

A WEEKLY JOURNAL 0F PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.
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1. Sweet Water Dam. 2. Conatructing Sweet Water treatle-height, 81 feet; length, 1,284 feet. 8. General view of Anme in eastern canyon. 4. Floating down Los Coches treetle-height, 60 feet; length, 1,774 feeh CONSTRUCTING FLUMES FOR PURPOSES OF IRRIGATION AND WATER SUPPLY IN SOUTHERN CALIFORNIA.-[See page 167.]

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## the monitor as a battle ship.

As to high speed, of course, that is not to be expected of a monitor. It was promised for the modern fight ing ship, but how much has been realized? Sixteen knots with forced draught, it is, perhaps, not unfair to say, is good time for the best of them, if we except few, and these mostly unarmored or protected cruisers Now, forced draught has come to be regarded as a re course of such doubtful expediency that there is rea son to believe it will in the not distant future go out o use. Without it the speed of the average armored ship is much below 16 kyots an hour. If we except speed and the comfort of the crew, the monitor would seem to be a more effective engine of war than the average
modern ship. It has greater buoyancy, and presents modern ship. It has great
but a minimum of target.
Analyzing its good and bad qualities, the London Engineer quotes the testimony given by Admiral Shufeldt, U. S. N., before the Senate committee, to the following effect :
"After an experience of a good many years at sea, feel that.I ought to say, first, in regard to the moni tors, that I think they can go to any part of the world and fight at sea as well as any battle ship that I hav ever met or have ever seen. First, because they have very much more stability. Of course, if there is a very heavy sea on, neither the monitor nor the battle ship can fight. If they can, it will be the first time I have ever known it. In the case of a ship rolling 40 degrees the battle ship Mr. Tracy proposes probably would find it just as difficult to work her battery as the moni tor, whereas the monitor will be rolling only a very few degrees, and would have very much more stability on that account. I think the monitor can go to sea anywhere, and I do not see any reason why you cannot give her a coal endurance. I know that the Mianto nomoh has not the coal endurance, and I know the Puritan has not the coal endurance, but in building new ships.I do not see why you cannot give them the coal endurance. I believe that the American sys tem, which is the monitor system, is the best in the world. You can improve upon the monitor system as much as you like. There is another point in regard to the monitor, that having a low freeboard and only two turrets. she can approach an enemy with much greater impunity than one of the high freeboard ships. She cannot be seen in a dark night. She could approach almost like a torpedo boat on our coast. Supposing an enemy to be anchored upon the coast, two or three monitors could attack her, and they might easily a void observation, because nothing would be above wate except the two turrets.'
Then it quotes Admiral Rodgers, who was in com mand of a monitor in a heavy storm
"The sea ran 30 feet high, but the behavior of the vessel was easy, buoyant, and indicative of thorough safety. Her movements filled me with admiration. I saw everything to admire, and nothing to improve The waves rolled furiously across the deck. Instead o spending their force against the side, as in an ordinary vessel, they swept harmlessly by."
Now, the turret of a monitor, the only target that would be presented to the fire of an adversary, may because of the great buoyant body under it, be made of a weight and thickness which is practically imper vious to the assault of heavy guns, while the largest modern fighting ship cannot float a weight of armo that may not readily be pierced at short range.
This being the case, it would seem reasonable to inquire what advantage it possesses over the monitor as an offensive war engine to make up for the enormous excess of cost? It can run away from the montor True. But it cannot hope to catch the unan if it, or be made to realize the promise of its designing, ought to be able to overhaul the most speedy craft of the mercantile fleet.
From this, it would seem that the ponderous and costly fighting ship, of which so many examples are to be found in European fleets, is but a nondescript, a giant only formidable in the warlike appearance of its fashioning.
The newest design is not always the best, a fact that has found ample corroboration in warship construction. It is fortunate, therefore, considering the qualities the monitor type is known to possess, and the doubt yet existing as to its possibilities, that it is to have further development and test; some of the best of the old ones, notably the Puritan and Terror, being now almost rehabilitated, and the navy department disposed to further investigation in the same direction.

## the celestial world.

the rotation of mercury
Schiaparelli, the eagle-eyed astronomer of Milan who has aroused great interest in the double canals and the changes taking place on the surface of Mars announces something new and passing strange in regard to Mercury. He finds convincing proof that the swiftest and smallest of the planets in his revolution around the sun always presents the same face to the great luminary, exactly as the moon makes her circuit

Schiaparelli commenced his observations in 1882 making them during the day, in full sunlight, and using telescope with an 8 inch objective. He has obtained 150 drawings of Mercury, and the markings or linea spots visible on his disk remain always the same, not having changed during the seven years of close scru tiny of one of the most skillful and experienced astro nomers in the world
He therefore concludes that the rotation of Mercury on his axis is completed in eighty-eight days, the time of his revolution around the sun. One hemisphere of the planet is constantly illuminated by the sun, the other is constantly in darkness. The eccentricity of Mercury's orbit is very great, consequently the libra tion in longitude is correspondingly great. A portion of the planet's surface along the circle of illumina tion must therefore pass in succession from darkness to ight.
What curious conditions, viewed in this new light, prevail on Mercury! An enormous temperature reigns in the central portion of the hemisphere forever lying under the blazing light of a noonday sun pouring forth from four and a half to ten and a half times the heat received from our sun at the summer solstice, a sun that never sets, while eternal darkness prevails on the other side, and a cold more intense than can be easily conceived.
Schiaparelli has found two astronomers, Perrotin and Terby, to confirm his observations on Mars. It is to be hoped that he will find equal confirmation for his observations on Mercury. They are more startling and overturn more entirely all preconceived ideas of the axial rotation of the little planet, supposed for a century to correspond nearly with that of the earth.
M. Flammarion announced and indorsed Schiapa relli's discovery at the meeting of the Astronomical Society of France, in Paris, on January 8.

SIX PLANETS.
M. Leveque, at Lyon-Monplaisir, a correspondent of L'Astronomie, records the observation with the naked eye of six planets at the same time, on November 1 o ast year, at $5 \mathrm{~h} .30 \mathrm{~m} . \mathrm{A} . \mathrm{M}$. The planets were : Venus in Vigo, Mercury near Venus, Mars and Saturn in Leo, Vesta in Cancer, and Uranus in Virgo. The sam harp-sighted observer follows the movement of Venus with the naked eye during the day.
the last decade of the nineteenth century. Several important and interesting phenomena will occur in the last decade of the nineteenth century Mars will be in opposition in 1892, under conditions more favorable for observation than have occurred for fifteen years, when, in 1877, his two satellites were discovered Jupiter will be in perihelion in 1892, July 24, when he is about $42,000,000$ miles nearer the earth than when in aphelion. Mercury will make a transit on the sun's disk in 1894, November 10, when the telescope will re veal his presence as a small black spot on the sun's bright face. A grand shower of November meteors will take place in 1899, when stars will fall from the sky like flakes of snow. A total eclipse of the sun will occur in 1900, May 27, that will be visible from Virginia to Louisiana.
eclipses in future years.
The $t$ wentieth century includes three years in which seven eclipses-the largest nu mber possible-take place In the year 1917 there are seven eclipses. In the year 1935 there are seven eclipses, five of them solar eclipses. In the year 1985 there are seven eclipses, three of thein being total eclipses of the moon.
the sun spot cycle.
The minimum of solar spots has probably passed From October 4 to December 11 of last year, a period of sixty-eight days, not a single spot was risible on the sun's face. A small spot appeared on December 12 near the western border, that disappeared on the nex day. An increase in solar activity may soon be ex pected.

## Protection of Fruit Trees.

The Massachusetts Agricultural College, located at Amherst, issues bulletins occasionally, giving result of their experiments, which are useful to the farmer and all persons interested in horticulture. In the last issue of the bulletin, we find the following directions for ridding fruit orchards of pests which are some imes very destructive
In addition to the simple mixture of lime, cement nd Paris green wash, we have found, if the above be mixed with skim milk, it adheres better than if mixed with water, in some cases adhering firmly for six months or more
Portland cement adheres more firmly than the Rosendale, and is more satisfactory when not mixed with milk than the latter
Several reports have come to us of young trees hav ing been injured by woodchucks during the summer and in one case we can report that out of more than one thousand trees treated with cement, milk, and Faris green, not one was injured during the past sum ner, while many not painted were seriously injured.
The a mount of Paris green used was one tablespoon ful to each two-gallon pail full of paint, mixed so as to easily apply with a paint brush.

THE MANUFACTURE AND USES OF ALUMINUM.
The formal opening of the great works of the Aluminum Brass and Bronze Company, at Bridgeport, Conn., which wiA be described in a succeeding article, makes it desirable, as a preliminary, that we state a few facts about the unalloyed metal itself. Quite learned men have indulged in wild talk about the metal, which is more widely distributed over the globe than any other, being known to exist in 200 different minerals, including all granites and common clays.
Wm. Anderson, C.E., in a recent address before a scientific society in England, stated that aluminum was discovered as a distinct metal by Marggraff 136 years ago; whereas the latter only sihowed that alumina was a distinct earth, the discovery of its metallic base being reserved for Woehler, who separated it as such in 1828 . If scientific men thus err, what may be looked for from the ordinary public? A recent order from a prominent manufacturer calls for a quantity of "illuminuin." At a late club meeting in a large New England city a capitalist inquired as to the precise object of the "alumni factory" just built at Bridgeport; whereupon a Yale graduate gravely assured him that the best factory of that sort was located at New Haven. The money king innocently, but aptly, replied that " if the Bridgeport article was no better than that produced at New Haven, he thought it would hardly find a market." He had been misled by the common mispronunciation of " alumnium."
The problem has been to extract the metal cheaply, and chemists of every land have labored for a solution. Oerstedt suggested a process of obtaining aluminum by treating the chloride with an alkali metal. Adopted by Woehler, and modified by Deville, the process was "a reduction of the double chloride of alnminum and sodium, by means of metallic sodium, in the presence of cryolite." It was thus that Deville was able to show at the Paris exhibition in 1855, as the greatest of modern chemical wonders, a bar of what he styled "silver-white metal made from clay." He sold aluminum first at $\$ 15$ an ounce, but in 1857 he reduced the price to $\$ 2$ an ounce. Improvements cheapened the product still further, so that Colonel Frishmuth, who cast the tip of the Washington monument, in 1884, was able to furnish the metal in bars at $\$ 15$ a pound In that year, however, he made only 1,800 ounces, and the entire import was but 590 pounds.
Prior to 1887, the entire amount manufactured annu ally was but 10,000 pounds, and it sold that year at $\$ 10$ a pound. To get even this small amount required the annual manufacture of 100,000 pounds of the double chloride and 40,000 pounds of sodium. To cheapen these two prelimiuary processes was essential to the cheap production of aluminum.
Hence the importance of the process patented by Mr. Hamilton Y. Castner, June 1, 1886, which was the first patent ever granted for an aluminum process in the United States. Its special feature was a cheap way of getting sodium. He reduced and distilled it in large iron crucibles, raised automatically through apertures
in the bottom of the furnace, where they remain till in the bottom of the furnace, where they remain till
the reduction is completed and the sodium distilled. the reduction is completed and the sodium distilled.
Through tubes in stationary covers the distilled metal passes to condensers, where it is solidified. When the process is completed, the crucible is lowered and a new one with a fresh charge is substituted and raised into the furnace. The residues are carbonate of soda and process is as simple as it is ingenious, and the tempera ture required is very moderate, the sodium distilling ture required is very moderate, the sodium distilling
as easily as zinc. One charge requires about an hour, and a battery of four furnaces can yield a ton of sodium a day. The metal is kept from oxidation by a covering of mineral oil till used.
The Deville-Castner process takes the double chloride finely divided and mixed with thin slices of sodium, and empties the mixing cylinder on the hearth of a re verberatory furnace, where the mass quickly melts, and a reaction takes place that finally liberates a silvery stream of molten aluminum that is drawn out from below, while the melted slag runs off from above The first run is purest and contains about three-fourths of the charge. The remainder is scraped off from the hearth, or found entangled with the slag, from which it has to be separated. The aluminum is finally remelted in plumbago crucibles, and cast into ingots, bars, or plates. The Journal of the Society of Arts, from whose very extended account the foregoing is abridged, adds that, day by day, as the manufactur progresses, improvements are made which either enhance the economy of production or the purity of the product, and speaks in the highest praise of the skill energy, and perseverance of Mr. Castner and his assist ants, by whom, more than any others, aluminum has
been brought into the market on commercially practicable terms, and in a condition of almost perfec purity.
Grabau's process may be briefly described. Powdered cryolite put into a solution of the sulphate of aluminum gives by reaction the fluoride of aluminum, which is then heated till ready to evaporate. The heated
fluoride is pulverized and thrown upon melted sodium
contained in a vessel lined with cryolite. The heat generated by the violent reaction melts the aluminum as well as the cryolite; and the molten mass being poured out, the pure aluminum settles at the bottom, while the cryolite is at the top. The main advantage of this method over the Castner process is that it goes on t a lower temperature and is extremely simple.
Numerous other processes are described by Richards in his exhaustive work on the subject, e. g., reduction by cyanogen, by hydrogen, by carbureted hydrogen, by carbon and carbon-dioxide, concerning all of which Dr. T. Sterry Hunt remarks that "there has been no pure aluminum made commercially save from the chloride by the use of sodium." Webster is the chief manufacturer in England, on his own patents; and large works have been erected in France on Bunsen and Deville's process by electrolysis.

