

A HYDRAULIC AIR-COMPRESSING PLANT.

# SCIENTIFIC AMERICAN 

ESTABLISHED 1845
MUNN \& CO.
Editors and Proprietors

## Published Weekly at

No. 361 Broadway, New York
TERMS TO SUBSCRIBERS

the soientific american públications

The combined subscrition rates and rates to toreign countries
be furnished upen application.
Remit by postal or express money order, or by bank draft or check.
MUNN $\&$ CO., 361 Breadway, New York.
NEW YORK, SATURDAY, MARCH 16, 1907.
The Editor is always glad to receive for examination illustrated artucles on subiects ot timely interest. It the photographs are sharp, the artucless short, and the facts authentic, the contributions
will rocelve special attention. Accepted articles will be paid for will rocelve special at
at regular space rates.

## government investigation of raillioad accidents.

The increase in the number of railroad accidents during the past winter has been so alarming as to suggest the urgent need for some preventive measures, immediate and drastic. There is little hope of any movement looking to this end being made by the rail roads themselves. They are too hopelessly hidebound in conservatism and self-sufficiency to admit that remedial measures can be taken that will have any material effect in decreasing, or rather in staying the increase in, the number of passengers and employees that are killed and wounded in the day-by-day operation of railroads.
The remedy must come from the outside, and it can be found in the introduction of that excellent system of government inspection of railroad accidents, which has been in vogue for many decades in some European countries, and notably in England, where govern ment inspection has been the chief factor in the wonderful immunity from accident which the railroad system of that country has enjoyed. Although two or three serious accidents have caused the death rate to rise to an unusual figure during the past year, the average annual number killed is extraordinarily low, and recently in a single year over a billion passengers were carried without the loss of a single life. In the Unite States, where we have no adequate government inspection of accidents, our railroads, during a period of a little over six months of the present year, have killed, in generally avoidable accidents, well on to half killed, in generally avoi
a thousand passengers.
Under the British system of government inspection, if a railroad wreck involving loss of life occurs, the railroad officials are prohibited from clearing up the wreck, except so far as is necessary to rescue passengers, until it has been made the subject of a searching examination by the presiding engineer of a Board of Trade commission, appointed specially for railroad wreck investigations. Roadbed, ties, rails, wrecked engine and cars, are left in statu quo, in order that the government officials may have every possible scrap of evidence at hand that can in any way assist in determining the causes, immediate and remote, of the disaster. An elaborate report is then prepared and placed on record. It can readily be understood that these reports constitute an invaluable mass of data for the guidance of the railroads in the prevention of future accidents.
Compare that method with the system adopted in the United States, where, as soon as an accident occurs, and especially if it be one incurring heavy loss of life, the wrecking train is rushed down to the wreck, the wrecked cars dragged back onto the tracks and hauled away, the Lord knows where, and those cars that are so badly wrecked as to be incapable of replacementthe very cars, mark you, which could afford the strongest evidence as to the cause of the disaster-are burnt up at the side of the track, and the metal parts carted away to the junk pile. In a word, the evidence upon which an intelligent and impartial study of the wreck could be based, is swept out of existence by the wrecking crew. Frequently, the only fruits of investigation that remain are the individual impressions of this or that head of the department-superintendent, chief engineer, road master, or whoever may happen to be engineer, road master, or
within reach of the wreck.

It is admitted that the leading railroads claim that careful investigations are made of every serious accident; but the results of these investigations are filed away in the secret archives of the company. Such lessons as may be learned from any particular disaster are confined to the officials of the road on which it takes place. There is no dissemination of information,
not even among the railroads themselves; and as to the making public of such information, it is never contemplated for an instant. True it is, that the publicity bureau of a railroad is sometimes instructed to make a statement; but such investigations and statements are always ex parte in character; and we may be sure that, where an accident is directly due to poor equipment or faulty operation, the typewritten sheets of the publicity bureau will make no mention of the fact.

If the publication of the findings of the Board of Trade investigation of English railroad accidents ended the matter, these investigations would have merely an academic interest; but it is upon these findings that the government regulations affecting the construction, maintenance, and operation of railroads are based; and it is our belief that to this system of investigation, with its subsequent law-making, the English railroads owe their remarkable immunity from accidents.
The crying need of the hour is the institution of a government board for the investigation of accidents on United States railroads. This board should be composed of railroad engineers of ability and experience. They should be paid salaries commensurate with their reputation, and sufficient in amount to place them beyond any possibility of temptation. They, and their local representatives in the various parts of the country, should be invested with sufficient authority to enable them to make the most searching investigation and to enforce the attendance for examination of any official or employee from president to trainman. Upon this commission would devolve the duty of outlining such legislative measures as, in its opinion, were necessary to secure the safety of the traveling public. It is our firm belief that before such a commission had been in active existence five years, the number of railroad accidents in this country would have been cut down 50 per cent, and that before a decade had passed the number would have been reduce to the more humane figures which obtain on European railroads.

## COMPARATIVE ECONOMY OF PRODUCER GAS AND STEAM

It is known in a general way that a goo produeergas engine plant will yield a horse-power upon about one-half the amount of fuel that is necessary to generate one horse-power with a steam plant. The rela tive efficiency of gas and steam has recently been made the subject of analysis by a well-known pioneer in the field of producer gas, J. M. Emerson Dowson, who bases his comparison upon a steam and gas power plant, each of a capacity of 250 horse-power. In the case of the steam plant, he finds that of 1,120 heat units contained in the fuel, 224 units are lost in radiation, flue gases, ashes, etc., and that 896 units appear in the steam that is generated. Of this amount, 112 units are lost by condensation in the pipes, etc., leaving 784 units that are supplied to the engine. Of these, 667 units are lost in the exhaust, leaving only 117 units to be converted into work in the engine. Of these, 17 units must be deducted for engine friction, leaving only 100 units, out of 1,120 originally in the fuel, available for useful work on the engine shaft. In other words, in order to obtain 100 heat units in useful work on the shaft of a steam engine, there must be 1,120 heat units in the fuel burnt up in the boiler. A simi lar investigation of the producer-gas plant shows that there need be only 525 heat units in the fuel consumed in the producer to give 100 heat units of useful work on the engine shaft. In the producer-gas engine 105 units will be lost in radiation, etc., from the gas plant; 126 mints will be lost in cooling the engine; 177 will be lost in the exhaust, and there will remain only 117 units to be converted into work in the cylinder, of which 17 will be lost in engine friction, finally leaving 100 units to perform useful work. This com parison shows a saving in fuel of 53 per cent in favor of the producer-gas plant. A comparison by the same authority of two 40 -horse-power plants, gas and steam, shows a saving of 70 per cent in favor of the gas plant. Excellent as is the economy of the gas plant as shown by these figures, it must be noted that the heat losses are still very large, and future improvement in economy must be looked for mainly in this direction, both in the gas plant and in the engine.

## PROGRESS ON THE ERIE CANAL.

As in the case of the Panama Canal, the work hith erto accomplished on the Erie Canal has included a large amount of preliminary operations which do not figure in the statistics of total excavation done in the prism of the canal. At the present writing, over $\$ 35,000,000$ worth of contracts are either ready to be let or have just been let, and these, when completed, will cover 209 out of the total 440 miles of canal to be excavated. Some conception of the magnitude of the preliminary work which has already been done may be gathered from the fact that the corps of engineers engaged on the surveys have run levels over nearly 1,500 miles, have done the transit work over more than 1,000 miles, and have completed the topographical maps of 130 square miles of territory. The investiga-
tion of the sub-surface along the route of the canal by drilling in earth, sand, and stone, has been carried out on a vast scale, the total amount of drilling that has been done amounting to over 40 miles of vertical depth. At the time of the last report of Col. Thomas W. Simons, consulting engineer in the construction of the work, which was made in January of the present year, the work under contract covered a distance of 70 miles and represented a prospective outlay of $\$ 20,000,000$. A fact, most encouraging and very unusual in work of this character is that every item of expenditure thus far placed on record is below the estimated cost. On that portion of the work then under contract, there had been a saving of nearly $\$ 3,000,000$ over the preliminary estimates. We have often had occasion to speak in these columns of the far-reaching effect in economy of time and expense which will be produced in engineering works by the extended use of concrete in place of stone masonry. In the present report, the extent of this economy in works of magnitude is forcibly illustrated, for Col. Simons states that when the Board of Engineers decided to use concrete instead of stone for the masonry of the canal, a saving of $\$ 16,000,000$ was effecte on this item alone. The report closes with the welcome statement that the last vestige of organize opposition to the canal work has disappeared. Although this opposition was at one time very active, the interests that were opposed to the improvement of the canal have abandoned their attitude, and no effort is being made in any quarter to hinder the prosecution of the work.
COMPLETION OF THE SECOND TUBE TO BROOKLYN.
With the completion, a few days ago, of the second of the twin tubes by which the Rapid Transit system of this city is being carried beneath the East River, the linking up of Brooklyn and Manhattan by an unbroken stretch of Subway tracks is brought one step nearer realization. Compared with the work of driv ing the longer tumnels beneath the Hudson River, the construction of the tubes beneath the East River has been a far more formidable task. If we except the difficulties encountered by the English company which attempted to drive the first tube beneath the Hudson River, the work of connecting Manhattan and New Jersey has not been attended with very serious trouble; at any rate, if there have been difficulties, they have been overcome so quietly that the public has hear very little about them... The East River, however, has proved a very difficult proposition, largely because of the varying character and consistency of the material through which the tubes had to be driven, sand, rock, and mud being successively encountered. It is to this variation of the material of the river bottom, coupled with what we have always considered to be the over-light construction of the tubes, that the trouble in the way of faulty alinement and elevation and the distortion of the tubes themselves, is largely due. The bending stresses at the point where the tubes pass rather suddenly from solid rock into soft mud have been so great as to crack some of the plates, and most of the delay on these tunnels has been due to the necessity of repairing these broken plates, and restoring the grade of the tunnel at points where it had fallen below the proper elevation.

PRESERVATION OF STEEL WORK IN TALL BUILDINGS.
The question of the probable condition of the .steel work of the modern office building, shut in, as it is, beyond the possibility of inspection, is one which has often been asked and very seldom definitely answered. During the past two years there have been a few opportunities presented by the demolition of skeleton steel buildings, to determine the amount of deterioration of steel when it is inclosed in masonry. But in each case the period of time which had elapsed since the erection of the building was too short to afford any adequate test; that is, a test from which definite conclusions could be drawn. A few months ago, however, during the reconstruction of San Francisco, it was found necessary to remove the six upper stories of the Mutual Life Insurance Company's building in that city; and as the building, which is a steel frame structure, was erected in 1893, the intervening thirteen years may be considered to have afforded an excellent test of the tendency to rusting, in a building of this character. The condition of the building, as describe by Mr. F. B. Gilbreth, who had the contract for removing the top six stories, shows that it was of the best construction of those days, and that the laying up, and filling of joints in the brick, stone, and terra cotta was as nearly perfect as possible. The exterior walls completely inclose the steel frame, which was put together with bolted connections. The floors were of hollow terra cotta arches and the partitions were hollow terra cótta blocks. According to the testimony of several occupants, the earthquake did practically no damage to any part of the structure, and in taking down the building there was no evidence that it was in the least injure by the heavy earthquake shocks.
The damage from fire was similar to that observed in the Baltimore and other big conflagrations. Com-
mon red-clay bricks stood the heat better than any other material; but according to Mr. Gilbreth the floor blocks and partition blocks showed that terra cotta in spite of the fact that it is incombustible, is a very unsatisfactory material to use in connection with steel. It expands so much more quickly than steel that it breaks up and falls apart by buckling long before it is ruined by fire or water.
The condition of the steel work of a steel frame building thirteen years old is, of course, the most inter esting feature of this reconstruction. The structural steel had originally been covered with red metallic paint, and where this paint was in contact with lime mortar, the steel was found to be in very• good condition and showed little indication of rust. This excellent preservation was due to the fact that the joints in the brickwork were exceptionally well filled, and the mortar well rammed in around the columns. There were some instances where the mason had been unable to slush in the mortar as well as might have been wished around the columns, and in one of these in stances there was found a piece of rust scale larger than a man's hand; but this was the very rare excep tion. Indeed, the beams from which this particular piece of rust was taken would stand comparison with the average steel beam that had been in stock in a steel yard for several months. Where the steel had not been thoroughly cleaned before painting, there were occasional instances of some rust under the paint Such cases were comparatively rare; and Mr. Gilbreth sums up with the statement that with these exceptions, the rust had not developed in thirteen years beyond a negligible amount, the straight columns, beams, tierods, and bolts being subsequently sold for use in new buildings now in progress of erection.

## GLASGOW AND MUNICIPAL OWNERSHIP. <br> by day allen willey

The city of Glasgow is the most notable community in the world from the standpoint of municipal ownership, owing to the various enterprises in which it engages, from housing its people to providing them with transportation. The operation of its street railway system through municipal control was one of the first ventures of this kind, being inaugurated in 1889 , when animal power was utilized entirely for hauling the street cars. At that time but three communities in Great Britain operated their street car systems. In 1904, however, no less than fifty communities con trolled these utilities, the majority of them adopting the municipal ownership idea on account of the suc cess which attended the experiment in Glasgow. The street railway system in this city serves a population of about $1, C 00,000$ in Glassow and its suburbs. At the present time it comprises 169 miles of surface track and a double-track subway, which is about $61 / 2$ miles in length. All of the surface lines are operated by electric motors, the cars being propelled by the overhoad trolley system so familiar in the United States. The cars, which are also constructed and equipped at plants owned and operated by the municipality, are of two kinds, one having seats on the top to accommodate passengers who may desire to ride outside. These are known as "double-deckers," and will seat about forty people, the cars provided with seating capacity inside only accommodating but twenty-five. As in other cities in Great Britain and on the Continent, a car is considered full when all of the seats are occupied, and no more passengers are permitted to enter, in contrast to the American system of crowding people into the cars until all of the available standing room is occupied.
To furnish adequate service in the city and suburbs about 800 cars are provided, each equipped with a series of motors developing about 50 horse-power on the average. Although the number of cars is small considering the extent of the traffic, the service is such that there is little cause for complaint as to the frequency of the trips or the speed maintained. Yet during the year ending June 1, over $208,000,000$ passengers were carried, an increase of nearly $100,000,000$ since 1899-illustrating how the traffic has expanded in less than ten years on account of the facilities afforded for cheap trips. This is indicated by the num ber of persons who have been carried during the year at the different rates of fare charged. No less than $291 / 2$ per cent paid an average of but one cent in American money, while 60 per cent paid an average of two cents a ride, and only 7 per cent three cents a ride. Actually less than one per cent of the total number of fares collected averaged five cents, the usual rate on street railways in American cities.
The Glasgow street-car system has not only been noted for the low rates of fare charged, but for the remarkable success it has attaine from a financial point of view. To show how the venture pays the city, a few statistics of the receipts and expenses may be given. During the year ending June 1-the last complete year reported-the total income amounted to $\$ 4,100,000$ in American money. After deducting the operating expenses amounting to $\$ 2,280,000$, a balance was left of $\$ 1,820,000$. Out of this, $\$ 300,000$ was ap-
propriated for taxes and interest, and $\$ 850,000$ for estimated depreciation of property and maintenance of way and rolling stock. From the balance, $\$ 175,000$ went to what is known as the "fund of common good." After deducting all of these payments there was placed to the credit of the general reserve fund about $\$ 200$, 000. Contrasting these items with the amounts allowe for depreciation and other expenses in connection with the operation of American street railways, it is apparent that the Glasgow corporation pursues a very gen erous policy as to renewals and betterment, but the fund of common good is being accumulated in connec tion with the sinking fund, and this now amounts to such a sum that the entire indebtedness incurred in purchasing, rebuilding, and equipping the railway sys tem has been reduce to $\$ 8,500,000$. As there are no dividends to be paid, the portion of the surplus avail able for such payment is practically included in the sinking fund provided for the liquidation of all indebt edness. It may be added that the sums appropriated for maintenance and depreciation represent no less than 6 per cent of the total capital invested.

