. If, for example, macadam pavement be chosen for a street having traffic, the last term $\frac{R}{L}$ would be so large as to make such a pavement the most expensive type that could be chosen. This fact is an added illustration of the importance of a wise selection of a pavement for the traffic conditions.

New York state for several years has been making the collosal mistake of issuing many millions of long-time bonds in payment of some form of macadam even on heavy traffic trunk highways, where they very frequently have failed after a comparatively short term of service. Such is the judgment of well qualified engineers who have had charge of the construction and maintenance of such roads. The seriousness of this situation will not be fully realized until after the officials responsible for this error have passed to their final reward. Other states nearer home have made similar mistakes.

The construction of some form of the macadam road fulfills at a minimum cost all reasonable demands on streets or country highways carrying a moderate traffic, especially if such roads have the added protection of continuous maintenance. This class includes over half of our country roads.

But if such improved highways happen to connect two or more large cities, the unusually heavy traffic which such a road at once attracts results in certain and speedy failure. The advent of automobile and other forms of motor traffic, while it has lengthened the life of hard city pavements, has been the chief cause of the destruction of macadam roads. The seriousness of this problem of the choice of proper road material is realized when we reflect that the demands made by this new form of motor traffic are certain to greatly increase in the near future. Highway engineers of every land are looking for an adequate remedy, but so far with only partial success. While constructional methods in nearly all other lines of engineering have been satisfactorily perfected and standardized, we find present highway construction on main trunk roads grossly inadequate for even the traffic of today, thereby causing needlessly large charges for maintenance.

It has seemed to the writer that real progress would be made by breaking away entirely from macadam construction on heavy traffic main highways. The improved and more permanent construction best suited to replace the macadam on such roads will here again be largely a local question. Ohio, Indiana and Pennsylvania have taken the first steps toward satisfying the demand for a more permanent construction by building many hundreds of miles of brick pavements laid on a concrete base with a cement grout filler, all supplemented usually by wings of dirt, gravel or macadam. The expense of such a pavement, about $1,000 per foot of width per mile, does not exceed the average price paid by New York state for its wider but short-life macadam roads, while the brick roads, if properly constructed, promise to be in good condition twenty-five years hence.

Wayne county, Michigan, has constructed a good many miles of main highways, leading out of Detroit, of rich concrete, seven inches thick, at prices which also compete with eastern macadam, while giving promise of outlasting the latter by many years. Where the proportion of automobile traffic is not too great, a large amount of traffic has generally been economically provided for by some form of the bitulithic construction. It may be that Wisconsin, with her widely distributed rich deposits of good gravel and other road materials can wisely follow one or all of these forms of permanent construction. Few states are more favorably situated for road building than Wisconsin. We are fortunate also in being able to profit by the experiments of our older sister states. These have shown us that there is no one best pavement and no one best way of constructing it under all circumstances.

We now recognize that the selection of road material and the method of incorporating it into a road is in large part a local question; in fact, that highway construction in city and country obeys the same rules of procedure as do all other forms of good engineering.

Practical Road Building.*

By John N. Edy, Assistant City Engineer, Billings, Mont.

Macadam Roads.

THE distinguishing feature of macadam road construction is the use of angular pieces of crushed stone, which, when rolled with a binder, are packed and wedged into a dense mass. Obviously, the value of the improvement depends largely upon the quality of the stone selected. While the foundation course may be built of inferior material, the wearing surface or top course must be of the best stone obtainable. The characteristics that determine the value of road metal are hardness, toughness and cementing quality. It is difficult to find these three important characteristics in any one stone. For instance, limestone is admirable for moderate traffic, possessing the quality of binding, but being not very hard. Sand stone is too soft for road uses, except in the foundation course. Granite is harder than, but does not bind so readily as, limestone. It is often advisable to use the hard, tough stone in the wearing course, and to use for a binder the screenings of some stone which has cementing value.

It may be that crushed gravel is the best available material. In communities just undertaking road improvement, it is usually a case of using local stone, even though the life of the road is shortened. When there is a great difference in the cost of local and imported stone, it will be cheaper to use the local material and resurface the road when necessary. The reader is reminded that the United States Office of Public Roads (in the Department of Agriculture), undertakes to make free tests and reports on all road material sent it. As the supervisor will hardly be an expert judge of these matters, he is advised to take advantage of this Government laboratory.

The method of placing crushed stone for a waterbound macadam is practically the same as outlined for a gravel road, except that the roller should weigh not less than 10 tons. The sub-grade must be carefully prepared, and the material placed in courses as noted. All dust is screened out and the binder applied in the proper amount to both courses. The top course should follow closely the completion of the foundation, say 100 or 200 feet intervening. The sizes of stone usually adopted are, for the foundation, ¾ to 2½ or 3 inches; for the top course, ¾ to 1½ inches; using all materials between, but none above or below the limits given. The surface slopes and the blind drains are built as explained under gravel roads. It is not good practice to use clay with a macadam binder. Continued rolling and sprinkling, together with the addition of a little sand or fine gravel, will cause the materials to bond. The binder used must contain some dust or fine powder, and water must be added to cause this binder to cement. It is not necessary that expensive screenings be spread over the completed macadam surface; but if some cushion coat is desired, sand may be used, and will usually be cheaper.

It will be found that the shoulders of a gravel or macadam road built on a clay sub-grade will be more easily maintained if they are coated with a surface of sand clay mixture. They will also better withstand the effects of travel that may come on them due to the passage of vehicles. And, as has been noted, this surface is most desirable when a single track improvement is used. The principal points to be observed are these:

1. The use of the most suitable stone, which must be crushed into angular fragments of proper sizes.
2. Thorough preparation of sub-grade, and the construction of shoulders to hold the materials in place.
3. The placing of the screened stone in courses, each to be bound and rolled with a heavy roller until firm.
4. The use of just enough binder, added separately, to fill the voids in each course.

Obviously the drainage must be cared for before construction begins.

It will be seen that the selection of the stone, especially for the foundation course, is mainly a question of utilizing the local product. Good macadam roads have been built on a gravel base. The success of highway improvement depends largely upon the length of road that is built for the money at hand. It is never economy, however, to work along wrong lines in an effort to satisfy all the taxpayers. There will always be a certain amount of dissatisfaction, no matter how valuable or how economical the improvement. The road builder must be sure that his methods are right and his materials the best he can get, and he should then spend enough money on the making of the road to insure the best results.

MAINTENANCE.

No effort should be made to maintain the surface at its initial thickness, the only requirement being that it be kept smooth. This is done by placing good material in ruts and other places of abnormal wear, always loosening the old surface before putting on the new stone, and never filling depressions with screenings alone. As previously stated, raveling may be prevented to a certain extent by covering with a thin layer of sand. Inasmuch as wind and continued dry weather cause damage to the road, every effort should be made to conserve the moisture and avoid rapid evaporation. This may be done by planting shade trees along the roadside; it is rare that a community can afford to sprinkle their roads. In hot, dry climates, therefore, it is questionable if uncrushed gravel roads should ever be built without the use of some asphaltic binder in the surface course. And while macadam may give better service under these conditions, no great expense should be incurred without considering the use of asphalt binder.

BITUMINOUS MATERIALS.

A new road destroyer has been developed in recent years in the shape of automobiles driven at high speed. But it is not the automobile in itself that harms the road. It has been demonstrated that motor traffic is not injurious to macadam roads, when the speed is kept within a limit of 15 miles per hour. And because these modern machines are being adopted by so many people, farmers, as well as others, for business and pleasure, it is useless to rave over the damage done by the automobile and go on treating our roads in the old way. The automobile and motor truck have come to stay. They have come to be used as a cheap means for every kind of transportation; and while any community may do its best to regulate the speed of this vehicle, the sensible thing to do is to meet the issue squarely by adopting some sort of surface treatment for those roads of greatest automobile traffic. Furthermore, as intimated above, this surface treatment is of real value to those roads that must exist under unfavorable climatic conditions, whether the motor traffic be excessive or not.

While it is highly improbable that the supervisor will be called upon to use asphaltic oil in road improvement without the advice of an expert on the subject, the following brief suggestions are nevertheless offered. In the first place, not all oils are suitable for road uses. While it is true that practically any oil sprinkled on the road will give temporary relief from dust, only those that run high in asphalt are of permanent value to the road. The asphalt is usually mixed with, or contained in, some lighter oil, which, upon application, evaporates and leaves the heavy binder to cement the surface particles together, forming an impervious crust over the road. Natural oils with an asphaltic base are used for this purpose, as are also tars. The economy of this treatment lies in the reduced cost of maintenance, and the better service which the road gives. There are two distinct applications of this principle, namely:

1. Constructing a new road with a bituminous binder; and
2. Applying the binder to the existing road.

It must be remembered that this type of road improvement is still in an experimental stage, insofar as any standard plans are concerned. The larger cities, those states having modern highway departments, and the United States Office of Public Roads, are making extensive investigations along these lines. Authorities agree that the principle is correct, but the exact method of carrying it into effect is still an open question. It has even been suggested that macadam roads be built acocrding to ordinary practice, and a thin coat of bituminous bound stone or gravel applied to the surface. The following notes regarding the treatment of old roads are taken from the 1909 Report of the Massachusetts Highway Commission:

"The doubt that exists is not as to the use of some bituminous binder, but which binder to use and the method of applying it. In many instances the bitumen must be used in the first construction of the road, but experience alone will determine the exact nature of the binder that will prove most economical. Because of this, and while investigating this phase of the subject, the Commission considers it advisable to use in general only the commonly used and inexpensive surface treatment of bituminous binder, using about one-half gallon to the square yard, and covering with stone screenings, fine gravel or coarse sand."

"Bituminous surfaces should have a crown somewhat less than the ordinary macadam road, probably $\frac{3}{8}$ inch per foot. The binder may be spread from a spraying machine, which heats and spreads the material over the road under pressure. In one instance, lighter oil was spread from a sort of trough made of two boards with an opening at the bottom, which was mounted on wheels, and which received the oil from a barrel. Oil has also been applied from an ordinary half-moon watering cart. When the heavy asphaltic oil was used, it was found necessary to heat it before applying. In all cases before applying the bitumen, the surface of the road should be thoroughly cleaned, all depressions filled, the road brought to a true crown and grade, and compacted. The oil or tar should then be spread as evenly as possible over the surface, brooming it in where necessary to secure a uniform coating, and covering with sharp sand, fine gravel or stone screenings, from which the dust has been removed, to a depth of $\frac{1}{2}$ or $\frac{3}{4}$ inch. The

MACADAM ROAD IN CASS COUNTY, MO.

road may then be thrown open to traffic. During the first few weeks after the road has been treated, covering material should be added whenever the oil or tar appears upon the surface. * * * * *"

It is customary to have the road in a perfectly dry condition, using from one-third to one-half gallon of oil per square yard of surface. This, of course, refers to the treatment of existing roads. The road must be carefully shaped, depressions being filled with stone ranging in size from ½ to 1½ inches. The oil should be permitted to penetrate into the road for 3 to 5 hours, depending on the temperature and condition of the road. The use of the asphaltic oil and fine gravel covering preserves the road, and does away with the dust. It is essential, however, that the covering be free from dust.

The following is taken from Bulletin No. 10, Missouri State Highway Department, regarding the use of macadam asphalt binder in the construction of new roads; binder 90 per cent. asphaltum:

"1. Specifications for macadam roads, as generally constructed, shall be followed in all particulars, except as follows: After the laying of the top course of stone, sand or screenings shall be spread over the surface to fill approximately 50 per cent. of the voids. The rolling of the top course and the spreading of the sand or screenings shall be continued at the same time, and until the sand or screenings have been settled to the bottom. In no case must the sand or screenings be applied in such quantities as to form a cushion upon the surface of the road.

"2. After the road has been prepared as above described, there shall be applied the asphalt binder, by means of a sprinkler of suitable design, such that the quantity of binder can be regulated and the width of application varied. The binder shall be applied at a temperature of from 150 to 175 degrees Fahrenheit. The quantity of binder to be used shall, in general, be sufficient to completely fill the voids in the stone, and to form a coating upon the surface. This quantity will vary from 1¼ gallons to 1½ gallons per square yard of surface. The binder shall be further incorporated into the voids with brooms, or by other means.

"3. After the application of the asphalt binder, screenings or sharp sand shall be spread so as to cover the binder. The surface shall then be thoroughly rolled until the remaining voids in the stone are filled with the bituminous mixture and a firm, even surface is formed. Screenings or sharp sand shall then be spread and broomed so as to absorb any of the binder that flushes to the surface and the same rolled; this process to be continued until no more asphaltum binder is brought to the surface.

"4. During the application of the asphalt binder, and until the road is finished, provision should be made to keep all travel off the road. The binder must be applied only in dry, warm weather, and no moisture should be present in the mineral aggregate when it is used.

"5. Provisions should be made to have a sufficient length of road ready to receive the asphalt binder, so that no delay need occur in applying the binder in a heated condition.

"Macadam asphalt binder can be shipped in tank cars or barrels. Tank cars are equipped with heater coils and binder can be heated to required temperature by means of a portable boiler of from 10 to 20 horsepower, when steam cannot be supplied from a stationary plant."

The above notes give some idea of the uses of asphaltic binders. As has been stated, tar is being used extensively for the same purpose. The road official will do well to investigate this method of preserving and maintaining macadam roads, being careful as to the binder he may purchase. In fact, the supervisor or commissioner should in no case undertake the construction of asphaltic macadam, or the application of oil to an existing road, without seeking the advice of some near-by city or state official experienced in the work, and familiar with the local conditions.

OIL AND EARTH ROADS.

Asphaltic oil has been used in the improvement of earth and sand roads, with very satisfactory results. The method is substantially as follows: The road is first drained and crowned; the surface is then loosened to a depth of about 6 inches, by plowing. The material is pulverized with a harrow. Two or three applications of asphaltic oil are given the road, after each of which the oil and earth are mixed by thorough plowing and harrowing. In some instances the mass is sprinkled with water during the mixing process. The road is finally shaped with a grader, and rolled until firm and smooth. The total amount of oil used for this construction will vary from one to three gallons per square yard of surface covered, depending upon the thoroughness of the work and the degree of perfection desired. For the given depth of 6 inches, however, probably not less than two gallons per square yard should be used, in two applications of ¾ gallon each, and one application of ½ gallon. For a depth of less than that assumed less oil may be used.

Sand roads may be readily improved in the manner outlined above. The oil earth road may be surfaced with 2 inches of fine gravel, bound with the oil, and a permanent and very desirable roadway result.

Use of Bituminous Material on Highways in 1911.*

By Prof. Arthur H. Blanchard. Columbia University, New York City.

AS CONSIDERABLE confusion arises because of misunderstanding of the various expressions and terms used in describing materials and methods of construction, certain definitions are given in order that the content of the descriptions as set forth below may be manifest to all. The nomenclature used in this paper covering bituminous materials and their use in the construction of roads and pavements follows:

Asphalts are solid or semi-solid native bitumens, solid or semi-solid bitumens obtained by refining petroleum, or solid or semi-solid compounds which are combinations of the bitumens mentioned with petroleums, or derivatives thereof, consisting of a mixture of hydro-carbons of complex structure, largely cyclic and bridge compounds, melting upon the application of heat.

Asphaltic petroleums are petroleums which yield asphalts upon reduction.

Asphalt cement consists of an asphalt, pure or mixed with foreign matter, which may or may not be fluxed with petroleum residuums.

Bitumens are mixtures of native or pyrogenous hydro-carbons and their non-metallic derivatives, which may be gases, liquids, viscous liquids or solids, and which are soluble in carbon disulphide. This definition was proposed by Committee D-4 of the American Society for Testing Materials.

Bituminous macadam pavements are those having a wearing surface composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous gravel pavements are those composed of gravel and bituminous materials incorporated together by penetration methods.

Bituminous macadam pavemens are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous surfaces consist of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character. This definition was proposed in the 1912 Report of the Special Committee on "Use of Bituminous Materials in Road Construction" of the American Society of Civil Engineers.

Sheet asphalt pavements are those having a wearing surface composed of a predetermined graded sand, fine material and asphalt cement incorporated together by mixing methods. Although this definition embodies the ideas of the leading authorities and covers common usage, it has been inserted because it has been claimed that a bituminous concrete containing as part of its mineral aggregate broken stone passing a ½-inch sieve and retained on a ¼-inch sieve should be classified under sheet asphalt pavements. Fortunately this assertion has not been received with favor by municipal engineers.

In order to give some idea of the extent of the use of bituminous materials in the construction of roads and pavements in the United States, the superficial yardage of roads maintained by surface treatments, of bituminous pavements constructed by penetration methods, and of bituminous concrete pavements built under the jurisdiction of the State Highway Departments of Maine, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania and Maryland during 1911 is given. In the following table the yardage for 1908, 1909 and 1910 is included for comparison:

	Tars and Tar-Asphalt Compounds.	Medium and Heavy Asphaltic Oils and Asphalt Cements.	Light Asphaltic Oils.
SURFACE TREATMENT OF ROADS.			
1908	57,700	239,500	....
1909	95,500	910,600	4,125,900
1910	123,400	2,434,200	9,890,400
1911	433,700	7,980,400	3,765,200
BITUMINOUS PAVEMENTS CONSTRUCTED BY PENETRATION METHODS.			
1908	37,800	25,200	....
1909	170,200	2,077,400	....
1910	339,300	4,840,200	26,500
1911	121,900	8,680,900	....
BITUMINOUS CONCRETE PAVEMENTS.			
1908	52,100	4,400	....
1909	136,000	219,500	....
1910	158,000	432,600	....
1911	24,400	508,100	....

As under the Rhode Island State Board of Public Roads no construction work was accomplished during 1911, due to the fact that no road appropriation was made by the Legislature, the yardage of bituminous concrete pavements constructed with tar and tar-asphalt compounds in 1911

*From a paper before Section D of the American Association for the Advancement of Science.

shows a decrease in comparison with the yardage recorded for 1908, 1909 and 1910, the bulk of which was built by the Rhode Island Board. It is of interest to note, however, that 750,000 gallons of refined tar have been ordered to be used in the construction of bituminous concrete pavements in Rhode Island during 1912. That more permanent forms of construction are favored by our State Commissions is clearly shown by the marked decrease in the use of light oils for surface treatment of roads and the decided increase in the surface treatment of roads with heavy asphaltic oils and asphalt cements. As showing the general increase in the use of bituminous surfaces and bituminous pavements from 1908 to 1911, the total figures for the four years are given. The total number of square yards for each of the above years is given in the following table:

1908	416,700
1909	7,735,100
1910	18,244,600
1911	21,514,600

These totals include the yardage of road surface treated with light asphaltic oils. A comparison of more value and representing material progress along the lines of improved methods of construction and maintenance should be based on totals from which the yardage of road surface treated with light asphaltic oils is omitted. On this basis the total yardage is as follows:

1908	416,700
1909	3,609,200
1910	8,327,700
1911	17,749,400

As noted above, one line of development in the surface treatment of roads has been the departure from the use of palliatives and a marked increase in the use of bituminous surfaces. This tendency is due in part to the unsatisfactory results which have accrued from using bituminous materials which did not "set up" in from 24 to 48 hours, to the necessity for repeated closing of thoroughfares and to the recognition on the part of many that bituminous surfaces are more economical and efficacious in the long run than treatments with palliatives. This change is not only characteristic of state work, but is even more characteristic of municipal work where the tracking of bituminous materials results on the whole in more material damage to property.

The second marked development under bituminous surfaces is in the increased use of various types of pressure and gravity distributers which have been specially designed for this work. The consequent abandonment of the use of pouring cans and ordinary watering carts for this work is to be commended. Many types of these machines have been used during the past year for this kind of work. It has been unfortunate that sufficient information has not been at hand covering the use of these various machines so that an engineer might know the limitations of a machine before purchasing. It is self-evident that, given the kind of bituminous material, the temperature of the material, the rate at which the distributer travels, the calibration of the distributer should be such that the operator will know how much it will distribute per square yard. Information of this character will, without doubt, be forthcoming with reference to many of the distributers to be used during the season of 1912. Extravagant claims have been made by the designers and manufacturers of distributers. In a certain instance it has been claimed that materials, ranging in character from light oil to an asphalt cement of a consistency suitable for use in the construction of sheet asphalt pavements, could all be distributed by a given machine in amounts per square yard varying from one-eighth of a gallon to two gallons. Recently the writer's attention was called to the fact that a certain designer was recommending the use of a pressure distributer, which necessitated the use of a steam roller in its operation, for the distribution, as a surface application, of a palliative which is always applied cold.

During 1911 bituminous surfaces have not only been used extensively on macadam and gravel roads, but they have also been used to a considerable degree on cement-concrete pavements. The improvement of the concrete pavement by the addition of the bituminous surface is marked, as, if the proper kind of bituminous material is used, the pavement is nonproductive of dust, is not slippery, and is less noisy than the ordinary concrete pavement. There is no apparent reason why the results accruing from the use of bituminous surfaces on brick pavements would not be equally good. Especially would such be the case where bituminous fillers are used, thus combining many of the advantages of bituminous fillers and bituminous surfaces with the inherent good qualities of brick pavements.

In the field of the construction of bituminous pavements by penetration methods, the numerous methods which have been employed during 1911 will be described. All these methods have as the principal desiderata the keeping of the bituminous material within 2 inches of the road surface and the securing of the uniform incorporation of the bituminous material and the broken stone. Due to the lack of uniformity in the density of the surface and in the amount of bituminous material applied by the many methods employed, it is obvious that the uniform incorporation of the road metal and the bituminous cement is difficult to obtain. The average pavement has been generally built in two courses, the foundation course being about 4 inches thick after rolling and the top course about 2 inches thick after rolling. Following are brief descriptions of the various methods to which reference has been made. In all the methods the construction is completed by the application of a thin coat of sand, stone chips or screenings:

Type A.—For the upper course broken stone is used containing sufficient small-sized particles to materially reduce the voids, as, for instance, crusher-run stone, which passes a 1½-inch screen and is supposed to be retained on a ½-inch screen. In this method, after the upper course is laid, the bituminous material is applied either before or after the surface is rolled, some favoring the former, because of the greater depth of penetration secured. When the upper course is rolled after the application of the bituminous material, a coat of mineral matter has usually been spread over the surface before rolling. The necessity for a second application or seal coat of bituminous material is determined by traffic conditions in many cases, although standard practice in some departments is responsible for the use of one or the other method, independent of the traffic.

Type B.—In case the metal of the upper course is a uniform product of about 1 inch or 1½ inches in size, the bituminous material is applied after the course has been lightly rolled. Stone chips are then spread upon the surface and thoroughly rolled. After the surface is broomed, another coat of bituminous material is applied. The above method is also used when the road metal varies from 1½ to 2½ inches, in which case ¾-inch stone is usually employed in place of chips.

Type C.—The foundation courses are filled to a certain extent with sand or small-sized broken stone and after the course is rolled, excess mineral matter is swept off. After the upper course of road metal is applied, its voids are filled to within about 1 inch of the surface and the bituminous material applied. The road is finished with a coat of sand or chips which is rolled, although in some cases a second application of bituminous material and chips is used.

Type D.—A closely packed foundation or a concrete base is used and large and uniform-sized stone employed for the wearing course. In this method a layer of sand, ¾ of an inch thick, is placed on the bottom course and bituminous material distributed, using about one gallon per square yard. The upper course of metalling is applied and the upper course thoroughly rolled, the bituminous mastic tending to fill the voids of the upper course. Another coat of bituminous material is applied and the surface finished by the application of a coat of chips or two applications of bituminous material are made, using likewise, two coats of sand or chips.

Type E.—The upper course is constructed in the usual manner and in place of sand or stone chips, a bituminous mastic is applied to the surface, being rolled into the voids and forming the finished surface of the road.

The remarks pertaining to distributing machines mentioned in connection with the discussion on bituminous surfaces apply with equal force to types of distributers used in the construction of bituminous pavements by penetration methods.

The construction of bituminous concrete pavements in connection with which broken stone is used in the aggregate has been developed along certain lines during 1911, although fear of litigation has restrained many engineers from advocating the use of this type of pavement. Instances of development in this field of construction will be cited in connection with each of the types of bituminous concrete pavements to be considered later. Although it is not intended to draw up a brief, nevertheless it may be of interest to include in this resume reference to certain specific cases of the early use of each type of aggregate.

Bituminous concrete pavements, in the aggregates of which broken stone forms an integral part, may be divided into three groups, as follows, the classification being based upon the character of the mineral aggregate:

Type A.—One size crusher-run stone, that is, any one product of a crushing plant.

Type B.—Combinations of one size crusher-run stone and fine mineral matter, such as sand, stone screenings and fine gravel.

Type C.—Finely-graded aggregates of broken stone and sand or other mineral matter.

Naturally Type A has been very popular due to its inherent simplicity. During the past year the writer has seen excellent pavements constructed by this method where the aggregate was a one size crusher-run stone, having the following characteristics based upon a mechanical analysis; all the stone passed a 1¼-inch sieve; not over 25 per cent. passed a 1¼-inch sieve and was retained on a ¾-inch sieve; and not over 5 per cent. passed a ¼-inch sieve. Descriptions of old pavements of this type are legion. As an illustration may be cited the following specification used in England prior to 1899: "The hot stone, when ready for mixing, is screened into material of three sizes, 1 to 2 inches for the body, ½ to 1 inch for the intermediate coat, and ¼ to ½ inch for the top dressing. The coarsest material is used in a layer 3 to 4 inches thick, the intermediate size forms a coat of about ¾ of an inch, and the top dressing is used in thinnest layer possible, with a view to filling all interstices. Afterward a dressing of ¼ inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a 10-ton roller."

The State Board of Public Roads of Rhode Island has used Type A since 1906. It has been admitted in writing by certain patentees "that so long as the construction is of the nearly uniform sizes of stone which you are now using, and you do not get the fine material applied from the surface or into the spaces between the particles of bitumen-coated stone more than our observations indicate you are now doing, or we believe it is possible to do, we would not claim this feature of the construction to be an infringement of our patent No. 727,505." The construction referred to in the above quotation covers the construction of a wearing course of a bituminous concrete pavement under the following specification relative to the broken stone: "The bottom course shall consist of stone from one and one-quarter (1¼) inches to two and one-half (2½) inches in their longest dimension, the upper course of stone from one-half (½) to one and one-quarter (1¼) inches in their longest dimensions." Only the upper course stone was mixed with bituminous material. The product of the crusher which met this specification was obtained from the ordinary type of crushing plant, the broken stone usually passing a 1½-inch screen and commercially being retained upon a ¾ or ⅝-inch screen. A mechanical analysis of a typical product used in Rhode Island may be of interest, and hence, is given below:

Per cent. passing 10-mesh sieve	1.0
Per cent. passing ¼-inch sieve	2.5
Per cent. passing ½-inch sieve	30.8
Per cent. passing ¾-inch sieve	34.2
Per cent. passing 1-inch sieve	23.4
Per cent. passing 1¼-inch sieve	8.1

As Deputy Engineer for the State Board of Public Roads of Rhode Island, the writer had charge of the construction and maintenance of bituminous surfaces and bituminous pavements for a number of years, and hence had the opportunity to inspect on numerous occasions the first section of bituminous concrete pavement constructed in 1906 under the above specification. This section has needed no repairs, although subjected to high speed motor car traffic of the heavy passenger type. Without doubt, broad-minded judges would admit that this type of pavement has inherent stability.

The second type, that is, one having an aggregate composed of one size crusher-run stone mixed with fine material such as sand, screenings or material of a similar character, is likewise described many times in early technical literature. For example, the following description was published over thirty years ago: "The manner of preparing, treating and laying the asphalt mass is as follows: He took asphalt, 125 parts; petroleum oil, 25 parts. These substances were melted and thoroughly incorporated together, and to this mixture he added, in a heated state, sand or powdered stone, 750 parts, and gravel or broken stone, also heated, 1,100 parts. The whole was then horoughly mixed."

During 1911 Type B was popular in various quarters. Washington, D. C., under the jurisdiction of Captain Mark Brooke, of the Office of the Engineer-Commissioner, bituminous concrete pavements were constructed under the following specifications, covering mineral aggregate: "The paving materials shall be composed of crushed trap rock screenings, concrete sand and mineral dust in the following proportions: Trap rock screenings, two parts; concrete sand, one part, and mineral dust, at least 5 per cent. of the above aggregate, mixed with asphaltic cement." The trap rock screenings referred to above varied in size from one inch to screenings and were devoid of dust. Detailed specifications were also given with reference to the character of the sand and the mineral dust. The writer has had the good fortune to examine various streets paved under the above specifications. In his humble opinion these pavements possess inherent stability under commercial traffic.

In connection with the discussion of the use of the third type, that is, a graded aggregate of broken stone with or without sand and fine mineral matter, the consideration of the following description, so old as to be covered with the dust of decades, is apparently pertinent: "Broken stones are preferred for the whole pavement, and shall alone be used for the covering. The greatest dimension of stones for the base (except as hereinafter noted) shall be between three inches and one-fourth inch, and for the covering between two inches and one-twentieth of an inch; the sizes shall be mixed in proportion, varying with the size to form a close mass, which, when dry and compact, can absorb not more than 20 per cent. of water."

During 1911 many thousands of yards of a pavement of Type C have been laid. In the borough of Richmond, New York City, over 40,000 square yards were laid on a total of eighteen streets last year under direction of Theodore S. Oxholm, M. Am. Soc. C. E. The mineral aggregate used conformed to the now famous Topeka specifications. A decree was signed by certain officials and representatives of certain patentees covering the use of the Topeka mineral aggregate. The following quotation is from the decree to which reference has been made: "It appearing to the court that of the mineral matter used in the pavements actually constructed in the cities of Topeka and Emporia, Kas., no particles of stone were used that would not pass a screen with openings one-half an inch in diameter, and that less than 10 per cent. of the stone or coarse sand used would be retained upon a screen with openings one-fourth inch in diameter, and the remaining mineral matter used being finer than one-fourth inch; and it further appearing that pavements constructed by the use of mineral particles as above described do not infringe the claims of complainant's patent No. 727,505, sued upon in this case; and it further appearing that the pavements actually constructed in the cities of Topeka and Emporia, Kas., do not infringe the claims of complainant's patent No. 727,505, sued upon in this case, and that any pavement hereafter constructed in substantial compliance with the following formula, to-wit: Bitumen, from 7 to 11 per cent. Mineral Aggregate—Passing 200-mesh screen, from 5 to 11 per cent.; 40-mesh screen, from 18 to 30 per cent.; 10-mesh screen, from 20 to 55 per cent.; 4-mesh screen, from 8 to 22 per cent.; 2-mesh screen, less than 10 per cent; sieves to be used in the order named, would not infringe the claims of said patent."

Mention should be made of the effect of the introduction of various types of low-priced mixing machines during 1911. The economical and satisfactory results accruing from the use of these machines for mixing certain types of aggregates with bituminous cements has caused the introduction of the mixing method in many localities where only the penetration method has formerly been hsed. During the season of 1912 many new machines of this type will be used with the consequent increase in the construction of the various types of bituminous concrete pavements outlined above.

During 1911 considerable thought has been devoted to the methods and materials employed in the construction of sheet asphalt pavements. Notable work has been done by a special committee of the American Society of Municipal Improvements and the committee of the Association for Standardizing Paving Specifications. Throughout the United States there appears to be crystallizing a firm belief that specifications for materials should be opened to admit such asphalt cements as "Bermudez," "California," "Pioneer," "Texaco" and "Trinidad," for instance, which have shown by service tests that excellent pavements may be constructed by their use. This tendency is commendable, as thus competition is increased and the high quality of the asphalt cement is maintained.

Construction of Asphalt Macadam in Webb City, Mo.

By E. W. Robinson, Assistant City Engineer.

OF THE forty miles of streets in Webb City more than 25 per cent. have been brought to grade and improved in some manner. Brick block is the only so-called permanent pavement that has been constructed up to the present time, and that only on the streets and alleys in the business section. The rest have been improved by some form of macadamizing or graveling, depending upon the cost that is desired. The property owners abutting upon a proposed street improvement pay the entire cost of the work in proportion to the frontage of each lot, as provided by the Missouri statutes for cities of the third class. Also a majority of the resident owners owning a majority of the frontage may kill any such improvement by filing a remonstrance with the city clerk within ten days of the date of the last publication of the resolution declaring such work necessary to be done. So it will be seen that the owners can, and do, set the limit which any improvement may cost, and it is up to the engineering department to get the best possible pavements within the required limit.

Up to within the last four or five years good results were secured with ordinary water-bound macadam, and what is known locally as "gravel pavement," which is nothing but a six-inch surface of mine "tailings" on a prepared sub-grade. Owing to the abundance and cheapness of the stone this class of pavements was secured for 30 to 40 cents per square yard, including excavation. But as soon as automobiles, motorcycles and motor trucks came into common use it was noticed that surfaces that heretofore were hard and smooth commenced to ravel and mud holes became frequent. Also considerable trouble was always experienced with washing on grades steeper than 3 per cent. owing to the fact that the local rock does not bind as well as limestone or other road metals.

The problem then was to get a cheap pavement that would withstand these new influences, and naturally macadam, with a bituminous binder, presented itself as the more acceptable. There had previously been two streets improved with a patented process consisting of mixing the top six inches of the soil with a heavy asphaltic oil and compacting with the rolling tamper. One was a fair success and the second was almost a complete failure, especially at a cost of $1 per square yard, which the property owners paid. It seems that the soil in this locality does not lend itself to that method of treatment.