But, after all, the only true rival of the Castner-De ville process seems to be the Hall process, on patent of Charles M. Hall, and carried on by the Pittsburg Reduction Company, who are now selling pure aluminum at a rate cheaper than nickel ; and tons of wetal are rolled by the Scoville Manufacturing Company, of Waterbury, into sheets, bars, rods, and tubing at a price less than German silver. Briefly the Hal process is this: A flux being discovered that, at a moderate temperature, takes the aluminum ore into solution, and that is of lighter spesific gravity, and that also is unaffected by the passage of an electric current, he fills a series of carbon-lined steel pots with the flux, which is kept in a melted condition. Carbon electrodes are plunged into these baths, through which passes the electrical current, which acts to send the aluminum to the sides and bottom of each pot. The baths are con stantly replenished with ore, and the process thus goe on for an indefinite period, night and day, at smal cost, and demanding but little attention.
Aluminum, whether pure or in combination, de serves to rank with the noble metals-although in certain forms it makes the basis of our common clay every cubic yard of which is said to contain 800 pound of the metal; in other forms it is massed in mountains and in others still it shines among the most precious stones, entering into the composition of the ruioy, sap phire, topaz, garnet, lapis-lazuli, and tourmaline.
Cryolite, found in Greenland, and beauxite, first found at Beaux in France, but since in Austria, Ireland and elsewhere, are the ores relied on for the manu facture of aluminum. Cryolite is a snow-white min eral, though often tinged red or yellow by impurities Beauxite is a hard white clay occurring in beds many feet thick. Corundum, found in Georgia, is the ma terial relied on in America especially for making the alloys. It varies from dull blue to black, and exists in massive form, as well as in crystals. The cost at the factory of these different minerals varies from $\$ 60$ to $\$ 140$ a ton.
The properties of aluminum are now generally known. Its color is white delicately tinged with blue and it resembles silver more than any other metal. It takes a brilliant polish, and may be rolled or forged as easily as gold or silver, and may be beaten into very thin leaves. It can be pressed or stamped into all sorts of shapes, or drawn into very fine wire. Its elasticity and tenacity are about the same as virgin silver, but change greatly under the hammer. It is said to resist the graving tool till properly varnished, when it may be cut like copper. Its sonorousness is very curious Cast in bell form its sound is sharp, and not prolonged but struck as a bar it is remarkably sweet, pure, and esonant. Its sound is resolved into two tones related o each other as are D and A. It might not work well in the form of tubular wind instruments; but fine effects might be had from a series of chromatic bar I do not know that the experiment has been tried
In estimating the relative cost of aluminum as compared with other metals, we must take its specific gravity into the account. A bar of aluminum weigh ing one pound would be about four times as large as similar bar of silver, brass, bronze, tin or iron. Hence, $t$ an equal price, aluminum would be four times a heap as silver. But as it now costs by weight only ne-eighth as much, it must be relatively about 32 time sheap. In other words, the purchaser would find it economical to use aluminum in preference to silver
for everything to which it is adapted. As a conductor of electricity it equals silver, and is eight times bette than iron, and as a conductor of heat it excels any other metal known. Neither air nor water, hot or cold, affects it, and it resists all acids except hydrochloric It slowly yields to a mixture of salt and vinegar, with result as harmless as clay itself. It does not seem to be affected by saliva, perspiration, or other animal agents. Hydrogen, nitrogen, sulphur, and carbon do not affect it, but it is rapidly attacked by chlorine fluorine, iodine, and bromine. From the above ob servation aluminum does not seem to have an intimate analogy with any other known metal, though Richards and Woehler place it near to silicon and boron in the carbon series.
Aluminum melts slowly, at about 700 degrees C. 292 degrees Fah.), without a flux, and in an ordinary
pieces of divided metal are first dipped in benzine to clean them, and if necessary are treated with nitric acid, and then put in the crucible little by little
A cinder remains at the bottom of the crucible. The molten metal may be cast either in metallic moulds or in very dry porous sand with numerous vents. Deville prefers a plumbago crucible without a lid, and exposes the red hot metal for a long time to the open air, to al low the exhalation of the acid fumes, after which the surface is skimmed without loss of metal. It is then cast into ingots. To get perfectly clean results this process is repeated three or four times. The pure metal thus obtained improves in color with using while what is less pure tarnishes in time, though perhaps equally brilliant on first casting.
The Aluminum Company, with offices at 115 Cannon Street, London, and works at Oldbury, near Bir mingham, issued a price list, November 1, 1889, from which we quote aluminum, 99 and qr. to 99 and 3 qr per cent. purity guaranteed, 15 shillings per pound; 9 to 99 , ditto ; 95 to 96,12 shillings a pound.
The first article manufactured from pure aluminum was a rattle for the young Prince Imperial of France in 1856, the sonorousness of which was much admired It was next made into jewelry, medals, and inlaid work. Its extreme lightness led to its being used for sextants, eye glasses, opera glasses, and the tubes of telescopes It has been found useful for the beams of balances, for delicate weights, and in the form of fine wire for embroidery. Culinary articles made from it were to be seen at the London exhibition in 1862, for which it seemed admirably adapted on account of its lightness and immunity from corrosion.
Experiments have been rapidly multiplied of late under the encouragement given by reason of the in creased cheapness of the metal, and a promising field is surely opening for its employment for many ornamental and useful purposes. The processes of solder ing, welding, veneering, gilding, and silvering alumi num are winutely described in Richards' work on the subject.
The imagination has been allowed free play as to the manifold advantages of a metal at once so ligh and so strong. As a single specimen of the poetical lights of which scientific men are sometimes capable I quote the prediction of one of the most eminent savants of America that "Some day aluminum will revolutionize the world. It will be used in the con struction of houses, thus superseding wood, stone, and brick. It will take the place of iron in ship building The ocean steamer of to-day will be but a canal boat compared with the aluminum ship that will fly as a bird over the waves." To all of which we can only say -possibly !
The aluminum industry is on a firm footing, both in Europe and America. There have sprung up two dis tinct lines of manufacture ; the one a chemical process, and the other strictly metallurgical. The former produces pure aluminum, and continues to be a complicat d process demanding skill and patience. The latter produces only the alloys of aluminum, and has been nade extremely simple by certain methods to be described in a future communication.

## Puget Sound Lumber Industry

The Port Blakely Mill is the largest mill on Puget Sound. It can cut logs of any length up to 130 ft . and has a capacity of $300,000 \mathrm{ft}$. every ten hours. The mill is a modern one, having been rebuilt after the fire of 1888, and has more power in proportion to its size than any other mill on the coast. It is furnished with two double circulars with sixty inch saws on both upper and lower arbors, two pony rotaries or resaws, and a large gang, besides the smaller machinery. This mill ships nearly all of its product by water to Calimill ships nearly all of its product by water to Call fornia and foreign ports. During the twelve months
ending November 30,1889 , they shipped eighty-eight ending November 30, 1889, they shipped eighty-eight
cargoes of lumber, of which fifty-five were sent to cargoes of lumber, of which fifty-five were sent to
foreign ports, chiefly to Australia, and thirty-three to domestic ports, chiefly to California, twenty-seven going to San Francisco, and only one to an Atlantic port -Boston-and that laden chiefly with spars and shingles. The total amount of lumber shipped was $49,450,310 \mathrm{ft}$., board measure. In addition there were $9,444,689$ lath, 635,136 pickets, 943,250 shingles, 177 spars containing $181,363 \mathrm{ft}$., and 3,842 piles containing 239,961 lineal ft . Besides this there was a large quantity of umber sent over to Seattle from this mill after the fire, amounting to between twenty and thirty million, with other local sales.-Pacific Lumberman.

## County Licenses.

An act passed by the Pennsylvania legislature in 1861 requires hucksters from outside of a county to pay icense of $\$ 20$ and hucksters living in the county to pay a license of $\$ 10$, imposing penalties for failure to pay these licenses. Judge Endlich, in a decision just render ed at Reading, held the law unconstitutional, on the ground that it was a law regulating commerce, such as Congress alone had power to pass, and also for the reason that it discriminated between residents and nonresidents.

## Sir Frederick Abel, a high authority on the subject,

 lately read a paper at the Royal Institution.Four years ago smokeless powder of extraordinary power was said to have been introduced with the Lebel rifle in France. It has since transpired, however, that several successive experimental compositions were tried with this riffe. Guncotton pure and simple was tried by $\operatorname{Sir} \mathbf{F}$. Abel for small-arm cartridges for some years with marked, but not uniform, success. Great advances were made, however, on Von Lenk's achievements with guncotton, and the adoption of guncotton as an explosive was then achieved by Sir F. Abel, and, though not as a military propellant, it has been used with great success in sporting cartridges. Colonel Schultze, of the Prussian artillery, has brought in the sporting powder identified with his name, consisting of wood converted into nitro-cellulose. In its best form this closely resembles a granulated nitro-cotton powder made at Stowmarket. Absolute smokelessness was not, however, attained, nor a high degree of accuracy. The smokeless powder of Messrs. Johnson \& Borland, and of the Smokeless Powder Company, are well established compounds in England. Camphor has been used with success to harden the surface and close the pores of the powder granules now used. In French and German smokeless powders, acetic acid and acetone have been used, not merely to harden the tablets or granules, but to convert them into horn-like material. The first powder used with the Lebel rifle took the form of small yellowish brown tablets as thin as stout note paper. The composition was made a mystery of, but apparently it contained picric acid-the basis of melinite. The powerful and much vaunted French explosive employed in shells has for its basis picric acid, which was first used by Designolle about twenty years ago. The earliest smokeless French powder undoubtedly failed in the quality of stability, and has been superseded by a simpler compound. German powder of great promise, elaborated at the Rothweil powder works, failed from the same defect of instability. Guncotton of low explosive power has, by the use of solvents, been converted into horn-like material, and pressed into the shape of rods, tubes, sheets, and other forms, which may be cut up into tablets or strips of any required shape. Mr. Alfred Nobel, the inventor of dynamite and other powerful blasting agents depending on nitro-glycerine for their basis, also made smokeless powder based on guncotton in the above form, bearing considerable resemblance to his blasting gelatine. Col. Hess, in Austria, rendered this substance less susceptible to accidental explosion by the incorporation of camphor previously used in the manufacture of the curious substitute for ivory, horn, etc., known as xylonite. Mr. Nobel has had some success in Italy with his smokeless powder, with which Krupp is also said to be experimenting. The government committee on explosives have used Nobel's powder and others in the form of wires and rods in bundles in small arms with excellent results. The most promising of them, besides fulfilling the conditions of smokelessness and stability, has developed much greater energy in smallbore arms. Considerable erosive action is produced, and the arm is heated, while but little fouling is produced. Success with small arms seems on the eve of attainment with smokeless powder, and its application to larger barrels of from 1.85 in . to 6 in . in caliber is attended with less difficulty. Probably the form of the gun will need modification, the pressure in the chamber being less and in the bore greater than with black powder. In our service the need for resisting climatic action of all kinds involves unusually great difficulties, and modifications in our system of magazines may be necessary.

As to the effect on operations of war, much license has been given to the imagination as to results arising from the use of powder from which noise as well as smoke has been eliminated. This has no foundation, the noise of smokeless powder differing only from that of black powder by being rather sharper and of shorter duration. German field guns and our own experimental pieces are fired with powder generating a very slight smoke, like the puff of a cigar, which is instantly dissipated. Independent rifle firing is not visible at 300 meters distance. The main effect in battle will be to increase the elements of calculation, leaving less to chance.

Recently in Sweden a glass composed of fourteen substances, of which phosphorus and boron are th most important, has been produced.

## MANUAL INSTRUCTION OF THE MECHANIC.

It has of ten been said that there is no good general without good soldiers. How true is this aphorism in industrial conflicts, wherein the engineer could not carry on his great enterprises successfully without a select personnel, and without the aid of skillful workmen trained to the practice of the manual arts. A good method of instruction in mechanics is consequently one of the most important of matters, from a scientific as well as from a social point of view. Such a practical and wise method, which has hitherto been wanting, has just been realized in a manner that we should be tempted to qualify as perfect, so long has it been studied and so ably arranged. The author of this interesting work is Mr. Denis Poulot, for whom, after an experience of forty years, the machine shop has no more secrets. Mr. Poulot's method of manual instruction,* which we have recently taken great pleasure in


Fig. 4.-DIAGRAMS SHOWING THE NORMAL POSITIONS OF THE BODY IN FILING AND HAMMERING.
studying in all its details, will render the greatest ser vices to all workshops, to all professional schools, and to all students of physics and mechanics, who are now so numerous. All those who handle the hammer, and who know how to strike the anvil or to work in the laboratory, will agree that it is a valuable thing for the man of research to know how to make, immediately and unaided, the apparatus that has just been conceived, and that he is impatient to experiment with. To all those whom such work interests, either as professors or work men, we recommend Mr. Poulot's method. The author begins with hygiene and costume, and gives advice as to what is to be first done, in case of wounds received from the hammer chisel, etc. Then he goes on to de scribe the methods of filing, chiseling, boring, etc.


Fig. 1.-VISE T00 LOW. Fig. 2.-VISE T00 HIGH. Fig. 3.-METHOD OF GETTING THE HEIGHT OF VISE. Pharm. Journ.
of the work of the forge, of the fire, fuel, etc. The sec ond year is devoted to the nicer sorts of work. It treats of the management of measuring instruments, of wire drawing, of the lathe, of tools for screw cutting, of brazier's work, of transmissions, etc. The third year comprises the execution and mounting of machines. Mr. Poulot's work is deserving of the greatest praise and will render the greatest services.-La Nature.

## Aqueous Solutions of Essential Oils.

It has been found by Bergmann that while mixtures o the fixed alkali soaps with hydrocarbons and essentia oils form only emulsions in water, under separation of the respective oils, a mixture of an ammonia soap with an essential oil will form a clear solution in water, es pecially in presence of an excess of ammonia (Chem Zeit., November 6). Turpentine oil, or some other es sential oil, is first mixed with castor oil, or a mixture of it with some other fat oil, the mixture is then sub jected to the action of concentrated acid, and the pro duct, after being washed with solution of salt, is saturated with ammonia in excess. Or the fat acids may be first separated by treatment of the fatty oil with concentrated acid, then washed with salt solution, and the essential oil added either before or after saturation with ammonia. The preparation thus obtained is said to form a clear solution, and not only to possess the properties of a soap, but also to exercise, in aqueous solution, the solvent action of an essential oil.-

## Casting Great Guns in Rhode Island

The twenty-fifth mortar of the thirty that the government ordered last year of the Builders' Iron Foun dry, Boston, Mass, was successfully cast the other day says the Boston Advertiser. The work is being done under the inspection of ordnance officers Capt. A. H Kussell, Lieut. D. A. Howard, and Sergt. Flynn. The guns are known as 12 inch breech-loading rifled mor tars, cast iron, hooped with steel. The first contract is to be fulfilled April 2, 1890 . The first casting, an experimental one, was made March 12, 1889. This was cut up into many pieces for tests, to ascertain th mechanical properties of the iron used and for infor mation concerning initial strains in the mortar body produced by cooling from the inside of casting. Al the requirements of the ordnance department wer satisfactorily obtained in this casting, and following it as a standard, the first casting to be used as a mortar body was poured April 6, 1889, since which time cast ings have been made at stated intervals. When it is considered that these mortars, when fired, are expected to put their shot within a target 10 feet wide, the accu racy with which they must be bored, rifled, and mounted can be imagined. Much new machinery fo this work is now being delivered, consisting of milling slotting, boring, and turning machines, gun lathes and rifling attachments. During the war this establish ment built many of the hea viest naval guns, but the changes that have taken place in gun making since that time necessitate entirel different machinery. These mortars are intended entirely for coast defense, and the fortifications already contem plated include many hun dreds of these guns. In anti cipation of this need the Builders' Iron Foundry is building up the largest pri vate gun manufacturing plant in the country. The mor tars are 11 feet long, and wit the steel hoops shrunk on weigh $151 / 4$ tons each. They are designed to be operated in groups of 1(i. They will be hidden from the enem by embankments, over which they will be fired. The firing will be directed entirely by

In order to give an idea of the ingenious manner in which Mr. Poulot instructs his pupils, we reproduce from his "Method" a few figures relating to work with the vise.
Fig. 1 shows us a vise placed too low, Fig. 2 repre sents one placed too high, and Fig. 3 shows us how the pupil can determine the proper height of the vise, by putting the apparatus at the level of the elbow whe he arm is bent and the hand placed under the chin.
Mr. Poulot has produced excellent diagrams for giving the attitude of the body and arms in the various ope rations of the mechanic. We reproduce two of these, one relating to filing and the other to hammering (Fig. 4).
Mr. Poulot's method is divided into three years of in struction. The first year comprises elementary motions relative to the mechanic's working stock, the element
"Methode d'enseignement manuel pour former un mecanicien." Paris Monrocq freres 1889.
one officer, who, by previou
study of a chart, can put his shot in any section of a harbor he chooses.
The regular charge is 80 pounds brown prismatic powder, giving a muzzle velocity of 1,150 feet, the projectile weighing 630 pounds, with a pressure of about 28,000 pounds per square inch on the powder chamber. The range of these mortars with this charge and pro jectile, with an angle of 45 degrees, is about six miles. The shot at that distance will pierce six inches of steel armor plate. The accuracy of fire is such that with ordinary care every shot can be delivered at this distance within an area covered by the deck of an ordinary vessel.

