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GARBAGE CREMATING FURNACE.

The matter of cleaning the streets of New York and disposing of the collected refuse is still so prominently before the public that we offer no apology for presenting to our readers an illustration and description of another cremating furnace, which operates on a different principle from any of those that have been presented in our columns the past few months.

It appears that about a million loads, or 750,000 tons, of ashes, street sweepings, and garbage were collected in this city last year and thrown overboard, and the amount is annually increasing.

Not only does this method of disposing of the city refuse seriously injure the harbor and neighboring beaches, but it involves an inexcusable waste of material; hence it is evident that other methods must be adopted, and of these none appears to us so practical as cremation, which in this connection means the destruction of a fruitful source of disease, the conversion of a waste material to a valuable commodity, and the consequent annual saving to the city of thousands of dollars.

The advantages of cremation of city refuse have been fully demonstrated in several small towns in England and on the Continent, though the cremating plants there used are costly and of very limited capacity; but the most ardent advocates of cremation here have doubted the practicability of daily cremating 2,000 tons of refuse, which is the average amount collected in this city.

The city produces per annum about 800,000 loads of ashes, 225,000 loads of street sweepings, and 20,000 loads of garbage; but the ashes are so contaminated with garbage that they are unfit for any economic purposes. Were the garbage kept free from the ashes the amount of the former would be increased by about 25,000 loads. But this separation of the two is thought by the Board of Health to be practically impossible, and certainly no legislation to this effect can be enforced without great difficulty and constant and expensive legal proceedings.

It is clear, then, that for the first year or two, or until the citizens have learned to keep separate receptacles for the ashes and garbage, the 800,000 loads of ashes must be screened to reduce the garbage in it to about 2 per cent, or the amount that can be rendered harmless by the alkalies in the ashes, and the separated garbage cremated, or that the whole amount of ashes and garbage must be subjected to the action of fire.

The street sweepings can be used without any intermediate treatment for filling low lands, and the treated ashes are as valuable for such purpose as the best gravel.

In the suburbs of small towns isolated places can be found for the erection of cremation furnaces of any design, and they can be operated there without causing complaint; but such locations are available about large cities only at such distances that the hauling of the refuse to them would be practically impossible.

In such isolated places even cupola or blast furnaces for cremating may be unobjectionably operated, although they cannot consume their offensive steam and gases; for as the charge in such furnaces always burns from the bottom, the steam and gases from the superincumbent burning and drying mass escape into the air undecomposed, and with concentrated offense. Hence such furnaces would not serve in the neighborhood of crowded cities.

It is indispensable, then, if the cremation process be adopted, that an inexpensive furnace of almost unlimited capacity must be devised, capable of working continuously and with great rapidity, and of consuming or decomposing the steam and gases that are generated in the process.

A furnace apparently fulfilling these conditions is shown in the accompanying illustration. It consists of a brick lined cylinder, 60 feet long or thereabouts, and 6 feet in diameter, set at an inclination of about half an inch to the foot, on anti-friction rolls, and revolved by worm and wheel. At the feed end of the cylinder is a small fireplace that is used only for the ignition of the pulverized fuel, which is the principal agent in this work, and for which the inventor of this furnace holds the only United States patents. At the delivery end of the cylinder is shown a receiving chamber or pit (the parts being broken away for this purpose), into which the dried material falls, and whence it is continuously removed by a bucket elevator.

Just beyond this pit, in the base of the smokestack, is the gas mingling and combustion chamber, in which the escaping steam and gases are decomposed and thereby rendered inoffensive.

The operation of the furnace is as follows: The fire is urged in the first fireplace until the latter is hot enough to instantly ignite the pulverized coal which is injected through it by the pulverizer or fan, as shown in the engraving. The jet of burning pulverized coal entering the cylinder quickly heats it throughout to a white heat. At the same time the fire on the grate in the gas combustion chamber has brought the walls and perforated dome thereof to a white heat.

The cylinder is then put in motion at the rate of from two to ten revolutions a minute, and the garbage and ashes, separately or together, are dumped into it from the carts.

The material, as it passes through the cylinder, is exposed to the direct contact of the intense flame and to the direct radiation from the hot brick lining of the cylinder for as long a period as may be desired, this depending upon the speed of the cylinder.

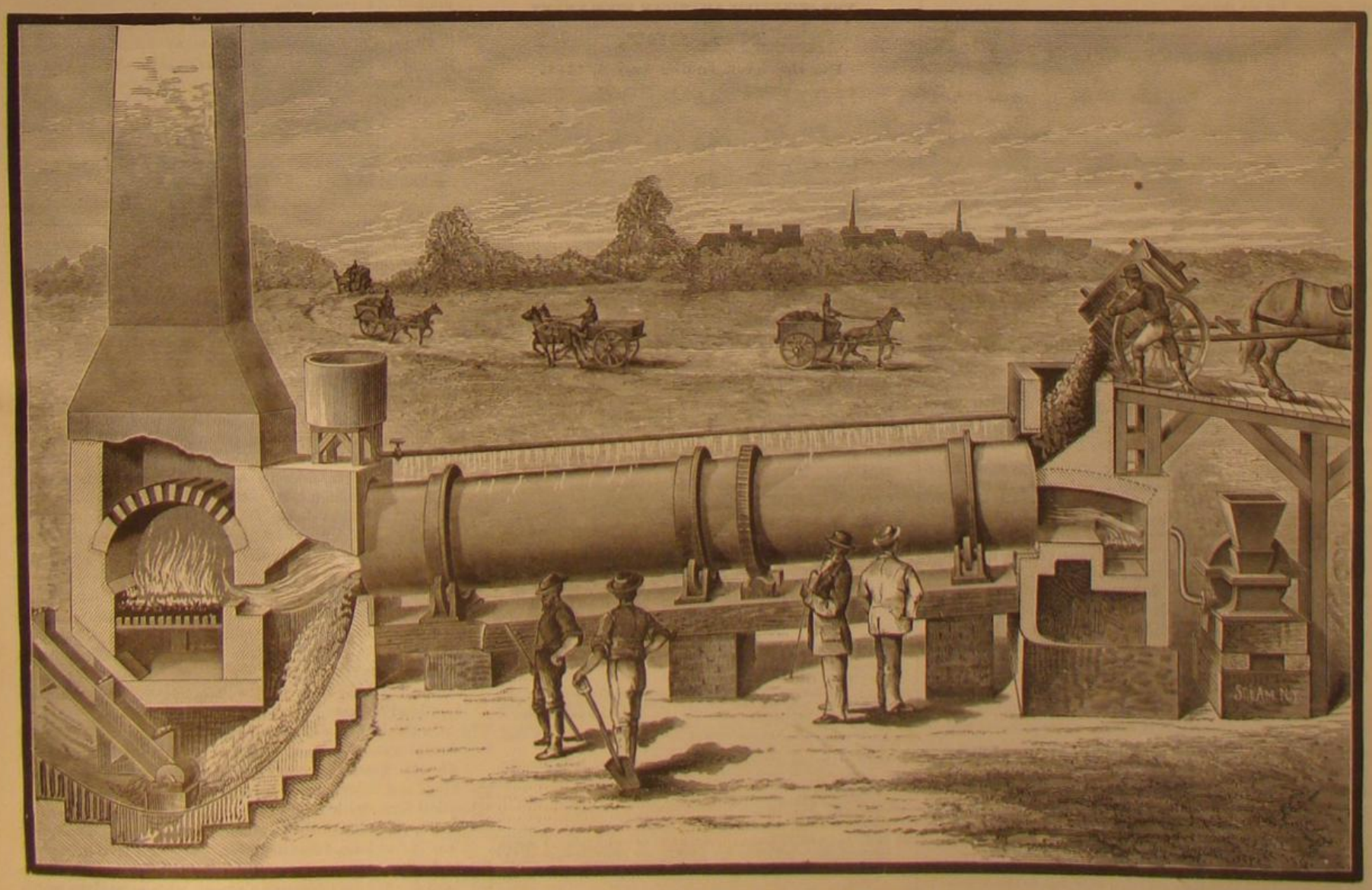
At a speed of about five revolutions a minute the furnace will dry the garbage to the best condition for a fertilizer, while at a speed of two revolutions a minute for the furnace the garbage will be reduced to ashes. The speed is regulated at will by the use of cone pulleys on the countershafts.

The enormous volume of steam and gases generated in the process move forward into the gas combustion chamber, and are there decomposed and burned, the perforated dome retaining them sufficiently long for this purpose.

There escapes then through the dome an intense white flame of sufficient volume to generate steam for all the purposes of the work; not the slightest offensive odor escaping.

A drip pipe discharges a constant spray of water on the cylinder to prevent the expansion thereof, so that the brick lining shall not become loose.

The illustration shows the smokestack constructed of



STORER'S GARBAGE CREMATING FURNACE.

brick above the gas consuming chamber; this construction is preferable for furnaces erected on land; but for those on barges an iron stack is better.

One cylinder, 60 feet long and 6 feet in diameter, will reduce to ashes each day the daily production of garbage in New York, or over 250 loads per diem, and the cost of it, complete with all its auxiliary parts and the engine to run it, will not exceed $12,000.

Two smaller furnaces on barges—one for the North and one for the East River—would dispose of all the city garbage, even if the garbage and ashes were separated, at a cost of plant not exceeding $25,000; and a still smaller one, erected on a barge, could be used for cremating dead animals, condemned meat, mattresses and clothing from emigrant ships and hospitals, etc., and could easily be removed about the harbor to any places where its services were required.

This furnace and the application of pulverized fuel, by which alone it could be operated, are covered by many patents that are controlled by the inventor.

For further particulars address Jacob J. Storer, Post Office box 773, New York.

Magnetic Separation of Iron Sand.