Before going into details of the method of construction it might be well to give a brief description of the nature of the stone used. Practically all the rock in the immediate locality is a hard blue and white flint, which breaks with a smooth fracture and with about as much binding quality as glass. Limestone occurs at no regular depth or thickness and its use would put the cost of the work completely beyond what the people are willing to pay. The flint used for road and concrete purposes consists of boulders, rip-rap and tailings from the lead and zinc mines of the district. The boulders and tailings occur in large piles at the mills in every direction and can generally be had for the hauling. The rip-rap is of smaller size than the boulders and varies more in size and quality than either the boulders or tailings and is found generally around shafts that have been put down to prospect a lease. Suitable material can generally be had for any work in the city with a haul from one-eighth to three-fourths mile, that is, if any of it could be called suitable. The tailings (commonly called gravel) varies in size from one-eighth to three-fourths inch, the proportions of each size varying from different mills and from different places in the same piles. This is the material used for the concrete work, and is used for filler and surfacing the macadam.

Asphalt macadam was started here in 1910, and about 26,000 square yards were constructed that year. The method employed was substantially as follows: The sub-grade was prepared six inches below the finished grade and rolled with a 15-ton macadam roller until thoroughly solid. The combined curbs and gutters were then covered with about all the tailings that would stay on them. This was to protect the concrete from becoming spattered with the binder and to be used in covering the surface before rolling. On the sub-grade was placed a five-inch base of rip-rap and small boulders, broken so that none would measure more than five inches in any direction. If the larger rock was in excess tailings were used to fill the voids and this base was rolled and compacted as much as possible. On this base was spread the asphalt binder at the rate of three-fourths gallon to the square yard at a temperature between 160 and 350 degrees Fahrenheit. This was covered with a thin layer of tailings and another coat of asphalt applied at the rate of one-half of a gallon to the square yard. This was covered thoroughly with tailings and rolled as soon as possible and until a smooth surface was obtained or the surface showed that further rolling was detrimental. As all the work was done by local concerns the city roller was used. Undoubtedly better results could have been secured had a ten-ton tandem roller been used on the surface instead of the fifteen-ton macadam roller. On the first job the asphalt was applied with a tank wagon, but this was abandoned for the rest of the work for the reason that it was almost impossible to spread the binder evenly. The wagon was not fitted for heating and keeping the material hot and trouble was experienced in that direction. The rest of the work was done by the hand method, using two-gallon sprinkling can fitted with special flaring mouth so as to give a flat stream. The contract price for this work ranged from 48 to 77 cents, depending upon the excavation, the average being 60 cents. These streets have stood up well under the traffic, considering of course the price paid for them. However, the last job put in that year always has been somewhat rough, owing to the fact that nearly all the good rip-rap had been used for the other work, and what was obtained was not well graded, with the consequence that large rock keep working to the surface.

In starting to lay out the work for 1911 it was seen at once that it would be necessary to have rock crushed especially for this purpose. The city made arrangements to install a crusher, but refrained from doing so after a private concern agreed to install one and furnish rock at reasonable price to all contracors who should be awarded contracts for paving. The specifications were then changed and provided for a four-inch base of rock not larger than four inches and graded to make as few voids as possible. On this base was placed a two-inch wearing surface of rock not larger than two inches and with no tailings added. After this course was ironed out with the roller one coat of asphalt was applied at the rate of two gallons to the square yard and at a temperature between 300 and 350 degrees Fahrenheit. This was then covered with about one inch of tailings and thoroughly rolled. This produced a much better construction, and the cost varied from 65½ to 83 cents, with an average of 73 cents. There were 27,500 square yards of this work done in 1911, some in the business part of the city, and so far is standing the traffic well. Considerable of this work was done later in the fall with the consequence that the cold stone chilled the asphalt and it did not get thoroughly distributed. This caused some raveling during the winter, but the spring sun is putting them in good shape. The experience here with this kind of rock is that it takes about one summer's sun and traffic to distribute the binder properly and settle the rock so that no further raveling takes place.

On the work done in 1910 only one asphalt kettle of 500 gallons capacity was used to heat the asphalt. This was pulled ahead as the work progressed by a team kept on the job for that and hauling the asphalt from the place of unloading to the street. In 1911 the roller was kept on the job continuously and was used to pull two 500-gallon kettles, and in this manner the asphalting was done much more rapidly than formerly. Also in 1911 special three-gallon pouring cans were used. It was discovered that the direction of the wind had considerable to do with the heating ability of the kettles, and considerable time was lost on account of not being able to keep hot asphalt for the pourer. Also when the men were not careful and got much foreign matter in with the asphalt it formed as a cake on the bottom of the kettle and lessened the amount of asphalt it would heat. There were three brands of asphalt used, one was shipped in tank cars, another in wooden barrels and the other in steel drums. The staves from the wooden barrels furnished all the fuel necessary when that material was used. During hot weather, after the staves or steel drums had been removed, the asphalt was cut into suitable sized pieces to put into the kettles by one man using a wire with a piece of wood for handle at each end. During the colder weather it was necessary to use a regular cutter made for that purpose.

An inspector was kept on the job continuously after the asphalting started. A constant check was kept on the amount of binder used by counting two or three times a day the number of cans poured in a stretch of 10 or 15 feet, as well as counting the number of barrels used and amount covered during each day. The organization of the asphalting gang varied with different contractors, but was substantially as follows for the work done the more economically: One foreman, one man pouring asphalt, one man carrying asphalt to pourer (two cans being used), two or three men cutting and placing asphalt in kettle and firing, two men spreading gravel, and at times helping fill kettles; water boy, who also helps fire kettles, night fireman to have kettles full of hot asphalt for morning. A gang of this size would on days when everything went all right cover 1,200 square yards in ten hours, but 900 square yards was a good average for the whole job. The following data give the cost of the asphalting on four different jobs, two for the work done under the 1910 specifications and two under the 1911 specifications:

No. 1—6,547.2 square yards, October, 1910—

	Cost per square yard.
Foreman, 77 hours at 55 5/9c...	$0.0065
Fireman, 119 hours at 22 2/9c...	.0040
Carrying and pouring asphalt, 99 hours at 22 2/9c..............	.0033
Spreading gravel, 133 hours at 22 2/9c	.0045
Cutting and placing asphalt in kettles, 112 hours at 22 2/9c, 11 hours at 44 4/9c...........	.0045
Team hauling asphalt and pulling kettles, 37 hours at 44 4/9c...	.0025
Asphalt, 32.48 tons at $20.20 f. o. b. Webb City..............	.1002
Total cost per square yard....	$0.1255

Average square yards per hour for whole job, 85.

No. 2—5,690.4 square yards, November, 1910—

	Cost per square yard.
Foreman, 54 hours at 38 8/9c...	$0.0037
Fireman, 100 hours at 22 2/9c...	.0039
Carrying and pouring asphalt, 64 hours at 27 7/9c..............	.0031
Spreading gravel, 136 hours at 22 2/9c	.0053
Cutting and placing asphalt in kettles, 60 hours at 22 2/9c....	.0023
Team hauling asphalt and pulling kettles, 26 hours at 38 8/9c.	.0018
Asphalt, 32.25 tons at $20.20 f. o. b. Webb City.................	.1145
Coal, 2 tons at $4...............	.0014
Total cost per square yard...	$0.1360

Average square yards per hour for whole job, 105.

No. 3—7,893 square yards, September, 1911—

	Cost per square yard.
Foreman, 57 hours at 40c.......	$0.00289
Carrying and pouring asphalt, 114 hours at 20c..............	.00289
Cutting and placing asphalt in kettles and firing kettles, 206 hours at 20c..................	.00522
Spreading gravel, 78½ hours at 20c	.00199
Night fireman, 45 hours at 20c, and water boy, 57 hours at 7½c	.00168
Hauling asphalt, team and two men, 42 hours at 55c.........	.00293

	Cost per square yard.
Asphalt, 64.879 tons at $20.20, f. o. b. Webb City	.16604
Total cost per square yard	$0.18364

Average square yards per hour for whole job, 138.

No. 4—3,921 square yards, September, 1911—

	Cost per square yard.
Foreman, 27 hours at 40c	$0.00275
Carrying and pouring asphalt, 54 hours at 20c	.00275
Cutting and placing asphalt in kettles and firing kettles, 59 hours at 20c	.00301
Spreading gravel, 68 hours at 20c	.00347
Water boy, 22 hours at 7¼c, and night fireman, 30 hours at 20c.	.00195
Hauling asphalt, team and two men, 28 hours at 55c	.00393
Asphalt, 32.665 tons at $20.20 f. o. b. Webb City	.16830
Total cost per square yard	$0.18616

Average square yards per hour for whole job, 145.

Receptacles for Street Sweepings and Washings.

By Dr. Robert Grimshaw, Dresden, Germany.

THE problem of collecting and removing kitchen waste, ashes, etc., is one the solution of which has given much trouble to "city fathers" and others in all quarters of the world where one is not hardened to dirt, disease and stench. There are countless ways of doing the work so as not to offend eye or ear and without encroaching too seriously on the municipal or private pocketbook. There is, however, only one way of not doing it, and that is common to every quarter of the globe. One system adopted in several cities is illustrated herewith. The inventors have given it the name of the "Augias," whereas I should have called it the "Herakles"; for it was his fearless and enterprising example of muscular paganism which first distinguished him as a scavenger.

The arrangement for use in collecting dry street sweepings and the like is shown in the accompanying illustrations and consists of sunken receptacles in the street pavements, closed by a double cover, which may be partly opened for the street sweeper to add his quota or entirely to permit the removal by hand cranes of the entire contents from the sheet metal box which neatly fits the excavation.

Fig. 1 shows the cover closed; Fig. 2 partly open for the reception of dirt, and Fig. 3 fully open for the removal of the box, which is being removed by crane attached to the garbage or offal cart, into which the box will be emptied.

The excavation, which is 48 inches deep, 30x26 inches in the opening, is lined with reinforced concrete, this lining being in one piece and weighing about 785 pounds. The cover weighs 72 pounds, the inner receptacle, which is 1.5 millimeter, or, say, .06 inch sheet iron, weighs about 13 pounds.

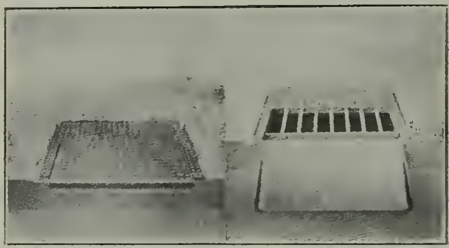


Fig. 1. Fig. 2.
RECEPTACLE FOR STREET SWEEPINGS.

Since the introduction of asphalt and the like for street paving and of sprinkling wagons in connection with mechanical sweepers and "squeegees" for the purpose of removing all the dirt by the wet process and carrying it off through the sewers, it has been found necessary in many cities where the sewer system is defective to provide "gullies" or receptacles for the street washings. These must be of considerable dimensions on account of the large proportion of water to the solid matter. Clearing out such sinks or gullies by hand dipping is expensive and unsightly; also not always exactly suggestive of "perfumes of Araby the blest." Attempts to empty them by pumping have showed that only the upper layers of water and thin mud can be cessitating subsequent dipping.

The method introduced by the Augias Company of Berlin into several German cities consists in using "gullies" such as shown in vertical section in Fig. 4, permitting the removal of lower layers also by pumping by the very simple process of drawing all off from the bottom and making the entire mass of only one consistency.

Fig. 3.
RECEPTACLE FOR STREET SWEEPINGS.

removed; the more solid under layers refusing to enter the suction pipe, and ne-

The gulley or receptacle consists of a main portion with suitable upper and lower gratings to permit the entrance of the sweepings, etc., and a side outlet where desirable. The lower portion of the receptacle is conical, and from it there rises a suction pipe, the upper end of which may be put in air-tight communication with the lower end of the suction hose of the ordinary pump employed for such material, and which delivers the latter to the usual tank wagon, as shown in the illustration.

Tests go to show that the removal of a cubic meter (35.3 cubic feet) of average contents of such a receptacle takes but two minutes after all is coupled up and going.

The process has the advantage of being rapid, sightly and cleanly, besides being cheaper and more thorough than hand work.

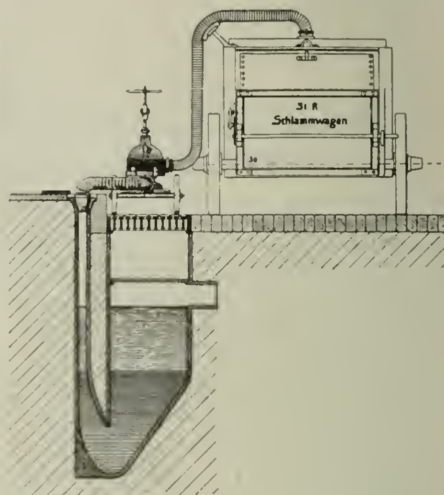


Fig. 4.
RECEPTACLE FOR STREET WASHINGS.
Pump Attached for Removal to Tank Wagon.

Nomenclature of Creosote and Creosoting Oils.*

By David Allerton, Portland, Oregon.

CREOSOTE seems to have been originally adopted in England as the synonym for dead oil of coal tar, and the product was first called dead oil because its specific gravity was greater than water; at least that was the reason given when I first became acquainted with it so many years ago that I hate to state the exact number for fear I may be accused of alluding to prehistoric times. When first used for preserving wood it was simply creosote, and when it was found necessary to define it by a certain specification, and not much being known about it at the time, except that it contained tar acids and naphthalene, a specified amount of these constituents was required as well as a specific gravity greater than water. Afterwards, as more chemical work was done in coal tar derivatives, creosote oil being, as we all know, separated from the crude tar, light oils, etc., by distillation, a process of analysis by fractional distillations was devised, the original object being to determine that the creosote had been obtained from crude bituminous coal tar; also a specific gravity greater than water, at least 1.02 and upward was required. This fractionation was so graded as to eliminate the very light oils and water and leave only an inconsiderable residue at the end of the process. At first the distillation was not usually carried above 310 or 315 C., but afterward as high as 354 degrees, when only a very small

*From a paper and discussion before the American Wood Preservers' Association.

amount was allowed to remain in the retort. The method of distillation was also standardized, and that method still obtains, the oil complying with certain requirements in a general way. I have not given the intermediate fractions, as they are well understood; and it is also equally well understood that an allowance must be made for a variation, due to the difference in the quality of various bituminous coals, as well as to the method of the original destructive distillation of the coal, and also the variations due to the method of analysis. There seems to be no doubt that all pure tar creosotes are good wood preservatives, even if they vary to some extent. It is evident that the less the viscosity of a liquid, either an oil or an aqueous solution, the easier it is forced into wood fiber, and that in treating refractory wood it is desirable to have a preservative of a very low viscosity. Of course, experience has long ago taught us that it is impossible to get an exactly even penetration in any charge of timber or ties, and the greater the viscosity the greater the variance; this extreme viscosity, and often the incompetency of the operator, is the cause of the complaints now being made as to the great difference in the penetration of the compound used in the timber or ties, in a given charge, of course, and it is well understood that a proper regulation of temperature and pressure is necessary to get a fairly even treatment, but with a lighter bodied oil, careful handling by the operator is not quite so necessary or important.

In quite recent years so-called standard specifications have been adopted by different associations, defining the specifications for creosote to be used in the treatment of ties and timber, as well as paving blocks, and the specifications define the gravity, usually giving a very high lower gravity and distillation points calling for an addition of coal tar or pitch (it seems to be known by both terms), but viscosity is lost sight of, although but a limited amount of insoluble matter (otherwise carbon) is permitted, it being assumed that no matter how thick and heavy the liquid is it can be made to penetrate wood if it contains no insoluble matter. This is fallacious. At first it was not definitely stated what the creosote was to contain, the required analysis only being given and allowing a large, and, in the paving mixture, a very large, residue above 354 degrees, merely stipulating that this residue should be soft; with American creosote it is always hard, but that does not seem to matter. Now, these mixtures are not what was originally meant by the term creosote, and I think that they should have been defined as to what they should contain besides the dead oil. Of course, the inventors of these heavy mixtures considered them a great improvement on the lighter preservatives, and they were governed by purely altruistic motives, we will admit. But I know from experience that it is very hard to get a penetration of any depth with these bodies of such viscous nature, most of the mixture remaining on or near the surface.

The cause for the excessive oozing of the oil, commonly called bleeding, from paving blocks, can be traced very simply to the use of such oils, as when they are treated with creosote this bleeding is very slight and increases with the weight of the oil.

Now, using crude coke oven tar as a basis, which contains somewhere about 30 per cent. of creosote, this material contains all the preservative necessary, as 30 or 40 per cent. of creosote is amply sufficient in any preservative mixture where a neutral body is used, either as a matter of economy or for some other purpose, such as increasing the waterproofing qualities, though this last is of doubtful advantage as compared with its disadvantages.

Coal tar is inert matter as regards preservative qualities and is used in creosoting for precisely the same purpose as barytes is used in paints, its objections being, as I have before stated, its high viscosity; but at present there seems to be no substitute on the market, and there is in some quarters a return to creosote as formerly used by those who have tried the heavy mixture; but undoubtedly the combined creosote and tar will still be used, and the purpose of this paper is to suggest a correct appellation of the various creosoting mixtures and creosotes.

I propose the dead oil of coal tar be designated as creosote; other creosotes, such as wood creosotes, oil tar creosote, etc., be so designated, and the mixtures of creosote with coke oven tar, filtered tar, or oil tar, etc., be designated creosoting oils, and the specifications for such oils to call for the per cent. of creosote contained and the per cent. and kind of matter added.

I trust that this is a conservative exposition of the subject and that it is not unworthy of consideration by your honorable body. A correct nomenclature would do away with any misapprehension or ambiguity of expression or the use of unnecessary terms; we know how the meaningless term, "chemically pure," has been used, and to say that an oil is a product of pure coal tar or a pure coal tar product is equally incorrect, for it might mean that the substance was coal tar or coal tar creosote, or that it merely contained a certain amount of either, and it is to the interest of producer and consumer to have a product properly defined.

In the discussion of the paper Mr. S. R.

Church said: "I would like to say that I am in sympathy with Mr. Allerton's desire to have a correct system of nomenclature for oils used in timber preservation. There is one statement in Mr. Allerton's paper that perhaps deserves a word of explanation. He says that coal tar is inert as a preservative, and simply acts as a filler. Now, creosote oil is derived from coal tar, and if you use the tar itself, for the sake of argument suppose you use the straight tar, you would have there at least 40 per cent. of creosote oil in your tar, and to that extent it cannot be true that coal tar as a preservative is inert. The distilled tar usually contains most of the creosote. The oils removed by the distillation would be the lighter oils and the water, and not, properly speaking, creosote."

Metering the Louisville, Ky., Water Supply.

THE constantly increasing demand upon the available water supplies of all cities, not as fortunately situated as to have an inexhaustible supply, taken with the recurring menace of a water famine, has caused more attention to be directed towards the question of preventing the waste of water. Even New York City, with its immense water supply awaiting delivery by the completion of the Catskill aqueduct, last summer was brought into imminent danger of a water famine, due to the waste caused by leaks and careless use by all classes of consumers.

The installation of meters on the service supply in a great number of cities has resulted in a reduction of the careless, and it ought to be said, criminal waste of water. It is interesting to note in this connection that the general adoption of meters has been only after a continued use of a small number of meters which are increased each year, and after the education of consumers to the benefit of their use. This process of education has taken various methods in different cities. In some cities publicity campaigns by the water officials have been sufficient to secure their adoption, while in others it has been necessary to force their adoption by legislation.

Washington, D. C., has been a notable example of this latter method. The marked opposition which was at first made to the adoption of water meters has in the space of a few years given place to a sentiment in favor of their use. The fact that the meter was found to be merely a safeguard against wanton waste; and, that its use did not mean excessive charges, has resulted in an entirely different attitude towards the metering of the supply. Those who use only that amount of water which is necessary feel that they are paying only that which is their portion, and that they are not being taxed to pay for water which other consumers waste.

In Philadelphia education has not reached the point where opposition to the use of meters has been removed. The water supply is owned and controlled by the city, and the opposition to meter installation has so far been successful. In fact, in 1904 an ordinance was passed which prohibited the use of meters, even in cases where the consumer requested an installation. The fact that, unless the water waste is checked, water works extensions will be necessary in the near future has resulted in an effort to have the ordinance revoked.

Louisville, Ky., which has a very efficiently managed water works system, has proceeded along the line of gradual adoption of meters, and in the 1911 report of the Louisville Water Company, which is municipally operated, Theodore A. Leisen, the chief engineer, gives a discussion of the question of metering the supply, which sets forth clearly the advantages to be gained by the procedure.

The 1909 report of the Louisville Water Company shows a net increase of 170 in the number of meters in use, making the total number of meters only 2,642. The non-metered revenue at that time was $401,633, or about 57 per cent. of the total.

In 1910 the net increase in meters was 205, making 2,847 meters in use, and the non-metered revenue still continued at 57 per cent., or at this time $417,187. At this time attention was directed by Mr. Leisen to the fact, though only 33 per cent. of the water supplied was metered, yet the revenue from the metered consumption was 43 per cent., proving that a waste existed, for which those having meters were charged.

During 1911 more attention was given to the extension of the metered supply, and a special meter department was established to systematize the work of installation and maintenance. Inspections were made, repairs were promptly attended to, and meters which were out of service were removed, so that at the end of the year there were only 2,800 meters in use. The comparison of the metered with the non-metered supply is given as follows:

	Gallons.	Per Cent.
Quantity of metered consumption	3,099,988,450	35.6
Quantity of non-meter-consumption	5,611,985,425	64.4
Metered revenue	$331,731.41	44.1
Non-metered revenue	420,159.41	55.9

As was noted in the previous year, the percentage of the metered consumption (35.6 per cent.) produced a greater percentage of revenue (44.1 per cent.).

A marked increase in the total consumption was noted in 1911, and Mr. Leisen, in his recommendations, states that the remedy for the situation lies in the metering of the supply. His discussion of the necessity of meter installation and the basis of charges which he proposes under the conditions of a metered supply are so well presented that they may be applied by water officials in other cities. His arguments are given as follows:

"The primary and most convincing argument in favor of selling all water by meter measurement is that the consumer pays only for what he actually uses, and in arranging for a meter schedule of rates this fact should be kept constantly in mind, and any scheme, however advantageous or simple, which departs from this principle will be open to more or less reasonable objection.

"No system of rates which ignores the necessity for a fixed minimum income from every service can successfully withstand the test of commercial requirements without making the unit rate for water excessively high, thereby working a hardship on the large consumer; but, on the other hand, the practice of establishing a minimum rate, which permits a predetermined quantity of water to be used under that rate—a system in vogue in this and many other cities—is objectionable for the reason that it nullifies the primal argument advanced for the adoption of the meter by deliberately charging the consumer for water which is not consumed in the majority of cases. As an instance, we charge a minimum rate of $36.50 per annum, which permits the consumption of 700 gallons per day. If the consumer only uses 350 gallons per day—an amount which experience has shown to be ample for the average dwelling—he is charged for double the water that he uses.

"Another undesirable feature in the tariff of meter rates prevailing in many cities is the sliding scale which discriminates against the small consumer, and, although commercially reasonable from the viewpoint of the water department, which can afford to supply in wholesale quantities at reduced rates, it is, nevertheless, unjust to the individual consumer.

"The first requisite of a proper system of rating is the production of a revenue sufficient for the operation of the plant in all its ramifications, including all necessary extensions and improvements. Assuming that the expenses for the next few years will be approximately the same as in the immediate past, and estimating the amount necessary for extensions, improvements, depreciation, etc., we have the following:

FIXED AND OVERHEAD OPERATING EXPENSES.		
Administrative and revenue	$65,000.00	
General expenses	40,000.00	
Distribution and general operation (50 per cent.)	25,000.00	
Interest	60,000.00	
		$190,000.00
PRODUCTION EXPENSES.		
Pumpage	$47,000.00	
Filtration	32,000.00	
Reservoirs	6,000.00	
Distribution and general operations (50 per cent.)	25,000.00	
		110,000.00
Total operating expenses		$300,000.00
CONSTRUCTION EXPENSES.		
Extension of mains 10-12 miles	$50,000.00	
New meters	50,000.00	
Other improvements	50,000.00	
Reserve for depreciation	25,000.00	
Surplus and incidentals	25,000.00	
		200,000.00
Total annual expenses or revenue required		$500,000.00

"A meter rate must, therefore, be arranged in such a manner as to produce not less than $500,000 annually.

"The overhead expenses, amounting to $190,000, exist independent of the quantity of water sold, and these fixed overhead charges should be met by a fixed income; and this it is proposed to do by means of a 'service charge', on each meter installed. There are 32,000 services in active use, and dividing this number into $190,000 would give $5.94 to be charged against each service. For convenience, it is proposed to establish this 'service charge' at $6 per annum for each ⅝-inch meter, $9 for ¾-inch, $12 for 1-inch, $24 for 2-inch, and on up to $72 for a 6-inch meter. If every tap were metered this 'service charge' would produce sufficient revenue to meet all fixed overhead charges and leave a safe contingent margin.

"The object in increasing the service charge in proportion to the size of the meter is two-fold. It makes a more equitable distribution of the charge, proportioning it to the service rendered, and it deters consumers from applying for a larger meter than is actually required. This 'service charge' would not cover the cost of any water consumed, but would take the place of a meter rental and serve the equivalent purpose of a 'minimum charge.' It covers the value of what is generally designated as a 'readiness to serve' charge, and, being based on the proportionate amount of fixed overhead charges, is figured on logical reasoning, and is not a mere arbitrary or haphazard charge.

"With this 'service charge' established as outlined herein, the water can be furnished to every consumer at exactly the same rate, regardless of whether he uses one thousand gallons or one million gallons; and this rate can be fixed at 4 cents net per thousand gallons, and within a few years it could probably be reduced, in which event we might claim, without fear of contradiction, that we were furnishing the cheapest water of any city in the country having similar conditions to contend with.

"To illustrate how this rate will work out in actual practice, a few cases are given with the old and the new rates:

L. & N. R. R. CO., 1911.		
Present Rate—17 meters, 345,139,916 gallons net		$16,145 52
Proposed Rate—"Service charge"	$882 00	
345,139,916 gallons at 4c	13,805 59	
		14,687 59
Reduction—9 per cent		$1,457 93
LOUISVILLE RAILWAY CO., 1911.		
Present Rate—21 meters, 210,801,586 gallons net		$10,104 81
Proposed Rate—"Service charge"	$696 00	
210,801,586 gallons at 4c	8,432 06	
		9,128 06
Reduction—9 per cent		$976 75
DWELLING—12-14 ROOMS, ¾-INCH METER.		
Present Rate—700 gallons per day, $36.50—25 per cent		$27 38
Proposed Rate—"Service charge"	$9 00	
700 gallons per day—255,500 gallons at 4c	10 22	
		19 22
Reduction—29 per cent		$8 16
DWELLING—7 ROOMS—30-FOOT LOT.		
Present Rate—General convenience and sprinkling	$26 10—25%	$19 58
Proposed Rate—"Service charge"	6 00	
300 gallons per doy—109,500 gallons at 4c	4 38	
		10 38
Reduction—47 per cent		$9 20

"The regular service charge of $6.00 per annum for a ⅝-inch meter, with a reasonable water consumption, would be a benefit only to dwellings whose flat or schedule rate exceeds $10.00 per annum, and in order to provide for metering very small dwellings, it is suggested that where the present rate is from $7.50 to $10.00 per annum, there shall be installed a so-called ½-inch meter with a service charge of $4.50, and where the rate is under $7.50 there shall be installed a so-called ⅜-inch meter, with a service charge of $3.00 per annum. The latter charge would provide a rate of $4.46 with 100 gallons consumption per day, or $3.72 with 50 gallons per day.

"The average cost per annum for each metered dwelling, based on the quantities assumed in the estimates, would be as follows:

1-inch Meter—500 gals. per day,	$12 00	plus	$7 40	equals	$19 40
¾-inch Meter—400 gals. per day,	9 00	plus	5 84	equals	14 84
⅝-inch Meter—300 gals. per day,	6 00	plus	4 38	equals	10 38
½-inch Meter—200 gals. per day,	4 50	plus	2 92	equals	7 42
⅜-inch Meter—100 gals. per day,	3 00	plus	1 46	equals	4 46

"There is no guesswork in determining the rate which will have to be established to provide the revenue necessary for the operations of the plant. All figures have been derived from the conditions existing in 1911, the only estimates being the probable quantity of water which will be consumed through meters, and this is taken on a basis so conservative as to insure the final result being in excess of the estimates. The average daily quantity to each metered tap in 1911 was 3,033 gallons, and for each non-metered tap 526 gallons. In calculating the revenue to be derived from metering all of the present non-metered services, only 315 gallons per tap has been taken as the average quantity to be paid for.

"The following is the total estimated revenue which would accrue under the proposed schedule of rates, with every service metered, based on the present number of services:

SERVICE CHARGE.

PRESENT METERED SERVICE.

990— ⅝-inch at $6.00	$5,940 00	
339— ¾-inch at 9.00	3,051 00	
770— 1-inch at 12.00	9,240 00	
240—1½-inch at 18.00	4,320 00	
256— 2-inch at 24.00	6,144 00	
104— 3-inch at 36.00	3,744 00	
64— 4-inch at 48.00	3,072 00	
37— 6-inch at 72.00	2,664 00	
2,800	$38,175 00	

PROPOSED METERS.

5,000— 1-inch at $12.00	$60,000 00	
5,000—¾-inch at 9.00	45,000 00	
12,000—⅝-inch at 6.00	72,000 00	
4,000—½-inch at 4.50	18,000 00	
3,200—⅜-inch at 3.00	9,600 00	
		$204,600 00
32,000—Meters—Total service charge		$242,775 00

WATER SUPPLY REVENUE.

PRESENT METERED SERVICE.

2,800 Meters—3,100,000,000 gals. at 4c		$124,000 00

PROPOSED METERS.

5,000— 1-inch—500 gals. per day,	912,500,000 gals.	
5,000—¾-inch—400 gals. per day,	730,000,000 gals.	
12,000—⅝-inch—300 gals. per day,	1,314,000,000 gals.	
4,000—½-inch—200 gals. per day,	292,000,000 gals.	
3,200—⅜-inch—100 gals. per day,	116,800,000 gals.	
	3,365,300,000 gals. at 4c	$134,612 00
Total revenue from metered services		$501,387 00
Other revenue		6,613 00
Total estimated revenue		$508,000 00

"It should be borne in mind in considering this proposition that all of the estimates are founded on the number of consumers on record for 1911, no attempt having been made to include the normal increase which is sure to result. It must be recognized also that the change to a metered system will of necessity be a gradual one and will require at least four or five years for its complete development, during which time the revenue will be reduced by degrees only on account of the proposed change in rates, but will be increasing steadily by virtue of the normal growth of business.

"Summarizing the merits of the proposition, the following features appeal to both reason and a proper sense of justice: It furnishes water at the lowest rate consistent with the requirements of the plant; it makes the same rate to every one for the water consumed, while through the medium of the 'service charge' it gives the large consumer the advantage to which he is entitled by the practical absorption of this charge; it places the burden of the service charge exactly where it belongs, for the reason that it costs the same to be prepared to furnish water through a given sized meter to the consumer who uses but 200 gallons per day, as it does to the one who uses 2,000 gallons, while it does cost more to be prepared to furnish the quantity of water which would be normally consumed through a 6-inch meter, than would be the case with a ¾-inch service, and, finally, it provides a system of rates based on the operating expenses, which can be readily adjusted to meet varying conditions without affecting its underlying principle."

Reduction in Putrescibility of Sewage by Settling and by Filtration.*

By Dr. Arthur Lederer, New York City.

WHEN we speak of a raw sewage being "strong" or "weak," we have, ordinarily, factors in mind which are furnished by the chemical determinations of total organic nitrogen, organic carbon, chlorine, and possibly fats. To one who is dealing continuously with one and the same sewage the suspended matter will give a fairly good idea of the strength of the sewage. It is likewise apparent that certain relations can be established between some of the chemical constituents from a long series of analyses. However, in different localities all these factors and relations will be subject to modifications, the chief cause for which lies in the varieties of trade wastes likely to be present in the majority of American sewages. In a general way a stronger domestic sewage will require more dilution in a water course than will a weaker, as expressed by any of these factors above.

Up to the time of the introduction of the methylene blue putrescibility test, we have lacked a definite expression for the strength of a sewage from the standpoint of a prospective nuisance. Since the vast majority of sewages reach the surface water in an unpurified or partially purified state, it is clear that any determination in which the natural agencies participate (as is the case in the putrescibility test of Spitta and Weldert) must of necessity come closer to the actual changes occurring in water courses than a purely chemical test, such as the determination of "oxygen consumed." This is the more apparent when we consider that the different methods in vogue of determining "oxygen consumed" give rise to very perceptible differences in the results. The methylene blue putrescibility test, as is well known, depends upon the formation of a colorless leucobase as the oxygen in the sample becomes exhausted. The test has been made more valuable by Phelps, who worked out relative stability figures which serve as a numerical measure of the relation between the available oxygen and the oxygen required for complete oxidization. Since the reaction is a biologic one, an incubation temperature of 20 degrees C. will favor the development of bacteria likely to take part in the self-purification of rivers, while a temperature of 38 degrees C. will favor the development of a bacterial flora not likely to take part in nature. The methylene blue test is at present almost universally used in sewage purification plants, and serves its purpose well. The main objection to the test, however, has been the time which is consumed to obtain results. This is the chief reason why sometimes an incuba-

*A paper before the American Public Health Association.

tion temperature of 38 degrees C. is preferred to the more desirable temperature of 30 degrees C.