## Cost of the Forth Bridge.

The original estimate of the cost of this great work was $\$ 10,500,000$; but the actual cost has been about $\$ 15,000,000$, or nearly the same as the bridge between. New York and Brooklyn.

The accompanying illustratile CAN.
The accompanying illustrations represent a milk can provided with an efficient surface cooler or refrigerator for keeping the milk constantly cool and sweet, with a device for carrying off the heat of the milk, one illustration showing a shipping and the other a delivery can. The invention has been patented by Agnes W. H. Smith, of Beaver Dam, Wis. The can is provided with a perforated dasher on the lower end of a hollow stem which has side apertures at intervals nearly to the top of the can body, and on this central tube is fitted a float which lies on the top of the milk, to prevent excessive agitation or churning of it while the can is in transit. The can also has a surface cooling top or cover made with an ice-receiving vessel, which fits closely in the top of the can, and has a curved margi-

nal flange, as shown in Fig. 1, under which rests a packing, making an air-tight joint between the top of the can and the ice box. The bottom of the box is highest at the center, where it has a hole through which the central air tube passes, next to which is a cold air passage to the top of the box. The top of the central tube has a perforated cap preferably held to the cover by a tie chain, to exclude dust from the tube and milk. The drip from the melting ice does not flow into the milk, but collects in the outer sloping bottom part of the box, the cold air from which flows downward through the tube into the body of the can and on to the milk around the float, or directly on the entire upper surface of the milk should the float be dispensed with. In Fig. 2 the can is shown provided with a jacket having an ice pocket in its lower portion.

## THE MAGIC MONEY BOX.

Among the experiments in physics, there are per haps few that were formerly as popular as the one in which a human head, capable of speaking, was seen lying upon a three-legged table beneath which there appeared to be nothing. The body to which the head belonged was in reality in the table, the head passing through an aperture and the body being concealed by
is proposed on a printed slip in the interior, and which it is not always possible to answer.
The box in reality is formed of two parts, as may be seen in the figure (B) to the right. The compartment into which the coin drops is concealed by two small mirrors at an angle of $45^{\circ}$, exactly as in the ex periment mentioned above. $-L a$ Nature.

## A Locomotive Explosion.

An explosion which shook every house in Benwood occurred February 15. The trouble was with the boiler of Baltimore and Ohio locomotive No. 442, of which Alfred Cunningham was engineer and David Goehring fireman.

The engine was going past the station at the rate of about four miles an hour. When the boiler exploded, and when the steam cleared a way, there was nothing left of the engine save the steel frame, driving wheels, and truck, surmounted by some tangled and twisted bars, rods, and tubes. The force of the explosion was such as to damage the track and tear up the platform such as to damage the track and tear up the platform
in the vicinity, while a car load of furniture which was standing a short distance away on another track looked as though it had been subjected to a half hour's bombardment by a field piece.
In a very few moments a large crowd was attracted to the scene, and a search was at once begun for the engineer and fireman. It was supposed, as a matter of course, that both men had been killed, but, to the great surprise of all, both men were not only alive, but comparatively well.
Engineer Cunningham was thrown by the force of the explosion over the freight cars which were standing on the side track, to and over the track of the Ohio River Railroad, and finally alighted in an old corn field. He was not much the worse for his rapid transit, and when it is considered he cleared one hundred and sixty feet at one flying leap, his escape seems little short of miraculous. Before he was found he had got on his feet and was walking back to where his engine had stood. To a newspaper man Engineer Cunningham said :
' I was carrying 130 pounds of steam, and as we ap proached the station there were three gauges of water. About twenty yards north of the station building I threw the injector on, and we ran on past. The explosion then resulted."
Fireman Goehring was found lying between two cars. He, the rear portion of the boiler and fire box, and the fragments of the cab, all left the engine about the same time. The iron work fell first, and then Goehling settled down, with the remains of the cablying over and partly on him. He went toward the bank, and when found was bleeding profusely from cuts about the head and face. A flying fragment of iron struck Track Foreman Boyd in the calf of one leg, causing a painful wound, and a fourth man, one of a group of five or six who were standing on the platform when the explosion occurred, was slightly cut in the side of the face by a piece of sheet iron. These com prise the casualties.-Safety Valve.

Kenyon's Substitute for India Rubber
The substitute consists essentially of a preparation of oxidized linseed oil, such as the skins and refuse o boiled oil. In carrying out the invention, oxidized linseed oil is mixed with a liquid in which it will dissolve or with which it will com bine when heated. The solvent material preferably used is the distillate produced in the manufacture of varnish from gums or gum resins, although varnish foots pine oil, or thick pine grease, resin, resin ous oil, or a mixture of two or more of these or other similar substances will als act as solvents when heated. The var nish distillate or other solvent is placed in a pan or still heated by steam or other wise, and the skins of boiled oil or oxi dized oil added and mixed well together (or they may be mixed prior to being placed in the pan). The proportion of the solvent to the oxidized oil will alto gether depend on the consistency of the product desired. To make the product of about the consistency of raw India rubber, one part of the varnish distillate to three parts of the boiled oil skins is used; but to produce a substance of a thick, treacly consistence, equal parts of each. The mixture in the pan is then heated to about the temperature of boiling oil, say 350 450 F ., and maintained at that heat for a considera ble time until all the hard or oxidized masses of oil are dissolved in or thoroughly incorporated or combined with the varnish distillate or other solvent used (say from twelve to twenty-four hours).

An English electrician has invented a material that he calls "alterion," for the prevention of corrosion in boilers. The interior of the boiler is coated with the material, and from time to time electrical currents are sent through it.

AN IMPROVED BARREL TRUCK AND JACK.
The accompanying illustration represents a hand truck for barrels containing oils or other merchandise to be drawn off or retailed from the original packages. It has been patented by Messrs. James H. Stansbury and Isaac U. Hyatt. Upon the forward cross bar of the

stansbury \& hyatt's barrel truck and Jack. truck frame are secured two metal chocks, having curved upper faces adapted to receive a barrel. The truck wheels are on an axle journaled in fulcrum plate bolted at their rear ends to the side bars at about the center, and forward of the wheels the plates are gradu ally curved upward to the forward ends of the side bars, where they are rigidly fastened, and at these points angled nose plates are secured to the upper face of the side bars, adapted to be entered beneath the chine of a barrel. The relative arrangement of the nose plates and roller fulcrum with the wheels allows the truck to overbalance forward but little when loading, and enables one man to easily handle a very heavy barrel. On the handle part of the truck frame is sup ported a vertically adjustable concaved saddle, on which and the front chocks the barrel or hogshead firmly rests. At each end of the saddle there is preferably formed a hook, allowing connection of oppo site ends of a stay chain or cord passed over the barre to hold it snugly to the saddle while the truck is being tilted downward after inserting its nose plates under the chine of the barrel
For further information relative to this invention address Mr. James U. Hyatt, Jamaica, N. Y.

## AN IMPROVED CASH CARRIER.

The accompanying illustration represents a simple and compact cash carrier for a store service system, in


## the fuller cash carrier.

which the cup is permanently attached to the car, and consequently not liable to be misplaced or lost, while he car requires but a slight effort to propel it along the wire. The wire at either end, next the stop, is increased in thickness, this portion being approached by a slight bevel, and as the car wheels ride up this portion of the wire toward the stop a spring brake on the car engages the periphery of the wheels. There is also a rubbe buffer on the stop by which, in connection with the action of the brake, the car is brought to a standstil without noise or jar, even if its motion had been ex essive. The car never fails to catch and never re bounds, while it requires but a slight turning of the handle at either end to release the brake when the car is sent on its way. Fig. 1 shows the car with the cash cup in position to be sent along the line, Fig. 2 illustrat ing the manner in which it is brought to the open posi tion, being always held upright, the closing of the cup to the bottom of the car being effected by simply push ing the cup up by the ring on its bottom. This cash arrier has been for some time in successful use and is highly commended by those who have it. For further information relative thereto address the Fuller Cash Carrier Co., Meadville, Pa.

## A Triumph of Education.

Toevery one interested in the welfare of the deaf and dumb the success of the oral training system, as lately exhibited at a theatrical performance of "Richard III." by the children at Old Kent Road Asylum, must convey an impression of deep satisfaction. If a certain slowness of utterance or an occasional jarring intona tion still reminded one of the lacking faculty, this is hardly surprising. These imperfections time alone will do much to remedy. It is far more remarkable that young people who could not remember having heard the human voice were able, with very fair acceptance, and with evident intelligence, to render in speech one of the masterpieces of the drama. Such a feat, we need hardly say, would have been quite impossible under any other but the oral method. The success of the performance, moreover, speaks volumes for the skil and patience possessed by the teachers employed in carrying this system into effect. No process of training exacts more of its communicators; none, perhaps, more distinctly requites their laborious efforts, and certainly none endows the learner more abundantly It is customary with many in this country to speak o the lip-reading system as an educational novelty ; ye it is far from being such. For centuries it has divided the field with one or other of the sign methods, and probably has always exerted a relatively great or even a preponderating influence. It was known and taught with success in Spain during the sixteenth century. It was used by Wallis and advocated by Dalgarno a cen tury later in England. Under Braidwood and Watson it afterward achieved some of its most brilliant successes. Nay, it continued to flourish side by side with the convenient but far less efficient manual method introduced by De l'Epee and Sicard, and adopted from their school by teachers in Great Britain and America. While, therefore, we must chiefly thank Samuel Hein ecke and his followers for fostering in its original form the precious germ of imitative speech properly so called, we must also remember that what he brings us is not in truth novel, but is a once neglected part of the educational patrimony of almost every European country. If a long list of recorded successes which reaches us from ages now becoming remote, and the proofs of striking success attained in our own day, afford the means of judging, we may safely conclude that both teachers and taught will agree to retain in chief esteem a method which has accomplished so much. Between the clear and intelligent utterance which it insures and the uncouth vocal ventures of the sign-taught mute there is indeed no rational compari son.-Lancet.

## Kangaroo Skins

When brought to bay, the kangaroo jumps like a flash for a hunter's chest, and tries to crush it in with his fore feet. To prevent this, each man wears across his breast a two or three inch thick matting. Armed with a spear, with a club attachinent at the other end, they ride upon swift horses into a herd. With the agility and equipoise of circus riders, they stand erect upon their horses, and use their spears and clubs. The kangaroo is able to jump clear over a horse. As the game is bagged it is skinned, and the skin is stretched on the ground and pegged down to prevent shrinkage The flesh furnishes meat for the camp. Each man places his private mark upon his booty, and when they have one hundred skins apiece, they return back to civilization. There are twenty varieties of kangaroos, among them the blue, red Wallaby, black, gray, and forester, the latter furnishing the best leather, as it lives mainly in wooded sections.
When the shipping ports are reached, the hunters dispose of the skins by auction to the highest bidders the skins being now in constant demand. Kangaroo hunters make large profits. One man is known to have cleared $\$ 4,500$, free of living expenses, in a singie year. The tanning of kangaroo skins is confined to men em ployed by Americans, as other dealers cannot afford to pay the high prices for the raw material. The result is that Parisian and London shoe manufacturers buy their stock of kangaroo leather directly from Newark and prominent dealers in Germany, Greece, Spain, and even Australia itself, obtain their supplies from the same source. The manufacturer here scouts the idea that the original seven league boots were made from the skin of the great Australian leapers.-Nature.

## Injury to Neighbors, Water.

Where one stores oil on his premises in such a way that the leaking oil penetrates the ground, and thus pollutes his neighbor's spring, he is liable to his neigh bor for the injury that results, although he may have been ignorant of the fact that the oil was affecting the water of his neigh bor's spring, according to the decision of the Kentucky Court of Appeals in the case of Kin nard $v s$. Standard Oil Company. The court held that while the owner of the land may appropriate to his own use hidden or undefined veins of water under his soil, and thus cut off the supply of water from a neighbor's well or spring, he has no right to contaminate the water so as to render it unhealthy or unfit for use when it reaches his neighbor's land.

AN IMPROVED GLASS POLISHING WHEEL.
The illustration herewith represents a wooden polish ing wheel composed of sector sections, each so cut and connected to the adjacent sections that the grain of the wood of each section will run at about right angles to the forward radial edge of the section. It has been patented by Mr. Wyman Kimble, of Honesdale, Pa Fig. 1 is a side view and Fig. 3 an edge view of such wheel, in which the sector sections are united by dove tail projections, Fig. 2 showing a construction wherein the dovetail joints are dispensed with and the section are united by tongue and groove connections, with double pointed tacks appliec over the joints. A whee


KIMBLE'S GLASS POLISHING WHEEL.
thus formed is especially designed to maintain an even wearing surface upon its peripheral edge, while readily taking the proper shaping upon its operating edge from the sharpening tool.

Improved Process for Fixing colors.
This invention, by F. Bayer \& Co., Elberfeld, Ger many, relates to an improved process for fixing coloring matter, such as the azo-dyestuffs, which possess the property of directly dyeing unmordanted cotton in an alkaline bath, and which are known in the trade as substantive coloring matters, on or in the animal or vegetable fibers to which they are applied in the pro cesses of dyeing and printing. The said substantiv coloring matters possess the property of forming, with he salts of the earthy and of the heavy metals, lake which in part are very permanent. By boiling in a so
lution of a metallic salt goods which have been dyed ution of a metallic salt goods which have been dyed
or printed in the usual way, the metal becomes fixed or printed in the usual way, the metal becomes fixed esults obtained naturally vary according to the natur f the metallic salt and coloring matter employed Zinc is found to be the best, suited for use in dyeing wool and silk, as it has no influence whatever on the color, and forms lakes which perfectly resist the action of boiling water, and better resist fulling or milling han do the original colors. The zinc can be employed in the form of sulphate of zinc or white vitriol. Woolen goods dyed in the usual way, with deltapurpurine for example, are boiled for a few minutes with a quantity of white vitriol corresponding to the dye employed The zinc is then completely taken up from the bath The wool so treated is now faster to fulling or milling and can be acted on with boiling water without suffer ing in the least. The dyestuffs are preferably employ ed in printing with an addition of neutral thickenin paste.

## A NEW MACHINISTS' HAMMER.

The illustration here with represents a new style of tandard hammer for machinists and blackswith which has just been brought out by the Billings \&


Spencer Company, of Hartford, Conn. These ham ners are drop-forged from the best tool steel, and ar carefully tempered and finished in the thorough man ner for which this company has so well established a reputation. They are made in four sizes, $1 / 4,3 / 4,1 \frac{1}{4}$, and $11 / 2$ pounds, respectively, and particular attention and "hang."

## ©orrespondence.

## Hektograph Pad-French Formula for <br> Composition.

To the Editor of the Scientific American:

\section*{Hektograph Pad.-French Ministry of Public Works. <br> | Glue. | 100 parts |
| :---: | :---: |
| Glycerine. | 500 |
| Finely powdered kaolin or baric sulphate | 25 |
|  | 375 |

For ink a concentrated solution of Paris violet is commended
To remove old copy from pad, a little muriatic acid added to the water."
This is the 25th copy from pad made according to bove formula.
For a tin dish $7 \times 11$ inches I used


I had to guess at weight of glue and think that 1 got trifle too much.