One of the American contributions for the Electrical Exhibition at Paris is a modification of Mr. Edison's magnetic separator for the treatment of iron sand found in large quantities on the south shore of Long Island and in other localities on sea coasts. According to Mr. Batchelor's statement to the *Evening Post* the Long Island sand contains 26 per cent of the finest iron known. Innumerable attempts have been made to separate the sand, and magnetic plates have been used before, but with no success on account of the presence of what is known as titanite iron, a substance which spoils iron. Edison discovered that titanite iron was less magnetic than the pure iron particles, and constructed his separator with that fact in view. The sand falls a distance of four feet in a thin stream from a slit in a V-shaped box holding about a ton. Under this box is a receiver divided into two compartments, the dividing partition being placed nearly under the slit in the sand reservoir and parallel to it. If no magnet is brought into play the sand all falls into one side of the box; but when a powerful magnet is brought near enough to act upon the falling shower, the pure iron particles are deflected in their fall and fly on the other side of the partition. The particles of titanite of iron are not attracted equally with the iron and are not deflected sufficiently to fall into the compartment with the pure iron. A company has been formed for the extraction of iron from Long Island sand, and is now at work with its first machine at Quogue, near Moriches, on the Great South Bay. This machine, which cost $700 to make, is managed by one boy, who keeps six men and two carts busy bringing sand for his hopper. It treats one hundred tons of sand a day, producing about twenty tons of pure iron, costing one dollar a ton to produce and selling for six dollars.

The British Patent Laws.

In the House of Commons, June 15, the Right Hon. Joseph Chamberlain, President of the Board of Trade, speaking on behalf of the Government, expressed his approval of the principle of a bill introduced by Mr. Anderson (Advanced Liberal), member for Glasgow, for amending the patent laws in the sense of a large reduction in fees and the extension of the time of patents, in imitation of the American system. He said the Government would be glad to legislate upon the subject at the earliest possible moment, but it would be impossible to do so at this session of Parliament. All the speakers on the subject dwelt upon the effect of the American patent system in fostering inventions.

The Increasing Cost of Paupers and Criminals.

The California Legislature recently published a report prepared by Chancellor Hartson, of Napa, Chairman of the Committee on Prisons, which contain some startling statistics. The cost of maintaining criminals and paupers is shown as follows:

1850—Population of United States	23,191,876
Criminals and paupers annually	$2,954,806
1860—Population of United States	31,443,321
Criminals and paupers annually	$4,445,143
1870—Population of United States	38,558,374
Criminals and paupers annually	$10,930,429

It is calculated that the census for 1880, when completed, will show an outlay of over $20,000,000 per annum for the cost of maintaining criminals and infirm people. This does not include the enormous outlay occasioned by the arrest and trial of criminals, but simply to their maintenance in prison.

PROFESSOR CHARLES E. MONROE, of Annapolis, states that the ordinary fruit acids, such as those contained in apples, tomatoes, rhubarb, lemons, etc., all acted upon tin. Some cider which he examined, and which had been stored in a tin fountain, contained one hundred and seventeen milligrammes of metallic tin to the liter in solution. One case was given where persons eating fruit preserved in tin cans were made violently sick, and tin only was found in the fruit. Corrosion of tin pipe by water was referred to, and it was suggested that the corrosion was due to the vegetable acids in the water.

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NEW YORK, SATURDAY, JULY 2, 1881.

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BOILER EXPLOSION NOTES.

The engravings of the boiler explosion at Messrs. Gaffney & Co.'s works, Philadelphia, not being ready, we are obliged to postpone them, together with our report, until our next issue.

We made a brief allusion last week to the peculiar finding of the coroner's jury in the above case. The explosion, it will be remembered, took place June 1st; the boiler was one of a nest of three, of cylindrical form, placed side by side, each 30 feet long and 36 inches diameter, with flat cast iron heads of the usual construction.

The jury found that the explosion was due to the improper use of cast iron in the flat head of the boiler; they also considered that the Hartford Boiler Inspection and Insurance Company was especially censurable for the incompetence and negligence of its agents who inspected and certified to the safety of the boiler; and they urgently recommended that the proper authorities take measures to prevent the recurrence of so terrible a disaster.

On the list of the jurors we find the names of J. B. Fontaine, of Fontaine, Abbott & Co., machinists; N. W. Williams, President of the Keystone Council, engineer; Samuel R. Marshall, formerly of the Wilkesbarre, Pa., Machine Works; J. Shield Wilson, Superintendent of Neafie & Levy's Penn Boiler Works, Kensington; Arthur Orr, of the firm of Orr, Hess & Co., machinists; and J. W. Nystrom, civil engineer.

We shall examine the subject more fully hereafter, and will now only remark that the facts, so far as gathered by us, strongly indicate that the jury rendered an erroneous verdict, and did not avail themselves of the means at their hands to verify practically the correctness of their conclusions. This is the more to be wondered at, because the gentlemen composing the jury were more than ordinarily qualified to make a searching investigation, and place before the public a full and correct explanation of the causes of the disaster. Any reliable information thus disclosed would be of importance to the "proper authorities" and to steam users in general.

The jury assign no reasons and point to no facts to warrant their verdict. From all the information we can gather it seems pretty certain that the explosion was due to an overpressure of steam, perhaps caused by inoperative safety valves and closing of the steam stop valves leading to the other boilers and to the dye works. It is, we believe, undisputed that most of the stop valves examined after the explosion were found to be closed.

Here were three boilers, all substantially alike, all having flat cast iron heads, all recently inspected and certified as safe. One of them, the newer and better boiler, explodes; the other two remain in their places intact and as capable, apparently, of useful service as ever. The jury had the opportunity of submitting the remaining boilers to a thorough test, and of determining on the spot, in the most convincing manner, whether the inspectors whom they complain of had really been remiss in their duty, and whether the jury's notion that flat cast iron heads are unsafe, was really correct. The omission of so obvious a duty detracts greatly from the value of the jury's finding, and makes it look as if they simply jumped at a conclusion.

Flat cast iron boiler heads are used on hundreds of boilers in all parts of the country, and many years of trial have proved them to be safe and serviceable. They generally stand better than the wrought iron parts of the boiler. While it is true that the concave cast head is the stronger form, and is preferable, still it was absurd for the Philadelphia jury to alarm their neighbors by proclaiming that all flat heads are unsafe. They should first have tested and demonstrated the truth of the matter.

As for the Hartford Company it has rendered invaluable service to steam users in the past; its agents and inspectors enjoy the reputation of being competent, reliable men, unlikely to make gross blunders in their inspections or certificates; and in the absence of the practical tests which the jurors might have made, their censure is of little account.

On the 10th of June another disastrous boiler explosion took place at Pottsville, Pa., in the large rolling mill of Atkins Brothers. Three persons were killed and six or more scalded. The exploded boiler was of cylindrical form, 26½ feet long, 30 inches diameter, with a flat cast iron head. Thirty-eight other boilers of similar pattern are used in this establishment, and all unite to form one general steam system, by which the blowers, the rolls, and other machinery of the concern are driven. All the boilers are heated by the products of combustion that rise from the puddling furnaces; the boilers being suspended over the furnaces by arched girders. Each end of each boiler is suspended by hook and staple to the girder. The exploded boiler broke completely in two at a point five or six feet distant from its front end, where the products of combustion first impinge upon the boilers, and where there are the greatest alternations of temperature, due to the opening and closing of the puddling furnace doors. We are preparing engravings and a full report on this occurrence, which we shall shortly publish. According to the theory of the Philadelphia jury the flat cast iron head ought to have blown out—but it did not.

On the 12th of June the boiler of the large and powerful wrecking steamer, B. & J. Baker, of Norfolk, Va., exploded when the vessel was near Cape Henly. Three persons were killed and several badly injured. The boiler was of cylindrical form, with return tubes, containing two tubular furnaces, the tubes of steel 28 inches in diameter. The boiler was 16 feet long, 7 feet diameter. The explosion is believed to be due to corrosion of one of the steel tubes which collapsed. We are preparing a report with engravings which will soon be published.

THE PRESERVATION OF EGGS.

The question, "How can eggs be preserved for market?" just now engages the attention of many of our readers. The following will prove of timely interest to many.

In the common "liming" process a tight barrel is half filled with cold water, into which is stirred slaked lime and salt in the proportion of about one-half pound each for every pail or bucket of water. Some dealers use no salt, and others add a small quantity of niter—one quarter pound to the half barrel of pickle. Into this the eggs, which must be perfectly fresh and sound, are let down with a dish, when they settle to the bottom, small end down. The eggs displace the liquid, so that when the barrel is full of eggs it is also full of the pickle. Eggs thus pickled, if kept in a cool place, will ordinarily keep good for several months. Long storage in this liquid, however, is apt to make the shells brittle and impart a limy taste to their contents. This may be in a great measure avoided by anointing the egg all over with lard before putting in the pickle. Eggs thus prepared are said to keep perfectly for six months or more when stored in a cool cellar.

A much better method of storing eggs is the following: Having selected perfectly fresh eggs, put them, a dozen or more at a time, into a small willow basket, and immerse this for five seconds in boiling water containing about five pounds of common brown sugar per gallon of water. Place the eggs immediately after on trays to dry. The scalding water causes the formation of a thin skin of hard albumen next the inner surface of the shell, the sugar effectually closing all the pores of the latter.

The cool eggs are then packed, small end down, in an intimate mixture of one measure of good charcoal, finely powdered, and two measures of dry bran. Eggs thus stored have been found perfectly fresh and unaltered after six months.

A French authority gives the following: Melt four ounces of clear beeswax in a porcelain dish over a gentle fire and stir in eight ounces of olive oil. Let the resulting solution of wax in oil cool somewhat, then dip the fresh eggs one by one into it so as to coat every part of the shell. A momentary dip is sufficient, all excess of the mixture being wiped off with a cotton cloth. The oil is absorbed in the shell, the wax hermetically closing all the pores. It is claimed that eggs thus treated and packed away in powdered charcoal in a cool place have been found after two years as fresh and palatable as when newly laid.

Paraffine, which melts to a thin liquid at a temperature below the boiling of water, and has the advantage of being odorless, tasteless, harmless, and cheap, can be advantageously substituted for the wax and oil, and used in a similar manner.

Thus coated and put into the lime pickle the eggs may be safely stored for many months; in charcoal, under favorable circumstances, for a year or more.

Dry salt is frequently recommended as a good preservative packing for stored eggs, but practical experience has shown that salt alone is but little better than dry bran, especially if stored in a damp place or exposed to humid air.

A mixture of eight measures of bran with one of powdered quicklime makes an excellent packing for eggs in transportation.