Recently interest was awakened in the test for the loss of dissolved oxygen in a sewage mixture on incubation for a definite period of time under anaerobic conditions. The loss of oxygen, as determined quantitatively, serves as a measure of the stability of the sewage or the sewage mixture. This test is a more direct measure of the probable effect upon the stream than the methylene blue test. The test is not a new one. On looking over German literature repeated mention is found of "Sauerstoffzehrung" among the analytical data, the result of which is obtained by methods substantially the same as described above. Mention was first made of the results obtained with this method in this country in the report of the Lawrence experiment station for the year 1900 (Massachusetts State Board of Health). The test was also referred to recently as a good measure of stability by the writer, and by C. B. Hoover, of the Columbus Sewage Works. Hoover likewise recognized that the analytical results usually employed to show the degree of purification effected by sewage treatment do not reveal quantitatively the relative stability, and hence cannot be looked upon as reliable indices of the deoxygenating properties of sewages, sewage mixtures or effluents. As a result of a long series of tests he obtained certain definite relations for sewages, septic effluents and filter effluents as determined from a modified "oxygen consumed" test and the loss of dissolved oxygen on incubation, described previously. It may be possible to establish such a relation in dealing with one and the same sewage for a long time, but the relation is bound to differ in various places to a great extent. The method does not lend itself to a ready expression of the stability. Hoover measured his loss of dissolved oxygen by incubation at 37 degrees C. for 24 hours. There is a possibility, as Phelps has pointed out, in certain effluents, particularly those from rapid filters, of oxygen becoming lost at this temperature without being consumed. The saturation point of oxygen at 37 degrees C. is not over 7 p.p.m., and consequently there is a tendency for some of the dissolved oxygen to escape. Tight stoppers are not likely to prevent the escape of the released gas, nor are mercury seals adapted for routine work.

Recently Phelps introduced his method of calculating quantitatively the stability of a sewage mixture from determinations made by anaerobic incubation at 20 degrees C. for a given period of time. The sewages are mixed with water saturated with oxygen, and the total amount of oxygen is determined directly. The

TABLE I.

PARTS PER MILLION.

Serial No.	Solids in Crude Sewage.		Suspended Matter. Original.		Suspended Matter. After Four Hours Settling.		Oxygen Consumed.			Organic Nitrogen.			Per Cent. Permissible Sewage.		
	Total	Volatile	Total	Volatile	Total	Volatile	Crude	Settled	Filtered	Crude	Settled	Filtered	Crude	Settled	Filtered
1	493	222	68	50	37	30	13.	5.5	46.	7.5	5.1	4.6	24.6	27.5	42.
2	629	313	266	124	91	55	29.	17.	11.	9.5	...	11.0	18.3	19.2	51.
3	594	295	118	84	45	43	30.	25.	20.	7.1	...	20.	4.2	5.0	11.1
4	630	335	162	119	52	40	37.	33.	23.	13.7	11.3	23.	2.6	5.5	9.4
5	680	385	194	126	75	55	52.	33.	26.	11.9	7.1	26.	5.0	7.3	11.8
6	654	344	227	127	67	44	51.	28.	23.	12.3	3.3	23.	4.7	10.3	21.3
7	592	322	187	120	65	57	52.	37.	29.	10.5	5.5	29.	3.0	5.4	13.3
8	642	318	206	107	65	50	45.	31.	21.	13.0	...	21.	10.1	18.3	29.4
9	547	270	76	52	51	44	27.	25.	24.	5.9	4.8	24.	17.7	19.1	29.8
Average	607	311	167	101	61	46	37.	26.	20.1	10.1	...	20.1	10.0	13.1	24.3

sample is then stored in a tight bottle for a suitable period of time and the oxygen redetermined. The rate at which the oxygen disappears under these conditions is a direct measure of the probable occurrence upon a stream. Under given assumptions, other than those actually occurring in a specific test, the following formula derived by Phelps may be used:

$$C = \frac{\log \frac{O^1}{O}}{Kt}$$

In this formula C represents the percentage of sewage permissible in the water used for dilution under the assumed conditions. O^1 is equivalent to the dissolved oxygen in the mixture before incubation expressed in parts per million, O the dissolved oxygen after incubation. K is a constant which defines mathematically the rapidity with which the oxygen is used up in a mixture of water and sewage. From a specific test K is determined. The formula can then be applied to other cases. According to Phelps K depends upon the character of the sewage matter and the concentration of that material in the sewage, and is independent of the extent of dilution or the character of the diluting water. Subsequent experiments made by the writer on crude sewages at the sewage testing station of the sanitary district of Chicago have proven, however, that the factor K is not independent of the amount of dilution. It represents in the formula the time which is allowed for the contact of water and sewage to produce the change in the oxygen of the mixture.

It occurred to the writer to utilize Phelps' quantitative expression of the stability of sewages to demonstrate the improvement of the liquid by the removal of the settling suspended matter and complete removal of all the suspended matter. The laboratory technique employed for these experiments was the same as employed by Phelps. Two dilutions were made as a rule on one and the same sewage. A dilution of one part of sewage to eight and ten parts of water from Lake Michigan has given satisfactory results. The time of incubation was 24 hours, and the temperature of incubation employed, 20 degrees C. The sewage was mixed with the lake water in a glass cylinder by a specially devised stirring apparatus, to insure the least possible aeration. A portion of the same sewage was also filtered through a single layer of Swedish filter paper, which removed all suspended matter and pseudo colloids. The same dilutions were made as with crude sewage and the initial dissolved oxygen determined just as in the crude sewage mixtures. The same dilutions were also made on another portion of the sewage after the suspended matter had been allowed to settle for four hours. Citrate of magnesia bottles, with patent stoppers, obtainable at any drug store, have proven very efficient for these incubation experiments. They do not permit air to enter, as do some of the bottles provided with ground stoppers.

All the results obtained were calculated on the basis of preserving 30 per cent. residual oxygen after a 24-hour period of contact or flow. Besides this test, other tests were carried on, such as total solids, oxygen consumed, and organic nitrogen, in order to bring out the relation of the volatile organic carbonaceous and nitrogenous matter in solution and suspension to the calculated permissible dilution. As mentioned previously, the factor K in Phelps' formula has not been found to be independent of the dilution. Special experiments carried on with three different dilutions on the same sewage have clearly shown that K will decrease with a lower dilution, and the factor C, of course, will be found to be correspondingly higher. It was further found that the difference in K between the lower dilutions is greater than the difference between the two higher dilutions. As yet the results have not demonstrated a constant difference between C (the percentage of sewage) resulting from the various dilutions, consequently an exponent has not been introduced in the original formula. The highest C value has been used to compare results. Values of one and the same dilution only are given for a comparison of the permissible percentage of crude, settled and filtered sewages in Table I. On the whole, the differences in the factor K in the different dilutions have not been materially different, and are hardly large enough to interfere with the intelligent interpretation of the results (Table I). The striking feature of this table is the last column, indicating the ratio of dilution or the "per cent. permissible sewage" (C) of the filtered sewage, as compared to the raw and settled sewage. The remarkable result is still more apparent in Table II, which indicates the improvement in percentages.

Looking over the average of the nine experiments in Table II, we note, for instance, that on removal of 63 per cent. of the total suspended matter, or 54 per cent. of the suspended volatile matter, the actual improvement in the sewage from the standpoint of a prospective nuisance is but 31 per cent. Results similar to this have been obtained by C. B. Hoover. The sewages with the low suspended matter (experiments 1 and 9) have the low percentage improvement. One exception is found in experiment 2, with a high suspended matter and a low improvement from a dilution standpoint. Now, when we turn to the results obtained by filtration we will note in Table II that the removal of only 37 per cent. of suspended matter, or 46 per cent. volatile suspended matter additional to sedimentation has shown an improvement of 143 per cent. for dilution purposes, or nearly five times the improvement gained by merely settling the sewage. Similar is the case with the carbonaceous matter as expressed in "oxygen consumed." A reduction of 30 per cent. of "oxygen consumed" is equivalent to an improvement of 31 per cent. in dilution, while an additional removal of 16 per cent. in "oxygen consumed" gives an actual additional improvement of 112 per cent.

A thorough study of these two tables will clearly bring out the fact that the removal of suspended matter capable of settling in settling tanks constitutes an improvement from the dilution standpoint much less than the percentage of suspended matter removed. Since we have to consider the improvement of any sewage or effluent from the standpoint of the degree of dilution required rather than from the standpoint of the reduction of any chemical constituents (as shown by analysis), the improvement made by settling consists mainly in the improvement of the physical character of the liquid by the removal of material which may cause deposits, and incidentally some improvement in the stability. However, the removal of an additional small quantity of suspended matter not capable of settling, by simple filtration will improve the liquid far out of proportion to the percentage of volatile matter removed. This permits of only one conclusion: that is, on a domestic sewage from a large area the finely divided, slowly settling suspended matter and pseudo colloidal matter not capable of settling make up the greater part of the putrescibility, due to the suspended and colloidal matter. This fact has been recognized before. Spillner states that the organic sulphur compounds in sewages which afford the material for the development of hydrogen sulphide are found in much smaller quantity in the suspended matter capable of settling than in the dissolved colloidal and finely suspended matter which has been removed by filtration in these experiments.

In the present state of the science of sewage disposal we aim to destroy the finely suspended matters by oxidation. However, most of the sewage is discharged to-day either in a raw or settled state. If a device can be worked out to take care of the finely divided non-settling suspended matters without resorting to biologic treatment, a degree of purification may possibly be attained intermediate between settling and biological treatment, which in many cases may be sufficient to avoid the expense of the more thorough biological treatment.

In conclusion, the writer wishes to express his thanks to Prof. E. B. Phelps, of Boston, and to Mr. Langdon Pearse, engineer in charge of sewage disposal experiments in Chicago, for valuable suggestions, and, further, to Messrs. H. B. Hommon and F. Bachmann for their conscientious analytical work.

TABLE II.

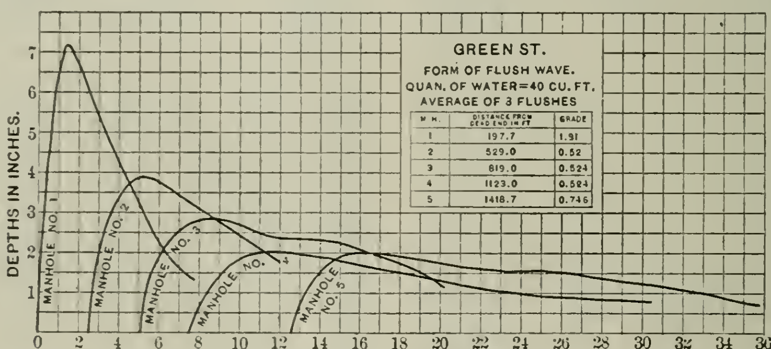
	Suspended Matter. Per Cent. Removed by Settling.		Additional per Cent. Removed by Filtration.		Per Cent. of Volatile Matter Left in Solution After.		Per Cent. Reduction of Oxygen Consumed.		Per Cent. Improvement in Permissible Sewage.	
Serial No.	Total.	Volatile.	Total.	Volatile.	Settling.	Filtration.	Settling.	Filtered.	Settling.	Filtered.
1	46	40	54	60	91	78	58	65	11	71
2	66	56	34	44	78	60	41	62	5	179
3	62	49	38	51	86	71	17	33	19	164
4	68	66	32	34	76	65	11	38	111	262
5	61	56	39	44	81	67	37	50	46	136
6	71	65	29	35	76	63	45	55	119	353
7	65	53	35	47	80	63	29	44	80	343
8	68	53	32	47	82	66	31	53	81	192
9	33	15	67	85	97	81	7	11	8	68
Average	63	54	37	46	82	68	30	46	31	143

Methods and Results of Sewer Flushing.

THE use of additional water at the times of low natural flow to aid in carrying off those materials which are deposited in the bottom of the sewers, due either to the low velocity or flat gradient of the sewer, has been practiced for a number of years. Few sewerage systems at the present time are constructed without the use of some flushing device at dead ends, or at those points along the line of the sewer where it is found necessary to reinforce the scouring action of the natural flow of the sewage upon the carrier. The action of this flushing device might be compared to the use of a booster engine to assist heavily-loaded trains over a steep grade; the grade in this case, however, being either the flatness of the sewer line or the frictional retardation of the pipe or channel.

Textbooks have stated a number of depth of water due to the flushing stream. In nearly every instance the observations were taken on a sufficient length of sewer to show a reduction in velocity to two feet a second, and in some cases to a greater distance. The effect of the flushing stream was stated to be valuable to distances varying from 1,300 to 2,500 feet with discharges of flushing water less than 500 gallons, and the distances increase to 3,500 feet for 12 to 18-inch sewers and 2,268 to 8,287 gallons discharge.

There is now under preparation a book on sewer flushing, prepared by Merritt & Co., Camden, N. J., which embodies a very clear explanation of the purpose of sewer flushing, some general data collected from various sources on the action of flushing water in sewers, as regards the amounts needed and the effective distance of its operation and its cost.



Results of Experiments on Green Street Sewer, Ithaca, N. Y. H. N. Ogden, Trans, A. S. C. E.

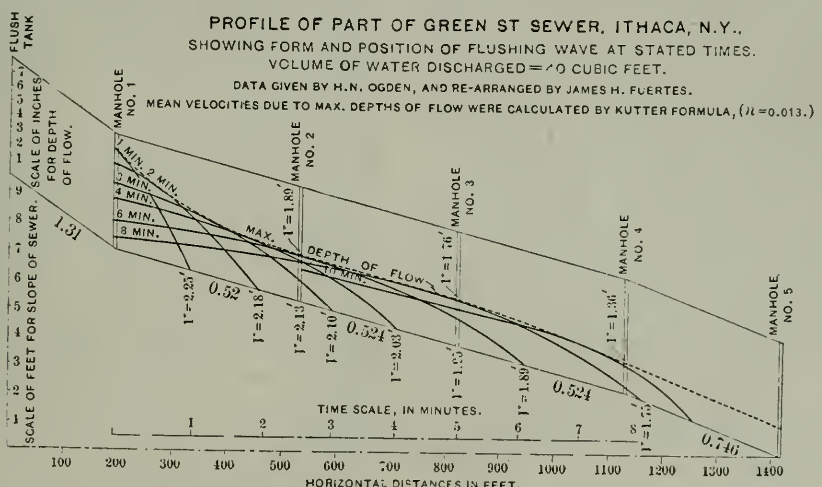
fixed rules, whereby the need for flush tanks may be established. Some further data have been furnished by articles contributed to the engineering press. These latter have been in the nature of observations made upon flush tanks under actual service conditions, and have been described at various times. The data obtained have been along the lines of the velocity and effective length of the wave produced by the action of different volumes of flushing water discharged into sewers laid on various gradients.

Among the first data of this nature which were published were a series of diagrams prepared by S. H. Adams, a London engineer, and reviewed in MUNICIPAL ENGINEERING, vol. xiii, page 170. These diagrams gave the length of sewer on which observations were taken, the velocities in feet per second, the depth of the ordinary flow of the sewage, and the

That portion of the book devoted to the amount of flushing water and the effectiveness of the flushing wave contains the results of experiments made in Ithaca, N. Y., and published in Transactions A. S. C. E., vol. xl, and the subsequent discussions. These experiments were made by H. N. Ogden, who in 1898 made inquiry among engineers of cities between 10,000 and 60,000 population, which had sanitary sewer systems, and presented the data obtained from his own experiments, together with the answers which he obtained in reply to his inquiries.

In reply to a question by Mr. Ogden regarding the relation between the minimum amount of water required for effective flushing and the grade of the sewer, there were only six answers received. Of these, two held that no difference should be made, three thought that less water could be used on the steeper grades and one who had studied the matter in relation to sewerage systems under his care stated that one flush daily on a 2 per cent. grade was as effective as two flushes daily on a 0.5 per cent. grade, the quantity of flushing water in each case being 300 gallons.

Mr. Ogden submitted a number of profiles showing the depths and computed velocities of the flush waves at varying distances from the point of admission of the flushing water, and also a graph showing the depth of the flush wave at various manholes where observations were made, with the time scale in minutes as the ordinate of the curves. These curves and profiles were further amplified by computations of J. H. Fuertes and Rudolph Hering.



In commenting on the Ithaca experiments, as described by Mr. Ogden, Mr. Hering says:

"The Ithaca data show how the velocity gradually decreases with the distance, and show the distances and depths of flow up to which the necessary cleansing velocity is maintained. They also show by figures how long such velocities continue. These velocities are not measured, but merely computed. They would, therefore, be somewhat different in practice, but how much is not yet known. As an example, when the flush wave is highest, a velocity of more than 2 feet per second is maintained for only one minute, and it extends less than 500 feet; when the water flows two-thirds this height, the velocity has continued for over fire minutes, and for this length of time it extends only about 400 feet; and when the water flows at one-third its greatest height, a velocity of over 2 feet per second has continued for about seven minutes, but for this length of time has extended only about 300 feet.

"This diagram clearly shows the well-known fact, that the greatest benefit from flushing is obtained by maintaining the cleansing velocity as long in time and as far in distance as possible. It is, therefore, desirable to determine for each case approximately the quantity of water needed to obtain a required and definite result in a sewer of a given size or slope, and the author's work materially facilitates this determination for the cases which he has covered."

Andrew Rosewater, formerly City Engineer of Omaha, Neb., made some experiments on 8 and 10-inch sewers, the results of which were given in MUNICIPAL ENGINEERING, volume xiv, p. 217. As shown by his observations, there is a marked acceleration in the velocity of the flushing water in 8-inch sewers laid on a gradient greater than 1.4 per cent., and that in sewers laid on a less steep gradient, opportunity is given for the latter portion of the flushing charge to catch up with the first portion, so that the sewer is more nearly filled. This does not, however, mean that a flushing charge of less quantity is recommended for a sewer laid on a steeper gradient, for though in the case of the more flat sewer, the latter portion of the discharge will reinforce that which has gone before, yet a greater quantity will be required in the case of the flat sewer to give the necessary velocity to carry along the heavier particles in the sewage.

The following points are given in the Merritt book to summarize the data which they give:

(1) Except on steep grades, the flushing water discharged into the sewer runs

full bore for only a comparatively short distance, practically the entire flushing effect being secured by the normal gravity flow of the combined sewage and flushing water.

(2) The greater the grade of the sewer, the less the volume of water to procure effective flushing of a given length of sewer.

Comparison of Cincinnati Pavements.

THE Bureau of Municipal Research of Cincinnati has issued a report dealing with the selection of pavements. This report, which was prepared by James E. Barlow, engineer of the bureau, gives a careful analysis of the paving question in Cincinnati and outlines a system of cost records and historical data which will prove of great value in determining the kinds of pavement to be adopted in the future. The portion of the report which deals with the question of economy in paving construction presents an exceptionally thorough discussion of the method of comparing paving materials as regards their ultimate cost.

In the following abstract of this portion of the report it should be remembered that the actual figures of the comparison in prices are influenced by the proximity of Cincinnati to the center of the paving brick industry, which makes brick pavement lower in first cost, and also that the limestone which is found in that locality is comparatively soft and traffic conditions are such that a longer life for the macadam pavements might be observed under different conditions. The method of arriving at the comparative economies, however, warrants only favorable criticism.

The most economical pavement is taken to be that which will show the lowest average cost per year during its entire life. This annual cost is defined as that amount of money which, if applied annually, will keep the street under consideration perpetually paved and repaired; and is compared to an annual rental such as would be required should a public service company construct and maintain the pavement and charge such a rental for its use. In such an event, however, an additional charge for profit for the corporation would be charged.

The average annual cost is composed of three principal factors:

1. Average annual cost of repairs.
2. Interest on the cost of the pavement.
3. Annual charge on account of sinking fund; i. e., a fund set aside and invested each year such that the pavement, when worn out, will have been completely paid for.

In order to apply this principle to the selection of a pavement for a given street, certain exact data are necessary, such as the durability and cost of repairs of each kind of pavement under various conditions, especially those of traffic. As a matter of fact, the information of this character which is available in most cities is meager and fragmentary, due to the long period necessary for such an extended investigation and the lack of continuity of records through changing administrations.

To determine the annual interest charge, the first cost of the various kinds of pavements must of course be known. A study of public records shows that the price per square yard in Cincinnati for the past four years for the various kinds of pavements has been approximately as follows:

Kind of Pavement.	Min.	Max.	Approx. Average
Granite	$3.25	$4.69	$3.70
Wood block.......	2.60	3.93	3.45
Bitulithic	2.14	3.22	2.65
Asphalt	1.81	2.62	2.30
Brick	1.86	2.50	2.25
Granitoid	1.54	2.50	2.10
Macadam	.66	1.30	.95
Bowlder	1.50	2.15	1.75

The above prices include: (a) Excavation equal to the total thickness of the pavement; (b) all consolidation of subgrade; (c) a six-inch concrete foundation, and (d) furnishing and laying the surfacing complete above the foundation. The macadam is 12 inches thick and has no concrete foundation; the bowlder likewise has no concrete foundation. Inasmuch as a good Portland cement concrete foundation should outwear several surfacings, it will be necessary for the determination of the replacement fund to separate the cost of the foundation from that of the surfacing. One dollar per square yard may be taken as a reasonable average price, including work and materials, for the concrete foundation; subtract this figure from the amounts above given and the difference will represent the average cost of the surfacings. Upon these costs the interest is calculated, the rate assumed being 4 per cent.

The average cost of repairs for individual pavements during their life is stated to be not available in Cincinnati. However, the gross amount of money expended annually for several years past on each kind of pavement is given. From this and such available records of the amount of each kind of pavement in use a figure is obtained for the average cost of local repairs per square yard per year, and summarized as follows:

Kind of Pavement.	Gross Expenditures for Repairs. 1908.	1909.	1910.	Average Cost Per sq. yd. Per Year
Asphalt	$ 62,994.00	$ 46,000.00	$ 48,271.44	$ .073
Granite	27,995.00	30,443.00	34,213.00	.026
Brick	14,005.00	22,797.00	10,016.00	.012
Bowlder	30,640.00	31,861.04	36,347.12	.033
Macadam	258,930.40	332,511.01	328,232.34	.076

The gross expenditures in the first three columns were taken from the annual reports of the street repair department. In order to determine the last column, the most recent United States Census Report was used as a basis for the amount of each kind of pavement in use. No allowance was made for streets under guarantee. Particular attention is called in the report to the high repair cost of macadam, especially as compared with brick.

The annual cost of repairs to a Portland cement concrete foundation is assumed to be negligible.

In determining the annual payment on account of the sinking fund, the two factors noted were the initial cost and the durability or length of life. For the latter the figure desired for each kind of surfacing represents the average length of life under the average conditions to which it has been subjected in Cincinnati. The figures given below are of necessity not exact, but are fair approximations.

Granite	25 years
Wood block	?
Bitulithic	?
Asphalt	15 years
Brick	15 years
Bowlder	25 years
Macadam	8 years

The life of the Portland cement concrete foundation is assumed to be fifty years.

With the foregoing data as a basis, the annual amount of money required for the sinking fund is readily calculated by the use of standard tables.

The following table gives a summary of the foregoing data, on the basis of which is worked out the continuous annual expense per square yard for keeping paved and repaired each different kind of pavement under its actual local conditions:

Underlying Data—	Granite.	Wood Blk.	Bit.	Asphalt.	Brick.	Bowlder.	Macad.
First cost of surfacing	$2.70	$2.45	$1.65	$1.30	$1.25	$1.75	$0.95
Assumed life	25 yrs.	?	?	15 yrs.	15 yrs.	25 yrs.	8 yrs.
Average Annual Cost of Surfacing—							
Interest at 4 per cent on cost of surfacing	0.108	0.098	0.066	0.052	0.050	0.07	0.038
Average annual cost of repairs	0.026	?	?	0.073	0.012	0.033	0.076
Annual charge for sinking fund	0.063	?	?	0.063	0.060	0.041	0.100
Oiling or watering	.....	.....	.....	.....	.....	.....	0.04
Total, surfacing	0.197			0.188	0.122	.....	.....
Average Annual Cost of Foundation	0.046	0.046	0.046	0.046	0.046	.....	.....
Total average annual cost per sq. yd.	0.243	?	?	0.234	0.168	0.144	0.254

From the application of this annual expense method it is seen that the respective costs of granite, asphalt and macadam, under the actual conditions under which each has been used in Cincinnati, are not far apart, while brick is considerably lower. Bowlder is disregarded, being considered obsolete for general use. Lack of data on life and repairs makes figures for wood block and bitulithic uncertain, the latter having been first laid only about ten years ago.

Perhaps the most significant facts brought out by the above table are the relatively high cost of macadam and the relatively low cost of brick, the macadam costing nearly 50 per cent. in excess of brick. In comparing the above annual costs, the fact must not be lost sight of that the different classes of pavement are not, on the average, subjected to the same traffic conditions; that is, macadam is used normally on streets of light traffic, and yet costs about the same as granite, which is used on the heaviest traffic streets. Hence, if the macadam were replaced with a more permanent pavement, its comparative costliness would be more marked than shown above.

The following table, which is taken from the last available report of the United States Bureau of the Census, gives a comparison of the various pavements in the principal cities of Ohio:

TOTAL PAVED AREA IN SQUARE YARDS—1907.

	Cincinnati.	Cleveland.	Toledo.	Columbus.
Stone Block	1,184,761	1,932,480	425,745	198,516
Wood Block	....	19,888	128,563	....
Brick	1,165,630	2,957,328	1,695,498	1,800,542
Asphalt or Asphalt Block	712,688	403,040	454,987	494,729
Bowlder	1,002,125	....	45,090	50,450
Macadam	4,032,525	24,324	255,552	145,150
Bituminous Macadam	....	13,728	34,933	2,151
Gravel	96,250	....	....	....
All others	137,375	....	....	....

The relative proportions of the several pavements used in each city are seen more readily from the following table:

PERCENTAGE OF EACH KIND OF PAVEMENT TO TOTAL PAVED AREA—1907.

	Cincinnati.	Cleveland.	Toledo.	Columbus.
Stone Block	14.2	36.4	14.0	7.4
Wood Block	....	0.4	4.2	....
Brick	14.0	55.1	55.8	67.0
Asphalt or Asphalt Block	8.6	7.5	15.0	18.4
Bowlder	12.0	....	1.5	1.8
Macadam	48.4	0.4	8.3	5.4
Bituminous Macadam	....	0.2	1.2	....
Gravel	1.1	....	....	....
All others	1.7	....	....	....

These area figures, it is stated, may not be strictly accurate, but they are the best records available. The table shows that Cincinnati has overwhelmingly favored macadam, one of the most expensive pavements, and has failed fully to utilize brick, one of the cheapest; while in the other cities the reverse is true.

In the larger cities of Ohio brick now constitutes from 80 per cent. to 90 per cent. of the total area paved annually, while in the smaller cities of the State it is practically the only pavement of a permanent nature used.

The local tendency in the use of pavements in the last few years is shown by the following tables:

PERCENTAGE OF EACH KIND OF PAVEMENT CONTRACTED FOR, 1908 TO AUGUST, 1911.

Granite	39.7 per cent.
Wood Block	24.7 per cent.
Bitulithic	3.2 per cent.
Asphalt	4 per cent.
Brick	14.5 per cent.
Granitoid	.... per cent.
Macadam	12.5 per cent.
Bowlder	1.4 per cent.

While recent paving work has included a smaller proportion of macadam than formerly, the use of expensive pavements is still observable. The statement is made that brick pavements should not be judged by most of those laid in Cincinnati, which are of poor quality.

EDITORIAL COMMENT

Engineering Publishing Company.—
Municipal Economy and Efficiency.

ENGINEERING PUBLISHING COMPANY.

It will be noted that this number of MUNICIPAL ENGINEERING is published by the Engineering Publishing Company. The change in publisher, while indicating a change in ownership, does not mean a complete change in management. The officers of the new company have all been connected for some time with the publication in the capacities of department heads, not having full authority in directing, of course, the policies of the publication. It is but fair to state that the officers of the new company now have full opportunity to put into execution plans that they have long cherished as department heads of the old company, which will make MUNICIPAL ENGINEERING a constantly improving source of authoritative information for its readers.

The magazine was started in 1890 under the title *Paving and Municipal Engineering*, by William Fortune, as a direct outgrowth of his work as secretary of the Indianapolis Commercial Club, with himself as editor, and William C. Bobbs, now the head of the Bobbs-Merrill Company, as business manager. The first three volumes, covering two and one-half years, were 9x12 inches in size and had a subscription price of $1.00 a year.

In January, 1893, the page was changed to the usual magazine size, the number of pages was largely increased, the subscription price was increased, and the title page first bore the name of Municipal Engineering Company as publisher. For nearly all of the time since that date, William Fortune has been the principal stockholder and manager of the business. Until 1901, he was also the editor. A department of "Letters for the People" was opened in the fourth volume, which was the forerunner of the present department, "From Workers in the Field." The "Question Department" was opened in July, 1895, with J. W. Howard, C. E., in charge, and was at first devoted to paving problems only. The present editor, Charles Carroll Brown, was put in charge of the department as regards other problems in July, 1896. Mr. Brown began "Editorial Comment" in August, 1896. Since 1901 he has been the editor-in-chief.

The development of the magazine has been no less rapid in the twentieth century than it was in the last decade of the nineteenth, and it has been necessary to increase the business department, first, by the addition of Russell Fortune, and then, of C. Stanley Sale, who have devoted themselves to the subscription and advertising departments, with ever-increasing duties in the management of the business, owing to the fact that the founder of the magazine has been drawn into other fields of work, which have demanded increasing attention from him.

The present time has seemed to be opportune for the transfer of the ownership of the property to those who are so intimately connected with its history, its progress, its purposes, its successes and its projects for the future. The result is that the Engineering Publishing Company has purchased the property of Municipal Engineering Company, and the magazine and the business connected with it will be conducted by a board of directors composed of Russell Fortune, as president; Charles Carroll Brown, as vice-president and treasurer, and C. Stanley Sale, as secretary and manager.

Although the past successes of the magazine have been marked and unusual in some respects, the new owners are confident of their ability to exceed those achievements. Both subscribers and advertisers will reap the benefit of the new enthusiasm which results from the greater responsibilities which they see before them.

Some of the improvements in contemplation will be ready for the new volume, which begins with the July number, and others will be announced in early numbers as they are finally developed through the careful consideration and discussion to which they are now subjected. The new organization takes this opportunity of expressing its appreciation of the good will and hearty support of the readers of MUNICIPAL ENGINEERING in the past, with full knowledge of the value of such support in promoting the growth of the publication, and to assure its patrons that its one great purpose is to make and publish the best and most reliable publication of its kind in the world.

MUNICIPAL ECONOMY AND EFFICIENCY.

The New York Bureau of Municipal Research, an organization supported by private funds, has been in operation about seven years. The Chicago Bureau of Public Efficiency, also supported by private subscriptions, was established with the aid of men trained by the New York Bureau. St. Louis has recently established such a bureau. Cincinnati, Philadelphia, Memphis and other cities have more or less permanent and efficient organizations of the same sort. Milwaukee is unique in having a Bureau of Economy and Efficiency, which has been supported by appropriations of various sorts made by the city government or by city departments. Prof. John R. Commons, one of its directors, has written a report of its first eighteen months' work, which is published in its Bulletin No. 19.

From all these efforts to increase the efficiency of our municipal governments one could, by careful study, make a fairly definite statement of the difficulties in the way, first, of showing clearly and without bias the existing inefficiencies and the reasons therefor; second, of securing full and consistent records of the operations of departments; third, of making plans for extracting the maximum of efficiency out of the departments; fourth, of securing laws modifying the organization of departments or of whole systems in case the maximum of efficiency cannot be attained under existing laws; fifth, of sustaining the bureau of efficiency permanently as perhaps the only method of keeping municipal officials up to the full performance of their duties, whether they have long or short tenure of office.

All of these difficulties are in the way of the utmost efficiency of the Bureau of Economy and Efficiency itself and some bureaus have failed entirely or are leading a more or less sedentary life as a consequence of finding one or more of these difficulties at least temporarily insurmountable. Thus one city finds it difficult to secure subscriptions enough to keep the bureau active, another finds its workers efficient in detail, but without the breadth of view necessary to produce the best results possible, another cannot find the expert guidance necessary, another finds a prejudice against criticism from outside sources which prevents the employment of experts from other cities and reduces the work of the bureau to a rather inefficient attention to minor matters, and the only bureau supported by city funds found it necessary to secure those funds in many different ways and to eke them out by all sorts of combinations with other organizations and with state officials and employes, that the expenditures might come within the meager funds available and at the same time secure valuable results. It will undoubtedly be difficult to maintain continuity under such conditions, especially in view of frequent changes in administrations and of the effect of political conditions upon the city council, which is the appropriating power.

Some of these difficulties are fairly well stated in Professor Commons's report, others are hinted and others remain to be inferred.

Thus far no bureau in any city has had time, force or opportunity to put into operation any complete system in any department. There are differences in character and efficiency of work, but the Milwaukee bureau may be considered as in some ways typical of those in operation, although it has the advantages and some of the disadvantages pertinent to its municipal support.