Not only the city itself, but the principal highways leading into it are served by the electric railway sys tem, the corporation securing permission to lay its tracks on the suburban roads from the local authorities. In return for this privilege it guarantees to keep a certain portion of the highway properly paved and in good condition. While the overhead trolley sys tem, as already stated, is used entirely on the surface the poles are of an ornamental pattern and the over head construction is very different from the unsightly work so often seen in American cities. Soon after the municipal authorities took control of the street railway system, it was decided to discontinue the use o any of the cars for advertising purposes. This meant an annual loss of about $\$ 50,000$, but the improvemen in the appearance of the cars has compensated for it at least in part. The total number of employees is about 3,200 . It is an interesting fact that since the city assumed control of the service it has reduced the time of working hours from twelve hours out of twenty-four to an average of nine hours per day, the average wages of motormen and conductors being $\$ 1.16$ in American money.
From the main power station during the last year a total of $26,340,000$ kilowatt-hours were generated, of which about $1,000,000$ were utilized at the station itself. The percentage of current lost in transmission and con version was about 11 per cent, the current supplied for operating street railway motors aggregating about $20,000,000$ kilowatt-hours, the average cost per hour for electricity after allowing for loss, taxes, insurance and depreciation of the equipment was about 2.1 cents per kilowatt-hour. This estimate is based on a charge of one-fifth of a cent per hour for fuel, the coal averaging about $\$ 1.75$ rer ton in American money. In addition to supplying the street railway service the corporation sold electricity for industrial and other purposes at a price averaging three cents per kilowatt hour, indicating the profit which it obtained from the disposal of the current in this way

The success attending the operation of the system has caused the Glasgow corporation to plan several ex tensions to the present system. It has obtained author ity to construct lines within the city and suburbs which will aggregate 27 miles and will be completed in the near future. These extensions have necessitated the enlargement of its plant for manufacturing cars which is even now very extensive. An addition is now under way which will be completed during the present year. It may be added that the municipal car factory is provided with a full equipment of modern powe tools both for wood and metal working, and that nearly all parts of the cars are manufactured here as well as assembled and finished. A considerable por tion of the power is electric current supplied from the station, many of the tools being driven by individual motors instead of steam power.

## the current supplement.

The electrification of the Simplon Tunnel railroad is the subject of the opening article of the current Supplement, No. 1628. The article is exhaustive, and is accompanied by many clear photographic illustra tions. Mr. A. Frederick Collins contributes the last of his series on a 100 -mile wireless telegraph outfit. In this installment he writes on the management and operation of ship and shore stations, giving alphabets which are employed in this country and abroad, as well as call letters of the United States naval stations, weather symbols, wind symbols, telegraphic abbrevi ations in common use, and a communication chart for steamships. Mr. F. Z. Schellenberg contributes an article on "Our Coal," in which he tells not only how coal is mined, but also something of the conditions which affect the miners. Mr. C. J.C. Zintheo's elaborate paper on Corn-Harvesting Machinery is concluded. Mr C. W. Parmelee likewise concludes his discussion of the technology and uses of peat. Of technological value is the article on gold and aluminium solders. Excellent formulas are given. The second installment of the
rticle on the manufacture of water-gas is published article on the distillation and rectification of alcohol is concluded.

## SCIENCE NOTES.

Rich deposits of phosphate are reported to have been iscovered recently in Riverside County, California, 1,500 feet above sea level, four miles from Whitewater, on the Southern Pacific. The deposits lie in a cupshaped valley overlooking the desert and within thirtyfive miles of the Salton Sea. The discoverers were prospecting when the find was made. It was before the recent storms. They were suddenly stifled by the stench, and realizing its cause followed against the wind until they stumbled upon their find in the valley. With the first rain the stench disappeared. The deposits are said to extend to a considerable depth and to cover hundreds of acres.
A little-known phase of entomology is discussed by einemann in his article on the number of facets in the eyes of insects, published under the title "Uber die Zahl der Facetten in den zusammengesetzten Augen der Coleopteren." He has had the patience to count the acets in the eyes of 150 species of beetles. He finds that the larger the specimen, the more numerous are the facets, and that usually there is not much difference in the sexes. The male in many cases, however, has more facets than the female. In Lampyris splendidula the male has 2,500 facets, while the female has but 300 . Melolontha vulgaris has, male, 5,300, female, 4,850; and Saperda carcharias, male, 2,200 , female, 1,800 . There is no general reduction in nocturnal species.
A public museum combined with a laboratory has recently been inaugurated at Brussels. This establishment was founded for encouraging the development and expansion of electrical work in the country as a result of experimental teaching, and to this end the museum has been equipped with all kinds of models and apparatus which the visitor can observe and try upon the spot. The museum contains four main halls, where all the apparatus is installed. One of the halls is devoted o the demonstration of the laws of the electric current, while in a second hall is found a collection of all the machines which give rise to electric or magnetic phenomena, as well as electro-chemical apparatus of arious kinds. A gallery which forms part of the second hall contains an exposition of apparatus such as lamps, agricultural machines, etc., and the latter are driven by motors. The sections of telegraphy, radioelegraphy, and telephony are well equipped with modern apparatus. In the third hall is installed the reading room, which is large in size. Many scientific publications are received here. The fourth hall contains the heavy electric machines, such as dynamos and motors. A number of professors is attached to the establishment, both for lecture and laboratory work.
The Austrian explorer Dr. Erich Zugmayer, who for ome time past has been engaged upon important explorations in the unknown parts of Thibet, and who was compelled at last to abandon his journey only because of pronounced hostility on the part of the natives acting upon instructions from the Grand Llama at Lhassa, and intense privations due to climatic influences, achieved success from geographical, zoological, and botanical points of view. The hardships encountered on the journey were of an exceptional character, due chiefly to the climatic conditions prevailing and the roligh character of the country traversed. His route extended toward the south and southeast and led through an entirely unknown part of the country. For two months the party continued its way with extreme difficulty at an altitude of 16,000 feet. Great suffering was entailed by the transport animals because of the hardships and abnormally severe weather encountered at those altitudes. When the party had reached a point at an elevation of 20,000 feet above sea level, Dr. Zugmayer, owing to the mortality among his animals, was compelled to abandon his projected route, and struck off in a westward direction to Kashmir, which had been his original objective by the more circuitous route. Despite the difficulties encountered and the enormous losses among the transport animals, the explorer was enabled to preserve the many valuable specimens he had collected. The return journey was made past the Rudok and the Panggong lakes. Upon arrival at Kashmir the explorer had only twelve emaciated yaks left, testifying to the arduous nature of his journey. In addition to mapping out a considerable portion of Thibet, hitherto unknown, Dr. Zugmayer has collected considerable data which will enable revisions of the existing maps of the country to be carried out, since he states that the latter are very erroneous. One fact he has conclusively established, and that is the recent volcanic conformations that have taken place in Thibet, a point which has been the subject of great discussion recently. At altitudes ranging between 16,000 and 20,000 feet he secured numerous botanical specimens which are of great value, while he also disoovered twenty new species of animals and fifty new groups of smaller animals.

## making artificial flowers.

Artificial flowers and leaves are made of silk and cotton fabrics stiffened with starch paste which is pre pared in the apparatus shown in one of the illustra tions. From the upper tank, heated by gas, where the starch and water are mixed together the paste passes through a sieve to the lower tank where it is kept in continual agitation by a rotary stirrer and cooled by cold water circulating through pipes. From this tank the paste is dipped and poured through a second sieve into a cask. The fabric is plunged into the paste, wrung out, and stretched on wooden frames, the bars of which can be moved by screws to regulate the tension of the fabric, and the layer of paste is made uniform by parallel strokes in one direction with a broad, fan shaped brush. Here the fabric is allowed to dry and if it is to be used in making leaves or petals of uni form color, the proper pigment is applied with a brush. It then goes to the cutting room. The cutting is done, by hand or machine, with punches of a variety of forms, shown, arranged on trays, in one of the illustrations. The cutter sits on a stool before a great wooden cutting block covered by a cushion supporting a thick sheet of lead, on which from two to four thicknesses of the prepared fabric are laid. The punch is guided with the left hand and struck with a heavy mallet held in the right. The operation of cutting by machine is similar, except that the mallet is replaced by a vertica steel beam moved up and down by an ec centric. Girls then fasten to the cut-out leaves pieces of fine cotton-covered brass wire which give them stiffness and represent the leaf stalks. The veins and folds of the leaves are imitated by pressing the pieces forcibly, in a hand press worked by a ver tical screw, between a copper plate engraved with a design in intaglio and an iron plate which bears the same design in relief, the two plates being hinged together to insure exact correspondence of the designs.

On leaving this apparatus the artificial leaf is a pretty good imitation of its natural model but, like an oil painting, it needs a final operation-varnishing.
For this purpose the leaves are immersed in melted wax in basins heated by gas. A mere dip suffices for a small leaf, but a large one is rotated by rolling the stalk between the hands to assure contact of the wax with every part. The soft, velvety appearance which is characteristic of the leaves of some plants is ob tained by dusting the waxed and re-heated leaf with fine starch, equalizing the coating with a soft brush and removing the excess of starch with a coarser brush.
Striped leaves are imitated by means of stencils, the colors being applied with a brush. Irregular markings are imitated by free-hand painting. The large leaves of sedum and other Crassulace receive one or more

## by jacques boyer.

coats of colored starch paste before being varnished. The edges of the leaves of rosemary, etc., are curled with hot pincers. Finally, the leaf stalk is usually covered with silk paper.

Stems composed of fabric are made by a machine in which three ribbons cut bias are unrolled from bobbins and pass through spiral metal tubes heated by gas which cause them to curl like shavings, and form little tubes which preserve their shape even when reeled. Stems are also made of India-rubber tubes. These are painted green and after drying are tinted brown on one
$\square$


Stamping and Veining Machine.
respect are wholly dissimilar to those in the interior, as far as examinations have disclosed their character While the State Drainage Board of Florida has begun to dredge the channel from the head of New River at Fort Lauderdale, on the east coast, northeasterly to the southern border of Lake Okeechobee-the first move made toward the drainage of any considerable portion of the Everglades-these and other unde termined matters essential to the ultimate success of
overlying the rocks which is said to constitute the substrata of the entire area.

This preliminary examination relating to the agricultural possibilities of the historical Everglades includes not only instrumental engineering, but problems in drainage construction and consideration of the subsequent behavior and value of the soil for productive uses. The examinations will be made with a view to determining the most feasible and practicable plan

10 parts of American turpentine oil. This second mixture is then added to the first, and 40 parts by weight of ammonium carbonate prepared with oil of lavender added to the whole. The mass is left to dry in a well-closed receiver.
When required for use, the powder is scattered in rooms or receptacles containing the articles which are to be protected from moths, the articles being either suspended over it or laid in it. The powder may,


Building a Tree.
this vast reclamation project still confront the State and other owners of land to be affected. The State Board, appreciating this state of affairs, has through the governor asked that the U. S. Department of Agriculture, through irrigation and drainage investigations of the Office of Experiment Stations, make the matter a subject of special investigation and report.
A preliminary examination of the Everglades was made by Mr. J. O. Wright, drainage engineer of the Office of Experiment Stations, followed by a conference with the governor and a number of memhers of Congress of Florida, which resulted in the Office of Experiment Stations undertaking an investigation, which includes the running of a line of levels from the west to the east side of the Glades, something never heretofore attempted. This survey was begun at Fort Myers in January last. It is in charge of Mr. John Tw- Stewart, assisted by Lawrence Brett, drainage engineers of the Office of Experiment Stations. These engineers have a-corps of assistants equipped for making all the necessary engineering and physical examinations. The line of levels, which starts at tide water at Fort Myers, will be carried across the State, connecting the surface of Lake Okeechobee and the upper part of the Everglades with tide water at the east coast. Examinations will be made of the physical structure and depths of muck or other material
for draining the whole or a part of the Everglades, in which will also be taken into account their probable agricultural value when drained. If the land can be successfully reclaimed, its value will be measured largely by the staple subtropical crops that may be produced and exported. It is expected that the investigations already begun will be continued until some definite conclusions have been reached upon all of the doubtful and undetermined factors pertaining to the drainage of the Florida Everglades.

## Preparation of a Moth-Exterminating Powder.

The following recipe for preparing a moth-exterminating powder called "Antimothine" is given by the Pharmazeutische Zeitung of Berlin: 500 parts by weight of finely-sifted sawdust are thoroughly mixed with 5 parts of powdered ammonium carbonate, prepared with oil of lavender. To this 10 parts of glacial acetic acid, mixed with 10 parts of water, are added and mixed until the effervescence, caused by the acetic acid, has ceased. By this treatment, the sawdust is made ready for the admixture of further ingredients. A second mixture is then prepared as follows: 500 parts by weight of finely-sifted sawdust are mixed with 20 parts of glacial acetic acid, diluted with 20 parts of water, 15 parts of spirits of wine, in which 5 parts of camphor have been dissolved, and


Cutting Out Leaves and Petals with Hand Punches.

rate of orre thousand per second it will require seventeen quintillions $(17,000,000,000,000,000,000)$ of years to empty it. Such a computation seems almost like trifling with science, indeed apparently trifling with the human intellect; but it is with these subtle theories that our physicists are wrestling, delving into the innermost chamber of the infinitely minute, to build for us, upon the most stable foundation, the macrocosm of a universe.

## Immigration Increabing.

During the fiscal year ended June 30, 1906, a record was established in the matter of immigrants who entere the ports, eclipsing ali former years. During that period no less than $1,166,353$ aliens were admitted, of whom $1,100,735$ were immigrants. The increase over 1905 was 106,598 . During the year 190511,480 aliens were rejected, and in 1906, 12,432. Of the immigrants, 764,463 were males and 336,272 females
Most noticeable is the increase in the percentage of immigrants from the countries of southern Europe and the decrease from those countries from which the United States in former years received most of her future citizens. During 1906 those countries of northern Europe whose people and ideas are very similar to our own furnished but few immigrants. Of these, there were from Ireland, 17,950; England, 15,218; Sweden, 3,281; Germany, 3,010; Denmark, 1,229, and Scotland 1,111 less than in 1905 . On the other hand, from Italy came 5,165 ; Russia, 30,768; Greece, 8,974, and Turkey 5,165 more than in the previous year.
The immigration from AustriaHungary amounted to 265,138 ; Italy, including Sicily and Sardinia, 273,120; Russia and Finland, 215,665; China, 1,544; Japan, 13,835; the West Indies, 13,656 .
The large amount of emigration from southern Europe is due to the very general unrest existing among the laboring classes of hose countries, and a very reprehensible activity on the part of agents of transportation companies, who, in order to secure passengers for h e i r respective lines, are often guilty of gross misrepresentations $\mathbf{o f}$ conditions and advantages in the United States, represented as a land of boundless plenty for all. The mental and physical grade of the immigrants now entering the United States is said by the Commission-er-General of Immigration to be much lower than in former years.
Of the immigration of 1906, the North Atlantic and North Central States received 90 per cent
of the total, and the South 4 per cent. The bulk of the immigrants avowed their intention of locating permanently in the larger centers of population, 374, 708 declaring New York State to be their destination, 198,681 asserting that they were going to Pennsylvania 86,539 to Illinois, and 73,863 to Massachusetts.

## Number of Motor Cars in France.

The number of motor cars in France which paid the tax in 1905 was 21,523 , with an aggregate of 179,361 horse-power. Of the total, 45,346 horse-power belong ed to the Department of the Seine, the number of cars being 4,627, or an average of nearly 10 horse-power per vehicle. In the remaining departments the number of motor cars was 16,896 , with a total of 134,015 horse-power, or an average of about 8 horse-power.

The Porquerolles wireless telegraph station regularly receives messages sent from Land's End; and now space telegraphy has been accomplished over a far greater distance. Quite lately a communication transmitted from the Eiffel Tower was recorded at the Biserte station, which is not laid out for long distances; and the circumstance was considered sufficient ly interesting to be telegraphed to the ministers.

HOW TO STUDY A STAR MAP.
by frederic r. honey, trinity college, hartford.
The following plan of a study of the heavens is offered for the assistance of the non-professional student, who finds his chief difficulty in the constantly changing positions of the stars from day to day; an apparent but not real change, due to the revolution of the earth round the sun.

Omitting a very small fraction, the length of the year is $3651 / 4$ days. During this period the earth rotates on its axis $3661 / 4$ times; i. e., the year is composed of this number of sidereal days, or the same star comes to the meridian this number of times, while the sun crosses it only $3651 / 4$ times.

This will be made clear by the following illustration: If the earth's orbit were a circle, its axis perpendicular to the plane of the ecliptic; and if it revolved at a uniform rate, Fig. 1 would represent it in twelve positions, with the understanding that the earth's diameter is enormously exaggerated to make the illustration clear.
Assuming the length of the year to be 360 days, each month having 30 days, the earth in the figure is represented at intervals of one month. While it is mov-


## HOW TO STUDY A STAR MAP.

ing from position $I$ to $I$, i. e., through 30 deg. of its orbit, it must rotate on its axis this number of degrees (from $a^{\prime}$ to $b$ ) in addition to the thirty rotations it performs during the month to bring the sun $S$ on the meridian.