Water glass—silicate of soda—has recently been used in Germany for rendering the shells of eggs non-porous. A small quantity of the clear sirupy solution is smeared over the entire surface of the shell. On drying a thin, hard, glassy film remains, which serves as an admirable protection and substitute for wax, oil, gums, etc. Eggs thus coated and stored in charcoal powder or a mixture of charcoal and bran would keep a very long time.

In storing eggs in charcoal the latter should be fresh and perfectly dry. If the eggs are not stored when perfectly fresh they will not keep under any circumstances. A broken egg stored with sound ones will sometimes endanger the whole lot. In packing, the small end of the egg should be placed downward; if in charcoal or other powder they must be packed so that the shell of one egg does not touch that of another, the interspaces being filled with the powder.

Under all circumstances stored eggs should be kept in as cool a place as possible. Frequent change of temperature must also be avoided.

The Strength of Small Spruce Beams.

Mr. F. E. Kidder has recently performed a series of experiments at the Massachusetts Institute of Technology, having for their object the determination of the moduli of elasticity and of rupture in small beams of white spruce (*Abies alba*), and such other information as might be derived from the data obtained. The results of these researches are embodied in a paper read before the American Academy of Arts and Sciences and printed in the current number of the *Journal of the Franklin Institute*. The conclusions drawn from the results of the experiments are as follows: The modulus of elasticity depends not only upon the elasticity of the material, but also upon the length of time that the load is applied. When subjected to loads not exceeding one-sixth of the breaking weight, spruce beams do not take a permanent set; but even under very small loads, if applied for any length of time, there will be a temporary set. Knots and gnarls in beams loaded at the center, when not within one eighth of the span of the center of the beam, do not materially affect the elasticity under small loads. Deflection is very nearly proportional to the load, far beyond the customary limits of the strain, and the modulus is consequently very nearly constant for all moderate deflections. A high modulus of elasticity does not always accompany high transverse strength. In spruce beams the upper fibers begin to rupture by compression under about four-fifths of the breaking weight, and the neutral axis, at the time of rupture, is very near the center of the beam, as shown by the fracture. Beams which are subjected to severe strains for a long time, bend more before breaking than those which are broken in a comparatively short time. The modulus of elasticity of small spruce beams, of a quality such as is used in the best buildings, may be taken at from 1,600,000 to 1,700,00 pounds, and the modulus of ru pture at 11,000 pounds.

LOAN EXHIBITION OF THE OHIO MECHANICS' INSTITUTE.

In view of the large assemblage of scientific men to be expected in Cincinnati during the convention of the American Association, beginning August 17, the department of science and arts of the Ohio Mechanics' Institute are organizing a preliminary loan exhibition of scientific apparatus, chemicals, microscopes, minerals and materials illustrating natural history and archæology. This exhibition will be open during the week of the association, in the Exposition Building, and it is expected that the exhibits will remain to compete for premiums and awards in the regular Exposition in September.

We are informed that from the number of applications for space already received the loan exhibition promises to be the largest of its kind ever held in this country. The display cannot fail to be interesting and instructive to the members of the association and the large number of students, teachers, engineers, and others likely to attend the meetings; and the opportunity for manufacturers and dealers to place their goods before those most likely to buy seems to be exceptionally promising.

The committee in charge consists of Prof. F. W. Clarke, of the University of Cincinnati; Prof. Wm. L. Dudley, Miami Medical College; E. A. Kebler, Esq.; J. B. Stanwood, C.E.; and Prof. Ormond Stone, of the Cincinnati Observatary.

THE JEANNETTE RELIEF EXPEDITION.

The Jeannette Relief Expedition, in the Rodgers (late Mary and Helen), sailed from San Francisco, June 16.

The Jeannette (formerly the Pandora) left San Francisco for Arctic exploration, by way of Behring Straits, July 8, 1879, under the command of Lieut. Geo. W. De Long, U. S. N., with a crew of thirty-one men. The Jeannette was last seen on the morning of September 3, 1879, in the neighborhood of Herald Island, sailing north.

The relief steamer Rodgers is commanded by Lieut. Robert M. Berry, U. S. N., and the other officers are Master H. S. Waring, Executive Officer and Navigator; Master Charles F. Putnam; Ensigns H. J. Hunt and G. M. Storey; Assistant Engineer A. V. Zane; Pay Clerk W. H. Gilder (late with the Schwatka Expedition); Passed Assistant Surgeon M. D. Jones, and Assistant Surgeon J. D. Costillo. The crew consists of a carpenter, a steward, two cooks, a blacksmith, three firemen, three machinists, and fifteen seamen.

The Rodgers is 155 feet in length and 30 feet beam, with a depth of 16½ feet, and registers 420½ tons. She is bark-rigged, with double topsails and auxiliary steam power, the engine developing about 156 horse power. She carries three years' full navy rations for her crew, besides a large quantity of pemmican and other stores, so as to be able, if necessary, to supply the Jeannette, or the missing whalers Mount Wollaston and Vigilant, which, with their crews of some sixty men in all, have not been heard of since, on the 10th of October, 1879, they were caught in the ice about eighty miles N. E. by E. of the spot where the Jeannette was last seen.

Chemical Examination of Drinking Water.

Dr. J. W. Mallet, University of Virginia, has undertaken for the National Board of Health, a special study of the methods of examining drinking water for organic impurities; and the board urgently request that physicians and sanitarians shall promptly report to Dr. Mallet any well marked cases of disease which may seem on medical grounds to be fairly attributable to organic impurities in the drinking water used by the patient. It is further desired that samples of each such water shall be forwarded to Dr. Mallet for examination, but not until after the reasons for suspecting the water have been submitted to Dr. Mallet, and notice has been received from him that the analysts are ready to proceed with its examination. Such notice of readiness will be accompanied by clear instructions as to the quantity of water required, and the mode of collecting, packing, and shipping it. The cost of packages and transportation will be borne by the Board of Health. Dr. Mallet's post office is University of Virginia P. O., Albemarle County, Va.

It is to be hoped that physicians will not neglect to aid this important inquiry, especially as it furnishes so favorable an opportunity to have tested *gratis* any water the wholesomeness of which they may have cause to doubt.

Water in an Amethyst.

An Atlanta paper reports the recent finding, in Rabun County, Ga., of an amethyst bearing a drop of water or similar liquid in a cavity near the center of the stone. It is not an uncommon occurrence to find such water-filled cavities in crystals of quartz and other minerals, but this cavity in amethyst is said to be unique.

Exhibition of Milling Machinery.

The British *Mercantile Gazette* has the following respecting the threatened invasion of the domain of the English miller by their enterprising cousins of the far West:

It has been stated that there are 10,000 millers in the United Kingdom, and that a very large proportion of that number had not, previous to the late exhibition, even so much as seen the devices by the aid of which our American cousins have asserted they will, before long, secure for themselves the exclusive manufacture of the enormously increasing growth of American wheat that now flows into this country. To enable the British and Irish millers to take stock of their position, and decide whether they will give up the fight, as many of our British farmers are doing, or embark more capital, energy, and skill in their business, the Council of the National Association of British and Irish Millers resolved to hold an international exhibition of milling apparatus, and although only a comparatively short time elapsed between the mooting of the suggestion and the actual accomplishment of the intention, the display of milling machinery was emphatically the largest and finest ever made.

It is the surprising growth of the milling industry in the United States which fills our home trade with the most serious misgivings; for, whereas the quantity of flour coming from the States was only 1,772,000 cwt. in 1877, it was 3,635,000 cwt. in 1878, rose to 6,863,000 cwt. in 1879, and nearly reached 7,000,000 cwt. last year.

There is also every apparent indication of the permanency of the rapid increase. One authority has it that in the State of Minnesota alone the mills turned out 6,000,000 barrels of flour in the year 1879, and that the mills in Illinois, Wisconsin, Iowa, and other States produced no less than 15,000,000 barrels in the same year. The city of Minneapolis has twenty-two mills with a capacity of 15,000 barrels daily. At St. Louis nearly 2,000,000 barrels of flour were manufactured last year; and in both of these two great centers of milling industry a number of new mills are in course of erection. The substitution of flour for whole grain in exporting lessens the weight for land transport and shipment by about 30 per cent, as the proportion of fine baking flour yielded by the wheat is some 70 per cent; the remaining portion of inferior flour, offal, and bran being used as a valuable interchange with maize for fattening American cattle. Even the packing in bags in place of barrels has had its effect. It has contributed toward the economizing of room in the holds of vessels, and the matter of cost reduced to a minimum by the smaller outlay necessary for the bags, and the realizing of their values when discharged in this country. Indubitably, therefore, the situation is, "not to put too fine a point upon it," serious, and millers are apprehensive that their anticipations—that at a not very remote period the vast imports from the other side of the Atlantic may, for the greater part, if not indeed wholly, take the form of flour instead of grain—may assume an unpleasantly material aspect. Without wishing to be "alarmist"-like, or to prognosticate that our national milling industry will become obsolete, it serves no good purpose to mince matters, and the British miller had better look to his guns if he wishes to hold his own in the whirlwind of competition. If anything is calculated to stimulate the energies of English millers and millwrights, certainly the great exhibition at Agricultural Hall ought to have done much to obtain the desired effect.

Comparative Value of Steam Engines.

Hallauer's recent experiments have led him to the conclusion that the difference between engines of one and two cylinders, in point of economy, is very slight. In ranging from 80 to 8,000 horse power, with revolutions varying from 25 to 90 per minute, the expenditure of steam for a given amount of work remains the same for the same type of motor; the consumptions for two cylinder motors are identical for Woolf and compound, whatever may be the volumes of the cylinders, provided the motors are regulated so as to give the maximum efficiency; the expenditures of steam in motors of one, two, and three cylinders, suitably regulated and constructed, are so nearly alike that the choice may be governed in each instance merely by the fitness of the type of the engine for the particular purpose desired.—*Bull. de la Soc. Ind. de Mulhouse.*

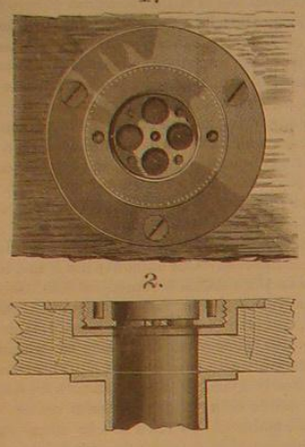
A NEW ballot box has just been submitted to the French government. It has two locks, each opening with a different key, and an apparatus which clips a stub or corner from the ticket deposited by the elector, and drops the stub into one part of the box, the ticket going into the other division. Simultaneously the machine registers on a tablet before the voter the number of tickets clipped. The ballots must agree in number with the stubs, and both with the "tell-tale," and the voter sees for himself that his ballot has been cast and taken account of.