The first estimates of probable cost of the bureau were some $50,000 a year, but the work was started with an appropriation of $5,000, followed later by appropriations of about $10,500 for special use in the water and health departments, $18,000 for the general work of the bureau in 1911 and $12,000 for its work in 1912.

The water department appropriations were expended in making a survey of water waste and electrolysis, which will be of value in devising methods of preventing the 23 per cent. of waste which is estimated from the results of the study of a small section of the city; and in reorganizing the business department, under the advice and approval of the State Public Service Commission, and installing a system of water accounts which was one of the results of this reorganization. No definite estimate of the financial results of this work can be made until the work indicated to be necessary has been undertaken and carried forward for some time, but the saving to the city in cash can easily amount to tens of thousands of dollars a year, and the quality and efficiency of the service is already improved greatly.

The investigation of the refuse incinerator, an abstract of the report upon which has already been published in Municipal Engineering, resulted in an improvement in the collection service and a saving of $10,000 a year, and the installation of some new machinery in the plant will increase materially the profits which may be derived from its operation.

The investigation of the bureau of sewers has resulted in a new system of operation by which better work is possible and the cost of operation can be definitely ascertained in such manner that economies can be instituted in the future. The lack of cost data in the past makes it difficult to make an estimate of the saving in this department. The same is true of the street sprinkling, flushing and oiling, sidewalk repair and street construction departments.

The new system in house drain and plumbing inspection has already shown a saving of $6,000 a year, and a consolidation of the construction and maintenance of the police and fire alarm telegraphs has saved $5,620 a year.

Seven other departments have been put under investigation and are developing improved systems of operation and record which will show similar savings if carried through.

Not all of the investigations have resulted in savings. The first intention seems to have been to improve the efficiency of a department by improving the service, and in nearly every case this has resulted in a decrease in expense or an increase in revenue as an accompaniment to the better service. In the health department, however, there has been a material increase in expense. The social survey of the city showed that many things were necessary to the sanitary welfare of the city which had heretofore been neglected. The work in prevention of tuberculosis, and in caring for children, in controlling contagious diseases, in sanitary inspections and abatement of nuisances requires much increase in force and expense, aggregating about $33,000.

The net result so far seems to be a promise of increased efficiency in all departments investigated and a net saving to the city which can be increased by further study and application of the same principles used in the work so far done.

The bureau recognizes its temporary character, there being no assurance, under the change of administration which has just taken place, that it will be continued when its appropriation for the current year is expended. The report therefore makes suggestions of methods of securing a measure of permanence in the work it is doing and of continuing it in the line of keeping the departments up to the standards of efficiency which have been set and of elevating them.

The idea underlying the suggestions made seems to be to keep the bureau as nearly independent of the municipal government as possible. Thus the Municipal Reference Department, which can do much in the way of investigation and comparison with other cities and in preparation and recommendation of ordinances and plans of operation, has been transferred to the public library control, its office in the city hall being operated as a branch library. This department can serve as the custodian of records and can publish the results in bulletins for general circulation.

Another suggestion is that one of the state bureaus, the Railroad or the State Tax Commission, take charge of the work. The Railroad Commission already has control over the accounting and some supervision over the operation of the water works as a public utility. If the city asks and pays the expenses the State Tax Commission can take similar charge of all the other city departments. Their supervision, under present laws, is limited to audit and inspection of work already done and does not include investigation and formulation of plans for improvement of methods.

The uncertainty regarding the action of city bureaus of efficiency is suggested by the statement that the New York Department of Commissioners of Accounts, which is responsible only to the mayor, was a handicap to civic progress until it was reorganized in 1909, since which time it has taken over much of the work of the private Bureau of Municipal Research. That it should be reorganized depended entirely upon the mayor, and that it was reorganized doubtless depended to a large extent upon the fact that the Bureau of Municipal Research was doing much work which the department should properly have done upon its own initiative or that of the mayor. There seems to be no safeguard against a relapse in case a future mayor does not desire to continue the work and the private bureau ceases its efforts to keep municipal officials up to proper standards of efficiency. The suggestion in the report that the Bureau of Economy and Efficiency be continued under the direct control of the mayor, presumably as to funds to pay its expenses as well as to work to be done, is coupled with the suggestion of a citizens' organization, supported by private subscriptions, to act as an independent critic of the bureau and of the departments which it is supposed to keep track of.

A brief reference to the City Service Commission which has been established recently points toward a possible combination which would be to some extent, and might be made almost wholly, independent of local political conditions.

The permanency of these movements is by no means assured as yet. Their real necessity is evident and the number of efficient workers is rapidly increasing. These are important factors, and the mass of data is increasing rapidly, so that something worth while will be evolved before long.

THE QUESTION DEPARTMENT

Indexes to Articles in Municipal Engineering.

The following lists of articles in MUNICIPAL ENGINEERING have appeared in vol. xlii:

Garbage and Refuse Collection and Disposal, p. 252.

Records in a City Engineer's Office, p. 253.

Water Purification in this number.

Construction and Operation of Septic Tanks and Other Sewage Disposal Plants, in this number.

Cost of Engineering and Fees for Municipal Engineering Service, in this number.

Cost of Construction and Operation of Sewage Disposal Plant.

I am interested in knowing the construction cost of a plant to treat 1,500,000 gallons of sewage per day. Would you please inform me through your columns the cost of construction of some works of that capacity, and what is the average annual cost of operating expenses per million gallons. Our sewage will not have to be pumped.

City Engineer, ———, Vt.

This question is not definite enough to receive a direct answer. If a simple sedimentation of the sewage is sufficient purification, the necessary tanks of the capacity named can be built for $1,500 to $3,000, according to local necessities and conditions as to excavation or embankment, thickness of walls, roof or building over tanks, etc. If septic tank action is sufficient the cost will be somewhat increased, according to system adopted, royalties to be paid, etc., and may easily be doubled or even more. If filtration is required, the first cost will be again doubled. Cost of operation increases still more rapidly, that of the sedimentation tank tank amounting to a few dollars for removal of sediment once or twice a year, and that of the last requiring much of one man's time with occasional assistance from laborers.

Some information can be derived from the following articles in recent volumes of MUNICIPAL ENGINEERING, those regarding the smaller cities being of direct interest in the study of the problem in the city from which the inquiry comes:

In vol. xlii: "Present European Practice in Sewage Purification," p. 9; "Chemicals in Septic Tanks," p. 39; "Tannery Wastes in Sewage, p. 78; "Information About Imhoff Tanks," p. 191; "Sewage Sludge Disposal," p. 227; "Residential Sewage Disposal Plants," p. 229; "Sewage Disposal and Pumping Plants," p. 307; "The Russell Sewage Disposal System," p. 347; "Governor Wilson Vetoes Bill Against Sewage Disposal Plant," p. 403.

In vol. xli: "Disposal of Sewage and Refuse," p. 289; "A Rotary Sieve for Sewage," p. 275; "Electrolytic Treatment of Sewage at Oklahoma City," p. 460; "Sewage Disposal with Respect to Offensive Odors," pp. 27, 116, 192; "Small Sewage Disposal Plant," p. 373; "Sewage Disposal in Bowling Green," p. 149; "Disposal of Single House Sewage, p. 42; "Disintegrator for Sewage Solids," p. 373; "Who Supplies Chloride of Lime for Sewage Treatment," p. 48; "Methylene B ue Sewage Tests," p. 373; "Electrolytic Sewage Treatment Plant at Santa Monica, Cal.," p. 229.

In vol. xl: "Patents on Septic Tank," p. 218; "Sewage Disposal and Pumping Plants," p. 264; "Modern Sewage Disposal," p. 181; "Sewage Disposal Plans of Atlanta, Ga.," p. 1; "Sewage Disposal with Respect to Offensive Odors," p. 395; "Sewage Plant at LaGrange, Ill.," p. 226; "Centrifugal Machine for the Drying of Sewage Sludge," p. 62; "Purification of Brewery Refuse," p. 433; Review of Maxwell and Brown's "Encyclopedia of Municipal and Sanitary Engineering," p. 365; "The Electrolytic Sewage Treatment Plant at Santa Monica, Cal," p. 229.

In vol. xxxix: "Sewage Purification by Irrigation," p. 38; "Covers for Septic Tanks," p. 39; "Effect of Sewage and Sewage Gases on Portland Cement Concrete," p. 41; "Wish to Utilize Denver Sewage," p. 54; "Purification of Dye Water," p. 88; "Use of Sewage for Irrigation at Fresno, Cal.," p. 117; Review of Raynes's "Domestic Sanitary Engineering and Plumbing," p. 148; Review of Moore and Silcock's "Sanitary Engineering," p. 229; "Cameron Septic Tank Patents," p. 238; "Books on Sewage and Sewage Disposal," pp. 291, 391; "Treatment of Brewery Wastes," p. 292; "The Present Use of the Septic Tank," p. 349; "Books and Patents on the Septic Tank," p. 390; "Eastern Installation of Septic Tanks and Contact Beds," p. 470; "Prevention of Odor From Septic Tank Effluent," p. 470.

In vol. xxxviii: "Cost of Septic Tank," p. 40; "The Character of Stream Pollution as Affecting by Purification Plant Design," p. 99; "New British Sewage Disposal Works," p. 177; "Information About Cameron Patents on Sewage Purification Processes," p. 192; "Sewage Purification for the City of Dresden, Germany," p. 248; "Sewage Purification and Stream Pollution in Ohio," p. 275; "Sewage Purification for New York City," p. 276; "Information About Sewage Disposal," p. 346; "Effect of Sewage and Sewage Gases on Concrete," p. 390.

In vol. xxxvii: "The Sludge Disposal Problem in Sewage Purification," p. 19; "Methods of Disposing of Sewage Sludge," p. 40; "Status of Sewage Disposal in America," p. 80; "Agriculture on a Sewage Filter," p. 105; "Effect of Sewage Pollution on Stream, Cost of Disposal Plant," p. 106; "Sewage Disposal Plants and Stream Pollution," p. 119; "The Cesspool and Its Dangers," p. 240; "Information About the Septic Tank," p. 253; "Books on Sewage Disposal," p. 253; "Report on Sewage Disposal for Trenton, N. J.," p. 267; Review of Dunbar's "Principles of Sewage Treatment," p. 269; Review of Gerhard's "Sanitation of Public Buildings," p. 270; Review of Scoble's "Land Treatment of Sewage," p. 270; Review of Starbuck's "Modern Plumbing Illustrated," p. 340; "Disinfection of Sewage and Sewage Effluents," p. 365; "Sewage Purification in Washington," p. 410.

In vol. xxxvi: "Information About Septic Tanks and Well Boring," p. 110; Review of Venable's "Methods and Devices for Bacterial Treatment of Sewage," p. 123; "Sewage Purification by Sedimentation," p. 173; "Best Method of Purifying Sewage," p. 238; "Information About Septic Tanks and Sedimentation of Sewage," p. 241; "Patents on Septic Tanks," p. 243; "Condemnation of Public Property for Sewage Disposal Plant," p. 252; "Growth of the Sewage Disposal Idea," p. 290; "Proposed Sewage Purification Process in Orange, N. J.," p. 325; "Methods of Sewage Disposal," p. 362.

In vol. xxxv: "Electric Purification of Sewage," p. 40; Review of Merriman's "Elements of Sanitary Engineering," p. 48; "House Sewage Disposal," p. 116; "Sewage Disposal in Columbus, O.," p. 211; "Methods of Sewage Disposal," p. 240; "State Control of Sewage Disposal," p. 242; "How to Build Residential Sewage Disposal Plant," p. 244; "Books on Sewage Disposal," p. 245; "Septic Tank Patents," p. 288; "The Septic Tank Patent Litigation," p. 311; "Residential Septic Tanks," p. 316; "Purification of Chicago's Sewage Recomended," p. 324; Review of Barwise's "The Purification of Sewage," p. 325.

In vol. xxxiv: "Septic Tank for Creamery Waste," p. 30; "Regulation of Stream Pollution and Water Purification," p. 92; "Septic Tank Patents Sustained," p. 94; "State Control of Sewerage and Water Supply in Pennsylvania," p. 106; "Patents on Sewage Purification Process Sustained," p. 107; Review of Vernon-Harcourt's "Sanitary Engineering with Respect to Water Supply and Sewage Disposal," p. 108; "The Law Regarding the Pollution of Streams," p. 228; "Residential Septic Tanks," p. 230; "Storage Time of Sewage in Septic Tank," p. 236; "Efficiency of Sewage Disposal Plants in New York City," p. 242; "State and National Control of Stream Pollution," p. 243; "The Septic Tank Patent Question," p. 303; "A Strong Sanitary Law," p. 354.

In vol. xxxiii: "State Sewerage Board Advocated for Ohio," p. 44; "Effect of Chicago Sewage on Mississippi River," p. 44; "Some Relations of Stream Pollution and Water Purification," pp, 151, 231; "Sewage Disposal by Biological Process," p. 173; "Books for Engineers," p. 175; "Books on Sewage Disposal," p. 249; "Sewage Disposal for Rural Residences and Villages," p. 249; "Books on Septic Tank," "Sewer Cleaning Machinery," p. 249; "New Jersey Municipalities Move Slowly in Matter of Stream Pollution," p. 261; "For and Against Chicago Drainage Board Plans," p. 262; "Rochester Proposes to Discharge Sewage Into Lake Ontario," p. 262; "Progress in Sewage Disposal," p. 312; "Sewage Disposal Plant at Kew Beach, Toronto, Ont.," p. 315; "Septic Tank Construction," p. 339; "Sewage Disposal for Institutions and Small Communities," p. 379.

In vol. xxxii: "Septic Tank for Chautauqua Grounds," p. 17; "Explosion of Saratoga Septic Tank," p. 42; "Cities Using Septic Tanks," p. 95; "Mt. Vernon, N. Y., Must Install Sewage Purification Plant," p. 193; "The Septic Tank Suit," p. 268; "Small Septic Tank and Filter," p. 395.

In vol. xxxi: "Disposal of Creamery Waste," p. 20; "Septic Treatment of Sewage," p. 20; "Sewage Purification Recommended for Baltimore," p. 47; "The Sewage Disposal Plant at Downers Grove, Ill.," p. 48; "The Origin of the Septic Tank," p. 178; "Disposal of Dye and Wool Finishing Waste," p. 204; "Report on Sewage Disposal for Paterson, N. J.," p. 211; "The Sewerage of Baltimore," p. 260; "Articles on Septic Tanks and Sewage Filters," with long list of previous articles, p. 280; "Sewage Disposal," p. 439; "Advance in Sewage Purification," p. 439; "Legislation Regarding Stream Pollution," p. 444; "Report on Sewage Disposal for Toronto," p. 454; "Books on Design of Septic Tanks," p. 454.

In vol. xxx: "The Tankage of Sewage," p. 36;; "Information About Septic Tank," p. 206; "Septic Tanks for Regina, Canada," p. 214; "Sewage and Dye Waste Disposal," p. 276; "Sewage Disposal in Septic Tanks," p. 350; Review of Baker's "Sewerage and Sewage Purification," p. 378.

The books mentioned in the above list as having been reviewed are the latest on the subject and nearly all of the valuable books are included in the list.

Who Can Prevent Pollution of Ohio River By City Sewage?

The city of Henderson, Ky., is considering the adoption of some plan for a system of sewers; but, while the town lies on the Ohio river, its topography is such that it is impracticable to carry the sewage directly into the river by gravity, without a prohibitive expense.

This being the case, the common council has been considering the alternative of pumping the sewage into the river, or else putting in some system of treatment and discharging it into a creek where most of it is now discharged.

In this connection, I wish to ask you a few questions.

What legislation has been adopted, or is being contemplated, if any, by the state of Indiana in regard to the discharge of sewage into the Ohio river?

What legislation, if any, has been adopted, or is being contemplated, by the states of Ohio and Illinois in regard to the discharge of sewage into that river?

If no such legislation has been adopted, or is being contemplated, by any of the states named, what time will elapse, in your judgment, before some such legislation is adopted?

R. W. Ball, City Engineer,
Henderson, Ky.

The states of Ohio and Indiana have made careful determinations of the pollution of the Ohio river by their own cities, and, with Illinois, have been considering the question of limiting this pollution. No state can pass a law which will be binding on any other state, and joint action of all the states interested has been assumed to be necessary before the pollution of the Ohio can be completely regulated. The states opposite Kentucky are in a peculiar situation, because the boundary of the state of Kentucky is at low water on the north side of the river and the states of Ohio, Indiana and Illinois front on the river, but have no rights of control in it below low water mark.

Careful search has revealed no way in which the states on the north side of the river can exercise any control over pollution of the river outside their own boundaries. The possibility that Kentucky could control the pollution of the river by the other states mentioned, on account of its jurisdiction over the whole of the stream at low water, does not seem to have arisen as yet. Perhaps Kentucky holds the key to the situation.

Leaky Sewer Joints.

A sewer system has been recently finished at this place and no house conections made therewith. From the outfall there is pouring a quantity of ground water. The 10-inch pipe was running about half full after a recent rainy season. During the construction of this system the joints were not packed with oakum but only cemented. Is this defect sufficient to cause much trouble? Should not the joints have been calked up sufficiently well to have kept out almost all of the ground water?

M., ———, S. C.

If the outlet pipe was not designed to carry a proportion of leakage, the amount reported would be objectionable ultimately, if not at present. It is quite common in a separate sewer for house sewage only, to make an allowance for ground water or other water from outside sources.

Really this is a matter of relative expense of construction. In ordinary ground, where there is little danger of leakage into the sewer, there being little or no ground water, a slight increase in size of pipe, or in estimate of depth of flow in the pipe, will make little or no difference in the cost of the sewer, and will keep the design within safe and economical limits. It will be true, also, that at the beginning the amount of sewage will be small, and the amount of leakage will be maximum, and the leakage will diminish from the gradual closing up of such small seepages of water through porous cement joints by the deposit of fine material from the surrounding earth. Thus the leakage will diminish as the amount of sewage increases and the sewer will probably not be overcharged at any time.

If the sewer is laid in ground which is permanently wet or in gravel or porous soil subject to great variations in amount of ground water, either the allowance for ground water must be large and permanent, thus increasing the size and cost of the sewer or special means must be used to make the sewer joints water tight. If the sewer discharges into a stream unpurified, estimates of the increase in cost of the sewer on account of the use of larger pipe and on account of making the joints water tight may be compared and the cheaper method may be chosen. If the sewage must be purified before discharge, the cost of purifying the sewage alone should be compared with the cost of purifying the larger quantity of sewage diluted with the ground water leakage and the capitalization of this difference in cost applied. This will probably show an increase in the cost of disposal of the diluted sewage over the undiluted and may turn the scale in favor of making the joints water tight and thus keeping the size of the pipes down to their capacity for house sewage only.

The decision, especially if the sewage is not to be purified, may be modified by the character of the material in which the pipes are laid. If this is coarse gravel with ground water supplied from an ample source, the joints will not have much opportunity to silt up and the leakage will continue indefinitely. In other cases the leakage will diminish more or less rapidly toward a minimum which may or may not become zero.

Information on all the points covered must be given before a decision can be made as to the effect of the leakage, and there must be further information regarding the terms of the contract before responsibility for objectionable leakage can be placed.

Information about methods of making water-tight joints can be obtained from practically every volume of Municipal Engineering and from the makers of materials therefor listed in the "Business Directory" published in each number of Municipal Engineering under the headings "Jointite," "Sewer Joint Compound."

Where to Get Molds for Concrete Pipe.

I am a member of council. Our borough wishes to convey underground a small creek or running stream of water that now flows in an open flume or ditch. The size of pipe required would be 36 or 48 inches. I myself am much interested in the project, and since we do not have the benefit of any municipal engineer, and myself having been connected with concrete construction, the town council looks upon me to formulate a plan whereby this project might be carried out.

The amount of pipe required would be about 500 feet, yet our funds available would permit us to lay only a small part each year until completed, as we could not raise any money by bond issue, since we already are bonded to the limit. I consequently think it would be better for us to purchase our own concrete pipe molds and make and place such pipe as our finances would permit each year until same was completed.

I wish to know where such molds can be purchased. I know of several concerns which control large reinforced concrete pipe molds, but do not sell molds, but contract pipe made on the job. This, you will see, would not fit our case, as we would not be financially able to handle any large part at one time, but, having molds, we could make and place as our means warrant.

M., ———, Pa.

The pipe line can be of reinforced or of plain concrete. In the former case the pipes can be made in lengths outside the trench and laid after they are cured. This could hardly be done with plain concrete with pipes of the sizes named. In either case the pipe could be made in place in the trench, over forms, provided the flowing water could be kept away from the concrete until it was fully set. The drain can also be made of concrete blocks made in molds and set over forms, using cement mortar for making joints. Reinforcement can be used with the blocks, if desired. In any case it is advisable to employ an engineer to make a plan for the work, deciding which method will be best under the circumstances, fixing the size of drain, the details of construction, etc. There is considerable difference in the cost of 36 and 48-inch drain, and an engineer may easily save his fee by his recommendations based on accurate knowledge. Names of competent engineers in the vicinity of the borough will be found in the "Business Directory" published in each number of Municipal Engineering, under the headings, "Civil Engineers," "Consulting Engineers." Makers of molds for pipe lengths, for monolithic, plain or reinforced concrete drains and sewers, and for blocks will be found under the headings, "Concrete Block Machines," "Concrete Shaping Tools," "Conduits," "Contractors' Tools and Machinery," "Culvert Pipe," three headings, "Drain Tile," "Hollow Building Blocks," "Sewer Machines," "Sewer Pipe," "Sewer Pipe Molds," "Trench Machinery," "Water Tank Molds."

Remedy for Scaling of Concrete Curb.

We have had some trouble here with our concrete curb. The plaster is cracking and in some places has fallen off. There seems to be no bond between the plaster and the concrete. Do you know of any way to replaster the old curb with a wearing course that would stick? The curb was put in last summer.

P., Borough Engineer, ———, Pa.

What can our readers recommend? The difficulty seems to be one of construction, such that the contractor, if the work was done by contract, should be held responsible and should be required to replace the curb entirely. There is no reason why a competent contractor should not be able to construct the curb so that there is complete bond of the body of the curb with the outer facing. If there has been failure to make this bond, it is almost or quite as cheap to tear the curb out and start new as to attempt to put a plaster on the outside of the curb and make it stick.

The use of the word "plaster" in the question in connection with the outer surface is an indication of a wrong idea regarding this outer surface. It is by no means a plaster, and should never be treated or applied as such, but it must be made an integral part of the curb, although it may be somewhat richer in cement than the body of the curb.

Street Cleaning, Garbage and Refuse Collection and Disposal.

Our city council is contemplating garbage disposal and would like names of firms or companies handling or manufacturing apparatus for street cleaning, transfer and disposal of refuse and garbage.

P., City Engineer, ———, Kans.

Names of such persons will be found in the "Business Directory" published in each number of Municipal Engineering, under the headings Dump Cars, Dump Carts, Dump Wagons, Garbage Disposal Plants, Incinerators, Refuse Destructors, Sweepers.

Private Collection and Disposal of Waste and Disinfection of Premises.

I wish to get some information through advertisements or otherwise concerning the modern methods of disposing of waste paper, rags, and such dry refuse as accumulates around offices and residences.

It appears that a systematic cleaning and disinfection of private premises by a concern organized for the purpose and prepared to do such work scientifically might form a basis for profitable business in spite of city health department. If you can refer me to a source of information along this line I will appreciate it.

J. M. H., Waco, Tex.

In the list of articles on garbage and refuse collection given on p. 252 of the April number of Municipal Engineering will be found a number of articles of direct application to such a case as that mentioned, so far as collection and disposal of the waste is concerned. If there can be complete separation of the household waste, so that the dry refuse mentioned can be collected without contamination by decomposing liquids or wet solids, there will probably be some profit over the cost of collection, sorting, selling and destruction of unsalable refuse.

Whether the private cleaning and disinfection of premises would be profitable would depend upon the local conditions. Ordinarily it is difficult enough to enforce the public performance of such duties without cost to the citizen, and collection of any assessment of cost can be made only by force of strong laws rigidly enforced. The town whose citizens would voluntarily pay such expense is indeed fortunate in the high quality of its citizenship.

Articles on Water Purification.

Would be pleased to have references to articles showing the advantages of mechanical filtration plants.

R. P. C., Columbus, Ind.

The best way to judge of the relative value of the various methods of filtration is to compare the operation of plants constructed according to their principles. The following articles in recent numbers of MUNICIPAL ENGINEERING give the descriptions of plants and other information and discussion of principles and practice. The books referred to are also excellent sources of information.

In vol. xlii: "The Chloride Process for Water Purification," p. 159; "Water Supplies, 1911-1912," p. 312; "The Value of Pure Water," p. 374; "The Cost of Water Filtration," p. 408; "Municipal Water Plant at McKeesport, Pa.," p. 410.

In vol. xli: "Municipal Water Purification Plant, Grand Rapids, Mich.," (rapid mechanical) p. 429; "The Water Filtration Plant at Toronto, Ont.," p. 445.

In vol. xl: "Chemical Clarification of Water," pp. 217, 433; "A New Reisert Water Filtration Plant," (rapid) p. 305.

In vol. xxxix: "A Machine for Washing Filter Sand," p. 66; "Water Purification by Ozone," p. 103; "Machinery for Ozonizing Water," p. 115; "The Sterilization of Water," p. 222; "Mechanical and Slow Sand Filtration of Water," making some comparison of the two systems bearing these names, p. 289; "Cities Using Hypochlorite in Water Purification," p. 387; "Chattanooga Water Works Report," p. 396.

In vol. xxxviii: Reviews of annual reports of Reading, Pa., and New Orleans, La., water departments, p. 56; "Proposed Improvements of Water Supply of Washington, D. C.," p. 57; "The Character of Stream Pollution as Affecting Purification Plant Design," p. 99; "Filtering Intake for Water Supply From River," pp. 112, 197; "Water Supply and Treatment for Power Plant Purposes," p. 160; "Cost of Filter and Standpipe," p. 264; "Experience With and Results From Municipal Water Softening," p. 383.

In vol. xxxvii: "The Sterilization Plant of the Jersey City Water Supply Company," p. 6; "A Biological Process of Clarifying Water," p. 23; Report of Convention of Am. Water Works Association, p. 53; "Plant and Process of Sterilization of Boonton Reservoir Water, Jersey City Water Supply," p. 86; "Water Softening or Purification and Its Saving," p. 92; "Water Sterilization at Boonton, N. J.," p. 158; "The New Water Filtration Plant for Toledo, O.," (rapid mechanical) p. 245; "Water Works, Water Supply and Filtration," p. 257; "Valuable Data Regarding Water Supplies," pp. 258, 330, which notes mechanical filtration at Birmingham, Ala., Macon, Ga., Anderson, Ind., Muncie, Ind., Bangor, Me., Binghamton, N. Y., Charlotte, N. C., Wilmington, N. C., McKeesport, Pa., Columbia, S. C., Norfolk, Va., and Petersburg, Va, slow sand filtration at Indianapolis, Ind., and Superior, Wis., infiltration wells or galleries at Springfield, Ill., and Ft. Wayne, Ind.; "Concrete in Water Works Construction," p. 387; "The Water Supply of McKeesport, Pa., p. 402.

In vol. xxxvi: Review of Turneaure and Russell's "Public Water Supplies," p. 52; "Information About Water Filtration," giving a list of earlier articles and books on the subject, p. 108; "The Water Filtration Plant at Ashtabula, O.," (rapid). p. 284; "Information About Sand and Mechanical Filters for Water," a list of previous articles, p. 315; "New Jersey Cities Can Erect Water Purifying Plants," p. 325.

In vol. xxxv: "Pennsylvania Water Companies Must Furnish Pure Water," p. 46; "The Collection of Water by Galleries at the Richmond, Ind., Water Works," p. 86; "The Public and Private Water Supplies of Indianapolis," p. 167; "Water Filtration and Meters in Washington," p. 190; "Method of Using Copper Sulphate in Reservoir," p. 249; "Cost of Operating Sand Filters," p. 252; Review of report of Reading, Pa., Water Commission, p. 258; Review of report of city engineer of Providence, R. I., p. 260; Review of report of Dover, N. H., water commissioner, p. 326; "Importance of the Proper Operation of Water Purification Plants," p. 352; "Litigation Over Patents on Negative Head Apparatus in Water Filtration Plants," p. 393.

In vol. xxxiv: Review of report of city engineer of Providence, R. I., p. 43; Review of Christie's "Boiler Waters, Scale, Corrosion, Foaming," p. 111; "The Collapse of the Lawrence, Mass., Filter Roof During Construction," p. 138; "Purification of Water Supply at Lawrence, Mass.," p. 209; "The Removal of High Turbidity from Water Without the Use of Coagulants," p. 240; "Pollution of Mohawk River is Serious," p. 242; "The Copenhagen Water Supply," p. 349; "Aeration of Water Supply," p. 364.

In vol. xxxiii: "Success of Washington Filtration Plant," p. 46; "Books for Engineers," pp. 96, 175; "Results of Filtration Experiments and Water Waste in Washington," p. 112; "Progress on Philadelphia Filtration Plant," p. 114; "Some Relations of Stream Pollution and Water Purification," pp. 151, 231; "The Water Filtration Plant of Harrisburg, Pa.," p. 155; "The Water Purification Plant of Harrisburg, Pa.," p. 221.

In vol. xxxii: "Proposed Improvements in Brooklyn's Water Supply," p. 99; "Decision on Philadelphia Filtration Contract Suits," p. 184; "Necessity for Filtration of Water Supplies," p. 400.

In vol. xxxi: "Work on Toledo Filter Conduit to Proceed," p. 29; "A New Slow

Sand Filter for Lawrence, Mass.," p. 92; "Needs of Washington's Water Supply System," p. 228; "On the Prevention of the Growth of Algae in Water Supplies," p. 291; "Books on Filtration and Analysis of Water," p. 397; "The New Orleans Water Works," (rapid sand filtration) p. 428; "Copper Sulphate Results," p. 467.

In vol. xxx: "Toledo's Water Purification Contract Enjoined," p. 300; "Filter for Small Reservoir," p. 349.

Indexes for Water Consumers' Accounts.

Please state what is the usual manner and what do you recommend for indexing accounts for reference from your rated water register? For instance, a consumer will come in and give his name and street number, but does not know his service number. How will you quickly locate him on the register? J. C. C., ——, Wash.

The card system of applications for water service should be used as a part of the water record system. The application card is in two parts, one part containing the "application" made by the customer for service, stating what connections are wanted, rates, etc. The other part is called the "connection card," and contains the instructions as to fixtures to be used, and on the back a sketch and blank for plumber's return of work done. The "application card" is filed under the street name and number when the application is made. The "connection card" is separated and given to the customer or his plumber, and is filled out and returned to the water office. After inspection is reported by the company's inspector this card is filed under the name of the customer. Each card has spaces in which are filled the register number, the application number and the page of the water register on which the account is entered. There are thus two card indexes of every service, by location and by customer's name, and there may be a further application register if desired, in which each application is entered and given its number, thus making it possible to find any account by any one piece of information about it.

Best Material for Village Streets.

This city will purchase some sort of material for use on the streets this summer. Heretofore crushed stone has been used, but last summer a few blocks were covered with novaculite as an experiment. This material has proven very satisfactory on level stretches of the streets, but this city is located on hills, there being more or less grades on each and every street, and the novaculite fails to stick as desired. Some new material which will stick on hills and will make a good even and hard street will be wanted. What can you recommend, and what have your advertisers?
City Clerk, ————, Ill.

Treatment of the existing roads with such reconstruction as may be found necessary in some places, using road asphalts as a material to hold the broken stone or novaculite in place may be recommended. The names of makers of this material will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the heading "Asphalt." Tar may be used in the same way, which can be purchased of firms named under "Concrete Tar," "Pitch," "Road Tar," "Tar and Pitch," "Tar, Road," "Tarvia." Perhaps some of the materials may serve the purpose, which are made by those listed under the headings "Dust Laying Compound," "Macadamizing," "Mineral Rubber," "Road Binder," "Road Oils."

If more durable pavements are desired there are several excellent pavements for the uses named, which are comparatively low in cost, made by some of the firms listed under "Paving Materials." Reference may be made also to the lists under "Granocrete Pavement," "Paving Brick," "Stone Pavements," "Wire-Cut Lug Bricks," if the funds available will cover the cost of such improvements.

Ashes for Macadam Binder.

I have been told that common coal ashes has been extensively and successfully used in Scotland as binder for macadam. Can you tell me whether this is correct, and whether it has been used in this country, and whether or not it is as good as stone screenings for water-bound macadam? Any information along this line will be very much appreciated. E. W., ———, Mich.

The writer knows of no such use of ashes. The use could be but local, as the amount of ashes produced, except in a large city, bears but a small proportion to the amount of binder necessary in the roads of the locality. Doubtless the fine ashes would serve the same purpose as stone dust or other fine material, but there are large proportions of cinders in ordinary ashes, which break up and are unstable and difficult to handle. There is also quite a large proportion of unburnt coal, which can serve no very good purpose in a road, besides being difficult to compact into the voids in the stone. It is generally considered that nothing is quite so permanent as a binder as clean sand and clean screenings of the stone used in making the road, and anything else is but an approximation in quality. When the material is as irregular in nature and condition as ordinary coal ashes the presumption is against success, or at least against permanent success.