The earth each day rotates on its axis 361 deg.; therefore in 360 days it rotates $360 \times 361$ deg., and $360 \times 361$ deg. $\div 360$ deg. $=361$ rotations during the year.

A star is always seen in directions indicated by the arrows, i. e., along lines which are practically parallel. If the reader will follow the earth in its consecutive positions, he will see that a star comes to the meridian at. intervals of exactly one rotation of the earth, while the sun reaches it $1 / 360$ of a rotation later.
During one complete revolution of the earth round the sun, i. e., after 360 solar days, the earth will have made relative to the stars $(360 \times 1 / 360)=1$ rotation more than the number of days indicates. The fact that the solar year is composed of $3661 / 4$ sidereal days does not complicate the discussion.

If this were all, it is evident that each solar day the earth would rotate a little less than 361 deg. But the earth's orbit is an ellipse of small eccentricity, and while its axis moves parallel to itself it is in-
clined at an angle of about $231 / 2$ deg. to the verticala consideration of which would involve the subject f the "equation of time," a discussion which is out side the scope of this article.
The other point to which attention is called is illustrated in Fig. 2. The differences between the distances of the stars need not distract the attention of the observer of the heavens. For the purposes of observation they may be regarded as situated upon the internal surface of a sphere whose diameter compared with that of the earth is so great that the latter may be represented by the point $E$.
Let $s$ represent the nearest fixed star. A circle described with $E s$ as a radius represents the "celestial sphere," upon whose surface all the stars may be considered to be located.
Thus a star, $A$, is represented at $a ; B$ at $b ;$ and $C$ at $c$.
The positions of a few of the bright stars are indicated in Fig. 3, which shows the celestial sphere with meridians or "hour circles" traced upon its surface, and "parallels of declination" at intervals of 15 deg. The earth is shown within it very much enlarged. In the drawing it would shrink to a mere point if it were drawn to the same scale as the celestial sphere. The parallel represented by the heavy line $z$ is that of Washington. The radial line produced to intersect the celestial sphere determines the position of the zenith of Washington; and the parallel of declination represented by the heavy line $Z$ may be called the zenith-parallel of Washington; i. e., as the earth rotates on its axis, each point of this parallel becomes in succession the zenith.
The earth rotates in the direction of the arrow $a$, while the celestial sphere remains stationary. It is convenient, however, to regard the earth as stationary, and to consider that the celestial sphere revolves in the opposite direction, viz., that of the arrow $A$.
If the reader will consider that when his body is erect it forms a continuation of the earth's radius, he will realize that the point $B$ is directly overhead, or his zenith. If he will turn his back to the Pole star and look directly south, he will be in a position to observe the majority of the stars which are labeled and indicated in the figure, and whose names-which may be found in the Nautical Almanac-are given in the table below.
The celestial equator, whose plane coincides with that of the earth, is divided into twenty-four equal parts numbered from 0 to XXIV. The numbering 0 begins on the far side or invisible surface of the celestial sphere, and the numbers I and II. are also invisible in the drawing.

The visible divisions are from III to XV; they are then continued on the invisible surface until XXIV or the 0 point is again reached. This arrangement of the drawing has been made to bring as large a number of bright stars as possible on the surface of the visible portion of the celestial sphere. They are represented by small black circles.
Those which are on the far or invisible side are represented by small open circles. By this arrangement seventeen of twenty-two bright stars are black, and the remaining five are open circles.
The "right ascension" of a star is the hour angle indicated by the Roman numerals on the celestial equator, and the "declination" the number of degrees measured on the hour circle which passes through its right ascension point; i. e., right ascension may be regarded as celestial longitude, and declination as celestial latitude.
For example, the declination of every point of the heavy line $Z$-the zenith-parallel of Washington-is 38 deg. 55 min .14 sec ., and the heavy line $z$ is the parallel of Washington whose latitude is also 38 deg.

55 min. 14 sec . The declination of Vega (marked $v$ ) is 38 deg. 41 min . plus; therefore this star is less than $1 / 4$ deg. south of the zenith, i. e., almost exactly overhead when it crosses the meridian.
If the observer will turn his back to the pole of the heavens, and look directly south, the celestial sphere will appear to revolve from the east to the west, i. e., rom his left toward his right. The highest point of the celestial equator is about 51 deg. above the horizon. Each of the twenty-four hours of right ascension is represented by 15 degrees. The degrees of declination on one side of the equator are marked plus, and those on the other side minus
Comparing the illustrations in Fig. 3 with the right ascensions and declinations given in the table, it is easy to become familiar with this method of locating a star on the celestial sphere.
If the conditions assumed in Fig. 1 were true, every star would come to the meridian exactly four minutes earlier each day, and four minutes multiplied by 360 $(360 \times 4 \div 60)=24$ hours.
It is then clear that the sidereal day being shorter by four minutes than the solar day, 361 of the former would be equal to 360 of the latter. But there are actually $3661 / 4$ sidereal days to $3651 / 4$ solar days. Dividing one by the other, $366.25 \div 365.25=1.002738$; and $1.002738-1.0=0.002738$, the excess of the length of the solar day over that of the sidereal day. Reducing this to minutes and seconds, 0.002738 of a day $=3 \mathrm{~m} .56 .5 \mathrm{~s}$. The sidereal day is then three minutes and fifty-six and a half seconds shorter than the solar day.
If the months were of the same length, we should be able to say that the same star crosses the meridian exactly two hours earlier on the same day of each succeeding month.
Fig. 4 is a map of that portion of the heavens which contains the stars whose positions on the celestial sphere are shown in Fig. 3. If the observer will place himself in the position already described, the heavens will appear to move in the direction of the arrow; and during a single night he will be able to identify several bright stars.
The heavy arc $Z Z$ marks the zenith-parallel, and the $\operatorname{arc} H H$ the horizon. The distance between the zenith and the horizon ( $=90$ deg.) may be roughly divided by the eye, and with the aid of the map a conspicuous star may be located.
In observing the stars a Persei (a); a Aurigæ or Capella (c); $\eta$ Ursae Majoris ( $s$ ); and a Cygni ( $x$ ), the observer should face the pole, as these stars cross the meridian a little north of the zenith. The observation of Capella which is very near the zenith will assist very much in identifying a large group of stars, including the magnificent constellation Orion and the Dog Star Sirius ( $h$ ). Capella crosses the meridian about forty minutes after Aldebaran (b) ; and these are followed by some of the brightest stars in the heavens. Some knowledge of the positions of these stars makes it a comparatively simple matter to use a star map, and thus to command a fair knowledge of the heavens in detail.
Vega ( $v$ ) is very near the zenith when it crosses the meridian early in the evening in September. Its right ascension is between XVIII and XIX. It is followed a little over an hour later by Altair ( $w$ ) which is about a third of the distance between the zenith and the horizon.
Next in order is a Cygni ( $x$ ) which is a little north of the zenith, and can be seen by facing the pole, and a little over two hours later Fomalhaut ( $y$ ), less than ne-fourth of the distance from the horizon to the zenith, will cross the meridian.

|  | Name. | Right Ascension. | Declination. |
| :---: | :---: | :---: | :---: |
|  |  | $\begin{array}{\|c\|c\|} \hline \text { Hrs. } & \text { Min. } \\ 3 & 17+ \end{array}$ | Deg.  <br> +4  |
|  | Tauri or Aldebaran........(b) | $30+$ | +1619+ |
|  | Aurigæ or Capella... ..... (c) |  | + 45 54+ |
|  | Orionis or Rigel ......... (d) |  | -818 |
|  | Tauri.... . ${ }_{\text {Orion }} \ldots . . . .{ }^{(\rho)}$ | 5 20 <br> 5 31 <br> 5  | +2831 + |
|  | Orionis or Betelgexse...... $(9)$ |  | + $723+$ |
|  | Canis Majoris or Sirius.... $(\boldsymbol{h})$ | 641 | -16 35 |
|  | Canis Majoris ....... .. (k) |  | ${ }^{28} 50$ |
|  |  | $4+$ | -2614 |
|  | Geminorum or Castor....(m) | $28+$ | + $325+$ |
|  | Canis Min or Procyon .. (n) | 7 $34+$ <br> 7  <br>   | + $527+$ |
|  | Geminorum or Pollux....(p) | $39+$ | + $2815+$ |
|  | Leonis or Regulus .......(q) | $10 \quad 3+$ | +12 $25+$ |
|  | Virginis or Spica.........(r) | ${ }_{13}^{13} 20+$ | - 1040 |
|  | Ursm Majoris............(s) | $\begin{array}{ll}13 & 43 \\ 14 & 11 \\ \text { + }\end{array}$ | $+4946+$ +1940 + |
|  | Scorpii or Antares ........ $(\boldsymbol{u})$ | $16 \quad 23+$ | -26 13 |
|  | Lyræ or Vega :.......... (v) | $1833+$ | + $38{ }^{41}+$ |
| $\alpha$ | Aquilæ or Altair. . . . . . . $\left.{ }^{( }\right)$ | ${ }^{19} 46+$ | + $837+$ |
|  | Cygni or Deneb.........(x) Pis. Austr. or Fomalhaut.. $(y)$ |  | $\begin{array}{ll} +44 & 56 \\ -80 \end{array}+$ |

There are now more than 750 motor omnibuses in London. Eighteen months ago their number was under fifty. No fewer than 184 million passengers are, it is said, now being carried annually.

## A HYDRAULIC AIR-COMPRESSING PLANT

One could scarcely conceive of a more direct method of seizing the power of a stream and coverting it into a more flexible form of energy for distribution to various points of application than that employed at the Victoria mine in the northern part of Michigan. The mine is located near the Ontonagon River, the powe of which is converted into compressed air, and with this the machinery and tools of the mine and the mill are operated. However, instead of using turbines, as is ordinarily done, to convert the hydraulic into me chanical power, and then using compressors to trans form the mechanical into pneumatic power, in this system the air is compressed directly by the water and without. any intermediate mechanism. The action is similar to that of the aspirator pump, in which, as is well known, a current of water acts by adhesion to exhaust the air from a receptacle. In the present case the reverse takes place, for bubbles of air are taken from the free atmosphere and then trapped in a cham ber.
The hydraulic system of compressing air is not new, even as a commercial enterprise. In the Scient fic American of April 8, 1900, we described a plant of this character installed at Magog, Quebec, to furnish power for the Dominion Cotton Mills Company. Sev eral other hydraulic compressors have since been es tablished. However, the plant of the Victoria mine aside from being one of the largest of its type ever built, possesses a number of very novel features which are most interesting.
A concrete dam has been built across the Ontonagon River, at a point 4,000 feet above the plant, and thenc water is conducted through a canal under a head of 71 feet. At the forebay of the canal three shafts have been sunk through solid rock to a large subterranean chamber. These shafts are fitted with intake pipes 5 feet in diameter sealed in with concrete. The cham ber is 281.5 feet long, 18 feet wide, and 26 feet high At the end opposite the intake pipes it terminates in tunnel 10 feet high and 18 feet wide, communicating with a large shaft $18 \times 20$ feet in cross section, which leads to the tailrace. The chamber collects the air which is sucked down by the water pouring down the intake pipes. The air is here held under a compres sion of 114 pounds gage, due to the difference between the water level in the chamber and the tail-water level Under normal conditions this difference in leve amounts to 271 feet, while the vertical distance from the water level in the chamber to the level at the top of the intake pipes is 343 feet. Hence, the total work ing head, from intake to tailrace, is 72 feet.
A receiving tank is built over each intake pipe $W$ ithin this tank, and mounted on the upper end of each pipe, is an intake head consisting of an annular funnel. The funnel is arranged to telescope over the end of the pipe, and is normally supported on a float ing bell or inverted tank, which serves to hold the mouth of the funnel just below the level of the water Around this funnel, and also supported on the bell, is an annular air tube, which is supplied with air by means of feed pipes extending well above water level. This annular tube is fitted with series of small tubes, which project radially inward into the mouth of the funnel. The tubes are only $3 / 8$ of an inch in diameter and there are 1,800 of them for each intake head. The water flowing into the funnel over these tubes acts, on the aspirator principle, to draw air from them in bubbles, which are carried to the chamber below At the bottom of the shaft the intake pipe is somewhat flared, and extends about 15 inches below the normal working level of the water in the chamber. Directly below each pipe is a conical concrete block, as shown in one of the illustrations. The water striking this block is spread out in an annular stream, thus de livering the air bubbles near the surface of the water During the comparatively slow passage through the chamber, the air bubbles, owing to their buoyancy, rise out of the water and are trapped, because the wate level in the chamber is 18 inches above the roof of the outlet tunnel. The water, however, continues out through the tunnel and up the inclined shaft, whence it discharges into the tailrace
The compression chamber above the normal level of the water therein has a capacity of 80,264 cubic feet. A 24 -inch pipe conducts the air to the various pneumatic machinery used in the mine. In order to prevent an excess of compression, a small blow-off pipe is provided, which leads up to the bell that sup ports the intake head of the central pipe. The lowe end of the blow-off pipe is submerged to a depth of a few inches below the normal level of the water in the chamber. When the pressure becomes excessive, the water is depressed, uncovering the mouth of the blow off, and permitting compressed air to rush up this pipe into the bell. The latter is then buoyed up by the air, lifting the intake head out of the water, and thus preventing further inflow until the compression has been reduced. In addition to the small blow-off, a larger blow-off pipe, 12 inches in diameter, is pro vided, which leads to the tailrace. The mouth of this blow-off is submerged to a somewhat greater'depth
than that of the small pipe, and when the water in the chamber is sufficiently depressed, air discharges through the blow-off, carrying with it a quantity of spray, which shoots out like a geyser to heights of from 150 to 700 feet. This artificial geyser presents a most pleasing spectacle, particularly in winter time, when the spray freezes and forms huge icebergs about the discharge nozzle.
When all three of the intake pipes are in operation, a total of 5,000 horse-power is available. However, one intake pipe has been found to furnish all the ower necessary for operating the machinery of the mill and mine. With this single intake, while deliver ing 11,930 cubic feet of air per minute at an absolute pressure of 128 pounds, an efficiency of 82 per cent is shown. A turbine operating with a loss of 10 or 12 per cent may be considered remarkably efficient; but before this mechanical power can be converted into compressed air, a loss of at least 30 per cent more must take place. The remarkable efficiency of the direct hydraulic compression is thus made apparent; but we should also take into calculation the remarkable conomy of operation; for the hydraulic compressor contains no machinery which requires attention or is iable to become deranged
As was stated in our previous article on the hydraulic compressor, one of the chief advantages of this ystem is the fact that the compression is isothermal. As the bubbles of the air are carried down the intake pipe they are compressed, but the heat of compression is conducted off by the water which surrounds them. in the ordinary systems of compressing air a great deal of difficulty is experienced, owing to the increase of temperature due to the compression, and also owing to the condensation of water vapor which occurs with a fall of temperature, or an increase of pressure, or both. However, the air which is trapped in the rock chamber at the Victoria mine is of a temperature almost as low as that of the water, and is practically free from moisture.

## Tourewpmatente.

Groscopic Resistance of Motors on Railroad Curves.
To the Editor of the Scientific American:
One point in the cause of the New York Central wreck which I have not seen mentioned, and which appears to me to be of possible importance, is the gyroscopic action of the motors on the electric locomotives. When one considers how stubbornly a toy gyroscope of only a few ounces weight will resist deflection from its plane of rotation, what must be the stress required to deflect from tangent to curve, at xpress train speed, the heavy revolving motors of a powerful locomotive?
C. H. Kennison.

Ayer, Mass., March 4, 1907.
[One effect of the gyroscopic action of the rotors and wheels of an electric locomotive would be to resist the angular movement round a curve; but since at express speed it would take from 20 to 30 seconds to turn the locomotive through 90 degrees of a 3 -degree curve, this resistance would be insignificant compared to the other resistances encountered.-Ed.]

## Tornadoes in Kansas.

To the Editor of the Scientific American:
While in Kansas a few years ago I had a very clear view of a tornado. It was about ten miles distant, passing swiftly over the prairie. It presented the appearance of a long rope about two feet in diameter. It extended from a dark, irregularly-shaped cloud to the earth, and was slightly curved. It was of nearly uniform thickness, and leaned about 35 deg. from a perpendicular toward the cloud. A line drawn from where I stood to the cloud would have made an angle of about 40 deg . with the earth's surface. After this rope-like projection had parted, I noticed in the irregular cloud a perfectly-shaped spiral of silver whiteness. It was shaped like a great auger, and extended from the point where the funnel or rope had been connected with the cloud forward in the direction the cloud was moving. All around it was in wild commoion, but the spiral itself seemed to stand like a great white ribbon coiled auger shape and fixed secure. This spiral, at the time I caught sight of it, was lying in nearly a horizontal position; the forward end being only slightly elevated. I have never met anyone who has seen this spiral in the tornado cloud; but by one who came dangerously near being caught by a passing tornado, I was told that the center of the whirlin:cunnel was as white as milk. From his statement, taken in connection with my own observations, I have ormed the opinion that the center of all tornadoes is perfectly-shaped electrical spiral, and that when in operation it connects the earth with the cloud. It is manifest that such a spiral would give the middle of the tornado funnel a white appearance. But it is not likely that one looking at it in its upright form would detect its spiral form. Indeed, it would have to turn itself in a most favorable position in order to reveal the eye of the observer its spiral form.
La Porte, Tex., February 26, 1907.
W. T. Hall.