Wm. T. Pepperel
Boston.
[The quality of the sample submitted speaks well for the formula, which varies in some points from that given in our Supplement, No. 438.-Ed.]
oxygen Explosions-Their Canse and Prevention To the Editor of the Scientific American
I was much interested in your article in the ScIENIficic American in reference to the explosion of an oxygen retort at Lexington, Ill., by which Prof. Jess and a number of others were severely injured.
In my experience of a number of years in the manu facture of oxygen for the lime light and other scientific purposes, I have become convinced that a large num bers of explosions are the result of a sudden plugging of the neck of the retort and outlet pipe with the bin oxide and decomposed chlorate.
Some years ago, while working with an extemporized retort similar to Prof. Jess', composed of 2 or $21 / 2$ inch ron pipe, about 10 inches long, one end closed and the other capped with a reducing cap into which was screwed a $1 / 2$ inch pipe, the retort exploded violently, but fortunately injuring no one. The retort had been inclined at an angle of $45^{\circ}$ over the source of heat, and the gas coming off slowly, I turned the retort to expose a fresh surface. The retort exploded a moment later. As the retort had been carefully cleaned, and as samples of the same lot of chemicals, when used in another reort, gave no bad results, I formed the opinion that the discharge pipe of the retort had been plugged by a sudden rush of gas, and the explosion followed. For several years I have used a conical retort of heavy sheet ron, about 8 inches diameter at base and $21 / 2$ inches at top, this fitted with a loose-fitting cap of copper or ron, with connection, and when used a joint made with fire clay. I have never had the slightest accident with this form of retort, and commend it to all.
C. Lucius Woolley.

Baltimore, Md.

## New Explosive Compound

Mr. H. S. Maxim has discovered that the addition of castor oil, or other suitable oil, to compounds of dissolved guncotton and nitro-glycerine, nitro-gelatine, or the like, increases the toughness of the product and modifies the explosive properties thereof, while greatly diminishing its liability to deterioration by exposure to the atmosphere. Castor oil is preferably employed, because it is soluble by means of the solvents which are employed for dissolving the guncotton and nitroglycerine or nitro-gelatine. The improved explosive compound is advantageously manufactured as follows : First, dissolve guncotton or trinitro-cellulose in acetone, ethylic acetate, or a similar solvent, either in a liquid state or in the form of vapor, until the said guncotton is brought to a sufficiently thin consistency, and then add to the dissolved guncotton the nitro-glycerine or nitro-gelatine, and after that the castor oil, and thoroughly incorporate these substances. Or the castor oil may be dissolved in a portion of the acetone, or other solvent, before the solvent is added to the guncotton. When the mixture is sufficiently dissolved, it it subjected to pressure in a cylinder, and so forced out through small holes in the form of threads or strips, which may be cut into small pieces.

## Length of Locomotive Boiler Tubes.

Some interesting experiments have recently been made by the Paris, Lyons, and Mediterranean Railroad on the comparative value of short and long tubes in the locomotive boiler. As a result of these experiments the road has adopted standards for lengths of tubes, varying from 13 feet to $143 / 4$ feet. With boilers having tubes of these lengths there was found a total evaporation in a given time about 5 per cent greater than with boilers having tubes $16 \frac{1}{2}$ feet in length, but there was a loss on the water evaporated per pound of coal varying from $21 / 2$ to 5 per cent.

## the san diego flume system.

The dreadful calamity at Hassayampa, Arizona, a few days ago, which caused such great destruction of life, has attracted attention to the system of artificially watering the parched, arid plains of the rainless region of the West by the use of dams and flumes. Much waste land in the West has recently been redeemed by irrigation. The dam lately destroyed at Hassaby irrigation. The dam lately destroyed at Hassa-
yampa was built in order that the sterile plains with yampa was built in order that the sterile plains with
which that part of Arizona abounds might be irrigated. which that part of Arizona abounds might be irrigated.
This system of overcoming the defects of nature by artificial means will be extensively used in the future, when the population in those regions has become dense enough to create a greater demand for farm land than exists at present. Then that desert land will be looked at longingly, and those dreary wastes will be transformed into fertile plains, and will perhaps be studded with flourishing towns.
One of the most perfect and extensive works of this nature is the San Diego Flume System, which has recently been completed, and which is designed to supply water to the city of San Diego and to irrigate the surrounding mesas, now simply barren deserts, with no vegetable growth save the cactus and the sage bush. But the days of these plants are numbered, and the inhabitants of that region are now looking forward to the conversion of this dreary region into flowering prairies.
San Diego is situated at the extreme southwestern limit of California, on a splendid bay. It is the southernmost American harbor on the Pacific coast. When the first railroad was brought into San Diego, in 1881, the population was 3,000 . Now she claims a population of 35,000 , and it would appear that the port was likely at no distant day to become one of the most important of the Western seaports. Distant nearly 500 miles from San Francisco, she is nearer Australia, South America, the Nicaragua Canal, and most of the Pacific Islands than is San Francisco, and by rail she is nearer Salt Lake City and nearer New York than is the Golden Gate.
The country, however, like much of that immediate ly east of the Rockies, and like the peninsula of California, lacks water, and it is to the end of remedying this defect that the flume system described below has been constructed.
Mr. Bryant Howard, president of the Flume Company, at the ceremony that took place to celebrate the opening of this great work, in the course of an admirable speech spoke with pardonable enthusiasm as follows :
"The county of San Diego, which, because it is only a county, we are apt to think of as of small size, is yet larger than several of our States. It is larger than the States of Massachusetts, Rhode Island, and Connecticut combined. It is larger than some of the kingdoms of Europe. Though a large portion of it is desert and mountain, it has more fertile land within its borders than Palestine when Solomon reigned in his glory, more than Greece when Pericles reared the Parthenon. It is one of the most favored regions of the whole earth. It is one of the most favored regions of the whole earth.
Its scenery is grand and beautiful; its skies soft as Its scenery is grand and beautiful; its skies soft as
those of Italy; its valleys and mesas unsurpassed in those of Italy; its valleys and mesas unsurpassed in
fertility; its hills and mountain sides are covered with flowers yielding treasures as precious as those of the famed Hymettus; its air is balmy as the breezes of 'Araby the Blest.' Here no thunderbolts destroy, no tornadoes bring devastation, no torrid heat enervates, no frigid cold benumbs or paralyzes. Here malaria can find no foothold; here the sunshine and ocean breeze give life to the blood, elasticity to the step, the breeze give life to the blood, e.
bloom of health to the cheek.
"But one thing we have needed. Our fertile hills and valleys and mesas are sometimes dry and barren. Thirsty earth cries for drink, and her thirst is not al ways quenched. The harvest has not always come to reward the labor of the farmer. The one thing we lacked is water. For here water is king. And now he comes to us in all his glory. He comes from the mountains, and all the valleys and mesas rejoice at his coming. In his footsteps shall spring herb and flower and fruit and grain. He shall wave his scepter over the land, and beneath it shall oil and wine and milk and land, and be'
The water is brought to San Diego, a distance of fifty miles, from the lofty Cuyamaca Mountains, where there is abundance of rain. The annual rainfall averages 30 or 40 inches. The living streams flow during all the year. By means of tunnels and trestles the water is conducted through the whole distance with an even fall of some 4.75 ft . per mile. The current flows at the rate of four miles an hour. The supply reservoir at the western terminus of the flume for the uses of the
city is 630 ft above the sea level, and it was for the city is 630 ft . above the sea level, and it was for the
purpose of retaining this high elevation that such expurpose of retaining this high elevation that such ex-
tensive trestle work was necessary. At this point the water is filtered, and is brought eight miles to the city through a fifteen inch pipe.
The original source of the supply is the Cuyamaca reservoir, located in the mountains at an elevation of 5,000 feet above the sea level. It holds $3,739,000,000$ gallons of water, but, in case of necessity, the dam can be raised several feet and the capacity doubled or
trebled. The dam is made of clay, and is 720 feet long, 35 feet high, and 140 feet wide at the base, 16 feet at the top. The front is riprapped. It is estimated that the watershed at present concentrated is some 150 square miles in extent. The water as it leaves the reservoir flows through the natural bed of a brook through a narrow gorge called Bowlder Creek, a distance of twelve miles to the diverting dam.
This is a splendid structure, built of granite and cement, 450 feet long and 35 feet high, 16 feet wide at the base, and 5 to 7 feet wide at the top. From the diverting dam the water passes into the great flume. This is 356 miles long, 6 feet wide, and 16 inches high. The side boarding will be raised to four feet as soon as the supply demands it. It is built of dressed redwood plank two inches thick, resting on heavy wood sills, stringers, and cross ties, and the whole resting on a solid foundation. Over $9,000,000$ feet of lumber was consumed in this work. Redwood was selected owing to the fact that water does not have the same deleteious effect upon it that it does upon other woods.
In the construction of the flume there are 315 trestles, the longest of which is the Los Cochos trestle, 1,774 feet in length and 56 feet high. Its construction required 250,000 feet of lumber. Some of the others are The Sweetwater pass, 1,264 feet long and 81 feet ligh Sycamore Creek, 720 feet long and 35 feet high; Connor Creek, 688 feet long and 34 feet high ; Knob Creek, 600 feet long and 55 feet high; Cut-off, 640 feet long and 48 feet high; Sand Creek, 600 feet long and 58 feet high; South Fork, 420 feet long and 86 feet high; Quail Canyon, 560 feet long and 68 feet high ; Monte, 438 feet long and 60 feet high; Chocolate, 450 feet long and 63 feet high.
There are over three hundred smaller ones. There are a number of tunnels cut through the solid granite or slate six feet square, cemented and arched overhead, supports being placed wherever the rock was in danger of falling. The principal ones are the Lankersheim Tunnel, 1,900 feet long; Los Coches, 313 feet El Monte, 290 feet; Cape Horn, 700 feet ; South Fork, 200 feet; Anderton, 270 feet; and Sand Creek, 430 200
feet.

The project of erecting this flume was conceived of wany years ago by Mr. T. S. Van Dyke, and for many years he and Mr. Wm. E. Robinson tried to interest the public of San Diego and procure capital for the enterprise which has recently been brought to a successful issue. Work was commenced in 1886. In wany places roads had to be constructed to facilitate the transportation of the timber, and over 100 wagons and 800 horses and mules were employed in transferring the lumber from the ships in the harbor at San Diego to different points in the mountains. The lumber was hauled by teams in caravans, consisting of several wagons dragged by teams of six, eight, or ten horses each. The lumber was cut and itted at the city in order to avoid unnecessary hauling. The cost of the work has amounted to about $\$ 1,000,000$.
It is estimated that, in addition to furnishing the city with a splendid water supply, it will be possible to irrigate from 40,000 to 100,000 acres of land. This land has hitherto been worthless, but with an abundant supply of water at hand it is only a question of time before this tract will be converted into flowering gardens and prosperous farms, for the soil is productive and the climate delightful. Part of this land has been acquired by the flume company, and is being worked with a view to converting it into productive property. There are a number of summer flowing streams that can be diverted into the flume in the Cuyamaca Mountains as soon as this becomes necessary, and other reservoirs will be constructed at different points. One of these, near the La Mesa tract, will contain $760,000,000$ gallons, and another above the Diverting Dam 1,250,000,000 gal lons.
In one of our views we represent a party of pleasure eekers in the act of floating down the flume.
This system, which we have taken as a type, is, however, only one of many in this same county of San Diego. There are seven other similar systems, either completed or in course of construction. It is claimed by some that the land is enhanced in value $\$ 100$ per acre, and some idea can be formed of what this work means to that country when it is remembered that from 500,000 to $1,000,000$ acres will be beneflted by these
works. We also give an illustration of the Sweetwater Dam, recently erected to furnish a water supply to National City (near San Diego) and the National Ranch. The names of other systems in that same region are Tia Juana, Sweetwater, Bernado, San Luis Rey Santa Margarita, and San Jacinto.
It is an interesting study to those living in a community where the conditions of society are pretty wel determined to think of a people who are living in a city that has increased tenfold in eight years and that are calmly waiting for the country about them to gradually
change from a cheerless desert into a blooming garden. They are not dreamers and romancers, looking for some work of magic, but practical business men looking forward to the season of transformation with the faith hat comes of well-considered plans and long studied design. They are looking to a literal reconstruction
of nature and to an extension of the possibilities of heir material growth that implies an entire reversal o the present order of things. Their material extension as a people was limited; but now the barrier that bound them has been removed, and they are waiting with a calm that is sublime for the new possibilities of an extended development and a new and more diversi fied civilization.

## The Proposed Great Bridge betw $\begin{gathered}\text { Jersey City. }\end{gathered}$

Engineer Lind bridge acr Lindenthal, who designed the projected plass the Hudson River at New York, lately
 proposed structure
The committee has received the reply of the secretary of war in answer to an invitation to express his views upon the bill. The secretary indorses and transmits a letter from Gen. Casey, chief of engineers, in which he says that the bill was referred to the Board of Engineers stationed at New York. Upon their findings he suggests that the center of the span shall be 155 feet above mean tide, and that a section shall be inserted requiring the plans to be submitted to the sec retary of war within one year from the passage of the act, the construction to begin within one year after that, and the bridge to be completed within ten years from the approval of the plans. Gen. Casey says that, with these amendments, he knows of $\mathrm{n} \rho$ objection to the passage of the bill so far as the interests of navigaion are concerned.
In the course of his argument Mr. Lindenthal conmented upon these recommendations adversely. He said that the company would be willing to have the center of the bridge 145 feet above tide water, which would be 10 feet higher than the Brooklyn Bridge, but to make the bridge 155 feet high would add enormonsly to its cost, and would render it almost impossible so to grade the approaches as to afford access to railroad trains. The best plan to adopt would be to fix the height tentatively at 145 feet in the bill, leaving a board of engineers to take testimony from navigators and railroad men and definitely settle the matter.
Mr . Lindenthal also contended that the time allowed by Gen. Casey for beginning the work was entirely in adequate. Vast preparations would have to be made to get together material for a structure unlike any other in the world in size and design. It would also be necessary for the company to acquire about thirty million dollars' worth of property in real estate for the approaches and right of way, and this was a time-consuming proceeding. He was willing to accept the sug gestion of Chairman Baker that the bill should pro vide for the beginning of the work in three years, with a proviso that the secretary of war might grant an exension upon reasonable grounds.
Mr. Lindenthal said that it, had been his task for the past five years to convince the public, and particularly capitalists, of the feasibility of his plan of throwing a single span bridge, 3,000 feet long, across the Hudson River, a plan which no other engineer had the courage or ability to put forward. As a result of his work he had secured the indorsement of the American Society of Civil Engineers and had gotten the support of capi tal for the construction of a bridge which in itself would cost $\$ 16,000,000$
In conclusion and in answer to questions, Mr. Lin denthal gave some interesting statistics relating to the bridge. Its central span would rise and fall eight feet, owing to changes of temperature. The anchorages would be half as large as the capitol at Washington, and each would contain fifty per cent more masonry than the largest of the Egyptian pyramids. The cables would be four feet in diameter (the Brooklyn Bridge cables are fifteen inches), and the to wers would be 500 feet high. The bridge proper would accommodate ten railway tracks. Foot passengers sould be lifted up to its level by elevators in the anchorages, but if it was desired to provide for the passage of vehicles, they would have to ascend the Palisades to reach its level.