Can our readers report any facts in response to this inquiry?

Cost of City Engineering and Fees for Municipal Engineering Services.

In the February number of your magazine I saw an article bearing on percentage of cost of engineering in small cities, which showed that the cost varied in accordance with the amount of work done. I should be glad to know if you have any further data published in any back numbers on the same subject. CITY ENGINEER, ———, N. J.

The article referred to gives a suggested system of charges for municipal engineering services when the city or town does not employ a city engineer on regular salary. There are several articles in other numbers of MUNICIPAL ENGINEERING giving information on this subject and others giving data as to the actual percentage cost of doing the city's engineering work, computed from the expenditures on public work and the total cost of the city engineer's office. These data are not always directly comparable, for in some cases the city pays the cost of inspection and it is included in the cost of the city engineer's office; in others the inspection is taken care of in another department and is not included in the city engineer's report, and in still others it is charged to the contractor or directly to the property owners, in which cases it may or may not, probably does not, appear in the city engineer's report.

In the current volume are the article referred to above, on p. 115, which applies the schedules of fees laid down in earlier articles to municipal work, and one on p. 258, giving a detailed schedule of charges which can be applied directly to any particular case, and a preliminary estimate of the total cost of engineering services can be made if the estimated cost of the improvement is made. This schedule will give nearly the same resulting charges as are given in that on p. 115. The schedule of California consulting engineers is given in this number.

In vol. xli, pp. 290 and 360, are articles giving cost of engineering on good roads, which may be of interest in this connection.

In vol. xxxix, p. 37, is an article on "Charges for Engineering Services Computed on Total Cost," and on p. 203 is one on "Charges for Engineering Services," giving the essential figures in a schedule printed in detail in vol. xiii, p. 197.

In vol. xxxviii, p. 76, is an article on "Relative Cost of Municipal Work Done by Day Labor and by Contract," which may throw some light on the subject; also those on the same subject on p. 194 and on "Handling Day Labor in Holyoke, Mass.," p. 202. "Cost of Engineering for Municipal Improvement Project," p. 346, briefly states a method of analyzing engineering charges and refers to earlier articles on the subject. "How to Procure Good Bridge Plans," p. 268, gives some data on fees for the work.

In vol. xxxvii are "Municipal Engineering in Portland, Ore.," pp. 155 and 334, and a report of a decision that "Council Cannot Make Unreasonable Reduction in Salary of Public Officer," p. 404.

In vol. xxxvi a review of the Hartford, Conn., city engineer's report, on p. 123, gives cost of the city's engineering; cost of asphalt plant engineering is given in article on "The Municipal Asphalt Plant of Detroit, Mich.," on p. 143; some data are given in "A Municipal Business Manager in Staunton, Va.," p. 279.

In vol. xxxv are some data in "Cost of Road Building," p. 78; "Engineering Fees for Street Paving," p. 181; also in a review of the annual report of the city engineer of Portland, Ore., on p. 259.

In vol. xxxiv, p. 365, is an article on "Lot Surveys by the City Engineer," which gives prices for this sort of work.

In vol. xxxiii, p. 412, is a little information in an article on "Comparison of Cost of Gravel Roads in Maryland and in Indiana," with references to earlier articles giving more data.

In vol. xxxi, p. 48, is a statement of cost of engineering in "The Sewage Disposal Plant at Downer's Grove, Ill."

In vol. xxx, p. 223, is an article on "Engineering Contracts," which gives some good instruction in respect to its subject. Cost of engineering in Pasadena, Cal., is given in a review of the auditor's report on p. 378.

Gas Lighting Franchise in Hanover Germany.

The Imperial Continental Gas Association of London recently contracted with the city of Hanover to pay $2,380,000 for an extension of its franchise to 1950. Hanover proper has slightly over 300,000 population. Under the old franchise the company paid the city a royalty of $0.0071 on each cubic meter of gas sold to the consumers, which is to be increased after 1925 to $0.0095. If the consumption exceeds 55,000,000 cubic meters, the royalty is to be $0.0107, and if exceeding 70,000,000 cubic meters, $0.0119 per cubic meter. At the conclusion of the contract, which was to run until 1925, the works, mains, offices, etc., were to be turned over to the city; but the city was to provide the capital for extensions and improvements during the last five years of the contract wherever expenditures exceeded $11,900.

In the new contract the city grants the substitution of a calorific test instead of an illuminating power test, the removal of the sulphur restrictions, and the introduction of a uniform price of $0.0333 per cubic meter, with discounts according to quantities used.

Public lighting is to be free and may be increased by 200 lights annually. All property is to be handed over to the city free of charge at the expiration of the franchise. In case another gas plant is needed, the city contracts to furnish the site with rail and water connections free to the company.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Asphalt Production in the Past Year.

Aside from its financial features, the annual report of the General Asphalt Company (owning the Barber, Trinidad and Bermudez companies), issued May 14, contains information of interest especially to the paving and road-building industry. The total volume of business increased from $16,004,173 to $16,542,281. For the first time in the company's history the item "asphalt," which includes crude and refined asphalt and asphaltic products in all forms, exceeds the paving account. Sales of asphalt increased from 247,491 tons in 1910 to 265,677 tons in 1911. Thus, while the consumption of asphalt increased in the amount just stated, and produced a revenue increase of $2,297,030, the paving done by the company shows a slight decrease, owing to the fact that a greater proportion of asphalt construction is done by customers of the company using Trinidad and Bermudez asphalts rather than by the company itself.

A full account is given of the development of Trinidad oil, which, the report states, is already being produced at the rate of 200,000 barrels annually, and is being increased. Experts who have surveyed these oil properties estimate the oil available at 250,000,000 barrels.

Manufacture and sale of asphalt products, of which the largest item is roofing, amounted to $1,379,245 in 1911, an increase of $173,844 over 1910.

Floor for Highway Bridge.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Answering request in May issue for suggestions as to new floor covering for a bridge on which old plank are now in use, we wish to report that we have re-covered more than fifty bridges of this type during the past ten years with our creosoted wood block on creosoted plank foundation.

We would suggest that in place of the 4x14-inch floor stringers now in use, there might be used an 8 or 10-inch I-beam of proper cross-section bolted to the present floor girders, and the 3-inch creosoted plank laid and fastened directly upon the iron I-beams, and the 3-inch paving block laid directly on the plank, and, after being laid, the joints to be filled with paving pitch poured hot over the surface and raked in the joints.

If thought advisable to give crown to roadway, steel or iron shim plates of varying thickness should be fastened under ends of I-beams over floor girders. This will give you 14 or 16 inches above level of top of floor girders instead of 17 inches, now in use.

If the lowering of present roadway on the bridge is desirable in order to change grade of approach, as is sometimes advisable, the I-beams may be fastened to angles or brackets riveted to the web of the floor stringers, in which case the grade of roadway on the bridge may be lowered from 6 to 12 inches below present level.

UNITED STATES WOOD PRESERVING CO.,
By DAVID E. OLDS,
New York City.

Handling Fire in Copenhagen by Pre-arranged Plan.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The undersigned is not in any way connected with the fire department nor with the concerns making fire machinery, but having come across the enclosed article by A. E. Friis about a fire in Copenhagen, Denmark, I have translated it (with a few omissions), thinking that certain points in it might be of interest to municipal officials here.

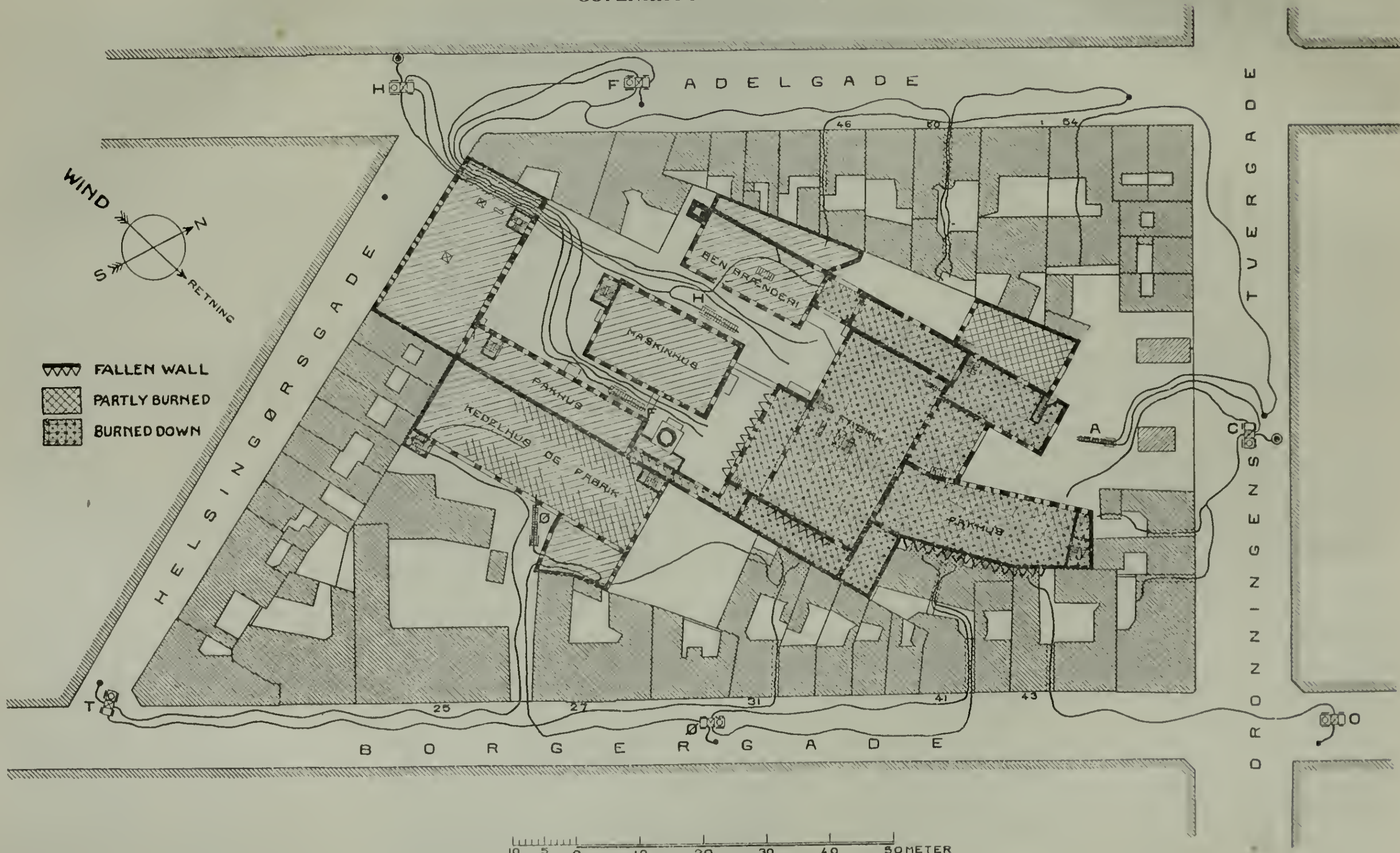
The conditions are, of course, in many respects different from here: building laws are much stricter in Copenhagen than in Chicago (for instance, no wooden houses are allowed), and are enforced to the letter; there is no building of more than six stories in the city, etc. Therefore the fire department in Copenhagen ordinarily is not kept as busy as in a large American city. The population of Copenhagen is 500,000.

NIC L. FEILBERG,
Mech. Eng., A. M. Am. Soc. Refr. Eng.
Chicago, Ill.

The night between February 3 and 4, fire broke out in Helsingoergade sugar refinery, and this developed into the biggest fire the city of Copenhagen has seen since the burning of Kristiansborg castle in 1884. The fire department worked according to a plan of attack previously arranged, and followed it up successfully in every particular.

The sugar refinery proper forms the central part of a complicated system of build-

COPENHAGEN FIRE PLAN



ings of the plant. Here the large storage of sugar and the many wooden constructions, coated in sugar, afforded the fire good conditions for spreading fast; and crowded in as the plant is between the narrow streets Adelgade and Borgergade, difficult of access from almost every point, a serious fire in it would always be a danger to the neighborhood.

Realizing this, the fire department had worked out in advance a plan of attack for this plant, the same as it has for certain other factories, theaters, storage houses, etc., where a fire would have a good chance of attaining big and dangerous proportions. This, however, is the first time there has been an opportunity to test such a previously arranged plan.

The alarm was struck at 2:30 a. m. When the fire engines arrived, the refinery building was one mass of fire, sending up an immense amount of smoke, and some flames reaching a height of about 100 feet. Men, engines and the other material marched up according to the plan, without a single hitch, first three engines, then two more, and finally, as a reserve, the engine from the navy yard, with an officer and thirty sailors.

The map shows how the fire was attacked, when at its maximum. The wind was toward Borgergade, and for a while compelled the firemen to withdraw to positions farther away than those first occupied; also falling wall parts endangered the work from this side.

In the fire walls that divided up the buildings, there were "fireproof" doors of double steel plate, but they proved insufficient as the high temperatures finished them up completely.

The water supply was satisfactory. It will be noticed from the map that two of the engines, C and I, received their supply from special hydrants, shown as double circles. These two hydrants are directly connected to the large water main, while the other fire hydrants are simply connected to the street line. Such special hydrants, with direct connections to the large water mains, have been put in place near all buildings that may be considered liable to cause big conflagrations. The water works had three more pumps going than under normal conditions.

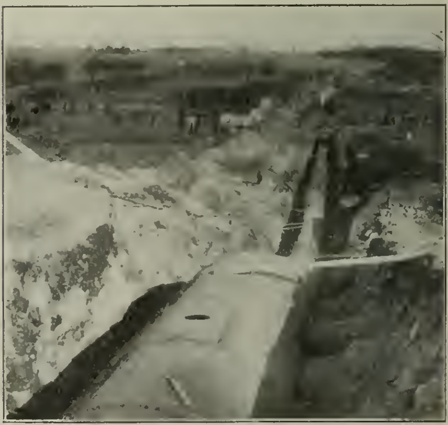
The force, under the chief's personal command, was five officers and eighty-seven men. The work was considerably handicapped by the cold weather (—4 degrees F.) At 6 a. m., the fire was so well under control that there was no more danger to other buildings. Not a single life was lost.

A. E. Friis.

Portland Cement and the Catskill Aqueduct.

Portland cement has been found of so great importance in connection with the construction of the great aqueduct which is to bring water to New York City from the Catskill mountains, a hundred miles away, that it is quite possible that the work would have been an entirely impracticable proposition without it.

Everywhere the great conduit is being lined with cement or is being constructed entirely of concrete. Thus there are long stretches where there is little or no upward hydraulic pressure. In such situations the aqueduct is a solid concrete tube. At other places the waterway goes below the hydraulic grade. In quite a number of such cases the aqueduct sinks far below the hydraulic grade and passes through solid rock. Here the inevitable irregularity of wall is smoothed by the use of Portland cement or concrete. Indeed, in one such case, that of the Rondout siphon, where the aqueduct drops 500 or more feet below the general surface, Portland cement was found of great value in the sinking of a temporary construction shaft. This shaft, when completed, was 500 feet deep. A great quantity of water had to be dealt with, not only at the time when the shaft would reach a water-bearing stratum, but in some cases before such penetration. The water would come in through explora-



KENSICO SIPHON.
Showing Temporary Manhole.

tory holes. Altogether, the shaft was flooded six times during construction. Portland cement grout put down ahead and under pressure was one of the two great factors in the actual conquest. The other great factor was the pumping plant, installed in a special chamber off to one side of the shaft, at a point about 300 feet below the surface. This plant was quite a powerful one, consisting of three horizontal condensing pumps of a combined capacity of 1,050 gallons per minute, furnished by the Cameron Pump Works, New York City. Three 100-h.p. boilers set up on the surface supplied the steam. After the installation of this stationary plant no flooding of the shaft occurred.

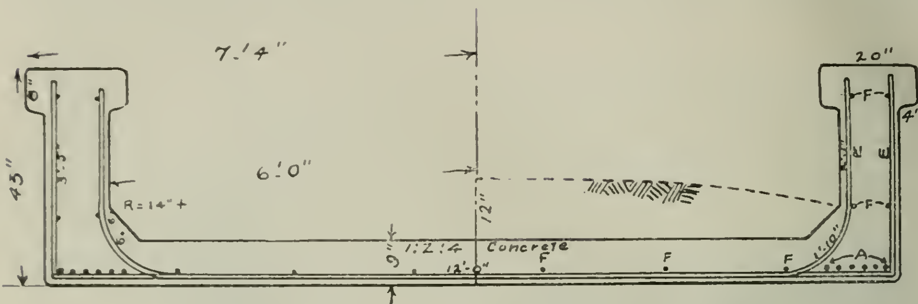
Cement is making possible the use of steel tubes at numerous points where the valley to be crossed is narrow. After the steel tubes are laid, they are covered outside with a thick envelope of concrete and inside by a 2-inch coating of cement grout. This is probably the first time in history that the steel pipe and cement have been combined on such a scale. If this type of construction proves thoroughly satisfactory, a large field for the application of steel pipe will be opened up. The problem involved relates to expansion and contraction. While the coefficients of linear expansion for concrete and for steel do not greatly differ, being respectively about 0.0000055 and 0.0000066 per Fahrenheit degree, they do differ somewhat, and the question is whether this difference will produce bad results. The largest of the steel tubes has a diameter of 11¼ feet. The circumference is, accordingly, about 35½ feet. An increasing temperature change of 100 degrees will tend to result in a tube having an increase in circumference of 0.023 foot, or 0.276 inch. The interior shell of cement will tend to have a circumferential increase of 0.020 foot, or 0.240 inch. That is to say, the interior cement shell will expand circumferentially 0.036 inch less than it should to keep pace with the steel tube. The reverse will be the case with the steel tube and the exterior covering of concrete. With a decrease of temperature of 100 degrees, the steel would tend to contract the inside coating of grout and to shrink away from the concrete on the outside. Now, it is hardly expected that a change of 100 degrees will take place under ordinary circumstances. The water flowing through will act as a temperature control. However, there are the atmospheric changes on the outside. Further, there will perhaps be periods when repairs are being carried out, during which time there will be no water present. On the other hand, it may be that the grout and the concrete possess within themselves the capacity to permit the variations without fracture. The actual results that will be disclosed in the future are of practical importance. It may be added that the interior shell is being put in solid, with no provisions for expansion and contraction. Section joins section, and they are made, in fact, integral with each other. There is, perhaps, no other way.

BRYN MAWR SIPHON.
Placing Concrete Envelope Around Steel Pipe.

Construction and Cost of Reinforced Concrete Girder Highway Bridges.

To the Editor of MUNICIPAL ENGINEERING:

Sir—During 1911, Halifax County, Va., built, as permanent improvement, three 30-foot reinforced concrete through-girder highway bridges with 12-foot clear roadways. The total contract price was $1,650, and the average price $550. The local conditions were practically the same; the height of abutments from bed of stream to bottom of girders being 7 and 8 feet, and foundations resting on blue clay mixed with some sand and gravel. Two-inch sheet piling was driven on front and sides to a solid bed, and an 18-inch footing course about 5 feet wide was laid. An "U" abutment was built on this foundation, set 6 inches from edge of foundation; and being 15 inches wide on top, vertical back, and ½ inch to 1 foot batter front and ends. Several ⅝-inch round rods were placed horizontally, bent into the wing walls and two extending from foundation diagonally through wings up to face of abutment fastened to horizontal rods. About 10 cubic yards of 1:3:6 concrete with about 10 per cent. of boulders was required for each abutment.



CROSS SECTION OF REINFORCED CONCRETE GIRDER BRIDGE.

The superstructure consisted of two side girders, 43 inches high, 20 inches wide on top, web 12 inches; and a 9-inch flat slab floor flush with bottom of girders, reinforced with ⅝-inch round rods, spaced 6 inches, and ⅜-inch round rods longitudinally every 2 feet. The lateral rods were 19 feet and 4 inches long, bent up vertically into girders, alternately inside and out. The main girder reinforcement was six 1-inch square rods 22 feet long, alternating 10½ feet from either end of girder. Four ½-inch square rods, 12 feet long were clamped at short ends of large bars, and bent up in pairs diagonally, to 2 inches and parallel with top of girder. Six hundred chairs were used to clamp rods in place, and hold steel up from forms. One bridge required 20 cubic yards of 1:2:4 concrete and 2,600 pounds of steel. Cement costs $2 per barrel delivered, stone (¼ to 1 in.) from $1.50 to $2 per cubic yard, and sand 50 cents per cubic yard.

In design of girders the following values were taken: Live load, 150 pounds per square foot; fs, 16,000 pounds; fc, 600 pounds; p, 0.0068; n, 15; k, 0.36; j, 0.88. The false work consisted of 1-inch oak covered with building paper on 2x12 stringers spaced 2 feet on sides and 2½ feet between, on centers; resting on a center pile bent, knee-braced at quarter points. This was left in place for 60 days. Each bridge was cast in one operation, usually in less than 10 hours with eight men. The roadway was surfaced with 12 inches of gravel instead of macadam. Traffic was allowed across the bridges within 10 days after casting.

CONCRETE GIRDER BRIDGE.
Near Pulaski, Va.

G. H. DERRICK, M. Am. Soc. C. E.,
Pulaski, Va.

MUNICIPAL MATTERS IN COURT

Higher Courts.—Highway Cost Apportioned to Municipalities.—Peoria Electrolysis.

Decisions of the Higher Courts of Interest to Municipalities.

If Sewer Fund Proves Insufficient, the General Fund May be Drawn Upon.—The charter of the city of Rome, as amended, creates a board of water and sewer commissioners, and authorizes it to contract in the name of the city for the water and sewer systems, that all moneys received by it from bond issues, etc., shall be kept to the credit of the water funds by the city treasurer, and paid out only on warrants of the board, and also requires the board to pay from such fund the cost of constructing an additional water system. Held, that a claim allowed by the board of audit for extras furnished under a contract with the board of water and sewer commissioners for the construction of a sewer system was payable from the fund provided for its construction, if it was adequate, and not out of the general fund.—People ex rel. Carey Construction Co. of Rome v. Smith et al. (N. Y.) 134 N. Y. S. 319.

Private Water Company Subject to Tax to Support Municipal Water Works.—Where plaintiff, a domestic water works corporation, furnished water to a village under a franchise, and thereafter the water supply became inadequate, whereupon the village obtained the right to construct and operate a municipal water works system, which was adequate for domestic purposes and fire protection, and resulted in a reduction of insurance premiums, complainant was not thereafter entitled to restrain the village from enforcing taxes against complainant's property, levied for the purpose of installing and maintaining such municipal water works.—Beauty Spring Water Co. of Lyons Falls v. Village of Lyons Falls (N. Y.) 134 N. Y. S. 290.

Insufficient Income Grounds for Receivership for Water Works Company.—An amended bill for a receiver of a water company alleged insolvency, and that the income of the plant for supplying water for municipal and private purposes was about $1,900, while the annual expenses of operation were about $600, leaving a margin for necessary repairs and improvements of $1,300, which was more than absorbed by interest payable on bonds of the company, etc. It also charged that the plant was in great need of repairs, which could not be made, because there was no one within the state with authority to provide therefor, and that a failure to appoint a receiver would result in great detriment and loss to stockholders and creditors, and would leave the city without adequate water supply, etc. Held, that the bill was sufficient to justify the appointment of a receiver with limited powers.—Thoroughgood v. Georgetown Water Co. (Del.) 82 A. R. 689.

Municipality Not Liable for Negligence of Independent Contractor.—A city, employing an independent contractor to construct a water works plant pursuant to reasonably proper plans, not contemplating an interference with the premises of an individual, and not such as to make necessary, with the ordinary care, any damage to such premises, is not liable for damages to the premises caused by an overflow in consequence of the act of the contractor in breaking a culvert and leaving ridges of dirt preceding a rain, causing an overflow of the premises.—Sappington v. City of Centralia (Mo.) 144 S. W. R. 1112.

Municipality is Responsible for Proper Construction and Maintenance of Sewers.—P. J. Ibach, who is a florist at Logansport, brought action in the Cass circuit court to recover damages which he avers were sustained by him on account of the negligent construction and maintenance by the city of a certain sewer in the territory in which his greenhouse is situated, whereby sewer water was caused to flow into his furnace, putting out the fires, and causing many of his plants and flowers to become frozen. In ordering the construction of a sewer, a city exercises its governmental power as to which it cannot be held responsible for negligence, but the actual construction is ministerial in character, and the municipality may be held for injuries from a failure to do the work in a proper manner, or from improper maintenance.—City of Logansport v. Newby (Ind.) 98 N. E. R. 4.

Contractor May Not Collect for Partial and Unnecessary Performance.—One is not allowed for a partial performance of an indivisible contract for cleaning out a drainage, at a certain price per rod, for the necessary distance to be covered, by a verdict for less than the distance claimed to be cleaned; the contractor not being entitled to recover for work as to any of the distance not reasonably necessary to be cleaned.—Colwill v. Urbana Construction Co. et al. (Ia.) 135 N. W. R. 76.

Exclusive Franchise Not Valid.—A municipality owning the source of a water supply and part of the mains granted to a citizen, his heirs and assigns, the right and privilege to supply the city and the inhabitants thereof with water for domestic and other uses, and for preventing and extinguishing fires, and authorized him to use the streets for the laying of mains. Held, that the grant was an exclusive one in the nature of a monopolistic franchise, and so invalid.—Ennis Water Works v. City of Ennis (Tex.) 144 S. W. R. 930.

City Is Not Bound ot Protect Contractors' Employes from Incidental Danger.—A city is not liable for injury to a sewer contractor's employe caused by his foreman negligently directing him to drill new holes in rock near unexploded blasts, on the theory that blasting is so intrinsically dangerous that the city was bound to protect the employe from the incidental danger.—Salmon v. Kansas City (Mo.) 145 S. W. R. 16.

A Deed Given to a City as a Consideration for Right to Lay Water Pipes Does Not Constitute an Exclusive Franchise.—A deed by a real estate company, which platted land and reserved to itself the fee in the streets with the right to lay water pipes therein, which conveyed to plaintiff water company "a right of way" on and under said streets for the purpose of maintaining water pipes and covenanted that grantor would not thereafter vest in any other person or corporation the right to maintain water pipes in the streets, did not give plaintiff the exclusive right to maintain water pipes in the streets, as grantor had a right to itself thereafter lay water pipes in the streets.—City of Norfolk v. Norfolk County Water Co. (Va.) 74 S. E. R. 226.

Notice to Make Repairs Is a Necessary Precedent to Contractor's Liability.—Where a paving contract provided that notice to make repairs should be served on the contractor, the giving of such notice is a condition precedent to the contractor's liability for failure to make repairs.—Asphalt Paving & Contracting Co. v. City of New York (N. Y.) 134 N. Y. S. 433.

Paving Company, Though Dissolved, May Be Held Liable for Repairs.—After the voluntary dissolution of a paving company to which a city was indebted, its vice-president, with the consent of the directors, executed under seal an assignment of its rights against the city to another. Held, that such assignment, being under seal and under the order of the directors, was valid, for a law which was in force at the time of the dissolution, provides that a dissolved corporation shall nevertheless continue in existence for the purpose of collecting its assets, and may sue and be sued for the purpose of enforcing such debts or obligations until its affairs are fully adjusted.—Asphalt Paving & Contracting Co. v. City of New York (N. Y.) 134 N. Y. S. 433.

Additional Water Filters May Not Be Classified and Paid For Under Maintenance Expense.—The Kingston city charter created a board of water commissioners, with power, with the consent of the common council, to construct and maintain a water works system. Section 98 provided that the moneys derived therefrom should be applied to the payment of the cost of maintaining, operating and extending the water works, and to the payment of principal and interest on bonds as they fall due. The board, by section 99, was given power to keep the system in operation independent of the city council, and to fix and collect water rates, and make and enforce rules and regulations. By section 101 the moneys derived from water rates and penalties were required to be paid to the city treasurer, to be credited to the water fund and applied to the payment of expenses of ordinary maintenance and management, the balance, if any, to the payment of principal and interest on bonds, and any surplus still remaining to be used for any lawful city purpose. Held that additional filters, requiring an expenditure of $16,235, was not ordinary "maintenance" expense, and that the board had no power to incur such expense without the consent of the city council.—Coykendall v. Harrison et al., Board of Water Com'rs., (N. Y.) 134 N. Y. S. 446.

A Town Assessed as a Municipality May Not Empty Private Sewage Into a Public Ditch.—Where a town was assessed as a municipality for the construction of a drainage ditch, such assessment gave it the right to drain the surface water from its streets and alleys and public grounds into and through the ditch, but it did not have the right to use such ditch as an outlet for the sanitary sewage from buildings located upon private lots not assessed.—Geiger et al. v. Town of Churubusco et al. (Ind.) 98 N. E. R. 77.

Sewage Discharge Into Streams May Not Be Enjoined Unless Damage is Proved.—Where a municipality, which was entitled to use a drainage ditch as an outlet for the surface water from its streets, alleys and public grounds, wrongfully used the ditch as an outlet for sanitary sewage from buildings located on private property, but such use did not in any way injure the health of the owners or occupants of other lands assessed for the construction of the ditch, the municipality will not be enjoined from so using the drain unless it appears that plaintiff is about to suffer some substantial injury for which there is no adequate remedy at law.—Geiger et al.

v. Town of Churubusco et al. (Ind.) 98 N. E. R. 77.

Precise Form of Drainage Need Not Be Stated By Riparian Owner Seeking Relief From Stream Pollution.—Where the petition states facts sufficient to constitute a cause of action against defendant, in damages, for the maintenance of a public nuisance, Held that it was not material that plaintiff did not demand the precise relief to which he was entitled, or that he mistook the true rule of damages; that he was entitled to whatever legal damages were recoverable for the wrong.—Colbert v. City of Ardmore (Okla.) 122 P. R. 508.

Apportionment of Cost of Highways Against Municipalities.

Legal questions arising from complications in connection with the new county highways which are to run through Watervliet and Cohoes in New York State, have been settled in an opinion given today by Attorney General Carmody.

The resolutions approving the improvement were approved by the Albany county supervisors in July, 1911. The 15 per cent. of the cost heretofore charged to the towns was transferred to the cities and the advertisement of these roads was withheld pending an adjustment of the question of apportionment.

The attorney general holds:

Where a county board of supervisors has adopted a final resolution and approved plans and specifications for improvement of a county highway, there should not be a reapportionment of the cost of construction of such highway so as to eliminate the towns therefrom.

Where the plans for construction of a county highway must be revised and an additional sum is necessary for its construction, such sum should be apportioned between the state and county.

The board of supervisors of a county shall, by resolution, apportion the cost between the city and county of a county highway constructed through or within a city of the second or third class in such county.

The Termination of the Peoria Electrolysis Case.

After fourteen years' litigation, United States District Judge Sanborn decided the electrolysis suit between the Peoria Water Works Company and the Peoria Railway Company in favor of the water company, issuing a perpetual injunction restraining the railway company from allowing its electric currents to damage or interfere with the water mains.

In his ruling, Judge Sanborn said:

The court having found and decided that the complainant water company has been and is being damaged by electrolysis, caused by electricity generated by the defendant, it is decreed that the defendant shall take such measures as to prevent further injury from electrolysis.

The decision of the court is regarded as necessitating complete rehabilitation of the railway properties.

Health Commissioner Sought for City of Boston.

A vacancy will soon exist in the position of chairman of the board of health of the city of Boston.

The duties of the chairman and his two associates are various and responsible. They embrace the control of contagious diseases, including bacteriological tests, disinfection and preventive measures; the inspection of milk, vinegar, provisions, tenements, slaughter houses, stables, and occupations and conditions dangerous to health; the medical inspection of the schools, containing more than 100,000 pupils; the management of a smallpox hospital and a quarantine station; the control of convenience stations throughout the city; the compilation and publication of vital statistics, and other miscellaneous duties. The department has over two hundred employes.

The mayor will consider applications from physicians, sanitary engineers or other persons experienced in this field, who are American citizens.

The salary of the position is now $4,500 per year, but the mayor has recommended an increase to $5,000, and is willing to recommend more.

The appointment is made by the mayor, subject to confirmation by the Civil Service Commission, and the new appointee will serve out two years of an unexpired term. The full term is three years. Applications should be addressed to Hon. John F. Fitzgerald, mayor, Boston, Mass.

Water Main Broken in Sioux Falls, S. D.

The breaking of the 12-inch water main, supplying the east portion of the city of Sioux Falls, S. D., completely shut off the water supply of that section of the city for a number of hours recently. The big main was broken by a pile which was being driven into the ground for the falsework of the new Eighth street bridge.

The breaking of the main was followed by an outburst of water at the place and the reduction of the pressure in the water mains throughout the city from 65 to 15 pounds. Immediate steps were taken by the city authorities to supply the East Side with water, and two lines of hose were connected with the hydrant on the west side and carried across the river to a hydrant on the east side of the bridge. A four-inch main was swung across the river the following morning and connected with the mains on the East Side until the big main was repaired.

STREET · LIGHTING

Alliance Municipal Plant.—Street Lighting and City Growth.

The Municipal Light Plant of Alliance, Neb.

Alliance, a town of about 3,000 population, is an example of a municipality which had municipal ownership thrust upon it. In 1892 a franchise was given to the Alliance Electric Company to operate a lighting plant until 1920. A clause was inserted providing that the city might purchase this plant in 1910 at a price to be agreed upon between the city and the company. In event of a disagreement regarding this purchase price a board of arbitrators was to be appointed to settle a price, which should be binding on both parties.