## WOODEN CARS IN A RAILROAD WREGR.

As a general rule, the Salentific Amprican publishes photographs of railroad wrecks only when there is some definite lesson taught by the disaster. The accompanying photographs of a wreck which occurred on the first of March near Colton, Cal., on the Santa Fé Railroad, tragically illustrate both the ever-present

Not only should the switch signals be mounted on a lofty signal post, but a lofty, distant signal should be provided, and the two so connected that when the switch is open, both signals will show a red semaphore by day and a red light by night. If a clear distant signal were provided, as it unquestionably should be, we believe that accidents due to express trains, or


The Massive Vestibuled Day Coach Crushed the Baggage and Smoking Cars into Fragments, but Itself Remained Practically Intact.
peril of the open switch and the frailty of the ordinary wooden passenger car, when it is placed between a heavy locomotive and a heavy Pullman car, and the train rushes at high speed into a head-on collision. In the present case, a passenger train, which was made up of a baggage car, a smoker, a vestibule day coach, and a Pullman observation car, was running at a speed of about fifty miles an hour as it approached a siding onto which a freight train had just backed, in order to give the passenger train a clear track. The train crew of the freight, by one of those fatal lapses of memory which are such a frequent cause of railroad disaster, omitted to close the switch, and the engineer of the passenger train failed to notice that it was open, until he was almost upon it. The centrifugal force as the engine attempted to swing around the sharp turnout was sufficient to overturn it bodily upon its side, and it ground its way over the roadbed for 150 feet before it came to rest, the tender breaking away at the point where it left the tracks. The train swept by the overturned locomotive and collided, practically at full speed, with the heavy engine of the freight train. The momentum of the vestibule day coach and the observation car drove the smoker into the baggage car and, as will be seen from our photographs, literally ground these two into fragments, the wreckage being more complete than anything we remember to have witnessed in a wreck of this character. Extraordinary to relate, only one person was killed outright, although two others were probably fatally injured, and a large number received minor injuries.

This wreck calls attention once more to the everpresent danger which exists in facing switches, which, while they may be eliminated on two-track roads, cannot be on single-track roads, on which the traffic runs in opposite directions on the same rails. Facing switches can be got rid of only by double-tracking, and the frequent occurrence of accidents of this kind proves that on the transcontinental roads, on which fast heavy expresses are run, double-tracking has become and, indeed, has long been, an urgent necessity. It is certain, however, that greater precautions could be taken to safeguard such switches. The provision of the present small dwarf signal, only a few feet high, at the switch points is a miserable and utterly inadequate safeguar.d.
indeed any kind of train, running into open sidings would become exceedingly rare.

The other lesson of the wreck is that the wooden day coach is literally a death trap in collisions, and cannot be too quickly superseded by the car of all-steel construction. To be convinced of this, it is only necessary to contrast the splintered wreckage of the frail smoker and baggage car with the practically intact under-frame and body of the vestibule day coach, whose
railroad companies. Ordinarily, the seats are merely screwed down to the flooring with wood screws, and undoubtedly the breaking away of the seats and the crowding of seats and passengers in a confused mass at the front end of the car is the cause of many severe fractures and contusions. Cast-iron legs and frames should be abolished, and replaced by light steel framing with the legs bolted, not screwed, to the floor.

## tablet writings from the ruins of nippur.

The expedition sent out by the University of Pennsylvania has uncovered and freed from the dust of ages one of the most interesting archives ever rescued from the debris of a buried city. Fourteen centuries before the birth of Christ, under the foreign rule of the Cassite kings of Babylon, Nippur became one of the most highly civilized and enterprising cities of ancient times. During this period of its prosperity, and before the hand of destiny consigned it to decay, Nippur must have been a highly desirable place of residence. Among the fine buildings were a temple and a temple school, from the executive department of which the archives referred to have been obtained. The "library" consists of about twenty-five thousand books and documents in the form of the clay tablets of the time, and the deciphering of these discloses many conditions not very different from those obtaining in Philadelphia to-day.

After years of study Prof. Clay, of the University of Pennsylvania, who has been described as "probably the foremost living copyist of cuneiform tablets," has succeeded in translating many of the important tablets in the collection. The clay tablets were found, it may be mentioned, in one of the ancient palaces un-


To the Right Is the Engine of Express; to the Left the Tender of the Freight.
more massive construction seems to have suffered prac tically no injury, not even the glass of the windows being broken. That both the vestibule day coach and the observation car were subjected to terrific shock was shown by thef act that in both of them the momentum of the seats was sufficient to tear them from the floor and pile them in a heap at the front end of the car. Here, by the way, is a menace to passengers which could very easily be remedied, and at little cost to the
earthēd by the workers, and were in perfect condition for the most part, because they had evidently been "filed away," if the expression can be applied to such ancient objects, the clay tablets being placed on edge, "reclining against each other like a shelf of leaning books in an ill-kept library of to-day."
Astute Arabs, rightly guessing that there were some monetary pickings in the relics that the members of the expedition sought in the ruins of Nippur, took a


Wreckage of Baggage and Smoker After They Were Crumpled into Fragments Between Vestibuled Coach and Freight Engine.


Roof and One Side of Baggage, and Fragments of Smoker Immediately After Collision. These Adjoining Views Taken on Opposite Sides of Wreck.
sly hand in the work, and through their reprehensible operations a number of tablets found their way to New York in the possession of private individuals. Some of these were deciphered with far too much airy freedom by the translator, but Dr. Clay has corrected errors in the interpretation of the signs on these tablets, so that the Babylonian data now in the possession of the University of Pennsylvania are as complete as care can make them. From the tablets translated by Dr. Clay it would seem that the saying regarding the futility of escape from death or the tax collector must first have been wailed forth from the overburdened soul of a resident of Nippur, 1400 B . C., for many of the documents found are records of receipts for rent or taxes from the outlying districts of the city. Others have reference


Tablets Showing Thumb Marks Instead of Seals.


The Payroll of the Officers and Servants of the Temple of Bel at Nippur.
unfortunate priest who had got into the clutches of the law because of his failure to pay a debt.
A wise ruling revealed by the tablets is a case in which the concomit-
nues were loaned out in the interest of the temple ex chequer, the priests being very careful to charge in terest on the money advanced. Still others record the payment of salaries to priests and to officials of the storehouse.
The taxes were paid, not in coin, but in natural products, such as corn, sesame, oil, dates, flour, and live stock. Although no record has been found to show the relative value of these articles, there was doubtless a regular rate of exchange in Nippur for the product of the farmer's toil. In most instances where the bookkeepers of Nippur recorded the payment of taxes, a note was made of the purpose for which it was paid. Thus one tablet states that grain was handed in for the maintenance of the priest, the temple servant, and the storehouse servant. Other payments are recorded as for the -temple gateman, the singer, the temple shepherd, and for sacrificial purposes.
According to Dr. Clay, the records of the tablets show that in this ancient town, the temple of the god was not only the foremost institution of the city, but that it practically supported and controlled everything in the immediate vicinity.
They were careful bookkeepers in Nippur fourteen centuries before the birth of Christ, for these tablets also show plainly not only the nature of the tax collected, but the town from which it was received. In these outlying places the taxes were either transferred to Nippur or used in local civic disbursements-a com-


A Payroll Showing the Marks Where the Items Were Checked Off by the Bookkeeper.

- ants are a farm crop, an ox with a broken leg, and a borrower who subsequently became a sorrower. The man who borrowed the ox obtained it from a farmer, who stipulated that the animal should be returned at a certain time, so that the work on his own farm should not suffer in consequence of his generosity. The borrower was unfortunate in that the ox broke a leg while working for the new driver, and in consequence the time for the return of the animal, which was the essence of the new arrangement, came and passed and the owner of the ox was unable to work his farm. The tablet shows that the borrower was compelled to make


How the Stylus Was Used in Writing the Tablets.


Supposed Forms of the Stylus as Reconstructed To-Day.
plicated and unwieldy system of collecting and distributing revenues, when it is remembered that the taxes were paid in either grain or cattle.
Many of the tablets are records of business transacted between private individuals, and some of these are intensely interesting as throwing light on the life of the inhabitants of this ancient city. For instance, one self-sacrificing citizen, according to the chronicle of the tablets, took the place in a prison cell of an
good the crop that would have been raised by the owner of the ox, had he not been deprived of the use of his animal by the chapter of accidents related.
For a time it puzzled the translator of these tablets to know the meaning of little indentations, apparently made' with a pointed instrument, by the side of the columns of record of disbursements made. It has been decided that these were the check marks of the person who made the payments. In modern parlance, as he

Tablet Envelopes, Showing Seal Impressions.

handed out the pay envelope the Babylonian bookkeeper checked off the amounts on the tablet in the way shown in one of the photographs, by making little impressions alongside the amount or name.
The use of the seal was all-important in the transactions of the business man of Nippur. It was an easy matter to forge a document drawn on one of the clay tablets, so the method employed to prevent this was to incase the tablet in a sealed envelope. Of these seals Dr. Clay says
"The seal impression is equivalent to the signature of the modern document. It belongs to the man upon whom the obligation rests, or who is the recipient mentioned in the tablet, or to whom the goods are delivered. The only way that protection could be assured was to incase the tablet, and for the obligor to make impressions with his seal upon the envelope. The holder of the document might be able to make changes on the case, but he could not remove it to alter the tablet because he could not restore the envelope which bore the impress of the seal of the obligor."
Frequently instead of a seal there was a thumb mark, showing that the Babylonians were alive to the importance of the method of identification so widely exploited in the present day as an unerring means of connecting the mark with the originator
Apart from the tablets themselves the most interesting thir. ${ }^{\circ}$ about the ancient writing is the way in which it was done. There has been some controversy concerning the shape of the stylus used by the ancient scribe in forming the characters on these clay tablets. Dr. Ciay has made several of these after the pattern


Original Tablets, Tablet Envelopes, and Modern Replicas.
on which he believes the originals were constructed Some of these are shown in the accompanying illustra Some of these are shown in the accompanying illustra-
tions. None was found in the ruins. The manner in which these writing instruments were used is also shown in one of the engravings herewith.

## CARBORUNDUM AND SILICON DETECTORS FOR WIREI.ESS TELEGRAPHY. <br> by a. FREDERICK collins.

A novel detector for determining the presence of electric waves, has just been brought out by General H. H. C. Dunwoody, and has been found sufficiently sensitive and trustworthy to be used for commercial wireless telegraphic work.
The device in question consists of a minute mass or fragment of carborundum-an artificial compound made of carbon and silicon in the electric furnaceheld in place between two metallic terminals or con ductor plugs, usually formed of copper or brass.
This detector has recently been made the subject of exhaustive tests by Mr. G. W. Pickard, who has found that it is somewhat less sensitive than the magnetic detector of Marconi, which in turn follows the electro lytic detector of Fessenden; that is to say, while it reãuires from 350 to 400 micro-ergs ( $1 \mathrm{micro-erg}$ being $1 / 1000$ of an erg*) to operate the electrolytic detector, and frōm 400 to 500 micro-ergs to impress a magnetic detector, it requires between 9,000 and 14,000 microergs to carry the conductivity of a carborundum detector so that it will produce an audible tone in a telephone receiver, with about the same amount of energy required by a microphone detector.
Notwithstanding this very considerable difference in the sensitiveness of the electrolytic and carborundum detectors when measured in the C. G. S. system of units, in the actual practice of wireless telegraphy the difference in receptiveness is barely perceptible over similar distances. In the first experiments with carborundum as an electric wave detector, it was found that its sensibility to the electric oscillations set up in the circuit of which it was a part, was a maximum when a certain critical potential prevailed in the local circuit of which it also formed a part.
In this respect it resembles the electrolytic detector when in action. For this reason a potentiometer or variable resistance is used in shunt with the detector. As carborundum is obtained in the form of crystalline masses, it has, in consequence, a very high resistance where the current flowing in the internal or dry cell circuit is small, but as the strength of the current is increased the resistance drops very rapidly.
Various curves have been plotted showing the resistance variation against the difference of potential across the conductor plugs of the detector, and in one of these it was demonstrate that the conductive charge occurred most rapidly between 1.0 and 1.1 volts. The conductance of the detector at this potential was about 250 microhms, or 0.4000 ohm , and a variation of 0.01 volt at the above potential value will produce a change in conductivity of about 10 microhms, or 4 per cent.
It is well known that the flat side of carborun...m is a very poor conductor and in order to obtain good electrical contact, the sharp edges of the carborundum fragment must be clamped between the opposed surfaces of the plug ends of the detector, when the actual contact is l mited to an exceedingly small area-not more than one millionth of an inch and probably less.
In common with the Fessenden hot-wire barretter and responders of the bolometric type, the action of the new Dunwoody detector is purely thermal. But instead of utilizing either an exceedingly fine metal wire of relatively low specific resistance and temperature coefficient, as does the barretter, or a large radiating or absorbing surface in proportion to its mass as does the bolometer, the carborundum detector employs a constricted current path lying along the edge of the crystal in contact with the oppositely-disposed sur faces of the conductor plugs.
The new carborundum detector is so designed that it can be inserted in circuit with a De Forest receptor instead of the detector formerly used; in other words, the carborundum detector is made interchangeable with the electrolytic detector, which it has superseded When placed in such a receiving circuit, the mani festatien is greatest when the potential impressed upon the detector is between 1.0 and 1.2 volts.
In other tests, the conductor plugs supporting the carborundum crystals were heated by a spirit lamp, when the resistance of the detector was observed to decrease greatly, but on cooling again it assumed its former resistivity, which is of the order of a megohm. The crystals of carborundum employed in the Dun woody detector are microscopically selected and only those having the sharpest edges are chosen, since these have been found to give the best result. The fragment of carborundum is placed between a spring and an adjustable screw plug, and by varying the

* In the C. G. S. system the erg is the unit of work and of energy, being the work done in moving a body through a distance of one centimeter against the force of one dyne, or the kine
at the rate of one centimeter per second.
pressure of the spring by means of a screw the point of maximum sensitiveness can easily be obtained.

The exact proportions of the crystal are not essential and it may vary from one to three millimeters on the side. The crystal to be used should never be touched by the fingers, as this often reduces its sensitiveness to an appreciable extent; the proper way to handle the element is to use a pair of tweezers.
Since the advent of the Dunwoody carborundum de-


THE NEW DUNWOODY CARBORUNDUM DETECTOR inserted in a receptor.
tector, Pickard has brought out one using silicon as the sensitive medium. Silicon is a non-metallic element, prepared as a dull-brown amorphous powder, as shining metallic scales or as dark steel-gray granules, sometimes showing crystallization. Any one of these may be used as a detector, and in any case it is pressed into good electrical contact between two conducting plugs as in the ordinary coherer.

Different from the coherer, this latest "thermo-elec tric regenerative detector" converts the energy of the oscillation set up in the receiving aerial, into heat at the junction of the silicon and the metal forming the conductor plugs by virtue of the high resistance of the former and the low resistance of the latter.
The amount of heat developed by the high thermoelectromotive force, and the consequent temperature rise, is proportional to the square of the resistance according to the well-known law of Joule. The detector gets its name as indicated above from the fact that this thermal energy is converted or regenerated into a direct electric current, the detector performing the same function as all others that have been devised, namely, that of a very delicate relay.

A machine for applying screws at the rate of fifty a minute, if necessary, has recently been placed on the market and consists of a hopper connected by a vertical flexible shaft and tube to the driving mechanism below. The withdrawal of the bit from each screw as it is

the detector applied to a de forest receptor.
driven causes a new screw to drop out of a magazine and fall in line with the bit and also allows a screw to fall from the hopper into the magazine. The use of the intermediate magazine was found necessary, as the operation of the machine is so rapid that too much time would be wasted in waiting for it to drop from the hopper. The screws are caused to revolve at the rate of 1,200 revolutions a minute by means of a friction drive so adjusted that the screw stops after it has been driven the required distance.