Compulsory automatic car coupling is the subject of a bill presented to Congress by Representative Flower, of New York. The bill recites that, in view of the numerous accidents and loss of life resulting from the present system of coupling railway cars by hand, a bill requiring all railway companies to equip their freight and passenger trains with automatic couplers has become a necessity. The act is to be operative after November 1, 1892. The Interstate Commerce Committee may in special cases extend the time one year longer. Failure to comply with the pro visions of the act subjects the off enders in each case to a fine of $\$ 500$.

THE production of cyanogen directly from atmo spheric nitrogen has been made the subject of further nvestigation by F. Breneman (Jour. Am. Chem. Soc.) which leads to the conclusion that while cyanides and ammonia may be thus produced experimentally, there are as yet insuperable difficulties in the way of adapting those methods to industrial purposes.

## THE NEW DRY DOCK AT HALIFAX.

The engraving represents the dry dock lately opened at Halifax, Nova Scotia. This dock is capable of admitting any vessel in the world, and is the largest on the American continent. The dimensions are: Length 601 feet, width at top 102 feet, width at bottom 70 feet, depth of water over sill 30 feet, width of en trance 89 feet 3 inches. The entrance is closed by a ship caisson 92 feet 7 inches long over stems, 35 feet 6 inches deep from keel to platform, and 23 feet wide amidshıps. The engineers were Messrs. Bateman, Parsons \& Bateman. The contractors were Messrs. Pearson \& Sou, Westminster, with whom was associated Mr. S. M. Brookfield, of Halifax. The harbor is never blocked with ice, and is remarkably well situated for a repair port.
Our engraving, which shows H. M. S. Canada in the dock, was prepared by En gineering from a photograph.

## Phosphorus.

At arecent meeting of $t h e$ Edinburgh section of the Socie ty of Chemical In dustry, Dr. J. B Readman read a paper on "The Manufacture of Phosphorus." At the outset he gave a short sketch of the short sketh the earlier me ture For about a hundred years bone ash had been used as a source of phosphorus, but now native mineral phosphate of lime had taken the had ak enthe place of bone ash of the phosphorus manufacturer, owing, no doubt, to the low price at which it could be obtained. From one or other of the phosphates of lime phosphu ric acid was preric acid was prepared. This phosphoric acid was treated in an evaporator until it precipitated its lime. It was then mixed with carbonaceous matter to the extent of 25 per cent. The 25 per cent. The mixture was desiccated in a retort, and stowed away for distillation. Distillation was effected in smallbottleshaped retorts, and the crude phosphorus which was produced was
mahogany brown in color. This crude substance was refined by redistillation, or by being treated with sul phuric acid. At the close of his paper Dr. Readman showed how little phosphorus was used in the manufacture of matches by giving the analysis of the amounts in a number of boxes by various manufactu rers which had been tested. In these the quantity varied from half a grain to two and a half grains per box.

Eikonogen Developer for Traveling
Distilled water which has been boiled and allowed to cool, 100 parts; sulphate of soda, 40 parts. Dissolve and add : Crystallized eikonogen, 10 parts ; caustic pot ash, 10 parts. Cork well. For use, dilute with from three to ten times its volume of water. At the Pho tographic Society of Great Britain, Mr. Warnerke strongly recommended this for short exposures and dull days.

THE NEW DRY DOCK AT HALIFAX, NOVA SCOTIA
India they are frequently employed for poisoning, while in Brazil they are used in the treatment of ophhalinia.
In India the seeds are rubbed up in their fresh condi ion, and then rolled up into a fine roll, whose sharp point stuck into the skin is sufficient to kill any man or animal, and leaves no more mark than the sting of an insect. It is stated that entire English colonie have been murdered in India in this manner. Pro fessor Kobert has examined the albuminous constitu ent, and has found that it is one hundred times more poisonous than strychnine, and is similar in its action to the poison which may be extracted from castor oil seeds. Like all other albuminous poisons, it loses its activity when boiled, and consequently the Abrus rrecatoria seeds may be even used as food. Dr poison is introduced into the blood, through the coagulation of the blood corpuscles.-Ther. Gazette.

Wood as a Source of Human Food.
Probably no modern science presents a wider field for speculation than that of chemistry, and more es pecially, perhaps, that branch of the science which reats of organic compounds. Since the day when Wohler overthrew forever the notion that organic sub stances were exclusively the products of the operation of a so-called vital force by his discovery of the synthesis of urea a great number of bodies, hitherto ob en or fully built up, as the result of a careful and most minute study of their exact nature. The discovery of the preparation of substances by artifice, more particularly the dyes, has, as a matter of course, influenced very considerably home and foreign industries. What shall be said then, when che mistry promises to solve hard problems of political and social econo my? In an ad dress delivered at Heidelberg, by no less eminent an authority than Victor Meyer, it is announced that "we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food." What an enorm ous stock of food then, will be found, if this be comes possible, in the wood of our forests, or even in grass and straw.
The fiber of wood consists es sentially of cellulin, $\mathrm{C}_{6} \mathrm{H}_{10} \mathrm{O}_{5}$. Can this be made to change int starch? Starch has exactly the same percentag composition, but as every one knows, it differs very much in it properties, and the nature of its molecule is prob ably much more complex. Cellulin is of little or no dietetic value, and it is not altered like starch, in boiling water. It readily gives glucose when treated with strong sul phuric acid, as is phuric acid, as is when cotton wool, which is practically pure cellu lin, is merely im mersed in it Starch gives the same product when boiled with weak acid. The author further quotes the researches of Hellreigel, which go to show beyond dispute that certain plants transform atmospheric nitrogen into albumen, and that this process can be improved by suitable treatment. The production, therefore, of starch from cellulin, together with the enforced increase of albumen in plants, would, he adds, in reality signify the abolition of the bread question. It must be borne in mind, however, that theory, fascinating and promising though it may be, is not al ways capable of being followed up by a practical result.-Lancet.

## Crystallography

If sodium sulphate be allowed to crystallize (New Idea) between plates of unglazed porcelain in the open air, and if the crystallization be reproduced two or three times by sprinkling with water, the plates fall to powder. The same phenomenon is observed with very hard stones. This crystallization may be the cause of the comminution of rocks which resist water.

Patent Legislation.
The Engineer thinks it would interest the public what manner of men they are who are always for tinkering the patent laws. There doubtless never was anything made by man that could not be mproved by some other man, but it is good sometimes to let well enough alone, and it is difficult to see where in the present patent laws could be improved.
Among a number of bills relating to patents, one proposes to change the lifetime of them from seventeen to seven years, and another provides that any patent hereafter issued may be canceled by special act and the payment to the inventor of not less than $\$ 50,000$ nor more than $\$ 100,000$, with authority for Congress to rant a further allowance to the inventor of the amount expended by him in perfecting his invention.
The Engineer proposes a bill which provides that the income of any person tinkering with the patent laws shall be permanently cut off, and he be confined in a lunatic asylum for life.

A RUNNING-BOARD FOR THE TOP OF CARS.
The illustration herewith represents a construction designed to prevent a brakeman or conductor from falling off the cars when operating the brakes from the top of a car, and also provides a running-board on each car adapted to closely approach a similar board on an opposing car, affording safe passage from one car to the other. This invention has been patented by Mr. Francis W. Pool, of No. 57 East Tenth Street, St. Paul, Minn. The board, at each end of the car, has projecting extremities wider than the body portion, to afford an easy and safe footing, these ends being stayed or strengthened by suitable brackets, and at the sides of the board are uprights supporting guard rails extending from end to end of the car. There is also a skirting rail near the bottom, so that the feet of one on the board will not be liable to slip outward. A transverse gangway of similar construction is likewise pro-


POOL'S RUNNING-BOARD FOR CARS.
vided for at each end of the car, to intersect with the running-board,

## THE MUMMY CATS OF BENI HASSAN.

A curious consignment of goods was received at London a few weeks ago, consisting of no less than 180,000 mummy cats from Egypt. These cats have lain in their sacred burial place at Beni Hassan for 3,000 years or more, and after having fulfilled for so wany centuries the destiny intended for them, have at last, under the impulse of nineteenth century progress, heen sacrificed upon the altar of "utility"-that modern all-devouring ogre. These mummies are now about to fill their finai function of fertilizing English farm land, and at the future resurrection poor pussy will have a sorry time trying to gather together her scattered bones.

We give sketches of four of the heads of these extraordinary objects, for which we are indebted to that new and energetic newspaper the London Daily Graphic. The English farmers are indebted for this excellent lot of twenty tons of manure to the lucky accident which befell an Egyptian who, while digging, fell into a pit which proved to be a subterranean cave completely filled with mummy cats, each one filled with mummy cats, each one
being separately embalmed and wrapped up after the usual fashion wrapped up after the usual fashion
of Egyptian mummies. Pussy of B.C. 2000 was a sacred object to a section of the ancient Egyptians, and when a cat died-as even a cat eventually must-it was buried with as much honor as any human being. The finder having reported his discovery, laborers were soon at work,

mummy cats recently discovered in egypt.
and turned out tens of thousands of the mummies. main field between Tipton and Kokomo, near SharpsSome were taken by the farmers of the place, others ville. Whether it is continuous with the productive went to a merchant in Alexandria, who shipped them area at Sheridan and that north of Noblesville has not to Liverpool, where another merchant, a local fertilizer, bought the consignment at $£ 313 \mathrm{~s} .9 \mathrm{~d}$. a ton. The auctioneer, adding insult to injury, knocked down the lot of 180,000 cats with the head of one of them as a hammer. To such base uses have the gods of Egypt come!

## OVED CANE MILL

The accompanying illustration represents a roller cane mill designed to obviate the use of the bridge or


## HATTON'S CANE MILL

knife placed between the two lower rollers of the ordinary mill, and to relieve the main frame of, the mill from pressure and danger of breakage. The invention has been patented by Mr. Joseph E. Hatton. The check frames are merely supports for the rollers, and the wain top roiler stands immediately above the lower or bagasse roller, while the front or cane roller is so arranged that its axis is on a line with the meeting surfaces of the other two rollers. In this way the second bite or crushing action is at a lower level than the first bite, the partially crushed cane dropping naturally upon the surface of the lower roller, and being carried over it without the use of a knife. To take the strain of the rollers, four resistance frames or yokes are employed, one on each side of each of the cheek frames, ployed, one on each side of each of the cheek frames,
these yokes being each formed with journal spaces these yokes being each formed with journal spaces
arranged obliquely to each other, so that the journal spaces of the yokes coincide with the spaces of the cheek frames. The journal blocks for the shafts or gudgeons of the rollers are placed in the bearing spaces of the cheek pieces and resistance yokes, and upon each block is an adjusting plate, these plates having no connection with the cheek pieces, but only with the resistance yokes, which take the entire strain of the rollers, the cheek pieces acting as mere supports and not as working elements of the machine. In case of breakage, the yokes are easily and cheaply replaced.
For further information relative to this invention
address Mr. J. E. Hatton, care of Messrs. Hatton \& Macias, St. Domingo City, Island of St. Domingo West Indies.

## Indiana Gas Lands.

The number of square miles of productive territory in Indiana, where gas is found in paying quantities, is about 2,500 . Of this 2,500 , probably 300 square miles. the southern prolongation mostly, wust be considered as moderately productive, leaving 2,200 square miles of good territory. A small productive area has been found near Brookville, Franklin County, though its connection, if any, with the main field has not been determined. Quite productive territory has been ound to the southeast of Winchester, Randolph County, though how far it extends in that direction has not been determined. Lynn, a small town south of Winchester, has also secured gas in paying quantities. The swell in the Trenton limestone near Kemp ton, in Tipton County, has proved quite extensive and prolific of vigorous wells. It is connected with th been determined as yet. Small areas have been discovered at Eagletown and Carmel, in the southwestern part of Hamilton County.-L., H. and Power.

A Water Route from Alabama to Pittsburg. A Sheffield (Ala.) dispatch, February 17, says Sheffield to-day celebrated the first shipment of iron from Alabama to Pittsburg by barges on the Ten nessee and Ohio rivers. The present shipment is 5,000 tons, taken by nine barges, which are towed by the steamer Percy Kelsey. The rate of freight is $\$ 2.50$ per ton, which is so much less than the rate by rail that it affects the iron trade of the whole country. It is expected that arrangements will at once be made to market the entire product of Sheffield's five furnace by this route.

## AN IMPROVED CAR BRAKE

The accompanying illustration represents a car brake in which the brake is arranged to be applied directly to the axle instead of the wheel tread. The invention has been patented by Mr. William Brunquest, of Menominee, Mich. Fig. 1 is a side view of a car provided with such a brake. Fig. 2 being a sectional and Fig. 3 a perspective view, showing the brake mechanism. In a casing arranged for connection with the car floor are bearings in which are mounted rollers with eccentric faces, between which the car axle passes there being arranged in connection with the rollers an endless chain or belt engaging teeth in the peripheral face of the rollers. All of the chains or belts of the several eccentric rollers are connected by an operating chain with the brake staff, by revolving which the rollers will be turned to bear hard upon the axles, to check their rotation. To throw the eccentric faces of the rollers out of engagement with the axles, a second


BRUNQUEST'S CAR BRAKE.
chain is employed, running on the opposite side of the rollers, and also connected with the brake staff, by urning which in an opposite direction the axles will be freed from the pressure of the eccentrics.

## Proposed Swiss Mountain Railway.

A project for a railway to the summit of the Jungrau, which rises to a height of about $13,670 \mathrm{ft}$., has latterly assumed a more tangible shape. Two designs have been proposed, one by Mr. Moritz Kochlin, at one time connected with the building of the Eiffel tower and the other by Mr. Trautweiler, engineer of the St. Gothard and Brunig railways. The first is understood to have received the most favorable consideration The mountain line proper will be about $31 / 4$ miles long This section is to be built either on the rack system of the Mount Pilatus Railway or it is to be divided into five sections of cable line worked by water power. At the end of each of the sections the passengers will be transferred to a car on the succeeding section. A reservoir on the summit of the mountain, supplied by a series of pumps at different levels, is to furnish the required water power. Mr. Trautweiler's design provides for an underground line over the whole mountain section, thus seeking to avoid climatic difficulties. There are to be four sections of a large pipe conduit, and the power is to be furnished by means of a cable. To drive this compressed air is to be used instead of water power. Mr. Kochlin's estimate of the cost of building the line is $390,000 \mathrm{l}$., while Mr. Trautweiler's estimate foots up to 230,0007 .