In 1910 the citizens voted to purchase the plant, the only thing which they could do under the circumstances, unless they waited ten years more. The agreement was negotiated as provided by ordinance, but they disagreed on the price. The arbitrators were appointed according to the provisions of this ordinance, and they returned a decision that the plant was worth $85,000, and named that as the price the city should pay. This was a great surprise to the city by reason of the fact that their valuation had been determined upon a different basis. The city had taken into account only the actual physical valuation of the plant, giving no consideration to the earnings, which formed the basis for the price set by the board of arbitrators.

The decision of the board placed the city in a peculiar dilemma. It could not retire from the trade, being bound by the franchise agreement. It did not wish to pay the large price set by the board of appraisers, as it was far in excess of the physical valuation of the plant. After some further negotiations the city succeeded in getting the price down to $55,000, at which figure, though still in excess of the value of the plant and equipment, the purchase was made.

At the time the city made the purchase they made provision to rebuild the power plant, they assumed a $15,000 mortgage on the old plant, and by doing this they had about $20,000 to apply on rebuilding the power plant. New machinery and a reservoir for fire protection will be added as soon as funds can be provided.

After a little more than a year of successful operation N. A. Kemmish, the superintendent, offers a comparison between the municipally and the privately managed plant. The following figures in both cases consist of the earnings and expenses from operation. The figures given for the Alliance Electric Company are for the year ending February 15, 1911, and in the case of the city they are for the year ending April 15, 1912. The same items of earnings and expenses are included in both cases. In the operating expenses no allowance was made in either case for taxes or depreciation, but maintenance and repairs were included. The taxes of the old company were $300 per year, and were taken out of their operating expenses in order to make fair comparison.

ALLIANCE ELECTRIC COMPANY.

Gross earnings of the Alliance Electric Co.	$32,822.55
For 12 months, operating expenses of Alliance Electric Co.	25,699.83
Gain over operation	$7,152.72

MUNICIPAL PLANT.

Gross earnings of city of Alliance for 12 months	$33,387.93
Operating expenses city of Alliance	22,075.16
Gain over operation	$11,312.77

CHARGES AGAINST MUNICIPAL PLANT.

Depreciation ($50,000) at 7 per cent.	$3,500.00
Interest on $75,000 at 4½ per cent.	3,375.00
Taxes	350.00
Insurance	455.40
Sinking fund to retire bonds	3,652.37
Total	$11,312.77

Number of light consumers, April 15, 1912, 433.

The city has served forty more customers, on an average, or 10 per cent. more than the old company, and with practically the same gross earnings, and the city made over $4,000 more, or 57 per cent. more than the old company.

The citizens and the officials of the department are so well pleased with the operation of the plant that their attention is now turned to securing an ornamental lighting system for their streets.

Street Lighting and City Growth.

BY C. L. ESHLEMAN.

From a paper before the American Civic Association, Washington, D. C.

The value of property on a business street is directly proportionate to the number of people who make use of the street as a thoroughfare. A corner lot on Broadway is worth more than a lot in the latest subdivision on Long Island, simply and solely because a greater number of people pass the Broadway corner during the day. It not infrequently happens that opposite sides of a street on the same block have considerably different values, due to the same cause. Anything which adds to the traffic of a given street must, therefore, add to the value of the abutting property. While conditions of accessibility to necessary utilities, such as railway stations, hotels, banks, public buildings, etc., have doubtless a preponderating influence in determining the traffic of a street, it is equally true that no subsidiary condition has such a vital effect as the lighting.

The merchants on one of the main business streets of a large eastern city saw that the bulk of traffic failed to pass them in the natural course of business. They installed a brilliant system of street lighting, and forthwith their street became the center of attraction; and similar instances can be cited in numerous other cities. It would, of course, be absurd to expect to create a popular business street out of a thoroughfare lying far beyond the natural limits of traffic; but there is no question that any street directly tributary to a business thoroughfare can be fully doubled in value by the installation of spectacular lighting.

In a more general way, lighting the entire business section of a city up to the standards of modern illumination does for the city, as a whole, what the lighting of a particular street does for that section—it increases values by increasing the traffic, not only from the city itself, but from the surrounding country and nearby towns. That good light increases the value of residential streets by making them more desirable needs no argument. Good street lighting, more than any other thing, gives to a city an air of progressiveness and prosperity.

It would doubtless be stretching the argument to claim that better street lighting would directly add to the healthfulness of the street. The power of suggestion in influencing action, however is no mere fancy; there is no denying the fact that one improvement suggests another. Improved forms of paving have produced cleaner streets, not merely because such streets are easier to clean than cobble stones, but, because of their much more elegant appearance, they show more strikingly the offensiveness of filth and neglect. The same reasoning applies with greater force to the lighting of a street. Not only will well-lighted streets be kept cleaner, as a matter of mere inclination, but they will be less littered and abused. There is extremely little wanton destruction or injury to property of any kind. Such cases arise mostly from thoughtlessness or association; and not only will good street lighting be an incentive to keeping the streets clean and sanitary, but will further react upon the residents themselves with a wholesome influence to cleanliness.

Before the days of systematic street lighting, only those ventured out at night who had urgent business or ample bodyguard. City streets have become safe as they have been well lighted. It is true that light alone would be insufficient protection, but it is equally true that police alone, in any reasonable numbers, cannot afford complete protection.

While this fact is generally recognized, there is one phase of the matter, on which more public education is needed. It is the practice in many cities, especially the smaller, to extinguish a considerable portion of the street lights at midnight or thereabouts, thus leaving them without this important protection for half of the night. To be sure, many streets are little frequented during this period; but a single breach of public order resulting in robbery or murder would more than offset the additional expense involved. A city in these days can certainly afford—and the citizens reasonably expect—to have the fullest possible degree of protection every hour of the day. The midnight schedule is a piece of petty economy entirely out of keeping with the wealth and civilization of our country at the present time.

What is called the moonlight schedule is even a greater fallacy, if literally carried out. Moonlight is far too uncertain a quantity to be reckoned with in so vital a thing as street lighting. A city should not only be lighted up adequately in every part, but should be kept lighted up during the entire part of the twenty-four hours when sunlight is not available.

Although "ornamental lighting" has been in vogue for many years, it has remained for the last two years to bring about definite and positive developments in this line. Before passing to a detailed description of the present street lighting practices, it might be well to take a casual glance at several forms of lighting that have been popular in past years. Successive developments in underground service have brought about successive developments in decorative lighting. Approximately ten years ago the change from overhead wiring to underground brought about the change from arc lamp span, or center street suspension, to suspension from more or less ornamental shepherd's crook poles. A number of notable installations placed at that time are still in service.

Following the pole suspension of inclosed arc lamps, we find the growing popularity of the festoon system. This consists of a carnival effect produced by stringing streamers of incandescent lamps either across the streets or parallel to the curb lines. Streamers were installed to produce a spectacular effect during a short period of festivity and then removed.

The festoon idea naturally developed into a more permanent system in the form of steel arches suspended across the main business thoroughfare. Installations of this nature produced definite night results, but the effect by day was not altogether pleasing. An ornamental lighting system must be esthetic as well as utilitarian.

The advent of high efficiency arc and tungsten lamps has revolutionized outdoor as well as indoor lighting, and has opened up worlds of possibilities. These high efficiency units make it possible to produce, not only spectacular, but highly ornamental effects—the production of illumination instead of simply light, the substitution of glow for glare.

An analysis of present business district lighting reveals two definite forms of installation:

1. Flame lamp or high efficiency metallic electrode lamps, suspended from ornamental poles.

2. The tungsten cluster or ornamental standard system.

Fifty to 100 feet spacing is common practice, 50 to 60 feet giving excellent illumination; 70 to 80, good; 90 to 100, fair. With 60 to 66-foot streets, units should be placed opposite each other and spaced 60 to 66 feet apart on both sides of the street. On wider streets units should be spaced correspondingly closer. The following is a general rule that can be followed to good advantages: The spacing of lighting units should be inversely proportional to the width of street. In small cities and towns having comparatively narrow streets (30 to 50 feet in width) good results can be obtained by staggering the lighting units, the distance between units on same side of street being 90 to 120 feet.

The foregoing discussion has dealt largely with business district ornamental lighting. Space will not permit a detailed discussion of systems available for residence districts, parks or boulevards. In a word, let us say that single unit series lighting should be adapted for these purposes.

An ornamental lighting installation reflects credit upon the city, pleases the people, increases business and begets a desire to improve the general lighting of the entire city. The opportunity is here; the means of making it golden are within easy reach. Don't neglect it.

French Experiments with Tarred Roads.

In a report made to the French Academy of Science particular attention is drawn to the danger to the eyes from dust arising from tarred roads. To determine the effect, mixtures of fine road dust, to which tar in varying proportions was added, were made up, and the eyes of rabbits dusted with the mixtures. The results were conclusive. While the pure road dust had little or no effect on the rabbits, their eyes were greatly affected by the presence of tar, and serious diseases broke out after these applications, showing the noxious effect of the tar.

Tarring produces good results only if the roads are well built and in repair, and composed of sufficiently hard materials; if the tar fully penetrates the crevices and does not form an external crust which the first winter rains would raise up and transform into mud; and, finally, if the drying conditions during the bad season are satisfactory. With these few restrictions, it may be said that tarring effectively protects the surface of highways against motor car traffic, and even against ordinary traffic if the latter be not extraordinarily heavy.

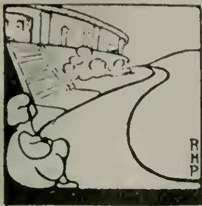
The use of superficial tarring is becoming more and more extended, principally in the neighborhood of Paris. In the St. Etienne district and other parts of provincial France, progress has been slower except near a few large industrial centers. However, a certain increase in the mileage of tarred roads was reported from 1908 to 1909. The appropriation allowed for these experiments in 1909 in twenty-four departments amounted to $19,077, covering seventy-eight miles of tarred roads, compared with 46.5 miles in 1908.

In the Department of Loire the tar is spread hot by hand or by a spray. Another method consists in rendering cold tar fluid by the addition of 10 per cent. of crude oil, and spreading it by the same means as the hot tar.

In the Department of Seine et Oise recent experiments have been made with divers tar and oil emulsions; deliquescent salts also have a real effect, but unfortunately of short duration, so that they can be employed only for special occasions, such as fetes, races, etc. This department employs every year solutions of calcium chloride for watering certain sections of the roads which are not in a sufficiently good condition to receive a coat of tar, at the cost of 2 cents per square meter (1.196 square yards). If the weather is too dry, the road is sprinkled with ordinary water.

Chloride of magnesium produces the same results, but the price is higher. It is used in Germany, where 3 per cent. solutions (because of their low congealing point) lay the dust in the streets during winter. Emulsions such as westrumite and similar products appear to be abandoned of late because of their high price and short duration.

In France a few experiments have been made with crude petroleum, so much employed in America, but they were not continued on account of the high cost and the inconvenience of the mud, which appears with the autumn rains.



ORGANIZATIONS & INDIVIDUALS

Electric Railway Association.—Brooklyn Engineers' Club.—The American Water Works Association.—American Society of Civil Engineers.—The American Road Builders Association.—Conference on City Planning.—International Association of Road Congresses.—Technical Associations.—Technical Schools.—Calendar.—C. H. Rust.—Personal Notes.

Tour of the American Electric Railway Association.

The officers of the American Electric Railway Association and the American Electric Railway Manufacturers' Association have completed an 11,000-mile tour of the United States. The journey took in cities as far south as Galveston, as far west as San Francisco and Los Angeles, and as far north as Vancouver, B. C., starting from New York City. The objects of the tour were threefold:

(1) To confer, not only with electric railway managements, but also with representatives of public utility companies in all lines, and with public officials and civic bodies and citizens generally on the subject of the relations between public service corporations and the communities they serve.

(2) To cultivate closer relations with the remote members of both associations.

(3) To enlarge the membership of both associations.

Thomas N. McCarter, of Newark, N. J., is president of the American Electric Railway Association, and H. C. Donecker, of New York, is secretary and treasurer.

Brooklyn Engineers' Club's Materials Exhibit.

The Brooklyn Engineers' Club's second annual exhibit of engineering materials, processes and models was held at the club house, 117 Remsen street, Brooklyn, N. Y., during the latter part of April. There were twenty-six exhibits, and each exhibit was accompanied by its own expert, who gave ten-minute talks each evening with his demonstration. The show was free to the general public, and no charge was made by the club to the exhibitors.

The exhibits varied from a model of the Piercy patent locomotive stage, conceived in South Africa and not yet adopted in America, to the Chambers fireless cooking gas range. The Thermit process of welding was one of the live exhibits of the week, and frequent demonstrations were made of the production of liquid steel at a temperature of 5,400 degrees Fahrenheit from a powder composed of iron oxide and finely divided aluminum.

The library on the second floor of the club house was given over to the exhibits of instruments of precision, while the parlors in the rear of the library were taken up by the exhibit of the Brooklyn Bureau of Highways, showing by charts Brooklyn's permanent pavements in comparison with other large cities. The New York fire department was represented by Deputy Commissioner P. P. Farley and Chief P. J. Graham of the repair bureau, both of whom gave talks concerning the more recent inventions adopted by the department.

The American Water Works Association.

The thirty-second annual convention of the American Water Works Association will be held in Louisville, Ky., on June 3-8. A very interesting program of papers, discussions and entertainment features has been outlined.

Among the papers to be presented are the following:

Ancient and Modern Water Works, by Edward Wegman; Floor Area Unit as a Basis for Estimating Consumption, by William W. Brush; Ice Troubles at Buffalo, N. Y., by Henry W. Lyon; A Method of Increasing Depth of Large Wooden Settling Tank, by A. H. Meyers; How We Crossed Two Streams with Ward Pipe at Rome, Ga., by M. L. Worrell; More Than Fifty Years' Reminiscence in Water Works, by H. G. H. Tarr; Progress of the Adoption of the National Standard Hose Couplings and Hydrant Outlet, by F. M. Griswold; Organization of the Bureau of Water Supply of the City of New York, by I. M. de Varona; Philosophy of Purchasing Supplies, by Elihu Cunyngham Church; Efficient Management, by Harrington Emerson; Steam Turbines and Centrifugal Pumps, by W. O. Berg; The Cost of Water, or Is It Worth While to Stop Waste, by Edward S. Cole; Method of

Locating, Measuring and Repairing Leaks in Distribution System at Lancaster, Pa., by F. H. Shaw; Results of Chlorination at Cleveland, O., by D. D. Jackson; Hypochlorite Sterilization at Kansas City, Mo., by S. Y. High; Water Softening at Owensboro, Ky., by E. H. Breidenbach; Electrolysis from Stray Railway Currents, by Prof. Albert F. Gand; To What Degree Must Sewage be Purified, by Chester G. Wigley; A Reliable Quantitive Test for B. Coli, by Shepperd T. Powell; Currents in Tropical Lakes, by John R. Downes; Wood Stave Water Conduit at Atlantic City, N. J., by L. Van Gilder; What is a Fair Rate for Cities, by Alexander Potter.

American Society of Civil Engineers.

The forty-fourth annual convention of the American Society of Civil Engineers will be held at Seattle, Wash., June 25 to 28, 1912. The local committee consists of eight members with Samuel H. Hodges as chairman.

The program includes papers by R. H. Thomson on "Pacific Coast Engineering," on "Harbors of the Pacific Coast," on "Irrigation," and one by a California member not yet announced. There will be the usual excursions to points of engineering interest, including the navy yard, creosoting plant, sawmills, shipp-building yards, Tacoma, Snoqualmie Falls power plant, logging camp, park system, Hood's Canal, Victoria, B. C., Mt. Rainier, and Alaska.

Rates will be the regular summer excursion rates with a probable special train from Chicago, if enough reservations are made.

Charles Warren Hunt, 220 W. 57th St., New York, is secretary, and will give full information.

American Road Builders' Association Remains Independent.

The American Road Builders' Association seems to have come to the conclusion that the chip which it has carried on its shoulder in rather conspicuous fashion has been knocked off, and it has refused to affiliate with the other organizations interested in holding a joint congress. There has been quite a pronounced tendency in this organization to restrict its membership to carefully selected approvers of the course taken by the board of directors and it is not surprising that the board finds itself unable to control the far larger membership of the other organizations interested in the cooperative movement.

The Road Builders have not always held themselves independent of special interests although their work has in general been very satisfactory, in technical quality as well as in the line of promotion. While they will be missed as an organization in the Road Congress of next year, it is quite possible that their places can be filled by individual memberships, even from the ranks of the seceding association.

MUNICIPAL ENGINEERING will do its best to secure publicity for the good things proposed or actually done by all the organizations and regrets that temperamental differences have made a break which will duplicate activities and therefore cause considerable waste both in the organizations themselves and among those who will try in the future as they have in the past to promote the cause of good roads even under disadvantages which seem to them so easy to remove.

Fourth National Conference on City Planning.

The Fourth National Conference on City Planning was held in Boston, Mass., on May 27-29, and was largely attended. In connection with the meeting an exhibit of city planning, illustrating the program of the conference, was held in the Boston public library.

The program this year was peculiarly practical and appealed alike to engineers, architects, landscape architects and students of sociological problems. There was an attempt to show just what city planning can do for certain types of areas and how the bills incident to improvement or reconstruction can be paid. Group sessions on city planning and housing and on city planning and the problem of circulation were held. The following subjects were discussed: 1. The Meaning and Progress of City Planning. 2. City Planning Studies of Specific Areas. 3. How the City Planning Bills are to be Paid. 4. The "Zoning" principle of Germany applied to the United States.

F. Shurtleff, 19 Congress street, Boston, Mass., is secretary of the Conference.

International Association of Road Congresses.

The third meeting of the International Association of Road Congresses will be held in London in June, 1913. Paris was the first meeting place in 1908, and Brussels was the second in 1910. Both of these meetings were most successful, and great interest is aroused in the London congress of 1913.

The purpose of the Congress is the consideration of "the best ways and means of coping with the great wear and disintegration of roads caused by the increase of vehicular traffic, more especially of motor traffic, which has taken place in recent years."

Full reports of the discussions and decisions of the congress, and complete sets of the various papers on different subjects will be published. These papers will comprise reports by leading authorities from all parts of the world, experiments and recent experiences in road engineering, methods of preventing dust and mud, the laying of light railways and tramways on roads, the choice of surfacing materials, the influence of weight and speed of vehicles on roads and bridges, the conditions to be fulfilled by horse-drawn or mechanically propelled vehicles, in order that they may not damage, or suffer damage, from the roads, etc. These papers will, of course, be of great value to not only local authorities, but also to road engineers, motor designers and manufacturers, and to every user of roads who is interested in their proper and efficient upkeep. The membership of the congress is open to all, and all publications will be sent to members.

W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S. W., is the honorable general secretary of the association.

Good Roads Special Delayed by Floods.

Many of the farmers of Texas, Oklahoma, Arkansas, Louisiana, Mississippi and Alabama have been inquiring of the American Association for Highway Improvement in Washington what has become of the "Good Roads Special" which was to have visited their districts on certain specified dates. J. E. Pennybacker, Jr., the executive secretary of the American Association for Highway Improvement, makes the announcement that, owing to the floods along the Mississippi, it was necessary to put the special on a siding, the schedule naturally being disarranged.

The trip of the "Good Roads Special" was arranged as a result of the co-operation of the United States Office of Public Roads and the American Association for Highway Improvement with B. F. Yoakum, chairman of the Frisco lines, who is also a member of the executive committee of the American Association. The full government exhibit, showing the effect of good roads and bad roads with stereopticon views, electric models showing how roads are made and stone crushers at work, is on board the train. H. S. Fairbank, assistant field secretary of the American Association, is delivering lectures from the train, and at every stop is lending his aid in the formation of road improvement associations for the local communities. In his report to Secretary Pennybacker, he says that twenty such associations have been formed already, and that all have become affiliated with the American Association for Highway Improvement.

Technical Associations.

The Tri-State Water and Light Association of the Carolinas and Georgia, after a two days' session at Salisbury, N. C., selected the following officers for the ensuing year: President, W. F. Stieglitz, Columbia, S. C.; secretary-treasurer, J. W. Neave, Salisbury, N. C.

The Southwestern Water Works Association was recently organized in Temple, Tex., with the following officers: President, Patrick Bracken, of Temple; secretary-treasurer, E. L. Fulkerson, of Waco; vice-presidents, Messrs. T. J. Powell, of Fort Worth; R. L. Jones, of Houston; H. L. McDuffie, of Sherman; Thomas Cronin, of Palestine; C. E. Bartholomew, of Austin, and W. H. Butler, of Brownwood.

The regular meeting of the Colorado Association of Members of the American Society of Civil Engineers was held at the Colorado Traffic Club, Denver, Colo., May 11, 1912. The subject "Flumes" was discussed. G. N. Houston, Sec.-Treas.

At the 311th meeting of the New York Electrical Society, held at the Engineering Societies Building, 29 West 39th street, Wednesday, May 15, at 8 p. m. Dr. Charles Proteus Steinmetz lectured on "Wave Motion." George H. Gay is secretary of the association.

The regular monthly meeting of the American Society of Engineer Draftsmen, held on May 16, in the Engineering Societies Building, was marked by the admission to Junior Membership of Miss Marie Oberlander, a student of architectural drawing at Teachers' College, Columbia University. F. F. Hickel, M. E., consulting engineer to the Worthington Pump Co., delivered a lecture on "Practical Applications of the Slide Rule." Walter M. Smyth is secretary.

On account of other conventions in Denver on September 10, the directors of the International Association of Fire Engineers have, at the request of Chief Owens, changed the date of the meeting to September 17-20, James McFall, Roanoke, Va., Secretary.

The Fire Marshals' Association of North America has completed arrangements for the annual convention to be held in Detroit, Mich., July 11 and 12. The following will speak during the two days' session: John W. Zuber, of Ohio, on "Inspection;" J. R. Young, of North Carolina, "Prosecutions;" Joseph Button, of Virginia, "The Criminal Match;" Alfred A. Lindback, of Manitoba, "The History of the Organization," and C. A. Ellison, of West Virginia, "Fire Prevention and Its Effect on the Cost of Fire Insurance."

At the twenty-fifth annual convention of the Montana Society of Engineers, held at Anaconda, the following officers were elected: R. A. McArthur, president; John H. Klepinger, first vice-president; Reno H. Sales, second vice-president; Clinton H. Moore, secretary; Sam Barker, Jr., treasurer.

At a meeting of the city engineers of the state, the Montana Institute of Municipal Engineers was organized. The meeting was held at Helena, Mont., on May 11. Henry Gerharz, of Billings, was elected president; Charles W. Helmick, of Helena, vice-president, and Carl C. Widener, of Bozeman, secretary-treasurer. The officers, with M. L. Morris, of Great Falls, and William McLean, of Lewistown, compose the board of directors, which was also appointed a committee to draft a code of ethics.

At a regular meeting of the Municipal Engineers of the city of New York, May 22, 1912, a paper entitled, "The Story of the Maine," was presented by Colonel William M. Black, Corps of Engineers, United States Army.

R. K. Brown was elected president of the Utah Society of Engineers at the annual meeting, held in Salt Lake City. E. H. Beckstead and F. D. Ulmer were elected vice-presidents; L. H. Krebs, treasurer, and Prof. R. B. Ketchum, secretary.

Technical Schools.

Work has been commenced upon the construction of the new Ceramics and Mining Engineering Laboratories of the University of Illinois. The contracts for the new Transportation Building and the Locomotive Testing Laboratory will soon be let.

Henry E. Riggs, M. Am. Soc. C. E., of the Riggs & Sherman Co., Consulting Engineers, of Toledo, Ohio, has been appointed Professor and head of the department of civil engineering at the University of Michigan. Prof. Riggs graduated from the University of Kansas in 1886. He spent a number of years in railway work and was for six years Chief Engineer of the Toledo, Ann Arbor & North Michigan Ry. Since 1896 he has been in private practice in Toledo. It is the purpose of the University to expand the civil engineering courses to cover three other departments; a structural engineering course under Prof. A. E. Greene; Fgeodetic surveying under Prof. Clarence T. Johnson, and a course in sanitary and municipal engineering.

Francis S. Foote, Jr., has been appointed associate professor of railway engineering in the department of civil engineering at the University of California. Mr. Foote is at present a member of the instructing staff of the school of Railway Engineering and Administration at the University of Illinois. He is a graduate of Columbia University.

Prof. John H. Nelson has been appointed professor of applied mechanics at the Worcester Polytechnic Institute to succeed the late Prof. Edward L. Hancock. For the past three years Prof. Nelson has been in charge of the department of applied mechanics at the Case School of Applied Science, in Cleveland, and he was also formerly on the teaching staff in mathematics and mechanics at the South Dakota State College.

Calendar of Technical Meetings.

American Water Works Association. Annual convention, Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River street, Troy, N. Y.

Mayors' Conference of New York. Third annual meeting, Utica, June 10-12. Mayor C. C. Duryee, president, Schenectady, N. Y.; C. C. Capes, secretary, New York.

National Electric Light Association. Annual meeting at Seattle, Wash., June 10-14. T. C. Martin, secretary, 29 West Thirty-ninth street, New York City.

New York State Association of Fire Chiefs. Annual convention, Albany, N. Y., June 20-21. U. G. Lucas, secretary, Poughkeepsie, N. Y.

American Institute of Electrical Engineers. Annual convention, Boston, Mass., June 25-28. F. L. Hutchison, 33 West Thirty-ninth street, New York City.

American Society of Civil Engineers. Annual convention at Seattle, Wash., June 25-28. C. W. Hunt, 220 West Fifty-seventh street, New York City.

Society for the Promotion of Engineering Education. Annual meeting at Boston, Mass., June 26-28. H. H. Norris, secretary, Cornell University, Ithaca, N. Y.

National Municipal League. Annual meeting, Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American building, Philadelphia, Pa.

Fire Marshals' Association of North America. Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

New England Water Works Association Thirty-first annual convention, Washington, D. C., September 18-19. Willard Kent, secretary. Headquarters, Boston, Mass.

Central States Water Works Association. Sixteenth annual convention, Detroit, Mich., September 24-26. R. P. Bricker, secretary, Shelby, Ohio.

American Society of Municipal Improvements. Annual convention, Dallas, Texas, November 12-15. A. Prescott Folwell, secretary, 50 Union Square, New York City.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment. Seventy-first Regiment Armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway. New York, N. Y.

U. S. Civil Service.

The U. S. Civil Service Commission will hold examinations as follows:

June 5. Examiner of surveys in the field servce of the Department of Agriculture at entrance salaries of from $1,200 to $1,500 per annum. Computer in the Astrophysical Observatory, Smithsonian Institute, Washington, D. C.

June 10. Chief of drainage investigation in the office of experiment stations, Department of Agriculture, at a salary of about $4,000 per annum.

June 12. Laboratory assistant in the Bureau of Standards, at a salary of from $900 to $1,200 per annum.

June 26-27. Assistant to inspector of ordance, War Department, at a salary of $1,200 per annum.

C. H. Rust.

C. H. Rust, who has for the past thirty-five years been connected with the city engineering department of Toronto, Ont., Can., has resigned. For the last fourteen years Mr. Rust has held the position of city engineer, in which capacity he has directed a great many important public works, including extensive sewerage improvements and betterments of the water front.

Mr. Rust was elected a member of the Canadian Society of Civil Engineers in 1887, and in 1901 was made vice-president of that body. In 1911 he was elected president of this organization. He was interested in other engineering and municipal societies, having been elected a member of the American Society of Civil Engineers, the American Society of Municipal Improvements and the American Water Works Association.

C. H. RUST.

Mr. Rust has been appointed city engineer of Victoria, B. C., Can., at a salary of $6,800 per annum, which is a considerable increase over that of his former position. At Toronto George G. Powell is acting city engineer.

Personal Notes.

James P. Gaffney has been appointed city engineer of Cumberland, Md.

Carr Edwards, St. Charles, Mo., has been reappointed city engineer for a term of two years.

Israel R. Bart has been appointed superintendent of the Armstrong Water Company at Kittanning, Pa.

D. F. McCarthy has been reappointed city engineer and superintendent of streets, sewers and water of St. Albans, Vt.

Theodore A. Leisen has been reappointed chief engineer and superintendent of the water works of Louisville, Ky.

J. R. Ellis has resigned as city engineer of Columbia, Mo., to become assistant city engineer of Regina, Sask., Can.

Albert P. Haines has been appointed engineer in charge of the construction of roads for the city of Fort Worth, Texas.

William H. Connell has been appointed chief of the Bureau of Highways of Philadelphia, at a salary of $6,000 per annum.

C. H. Sweetser, consulting engineer, Olympia, Wash., has been appointed engineer in charge of the construction of highways for Pierce county, Washington.

James E. Carroll, for nine years past city engineer of Crookston, Minn., has been appointed assistant commissioner of public works, of St. Paul, Minn.

Dr. Rudolph Diesel, inventor of the Diesel engine, was elected an honorary member of the American Society of Mechanical Engineers at the meeting held on April 30.

James M. Porter, Pittsburgh representative for a number of paving brick and paving block manufacturers, has removed his office to 1842-43 Oliver building, Pittsburgh, Pa.

A. J. Hammond, consulting engineer of South Bend, Ind., and chief engineer of the Chicago Bureau of Public Efficiency until recently, has been appointed bridge engineer of Chicago. T. G. Pihlfeldt, who held this position for many years, has been retained as bridge designer.

Walter G. Kirkpatrick, Massena L. Culley, John E. McCorkle, Jr., and John R. Baylis have become associated under the firm name of Kirkpatrick, Culley, McCorkle & Baylis, for the practice of engineering in the Southern States, making a specialty of hydro-electric power developments and municipal improvements. The offices of the new firm are at 703 Farley building, Birmingham, Ala. Mr. Kirkpatrick has been engaged in this work for twenty-five years, with an office at Jackson, Miss., and has been recently appointed city engineer of Birmingham, Ala. Messrs. Culley, McCorkle and Baylis have been associated with him in engineering work for a number of years.

As a result of the recent election of a new municipal administration in Milwaukee, a number of changes have been made in the executive offices. Fred G. Simmons has been appointed commissioner of public works. Henry P. Bohmann has been appointed superintendent of water works. F. W. Blodgett, who was at one time engineer of the park board of Milwaukee, has been appointed as superintendent of street construction. C. O. Davis, formerly roadmaster of the Milwaukee Electric Railway and Light Company, has been appointed superintendent of street cleaning and garbage collection. J. C. Pinney, Jr., instructor in bridge engineering at Marquette University, Milwaukee, Wis., has been appointed superintendent of bridges and buildings.

MACHINERY AND TRADE

The National Police Signal System.

A complete telephone system, a light and alarm bell signal, and an automatic recording system are all embodied in the National Police Signal System, of which the first installation was made in Buffalo, N. Y.

An experience of more than twenty years in practical police signal work, coupled with wide technical experience as an electrician, has enabled the inventor of the National Police Signal System to perfect a device that eliminates entirely the register and tape apparatus and substitutes therefor absolute automatic sealed registry of movements of patrolmen to such a degree that the chief or other commanding officer knows at all times, day or night, just where every man on the force is located, and can talk with one or ten or fifty of them on a moment's notice. A patrolman may be summoned at once by gong or flashlight as desired.

The central station switchboard may be arranged for the operation of as many circuits as desired. It is so arranged that telephone communication can be held between any two patrol boxes or from any patrol box to any telephone on local telephone system.

A visible and audible signal is given at the switchboard during the operation of each patrol box, the signals remaining in continuous operation only when telephone communication is desired with the central office, and discontinuing when central office operator answers call. The operation of all patrol bixes is automatically recorded whether attendant is at switchboard of not.

The recorder consists of an electric time-recording device so arranged and mounted that the record remains in constant view for a period of eight, twelve, or as many hours as desired. The importance of having a record in view for a number of hours cannot be overestimated as a mere glance at the record shows every box pulled and enables the central office operator to quickly locate any patrolman. It is impossible for the central office operator to make false record of the operation of any patrol box.

The patrol box is iron clad, thoroughly coated with a moisture and acid proof compound. All apparatus is protected from moisture and dust by the iron case. The apparatus consists of a telephone transmitter, receiver and hook-switch, wagon or emergency call equipment and door switch for disconnecting all the apparatus from the line when outer door is closed. All wagon or emergency calls are automatically recorded.

Associated with each patrol box is a red lamp and a loud ringing bell; these being used to signal patrolman by day or night. As many lamps and bells as desired can be operated from any one patrol box. This permits locating these signals at points of vantage for signalling an officer. The lamps and bells associated with any one patrol box can be operated without operating those associated with any other patrol box, or all the lamps and bells on the entire system can be operated at the same instant.

Several devices have been designed for police signalling, but they are with one exception register and tape systems, and as such, they have many deficiences. The National Police Signal Company have perfected a device that eliminates entirely the register and tape apparatus, and substitutes therefor absolute automatic sealed registry of movements of patrolman to a degree that the chief or other commanding officer knows at all times, day or night, just where every man on the force is located and can talk with one or as many as desired at a moment's notice.

The National Police Signal System is not constructed in series. Should an open circuit or other trouble occur, it can only effect one box. In this system positive indication of an open circuit, grounded lines, etc., are given at the central office, and trouble can be repaired at once.