THE *Archiv der Pharmacie* gives the following formula for making paper for wrapping up silver. Six parts of caustic soda are dissolved in water until the hydrometer marks 20° Baume. To the solution add four parts of oxide of zinc, and boil until it is dissolved. Add sufficient water to bring the solution down to 10° Baume. Paper or calico soaked in the solution and dried will effectually preserve the most highly polished silver articles from the tarnishing action of the sulphureted hydrogen which is contained in such notable quantities in the atmosphere of all large towns.

NEW STRAINER FOR THE OUTLET OF TUBS AND BASINS.

The engraving shows an improved strainer for the outlet of tubs and basins, recently patented by Mr. William Slow, 68 West Houston street, New York city. It can be readily removed from the washer of the outlet of a tank, tub, or basin, for the purpose of clearing it in case it becomes clogged.

The washer is recessed and internally threaded to receive the strainer, which is screwed in. A small wrench or key accompanies the strainer, and is used in removing it from the washer whenever it requires cleaning or when it becomes necessary to remove any obstruction from the pipe. The strainer may consist of an apertured plate, or it may be made of wire cloth secured to a suitable rim.



SLOW'S STRAINER FOR THE OUTLET OF TUBS AND BASINS.

Fig. 1 is a plan view of the strainer, and Fig. 2 is a vertical section showing the manner in which it is applied to the tub or basin.

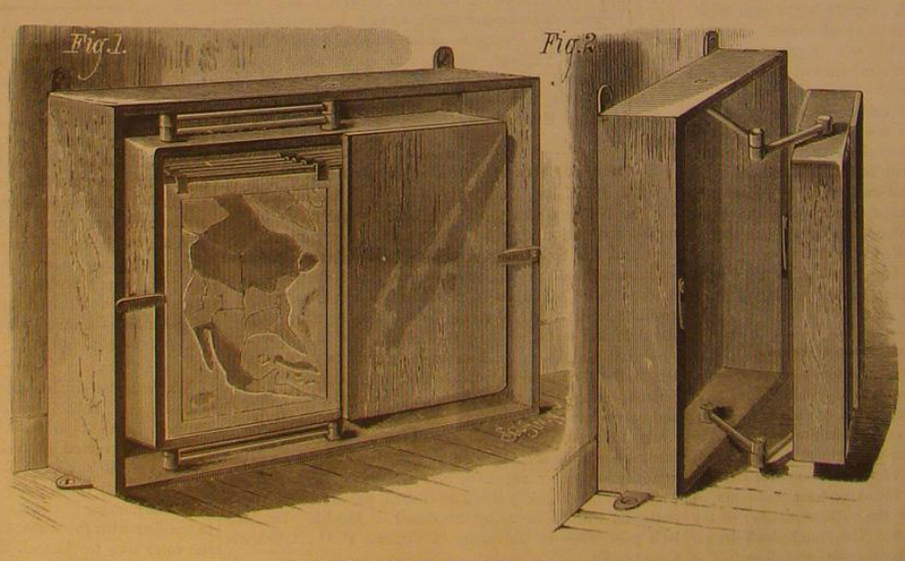
The World's Progress in Ten Years.

An English statistician, Mr. Michael G. Mulhall, gives the following figures as representing the world's increase in the elements of progress in the decade between 1870 and 1880: Percentage of increase in population, 9·76; in agriculture, 8·58; manufactures, 18·60; commerce, 38·20; mining, 47·06; carrying trade, 53·32; earnings of nations, 19·84; public wealth, 10·57; taxes, 22·34; public debt, 43 39. The tangible increase in public wealth since 1870 would suffice to pay off 88 per cent of all existing national debts.

NOVEL CHART RACK.

The engraving represents a novel chart rack for holding charts and maps, such as are used in school rooms for instruction, and for protecting the charts when not in use. It permits of showing either side of the chart or map. A reversible chart frame is supported by two jointed arms at the top and bottom in a fixed frame attached to the wall. One half of the reversible frame is covered to form a chamber into which the charts may be moved to shield them from dust and danger of mutilation when not in use. The charts slide upon rods, and may be viewed from either side by simply turning the reversible frame. The outer frame may be made portable and may be supported by an easel or movable frame. It is not limited as to size, and intended principally for use in schools, but it may be used to advantage in places of business for displaying samples, placards, etc.

This useful invention was lately patented by Mr. William C. Cadwell, of Logan, Iowa.



CADWELL'S CHART RACK.

Artificial Soil.

M. Dudouy, of Saint Ouen, has been very successful in chemical horticulture. In his garden he has cultivated legumes, flowers, and trees in parallel rows in three manners: 1, with ordinary manure; 2, with chemical manures in garden soil; 3, with a special compound, which he calls *floral*, in pure sand.

The results of the third experiments have been very striking, yielding the earliest, the largest, and the most delicate vegetables, as well as the most thrifty and brilliant flowers. The *floral* contains nitrogen, phosphoric acid, potash, magnesia, and sulphur, in a form so concentrated as to require dilution with twenty thousand times their volume of water. The experiments have been continued for five years with uniform success.—*Les Mondes.*

ENGINEERING INVENTIONS.

An improved railroad signaling apparatus, patented by Mr. Robert B. Sanderson, of Bridgewater, Pa., consists of a box having signal colors painted in sections upon its side, a pivoted skeleton plate, a pulley and cord, and a cord and weight, or equivalent spring, whereby the signals can be displayed by adjusting the skeleton plate.

Mr. George H. Knapp, of Brockton, Mass., has patented a novel arrangement of levers, in combination with the main and switch rail rods and movable rails of a railroad, whereby the switch is operated by the contact of strikers attached to the engine and controlled by the engineer.

With the ordinary bilge pumps it is impossible, when the vessel rolls heavily and quickly, to maintain a continuous discharge of the bilge water, for as the vessel rolls to starboard the suction pipe on the port side becomes bare and the water which is in it below the lower valve flows back into the bilge while only the pump on the starboard wing draws water until the vessel rolls back to port, when for some time neither pump works until the water can collect on the port side, when the port pump will operate. Considerable time thus elapses on each roll of the vessel before a pump has filled its suction pipe up to the lower valve, and by the time the pump begins to discharge the vessel will roll in the opposite direction. Thus the pumps work poorly and the water accumulates, and the result is that at every lurch the water rushes up in the wings of the vessel and injures the cargo; and on a steam vessel the water surges up on the stoke-hole plates and carries off ashes and coal into the bilge, causing the pumps to choke. Mr. Joseph J. De Kinder, of Philadelphia, Pa., has patented apparatus to overcome these difficulties; the invention consists in a device preventing the back flow of the bilge water from the suction pipes during the rolling of the vessel by alternately closing the valves of the suction pipes by means of a self-acting pendulous weight, the operation of the parts being such that as the vessel rolls, so as to leave the bottom of either of the bilge pump suction pipes dry or out of water, the valve of the pipe will be closed and the back flow of the bilge water in the pipe will be prevented.

An improved excavator has been patented by Mr. William H. Knight, of Quebec, Province of Quebec, Canada. The object of this invention is to furnish machines designed especially for excavating snow and earth upon lines of railway in course of construction or completed, but which may be used with advantage in excavating for other purposes.

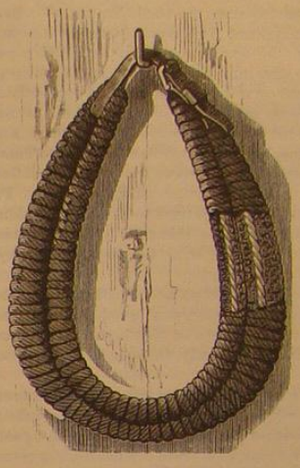
Mr. W. Clay Lutz, of Bedford, Pa., has patented an improved hollow iron railroad tie, composed of an upper and lower section bolted together, the upper section being provided with a vertical web for receiving the rail.

Mr. John F. Anderson, of Jersey City, N. J., has patented an improvement in the construction of tunnels, the object of which is to facilitate the construction of tunnels where the earth is composed of soft materials such as sand and silt, and at the same time insuring greater safety for the men engaged in constructing such tunnels. The invention consists in constructing and carrying forward in the earth, in advance of the main tunnel, a central tube or small tunnel having a metallic shell, which the inventor terms a "pilot tunnel," by which the nature of the soil in advance of the main tunnel can be ascertained, and the earth at the heading may in part be supported during the excavation of the main tunnel. Another feature of the invention consists in extending the rear portion of the shell of the central or pilot tunnel back from the heading into the completed part of the main tunnel, and in using this shell as a temporary support for the walls and shell of the main tunnel during their erection.

AN IMPROVEMENT IN HORSE COLLARS.

We give an engraving of a useful improvement in horse collars, patented by Mr. Andrew D. Martin, of Abbeville, La. This collar is made by winding Spanish moss on a flexible base, such as a rope. It has the proportions and general form of a leather collar, but is superior in many respects. It is always soft and pliable, and will never injure or gall the flesh, while in many cases it has been known to heal a sore or gall produced by a bad collar. It admits air to the skin, and is in all respects comfortable and easy.

The inventor informs us that restive horses have been easily broken by the use of this collar, and that it is well and favorably known in all parts of Louisiana and in some of the other States.



MARTIN'S IMPROVED HORSE COLLAR.

The moss is wound upon the flexible base by means of machinery especially adapted to the purpose, which the inventor can supply to any one engaging in the manufacture of the collar.

Further information may be obtained from the inventor as above.

A Remarkable Drying Agent.

Anhydrous phosphoric acid is believed to be the most powerful desiccating agent known. When air from which moisture has been removed as far as possible by the ordinary means, and is then carefully dried by sulphuric acid at temperatures not exceeding 25° C., it is still found that the two-millionth part of the weight of the air in the form of moisture will be removed by the anhydrous phosphoric acid.