## LEDUC'S ARTIFICIAL PLANTS AND CELLS. <br> by dr. alfred gradenwitz.

A strong reaction against the somewhat childish endeavors of the alchemists to convert one element into another and to generate living beings from inert matter, pervades the history of nineteenth century science. Perhaps we have been prone rather too eagerly to discard the doctrines of former times, banishing many theories which in the course of the last few years have again been found worthy of serious discussion.
We are no doūbt at present on the eve of great revolutions in our scientific views; the phenomena of radioactivity have shaken the belief in the immutability of the atom and even the principle of the preservation of matter, at least in its familiar form. Nor does the distinction of three strictly separated states of aggregation stand the test of recent investigation; transitions are found to exist between the different states, and we are warranted in presuming that between the material and the immaterial (the luminous ether) there are likewise numberless intermediary states. Finally there have been discovered transitional stages between inert matter and living beings, from which many interesting conclusions in regard to the nature f life can be drawn.
While Prof. Lehmann's recent researchès on apparently living crystals have shown that certain bodies, mineral in outward appearance, behave like living organisms of the lowest type (bacteria), Prof. Leduc, of Nantes, has found the vital functions in animal and vegetable cells to be controlled exclusively by the physical laws of diffusion (osmosis) and cohesion (molecular attraction). On the basis of these phenomena he has even succeeded in artificially producing objects which, not only in appearance but in behavior, closely resemble natural cells, growing, absorbing food, and propagating themselves in exactly the same way.
The botanist might be somewhat embarrassed when asked to incorporate in his familiar system of classes, orders, and families the forms illustrated in Figs. 1 o 4 Still he would hardly have any doubt of their genuineness, their whole aspect being typical of repreentatives of the vegetable kingdom, especially of cer tain water plants.
Nevertheless, they are not living beings of any sort, but artificial bodies formed in the laboratory of the chemist. While their very aspect is certain to inspire interest, it is obviously far more interesting to observe them in the making, to watch how from an artificial seed a shoot springs and develops (at a rate readily controlled by the experimenter) into stems, leaves, buds, twigs; ears, and blossoms, and after some time dies like a real plant. The birth and death of a plant can thus be artificially reproduced within the space of a few hours.
Below are given some details concerning the artificial seed and the medium in which it is immersed for germination. A seed one to two millimeters in diameter, consisting of two parts of saccharose (cane sugar) and one part of copper sulphate, is immersed in an aqueous solution containing two to four per cent of potassium ferrocyanide, one to ten per cent of sodium chloride or some other salt, and one to four per cent of gelatine. In this solution, the seed germinates in a few days or a few hours according to temperature; under favorable conditions the germinating process can even be shown as a lecture experiment in a few minutes.
The seed surrounds itself with a membrane of copper ferrocyanide which is permeable to water and to certain ions, but is impermeable to sugar. This semipermeability produces a high osmotic pressure in the interior of the artificial seed, resulting in the absorpion of matter from the surrounding medium and thus in the growth of the whole structure. If the liquid be spread on a glass plate, the growth takes place in a horizontal plane. In a deep vessel, on the other hand, the plant form grows simultaneously in a horizontal and a vertical direction, forming stems which on arriving on the upper surface of th, liquid, spread out in flat leaves resembling those of a water plant.
A single artificial seed one millimeter in diameter can thus produce 15 to 20 vertical stems which someimes reach a height of 25 to 30 centimeters, being either simple or branched, frequently carrying lateral leaves or twigs and terminals shaped like spheres, mushrooms, ears, spires, etc., according to the composition of the culture liquid.
These experiments thus prove that the functions formerly considered as being characteristic of the process of life are due to and controlled by purely physi cal forces. In fact, the forms in question obviously receive their food by intussusception or internal absorption like living beings, whereas crystals, as is well known, increase by external accretion. Furthermore, the plant forms are really organized, possessing all those organs (stems, leaves, and terminal parts) which are characteristic of plants. As finally the substance used in building up these artificial plants, viz. copper sulphate, rises in stems up to 30 centimeters in height (with a diameter of one millimeter) they are necessarily provided with an apparatus of circula-
tion. Their growth is thus no doubt a real one like that of a plant, a small (artificial) seed developing into a complex form several hundred times larger than itself.
It is further interesting that the products of growth arising from the artificial seed are, like real plants, susceptible to numerous chemical and physical re actions. In fact, their development is arrested by many poisons, while their direction and growth are determined by differences in the internal diffusion pressure and in temperature. However, there are still further analogies between these artificial organisms and real ones. The former, like the latter, are endowed with the power of healing any injury, as whenever a stem is broken before the completion of its rowth, the fragments cling to and combine with one another, after which the process of growth again commences. Ther is only a single function of living plants which has not so far been artificially reproduced, viz., propaga tion in successive genera tions. Except for this de ect the whole of the vita process of vegetable organ isms would have been imi tated artificially, at leas in its outward appearance this problem, however seems to be susceptible of realization like those al ready solved.
The internal mechanism of the processes controlling the behavior of these arti ficial plants will be better understood by briefly re ferring to Leduc's previou experiments.* In these ex periments two mutually precipitating solutions. g., potassium ferrocy anide and a salt of cop-per-were sprinkled on gelatine-coated glass. The copper ferrocyanide depos ited at the surfaces of con tact of the drops formed the envelopes of polygona
cells. Similar cells ar formed when potassium so ution alone is sprinkled on the gelatine.
During the process of formation the artificial cell is the seat of active mole cular motion, consisting of an inward current of wa ter from the moist gela tine and a current of dis solved matter flowing from the center to the surface This apparent life can b prolonged by maintaining around the cell an environ ment that will feed it or replace the loss due to diffusion
These movements are checked by premature dry ing but recommence on the addition of water, suggest ing an analogy to the la tent life of seeds and rotifera.
As the ions or constitu ents of dissolved salts dif fuse independently, part of the molecule appears to be assimilated, or fixed in the cell, while the rest is elim inated. A diffusing drop of copper sulphate, for ex ample, leaves at the cente
yellow nucleus consisting of metallic copper. Thi is surrounded by a blue ring of the unaltered solution which is itself surrounded by a translucent ring con taining bubbles of gas due to the action of the released sulphuric acid upon the gelatine

Artificial cells are affected in structure and development by moisture, dryness, acids, alkalies, and various other substances added either to the drop of liquid or the surrounding gelatine. In this way many varieties can be produced, including cells with dark or light nuclei, with or without nucleoli, and cells of homogeneous protoplasm without nuclei, like the cells of


Fig. 8.-Sodium chloride crystal in
Fig. 9.-Morphogenetic effect



Fig. 6.-Artificial cell tissue.

Fig. 10.- Seementation of
ligoid artificial cells.
Fig. 11.-Artificial and natural karyokinesis
GAR, COPPER


Fig. 7.-Liquid cell tissues.
 R
g. 1.-An artificial plant which

ig. 5.-Field of diffusion between two opposite poles of inert matter, these objects sprout, branch, and nourish themselves like actual living organisms.
fluid a tinted drop of the same fluid between two drops of greater osmotic pressure. The central drop repre sents the nucleus, the others the centrosomes of the living cell undergoing segmentation. The central drop becomes granular and develops a pigmented ring which represents the chromatic band of the natural process and, like it, breaks up into chromosomes. These move toward the centrosomes and collect about them, forming two nucleated pigmented masses. Meanwhile a partition has formed between these masses which is continuous with their spherical walls, so that finally we have the image of two cells, with nuclei, protoplasm, and cell walls, presse closely together.
Prof. Leduc also produced in these experiments with
drops phenomena of growth similar, on a small scale, to those obtained later with solid "seeds." When a solution of cane sugar containing a trace of potassium ferrocyanide is dropped into a dilute solution of copper sulphate the drop of syrup becomes covered with a pellicle of copper ferrocyanide, forming an artificial cell. Under the influence of the difference of osmotic pressure between the drop and the surrounding liquid, water passes inward through the membrane of copper ferrocyanide which the sugar cannot traverse. The drop, or cell, increases in size and puts forth a bud which is immediately surrounded by a pellicle and proliferates in turn. In this way is formed, slowly, a chain of connected cells, the last of which may have


Fig. 2.-Artificial organs showing mushroomshape
plasm and a nucleus. With lich chloride, however, entirely liquid ell tissues (Fig. 7) are obtained. All the varieties of cells observed in nature can thus be artificially produced by suitably regulating the conditions of the experiment. Even the strange karyokinetic figures produced during the segmentation of cells, and of which no adequate explanation has yet been given, are read ily obtained in these artificial growths.
All living organisms are made up of solutions of crystalline substances and colloids; when their con entration increases, the molecular force of crystallization is manifested. Each center of crystallization sur rounds itself with a field of force (Fig. 8) that in some cases is rather intricate, and whenever, besides the
forces of crystallization, other forces, differences in osmotic (diffusion) pressure, are present, forms are obtained which in their outward appearance resemble certain inferior organisms. As the solid tissues of organisms are produced by solidification from the solutions above referred to, their shape and structure necessarily are influenced by the force of crystallization (Fig. 9).
When drops of a solution are introduced into the same solution at different concentration, these drops at first spread out in all directions; owing, however to the effect of molecular attraction (or cohesion) there soon takes place a granular segmentation of the liquid (Fig. 10). In fact, as this cohesion between the various molecules is different, those between which the attraction is greatest will combine into spherical grains as soon as the force of attraction exceeds the force of diffusion, while the other molecules fill the intervals between the grains. In this way the phenomena of segmentation observed in germinating eggs, which had previously seemed so puzzling, are not only accounted for but can be readily imitated by an artificial process.
From Lehmann's researches on apparently living crystals it is inferred that certain crystallized structures show a behavior quite analogous to inferior organisms, moving, growing, feeding, and propagating themselves like the latter. The investigations by Prof. Leduc which have been described above, on the other hand, prove that the fundamental element of animal and vegetable organisms, viz., the cell; is exclusively controlled in its vital functions by the same physical laws that govern the forms of the minerai kingdom. From both sides there is thus being constructed a bridge between the province of inert matter and that of living matter, and in the place of the strict barriers previously supposed, we are warranted in presuming the existence of a multitude of gradual transitions and intermediary stages.
It should be observed that the Leduc phenomena were first observed by Traube in 1867 (Archiv. f. Anatomie $u$. wissenschaftliche Medizin, 1867, p. 67), who produced them. Such artificial cells have long been known as Traube cells. Traube also produced them by means of tannin and lead acetate, water glass and- lead acetate, gelatine and tannin, and the like. In repeating Leduc's experiments Prof. Hans Molisch found that the acetate and the chloride of copper produce better results than the sulphate. The sugar, salt, and gelatine serve to increase the growth and ramification, but it should be pointed out that Reinke described branched and tree-like artificial growths more than twenty years ago.* If crystals of copper sulphate are thrown into a solution of water glass they become enveloped in light blue pelliclēs of copper silicate and these silicate cells develop into tree-like forms if sufficient water glass is present.
Even Leduc's discovery that artificial cells, like natural cells, are affected by various influences was anticipated by Traube, who described the effects of light and gravitation and the variations in form and rapidity of growth produced by adding grape sugar, salt, etc. In Molisch's opinion Leduc's experiments mark no advance beyond the results obtained by Traube in 1867. His artificial cells teach nothing new and they are no more like living organisms than a paper flower is like a real flower or a wax doll is like a living child.
Prof. Gaston Bonnier, of the Académie des Sciences and the University oí Paris, entertains very skeptical views of the biological value of Leduc's experiments. These views he has voiced as follows in La Science au XXme Siècle
"I pointed out to the Academy, in the meeting of December 24, 1906, that these tubular precinitates had long been known and possessed no organization comparable with that of living things. I also repeated before the Academy, some interesting variations of these amusing experiments de vised by one of my pupils-a minor. In La Revue of January, 1907, I showed that this alleged discovery was only a repetition (f Traube's classical experiments.
"At the meeting of January 7, 1907, Prof. Leduc made a rejoinder to which I replied on January 14, as follows:
"In a lecture just published M. Leduc expresses his amazement that Pasteur's researches have for thirty years silenced the discussion of spontaneous genera tion, and the brochure ends with the words: 'To com plete the synthesis of life only one function remains to be realized-successive reproduction. I regard this

special camera for copying and enlarging.
cyanide or a 10 per cent solution of sodium or potassium silicate. The production of these precipitates is a common lecture experiment. Leduc asserts that all forms obtained by earlier experiments were stunted, unstable, and shapeless but that his culture liquids produce large, stable growths with sharply differentiated roots, stems, and apical organs. But the descriptions
*Moritz Traube, Centralblatt für medizinische Wissenschaft, 1865 Archiv. für Anat., Phys. und
Botanische Zeitung, 1875, p. 56.
$\dagger$ Pfeffer, Osmotische Untersuchungen, 1877, p. 11. Botanisches Institut, Tübingen, 1886, vol. ii., p. 30.
cited above show that all of Leduc's results were ob tained before him.
"Our colleague, M. Gerner, has produced growths which could be preserved in paper like dried plants and which were mistaken for seaweeds by amateur botanists. Some of these arborescent forms have long been exhibited in apothecaries' windows, especially at Nancy.
"It is difficult to see what new fact is brought out by Leduc's experiments. I am not now speaking of the curious experiments in which he reproduced the structure of organized tissues-that is a different question.
"In his notes to the Academy, Leduc asserts that his pretended artificial plants give evidence of cellular structure, circulating system, thermotropism, osmotropism, and nutrition.
"It is well known that the forces which act in living beings are simply physicochemical forces. Traube and others have studied the effect of these forces on semipermeable membranes and Leduc has added nothing to their results. As for cellular structure and circulatory system nothing of the sort is to be found in these tubular precipitates.*
"It has been maintained that Leduc has made no claim to the creation of life by spontanecus generation, but this assertion is contradicted by his own words, quoted above.
"The net result of the whole affair is simply nil."

## AN EXPERIMENT IN ACOUSTICS.

The school bell and good legs are all that are needed for this experiment. Students who make it find it easier, as a rule, to understand the relation between pitch, wave length, and the number of vibrations. Where elementary astronomy is taught, the same experiment may prove to be a helpful as well as a healthful diversion during the study of a rather abstruse chapter-the application of the spectroscope to the determination of the radial motion of stars.
Select the swiftest runner of the school. Give him a bell, and place him on level ground at some hundred feet from the rest of the class. At a signal, the students run as fast as they can toward the bell bearer, while he bimself runs toward the students, without ceasing for a moment to ring his bell. So long as some distance remains between the students and the bell, nothing abnormal seems to occur, although the students, without being aware of it, perceive a sound of a somewhat higher pitch than that which strikes the ear of the bell bearer. But at the precise moment when the runners pass the bell, and instead of running toward it begin to run away from it, there is an instantaneous and very distinct dropping of the pitch of the sound, which remains graver as long as the distance increases between the runners and the man who rings the bell.

While the hearers are running toward the source of vibrations, they meet, in a given time, a greater number of these than if both the bell and the boys had remained in the same place. When the bell bearer and the students ran away from each other, the hearers go in the same direction as the vibrations, and the reverse phenomenon occursthe number of vibrations which reach the ear in every second is smaller than it would have been had all the participants remained on the spot. As the pitch of a sound depends upon the number of its vibrations per second, that of the bell will drop at the very moment when the distance between bell and hearers ceases to decrease and begins to increase.

If the man who rings the bell can be provided with a bicycle, the fall in the pitch of the sound is of course still more pronounced.

## SPECIAL CAMERA FOR COPYING AND

 ENLARGING.The camera illustrated here is one that was designed and built for the United States Geological Survey for photographing fossils or other similar objects. In photographing fossils the Survey uses a process known as the Williams process. This method was worked out by Prof. Henry S. Williams and Norman W. Carkhuff, and consists in an elimination of the color of the tossil by a process of sublimation.
Fossils cannot be photographed for scientific purposes in a haphazard manner. There are certain characteristics that must always be orientated in relatively

* Prof. D'Arsonval, who presented Leduc's note, has recently (January 21, 1907) presented a communication from Charrin and Goupil describing experiments which prove that no phenomenon anal.
occurs in the production of these arborescent growths.
the same position and illuminated in the same way, in order to produce results of any practical value to the scientist. Some of these fossils are photographed to the same size as the original, while others are much enlarged; great accuracy is required in this particular. As some of these fossils are exceedingly small and delicate, it is obvious that to do the work economically special apparatus is required. Could a comparison be made between the first piece of apparatus used by the original experimenters and the apparatus just comleted, the remarkable evolution in scientific camera building would make old camera operators wonder at the change.
The camera is mounted on a tilting base, so arranged hat either end may be elevated or lowered to any desired position, in crder to secure the proper lighting of the subject. The operator can make any of the following adjustments on the camera or subject with out leaving his natural position at the back while observing the focusing screen: either move the sub ject back or forth from the lens or revolve the sub ject support; move the camera back or forth on th tilting stand; raise, or lower, or shift the front of the camera in either direction; revolve the back from horizontal to a vertical position, or to any inter mediate point; elevate or lower the subject support in order to secure the proper lighting, all by mechan ical devices. It will be observed that the rod running along under the base operates a mechanism below at the front for rotating the subject base.
The base of the stand contains two cabinets for storing lenses or small parts. The focal capacity of the camera, including cone extension, is $71 / 2$ feet; length of stand top, with subject support and camera extended, 11 feet; size of plate, $61 / 2 \times 81 / 2$, with kits to $31 / 4 \times 41 / 4$. We are informed that the apparatus was specially made for the purpose mentioned above by the Folmer \& Schwing Company, of Rochester, N. Y The design reflects much credit as an excellent example of American workmanship.