## The Manitou and Pixe's Peak Cogwheel Railway. red. r. hastings.

On the 24th day of last September a faint blast reverberating down the rocky sides of Pike's Peak announced to the world that the "Peak Railroad" was no longer a fancy, but a fact. Eight hundred men and one hundred and twenty teams of horses and mules were set at the work of constructing the roadbed. All provisions, tools, and camping outfits were transported to the camps along the line on the backs of mules and burros by trail. None but those familiar with the Rocky Mountain region can form an adequate conception of the enormity of the work. The precipitous cliffs of solid granite, the deep canons and ravines, the snow fields of great depth, seem obstacles set by nature never to be surmounted by man. Yet to-day the roadbed is completed, except one mile of the line on the summit, which will be left until after the spring thaws. The work was commenced near the summit in the fall and continued downward, so as to escape the great severity of the winter in such an altitude.
The road will be operated by the Abt cogwheel system, and will be the only road in America of that system. The roadbed is 15 feet wide, increased to 20 feet through cuts, thus giving protection, in case of derailment, from more serious accident. There is to be no trestle work on the entire line, and all bridges will be constructed of iron. The culverts will be built of solid masonry, and placed wherever necessary to guard against washouts.
The track will be of standard T-rails, standard gauge, and laid on red spruce ties. The rack rail, laid in the center between the rails, will weigh 110 pounds to the foot and be laid in short sections, of which the cogs or teoth are cut with great precision.
The engines, built by the Baldwin Locomotive Works, will weigh about 35 tons, and be operated by cogwheels alone, there being no adhesion drivers, which are so placed as to gain every advantage from the weight of the engine. The double set of pinion brakes that work in the cogs can stop the train in ten inches, going either way, on any grade, and at the maximum speed, eight miles an hour. The engines will be powerful enough to carry three coaches.
The cars, built in Springfield, Mass., are designed to sit low, within 18 inches of the rails, and are not tilted with the grade, but built on the trucks, so as to bring the coaches level. The cars are not drawn, but pushed by the engine. One hundred and fifty people will constitute a train load. The trip from Manitou to the summit will take an hour and forty-five minutes; the down trip, half an hour less time.
The entire length of the road is somewhat over nine miles, and the elevation overcome between Manitou and the summit is about 8,000 feet, nearly 1,000 feet to the mile.
The maximum grade is 25 per cent, minimum 8 per cent, with an average grade of 17 per cent.
The company are considering the question of lighting the road by electricity, so the ascent can be made by night, and the sunrise be witnessed by passengers in the morning on the summit.
The road will be completed, in all probability, by next June, and will then represent more than half a million dollars.

A fuller, illustrated article will appear at a later date, on the road.
It may be of interest to note the following list of the cogwheel lines of the world :

| Location. | When built. | Ascent. |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Mount Washington. | 1866-69 | 1 ft . in $2 \cdot 67 \mathrm{ft}$. |  |  |  |
| Vitznau-Riga. | ... 1870 | 1 | " | 4 | . |
| Kahlenberg-Vienna. | . 1872 | 1 | " | 10 | " |
| Schwahenberg-Pesth. | ... 1872 | 1 | " | 10 | " |
| Arth-Riga....... | ... 1874 | 1 | " | 48 | " |
| Rio de Janeiro.. | ... 1882 | 1 | " | $6 \cdot 6$ | " |
| Drachenfels to Rhine.... | 1883 | 1 | " | 4.5 | " |
| Pike's Peak and Manitou | ... 1890 | 1 | " | 4 | ${ }^{*}$ |

Improved Treatment of Ores.
by e. b. parnell
The quartz or other ore is first heated to a fair red heat in a suitable furnace, and then immersed in its heated state in water. The result is that the ore becomes so softened that it can be crushed by rollers with great ease. A form of apparatus that may be employed to heat the ore consists of a horizontal tube, through which the ore is propelled by a helical revolving screw mounted upon a hollow shaft. Into this tube, through perforations in the hollow shaft, is drawn air which has been previously heated by any suitable furnace. At the time the ore reaches the end of the tube i.t becomes sufficiently heated by the air, and is discharged vator to a second tube, which is similarly constructed to the first, and has passed through it the air proceedto the first, and has passed through it the air proceed
ing from the first, for the purpose of drying the ore. The ore is delivered from the last tube into the hopper of the rolling or other machine. Instead of discharg ing the ore from the first tube into a tank of water as above described, the ore may be discharged on to an end less band, which would carry the ore under a shower of water and into a suitably constructed oven before finally dropping it into the hopper of the rolling mill.

## Paste and Glue.

In the Photographic Times Mr. W. H. Gardner collects together a number of formulæ of various mount ants, of which we give the following :

GELATINE mountant (no. 1).
Cooking gelatine................................................................... 10 ounce.
Alcounces. 95 per cent......................2 to 1 ounce.

Soak gelatine in cold water for an houror more, take out and drain off all the water which will go, add to alcohol in wide mouthed bottle. Add one-half to one ounce of glycerine, according as gelatine is of a hard or soft kind. Put bottle in hot water, with occasional shaking until gelatine is quite dissolved. Will keep indefinitely, and has only to be heated up when wanted for use.

ANOTHER (No. 2).

| Water. $\qquad$ 16 |
| :---: |
|  |  |
|  |  |

Glycerin
Dissolve the gelatine in the water, then add the glycerine, and lastly the alcohol.

PERMANENT PASTE (No. 3).

| Arrowroot. | 10 parts. |
| :---: | :---: |
| Water | 100 |
| Gelatine. | 1 part. |
| Alcohol. | 10 parts. |

Soak gelatine in the water, add the arrowroot which has first been thoroughly mixed with a sinall quantity of the water, and boil four or five minutes. After acid.

## ANO <br> Best Bermuda arrowroot ........... Sheet gelatine or best Russian glue. Water <br> Water.

Put the arrowroot into a small pan, add one ounce f water, and mix it thoroughly up with a spoon. or the ordinary mounting brush, until it is like thick cream then add fourteen ounces of water and the gelatine broken into small fragments. Boil for four or five minutes, set it aside until partially cold, then add the methylated spirit and six drops of pure carbolic acid. Be very particular to add the spirit in a gentle stream stirring rapidly all the time. Keep it in a corked stock bottle, and take out as much as may be required for the time, and work it up nicely with the brush.

Starch Paste (no. 5).
Pour cold water on good laundry starch to barely moisten it. Then stir in boiling water until proper consistency is reached. Squeeze through canvas if not free from lumps. Starch paste should be freshly made for each batch of prints.

## ANOTHER (NO. 6).

Allow four parts by weight of hard gelatine to soften in fifteen parts of water for several hours, and then moderately heat until the solution is quite clear, when 65 parts of boiling water should be added while stir ring. Stir in another vessel 30 parts of starch paste with 20 of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling gelatine solution should be poured while constantly stirring and the whole kept at a boiling temperature. When cool, add to the whole ten drops of carbolic acid to pre vent souring. This makes a very tenacious paste.

CASEIN muCilage (no. 7).
Heat milk with a little tartaric acid, whereby casein is separated. Treat the latter while still moist with a solution of six parts of borax to one hundred of water, and warm gently while stirring, which will cause the casein to be dissolved. Of the borax solution enough should be used to leave only a little undissolved casein behind.

Good mounting paste (no. 8)
Add to $250 \mathrm{c} . \mathrm{cm}$. of concentrated gum solution (2 parts gum to 5 water) a solution of one gramme sulphate alumina in $20 \mathrm{c} . \mathrm{cm}$. water. (Alum does not answer the purpose as well.) The addition of the sulphate is ef ective, in that this gum is not so readily softened by moisture, and, besides, wood can be fastened to wood by means of it. Its adhesive qualities are, in general, greater than those of pure gum arabic.

## IMPERVIOUS PASTE (NO. 9).

Soak ordinary glue in water until it softens, remove it before it has lost its original shape, and dissolve in ordinary linseed oil on a gentle fire until it acquires the consistency of a jelly. This paste may now be used or all kinds of substances, as, besides strength and hardness, it possesses also the advantage of resisting the action of water.
thin mucilage (no. 10).
A paste that will not draw engravings when pasted down on paper must be thin. A mixture of equal parts of gum tragacanth and gum arabic forms with water a thinner mucilage than either one alone.

LIQUID GLUE (NO. 11).
With any desired quantity of glue use ordinary whisky instead of water. Break the glue in small frag
ments and introduce these into a suitable glass vessel, and pour the whisky over them. Cork tightly, and set aside for three or four days, when it will be ready for use. The whisky must not be too strong, and a little heat is generally required.

ANOTHER (NO. 12).
Same as above, except that acetic acid is used in place of whisky, and that the bottle containing ingredients must be placed in hot water to dissolve the glue.

## Glue.......... Water...... Nitric acid.

ANOTHER (NO. 13).

Dissolve the glue in the water by immersing vesse containing same in hot water. When solution is effected, add the acid. Effervescence will take place with the evolution of orange nitrous fumes. Now cool. It should be kept in a well stoppered bottle, and will re should be kept in a well s
main permanently liquid.
As regards the formulæ collected by Mr. Gardner, we may remark, says the Photo. Review, that of the above Nos. 13, 12, and 9 are quite unfit for mounting silve prints, although they may be useful for other work in the studio ; Nos. 12 and 13 for cardboard and light wood work, where the presence of acid is not likely 10 be detrimental ; and No. 9 (which is really an emulsion of glue and linseed oil, and requires well beating together) for cementing articles likely to be exposed to damp. Strips of cloth used to make the developing room light-tight may well be cemented with No. 9, es pecially if ten grains of finely powdered bichromate of potash be stirred into each ounce just before use.
The desirability of employing Nos. 7 and 8 as mount ants for silver prints is open to doubt, although these are excellent for cementing all such ordinary material as come under the denomination of "stationery."
We thus have left adhesives Nos. 1, 2, 3, 4, 5, 6, and 10 as quite safe for silver prints if good materials are used, and do not become decomposed subsequently Gelatinous mountants made with a considerable pro portion of alcohol, like No. 1 or No. 11, have the ad vantage of not considerably stretching either mount or print, and are especially useful when prints (whether silver or Woodburytype) have to be mounted on thin card as book illustrations. In the case of Nos. 2, 3, 4 the alcohol is used mainly as an antiseptic, and is not present in sufficient quantity to have wuch influence as a preventive of stretching or cockling. The simple starch paste, No. 5, is not satisfactory in all instances, owing to want of sufficient adhesion, in which case it is an excellent plan to adopt No. 6, in which starch and gelatine are used together.

## An Oil Gas Lamp.

An ingenious modification of the oil gas method has been adapted by Mr. Gilbert Robinson, of Elland, in the design of a high power lamp of the Lucigen class, for outdoor purposes. The object of this new variety of the order of lamps that have seriously interfered with the prospects of the el ectric arc lamp for a variety of purposes, is the abolition of all outside mechanical appliances for generating the light. Pressure is re quired, of course, and this is obtained by confining the gas produced from a portion of the liquid hydro carbon combustible exposed to the heat of the flame for this purpose. The lamp is thus made independent of pumping, air-compressing machinery, etc., and only needs to be started by making the burner hot with the flame of a handful of oily waste burnt in a receptacle provided for the purpose. The oil is then turned on, and the lamp works automatically until the reservoi is emptied. This simplicity of principle permits of simplicity of design. The gas-making portion of the amp comprises a tube in which the oil is exposed to the heat of the flame. When the gas is made, it is divided into two currents-one going into the top of the reservoir, to force the oil out into the carbonizing tube; the other going to the jet, whence it issues, afte a few minutes' working, at a pressure of 20 lb . It is thus oil gas that is burnt; and the maker calculates that by this means a light of 3,000 candles can be obtained at a cost of 2 d . to 3 d . per hour, according to the facilities for obtaining the common oil required.

Scratching the Back for Intermittent Fever
Dr. Alois Fenykovy communicates to a Vienna nedical journal an account of some observations made on the treatment of intermittent fever by means of friction of the back along the spine. Many years ago, as stated in the Lancet, while at Nisch with his regiment, there occurred so many cases of intermittent fever that the stock of quinine was becoming ex hausted, and, in order that the patients might not be entirely without some sort of treatment, it was ordered that they should be rubbed twice a day along the spine with simple ointment. The day after this order had been given, it appeared that the usual attack had not come on. Accordingly, since that time Dr. Fenykovy has very frequently employed this treatment, and usually with marked success. Indeed, he says that three-fourths of his cases have done very well without any quinine at all.
recently patented inventions. Engineering.
Compound Engine. - John Riekie, Lahore, India. This engine has two high pressure cylinders and a low pressure cylinder arranged be-
tween them a a port leading from the steam chest to tween them, a port leading from the steam chest to
each high pressure cylinder, and two ports leading to each high pressure cylinder, and two ports leading to
the low pressure cylinder, with various novel features, the low pressure cylinder, with various novel features the design being to exert equal power on the crank
arms at all grades of expansion, and have the com pounding on each crank separately.

## Electrical.

Lamp Adapter.-James Stewart, New York City. This adapter is formed of a button of in sulating material surrounded by a screw-threade eripheral band, a ring being embedded in the butto and connected electrically with the band, while a cen tral stud is provided with a contact piece, in order that
lamps of different kinds may be adapted to lamp mpe or not made for them

## Mechanical.

Transmitting Motion. - John N. everance, Boston, Mass. This invention covers stopping the some positively in a given position, auto matically at each revolution, when necessary or when desired by the operator, the stop motion being of great
strength and durability, and the device being applicable trength and durability, and the device being applicable to all kinds of mach.
Pipe Cutter. - Timothy Byrne Bloomington, Ill. This a machine specially designed or cuttiug pipes from the inside, where the exterior
face of the pipe cannot be conveniently reached, and has a frame with a slotied hub, a cutter carrier formed conical aperture, while a feed sprew with a having a conical aperture, while a feed screw with a con

## Agricultural.

Hay Rake.-Henry L. Banta, Canon City, Cal. This is a rake whohing ree und ere as elf-dumping or a hand dumping rake, and each toot eeth will be allowed to spring up over stones and othe light obstructions and will then be pressed down aga in contact with the ground
Harvester Reel.-Ludvig Peterson, achment comprising a ratchet wheel secured on the shaft of the reel and a spring fastened at one end to a lever for adjusting the reel, ard at its other end engag ng the teeth of the ratchet wheel, to prevent the ree from turning backward and throwing the grain into machine.
Cultivator. - Frank A. Ruggles, hree Rivers, Mass. Combined with a slotted fram and a series of cutting disks mounted in the arms, making a hand implement especiully adapted for garden use, and which may be used as a
cutter and culti vator combined.