Central Sugar Mills in Louisiana.

An important innovation has been made in the working of sugar plantations in Louisiana by the success of an independent sugar mill in St. Mary's Parish. Hitherto the custom has been to work up the cane of each plantation in a plantation mill; and as the small farmer could not own or operate a mill the cultivation of sugar cane has of necessity been monopolized by wealthy planters. The effect of the independent sugar mills in providing a general market for cane cannot but be much the same as that produced in dairy regions by the establishment of central cheese and butter factories, or that in wheat-growing regions in separating the work of the farmer from that of the miller. The superior economy of grinding the cane and converting the juice into sugar in a few large and well appointed factories, instead of a multitude of small and rude establishments, is obvious. But a still greater advantage is promised from the circumstance that the new plan enables small farmers to engage in cane growing, thus removing the necessity for large plantations and making possible a vast extension of the area devoted to sugar. At the mill referred to the cane is purchased by the ton, in any quantity offered; and similar factories are being projected in other parts of the State.

ALUM water is recommended for preventing bugs and worms from infesting flouring mills. Take two pounds of alum and place it in three quarts of warm water (or in that proportion), and let it stand on the stove until the alum disappears. Apply while hot with a brush to the crevices of the bolting machine and other places that conceal the insects.

IMPROVEMENT IN STEAM BOILER FURNACES.

The engravings show what the inventor calls a rational construction for generating steam. And the reason why it is called a rational construction is because it utilizes heat that is wasted and lost in all other forms of steam boilers set in brick.

On the side walls of an ordinary boiler set in brick, and on the side of the grate bars, there are some sixty square feet of surface, that absorb fifty per cent of the heat of the fuel.

If the users of steam boilers, as usually set, realized the full value of their fuel, they would, in most cases, be able to evaporate at least fourteen pounds of water to each pound of coal consumed; whereas, with imperfect construction and setting, it is a rare thing to find them that evaporate (allowing for dry steam) over seven pounds of water for each pound of fuel. To overcome this deficiency in the imperfect setting of steam boilers, Mr. Charles D. Smith—who is connected with the house of Edward Barr, 78 John street, New York city—has invented and constructed a furnace that has been applied to a large number of boilers, both new and old, and, as we have been informed by parties using it, with great success. At the brewery of Anton Hupfels, 38th street and Third avenue, they formerly used two horizontal tubular boilers, 54 inches diameter by 16 feet long. To one of these boilers, one of these furnaces was attached three and a half years ago, since which time this boiler and furnace have done the work that formerly required both boilers, notwithstanding an increase of business. This increase in efficiency was secured without expense to boiler or furnace, and effected a saving of fuel.

We are informed that three years ago two boilers, with furnaces attached, were placed at Lord & Taylor's, corner of 20th street and Broadway. The chief engineer, Mr. Scott, who has been in charge there for eleven years, tells all who inquire that he effects a saving of 28 per cent in fuel alone.

The improvement has also been applied in the brewery of Donald Smith, on 18th street and Eighth avenue, with the same results.

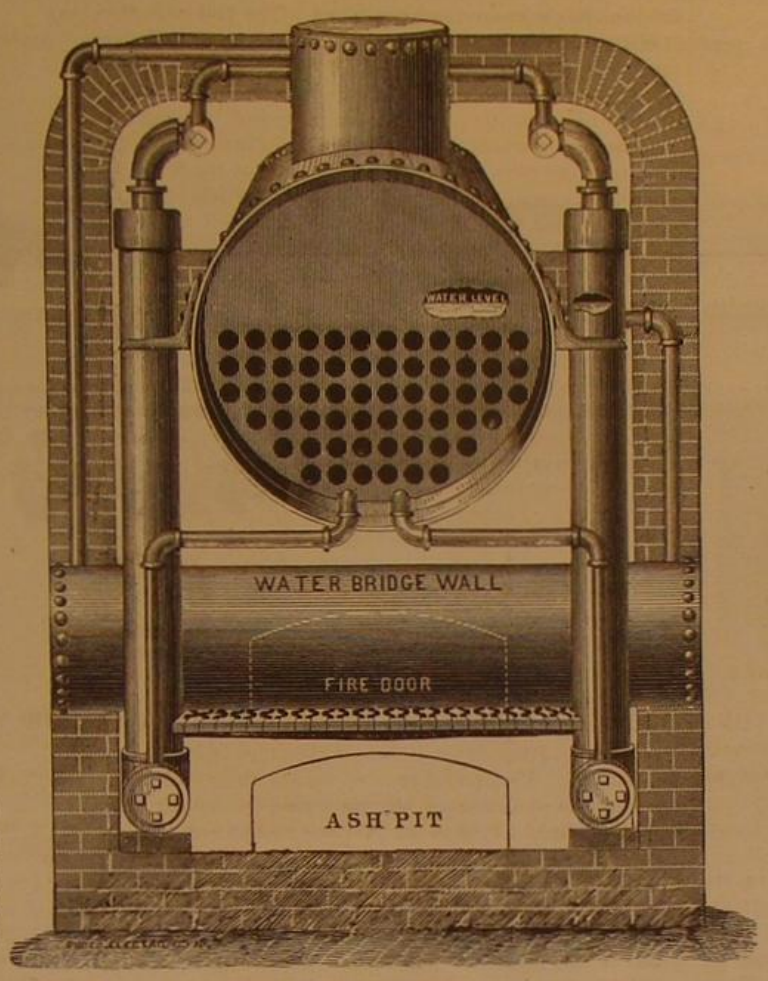
We are informed that the improvement has been adopted by the following large corporations: Cambria Iron and Steel Works, Johnstown, Pa.; Merchant's Mills, of Fall River, Mass.; Manhattan Silver Mining Company, of Austin, Nev.; George Ehret, brewer, New York, who, after using it for three years, applied it to all his boilers. Many others have adopted it.

The columns on the sides take the place of the wall of fire brick each side of the grate bars. They are made of five-inch pipe, and will stand a cold water pressure of 2,000 pounds to the square inch. The round bridge wall is made of steel plate. It is 14 inches in diameter, and takes the place of the brick bridge wall. The pipes from the bridge back are 2½ inches in diameter, and in an ordinary boiler add about 200 feet to the fire surface. The fire surface required is but 4 square feet to a horse-power; in heating surface, as generally estimated, 12 to 15 square feet are required.

The larger engraving is a side elevation of the boiler with parts of the arch, boiler, and tubes broken away to show interior construction. The smaller engraving shows the boiler and arch with the front removed.

The judges' report of the test of steam boilers at the Centennial Exhibition, in Philadelphia 1876, shows that the application of these water walls to a horizontal tubular boiler gave a higher evaporation by over 12 per cent, with an increased capacity of 74 per cent over any other boiler competing in the test, showing that the fuel generally wasted amounts to 65 per cent of the amount used.

Further information as to construction, operation, etc., may be obtained by addressing Mr. Edward Barr, dealer in iron pipe and steam supplies, and sole manufacturer of Smith's furnace, 78 John street, New York city.



END VIEW OF BOILER WITH SMITH'S IMPROVED FURNACE.

The Electric Light for Deep Water Investigations.

Some interesting experiments have been made at Baltimore to test the applicability of the electric light for deep water investigations, the aim being to illuminate brilliantly the water and the bottom to depths of two hundred feet or more. The tests were made with a Brush apparatus operated by an eight horse power engine, mounted upon a scow and towed about the harbor by a tug boat. The results obtained were not fully satisfactory, owing principally to the roughness of the water, but the trial was a most interesting one, and the power of the electric light was strikingly manifested.

A movable parabolical reflector was used back of the light, which was again and again thrown against vessels from two to two and a half miles distant, bringing them out in clear, full view, and enabling their names to be read with the aid of a glass. When the light was thrown upon the dome of the City Hall, it leaped out of the darkness and stood up against the dark sky as if suspended in mid-air. One of the curious features of this part of the display was that to persons in the city the shadows of steamers and other vessels, passing between the light and the City Hall dome, were distinctly portrayed against the white background.

The Telephone in Hungary.

Mr. D. H. Washburn, who has been engaged for some months introducing the telephone into Buda-Pesth, Hungary, reports very encouraging success. He writes that the director of the company, Mr. Francis Puskäs, had obtained the exclusive right to use the telephone in Hungary, and that connections were being made between Buda-Pesth and the adjacent towns. The charge for the service is 15 guilders—about $6—a month. The Edison transmitter is used with magnetic call. Supplies are got mainly from New York.

Mr. Washburn finds the Hungarians very backward in the adoption of modern improvements. A good mechanic in Buda-Pest gets from $6 to $10 a week, and does as much work as an American, with improved tools, could do in an afternoon. The cost of living is reasonable, a good dinner with wine costing about 75 cents. The beef is poor, and the pork dear, a guilder (41 cents) a pound. Vegetables are good and cheap. Rents are not high.

As an indication of the inconveniences of a paternal government Mr. Washburn mentions the fact that before a man can subscribe to the telephone exchange his name and business have to be sent to four different government offices for permission. The telephone company has to report to the authorities what everything costs and what every employe receives. "In fact," adds Mr. Washburn, "every one that lives here is but a slave of the government."