The Deadly Electric Wire and the Conditions Cnder

## Which It Is More or Less Dangerou

The danger incurred in touching an electric circuit does not depend wholly on the voltage or electric ten sion. Two-thousand-volt circuits have been touched with impunity, and contact with incandescent-light
circuits of only one hundred and twenty volts has caused instant death.

The physiological effects of electricity are due partly to electrolysis or decomposition of the blood and other fluids and partly to paralysis of vital organs. Both actions are proportional to the strength of the current that actually passes through the body and this current strength is equal to the voltage of the circuit touched divided by the electric resistance of the body. The average resistance measured between a hand and the feet, when the hand is moist and the shoes are soaked with water, is about 5,000 ohms. A current of one-twentieth of an ampere-onetenth of the current used in an incandescent lampmay cause death. Hence, the question is, Under what conditions will contact with an electric wire send such a currient through the body?

If the right hand touches one wire and the left hand simultaneously touches the other wire of a 110volt incandescent lighting circuit, the body, assuming its resistance to be 5,000 ohms, will be traversed by a current of $110 / 5,000$ ampere, or little more than onefiftieth of an ampere, which is within the limit of safety. But if the hands are dry the resistance measured from hand to hand is fully 10,000 ohms, so that both wires of even a 220 -volt circuit, such as is used in some incandescent lighting systems, can be touched without danger of serious injury. In certain factories, however, where the air is damp, warm, and laden with acid vapors, the skin becomes softened and the resistance so greatly diminished that it is not safe to touch both wires of even a 100 -volt circuit.
The writer's left hand once came so near the terminals of a 1,000 -volt transformer that it drew luminous electric arcs from them. The current, having so small a resistance-less than two inches of the handto overcome, was very strong, but it caused no injury except local burns because it did not traverse a vital part. In instructive contrast to this case is the experience of the inventor of an electric bath tub containing metal plates that could be connected with a 220 volt lighting circuit. The inventor tested the device on himself and was instantly killed because soaking in water had so reduced the resistance of his body that even this low voltage produced a deadly current. If a man, standing on a trolley rail or even on the ground, touches a broken trolley wire carrying the
usual pressure of about 500 volts, a current of one tenth of an ampere will pass through his body, if it resistance is $5,000 \mathrm{ohms}$, and will probably cause death. In this case the ground or the rail represent the second or return wire. It is much less dangerous to touch a single wire of a double-wire circuit, well insulated from the ground, for in order to reach the other wire the current that traverses the body must flow through or over some of the insulators, that is to say, through a very great resistance, so that the current is very weak. But in a very long line the sum of these little leakage currents through many insulators may be too great for a human body to carry with safety. Hence, the danger is proportional to the length of the line. Simultaneous contact with both wires of a high-voltage circuit is, of course, fatal.
The static electric charge of the wire, as distin guished from the flowing current, is another source of danger, at least in alternating circuits. In continu-ous-current circuits this charge acts only once, at the first instant of contact, but in alternating-current circuits the charge is changed from positive to negative and back to positive usually about one hundred times a second, and when a man touches the wire the elec tricity which forms these charges surges back and forth through his body. Most of the casualties produced by touching alternating circuits are due to this cause. The danger is proportional to the electric "capacity," and therefore to the length of the wire Burying the wires increases their capacity and makes them still more dangerous to handle, but it effectually keeps the average citizen away from them.
The danger is proportional to the frequency of alternation, if the frequency is not very great, but currents of several hundred thousand alternations per second, such as Tesla employed in his amazing experiments, do not penetrate deeply, so that when they traverse the human body their effects are confined to the skin and are not serious. The facts that high voltages and high frequencies have been commonly associated in experiments and that extremely high frequencies have been shown to be harmless have led to the widespread belief that exceedingly high voltages are quite free from danger. This is entirely erroneous, as the curious reader may easily prove to his wn satisfaction-or, at least, that of his heirs.Condensed from Herman Zipp in Die Umschau.

## recently patented inventions.

 Pertaining to Apparel. CORSET.-E. Savoye, Rue du Caire, Paris, France. The corset is sut out as to enable upper part of the corset to be made up of a single piece, the continuity of which affords great advantages both in the way of comfort and facility of manufacture. This mode also btains a continuous ornamentation, by means of embroidery, designs in colors, and the like without any of the difficulties resulting here tofore from the construction ofseveral pieces stitched together.

## Electrical Devices.

telephone-magnet. - A. E. Harrison New York, N. Y., and C. M. Haslett, Jersey City, N. J. The objects of the invention are,
to confine the effect of a plurality of magnetic poles upon one or more pole-pieces; to give the pole-pieces such conformity as will enable the windings to be placed directly upon them rather than upon the magnets proper; to shape the pole-pieces so as to accommodate a large number of turns of the wire and also to de-
crease the loss of effective magnetic lines; to rease the loss of effective magnetic lines; to more direct path for the magnetic lines of force and also to concentrate their effect within a small area.
WIRING-KNOB.-W. C. Gordon, Windsor, Vt . The principal objects of the inventor are o provide for more securely holding wires than especially for so constructing the cap with which these insulators are usually provided that it will grip the wire equally at all times independently of the position in which it may
be placed on the base of the knob so long as be placed on the base of the knob
it is centered with respect thereto.

## Of Interest to Farmers.

Reeling device.-C. A. Hadland, Ben ington, Minn. This device is designed to be
mounted upon a wagon-body so that the wire mounted upon a wagon-body so that the wire
may be reeled or unreeled as the wagon moves; and the purpose of the invention is to for which Letters Patent were formerly granted to Mr. Hadland, the improvement being such as to simplify the construction and to render action more positive and reliable
hay-Stacker. - B. F. Powell, Manzanola, Col. One purpose of the invention is to provide a portable hay-stacking device in which a sled or hay-frame previously loaded upon the field is drawn up an incline and received upon a tipple of simple, light, and durable construc-
tion and wherein when the load is automatiction and wherein when the load is automatic-
ally dumped from the sled by means of the
tipple the empty sled will slide down the in cline in the ground of its own accord.
WAGON--J. RUPPERT, Glencoe, Minn. This type of farm-wagon is capable of being quickly converted into shape for use as an ordinary box farm-wagon, a hay-rack, a stock-rack, or
wood wagon. The body is so constructed th wood wagon. The body is so constructed that adjustment of the necessary added parts and so that such parts can be expeditiously and readily locked in position or removed, as required.
baling-Press.-C. E. Field, Slater, Mo. One purpose of the improvement is to provide a construction of press in which a plunger is
not employed and wherein the feed mechanism is such that the press can be fed at any time while in operation, it not being necessary to
await the return of the plunger, as required in await the return of the plunge
presses known to the inventor.

Stalk - Cutter. - F. P. Chapa, alice Texas. In this patent the invention relates to devices for cutting cotton, corn, or other similar stalks, and has for its object to provide a rows of standing stalks and cut them by novel and improved means. The device in use is drawn by manual, horse, or other power.

## of General Interest

DRY-GOODS MARKER.-P. H. Stewart and E. A. Miller, Hopkins, Mo. The marker of a bolt of cloth at one end thereof and auto matically engage the same, holding it in fixed position. A card of celluloid or like material is held to the front face of the marker by inturned retaining-cleats, the latter having nibs extending at each end, which are bent in such a manner as to prevent the celluloid card from sliding from the cleats.
NON-REFILLABLE BOTTLE.-H. N. Roth Weiler, Seattle, Wash. The bottle is designed
for containing spirituous liquors, proprietary for containing spirituous hquors, proprietar, sup, sauces, etc.-and any other materials in liquid form in which the refilling of the bottles with a surreptitious substance is to be pre vented. The invention consists in the construction and arrangement of the bottle in combination with a valve, a sealing cap, and dispensing devices designed to be filled and also
discharged under an air-pressure discharged under an air-pressure.
ROLLER-SUPPORT FOR EDGEWISE-MOV Able doors.-G. Georgenson and J. E Hennen, Fond du Lac, Wis. The invention is characterized particularly by an operating. handle convenient as a handle for pulling the
door open or closed and also for shifting the rollers on or chich the door slides, so that the the handle is in idle position the shoes at the lower edge of the car-door rest upon the track
on which the door slides, so that it will not
accidentally slide open ; but when the handle is perated the rollers are pressed down upon the track to lift the door and shift the weight onto th
move.
FLOWER-BAND MOLD.-A. M. Lockard, Herrin, Ill. This molding apparatus is for producing a lower-band from molded or cemen is a device made in circular form and either in one piece or in sections for use in surrounding and p
trees.
AUTOMATIC GRAPPLING-HOOK - e Langley, Woodward Oklahoma Ter. The ob ject of the inventor is to provide a device of objects with graple and automatically take hold It may also be used as a means for returning lost tools, buckets, casings, etc., from wells and cisterns, and for use in removing safes and other valuables from burning ruins and other places inaccessible by usual methods. It may
be used for removing stumps, logs, and all heavy foreign matter from lakes, etc.
buffer.-S. M. Goldberg, New York, N. Y. The principal object of this invention is $t$ provide a toilet article with a bufing-surface which can be readily removed and replaced, so to be discarded, also to provide means for se curely holding the buffing material upon a base and to provide a removable handle.
bobein.-G. Popplewell, Louisville, Ky. he invention refers to bobbins, more particularly such as are used on drawing, spinning, and twisting frames. The object is to provide a bobbin which is simple in construction, exceeding strong to stand all ordinary wear and allow repeated use of the bobbin. While ex tremely hard the bobbin is slightly flexibl
well adapted to withstand rough usage. well adapted to withstand rough usage DEVICE FOR EXHIBITING HATS, BON ford, AND Mhe Like.-F. W. Nunn, Guil ord, New South Wales, Australia. The object the article to be displayed can be quickly and firmly fastened and also readily removed, while it can be quickly changed from an upright to an inverted position or placed at any angle in order to show the article to its best advantage, according to its position in a show-room or
op-window.
FASTENING DEVICE FOR ORNAMENTS.L. Paul, Chicago, Ill. A purpose of the
mprovement is to provide a fastening device or ornaments adapted for application at the work in any piece of metal work or cabinet use on cover the seam, being particularly for made withoure-frames, the application being the article to which it is applied.

## AIR-SHIP.-J. A. Elston, Jefferson City, Mo. The purpose in this case is to provide an air-ship or vessel very light and strong, an air-ship or vessel very light and strong, and wherein the operator will be comfortably and wherein the operator will be comfortably seated and able to manually operate it with ease and slight bodily exertion. Another purpose is to provide a construction in which wings are employed as a motive power, with or without assistance of balloon or gas-bag or its equivalent, and wherein the operator will

 be protected from the elements.LIQUID MEASURING AND REGISTERING FAUCET.-W. M. DAvison, Government Road, FAUCET.-W. M. Davison, Government Road
Porth Australia, Australia. The device consists, essentially, of a measuring plug or chamber fitted within a body or case, at one end of which is a registered mechanism operated by the movement of the measuring plug,
The body has on one side a tubular inlet proThe body has on one side a tubular inlet pro-
jection, whereby it is fitted to the neck of the jection, whereby it is fitted to the neck of the
bottle, the barrel, or other liquid-containing vessel and has on the other side an outletspout, from which the liquid is delivered into the glass or other receptacle.
POINTING-TOOL--B. F. Davis, Miami, Fla. The aim of this improvement is to provide a
tool especially adapted for pointing up masonry and other structures where liquid or semi-liquin mortar or cement is to be applied at the finish ing operation and to so construct the device that it will be simple and economic and capable of operation by one hand.
Cryptograph.-H. Burg, Mollkirch, Can ton de Rosheim, Alsace-Lorraine, Germany. In this apparatus each change of combination is produced by the displacement of a carriage which is reciprocated directly by hand, the extent of such reciprocation varying automatically and this reciprocation of the carimed law mitted to a crown of letters movable is trans trically with respect to a fized crown of the said crowns serving to make the cryptog raphic translations.
PROCESS OF FORMING OIL-CUPS.-J Towers, Albuquerque, Ter. New Mex. Generround bar of iron or steel, upsetting the end in a die of suitable fashion to form the base and stem of the cup, and thereafter welding a pipe thereto and further shaping the upset
portion in a second set of dies to form the portion in a
complete cup.

## Hardware

MITER-BOX.-J. Peach, Traverse City, Mich. In the present patent the invention has reference to wood-sawing, and its object is the
provision of a new and improved miter-box provision of a new and improved miter-box
arranged to permit of cutting the wood or other material at any desired angle and without changing the position of the saw in the saw

## Heating and Lighting.

GRATE FOR BOILER-FURNACES, ETC.-P S. Spiller, Austin, Texas. In this instance th
invention has reference to an improvement in invention has reference to an improvement in
grate-bars for steam-boiler furnaces, stoves, or any fire where soft coal, lignite, or any other
fuel is used which throws off carbon, its object higher degree of is obtained by the usual grate-bars.

## Household Utilities.

CABINET.-Marion W. Randolph, Seattle, especially for use by those who live in apartkeeping conveniences and for those cases whe there would be objections to odors which com monly result from the use of gas, coal-oil, or
alcohol, and the invention also seeks to avoid the objectionable odors experienced in cooking fish, cabbage, onions, or the like

## Machines and Mechanical Devices.

Machines and Mechanical Devices.
MEASURING AND REGISTERING PUMP MEASURING AND REGISTERING PUMP.
-W. M. Davison, Government Road, Port Pirie, South Australia, Australia. The inven lion comprises a device whereby publicans and quantities of liquids-such as pints, half-pints and butchers-and at the same time a record is kept of the number of such measures sold It is especially useful as a check upon bar at tendants, the register being so constructed an
operated that it cannot be tampered with. Pianissimo Device.-H. Metzger, Castle ton, N. Y. When the soft pedal is pressed in
ordinary pianos and the hammer-rest rail is wong rearwardly then the hammer-butt moves away from the upper end of the jack, and when the key is subsequently pressed and the jack
laised, it moves a distance inactively before reengaging the hammer-butt and impart ing movement to the hammer. To compensate
or overcome this inaction or lost motion of the or overcome this inaction or lost mo
jack is the object of this invention.
Charging apparatus.-T. F. Wither bee and J. G. Witherbee, Port Henry, N. Y The invention relates to a charging device espe cially designed for blast-furnaces, but capable
of general use. By charging through the large of general use. By charging through the large
or the small bell, as conditions may require or the small bell, as conditions may require,
perfect control of the distribution of the charge is given to the furnace manager of the charge one kind of fuel be used, or if it is desired special locality, it can be readily done by use of the invention.

## Railways and Their A ccessories.

 SNOW-PLOW.-J. S. Stout, Oxford Junc tion, Iowa. One of the purposes of this im provement is to provide a plow especiallyadapted for use upon railroads for removin snow and to construct the plow in multiple shovels arranged in a bank one above the other ach shovel being independent in its action, the structure.
BRAKE-SHOE ADJUSTER.-J. S. Ash worth, East St. Louis, Ill. The object of the inventor is to provide means adapted to auto matically compensate for the wear on the brake shoe and to keep the shoes normally in th
same position relatively to the periphery o same position relatively to the periphery o
the wheel, so that the levers operating th efficiency and remain so until the brake-stan efficiency and remain so untr the brake-shoe
wear out.
CAR-DOOR.-Joseph A. Bourgeots and John A. Bourgeors, Algiers, La. The inven-
tion relates to car-doors; and the object of the tion relates to car-doors; and the object of the
invention is to produce a door which may be readily opened and closed and which may be position. On account of the manner in which the edges of the doorway are beveled it is impossible for rain to leak through the door when

SAFETY-APPLIANCE RIVET-BOLT.-J. W Curran, Newport, Ky. The object of the in vention is to simplify the present methods of applying grab-irons, sill-steps, uncoupling-lever brackets, stake-pockets, air-pipe clamps, retain-
ing-valves, brake-staff stands, etc., to steel ing-valves, brake-staff stands, etc., to stee
freight-cars. The present method when one of he steps, chates the moving of the freight inside the car in order to get at the rivets for cutting ou the same.