It is not necessary with this system to telephone a call for a patrol wagon, or to send in an emergency call verbally. The mere pressing of the wagon or emergency call button sends the necessary signal to the central office. This is of great convenience, especially to the patrolman handling an unruly prisoner.

Under this system reserve patrolmen can be sent on regular beats, thereby increasing the efficiency of the force and the efficiency of having men on hand is not impaired in the least as the central office operator can call all the patrolmen at a moment's notice and give special instructions.

The Superintendent of Police of Buffalo, Michael Regan, has expressed his satisfaction with the success of the system, as has

Rhinelander Waldo, Commissioner of Police of New York City. The system is manufactured and installed by the National Police Signal Co., 221 Ellwanger & Barry Building, Rochester, N. Y.

The New Factory of the H. W. Clark Co., Mattoon, Ill.

The H. W. Clark Co., of Mattoon, Ill., manufacturers of the Clark meter box and other water works appliances, have been forced to larger quarters by the rapid increase in their business during the past year or two. This new plant and equipment will not only better care for their present large business, but will permit of future growth.

The illustration on this page gives a fair idea of the magnitude of their new buildings, which have a floor space of over 45,000 square feet.

In is their intention to add, at a very early date, several new water works specialties to their line. In addition to their regular large line of meter housings, they are equipped for and are especially solicitous of business demanding special and out-of-the-ordinary requirements in meter box castings to meet local conditions.

The goods now manufactured by this company are known to practically every water works manager and superintendent, the Clark meter box having been adopted by many cities as the standard housing for all meters placed out of doors. They have a style and size of meter box to suit every condition of service and climate, as well as every size of meter or depth of service. Their "Teksagon" meter couplings eliminate the troubles of leaks and choked waterways experienced where gaskets are used. The Clark iron collapsible forms are being used very extensively by water works men who desire to make the box bodies for their meter boxes of concrete. They also manufacture special water works gauges, the "Clark sanitary well construction" and the "Clark perfect double-acting deep well pump plungers."

The company was incorporated a little over a year ago. The officers are: H. W. Clark, president; C. H. Tillotson, treasurer, and Dwight P. Child, secretary. They issue a very comprehensive catalogue, fully descriptive of their line, which will be forwarded to any one interested.

THE H. W CLARK FACTORY MATTOON, ILL.

Northwestern and Miracle Machinery Manufacturers Consolidated.

What is considered to be one of the largest deals ever consummated in the history of the concrete machinery manufacturers, in importance of the transaction, the money involved and in the interests affected, is the consolidation of the Miracle Pressed Stone Co., of Minneapolis, Minn., with the Northwestern Steel & Iron Works, of Eau Claire, Wis., for the manufacture of concrete machinery and tools.

Both concerns are very well known, do a large business and enjoy a high reputation among concrete workers and contractors. This consolidation will give them the distinction of being the largest makers of concrete machinery in the world.

The Northwestern line has been established for the past decade and its concrete making machinery and tools are used in every country on the globe. It meets the big demand for medium priced machinery and offers every conceivable kind of machine, tool or mold necessary for all kinds of concrete work.

The Miracle line, consisting of concrete machines of single and double staggered air-space, two-piece wall block machines, brick machines, mixers, tile molds, ornamental molds and molds for cornices, chimneys, piers, burial vaults, etc., is one of the oldest lines in existence.

The Minneapolis plant will be abandoned and all machinery, stock, etc., will be moved to Eau Claire, where the manufacturing will be done in the plant of the Northwestern Steel & Iron Works. This last step was taken because of adequate facilities, added conveniences and more space afforded at the Eau Claire plant.

A Small Portable Concrete Mixer.

A new concrete mixer has been placed on the market by Chain Belt Company to meet the demand for a machine of small capacity, that can be easily moved from place to place with one horse. It is particularly well adapted for the use of contractors who have occasion to do small jobs of sidewalk laying, and for use in the country in building silos, barn floors, troughs, etc.

The mixer shown in the accompanying photograph, is called the No. 00, and has the capacity of 4½ cubic feet of loose material, or 3½ cubic feet of mixed materials per batch. It is furnished with gasoline power, being provided with a three-horse power water cooled engine. This machine can also be rigged up with an electric motor. The drum, like those of all Chain Belt mixers, is made entirely of a special mixture of semi-steel, and is cast in two sections.

The mixing is accomplished by means of ¼-inch steel mixing blades and malleable iron buckets in the interior of the drum. On this machine, as with other Chain Belt mixers, gears are conspicuous by their absence, as the drum is driven by steel roller chain belt. The roller track surfaces of the drum and the rollers on which it rests are made of chilled semi-steel and there is the least possible opportunity for the moving parts to wear out.

It is manufactured by the Chain Belt Company, Milwaukee, Wis.

A SMALL PORTABLE CONCRETE MIXER.

A Detachable Electric Row Boat Motor.

The Jewel electric boat propelling device is attracting the attention of hunters, fishermen, automobilists and pleasure seekers at summer resorts.

This portable device weighs complete twenty-five pounds and can be attached to any canoe or row boat by means of adjustable clamps.

The electrical motor is mounted vertically on a supporting tube and is said to have a maximum speed of 2,500 r. p. m. Two 6-volt 60-ampere hour storage batteries connected in series supply current for the motor. The motor is direct connected to a vertical transmission shaft about two feet above the water line.

The power is transmitted to a pair of special gears somewhat similar to the worm gear type. The circular gears operate in a gear housing below the water line and change the vertical power transmission to the horizontal propeller shaft.

The Jewel detachable row boat motor is manufactured by the Jewel Electric Co., located at 1122 South Michigan avenue, Chicago, Ill.

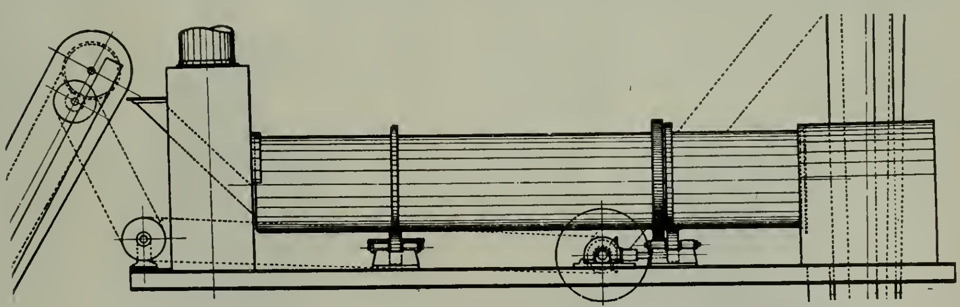
A Correction.

Due to a typographical error, the address of the Des Moines Bridge and Iron Co., which was given on page 419 of the May issue, was stated to be 912 Casey Building. It should have been 912 Curry Building, Pittsburg, Pa.

Portable Dryer.

It is usually found that the ordinary portable sand and stone dryer or heater is difficult to move from point to point on account of excessive weight. The machine shown in the drawing is designed for portable and semi-portable work. It is light and simple in design, yet all parts are made strong and durable, no sacrifice being made in any case to secure lightness at the expense of strength.

The American process direct heat dryer is of the direct heat and direct contact type. It consists essentially of a cylindrical steel shell, provided on the interior with longitudinal shelves. Near each end of the shell is a weldless rolled steel tire which rests on carefully chilled and ground friction wheels. These wheels are rotated by gearing or chain belting, and they in turn impart rotation to the shell. The dryer as a whole is set on a gentle slope, determined and fixed by experience.



THE AMERICAN PROCESS PORTABLE DRYER.

The operation of the machine is simple and thorough. The wet material enters the shell at the higher end, falls to the bottom of the dryer, is caught by a shelf, elevated to almost the highest point of the rotation, and is then showered through the furnace gases. This cycle of operations is repeated until the material, in a dried condition, is discharged from the lower end of the dryer. The motion of the material towards the discharge is because of the slope of the dryer. The material travels in the opposite direction to that of the hot gases in order to bring the highest temperature in contact with the dry material thus heating the material to any temperature required. The driving arrangement for conveyors going to and from the dryer or heater is simple in design and does not require much power.

The manufacturers, the American Process Company, 68 William street, New York City, make a specialty of dryers and have made a study of a type to secure maximum capacity with a minimum amount of fuel and lowest possible cost for repairs. The moving parts are few and so constructed that the wear is small and entirely confined to parts easily repaired or replaced at small cost. The wearing parts are all exposed and can be watched by the operator without taking him from other duties, and it is claimed that the machine is altogether the most economical and inexpensive on the market.

The H. W. Johns-Manville Co. Moves to Larger Quarters.

The executive offices and New York show rooms of the H. W. Johns-Manville Co., manufacturers of asbestos, magnesia and electrical supplies, were moved on April 20, from their old quarters at 100 William street, to the new twelve-story H. W. Johns-Manville building, Madison avenue and Forty-first street, New York City.

This move marks the fifty-fourth annivercary of the company. Under the name of H. W. Johns Manufacturing Co. the business was conducted at 87 Maiden Lane, previous to May 1, 1897, when it was moved to 100 William street. In 1901 the firm name was changed to H. W. Johns-Manville Co., a consolidation being effected between the Manville Covering Co., of Milwaukee, Wis., and H. W. Johns Manufacturing Co. This last combination brought together two of the largest manufacturers of pipe and boiler coverings, packings, roofings, etc., in the world, and the growth of the company since that time has been marked.

They now have factories located in Brooklyn, N. Y., Milwaukee, Wis., West Milwaukee, Wis., Hartford, Conn., Nashua, N. H., Lockport, N. Y., and Newark, N. J., with an asphalt refinery at South Amboy, N. J., and extensive asbestos mines at Danville, in the

Province of Quebec, Canada, which are the largest in existence and produce an exceptionally fine grade of asbestos. They also have a branch house in every city of any size in the United States and Canada, as well as representatives in about all foreign countries.

In the new quarters the company will occupy an entire twelve-story office building. In its entirety the company now occupies over 2,657,160 square feet of floor space, or about 61 acres. The employes number approximately 5,000 and there are about 425 salesmen.

The Matchless Sanitary Street Cleaning Machine.

A recent "municipal parade" in an enterprising western city furnished an object lesson in the lack of efficiency in our street cleaning methods. Following the line of modern street rotary brooms, and flushers, came a straggling line of ordinary boxes on wheels, each containing a shovel, and propelled by one able-bodied workman. Following these came a double number of laborers, each with a flat scoop which he pushed before him as he marched. It was thus demonstrated to the citizens who watched the parade, that it took two men to serve each of these push carts, or three men for each street dirt carrier.

In contrast to this is the Matchless Street Cleaner, manufactured by the Matchless Cleaner Company, Troy, N. Y. In this case only one man is required to quickly and efficiently operate each street cleaning unit. The machine consists of a two-wheeled cart, strongly built of steel throughout, with light wooden wheels. The dust pan, which is the distinctive feature of the machine, is attached to the cart by a revolving arm. The pan is constructed of galvanized iron, with a blade 28 inches long and 6 inches wide, made of spring steel.

The method of using the machine is so simple as to make its efficient use possible, even to the most unskilled labor. The cart is pushed to the part of the street to be cleaned, and the dust pan lowered to rest upon the pavement a short distance beyond the dirt to be gathered. The dirt is then swept by means of a push broom, into the pan which rests in contact with the even surface of the pavement. With the last push of the broom, the brush is left in the pan while the machine is pushed to the next section of pavement to be cleaned. When the dust pan is sufficiently filled, or when it is desired to move the machine for some distance, the mere action of taking the handle of the machine to pull it to its next location, causes the pan to be raised and be emptied into the metal receptacle of the cart.

The Matchless machine dispenses entirely with the use of shovels and scrapers; and the saving of time by its operation is an item which will materially increase the area cleaned by each machine.

Sweeping Position.

Dumping Position.

THE MATCHLESS STREET CLEANER.

An Efficient Weed Killer.

A weed killer to be thoroughly satisfactory for use in parks and cemeteries and on other public work should possess, in addition to its property of destroying vegetation, the elements which render it stainless and non-injurious to stone, metal or woodwork. These attributes are stated to be true of the Key Brand Weed Killer, manufactured by the Interstate Chemical Company, 120 Bayview avenue, Jersey City, N. J.

The preparation is put up in cases and barrels. Before application to the roadway it is mixed with 40 parts of water, and it is spread by means of a sprinkling can or watering cart. The effects of this treatment are said to be much more permanent than the old procedure.

Its use is recommended for the permanent clearing of roadways, paths, streets, gutters, tracks and playgrounds of weeds and grass, for the reason that one application of a gallon for each 25 square feet is said to be effective for several years. It is supplied in barrels, kegs and cans.

Association of American Cement Manufacturers.

The session of the Association of American Portland Cement Manufacturers at the Hotel LaSalle, Chicago, on May 9, was devoted entirely to the subject of good roads and the use of concrete in their construction. The speakers were Logan Waller Page, director Office of Public Roads, Washington, D. C.; Wm. M. Pindell, president Dolarway Paving Co., New York City; W. P. Blair, secretary National Paving Brick Manufacturers Association, Cleveland, Ohio; Edward N. Hines, road commissioner Wayne county, Detroit, Mich., and J. S. McCullough, city engineer, Fond du Lac, Wis.

After the conclusion of the program a special train was chartered and the entire party went to Ann Arbor and Detroit on an inspecting tour of the concrete road work in and near those cities. At Ann Arbor, City Engineer Groves conducted the party on an automobile trip over all the pavements which have been built under his direction. At Detroit, the Wayne county roads were inspected under the guidance of Commissioner Edward N. Hines. In the evening the entire party were the guests of Edward M. Hagar, president of the association, at dinner at the Hotel Pontchartrain.

Trade Publications.

The United States Wood Preserving Company, 71 Broadway, New York City, have prepared a handsomely illustrated booklet devoted entirely to the use of their creosoted wood blocks upon bridges. The roadways and superstructures of about 25 interesting bridges are shown, together with drawings illustrating the use of wood block in bridge flooring.

The April issue of Paving and Roads, issued by the Texas Company, Battery Place, New York City, contains among other articles the following: Extracts from the report of W. W. Crosby to the State Roads Commission of Maryland; Equipment for surfacing roads by the penetration method, by H. Tipper; and the Report of the Association for Standardizing Paving Specifications.

"The Lehigh," published by the Lehigh Portland Cement Co., Peoples Gas Building, Chicago, contains for this month some general material of interest to their distributers, some photographs of the Cleveland Short Line Railway, and the use of cement thereon, and some advertising helps for the dealer.

The Universal Portland Cement Co., Chicago, is publishing a monthly booklet, called the "Permanent Pavement." It is a live publication, which, though frankly devoted to the cause of concrete roads, contains in addition to valuable matter along this line some interesting data which concern the cause of good roads in general. The current issue contains some description of the highway organizations in a number of the states, a discussion of the attitude of railroads toward good roads, and some interesting descriptive matter on concrete pavements.

The Fort Worth Advertising Men's Club prepared a very attractive book of views of the city in anticipation of the visit of The Associated Advertising Clubs of America, which was held on May 22nd.

The Goulds Manufacturing Company, 131 West Fall street, Seneca Falls, N. Y., have issued Bulletin Number 112, devoted to handy data on power pumping. It contains matter relative to pumps, their installation, operation, economy, capacities and rates of suction and discharge; piping, including standard dimensions for wrought iron and light well casing, and a table for equalizing pipes; power, including rules for determining the size and speed of gears, data on shaft transmission, etc.; water, including tables of equivalents, pressure at different heads, friction, discharge, and tables of discharge for nozzles and effective fire streams; and some general information on making estimates for pumping equipment, together with general tables. The Bulletin possesses a great deal of useful information in a very convenient form.

The Universal Portland Cement Co. has issued the fifth edition of the book, "Cement Sidewalks." This is a comprehensive and instructive treatment of the correct methods of laying concrete walks and has been in very wide demand. Copies are sent out by the company free of charge.

Trade Notes.

Birmingham, Ala.—The Birmingham Railway, Light and Power Company plans to place all electric wires under ground at a cost of about $260,000.

San Diego, Cal.—A $75,000 bond issue for playground improvement has been voted. Allen H. Wright, city clerk.

Springfield, Ill.—The purchase of an automobile patrol wagon is contemplated. Chief Underwood.

New York, N. Y.—Dana Pierce, an electrical engineer, has been put in charge of the New York office of the Underwriters' Laboratories as electrical engineer of the Laboratories. He is in position to afford electrical manufacturers through testing stations in both Chicago and New York improved facilities for obtaining opinions and reports upon their products with increased promptness and efficiency.

Akron, O.—Thomas E. Rook has been appointed western sales manager for the American Sewer Pipe Company and will have charge of the territory west of New York and Pennsylvania. Mr. Rook was with the American Steel & Wire Co., and more recently was vice-president and manager of the Cleveland Coal Co., Cleveland, O.

Massillon, O.—The Massillon Iron & Steel Co., has been thoroughly reorganized with ample working capital and is now in full operation, turning out hub and spigot, and flange pipe and fittings as well as a general line of heavy castings and machine work.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bedford, Ind.—June 4, 1 p. m. Constructing 6 gravel or macadam roads in Marion, Shawswick, Guthrie and Perry twps. Ezra W. Edwards, audt.

Bloomington, Ind.—June 5, 2 p. m. Constructing stone roads in Bloomington and Washington twp. Horace Blakely, audt.

Bluffton, Ind.—June 6, 10 a. m. Constructing gravel road on line between French and Harrison twps. L. A. Williamson, audt. Wells Co.

Brazil, Ind.—June 7, 11:30 a. m. Constructing limestone road in Brazil twp. Edgar A. Staggs, audt.

Crawfordsville, Ind.—June 4, 10 a. m. Constructing highways in Coal Creek and Union twps. Bennett B. Engle, audt.

Corydon, Ind.—June 5, 2 p. m. Constructing gravel and macadamized roads in Harrison twp. William Taylor, audt.

Frankfort, Ind.—June 6, 2 p. m. Constructing 12 gravel roads. Chas. F. Cromwell, audt.

Huntington, Ind.—June 3, 10 a. m. Constructing a gravel road in Huntington twp. Harold Guthrie, audt.

Indianapolis, Ind.—June 3, 10 a. m. Constructing sidewalks along Fall Creek Parkway. T. L. Lowry, engr., board of park comrs.

Kentland, Ind.—June 3, 2 p. m. Constructing macadamized road in Iroquois rd. E. R. Bringham, audt.

Lafayette, Ind.—June 5, 10 a. m. Constructing 3 gravel rds. Geo. W. Baxter, audt.

Marion, Ind.—June 4, 2 p. m. Constructing highways in Jefferson, Mill, Center, Franklin, Richland and Pleasant twps. E. H. Kimball, audt.

Marion, Ind.—June 13, 2 p. m. Constructing gravel rd. on line between Huntington and Grant counties. E. H. Kimball, audt. of Grant Co.

Newport, Ind.—June 3, 10 a. m. Constructing gravel rds. in Highland twp. H. T. Payne, audt.

Noblesville, Ind.—June 4, 2 p. m. Constructing 2 gravel rds. in Clay twp. Geo. Griffin, audt.

Osgood, Ind.—June 7. Improving Cravens st. and constructing concrete walks. M. F. Hollman, Village prest.

Portland, Ind.—June 3, 10 a. m. Constructing gravel rd. in Jackson twp. John Bonifas, audt.

Richmond, Ind.—June 5, 11 a. m. Improving a highway in Wayne twp. Lewis F. Bowman, audt.

Rushville, Ind.—June 4, 2 p. m. Constructing gravel rds. in Ripley and Center twps. J. M. Stone, audt.

Sullivan, Ind.—June 4, 12 m. Constructing 2 stone rds. in Hadon twp. W. F. Bicknell, audt.

Wabash, Ind.—June 4, 1:30 p. m. Constructing 2 gravel and macadamized rds. in Liberty twp. Daniel Showalter, audt.

Washington, Ind.—June 4, 2 p. m. Constructing 4 gravel rds. Lew S. Fuller, audt.

Winamac, Ind.—June 4, 12 m. Constructing 2 rds. W. E. Munchenberg, audt.

Clinton, Ia.—June 4. Constructing 13,000 sq. yds. of wood block, vitrified brick, sheet asphalt and concrete paving, and 3,750 lin. ft. of curb and gutter. Certified check $1,000. J. B. Throne, city engr.

Waverly, Ia.—June 4. Constructing 34,000 sq. yds. of paving and 16,000 lin. ft. of curb. Bid will be taken on bitulithic, sarcolithic, mineral rubber, Portland cement concrete, asphaltic concrete, Dolarway and brick block. S. A. Lee, city clk.; Ralph B. Slippy, city engr. 401 Marsh-Place Bldg., Waterloo, Ia.

Jackson, Miss.—June 4, 2 p. m. Paving W. Capitol st., S. State st., Hamilton st., with brick, bitulithic, wood block, sheet asphalt, petrolithic, Dolarway, granitoid, or other pavement. Certified check 5 pct. J. S. M'Leod, st. comr.

Albany, N. Y.—June 3, 1 p. m. Road construction as follows: Allegheny co., 6.1 mi.; Broome co., 6.05 and 8.9 mi.; Cayuga co., 11.52 mi.; Chautauqua co., 5.97 mi.; Cattaraugus co., 0.78, 4.52, 1.21 and 2.27 mi.; Dutchess co., 2.97 mi.; Erie co., 3.79 and 1.11 mi.; Franklin co., 2.07 mi.; Greene co., 3.39 mi.; Hamilton co., 6.01 mi.; Jefferson co., 5.31, 11.50 and 1.07; Niagara co., 2.79 and 6.65 mi.; Oneida co., 18.04 mi.; Onondaga co., 4.84, 7.72 and 0.19 mi.; Oswego co., 12.8, 2.79, 3.09 mi.; Rensselaer co., 0.67 mi.; St. Lawrence co., 14.92 mi.; Schenectady co., 4.16 mi.; Tompkins co., 3.10 mi.; Westchester co., 5.22 mi., and Yates co., 1.75 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state engr.; Duncan W. Peck, supt. of pub. wks.

Albany, N. Y.—June 4, 1 p. m. Road construction as follows: Albany co., 0.43 and 0.46 mi.; Allegheny co., 9.9 mi.; Broome co., 3.15 mi.; Clinton co., 2.24 and 8.25 mi.; Cayuga co., 2.75 mi.; Columbia co., 6.17 mi.; Chautauqua co., 5.53 mi.; Cattaraugus co., 6.74 mi.; Erie co., 2.6 and 1.86 mi.; Greene co., 4.62 and 6.13 mi.; Hamilton co., 7.82 mi.; Jefferson co., 7.32 mi.; Monroe co., 3.43 mi.; Nassau co., 1.24 mi.; Niagara co., 3.16 and 6.81 mi.; Onondaga co., 4.32, 3.31, 1.03 mi.; Orange co., 3.88 mi.; Oswego co., 8.15 and 6.17 mi.; Saratoga co., 7.52 mi.; Seneca co., 4.02 mi.; Sullivan co., 10.95 mi.; Tompkins co., 6.26 mi., and Suffolk co., 12.92 mi. Certified check 5 pct. on each bid. C. Gordon Reel, supt. of highways; John A. Bensel, state engr.

Albany, N. Y.—June 5, 1 p. m. Road construction as follows: Albany co., 4.21 mi.; Broome co., 3.21 mi.; Clinton co., 1.79 mi.; Cayuga co., 1.40 mi.; Chautauqua co., 21.15 mi.; Cattaraugus co., 4.49 mi.; Delaware co., 13.43 mi.; Erie co., 3.49, 3.15 and 4.20 mi.; Franklin co., 5.49 mi.; Jefferson co., 8.45 and 13.39 mi.; Livingston co., 1.25 and 6.32 mi.; Monroe co., 6.63 mi.; Niagara co., 2.52 and 5.13 mi.; Oneida co., 7.78 and 0.83 mi.; Onondaga co., 3.42, 0.49 and 11.11 mi.; Oswego co., 42.25 and 5.23 mi.; Ontario co., 7.37 mi.; Orange co., 5.86 mi.; Orleans co., 4.62 mi.; Putnam co., 6.27 mi.; Rensselaer co., 3.66 mi.; St. Lawrence co., 10.26 and 8.91 mi.; Schenectady co., 1.38 mi.; Warren co., 3.53 mi. Certified check 5 pct. on each bid. C. Gordon Reel, supt. of highways; J. A. Bensel, state highway engineer.

Albany, N. Y.—June 6, 1 p. m. Road construction as follows: Cortland co., 0.87 mi.; Chenango co., 5.16, 4.73 mi.; Chemung co., 5.47 and 4.37 mi.; Essex co., 2.13 and 3.69 mi.; Lewis co., 1.31 mi.; Livingston co., 2.12, 4.26 and 2.92 mi.; Madison co., 0.43 and 4.23 mi.; Onondaga co., 4.24, 7.59, 6.08 and 10.48 mi.; Oswego co., 6.37 and 5.72 mi.; Saratoga co., 1.03 and 1.75 mi.; Steuben co., 3.90 mi.; St. Lawrence co., 5.99, 5.37, 4.58 and 1.0 mi.; Schuyler co., 6.56 and 5.15 mi.; Suffolk co., 3.88 mi.; Tompkins co., 6.67 and 1.17 mi.; Tioga co., 3.65 mi.; Westchester co., 7.34, 7.07 mi.; Washington co., 6.01 mi.; Tioga and Broome cos., 10.72 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state highway engineer.

Albany, N. Y.—June 7, 1 p. m. Road construction as follows: Chenango co., 3.0, 3.81 and 2.33 mi.; Chemung co., 12.39 mi.; Delaware co., 13.37 mi.; Essex co., 2.19, 2.21 and 6.06 mi.; Clinton co., 4.97 mi.; Fulton co., 1.01 mi.; Lewis co., 4.60 mi.; Livingston co., 7.21, 5.51, 3.43 mi.; Madison co., 5.09 mi.; Montgomery co., 6.20 mi.; Niagara co., 7.95 mi.; Otsego co., 12.21 mi.; Rockland co., 4.47 mi.; Seneca co., 6.88 mi.; Steuben co., 3.92 and 17.19 mi.; St. Lawrence co., 11.66, 2.51, 4.09, 4.08 and 6.56 mi.; Suffolk co., 11.25, 1.32 and 1.04 mi.; Sullivan co., 8.51 and 1.37 mi.; Tioga co., 9.83 mi.; Wayne co., 7.0 mi.; Wyoming co., 3.52 mi, and Rensselaer co., 0.51, 0.95 and 1.58 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state engineer.

Cleveland Heights, O.—June 18, 12 m. Furnishing material and oiling a number of rds. in and around the village. H. H. Canfield, city clk.; The F. A. Pease Engr. Co., 931 Williamson bldg., Cleveland, O., engrs.

Columbus, O.—June 4, 2 p. m. Road construction as follows: Engrs. est. No. 378, macadamizing the Gibson-Snouffer rd. in Perry twp.; certified check, $200; engrs. est. No. 379, including Harrisburg and Georgesville rd. in Pleasant twp.; certified check, $500; engrs. est. No. 382, including the Columbus and Westerville rd. in Blendon twp.; certified check, $500. John Scott, clk. bd. of Franklin co. comrs.

Norwalk, O.—June 5, 1 p. m. Road construction as follows: I mi. of concrete roadway on the Fairfield rd.; 1¼ mi. of macadam roadway on the Old State rd. Certified check, $300, on each bid. A. E. Ward, clk. of Bronson twp.

Steinersville, O.—June 4. Macadamizing 2.4 mi. or rd. in York twp. G. L. Bonar, clk., Powhattan Point, O.

Steubenville, O.—June 14. Constructing the Bantam Ridge rd. in Jefferson co. O. J. M. Thompson, chr. rd. comrs.

Pittsburgh, Pa.—June 13, 10 a. m. Constructing Versailles extension and the Bristol rd. Certified check $100 on each bid. R. G. Cunningham, co. audt.

Davenport, Wash.—June 7, 1:30 p. m. Surfacing roadway and constructing 16,583 ft. of permanent highway in Lincoln co. J. W. Brislawn, clk. bd. co. comrs.

Wenatchee, Wash.—June 6, 10 a. m. Constructing permanent highways Nos. 2 and 3, the first, 6,560 ft., and the second, 11,824 ft. T. S. Gellatly, audt. of Chelan co.

CONTRACTS AWARDED.

Los Angeles, Cal.—Paving Alvarado st. with vitrified brick, to the Fairchild-Gilmore-Wilton Co., Los Angeles, Cal., $36,997.

Hartford, Conn.—Macadamizing 2,256 ft. on Lincoln st., to the Pierson Engr. Co., Bristol, Conn.

Aurora, Ill.—Paving 7 East Side sts., to the McCarthy Improvement Co., Davenport, Ia.

Bement, Ill.—Paving Bodman st., to Wm. F. Lodge and James P. Lodge, Monticello, Ill., $16,634.

Freeport, Ill.—Paving Iroquois st., to the Gund-Graham Co., Freeport, Ill., $10,001.

Brazil, Ind.—Constructing the R. L. Kennedy rd., to Hawkins Bros., $13,163.

Greensburg, Ind.—Constructing macadam road in Sandcreek twp., to Ralph Davis, Greensburg, $12,420.

Hartford City, Ind.—The following road contracts have been awarded: Constructing the Blair rd., to Geo. Saunders, Muncie, Ind., $6,728; constructing the Fleming-Futrell rd., to S. T. Williams, Hartford City, Ind., $12,850.

Terre Haute, Ind.—Constructing the Haynes gravel rd., in Nevin twp., to Hawkins Bros., Brazil, Ind., $13,739; constructing the Trueblood rd., in Nevin twp., to Wood & Vangilder, $9,960.

Mason City, Ia.—Constructing 45,000 sq. yds. of concrete pavement, to Geo. Gabler, Mason City, Ia.

Rock Island, Ill.—The following paving contracts have been awarded: 2nd ave., repaving, to the McCarthy Improvement Co., $25,900; 4th ave., to the Independent Construction Co., about $10,000; 6th ave., to the McCarthy Improvement Co., $3,804.

Manhattan, Kan.—Paving Bluemont ave., to Peak & Stingley, Manhattan, Kan.

Pittsburg, Kan.—Paving Jefferson ave., to Thogmartin & Gardiner, Ft. Scott, Kan.

Shreveport, La.—Paving Cedar and Laurel sts., to the Southern Bitulithic Co.

Baltimore, Md.—The following paving contracts have been awarded: Vitrified brick, to the Cunningham Paving & Construction Co., Baltimore, Md., $35,998; wood block paving, to the United States Wood Preserving Co., 165 Broadway, New York City.

Boston, Mass.—The following paving contracts have been awarded: For wood block pavement in Hammont st., to the Fred S. & A. D. Gore Corp., $17,831; for wood block pavement in Massachusetts ave., to the Fred S. & A. D. Gore Corp., $32,179.

Boston, Mass.—The following paving contracts have been awarded: Washington st., with wood block, to William J. Barry, $105,299; Massachusetts ave., with wood block, to the Fred S. & A. D. Gore Corp., $32,179; Hammond st., with wood block, to the A. G. Coleman & Sons Co., $18,782.

Luverne, Minn.—Constructing 4½ mi. of state rd. No. 1, to Henry Enke, Lake Wilson, Minn.

St. Louis, Mo.—The following street improvement contracts have been awarded by the board of local improvement: Improving John st. with brick, to John McMahon, $2,244; improving Gasconade st. with brick, to Eyerman Construction Co., $3,174; improving Grace ave. with brick, to Eyerman Construction Co., $8,072; improving Newhouse ave. with brick, to John McMahon, $3,357; improving Shaw ave. with brick, to Eyerman Construction Co., $26,365. Reconstructing Arsenal st. with brick, to Eyerman Construction Co., $7,726; reconstructing Cherokee st. with brick, to Eyerman Construction Co., $3,701; reconstructing Mound st. with brick, to John McMahon, $3,413; reconstructing N. Market st. with brick, to John McMahon, $31,588. Improving Delmar bvd. with wood block, to Harry F. Heman, $7,732; improving Delmar bvd. with wood block, to Granite Bituminous Paving Co., $15,112. Reconstructing Locust st. with wood block, to Eyerman Construction Co., $16,748; reconstructing Olive st., to Eyerman Construction Co., $8,678.

Helena, Mont.—The following paving contracts have been awarded: Helena ave. with brick, to Smith & Saner, $14,344; Railroad st. with brick, to Louis Johnson, $22,332; Davis st., to Louis Johnson, $4,439.

Helena, Mont.—Paving construction in the 9th ave. improvement district, to the Miracle-Tripp Concrete Co., $24,811.

Missoula, Mont.—Paving a number of sts. with brick, to Geo. Dietrich, Seattle, Wash., $58,728.