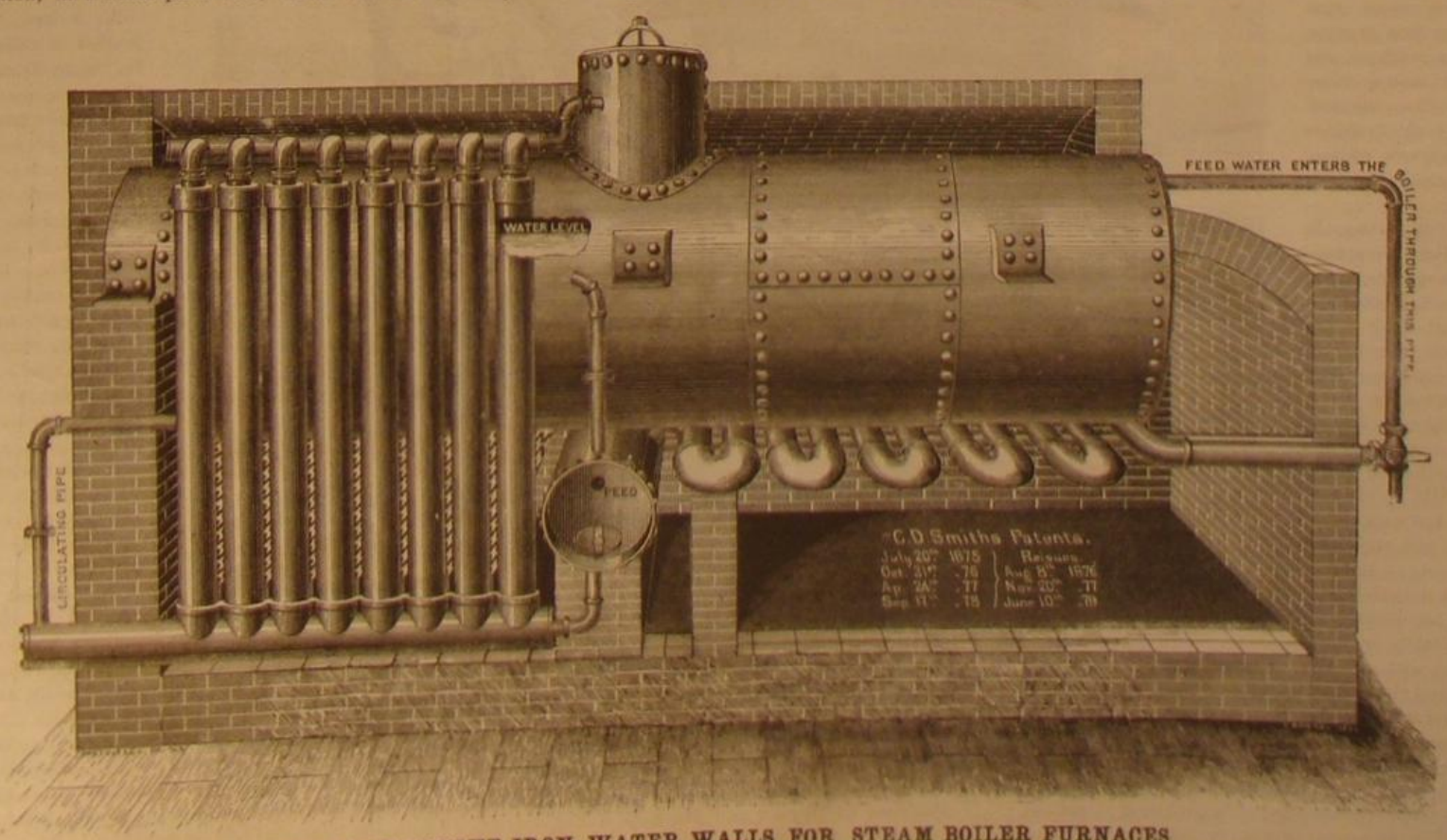
NEW INVENTIONS.

An improved adjustable rack, to be attached to brass band instruments, for holding books or leaves of music, has been patented by Mr. Charles Parent, of Biddeford, Me.

A telegraph operator at a railroad station is responsible for the switches, and is required to telegraph the approach of trains. Besides this he has frequently to answer inquiries from other stations as to whether certain trains are approaching, and usually attends to the ordinary telegraph business. To watch the track he must frequently leave his table, especially if the track is curved, so that his work is not only interrupted, but there is more or less risk of its being improperly done. Mr. Sidney L. Palmer, of Serena, Ill., has patented an arrangement of reflecting mirrors, which convey to the operator's table a picture of the track extending in both directions from the station.

In training horses for trotting, toe weights are attached to their shoes to cause the horses to throw out the fore feet and make longer strides, but after a little service the weights in common use become loose and are with difficulty tightened on the shoe spur or clip. To avoid this difficulty, Mr. Peter Broadbooks, of Batavia, N. Y., has patented an adjustable toe weight that can be securely held in place.

An improved earring fastener, patented by Mr. Geo. Krementz, of Newark, N. J., consists in a forked spring sliding in a circularly-bent tube, and having an ear wire projecting from one end of the bent tube attached to one shank, the other shank being provided with a catch for locking the spring and the ear wire.



SMITH'S WROUGHT IRON WATER WALLS FOR STEAM BOILER FURNACES.

ELECTRIC INDUCTION BY STRESS.

Joule has shown that when a bar of iron is magnetized by means of a helix and electric current the bar is elongated appreciably. These elongations have been measured by Prof. E. A. Dolbear.

While undertaking some experiments in December, 1878, it occurred to me that the inverse of this ought to be true, namely, the forced elongation of a bar of iron, surrounded by a helix, would give cause for an electric current through the helix and connections. A series of experiments followed which completely verified the supposition, a recital of which may be of interest. The publication of them was deferred from time to time in the hope of more varied experiments, and in the possible discovery of like experiments by others.

By placing one branch of a sounding tuning fork near the pole of an electro-magnet, the coil of the latter having a Bell telephone in circuit, the tone of the fork is found to be reproduced in the telephone. But this is like using a Bell telephone for a transmitter, the branch of the fork in the present case serving for an armature, as does the diaphragm in that instrument. Again, when an iron bar is fastened at its center and made to vibrate longitudinally near an electro-magnet, a telephone in circuit will speak, and for the same reasons as before. Remove the core of the magnet and the sound is still heard at the telephone, and it is not necessary that the bar be a magnet. Bars of iron were selected that possessed a minimum amount of magnetism, in fact an almost inappreciable magnetism, and still a loud sound was emitted by the telephone.

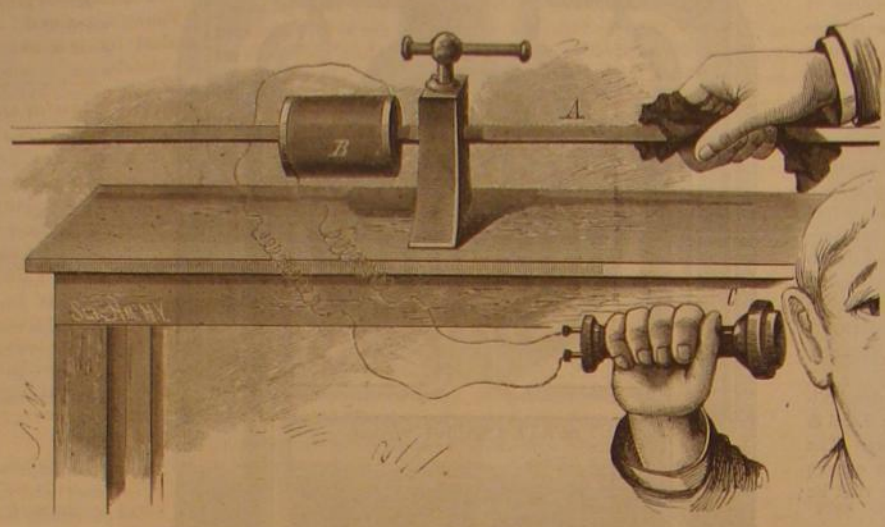
The helix used had no iron about it when the core was removed, and the opening for the core was large enough to encompass the bar without touching it. The bars used were several times the length of the helix.

At first it was supposed that the *motion* of the iron longitudinally was chiefly concerned in the production of sound. On this supposition the sound would diminish as the helix was moved toward the middle of the bar where it was firmly secured in a clamp for longitudinal vibration. But instead of this, the intensity was increased; and to such an extent that the auditor at the telephone in a distant room could positively say whether the coil was at the end or at the middle of the longitudinally vibrating bar. This made it clear that the sounds observed were not to be explained altogether on the ground of vibratory motion of the particles of the bar, because the motion of the bar at its middle is *nil* when clamped at this point and vibrating longitudinally at its fundamental; while at the ends we have a maximum degree of vibratory motion. But at the middle of a bar thus conditioned we have a node, and the strains are here known to be those of extension and compression and at a maximum for the bar, while at the ends the alternating strains are *nil;* that is, where the motion is greatest the strains are least, and *vice versa*. It seems, therefore, certain that at the middle the sound is chiefly due to the vibratory stresses, while at the ends it is almost entirely due to motion.

The engraving shows the apparatus. Rods were used which were from one-quarter to one-half inch in diameter and three feet long. The coil was about three inches long, and so connected with the free circuit wires that it could readily be moved along the rod. As the clamp prevented placing the coil exactly at the middle of the bar, the latter, to test this point, was taken out and suspended by two filaments so light as not to interfere with the vibration, and the bar made to vibrate longitudinally by striking on the end with a mallet. The coil was placed directly at the middle and also shifted to right and left, but the sound was still loudest at the middle. Sounds produced by the transverse vibrations, now accidentally occurring and mixing with those due to the longitudinal vibrations, were heard, but were readily distinguished by the pitch of tone. These were separated from the above consideration of longitudinal vibrations.

To further test the matter of electric induction by stress, a rod was passed through the coil, and the rod put under tension in a testing machine. A galvanometer now placed in the circuit became very active as the strain was put on. The bar was an ordinary three eighths rod of commercial bar iron. It was at once found to be permanently stretching, and the galvanometer needle was all the while flying about as the extension continued. When the bar was removed it was found to be strongly magnetic, much more so than it could have been when put in. It was also heated. It therefore seemed difficult to determine whether the observed currents of electric induction were due to strain, stretch, magnetism, motion, or heat, in part or together.

A piece of white chilled cast iron was then tested to 42,000 lb. compression, and found to resist the full power of the machine without crushing or set. The coil was then placed around the rod, and the test for stress electric induction applied. Under compressive strains the needle gave unmistakable evidence of electric currents, though they were much feebler than in the previous case of soft iron.



MANNER OF PRODUCING ELECTRIC INDUCTION BY VARYING STRESS.

Experiments on steel bars, not magnetized, gave appreciably the same effects as iron bars. Magnetized steel was not tried, but it is presumed that at the end of the bar magnet vibrating longitudinally the sounds would be intensified, while at the middle of the bar, normally magnetized, the sounds probably would not materially differ from those obtained from non-magnetic bars.