## Pertaining to Vehicles.

AXLE.-H. K. Brison, Fayette ille, Tenn A purpose of this invention is to provide
bearing for the hub of a wheel which will not bearing for the hub of a wheel which will not
only permit the wheel to turn with a minimum of friction, but which will also provide a cushioned support for the hub, enabling the wheel to have a vertical movement without lost motion, thus tending to render a vehicle to which
said axle-spindle is applied easy riding, even upon very rough roads.
Harness.- A. Lee, Hot Springs, Ark In the present patent the invention has reference to certain improvements in harnesses for horses whereby the weight of the collar on a other portions of the body to prevent the neck from becoming sore through the chafing of the
collar.

## Designs

DESIGN FOR A BOX.-W. Jones, Lurgan, reland. This ornamental desiga is intended for representation on the top or cover of a box.
Three upright frames of simple structure are upheld by the hands of a boy and two girls. Each frame holds a domino poised on its end domino.
Note.-Copies of any of these patents will furnished by Munn \& Co. for ten cents each. Please state the name of the patentee, title of
the invention, and date of tnis paper

## Notes andQueries.

 HINTS TO CORRESPONDENTSames and Address must accompany all letters or
no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give
date of Ref erences to former a articles or answers should give
date of paper and page or number of question.
Inquiries ont answered in reasonable time should be
repeated; correspondents will bear in mind that
 g to purchase any article not adver.
pur columas will be furnished with
of houses manufacturing or carrying same.
Written Information on matters of personal
her than general interest cannot be expected Without remuneration.
Scientific American Supplements referred to may he
bad at the office. Price 10 cente ach.

| Books referred to promptly supplied on receipt of |
| :--- |
| price. |
| $\begin{array}{l}\text { Minerals for } \\ \text { marked or for labeled. }\end{array}$ |

(10423) D. C. C. says: Please settle the following dispute through your Notes and Queries column. Suppose two wires to be connected to opposite poles of a battery or other
source of an electric current. A claims that source of an electric current. A claims that
as long as the wires are not connected they are not charged, i. e., that there is no urrent passing over the wires. $\mathbf{B}$ claims that they are connected to a source of current, whether the wires themselves be connected or is it that a person taking hold of them receives a shock? A. The two poles of a battery or ther source of electromotive force are always charged, as you call it. The wires leading rom a dynamo or battery anywhere along their length are at a difference of potential equal to
the e.m.f. of the source of energy. And if a the e.m.f. of the source of energy. And if a
connection be made between them, a current will flow. The difference of potential is regarded as the cause of the flow of the current, and is expressed in volts, while the current is not connected, no amperes are flowing, but the
volts between the wires are just as great as possible. B is right in his opinion.
(10424) A. McK. says: A friend of mine got into an argument with me concerning
the moon. He said that "every time the moon makes a revolution round the earth it makes makes a revolution round the earth it makes
one revolution on its "as the same side of the moon was always can revolve on its ewn axis." Will you please say which of us is right? A. Because the moon
keeps the same face toward the earth it must otate once on its axis while it goes around the ball or an apple or anything round in the hand and place a lamp on a table in the middle of the place a lamp on a table in the middle of the room. The ball is to represent the moon,
and the lamp the earth. Now carry the ball ball always toward the lamp. You will have to rotate the ball as you carry it in such a way
that it will turn entirely around on its own axis while it is carried once around the lamp. Try it again in another way. Mark one side
of the ball. Begin on the east of the lamp, of the ball. Begin on the east of the lamp,
with the mark toward the lamp. The mark will be on the west side of the ball. Carry the
ball around to the north of the lamp, with the mark always toward the west, that is, without not now be directed toward the lamp, which is now south of the ball, and the mark must be turned from west to the south a quarter of a circumference before it is again toward the lamp. Repeat this at each quarter of the way around the lamp and you will have turned the
ball through an entire circumference in making ball through an entire circumference in making the circuit of the lamp and bringing each quar ter of the circuit of the lamp. The moon does ter of the circuit of the lamp. The moon does
rotate once on its axis during each lunation.
So also do Mercury and Venus in So also do Mercury and Venus in each of their
revolutions around the sun, and they also keep the same face always toward the sun. Should the earth come into the same relation to the
sun, a day will be a year long. Many astronomers think this will be the case at some time in the remote future.
(10425) D. LeM. C. asks: 1. I am described on page 400 of "Experimental Science," and would like to know of whom I
can buy the zinc and carbon plates there decan buy the zinc and carbon plates there de-
scribed. A. You can get the zinc and carbon plates of any size you may wish by addressing
dealers in electrical supplies. See our advertisdealers in electrical supplies. See our advertis-
percha for the lining of the cells. All that have been able to find in this city is some ver
thin gutta percha (about like a sheet of paper) and was told that it was used in the repair glue. Is this what the book means? If not where can I buy what it does mean? A. We think you would do much better to use glass jars for the cells of the plunge battery, but if you prefer hard rubber you can get them
from the same company. They can send you a list of such jars as may be on the market.
3. On page 92 of "Experimental Science" it tells how to make an air pump from rubber tubes Is such a pump durable? Will it crack and
leak after being used a few times? I tried leak after being used a few times? I tried
to buy the rubber, but was told that it would I can can get it for $\$ 1.50$ as the book says. A
We cannot say that we think you would find an air pump made with rubber tubing of much for a short time, but would not be durable You cannot get much rubber tubing now for
$\$ 1.50$. Prices are much higher than when "Experimental Science" was written eighteen years ago. 4. In the description of the electro-
magnet on page 458 of "Experimental Science" magnet on page 458 of "Experimental Science"
it gives the width of the soft iron yoke as $21 / 2$ inches and the diameter of the wooden spools as 4 inches. According to these dimen
sions, the spools would be larger and project over the iron yoke. Yet in the engravings the
yoke is the largest, and the spools do not yoke is the largest, and the spools do no
project over it. Which is right? Will it de crease the power of the magnet if the walls
of the spools are more than $1-16$ inch thick? A. The drawing of the yoke of the electro magnet on page 458 does not correspond to the dimensions given in the text. That does not
matter, since every one knows that the y oke needs to be at least of the same cross section as the core, and may be as much larger as may as a base for the magnet to stand upon, no
as harm is done. The walls of the spools do not
affect the magnetism. If they are made thicker 'than necessary, the windings will be so far from the core that the magnetism will be aker and the magnet will not be strong for
Make the spools as light as you can and till strong enough to hold the wire
(10426) T. H. A. says: 1. Quite often have to recharge small storage batteries of 6 volts. The only method I have to know
when the battery is fully charged is by the soluwhen the battery is fully charged is by the solu
tion throwing off quite a lot of gas bubbles. tion throwing off quite a lot of gas bubbles.
have been told that I should have a hydro mave been told that I should have a hydro
meter to do the storing correctly. What size hydrometer should I get for these 6 -volt cells, the where can they be had, and about of C. P. sulphuric acid to four parts of dis-
tilled water. What should the hydrometer read before the solution is charged and when fully charged? In drawing off the solution from the battery while charging to get a hydrometer
reading, if the plate is exposed much will it reading, if the plate is exposed much will it
injure the battery? I have been told not to charge a battery up to its full voltage. For example, take a 6 -volt cell. I start charging cut it down half. ( 2.5 volts) until gassing gets common way to judge of the charge of a storage battery by the bubbles of gas which are given off from the plates. When the gas comes
off freely, the cell is fully charged. The ma terial of the plates is no longer able to take up the oxygen and it appears at the positive pole, as the hydrogen does at the negative pole.
The best way of testing the charge is by means of a voltmeter. A battery is in need of charging when the voltmeter shows 1.7 volts pe
cell. It is fully charged when the voltmete indicates 2.5 volts per cell, or perhaps a little more than this figure. The hydrometer test
consists in floating a glass hydrometer in the liquid of the cell, and charging till the liquid has a density of 1.3 on the scale. When the
cell is discharged, the hydrometer will probably indicate about 1.1. 2. A claims that in foggy weather, when the smoke descends to the
ground, that the atmosphere is light and will ground, that the atmosphere is light and will heavy and will not permit the smoke to ascend. Which is correct? A. When smoke falls toward smoke is heavier than the air. In fine weather the air is heavier and the smoke rises.
(10427) G. L. H. says: Will some sci ntific reader kindly enlighten me upon the
two following problems, which have been sub jects of argument to some of us recently? 1 A body sinks and is swallowed up in a quick sand, the body being actually lighter in specific
gravity. Why? A. Light quicksand is not much heavier than water, and the fine parti cles of sand nearly float in water as a sedi-
ment. The sinking of a person in quicksand ment. The sinking of a person in quicksand
we have always thought to be due largely to the struggles of that person; the sticky mas olding him as he tries to rise and giving
way under him as he treads in it. If we were caught in quicksand we should throw ourselves fat and keep as quiet as possible, spreading
ourselves out over as large a surface as pos sible. 2. How is it that salt (sea) has so bad an effect on a human being when absorbed into case of shipwrecked mariners? The human body, in its constituents, is almost the same as sea water. Does the drinking of sea water
necessarily produce mania, or could a person under normal circumstances drink salt water
without harmful results? A. A person cannot uces most intense thirst. It is, it also prorom the thirst that the awful condition of men in an open boat at sea without fresh water comes. No person could drink water with
rdinary salt in it for any length of ordinary salt in it for any length of time ne drink sea water, which contains other and less agreeable mineral salts.
(10428) A. W. D. says: Will you please inform me if it is possible to electroplate material with aluminium the same as can bé
done with copper or silver? If such is the ase, will you please tell me what Supplement will give me an account of the process? There have been many processes of plating with aluminium described in papers and in patents. We have never tried any of them, so as to know by actual experience that they are re-
liable. Watt says of them in the last edition of his "Electro-plating," page 476 : "The presnt writer has never seen any sample of alumnium so deposited, and has never heard of any btained." His book contains the several methds hot and cold which have been employed or this purpose. We can send you the book or $\$ 4.50$. I'lating with aluminium is perhaps possibility, but an improbability
(10429) J. T. W. says: Can a person buy books that would be of as much value
o him as a correspondence school course in the study of mechanical electrical engineering? f so, what books do you recommend, and at what price, and where can same be obtained? . It is not likely that a person unaided can obtain as good a knowledge of electrical enineering by reading as by study with the assis-
tance of a correspondence school. It should also be stated that no schoot can make a cholar. The scholar makes himself, even in the best school. The books of a correspondence he assistance of the examination papers and hing. Should mistakes areks we can supply them, the best to be had on the subjects: Sloane's '"Handy Book,' $\$ 3.50$, a reference book of facts and principles. Thompson's "Dynamo Machinery," $\$ 7.50$, Vol. 2, Direct and Alternat-
ing. Crocker's "Electric Lighting," $\$ 6$, two ing. Crocker's "Electric Lighting," \$6, two
olumes, the best book on the subject. Foser's "Electrical Engineer's Pocket Book," $\$ 5$, Pocket Book," \$5, indispensable. Bell's "ElecPocket Book," $\$ 5$, indispensable. $\begin{gathered}\text { Bell's "Elec- } \\ \text { rical Power Transmission," } \$ 4 .\end{gathered}$ After these come books on railways, telephones, and all the special branches of ,work which y ou may (10430) J. R. says: 1. What is sponaneous combustion? A. Spontaneous combuswhich is generated in itself by the contact with the oxygen of the air. 2. What is the cause of same? A. The drying oils used in paints, inseed oil chiefly, dry by absorbing oxygen nd oxygen is a slow combustion. If this goes n in a confined space where the heat cannot easily be radiated, the temperature will rise
high enough to ignite cotton rags. Such oily ags often are the causes of setting a building A. The temperature necessary to set an artion fire varies with the material.
(10431) J. L. P. says: In your answer to question 10342, January 26, you state wat two spheres of the same size will fall gravity in the air. If the specific gravity of tmosphere it would rise, and if just a little more it would fall very slowly. Therefore it must follow that the greater the specific grav-
ty of a body the more rapidly it will overcome the friction of the air, and consequently will fall faster than a body of the same size and shape but of a less specific gravity. Would that not be the case? A. You misconstrue the
answer to Query No. 10342 by overlooking the fact that the query was specifically about lead sta aluminium spheres. These will fall as
tated for a limited distance with equal veloities. The fault with the answer is that this istance is not stated, an omiss we are not able to account. This distance is placed by Wood in his "Mechanics" at from 100 feet to 200 feet, a distance which we have not verified. Aluminium is 2,000 times as as heavy as air. The power of aluminium to overcome the resistance of the air is only onetimes as much as that of the ball which. you
(10432) J. M. P. says: 1. I am constructing a Wimshurst machine with two
plates. How far apart should the plates be? How many sectors should be on each plate? The plates are 16 inches in diameter. A. The as near a Wimshurst machine should be run do without touching. You may be able to bring them about a quarter of an inch apart.
Would a large test tube be all right to make a Leyden jar with? How can I coat the inside of the jars, and how high up should the tinfoil come? A. The Leyden jars should be
about 2 inches in diameter and 6 inches high. Use rather stout glass free from lead. Cut the tinfoll into strips an inch wide for the inside,
the jar and with a paper cutter, and perhap
a brush, smooth them into their places. little practice and handiness will enable you make a good job of it.
(10433) E. E. L. says: Is there any difference in the energy of a boiling liquid in different latitudes, the atmospheric pressure being the same for each place? What is the
intensity of an ordinary saturated steel magnet as compared with the earth's magnetism for any given locality? A. The boiling point the energy of the steam is the same for all the energy of the steam is the same for all
places where the temperature of boiling is the same. The temperature of boiling is the same for all places which have the same barometer surface. The magnetic intensity of a steel bar magnet is, according to the tables given
in Thompson's "Electro-magnet," from 14,000 to 16,000 lines per square inch
(10434) J. T. says: 1. What is the cause of the large ring which appears around the moon in threatening weather? A. The
lunar and other halos are produced by the aclunar and other halos are produced by the ac-
tion of the drops of moisture or ice crystals in the air upon the light as it comes toward the eye. 2 . Why does not the atmospheric pres-
sure, 15 pounds to the square inch, crush the small incandescent electric lights, which are supposed to be exhausted of air, or any other is not crushed by the pressure of the air upon it because it is strong enough to hold up 15 pounds per square inch. An empty eggshell will hold a pressure of 675 pounds per square Inch on its end. 3. Why does not the upward
motion of a bird's wing completely neutralize motion of a bird's wing completely neutralize
the effect of the downward motion? A. The the effect of the downward motion? A. The
up stroke of a bird's wing is executed so as to take the air at a different angle from the down stroke. The feathers do not return upward so as to present the same resistance to the ai
as they did when they were struck downward as they did when they were struck downward.
4. Why is the power of a telescope or microscope limited? A. The magnifying power of a microscope is limited by the indistinctness of is limited by the faintness of the light at great dispersion, and more by atmospheric condi ions.