Albany, N. Y.—The following extensive road contracts have been awarded. Albany city line to Watervliet with brick, distance 2.45 mi., to John B. Dover, Ballston Spa., $61,125; East Berne to Glyckmans Church, 4.36 mi., to Ruddy & Saunders Construction Co., Troy, $41,215, and Feura Bush to Indian Fields, 8.27 mi., to Herlihy Constructing Co., Glens Falls, $81,406. Rensselaer County—Speigletown to Melrose, 2.55 mi., to Corliss Construction Co., Troy, $26,720; De Freestville to Couse, 3.14 mi., to Arnold & Shearer, Albany, $34,471; 0.41 mi. in Nassau village, to County Construction Co., Troy, $5,606; Cropseyville to Grafton, 5.93 mi., to Snead & Wilson, Brown's Sta., $68,799; Wyantskill to DeFreestville, 4.10 mi., to William Paterson, Albany, $33,362, and 0.29 mi. in Nassau village, to the County Construction Co., Troy, $4,083. Greene County—Cairo hamlet, 0.46 mi., to Catskill Supply Co., Catskill, $5,197; Saugerties to Catskill, 3.87 mi., to Rosseau & Parker, Hudson, $46,582, and Hunter to Winham, 6.27 mi., to S. B. Van Wagenen, Rondout, $74,555. Washington County—Hudson Falls to Fort Ann, 8.23 mi., to James Anderson, Albany, $63,362. Clinton County—1.28 mi. in Battleman, to Spellman-Oliver Co., Chateaugay, $15,498. Otsego County—1.93 mi. in Unadilla village, to Hollington Co., Troy, $39,427. Saratoga County—Stillwell to Schuylerville, 5.38 mi., to W. G. Fox, Saratoga Springs, $60,538.

Canton, O.—Paving the Louisville rd. for a distance of 2½ mi., to W. H. Voght & Son, Massillon, O.

Cambridge, O.—Constructing 2 mi. of rd., to Adams Bros., Zanesville, O., $16,000.

Girard, O.—Paving and constructing storm water sewers on State st., to Turner & Olsen, Youngstown, O., $84,224.

Youngstown, O.—The following paving contracts have been awarded: Mt. Pleasant st. to James McCarren, $17,276; Earle ave., to Kennedy Bros., $12,474; Erie st., to A. Serafino, $4,971; Garland ave., to Turner & Olson, $1,007.

Hillsboro, Ore.—Constructing asphalt macadam and asphalt pavement, to the Barber Paving Co., $118,000.

Portland, Ore.—Constructing 2 mi. of Warrenite pavement, to Warren Bros. Co.

Salem, Ore.—Constructing ¼ mi. of Dolarway concrete paving, to the W. Geiger Contracting Co., Salem, Ore.

Pittsburgh, Pa.—The following extensive paving contracts have been awarded by the board of public works, Joseph G. Armstrong, director: Repaving with blockstone, Penn ave., to H. C. Howard, $27,821; Selby ave., to Thomas Cronin Co., $6,848; W. Carson st., to Booth & Flinn, $2,195; Wilkins ave., to Thomas Cronin Co., $8,747; Liberty ave., to H. C. Howard, $8,582. Repaving with wood block, Sandusky st., to M. O'Herron Co., $2,156; Ohio st., to H. C. Howard, $16,373; repaving with brick, Pretense alley, to J. H. Sheets, $1,340. Repaving with asphalt, Penn ave., to Booth & Flinn, $8,837; 5th ave., to Booth & Flinn, $21,646; Perrysville ave., to Booth & Flinn, $18,462. Grading, paving and curbing with brick, Loretta st., to M. O'Herron Co., $9,749. Grading, paving and curbing with blockstone, Merriman alley, to Thomas Cronin Co., $1,967.

Chattanooga, Tenn.—The paving of Glass st., to G. L. Coffey & Co., Chattanooga, Tenn., $17,100.

Dallas, Tex.—Paving Exposition ave., to the Roach-Maning Paving Co., Fort Worth, Tex., $56,157.

Cashmere, Wash.—Constructing concrete sidewalks and curbing, to C. H. Payne, Spokane, Wash., $17,605.

Bellingham, Wash.—Paving 15th st., to Peterson, Wevel & Hawkins, $15,229.

Olympia, Wash.—Paving E. 4th st. with asphalt, to W. A. Weler, Olympia, Wash., $32,471.

Seattle, Wash.—The following road improvement contracts have been awarded: Replanking Railroad ave., to J. A. McEachern Co., Bailey bldg., Seattle, Wash., $22,970; grading 42nd ave., S., to Marx, Russell & Gallagher, Bailey bldg., Seattle, Wash., $15,210.

South Bend, Wash.—The following paving contracts have been awarded: Bitulithic paving, to the Barber Asphalt Paving Co., $15,658; regrading the Water st. hill, to the Jahn Construction Co., Seattle, Wash., $13,605.

Tacoma, Wash.—Paving the Point Defiance Park rd., to Joseph Warder, Tacoma, Wash., $19,525.

Walla Walla, Wash.—Constructing pavement in 10 to 12 alleys, to Tribou Blackman, Walla Walla, Wash., $10,344.

Wheeling, W. Va.—The paving of S. McCullough st., from Baker st. to 12th st. with brick paving on concrete foundation, to Coss & Meyer, $15,340.

CONTEMPLATED WORK.

Fort Smith, Ark.—The construction of 200,000 sq. yds. of paving in the original paving district is contemplated.

Marysville, Cal.—The paving of 4th and 5th sts., to cost about $25,000, is contemplated.

Carrollton, Ga.—A $10,000 bond issue for street improvement has been voted.

Fitzgerald, Ga.—A $120,000 bond issue for paving improvement has been voted.

Burnham, Ill.—A $10,000 bond issue for paving construction has been voted.

Carlyle, Ill.—The paving of about 2 mi. of streets is contemplated for the early fall. Ben Bond, secy. bd. of loc. imp.; F. A. Lietze, engr.; H. G. Webber, special counsel.

Freeport, Ill.—The improvement of Taylor ave. and Hendrickson st. for the construction of a storm sewer and brick paving on a concrete foundation, to cost about $35,000, is contemplated. City Engr. Hepner has prepared plans and estimates.

Pontiac, Ill.—The construction of 29 blocks or about 1½ mi. of brick paving on concrete base is contemplated. T. B. Knight, city engr.

Bluffton, Ind.—The co. comrs. have signed bonds for 20 gravel and stone rds. in Wells co., the estimated cost of which is $84,140.

Marion, Kan.—H. A. Rowland, McPherson, Kan., has been retained to prepare plans and specifications for 15,000 yds. of paving.

McPherson, Kan.—The city council has passed resolutions for paving 10 blocks of sts., to be completed this summer. H. A. Rowland, city engr.

Wichita, Kan.—City Engr. Bert C. Wells has prepared estimates on paving to cost about $59,000.

Pineville, Ky.—A $600,000 bond issue for road construction has been voted by Bell co.

Bad Axe, Mich.—An $18,000 bond issue for road construction has been voted by Sheridan twp.

Oxford, Miss.—Lafayette co. has voted $200,000 bond issue for road construction.

Warrensburg, Mo.—A $40,000 bond issue for street improvement and sewer construction has been voted.

Hickory, N. C.—A $50,000 bond issue for road construction has been voted by Catawba co.

Montclair, N. J.—The paving of Orange rd. and Upper Mountain ave., to cost $195,000, is contemplated.

Ventnor City, N. J.—A $25,000 bond issue for street improvement has been voted.

Au Sable Forks, N. Y.—A $10,000 bond issue for road construction has been voted.

Buffalo, N. Y.—The supervisors have provided $110,000 for their portion, 35 per cent., on the following roads to be improved: Glenwood-Holland, 3.14 miles, estimated cost $67,500; Sand Hill road, 1.11 miles, estimated cost $53,900; Water Valley-Clarksburg road, 2.89 miles, estimated cost $49,000; Chaffee-Farginia road, 4.2 miles, estimated cost $60,400; the Tonawanda Creek road, 3.77 miles, estimated cost $84,500.

Frankfort, N. Y.—A $24,000 bond issue for road construction has been voted. George K. Nite, town clerk.

Medina, N. Y.—A $15,000 bond issue for road construction has been voted.

Newcastle, N. Y.—(Mt. Kisco P. O.)—A

$135,800 bond issue for road construction has been voted.

Rye, N. Y.—A $33,000 bond issue for improvement of the Boston Post road has been voted. A $30,000 bond issue for street improvement in the village was also voted. George L. Henderson, village clerk.

Stillwater, N. Y.—A $16,000 bond issue to provide funds for the paving of Main street has been voted.

Watkins, N. Y.—A $37,500 bond issue for pavement construction has been voted. Raymond Hoare, village clerk.

Westfield, N. Y.—A $26,000 bond issue for paving North Portage street with brick has been voted.

Newton, N. C.—A $50,000 bond issue for road construction has been voted. W. C. Gaither, town attorney.

Roseburg, Ore.—The paving of North Roseburg street with concrete, to cost about $39,000, is contemplated.

Dale, Pa.—A $25,000 bond issue for paving construction has been voted.

Munhall, Pa.—A $15,000 bond issue for street improvement has been voted.

Dethan, S. D.—The construction of a complete waterworks system is contemplated. Money is available for immediate construction.

Livingston, Tenn.—A $150,000 bond issue for road construction has been voted by Overton county.

Austin, Tex.—A $250,000 bond issue for street improvement has been voted.

Bastrop, Tex.—An $80,000 bond issue for road construction has been voted.

Kerrville, Tex.—A $20,000 bond issue for street improvement has been voted.

Terrell, Tex.—Bids will be requested soon for 20,000 sq. yds. of pavement. W. Irving Bean, acting city engineer.

Washburn, Tex.—Bayfield county has voted a $50,000 bond issue for road construction.

Tacoma, Wash.—The city is contemplating the installation of an asphalt paving plant. It has been suggested that the city and county join in the purchase of such a plant.

Chatham, Va.—A $20,000 bond issue for street paving has been voted.

Stafford, Va.—A $100,000 bond issue for road construction has been voted.

SEWERS.

BIDS REQUESTED.

Reinbeck, Ia.—June 4. All bids for the construction of a sanitary sewer system and extensions to the water works system were rejected on May 13 and will be let at the date above noted. R. D. Ferguson, town clerk. Iowa Engineering Company, Clinton, Ia., engineers.

Grandview Heights, O.—June 17, 12 m. Laying water mains on Grandview avenue and First avenue. Constructing sewers on Grandview avenue and First avenue. Certified check $1,000. John Hinterschied, clerk.

Newburgh, O.—June 15, 12 m. Constructing sewers and water mains on 15 sections of street. Certified check $200. J. M. Shimek, clk.

CONTRACTS AWARDED.

Torrante, Cal.—Constructing sewage disposal plant, to Bent & Pennebaker, $50,000.

Bridgeport, Conn.—Constructing sewers, to the Pierce Manufacturing Company, $20,000.

South Bend, Ind.—Constructing four sewers, to L. H. Wedster, and two sewers, to Henry De Voss and Dedaette & Cousens.

Boise, Idaho.—Constructing the main sewer in District No. 2, to the Idaho Hardware and Plumbing Company, Boise, Idaho, $25,063.

Des Moines, Ia.—Constructing the Greenwood Park sewer system to the J. W. Turner Improvement Company, $23,700; constructing 44th and Center street sewer system, to T. J. Casselbury, $1,118.

Knoxville, Ia.—Constructing two miles of sewer, Hoar-Partington, Iowa City, Ia., $32,827.

Mankato, Minn.—Constructing a complete sewer system, to Lars Overn, St. Peter, Minn., $10,221.

Newark, N. Y.—Constructing complete sewerage system and a siphon, to Stephen Flanagan & Son Construction Company, Scranton, Pa., $67,403.

Charlotte, N. C.—Constructing nine miles of sewer, to Dabbs & Myers, Meridian, Miss., $37,884.

Girard, O.—Paving and constructing storm water sewers on State street, to Turner & Olsen, Youngstown, O., $84,224.

Portland, Ore.—The following sewer contracts have been awarded: Trunk sewer No. 1, to Gibbisch & Joplin, $66,202; trunk sewer No. 2, to K. Fauset, $72,271.

Cresson, Pa.—Constructing sewage disposal plant for the State Sanitarium, to Julian M. Solomin, Philadelphia, Pa., $15,734.

Everson, Pa.—Constructing 16,000 feet of sewer, to "Bud" Sike, $10,568.

Milbank, S. D.—Constructing 10,000 feet of sewer on Thompson street, to Lars Overn, St. Peter, S. D.

Cashmere, Wash.—Constructing a sewerage system, to the Jahn Construction Company, Seattle, Wash., $11,507.

Seattle, Wash.—Constructing sewers in Second avenue N. E., to Clark & Colasurdo, Seattle, Wash., $19,577.

Seattle, Wash.—Constructing sewer on Tenth street, North, to Clark & Colasurdo, Seattle, Wash., $19,577.

CONTEMPLATED WORK.

Jasper, Ala.—A $15,000 bond issue for a sewer system has been voted.

San Diego, Cal.—A $120,000 bond issue for sewer improvement has been voted. Allen H. Wright, cy. clk.

Fort Meade, Fla.—A $20,000 bond issue for sewer construction has been voted. W. E. Arthur, chairman Board of Bond Trustees.

Carrollton, Ga.—A $9,000 bond issue for sewerage construction has been voted.

Weiser, Idaho.—The construction of about eight miles of sewer, to cost about $70,000, is contemplated. R. J. Wood, city engineer.

Carlyle, Ill.—Assessment rolls are being prepared for a vitrified clay pipe sewer system to cost $18,067. Ben Bond, secretary Board of Local Improvements; F. A. Dietze, engineer, and H. G. Webber, special counsel.

Elgin, Ill.—The construction of a sewer to Thomas Cronin Co., $1,600; S. 25th st., on West Chicago street, to cost $78,500, is contemplated.

Wood River, Ill.—The construction of a sewerage system, estimated cost $27,320, is contemplated.

Creston, Ia.—The construction of sewers in District No. 1, including 3,000 feet 18-inch, 1,500 feet 6-inch and 100 Y's, is contemplated. J. F. Golden, city clerk; T. S. Delay, Creston, Ia., engineer.

Wichita, Kas.—The construction of a sewer on Third street, to cost about $33,000, is contemplated. Bert C. Wells, city engineer.

Sturgis, Mich.—A $57,000 bond issue for sewer construction has ben voted. E. Nicholson, city engineer.

Hibbing, Minn.—The city engineer has been instructed to prepare plans and estimates for the construction of sewers amounting to $76,000.

Warrensburg, Mo.—A $40,000 bond issue for street improvement and sewer construction has been voted.

Longport, N. J.—A $14,000 bond issue for sewer construction has been voted. Ralph Havarul, myr.

Buffalo, N. Y.—The construction of an 8-foot brick sewer in Swan and Seneca streets is contemplated. A $50,000 bond issue has been ordered.

Monroe, N. C.—A $30,000 bond issue for sewer construction has been voted.

Bexley (Columbus P. O.), O.—A $90,000 bond issue for the installation of a sewerage and a water works system has been voted.

Geneva, O.—Cumings & Downer, Painesville, O., have been retained to prepare plans and estimates for a complete sewer system on Eastwood and East Main streets.

East Mauch Chunk, Pa.—The construction of a sewer system to cost about $35,000 is contemplated.

Ligonier, Pa.—A $65,000 bond issue for the construction of a sewage disposal plant has been voted.

New Kensington, Pa.—The erection of sewage disposal plant to cost about $40,000.

Austin, Tex.—A $250,000 bond issue for sewer construction has been voted.

Chase City, Va.—A $45,000 bond issue for the construction of a sewerage system has been voted. M. J. Gregory, town clerk.

Bellingham, Wash.—The City Council has authorized the purchase of two automobile fire trucks to cost $12,000.

Spokane, Wash.—City Engineer McCartney has prepared plans and estimates for an intercepting sewer to cost about $215,000.

Fond du Lac, Wis.—A committee of the City Council has been appointed to investigate different systems of sewage disposal with a view to recommending a type of plant to be built by the city. J. S. McCullough, city engineer.

WATER WORKS.

BIDS REQUESTED.

Fort Huachuca, Ariz.—June 12, 10 a. m. Constructing eight and one-half miles of 8-inch steel water pipe. J. L. Jordan, captain and quartermaster, U. S. A.

Shelby, Mont.—June 10, 7 p. m. Constructing water works system complete. Formerly advertised to be let on May 28. City clerk.

Grandview Heights, O.—June 17, 12 m. Laying water mains on Grandview avenue and First avenue. Constructing sewers on Grandview avenue and First avenue. Certified check $1,000. John Hinterschied, clerk.

Newburgh, O.—June 15, 12 m. Constructing sewers and water mains on 15 sections of street. Certified check $200. J. W. Shimek, clk.

CONTRACTS AWARDED.

Colton, Cal.—Laying 10-inch water main on Eighth street, to the O. L. Emery Co.

Lyndon, Kas.—The following water works contracts have been awarded: Construction work, to Commercial Construction Company, Kansas City, Mo.; furnishing tank and tower, to the Tank and Tower Company, Memphis, Tenn.; furnishing filtration equipment, to the Pittsburgh Filter Company, Pittsburgh, Pa.; hydrants, valves and pumps, to the English Tool and Supply Company, Kansas City, Mo. Total cost, $27,471. J. W. Mavilty, engineer.

Boston, Mass.—The following water works contracts have been awarded: Laying water pipes in Sumner, Princeton and Trenton, to Lewis Balboni Co., $1,568; for laying water pipes with flexible joints in Boston Harbor, to John H. Gerrish, $15,754.

Carlton, Ore.—Constructing complete water works system, to James Kennedy Construction Company, Portland, Ore.

Sutherlin, Ore.—Constructing a complete city water works plant, to Bunnton & Jeffery, Portland, Ore., $14,500.

Mitchell, S. D.—Laying 10,549 feet of water mains, to E. L. Dimick, Laurel, Neb., $9,896.

Nashville, Tenn.—Constructing 30,651 feet of 6-inch water main, to William Leftwich & Co., Nashville, Tenn.

Seattle, Wash.—Laying water mains on Eighteenth avenue, South, to the Jahn Construction Company, Leary building, $28,693.

CONTEMPLATED WORK.

Stevenson, Ala.—A $14,500 bond issue for water works construction has been voted. C. E. Howser, chairman Board of Commissioners.

Springdale, Ark.—Plans are being prepared by Winters & Dove, Ft. Smith, Ark., for the construction of a complete water works system.

San Diego, Cal.—A $340,000 bond issue for water works extensions has been voted. Allen H. Wright, cy. clk.

Oak Creek, Colo.—The construction of a municipal water works plant to cost $30,000 is contemplated.

Fort Meade, Fla.—A $19,000 bond issue for the construction of a water works system has been voted. W. E. Arthur, chairman Board of Bond Trustees.

Weiser, Idaho.—The construction of ten miles of water mains to cost about $90,000 is contemplated. R. J. Wood, city engineer.

Joliet, Ill.—A $35,000 bond issue for water extension has been voted. M. Berscheid, city clerk.

Wood River, Ill.—The construction of a water works system estimated to cost $28,356 is contemplated.

Red Lake Falls, Minn.—A $25,000 bond issue for water works improvement has been voted. Joseph Perrault, city clerk.

Raton, N. M.—Hiram Phillips, St. Louis, Mo., is preparing plans and estimates for a water works system to cost about $400,000. A bond issue has been voted. Floyd Hanes, city clerk.

Grand Forks, N. D.—A $25,000 bond issue for water works construction has been voted.

Bexley (Columbus P. O.), O.—A $90,000 bond issue for water works and sewerage construction has been voted.

Clatskanie, Ore.—A $30,000 bond issue for water works improvement has been voted.

Barnwell, S. C.—A $22,000 bond issue for the construction of an electric light and water works plant has been voted.

St. George, S. C.—A $20,000 bond issue for water works has been voted.

Yankton, S. D.—A $60,000 bond issue for water works improvement has been voted.

Palacios, Tex.—A $25,000 bond issue for water works construction has been voted. W. B. Willis, cy. secy.

Henrietta, Tex.—An $18,000 bond issue for water works construction has been voted.

Sherman, Tex.—A $33,000 bond issue for water works improvement has been voted. B. Kreader, city secretary.

Waco, Tex.—A $400,000 bond issue for the construction of a water filtration plant has been voted.

Clifton Forge, Va.—A $190,000 bond issue for water plant has been voted.

Bremerton, Wash.—A $150,000 bond issue has been voted for the purchase of the plant of the Bremerton Water and Power Company. E. J. McCall, city clerk.

Centralia, Wash.—A $250,000 bond issue for the construction of a gravity water system has been voted.

Chehalis, Wash.—A $115,000 bond issue for a special water supply and a $70,000 bond issue for a gravity water system has been voted. S. J. Allen, city treasurer.

Chinook, Wash.—A franchise has been granted to Lars Birdsdik to install and operate a water works system. A plant will be constructed about July 1.

Grafton, W. Va.—A $90,000 bond issue for water works improvement has been voted.

Huntington, W. Va.—The citizens have voted to construct a new municipal water works system with a capacity for 100,000 population, and to cost about $800,000.

Chilliwack, B. C., Can.—A $144,000 bond issue has been voted for the purchase of the Elk Creek Water Works Company.

BRIDGES.

BIDS REQUESTED.

Twin Falls, Idaho.—June 17, 10 a. m. Constructing two steel bridges across Rock Creek canyon. Certified check, 10 per cent. on each bid. O. G. Zuck, chairman Board of County Commissioners; E. J. Finck, clerk.

Monticello, Ind.—June 18, 12 m. Constructing thirty-three bridges. A. G. Fisher, auditor.

Rushville, Ind.—June 4, 2 p. m. Constructing several bridges. J. M. Stone, auditor.

Frankfort, Ky.—June 6, 12 m. Constructing a two-pier bridge across the Flat creek. Bids to include both steel and concrete structure. R. G. Hieatt, judge of the fiscal Franklin county.

Cleveland, O.—June 15. Constructing concrete bridge on the Cady rd. under Report No. 2940, and concrete culverts on the Drake rd. under Report No. 2945. Jno. S. Goldenbogen, clk.

Cleveland, O.—June 19, 11 a. m. Bridge construction as follows: Report No. 2934, culverts; Report No. 3925, abutments on Canal road; Report No. 2937, steel bridge on Canal road. Certified check 10 per cent. John F. Goldenbogen, clerk of Cuyahoga county.

Jefferson, O.—June 3, 1 p. m. Constructing fill, approach to bridge, as noted in Bulletin of May 11. A. V. Hillyer, clerk of Ashtabula county.

Norwalk, O.—June 5, 1:30 p. m. Constructing concrete roadways on the Townsend and the Fairfield roads. Certified check $100 on each bid. J. M. Bechtol, township clerk.

Bedford, Pa.—June 3, 12 m. Constructing steel superstructure and concrete substructure for single-span bridge over Dry run. Certified check $1,000 on superstructure and $500 on substructure. George R. Shuck, clerk.

Clearfield, Pa.—June 7. Constructing an 80-foot span through plate girder highway bridge over Moxhannon creek. Certified check $500. Jacob Woodring and B. A. Grove, commissioners of Centre county.

Strousberg, Pa.—June 3, 12 m. Constructing one double-arch masonry bridge over McMichaels creek, in Monroe county. Certified check $500. R. C. Evans, clerk county commissioners.

Ritzville, Wash.—June 6. Constructing six county bridges. A. F. Rosenoss, clerk of county commissioners.

CONTRACTS AWARDED.

Ventura, Cal.—Constructing the Sisar and Santa Paula bridges, to F. M. Kearns.

Tampa, Fla.—Constructing steel bridge on Lafayette street, to the Edwards Construction Company, Tampa, Fla.

Julietta, Idaho.—Constructing a 70-foot steel bridge east of Juliaetta, to the Security Bridge Company, Lewiston, Idaho.

New Lenox, Ill.—Constructing concrete bridge, to the Joliet Bridge and Iron Company, Joliet, Ill.

East Chicago, Ind.—Constructing a bridge at Forsyth avenue, to Geo. Owens Reed, Michigan City, Ind.

Newcastle, Ind.—Constructing bridge in Decatur county, to the Pan-American Bridge Company.

Richmond, Ind.—Constructing four steel bridges, Isaac E. Smith, Richmond, Ind.

Creston, Ia.—Constructing reinforced concrete deck girder bridge in Union county, to Kimballton Construction Company, Atlantic, Ia., $16,037.

Rock Rapids, Ia.—Constructing bridges in Lyon county during 1912, to Western Bridge and Construction Company, Omaha, Neb.

Lewistown, Mont.—Constructing a bridge across Cottonwood creek and bridge over Warm Springs creek, to the Security Bridge Company, Minneapolis, Minn.

Fulton, N. Y.—Constructing a concrete arch bridge over the Barge canal, to R. D. Murdock, Crown Point, N. Y.

Hendersonville, N. C.—Constructing two steel bridges across the French Broad river, to the Roanoke Bridge Company, Roanoke, Virginia.

Buffalo, N. Y.—Bids for the construction of the new bascule bridge across the Black Rock Harbor, at Ferry st., have been opened by Col. J. E. Warren. The Great Lakes Dredge & Dock Co., Chicago, Ill., were the low bidders, at $126,871.

Dayton, O.—Constructing the Herman Avenue bridge, to G. K. Cetone, Dayton, O.

Jefferson, O.—Constructing a bridge over Hubbard's run, to B. F. Hewitt, Jefferson, O.

Marietta, O.—Constructing the Browns run bridge, to the Caldwell Mining Car and Foundry Company, Caldwell, O.

Mt. Gilead, O.—Constructing the Anchor Mill bridge, to the Hackadorn Construction Company, Indianapolis, Ind.

Pawnee, Okla.—Constructing five steel bridges, to the Canton Bridge Company, and two bridges, to T. E. Myers, Pawnee, Okla.

Astoria, Ore.—Constructing steel bridge over Big creek near Knappa, to the Portland Bridge and Iron Company, Portland, Ore.

Rapid City, S. D.—Constructing two bridges across the Cheyenne river, to the Hennepin Bridge Company, Minneapolis, Minn.

Colfax, Wash.—Constructing bridge across Hangman creek, to O. H. Stratton, Spokane, Wash., $6,200; constructing the Union Flat steel bridge, to the same, $2,180.

Everett, Wash.—Constructing bridge on Third street, to the Everett Construction Company, Everett, Wash.

Olympia, Wash.—The following bridge contracts have been awarded by the State Highway Commission: The Lewis river bridge near Woodland, to the Washington Engineering Company, Tacoma, Wash., $37,500; superstructure of the Skagit river bridge near Mt. Vernon, Wash., to Derrick & Derrick Company, Seattle, Wash., $34,673. William J. Roberts, State Highway Commissioner.

CONTEMPLATED WORK.

Santa Barbara, Cal.—The construction of a $60,000 bridge across Ventura river is contemplated by the Board of Supervisors of Ventura county.

Daytona, Fla.—D. D. & C. M. Rogers are preparing plans for the construction of a concrete bridge over the Halifax river.

Junction City, Kas.—The construction of a steel bridge across the Camden river, to cost about $50,000, is contemplated.

Stockton, Mo.—A $19,000 bond issue for road improvement has been voted.

Glendive, Mont.—A $170,000 bond issue for bridge construction has been voted and sold to the Minneapolis Trust Company.

Gloversville, N. Y.—A $20,444 bond issue for bridge construction has been voted. M. C. C. Stetson, city clerk.

Lawrence, N. Y.—A $10,000 bond issue for bridge construction has been voted. M. J. Pettis, village clerk.

Wilkesbarre, Pa.—Albert Lucius, consulting engineer, New York City, has prepared plans and estimates for a concrete bridge at West Market street.

Beeville, Tex.—A $15,000 bond issue for the construction of bridges has been voted. Dan Troy, county clerk.

Richmond, Va.—W. W. Latrobe has been instructed by the Chesterfield Board of Supervisors to request bids for the construction of bridges over Swift creek.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTEMPLATED WORK.

Newark, N. J.—The Board of Public Works has ordered a preparation of plans and specifications for a 400-ton garbage disposal plant.

Munhall, Pa.—A $25,000 bond issue for the construction of a garbage disposal plant has been voted.

Parkersburg, W. Va.—The construction of a garbage incinerator for the purpose of destroying dry garbage is contemplated. Mayor Murdoch.

STREET LIGHTING.

CONTEMPLATED WORK.

Birmingham, Ala.—The Birmingham Railway, Light & Power Co. plans to place all electric wires under ground at a cost of about $260,000.

Alameda, Cal.—One hundred and fifty thousand dollars for the construction of a power house has been voted.

Lavonia, Ga.—A $5,000 bond issue for electric light construction has been voted. H. P. Sewell, city clerk.

Carroll, Ia.—The installation of an ornamental lighting system on a number of streets is contemplated.

Muscatine, Ia.—The extension of an ornamental lighting system on Mulberry street is contemplated.

Williamsburg, Ia.—The Troy Canning Company has been given a franchise to install and operate an electric light plant for a period of 25 years.

Lawrence, Kas.—The Commercial Club is endeavoring to secure an ornamental lighting system on Henry and Massachusetts streets.

Osawatomie, Kas.—A $20,000 bond issue for a municipal light plant and other improvements has been voted.

Topeka, Kan.—G. E. O'Neill, supt. of the city electric light plant, is preparing plans for the extension of an ornamental lighting system on 4th st.

Morris, Minn.—A $30,000 bond issue for electric light improvement has been voted. C. D. Burpee, village clerk.

Clarks, Neb.—A $5,000 bond issue for the construction of an electric lighting plant has been voted.

Lestershire, N. Y.—A $9,500 bond issue for the installation of an ornamental lighting system has been voted. W. C. Lewis, village clerk.

Lyons, N. Y.—A $10,000 bond issue for light improvement has been voted. W. J. Collins, vil. clk.

Schnectady, N. Y.—The installation of an ornamental lighting system on State street is contemplated. Henry W. Peck, general manager of the Schenectady Illuminating Company.

Cincinnati, O.—Resolutions have been passed for the lighting of the following streets with the inverted luminous arc system of electric lighting: Fourth avenue, three sections, Eighth avenue, Central avenue, Seventh avenue and Vine street. Arthur Espy, clerk of council.

Barnwell, S. C.—A $22,000 bond issue for the construction of an electric light and water works plant has been voted.

Anderson, S. C.—W. W. Hess, Philadelphia, Pa., has secured a franchise for the erection and operation of a gas plant.

South Bend, Wash.—The installation of an ornamental lighting system along the main business street is contemplated.

Duncan, B. C., Can.—The council is contemplating retaining an engineer for investigating the question of installing a municipal lighting and power plant.

FIRE APPARATUS.

BIDS REQUESTED.

Wichita, Kas.—June 3, 12 m. Constructing and installing a complete fire alarm and police telegraph system. Certified check $1,000. William Sence, city clerk.

Cleveland, O.—June 3, 12 m. Furnishing a police patrol for the city of Cleveland. Charles W. Stage, director of public safety; Hiram S. Stillman, secretary.

Portland, Ore.—June 27. Furnishing the following automobile fire apparatus: One automobile aerial, quick-raising truck, one auto pumping engine and eight auto combination chemical and hose wagons. Executive board of the fire department.

CONTEMPLATED WORK.

Prescott, Ark.—The installation of a fire alarm system is contemplated. T. D. Moody, chief.

Sacramento, Cal.—Chief Anderson has recommended the immediate changing of all engine trucks to automobile propelled trucks.

San Diego, Cal.—An $80,000 bond issue for fire department improvement has been voted.

Santa Clara, Cal.—A $5,500 bond issue for the purchase of fire apparatus has been voted. E. G. Senton, twn. clk.

Selma, Cal.—A $10,000 bond issue for the purchase of automobile fire apparatus has been voted.

Tampa, Fla.—The purchase of automobile fire trucks of the combination hose and chemical type is contemplated by the city.

Coeur D'Alene, Idaho.—The purchase of the following motor fire apparatus to cost about $15,000 is contemplated: One combination ladder, chemical and hose wagon and one combination pumping engine, hose wagon and chemical engine.

Muncie, Ind.—An appropriation has been made for the purchase of a chief's automobile.

Sioux City, Ia.—The Commercial Club will purchase automobile fire apparatus which will be leased to the city until the latter can purchase. It is proposed to purchase three fire engines, an automobile hook and ladder truck and some combination wagons.

Leavenworth, Kas.—The purchase of motor fire apparatus, hose and ladder equipment is contemplated.

Baltimore, Md.—The purchase of three automobile fire trucks is contemplated.

Boston, Mass.—The Revere fire engineers will purchase a combination automobile wagon and an automobile for the chief. Arthur Kimball, chief.

Grand Rapids, Mich.—The sum of $14,700 has been appropriated for the purchase of motor fire apparatus.

St. Joseph, Mo.—Fire Chief P. P. Kane has recommended the purchase of motor fire apparatus to cost about $75,000.

Orange, N. J.—A $15,000 bond issue for fire department improvement has been voted.

Auburn, N. Y.—The purchase of motor apparatus to cost about $22,000 is contemplated.

New York, N. Y.—Acting on advice of Controller Pendergast, Fire Chief Johnson rejected all bids for motor fire apparatus and will readvertise.

Akron, O.—Chief Murtz is contemplating the purchase of automobile apparatus for Fire Station No. 3.

East Liverpool, O.—R. J. Marshall, mayor, has recommended improvements to the fire department including motor apparatus.

Salem, O.—The purchase of motor fire apparatus and an automobile ambulance is contemplated by the city.

Meadville, Pa.—The purchase of a motor fire engine and a motor hose truck is contemplated.

Sharon, Pa.—A committee has been appointed to obtain prices on a combination automobile fire truck with pumping engine and an automobile hose wagon.

Chepachet, R. I.—A committee has been appointed to investigate motor fire apparatus. Howard W. Farmun, chr.

Bellingham, Wash.—The City Council has made an inspection trip to Vancouver, B. C., with a view to purchasing motor fire apparatus.