A few other metals were tried, copper and brass particularly, but no sounds were heard from them. These experiments, though far from being complete and exhaustive of the subject, warrant us in the following conclusions, namely:

1st. That the fact of Joule, of the distortion of bars of iron by magnetization with electric currents, is operative in the inverse order, namely, distortion of bars by mechanical force induces electric currents in surrounding coils.

2d. Most other metals than iron or steel give but feeble if any observable results of stress electric induction.

S. W. ROBINSON,
Professor of Physics and Mechanical Engineering,
Ohio State University

RECENT INVENTIONS.

An improved tip for lamp-wick tubes has been patented by Mr. Hamilton B. Follett, of Brooklyn, N. Y. The object of this invention is to produce a very brilliant and regular flame in a kerosene lamp or stove, and to prevent any irregular or undue carbonizing of the wick. It consists in a small plate of metal, which passes edgewise and longitudinally over the middle of the upper edge of the wick tube, a short distance above.

Mr. Alfred I. E. Knight, of New York city, has patented a convenient inkstand or cabinet constructed with means for holding pen holders, sponges, rules, etc., and also a central removable panel, ornamentation, or calendar, and formed with surfaces adapted for emblematical or lettered advertising.

An improved apparatus for stowing cotton bales in vessels has been patented by Mr. John F. Taylor, of Sharon Springs, N. Y. The object of this invention is to facilitate the stowing of cotton bales in vessels, and enable the stevedores to stow a much greater quantity in a vessel than is possible when the stowing is done in the ordinary manner.

Mr. George Hill, of White Hall, Ill., has patented an improved stew pan which can stand very intense heat without breaking, has a support that admits of a circulation of air under the vessel, and has ears for fastening the bail, which are so protected that they cannot be broken off by slight jars or shocks, as is the case with the ears of the ordinary earthenware pan.

Pocket scales designed especially for physicians practicing in the country and in small towns, where it is necessary for them to carry and weigh out their medicines, for family use in weighing medicine, and for prescriptions and other delicate weighing, have been patented by Mr. Isaac S. Hopkins, of Oxford, Ga.

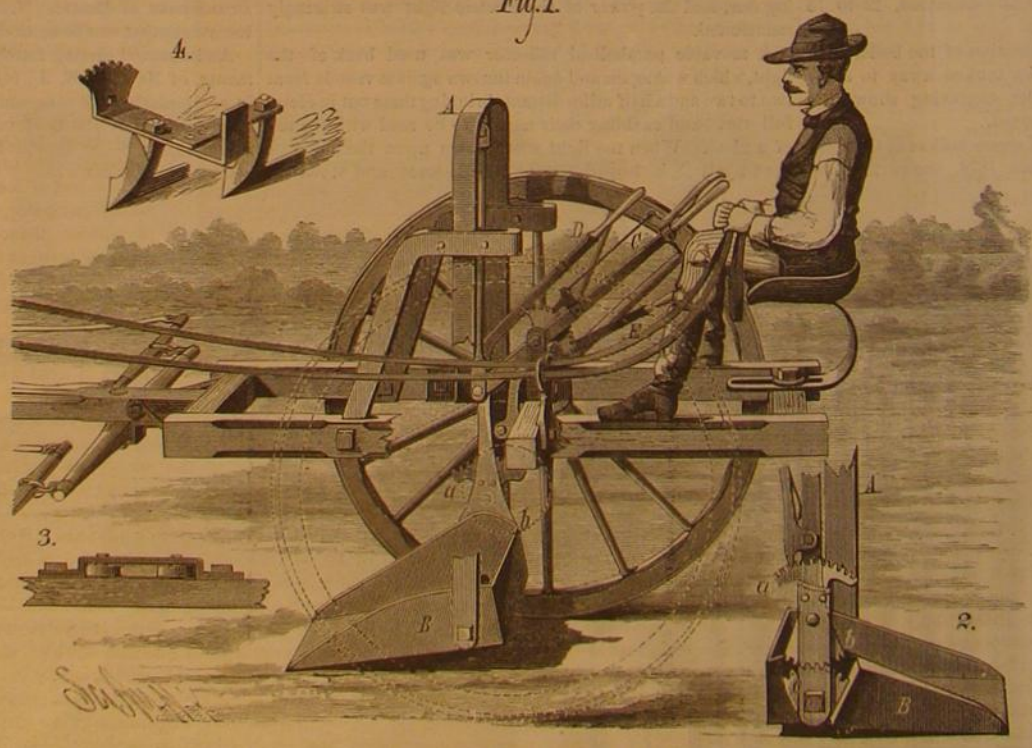
An improved device for testing milk by comparing its color with a scale of shades of colors, has been patented by Mr. Friedrich Heeren, of Hanover, Germany.

An improved last, for the manufacture of boots and shoes, has been patented by Messrs. John Martin and Josiah Merrill, of Great Falls, N. H. It can be changed to suit the style at a small cost.

NEW ROAD SCRAPER.

We give herewith an engraving of an improved road scraper for moving dirt from one locality to another and for leveling and grading. It is mounted on wheels and is provided with levers, by means of which every movement of the machine may be readily controlled by the driver, who sits on the seat at the rear of the main frame.

Fig. 1.



AGEE'S ROAD SCRAPER.

For the sake of showing the working parts of the machine one of the supporting wheels is removed, and parts of the framing are broken away.

A forked frame, A, is guided in roller bearings in the main frame and in the braces extending upward from the frame, and has pivoted between its lower ends the scraper, B, which is made either wholly or in part of iron or steel. A lever, C, is fulcrumed on a standard attached to the axle, and is connected with the upper part of the forked frame, A, by means of a connecting rod, so that the support may be moved up or forced downward as occasion may require. The lever, C, is provided with a pawl which drops into a toothed sector attached to the lever support, and holds the frame, A, at any desired height.

A toothed sector, *c*, is secured to the side of the scraper, and is engaged by another toothed sector, *b*, pivoted to the frame, A, and extended upward and backward, forming the lever, D, and the latter carries a toothed sector, *a*, which is engaged by a pawl pivoted to the side of the frame, A, and extended upward and rearward, terminating in the handle. This pawl locks the scraper securely at any desired angle that is in position to scrape up the earth, or with the edge elevated in position to retain the earth. It will be seen that with mechanism thus arranged the driver

can, without difficulty, depress the scraper and hold it, or he can raise it and hold it, or manipulate it in any desired way without a great deal of exertion.

Fig. 2 shows the details of the mechanism for operating the scraper. Fig. 3 shows the roller guide for the frame, A, and Fig. 4 shows a plow attachment that may be used in place of the scraper for loosening the soil preparatory to removal by the scraper. One of the plows is secured directly to the pivoted bar, and the other is secured to a short beam extending backward. These plows are raised, lowered, and tipped in one direction or the other by the levers used to operate the scraper. If desired, a single plow may be attached to the center of the pivoted bar.

The merits of this device will be appreciated by any one having had much experience with ordinary scrapers.

Further information may be obtained by addressing the inventor, Mr. G. S. Agee, Mint Hill, Osage county, Mo.

Elasticity Viewed as Possibly a Mode of Motion.

At a recent meeting of the Royal Institution, Sir William Thomson, LL.D., F.R.S., etc., said, with reference to the title of his discourse: "The mere title of Dr. Tyndall's beautiful book, 'Heat a Mode of Motion,' is a lesson of truth which has manifested far and wide through the world one of the greatest discoveries of modern philosophy. I have always admired it; I have long coveted it for elasticity; and now, by kind permission of its inventor, I have borrowed it for this evening's discourse.

"A century and a half ago, Daniel Bernouilli shadowed forth the kinetic theory of the elasticity of gases, which has been accepted as truth by Joule, splendidly developed by Clausius and Maxwell, raised from statistics of the swayings of a crowd to observation and measurement of the free path of an individual atom in Tait and Dewar's explanation of Crookes' grand discovery of the radiometer, and in the vivid realization of the old Lucretian torrents with which Crookes himself has followed up their explanation of his own earlier experiments; by which, less than two hundred years after its first discovery by Robert Boyle, 'the Spring of Air' is ascertained to be a mere statistical resultant of myriads of molecular collisions.

"But the molecules or atoms must have elasticity, and *this* elasticity must be explained by motion before the uncertain sound given forth in the title of the discourse, 'Elasticity Viewed as Possibly a Mode of Motion,' can be raised to the glorious certainty of 'Heat a Mode of Motion.'"

The speaker referred to spinning tops, the child's rolling hoop, and the bicycle in rapid motion as cases of stiff, elastic-like firmness produced by motion, and showed experiments with gyrostats in which upright positions, utterly unstable without rotation, were maintained with a firmness, strength, and elasticity as might be produced by bands of steel. A flexible endless chain seemed rigid when caused to run rapidly round a pulley, and when caused to jump off the pulley, and let fall to the floor, stood stiffly upright for a time till its motion was lost by impact and friction of its links on the floor. A limp disk of India-rubber caused to rotate rapidly, seemed to acquire the stiffness of a gigantic Rubens' hat brim. A little wooden ball, which, when thrust down under still water, jumped up again in a moment, remained down as if embedded in jelly when the water was caused to rotate rapidly, and sprang back as if the water had elasticity like that of jelly when it was struck by a stiff wire pushed down through the center of the cork by which the glass vessel containing the water was filled. Lastly, large smoke rings, discharged from a circular or elliptic aperture in a box, were shown, by aid of the electric light, in their progress through the air of the theater when undisturbed. Each ring was circular, and its motion was steady when the aperture from which it proceeded was circular, and when it was not disturbed by another ring. When one ring was sent obliquely after another, the collision or approach to collision sent the two away in greatly changed directions, and each vibrating seemingly like an India-rubber band. When the aperture was elliptic, each undisturbed ring was seen to be in a state of regular vibration from the beginning, and to continue so throughout its course across the lecture room. Here, then, in water and air was elasticity as of an elastic solid, developed by mere motion. May not the elasticity of every ultimate atom of matter be thus explained? But this kinetic theory of matter is a dream, and can be nothing else, until it can explain chemical affinity, electricity, magnetism, gravitation, and the inertia of masses (that is, crowds of vortices).