## (10435) B. D. M. says: 1. Is it possi-

 ble to generate light without heat? If sogive illustrations. A. It may be possible to generate light without heat, but it has not yet been done. It is one of the ignes fatui of inventors, like the utilization of tidal power
and of the heat of the sun's rays. 2. Give proof that ice freezes at the underside, after a layer has formed, and not at the top. A. is that water is in contact with that surface of the ice and the upper surface is at the ame time dry. The ice increases very rapidy in thickness to the extent of several inches
on a severe night. The only other source of moisture is the vapor of the atmosphere, and
that is not sufficient in quantity to supply that is not sufficient in quantity to supply
the amount of ice which forms in a few the amount of ice which forms in a few
hours. If the ice came from the air, the apidity of its precipitation would exceed that a heavy rainstorm
(10436) J. L. B. says: On page 199 of the Scientific American of March 2, 1907,
in the Notes and Queries department, No. 10409 , you say a vessel sinking will always go to the bottom, because the water pressure will tend to
make it heavier with reference to the water. make it heavier with reference to the water.
Why will it be made heavier than the water? Why will it be made heavier than the water?
I can understand the water compressing it to I can understand the water compressing as to make it heavier than the water. You also say faster, since the water is not compressed to any extent at greater depths than it is near the Smithsonian Institution, showed that the compression of water on the ocean bottom was about two tons to the square inch, and higher up about half a ton. Would a vessel be compressed to such an extent in sinking? It seems
to me that this would mean that a vessel weighing two tons would need to be compressed more than enough to occupy a square inch at bottom
to cause it to sink. Since you say it would each the bottom I am willing to take your word for it, but I can't understand it. Again, (date of publication unfortunately forgotten) hat although the ocean bottom had been sounded for several miles deep, bottom had never been found in Lake Tahoe, because (as
explained) the water pressure prevented the weight used from sinking more than several miles, at which point the temperature of the water was considerably below freezing, but on
account of the great density of the water it was unable to congeal. I fail to understand how waing is able to compress an object to a
greater extent than the water itself is comgreater extent than the water itself is comsame extent, the object hangs suspended in the periodical mout moving in either direction. The that the bodies of the people drowned in this lake (none of which have ever been recovered) are suspended, frozen stiff, about two miles below the surface. A. A vessel which is lighte sel in order that it may sink must be heavier than water at the start. All iron ships are ballasted. Such a vessel will sink if flled with
water. If it sinks at all it will go to the! of essays and lectures written and delivered
bottom, since water is compressed but little by at various times by the author, detracts noththe pressure it sustains, and iron, wood, etc., ing from its value. Indeed, had it been are compressed more than water by the same
pressure. Dr. Dall showed that the pressure pressure. Dr. Dall showed that the pressure
at the bottom of the ocean was two tons to the square inch, not as you say, the compression of the water. Water is not compressed a very reat deal by a pressure of two tons to the
square inch, not so much as a stone would be Water is compressed about 1-75 part by that pressure, that is 75 cubic inches would become 74 cubic inches, and not, as you say, to 1 cubic nch. With reference to what you quote from a paper about Lake Tahoe, we can say that it impossible. Water cannot be cooled below freezing by any possibility and remain water
in an open lake. And water must be colder on in an open lake. And water must be colder on
top if the temperature of any part of the water top if the temperature of any part of the water
is at the freezing point. Dead bodies are not ozen in water down deep below the surface from sinking in it.
(10437) C. B. R. asks: Will you kindly explain who has the advantage in the following case, and why? In shooting at flying bothets thrown from the traps, I shoot with
open. My friend claims I should close one eye, as I could get a better alinement of the gun. My claim is that I can get a better nd quicker sight at my target by using both plays while shooting right-handed. Do I shoot crossways, look crossways of the gun barrel, or do I unconsciously sight with one eye, while oth are open? Give the theory of aiming a sun with both eyes open. A. If you can shoot with both eyes open and hit, it must be that you
aim with the right eye and disregard the line of sight from the left eye to the target. You an test this by looking along the gun withou mine whether the sights are in line with the right or with the left eye. We do not know any theory of aiming with both eyes open. Most people use but one eye at a time when both eyes are open. Some habitually use the right a
thers the left eye at their ordinary work.
(10438) J. O. B. says: I find that upon holding an electric light incandescent lamp by the glass and applying the metal to
an idler on the main belt of the dynamo (which gives about 15 -inch spark) and taking away, I can get a powerful charge by plac-
ng my other hand on the metal. Can you explain? I also find the lamp "burned out," but it still gives the above results. A. By holding the incandescent lamp as you describe ou charge it as a Leyden jar is charged, and pon touching the metal which is connected to the inside of the jar you receive the shock of the inside coating, and your hand holding the bulb is the outside coating. The charge is a charge of static electricity
(10439) P. A. O. says: Will you be kind enough to give the answer to the following probof, which has agitated the besently : A farmer and his wife de sired to weigh a pig, and had no scales. The man weighed 160 pounds and his wife 139 pounds. They put a board across a fence so that when they sat upon each end of the board it exactly balanced. Then they changed places, the wife taking the pig in her lap, just balancing the hoard again. How
much did the pig weigh? A. Your problem may much did the pig weigh ? A. Your problem may
be solved in the following manner: Referring to

companying sketch No. 1: $x=$ distance from distance from the first position of the wife to the ence. Let $w$ equal weight of the pig. Then $160 x$ $=139 y .160$ pounds $=$ weight of the man. 139 ounds $=$ weight of his wife. In sketch No. 2 the akes the pig in her lap, and they again balance as the first position

instead of being a compilation of separate es-
inden as andinated whole, instead of being a compilation of separate es
says, etc., it must still have been recommended which the student of artillery and explosives which the student of artillery and explosives
will turn for information on subjects upon will turn for information on subjects upon
which correct information is only too scarce The great value of this work will be at once evident, when it is stated that it consists done by the author throughout the long period covered by his industrious professional life of nearly half a century. When Sir Andrew Nobel entered the service, the line-of-battle ships in the British navy were all sailing
vessels, and their armaments and appliances differed but little, except as regards size, from those used in the days of Henry VIII. and pervaded both services, and the introduction of rifled ordnance was received with the greatest distrust. It is impossible to speak in any de tail of a work of this magnitude; but the chapters on the Tension of Fired Gunpowders, on Friction in the Bores of Rifled Guns, and those dealing with the Tension of Gases Expanded Without Doing Work, will be read with the deepest interest at the present time, when the subject of erosion of guns is so much in who has had wider experimental knowledge o the subject treated in this volume than its celebrated author. When he first took up th examination of gunpowder, knowledge on th subject has been described as "simply chaotic"
and the description of the investigation mad
action of powders when fired in completely nclosed vessels, makes extremely interesting and profltable reading
Poor's Manual of the Railroads of the
United States. Street Railway and Traction Companies, Industrial and of the Debts of the United States, the of the Debts of the United States, the New York: Poor's Railroad Manual Company, 1906. Large 8vo.; pp. 1808. Price, $\$ 10$.

With its 1,808 pages and its well-earned mation for accuracy and voluminous infor Manual the number continues to hold for the railroad men and the public generally many years ago. The following important features eretofore published separately in the Railroad Manual Appendix, have been incorporated, Ready Refirence Bond List; second, Poor Annual Meetings, Transfer Agencies, etc third, Table of Dividends paid for eight years by the addition of the new features referred 0 , and the natural expansion of the regular departments of the book, the work this year has increased in test 192 pages, the statements for no less than 120 industrial corporations having been procured and incorporated in this new issue. Attention is also directed to the great increase in the number of railroad and other maps.

INDEX OF INVENTIONS
For which Letters Patent of the United States were Issued for the Week Ending March 5, 1907.

## AND RACHBEARINGTHATDATE

| [seenoteatend of listabout copies of these pate |  |
| :---: | :---: |
| Accounting appliance, credit, R. D. Pardee Acid, purification of sulphuric, Driffield \& Wright |  |
| cousticon, Turner \& Johnston............ ${ }^{846}$ |  |
| Adhesive compound, glue, etc., M. R. Isaacs 845,791 |  |
| Advertising device, J. |  |
| Advertising device operating mechanism, <br> Wadsworth \& Appleby.................. 845,986 <br> Air and gases, thermic compressor for, E. |  |
|  |  |
|  |  |
| Air puris signal, R. J. Zorge..............8 845,991 |  |
| Churchward ............................ 845,756 |  |
| loy of steel, self hardening, J. Church- | 8 |
| oys to alter their compo of, I. L. Roberts..... |  |
| Alumina and alkali compounds of sulfur,manufacture of, $A$. Clemm............ 845,854 |  |
| Amusement device, I. S. Moscovitz........ 84 |  |
|  |  |
| Arch plate, ${ }^{\text {A }}$, Schillinger.................... 846.247 |  |
|  |  |
|  |  |
| Auger '1andle, extension. J. Blackburn..... 846,389 Augers, manufacture of single spiral, A. Krieger |  |
|  |  |
| Automatic switch, Dohrmann \& \& waite.... 846,096 |  |
|  |  |
|  |  |
| Awl, sewing, A. M. Parker.................. 846,242 Axle lubricating mechanism, H. W. Sanford 846,056 |  |
| Bag-turning machines, bag-holding mechan- |  |
| ism for, S. T. Lockwood................. |  |
| turning machines. turning arm actuat- |  |
|  |  |
|  |  |
|  |  |
|  |  |
| Barrel, metallic, C. L. Coffin..... |  |
| aring, ball, A. C. H ahfeld............. ${ }^{845,778}{ }_{846}$ |  |
|  |  |
|  |  |


|  |  |
| :---: | :---: |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |




Modern Steam Engineering in Theory and Practice by gardner d. hiscox, m.e.


Punches, Dies and Tools for Manufacturing in Presses


## Modern Plumbing Illustrated



MUNN \& CO~s
Publishers,
for 361 Broadway, New York

## $\stackrel{\left.\begin{array}{c}\text { Pri } \\ \text { Pri } \\ \text { Pri }\end{array} \right\rvert\,}{\substack{\text { an }}}$

Plow, L. M. Whisen hant....
Plow, riding, W. L. Casada
Pnoum



 Road construction, Mourne \& Tinsley.......
Ralter.......
Rock drill mating and sharpening apparatus,
Glossop, reissue







$\qquad$ Squ
Squ
Sta



 Steam trap, W. Geipel
Steel tel tepering bath,
Steering and propelling

Ster hanger, A. N. Maross $\ldots \ldots . . . . . . .$.
Step
Stitch impressions or indentations, burnish Stitch impressions or indentations, burnish-
ing machine for imitation, L. W. G.
Flynt
Stone blocks, machine for making articicial,

 Street or station indicator, C. A. Myers.
Striking bag apparatus, J. F. Emes.....
Stubble cutter and destroyer, cane,


Suspenders, ©. H. Loorye..
Suspenders
traud

## Classified Advertisements

Advertising in this column is 50 cents a line. No less
than four nor more than ten lines accepted. Count
seven woids to the line. All orders must be accompanied by a remittance. Further information sent on

## bUSINESS OPPORTUNITIES.








Patrern lerters AND FilGREs (White Metal
and rrass for ust on paterns for castings
tiet

 PATENTS SOLD ON COMMISSION:-If You wis

For sale.-Portaple Compressed Air House Clean-




## ISELL PATENTS.-To buyor havingone to sell, write

HELP WANTED.


## PARTNERS WANTED



 invention is comparatively very simple in construe,


## TYPEWRITERS.





|  |
| :---: |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## NOVELTIES. <br> GREENBACKS!-Pack of 81.376 mitation bills and 

## WATER FILTER.




FACTORY AND MILL SUPPLIES. FACTORIES, CUT DOWN YOUR INSUANCE by
putting in a Cald well Tank and Thorer for fre prote


## PHOTOGRAPHY <br>  

## MACHINERY FOR SALE 

## OFFICE SUPPLIES






##  

## SOUVENIR POST CARDS.





## SCHOOLS AND COLLEGES.





## COINS, MEDALS, CURIOSITIES.



## DEAFNESS

 EYE-GLASS SPECIALTIES.



DUPLICATORS


## Sw Ta Ta Tel

Telegraph pole, metal truss, i.. Bilessing. 846,382
866,024
845,830
886,011







vebicle body, ©outerchangeabie,
Beecaer

能




 DESIGNS.
Badge, J. A. Montgomery...................
Dish or similar article, covered, C. J. Ahr-
Plate or similar article, c. c. j . Abrenfeldt, TRADE MARKS.






$\qquad$




Cococolate, sweet and unsweetened, and co.







## 

tain, Winchester Repeating Arms Co..
Flavoring extract, Charles Jacuin Ct Cio.
Flavoring extracts, Blanke-Baer Chemical
Flour, wheat, Medilin Milling $\mathrm{Co} . \ldots .$,
Flours, wheat,
rye, and Graham,



Hose supporters, A. Stein \& Co.




| 46 StorageBatterie 1000 Miles On One Charge BEST for LEAST MONEY Guaranteed for One Year BELL PUMPS <br> Will Save Your Tire <br> Franco=American Auto \&ouply Co. Sole Agents 1404-1406 miciligan avente chicago, ille. |
| :---: |
|  |  |
|  |  |




 PARKER, STEARNS \& C0., 228.229 South Street, New York




ENGINE MANUFAGTURER WANTED




$\boldsymbol{H}_{\mathrm{E}}$
EMENT BOOKS

 -

CTUDENTS' and Draftsmen's Library Club S Send for Catalogue and information as to buying


SELL YOUR OLD RUBBERS \& METALS


$\qquad$

## TEXAS LANDS

acre are now selling ats $\$ 25$ to $\$ 30$ per acre. Southern
latitude makes it possible to ship the tender, highpriced vegetables long before northern garden have sprouted. Finest all-the-year-round climat in America. Excursions from Chicago each first
and third Tues trip-30-day return limit. Write to-day for my il
lustrated book about lands in the GUI, F COAST lustrated book about lands in the GUI,F COAST
COUNTRY of Texas and full particulars. John
SEBASTIAN, Dept. G. C., Ia Salle Station, Chicago.
 COPYRIGHTS \& Anyone sending a sketch and description pay
qutccly ascertin our opinion free Mhether an
invention is probably patentable Commenica.


## Scientifific American.



|  |  |
| :---: | :---: |
|  |  |
|  |  |

 There is no cost for EXTRAS, because we furnish nails and cement for ps free with every roll
There is no MAINTENANCE cost, because its mineral surface makes painting and coating absolutely unnecessary.
There is no REPAIR COST, because Amatite is so constructed that it There is no LABOR cost, because Amatide roo
There is no LABOR cost,
The first cost is the only cost-THE FINAI, COST,
Amatite is the only Ready Roofing embodying every good point that a Heat and cold, rain and snow, acids and chemicals do not affect it, and in addition to this its mineral surface makes it one of the best fire-retardn. Free Sample A Booklet telling more about it and a Free Sample will be sent Barrett Manufacturing Co.



## 万ow to Thake a 100=mile cJuireless Celegraph Outfit

## expert, Mr. A. Freder

 escriptionsdescriptions.
The design and construction of a roo-mile $\quad \begin{gathered}\text { The adjustment and tuning of a roo-mite } \\ \text { wireless telegraph set is described in ScIEN- }\end{gathered}$ wireless telegraphoutit tis discussed in ScIEN-
 IESS telegraph American Supplement rbe in Scien In SCIENTIFIC AMERICAN SUPPLEMENT 1623 ,
the instalation and a ajustment of a roo-nile
wireless telegraph station is fully explained. AMERICAN SUPPLEMENT 1625 .
The managennent and oppration of ship and Thesesixarticles constitute a splendid treatise on the construction, operation and theoryof Single numbers will be mailed for 10 cents

MUNN (8. CO., 361 Broadway, New York, N. Y.


Rubber Pump Valves
For Cold and Hot Water, Oils, Acids, High Pressure Mine Service and for every pumping requirement. of of of Mechanical Rubber Goods of every description
of unsurpassed qualities, including BELTING, of unsurpassed qualities, including BELTING,
HOSE PACKINGS, Gaskets, Mats and Matting, Tubings, Springs, Interlocking Tiling, Emery Wheels and MOULDED and CUT SPECIALTIES for any mechanical
and commercial device, $\& * * * \& \in$ NEW YORK BELTING $\boldsymbol{\varepsilon}$ PACKING COMPANY, Ltd. 91 \& 93 Chambers Street, New York


## Bausch \& Lomb

## Fine Balances

Our line of Analytical Balances is very
comprehensive, including all the leadcomprehensive, including all the lead-
ing makes. We can supply balances at ing makes. We can supply balances at
all prices; also druggists' and other small balances from $\$ 350$ up. This is only a part of our great line of labora-
tory apparatus. Write for prices and tory appar
catalogs.
Bausch \& Lomb Optical Co.







UUFKIN
TAPES AND RULES
For sale everymbere
Catale
ARE THD



## HOWARD WATCH

All you have to do is ask us for a FREE copy of "Watch Wis-dom''-written by Fra Elbertus himself. It's worth reading even if you don't buy a Howard. But ASK-


A smooth running engine is more satisfac-
tion than smooth roads. Moblloll- the perfect automobile lubricant-is the only
oil that makes smooth, easy runningabso. oil that makes smooth, easy running abso
lutely certain. There is a grade of


## SIMPLE IN CONSTRUCTION

 ing parts in the NEW YORK STANDARD

## CHRONOGRAPH

than in any other. It is the only 1-5 second re= cording watch made in America and the only one made anywhere that is Fully Guaranteed.

## Ask Your Jeweler About It.

New York Standard Watch Co., 401 Communipaw Ave., Jersey City, N. J.


Makes Money
Persons in over two hundred
towns in the Unite States
and Foreign Countries now



a yearand we canprove it
 Carpets, and every
from floor or room.
Stationary Plants or Residences, Hotels, Churches,
Theaters. ©fice Buidings, Hospitals, etc. Estimates
furnished.
WE OWN THE PATENTS


DRILㄴING

 perate them easily. Send for catalog.
WILLIAMS BROS., Ithaca,
r. Y.