## Miscellaneous.

Turning Telegraph Pins.-William W. McNeal, Stockton, N. J. Combined with revolving carrying center pins and mandrels, the latter revolved by the belt when the blocks carried by them and the center pins approach the cutters, making a simple machine designed to turn out a large number of pins in a short time.
Cigarette Machine.--Louis Josselin, New Orleans, La. This is a machine of a width equal
to the length of two or more cigarettes, and is desiyned o the length of two or more cigarettes, and is designed to quickly roll and seal the tobacco in the wrapper, and cut the cigarettes to the proper size, the invention covering
Coin Operated Machine. - Peter Schneider, Brooklyn, N. Y. This machine has a coin mechanism for automatically delivering one cigar at time, so that when a particular coin is deposited the device may be operated by hand to release the cigar deposit the coin, and relock the cigar delivery mechanism, for automatic cigar selling.
Explosive Staff.-William L. Heiskell, Indianapolis, Ind., and Francis E. Drake,
Columbus, ohio. This is a device adapted for employent in conne. with theatricals and tableaux, etc providing a staff carrying a trident or spear, with a firing attachment for exploding cartridges, so that the
ash may be rendered visible if desired.
Educational Appliance.-Franklin E. Meyers, Garrett, Pa. This is a movable figure arithmetical chart to facilitate the teaching of addition,
and consists of a framing with figured slats adjustable longitudinally, whereby the figures at one end of each of the slats may be brought successively into register with each of the figures on the other slats, the construction being readily taken down and packed in small space for storage or transportation.
Pencil Sharpener. - Frank Dunworth, New York City. This invention consists of a
staple-shaped knife adapted for insertion in the edge of staple-shaped knife adapted for insertion in the edge of clined bow section with a lower cutting edge, whereby in contact with the device
Рhoto Negative Bath Dish.-John R. Moeller, Grand Island, Neb. This is a dish with the lower end of the end ribs, and a corrugated parti-
tion, to support a number of negatives in a single dish o that they will not bear against each other, whil

Draught Equalizer. - John L owle especially designed for grain harvesters or binder three horses taking the draught from the inside nex the standing grain and the other horse on the opposit side of the pole taking the draught from the outside he invention being an improvem
Self-Oiling Axle Bearing.-Jame . Patten, Balimore, Md. This bearing is especially esigned for all kinds of vehicles, and consists of a
xle having a sliding rod working in a groove in th ale hang a sliding roetwo tho aroove in th he end of the bearing surface of the axle to an oil chamber, the rod being connected with a cam groove in he face of the axle box to pump the oil from its chamer and diffuse ic over the face of the axle bearing.
Baling Press. - Andreas Mattijetz, Giddings, Texas. The construction of this press is such that at each reciprocation of the plunger at one
side in the follower chamber for the introduction of side in the follower chamber for the introduction of he material to be baled, which is held from any retro grade movement, while the size of the baling chamber s adjustable, and the press and the power e
connection with it are readily transportable.
Coiled Wire Brush. - John B. hristoffel, Brooklyn, N. Y. This is a flexible bru or cleaning flues, tubes, etc., and consists of two o
more twisted wires and one or more spring wires colle around the twisted wires in spiral shape to form a cylindrical brush with tapering ends, the inventio being an improvement on a former patented invention
,
Well Boring APParatus. Lawrence V. Elder, New Orleans, La. This invention onsists in providing the well pipe with a temporary
coupling device for the saccessive sections longitud nally movable on the pipe from one section to the ther without the necessity of removing the couple hereby the sections may be added more expeditiously.
Rock Drilling Machine. - Jacob Irgens, Palisade, South Jakota. This is a machine
adapted to be operated by hand or other power, having a rotary shaft mounted in a vertically adjustable hammers pivoted to the arm, a frame supported from the carriage carrying the drilling tool, and other nove features, designed to afford a simple, durable, and ver
,
Means for Propelling Vessels.hraham Heuman, New York City. The main crank hips on which is a walking journaled athe hatt mat carrying side wheels, and to this shaft are geared tho parallel propeller shafts carrying screws at the rear he vessel, which is thus provided with both systen
Lumber Kiln.-Andrew T. Anderson LUMBER KILN.-Andrew T. Anderson
Trinity, Texas. This is a kiln constructed with special Trinity, Texas. This is a kiln constructed with speci prevent their escape into the chamber containing the umber, the fuel chamber having small perforations for he passage of products of combustion, above which is a primary combustion chamber, adjacent to which 18
final combustion chamber having exits near its bas anal combustion chamber having exits near its bas
Furniturf Polish.-James M. Hall Curtis Morris, and Willie S. Hamilton, Ritchie Cou Iouse, West Va. This is a polish containing certai proportions of different ingredients designed to equal ine varnish in important particulars, yet cheaper a temperature without blistering or cracking, there being m.ong the ingredients linseed oil, turpentine, copal
varnish, alcohol, muriatic acid, olive oil, etc., in pro portions specified.
Hat Hanger.-Joseph Massey, Far trip having suitable supports beneath of a thin meta and extending from end to end or side to side, following he crown, with a spring-actuated hanger pivoted hereto, its end having a spring or loop, the device sup-
Suspender.-Jacob Katzenberg, New York City. This is a combined suspender and shoulder brace, and has a back heart piece with two suspende and their front suspender ends, with straps to go under the arms, transverse straps, and an adjustable vertical

Shoe Lacer. - Abner C. James, Pomona, Cal. This lacer has a stop and a lip at its
respective ends, with a flexible metallic strand incorporated in the lace between its tip and middle portion, the netal strand being of a length to be bent back and Wash Boiler. - Lyman I. Burbank Wh Charles Nippert, Ashland, Wis. This invention is an improvement in that class of boilers which have a a circulation of water downwardly through them, the water after being heated rising through sid
Washing Machine. - Levi J. Mont omery and Clark P. Townsend, Broken Bow, Neb. This invention relates to an apparatus whereby clothes ing and in which circulating hot water and steam are atilized to insure a quick and thorough cleansing of the thes without injurin
Clothes Pin. - Edmund H. Turner, Fergus Falls, Minn. This is a wire clothes pin formed
of a single piece, having the end of the wire provided with interlocking eyes or riil ge, and having curved ends to slide upon the line, and downwardly and inwardly
curved sides to clasp the clothes line and hold a gar-

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and. The fourth volume includes his treatise on the English Constitution, two essays on Parliamentary Reorm, and a series of chapters on "Physics and Poliics," which title would be more appropriate to the subject, perhaps, were the first two words omitted. The fth volume contains three works, "Lombard Street," " International Coinage." and "Depreclation of Silver." very complete index covering 45 pages is an invalua and the labor expended on them by the author make the work authoritative within its scope. To all who enjoy the detalled study of English literature, statesmanship, and political economy, these books may be
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3. Residence of Mr. Woodruffe, Tompkinsville, N. Y Perspective and floor plans.
A cottage at Stuyverant Place. Staten Island. Cost $\$ 11,000$. Plans and perspective elevation
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11. A residence at Binohamton, N. Y.. ere
of $\$ 7,800$. Plans and perspective.
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## 4fuctukuris

HINTS TO CORRESPONDENTS.
Names and Addrese must accompany all letters,
or no attention will be paid thereto. This is for our
infor

(1924) B. F. A. asks: In the magnetic telephone described page 374. vol. 67, how is the party at A battery or magnetic call may be used.
(1925) A. La F. asks how to find the chord of a segment, given area of segment and the equal to the length of the arc in terms of the radius multiplied by $1 / 2$ radius. This gives the length of arc By dividing the length of arc by $\pi(3 \cdot 14159+)$ and multiplying by 360 we get the degrees of the arc. which may be carried out to minutes and seconds. From a table of
circular functions we tind the sine of half this arc. This circular functions we tind the sine of half
function multiplied by 2 gives the chord.
(1926) W. B. H. asks : Is there anything I can apply to whitewash (contains no glue) to loosen
it, so it can be scraped off the board lining of a buildit, so it can be scraped off the board lining of a build-
ing? A. A weak acid is the only thing we can suggest. Even then the remedy might be worse than the disease produced.
(1927) H. P. L. asks: What produces the letters that you may see by holdiug a sheet of fools metal pattern upon the wet pulp before it sets. Somethey are due to unequal thicknees of either case. 2. Give some authority which has the nearest practical perpetual motion machine explained
A. There is no "nearest practical perpetual motion $m$ a chine." We refer you, for the history of attempts to produce perpetual motion, to Dirck's "Perpetual Mo-
tion," slo. We have some copies, but the work is out tion,", $\$ 10$.
of print.
(1928) G. H. H. says : Please inform me at your eari iest convenience who was the originator of
the horse bso. A. The feet of horses were protected by leather boots to keep the hoof from spitting and
chipping while on people, as carly as the times of Aristotle and Pliny These boots were sometimes shod with metal. The
mules of Nero were said to be shod with silver. Homer
 mentions "brazen-footed steeds." Iron shoes nalled to
the hoof were first mentioned in the works of the Empero Leo in the 9 th century, and were introduced int England by William 18t, about 1688.
(1929) C. M. H. writes : Is there any chemical that will remove ink from paper withoul
affecting paper! A. Oxalic acid, tartaric acii, or some bleaching agent such as javelle water is generally used
for the above purpose. They inevitably affect the pape to some extent. The best plan is to apply them with camel's hair pencil and to carefully blot off and after-
ward to wash with water applied repeatedly in small ward to wash with water applied repeatedly in small
quantity and blotted off with ciean bloting paper. . Restrict he irrst application to the ink spo
(1930) H. J. T. asks: 1. Is there such a thing as a cloth or fabric woven of glass? If so, where
is it made? Is eaid material sufficiently flexible to fit it for practicial use? A. Such cloth has been woven from
spun glass, but never so as to be much more than a curiosity. It will inevitably be fragile and liable to
(1931) M. S. asks: 1. What chemicals are used for fluxing steel castings in melting? Also
what proportion and what irons are used in making soft steel castings? What chemicals, if any, are used in the annenling of eteel castings? A. For fluxing stee
in the crucible use borax, calcined soda, and pulverized charcoal thoroughly mixed, equal parts. Use scrap cast
and wrought iron in proportions which you will have to decide by experiment. With a good clear neutral flame
(1932) P. E. M. writes : Please inform me what it is that is used on the finger (if anything) in making a musical sound by rubbing the finger tips on
top of tumblers or goblets? A. It is sufficient to wet the finger occasionally by immersing the tip in wate Resin may be used, but is not necessary.
(1933) R. F. M. writes: 1. What kind of silk is best for making a small balloon about 3 feee
diameter, or is there any kind of cloth that would hel the gas? A. Use thin pongee silk varnished. There is no cloth made that will answer without varnishing.
Silk is not necessary. See our SUPPLEMENT, Nos. 24 Silk is not necessary. See our Supplement, Nos. 24 .
and 726 , for articles on the subject.
2. Will illuminating gas do? A. Yes. 3. Send me theaddress of some gineering. A. Lehigh Universty, Bethlehem, Pa.
(1934) L. B. H. asks: 1. What is the most economical appliance for saving the sulphuric
acidarising from the burning of copperas, and which can be applied to a furnace at present in use for making from one hundred pounds of copperas. A. Condense in a leaden worm. About 67 lb . of acid will be yielded by 100 lb. of copperas. 2. What should the resistance of a telephone receiver be? A. From 100 to an0 ohms.
3. Is it necessary that the coils of single silk-covered No. 4 Where can I get a descrintion of Editan' No. 4. Where can I get a description of Edison's carmitter? Also, is it as good receiver so Bell's? A. We know of no such instrument in use.
(1935) R. T. R. asks : Can I use manufactured ice in a soda water apparatus? 1 am told
some chemical reaction takes place, which causes the metal pipes to corrode, and burst, perhaps dissolves
them. A. You can use it with perfect safety. It will
(1936) R. C. R. asks: Why does a tin is compressed or squeezed flat, or otherwise out of it regular shape? In other words, it loses part of its cubic
contents when you force its sides together, but the surface area of the inside of the vessel remains the same. exemplified in the fact that of all figures of equal perimeter, a circle incloses the largest area. It is proved (1937) E. C. says : I have made a pure copper roller C . good, sound casting? This roller is used for wringin and drying acids out of the cotton. A. It is a very
difficult matter to make good, sound castings from pure copper, that will not show a spongy surface whe turead off. By anding per cent tin you will make the
metal flow free and at lower temperature. The metal should not be boiled, or overheated, which is a cause of sponginess. The manner of pouring should also be
arranged by gating down the side for bottom filling. placing the mould at a low angle, so as not to carry a
(1938) P. R. A. asks: 1. What is the best way to color a meerschaum pipe, and what is the
active agent that produces the color?
A. Smoking obaco in it; the empyreumatic oils absorbed by the meerschaum color it. 2. Is it true that burning a pipe
prevents subsequent coloring? A. This will to some prevents subsequent coloring? A. This will to some What is the process for bringing out and making the

## into melted wax, and should be continually polished or

 bbed with a silk cloth.(1939) J. I. asks: Can you tell me what will take ink etains out of a Turkish rug? A. W
hesitate to recommend anything, as oxalic acid might injure the rug. Javelle water might answer, but there would be the same risk. Washing with plenty o
water, squeezing up with a spoon, followed by bloting might help.
(1940) S. G. G. asks for explanation of the chemical action of eiliceous waters that petrify wood. A. The wood slowly decayed, and the silica by
evaporation of the water or change of the temperatur or other condtitions gradually took its place. No
(1941) C. H. \& A. write : I noticed in an exhibition a man who, upon touching some one of have heard later that tio. 8 was produced by the party bathing his hands in some kind of liquid. If this b
true, can you kindiy inform me what is the nature o this liquid? If not, how is the effect brought about A. The man may have stood upon a metal plate insu-
lated but in contact with an excited electric machine or nduction coil. The contact may have been made by wire or other equivalent means. The general condi-
tions are a fair insulation of the man's person and con tans are a arir insulation of the man's person and con-
tact with an excited prime conductor. No such solutact with an excited prime conductor. No such solu-
tion as you describe was used, as none exists. The tion as you describe was used,
exhibition is a well known one.
(1942) M. J. B. asks : Can the tempera ure of a refrigerator be reduced by any known che this are known, but they are only applicable to larg ettablishments. You will find a great many artificial ice and refrigerating processes described in our (1943) A. B. asks how to soften hard well water containing lime, so that it may be used for
sirup. A. If the hardness is due to bicarbonate of lime boiling or the addition of lime water, with standing will sof.
cured.
$(1944)$
(1944) O. C. McW. writes for some in remation as to the process of silvering mirror plates by
the nitrate of silver process. A. Various formulas are iven. The following is typical: Dissolve 10 grains of
itrate of silver in 1 oz. of water, add excess of stro ammonia, just enough to give a clear solution and to re dissol ve the brown precipitate which will frrst form in another bottle dissolve 10 grains Rochelle salt in 1 oz irst to one.third of the second solution. The glass ma Lave a little wall of beeswax made around it. A hall
our or more in the sunshine or in a warm place at 70 to $80^{\circ}$ should give a good silvering. The chemicals mus be pure, distilled water should be used, and the glas hould be scrupulously clean and polished. After the action has ceased, it should be washed and rubbed
gently with a little moist wadding if the outer or es is to be polished.
(1945) M. F. D. writes : Some time ago saw directions for reinking a typewriter ribbon with at removing it from the machine.by using a glie bottibeing reeled from one spool to the other. I have not seen any receipt for making suitable ink for this pur pose. Have you ever published such a receipt? A. Use
castor oil colored with
ayy desired aniline color pre viously dissolved in alcohol. If too thick, thin wit aicohol. See Scientrfic American, vol. 59, No. 21,
for an article on this subject.
(1946) B. L. J. asks: 1. How can I preent printed sheets, such as posters and labels, from
sticking together when printed with railroad red print sticing together when printed with railroad red print-
ing ink? Ihave great trouble with the red ink every hey stick. . have no trouble with any other color but he railroad red. A. Complain to the manufacturer of the ink. Possibly it needs thinning. 2. What kind of Ink can I use for inking type writer ribbons, that they
will rot dry so quick? I use copyng ink on will rot dry so quick?
muslin, but it soon dries; will not give up the color after 4 or 36 hours. Please state proper way to prepar
hem. A. See preceding query. 3. Please give me ood receipt for making a good cheap composition for inking rollers for cylinder printing press. A. For or-
dinarily fast. presses on book work, and for general dinarily fast. presses on book work, and for general
printing, or for inking tablete, use $101 / 2$ pounds best gline, $21 / 2$ gallons black molasses or honey, 2 ounce enice turpentine, 12 ounces glycerine. The quant ties of glue and molases should be slightly varied
according to the season-a and a little less in winter. If French glue is used, houla soak overnight ity of water, but most domestic glue will take up
unficient water in about two hours. The turpentin and glycerine should be added and well mixed just be ore pouring. To make what is known as the black composition, usea on high speed newspaper presser
there should be added to the above 1 pound of India tuber, cut in fine shreds, and dissolved in benzine The dissolved rubber should he mixed with the turpen tine and added to the composition the last thing hefore
pouring. the glycerine and vinegar being mixed with the lue and molaseser a short time earlier. 4. Also how make liquid glue such as binders use, and how can color it? A. Dissolv
nitric or acetic acid.
(1947) S. R. M. says : 1. I would like a receip to make a paste to fasten labels to new tin coal
oil cans that the oil will not loosen if it should get on label. A. Try gum tragacanth or dextrine. 2 . Will
he variation caused by temperature in a clock with iron pendulum rod beating seconds be the same as a clock beating four times one second with same kind of rod? Both clocks supposed to keep good time except
the difference caused by temperature alone. A. Theo. etically there should be a difference in the temperature ariation of plain pendulums of the eame material,
versely as their lengths. Thus a half second pendulum is but one-quarter the length of a one second pendulum,
its variation in length 1s but one-quarter asmuch and
ist beat is but one-half. Hence there should be less
ter ariation in the short pendulum clock from change of temperature. 3. What is what least percentage or solid gold? A. There is no lepal standard for the fine-
less of gold alloys for watches or jewelry. 4. What ness of gold a.lloys for watches or jewelry. 4. What
noes the word carat signify as applied to diamonds and oes the word carat signify as applied to diamond8 an
recious stones, and what is the letter used to abbreviat he word carat as used by jewelers? A. Carat onl signifes weight as applied toprecious stones, and is ab-
breviated as "C." or Ca. 5 . What does the word carat signify as applied to gold, and is the letter K. the pro per abbreviation? A. The fineness of gold alloys is expressed in parts of 24 as being pure, called carats.
harked $K$. from an old custom of spelling it with a $K$. 6. What is the proper abbreviation used for penny weight as used by jewelers? Some use dwt., some pwt.
I. Dwt. is the correct abbreviation. 7 . What is the arat of United States coin gold? What is the metal or cinil is about 22 carats fine, or 900 parts pure gold in ,000. 8. Is it proper to say zinc is the alloy used with
Copper to makebrass? A. Yes.
(1948) F. B. asks : 1. The size of cores (length and diameter) and size of wire and number of layers to give the best effect in a magnet working from
y cells gravity battery through $200-250$ feet of wire o. 18. A. Make your cores 4 inches long and $\$ /$ inc In diameter. WInd them with No. 24 wire, 34 pound th the hammer for a 16 inch gong. is there enough current? A. The current is sufficient. 3. Should the battery be Also give size of cores and winding for two cells parta motor battery. rated at 2 volts and 10 amperes each. A.
Same size cores. The wire on the magnet and the line ire should not be smaller than No. 12. This battery
 he books (and prices) from which I may learn the rudi mentary mathematics of practical electricity? Also oper mode of handing ecribing their construction tink "Experimental Science" will answer your pu
(1949) A. A. D. asks: 1. What battery is needed to run a surgical lamp of one-half, one, and wo candere power? Is a Leclanche battery of any valu running such lights? A. Three cells of Leclanch wit run a lamp of tis size or ten or fifteen minutes a The stronget primery batery the plunging bichromate. It has an E.M. F. of two volts, and when made very large has very little resist.
ance The Grove battery has an E. M. F. of over 19: olts The Grove battery has an E. M. F. of over 1 , $f$ the wires in electric bell work anything to do with he battery, that is, will a Leclanche cell ring a bell at
 the circuit increases the resistance of the circuit, necessitating an increase in the number of cells required to
(1950) G. D. H. asks (1) how census appointments are made. A. Address inquiries to Robert
J. Porter. Esa. Supt. U. S Census, Washington. D. C nd alsoapply to the representative of your district. How soon will the maps of 1890 be published? A. It is ncertain. 3. Can a piece of cloth or rubber elastic be nd ends? A. This can be done by hand on a trame from the size of 5 to 10 that can be used among we clothes for years without turning them black or soiling hem in any sape or manner? If so, has the wire much pring? A. Heavily galvanized steel wire will do this If the expense is not too great, German silver wire,
worth about 50 or 60 cents a pound, might be used. Either kind would be fairly elastic.
(1951) P. C. writes: A friend of mine lectric his honse piped for gas, but has decided to use hem in to run the wires through the gas pipe, but the ompany objected, saying the lights would not burn, and if they would it would not be safe on account of danger from fire. Now I think the lamps would brn all
right and there would be no danger from fire if he would connect the gas pipes with the water pipes, by a large that might get on to the gas. pipe would be distributed that might yet on to the gas pipe would be distributed
over the whole water system of the village, thus giving it such an extensive grounding as to render it harmless. Please tell us who is right. A. It is a common practice here to run wires for incandescent lamps through the pipes of lamp and gas fittures. We think there
conld be no danger in arranging the wires as you propose, but it might be obiectionable on arcount of the dififculty of getting at the wires for alteration or
(1952) W. J. asks what is understood by the technical term or word erg, and how applicable in
electrical science. A. It is the unit of work and energy in the C. G.S. system of units. It is the amount of work done by a force of one dyne exercised through the space of a centimeter. A dyne is the force which in one second would impart to a gramme an acceleration of motion of oue centimeter a second. An erg is equal to 981 gramme-centimeters, or 1,937 grain-feet, or 0.277
foot pounds nearly; 119,133 ergs per minute represent foot pounds near
one horse power.
(1953) Echo asks : Please name some of the simplest methods of producing momentum or sus-
tained motion, suitable for working clock without tained motion, suitable for working clock without
springs or pendulum. A. As motive power, weights, and barometer may be used. The opening and shutting of a door may be utilized. As a substitute for a regular pendulum the balance wheel is the only appliance used oo a great extent. The conical, the fyling, and the tor ion pendulums find some application. 2. What other sand or hour clasese and sun dials? A. The clepsydra water clock in many forms, burning candles, the
2. Are hour (sand) glassesmade in this country (America)
nd in any other than the customary form? A. Houl
. and in any other than the customary form? A. Hour
glasese are made abroad. The principal trouble is in
procuring proper sand. We cannot give the date you
(1954) S. F. J. asks if there is any nethod of restoring bad-smelling butter to its natura hurning and agitation with lime water. Hemlock twigs and otber balsamic leaves may be added also.
If the butter is thoroughly bad, there is little chance of aking it in
(1955) J. J. P. asks: 1. Can the disk Leclanche battery be used on closed circuit for any
lengh of time? A. Not more than a few minutes. A. No. 3. What make of accumulator is the best an most economical? A. Address the manufacturers for heses particulars. 4. Which gives the steadiest current A. hiere is iittle difference in this respect. 5. Is ion coil greater than that from the primary current
(1956) S. asks : Is an iceberg fresh or salt, and why? A. It 18 fresh. Icebergs are rrayments
of glaciers that descend npon the shores of the Arctic eas and break off from the main mass. They are not frozen salt water. Even if they were, most
would be removed in the process of frezing
(1957) J. F. asks what time it takes to send a cablegram from New York to Liverpool. provid-
ed the line is clear and no connections to be made. A. Three seconds upward.
(1958) Electric writes: 1. Given 10 cells ance taken as zero, external resistance at 5 ohms: Find connected in multiple arc. A. Connected in series the E . r. F. would be 20 volts; then by ohms' law $-=C ; \frac{1}{5}=4$ in peres, the strength of the current. When connected
in the same law. $\boldsymbol{f}=0 \cdot 4$ ampere. 2. Also is multiple (1959) H. I. H. asks : What will remove the coloring matter of postage stamps, postal cards,
etc.? A. An aqueous solution of oxalic acid is a good eneral reagent for bleaching colored paper
(1960) E. S. R. asks for the best way of vulcanizing rubber in the manufacture of rubber
stamps, and the method employed. A. The gum is mixed with sulphur and is heated in a steam vulcanizer pulation of india the mbourd. are givenin our SUPPIEMENT. Nos. 249, 251, 252
(1961) F. J. asks : How are stereotypes made from a printed page without the use of type? A.
Such processes are described in our Surplement, Nos. $4,58,141,174,333$.
(1962) W. D. C. asks: Can you please Yive me a recipe for a preparation of phosphorus which,
rubbed on any article, will cause it to become phosphorescent I I I shoulde like something harmless to the used, but there is always danger in manipulating phos phorus. Balmain's luminous paint might answer your pa
No. 229.
(1963) C. E. D. asks: Can you furnish me, through the columns of your paper, with a list of
simple inventions which have been the means of bringing fortunes to the inventors? A. We recommend you to to Make it Pay,", price $\$ 1$. On pave 33 of this worl racter you ask for is given.
(1964) J. H. C. asks: 1. What is the average number of pounds of hard coal that a good
steam engine will consume in ten hours, per horse power? A. For a large compound condensing engine and ty ib., thence up to 40 or 50 lb ., according to size of ordinary illuminating gas, per horse power, would run a yood gas engine ten hours? A. 200 to 300 cubic
feet. 3 . Is gas made by consumers from nobtha or gasoline eafe? A. It is safe except as regards danger element of risk, 4. What would it cost per thousand feet? A. This depends on circumstances, and cannot well be stated definitely hele. 5. What would material to run an electric motor ten hours cost per horse power,
by the storage battery system? A. This caunot be given, as the data a nre not yet settled definitely. 6. What is the greatest power that it is practicable to obtain this way? A. Any power desired. Your other queries
(1965) A. J. S. asks: 1. How to make or procure something like what is used on slot ma-
chines to tell how much current an induction coil produces. A. Place a fine-wound galvanometer on the secondary 2. Give solution for nickel plating some small artcle, and how to arrange connections
to same. A. See our Supplement, No. 310 , for plating to same. A. See our Supplemenc. No. 310, for plating
in general and arrangement of connections: nickel solutions have been often given in our columns, such as following: Sulphate of nickel, 1,000 parts; tartrate of ammonia, 725 parts; tannic acid, 5 parts dissolved in a of the water, then add the rest.
(1966) M. B. K. asks: 1. For the proportion in volume of common illuminating gas and One of gas to 10 or 15 of air. 2. Also the force exerted by the explosion of one cubic inch of the misture? A. The force exerted at the time of explosion may be very soon condenses and the products of explosion rapilily cool. The pressure for an infinitesimal period may run
up into hundreds of pounds per square inch. ap into hundreds of pounds per square inch. 3. For
works containing information as to forcees exerted by gunpowder, dynamite, nitro-glycerine?
you to "The Modern High Explosives," Wy Eissler, 84.
(1967) M. B. asks : 1. What is the best solvent for caoutchouc? A. Coal tar naphtha is used
sometimes the solution is effected under pressure. The gum should te masticated first. In our Supplement . Is painting with red lead and boiled linseed oil the est protection for an iron shaft against rust, the shat being exposed to action of water? A. It is very good We wo
lead.
(1968) S. S. D. asks for the ingredients sed in producing cold chemically. A. One part nitrate of ammonia in two parts of water may be used. except in special cases or on the manufacturing scale here are many other fre
(1969) J. R. asks: Will crude coal gas mixed in proper proportion with atmospheric
readily exploded by an electric spark? A. Yes.
(1970) Operator writes: I am working telegraph instrument in one corner of a room about 9
by 13 feet, but am annoyed and hindered by a loud echo aused by the sound of the instrument. How can across the room will dissipate the sound. In what direction should they be placed? I forgot to say the walls are about 15 feet high. A. Hang drapery or muslin on he two opposite walls from the machine. If that doe not entirely prevent the echo, drape the ceiling also This can be done in a tasteful manner, so as to
ment the room. The wire work is not sufficient.
(1971) W. F. M. asks : What composiion would be best adapted to paint, the inside of used in silvering photographic paper? A. Use parafin sed in seeswax melted into the pores of the perfectly dry ood.
(1972) B. D. B. asks for a good receipt for hektograph ink. A. Dissolve 1 oz . aniline blue in 7 oz and a few drops of ether and carbolic acid.
(1973) "An Old Subscriber" writes Who first gave the names ay, ee, eye, yoo to th ere these names established? Other languages usin he Roman alphabet call these letters ah, eh, ee, oo A. It is undoubtedly due to the Anglo-Saxon race, who succeeding the Britons, introduced a new language, whose pronunciation excluded the Romance languag guages the Continental pronunciation of the vowels remainsare to be sought in Wales and Cornwall and the Isle of Man.
(1974) I. M. B. asks : How to take ink out of parchment. A. The old manuscript writers used pumice stone. This removes ink from the surface. If chloride of lime or oxalic acid, blotting off carefully nd washing with .
(1975) H. M. C. asks the price of the rabe metals. We give
subject to fluctuations.

Aluminum-(Metallic), per lb..... $\$ 2$ to $\$ 2.50$ Sheet, per Ib.
Arsenic-(Metallic), per Ib. Barium-(Metallic), per gram Bismuth-(Metallic), per lb
Cadmium-(Metallic), per 1b
Calcium-(Metallic), per gram Cerium-(Metallic), per gram. Chromium-(Metallic), per gram Cobalt-(Metallic), per lb Didymium-(Metallic), per gram Erbium-(Metallic), per gram Glucinum-(Metallic), per gram Indium-(Metallic), per gram Iridium-(Metallic), per oz Lanthanum-(Metallic), per gram
Lithium-(Metallic), per gram. Magnesium-per
Manganese-(Metallic), per 1 b Chem. pure, per oz.
Molybdenum-(Metallic), per gra
Osmium-(Metallic), per oz. Palladium-(Metallic), per oz Platinum-(Metallic), per oz...
Potassium-(Metallic), per lb... Potassium-(Metallic), per $\mathrm{lo} \ldots$.
Rhodium-(Metallic), per gram. Rhuthenium-(Metallic), per gram
Rubidium-(Metallic), per gram. Rubiaium-(Metallic), per gram Sodium-(Metallic), per lb. Strontium-(Metallic), per gra Tantallum-(Metallic), per gram Tellurium-(Metallic), per gram Thallium-(Metallic), per gram Titanium-(Metallic), per gram Tuorium-(Metallic), per gram Tungsten-(Metallic), per oz. Vanadium-(Metallic), per gram Yttrium-(Metallic), per gram
(1976) J. Y. asks: What is the liquid have used both spirit and alcohol varisid paint? urn the bronze black or a dark color. A. Use japan drier with a small percentage of boiled linseed oil Both should be fresh.
(1977) A. T. O. writes : I once saw a chenical sermon." Two colorless fluids being
mixed, the result was a black fluid; a red fluid added to this last restored the black fluid; a red fluid added formed that the fluids, in the order used, were a solution of tannin or tannic acid, ferrous sulphate, and bromine. I succeeded in all but the use of the bromine; the black
color was discharged, but the result was red. Will you kindly show me the way to success? A. Yon used too
strong solutions. The solution of ferrous sulphat
should be very dilute, and oso should the tannin. The bro
mine should be dissolved in water and added to the mix
ture in just sufficient quantity to effect the decoloriza mixtion. Use all reagents as dilute as possible.

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February 25, 1890,

## AND EACH BEARING THAT DATE

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| Cult |



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Door hanger. P. N. French
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Fence, E. M. Andrews........
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