Le Sage's theory might easily give an explanation of gravity and of its relation *to inertia of masses*, on the vortex theory, were it not for the essential allotropy of crystals, and the seemingly perfect isotropy of gravity. No finger post pointing toward a way that can possibly lead to a surmounting of this difficulty, or a turning of its flank, has been discovered, or imagined as discoverable. Belief that no other theory of matter is possible is the only ground for anticipating that there is in store for the world another beautiful book to be called "Elasticity a Mode of Motion."

Drawings of Washington Monument Memorials.

A series of drawings of the various memorial stones contributed to the Washington Monument at Washington, was made thirty-one years ago, during leisure intervals, by Roger Williams Wilcox, then a young patent-model draughtsman. He died the following year; but his sketches were carefully treasured by his mother; and now in her old age they have been purchased by the Monument Association.

The stones form the inner walls of the memorial chamber in the base of the great monument. Many of the stones are of costly character, with highly wrought emblems and inscriptions upon them. The drawings are of especial value, because they represent the individual stones as they appeared soon after arrival in Washington, and before they were set up within the monument.

PORCELAIN URN.

Nothing is more beautiful than some of the richly ornamented pieces of pottery turned out of the factory at Sevres. The engraving shows a fine specimen of Sevres porcelain

PORCELAIN URN FROM KENSINGTON MUSEUM.

preserved at the Kensington Museum. It is remarkable for the elaborateness of its design and the delicacy with which it is treated in every part.

Stress and Strain.

At a recent meeting of the Royal Society, a paper on "The Influence of Stress and Strain on the Action of Physical Forces," was read by Prof. W. Grylls Adams, M.A., F.R.S. It was Part I., and related to elasticity: "Young's Modulus." A large number of experiments with different loads were made, and after many unsuccessful attempts to account for certain discrepancies which could not be explained away as errors of observation, the following facts were elicited:

1. After a wire has suffered permanent extension, the temporary elongation which can be produced by any load becomes less as the interval between the period of permanent extension and that of applying the load becomes greater.

2. This increase of elasticity is greater in proportion for large loads than for small ones.

3. The increase of elasticity takes place whether the wire be allowed to remain loaded or unloaded between the period of permanent extension and that of the testing for the elasticity.

4. The rate of increase of elasticity varies considerably with different metals; with some the maximum elasticity is apparently attained in a few minutes, and with others not till some days have elapsed, iron and steel being in this last respect very remarkable.

5. The elasticity can also be increased by heavily loading and unloading several times, the rate of increase diminishing with each loading and unloading.

6. A departure from "Hooke's law" more or less decided always attends recent permanent extension, even when the weights employed to test the elasticity do not exceed one-tenth of the breaking weight.

7. This departure is diminished very noticeably in the case of iron, and much less so in the case of other metals, by allowing the wire to rest for some time either loaded or unloaded; it is also diminished by repeated loading and unloading.

The effect of permanent extension on the value of "Young's modulus" was tried according to the direct method for iron and copper, and indirectly for most of the metals.

Steam Whistles in a Fog—Curious Phenomena.

Captain Shirley, of the steamer City of Lawrence, of the Norwich and New York Transportation Company's line, reports a strange phenomenon on the Sound during foggy nights, which is worthy the investigation of scientific men. He says that when the steamer City of Lawrence was three or four miles east of Stratford Shoals light, on the night of the 12th May, he heard a whistle which sounded off the starboard bow. He blew the whistle of his boat several times, giving two blasts each time, but could get no reply. He stopped his boat, blew three whistles, and was delayed some three minutes, when the steamer State of New York suddenly appeared, blew two whistles, and passed him on the left. On the same night, when near Faulkner's Island, the State of New York whistled to the north of the Lawrence. She blew two whistles, and the New York returned one blast, and she passed to the southward. Capt. Shirley did not hear her whistle from the time that he heard her first blast until she passed him. Whistles were heard to the eastward, but not to the westward that night.

Sunday night, when the Lawrence was two miles from Bartlett Reef lifeboat, the bell was heard plainly, but when the Lawrence had got within a mile of the lifeboat they lost the sound until within an eighth of a mile of it, when they saw the glimmer of the light. The same phenomenon occurred off the Cornfield light.

The water was calm, and a light northeasterly breeze was blowing. When off Huntington, on the same night, Captain Shirley heard a whistle blow four or five times. It then grew fainter and fainter, until it could be no longer heard. He thought that it was a steamer going away from him. After running for two or three minutes, he heard a whistle close ahead on the starboard bow. The Lawrence blew three whistles and backed, and had to hail a large tug with barges in tow to leave their helm to their starboard to prevent a collision. The tug passed the Lawrence with but ten feet of lee room. Capt. Mott, an old Sound navigator, remembers the occurrence of similar phenomena on the night of the collision between the steamers Stonington and Narragansett, in June, 1880.

Why the sound of whistles is not conveyed as well on a foggy night as on a clear one is a problem to be solved. It cannot be attributed to head winds or heavy seas, for the sea was calm and the air almost motionless. The signals at Huntington and Execution lights have been heard over fifteen miles against a northeast gale. The navigators of the Sound are anxious to have the phenomena explained.—*Norwich (Conn.) Bulletin.*

Elevated Railroads.

Elevated railroads are now entitled to rank among American institutions, and in the future will call for a large consumption of iron. There are, according to the *Iron Age*, three schemes of this character under discussion in St. Louis, and the only question is which shall be adopted. Philadelphia is making good progress in following the example of New York. Brooklyn encounters an obstacle, partly arising from the configuration of the surface, which favors the construction of tunnels, but the city is in desperate need of some form of rapid transportation. Boston hesitates, apparently on account of objections to architectural disfigurement. But elevated railroads in all our large cities is only a question of time, for while individual pieces of property may be injured by their propinquity, millions are added to the aggregate assessable value, and their convenience is beyond calculation.

The latest phase in New York is the employment of elevated roads for the transportation of freight. By no other method yet contrived can the jam of vehicles on our water front be relieved.

Correspondence.

Gamgee's Zeromotor.

To the Editor of the Scientific American:

Having some few years ago, in conjunction with Mr. Maxwell Lyte, F.C.S., made some experiments with liquid anhydrous ammonia as a motive power, I ask leave to make some remarks on Professor Gamgee's proposed engine; for it seems to me that both he and his critics have failed so far to put the matter in its true light.

You correctly state in your article of the 14th ult., that his engine is analogous to a steam engine which should exhaust into its own boiler. But it would be incorrect to say that such an engine would not work. An engine with a surface condenser, from which it draws the feed water for its boiler, does in fact exhaust into its own boiler. In such an engine heat is first introduced into the water from the heated gases in the fire box and tubes; and after the steam has done its work in the cylinder, it is condensed through the abstraction of heat by a stream of cold water. But the heat introduced in the boiler is found to be in excess of that abstracted in the condenser by an amount directly proportional to the work done by the steam in the cylinder. Consequently a certain amount of condensation has taken place before the steam enters the condenser.

In Professor Gamgee's proposed engine, atmospheric air or water at the same temperature is to be used as the heating medium, as the liquid in the generator is boiling at a much lower temperature. There is no condenser, or, as Professor Newcomb puts it, "there is no external source of cold." There, is, however, an abstraction of heat due to the work done in the cylinder, and to this extent a partial condensation of the vapors, the volume of which, at the initial pressure, being thus reduced, a smaller mass of vapor at the initial pressure and temperature will suffice to force it back into the generator. The balance of a mass of vapor equal to the original mass is then available to do a certain amount of outside work. The heat lost in the cylinder is to be replaced in the generator, as above stated.

It is, then, still the old story of the "*conservation of energy;*" and, theoretically, such an engine, after making its first stroke, ought not, as said by Professor Newcomb, to stop; but, if its parts are all properly proportioned, the cylinder and pipes perfectly non-heat-conducting, and the temperature of the air remain constant, it ought to go on continuously, doing a given duty.

But when we consider it from a practical point of view, we find, first, that a colossal engine will be required to do a very small amount of work.

In a condensing steam engine there is a difference of about 1,000 degrees (Fahr.) of heat between the steam issuing from the boiler and the water returning to it. On the other hand, in Professor Gamgee's engine, this difference will not exceed 60 degrees. There is no advantage to be gained by working with high ratios of expansion in this engine, as the heat converted into energy during the expansion will be restored during recompression. Without going into the question of the relative specific heats of water and ammonia, we may say roughly that, for the two engines to indicate the same power when working at the same number of revolutions, they must have cylinder capacities in inverse proportion to the above differences of heat respectively. Again, in the steam engine the difference of temperature between the gases in the fire box and the water in the boiler is about 2,000 degrees (Fahr.). In Professor Gamgee's engine, if a pressure of 100 pounds per square inch is to be maintained, the difference of temperature between the heating medium and the contents of the generator cannot exceed 60 degrees. We shall not be far wrong in saying that the heating surfaces of the two engines must be in inverse proportion to these differences of temperature respectively. If Professor Gamgee employ a continuous stream of water as his heating medium instead of air, his heating surface may probably be reduced to one-quarter that required for air; but then he is dependent for his stream of water on some force external to his engine, and which might probably be more usefully employed.

It is scarcely worth while going into any more practical objections to his engine, such as the loss of power through priming, leakage, and heat conduction through the parts of the engine, and many other points. I will only point out that a considerable amount of some form of energy will have to be employed to produce the anhydrous liquid ammonia, a great deal of which energy will be lost for any useful purpose in the shape of heat dissipated in the air, or perhaps a stream of water produced for the purpose. His engine will have to do, in order to pay for this, a very much greater quantity of useful work than I believe will ever be got out of it; for I doubt very much myself if it will even overcome its own internal friction.

VALENTINE G. BELL, M.I.C.E.,
Chief Resident Engineer, Jamaica Government Railways.
Kingston, June 4, 1881.

Pin Worms, and How to Get Rid of Them.

To the Editor of the Scientific American:

It is exceedingly desirable that people should know more of the history of *Ascaris vermicularis* (pin worm). Encyclopedias give everything about them excepting what we ought to know, even the pictures. Please give us a paper on the subject, not for scientists, but for parents. I am a man 60 years old, and shall die of them. I know of no relief for their poison but cool injections. Every few weeks they produce diarrhea, and the visible surface of my outflow will give fifty to the square inch, to say nothing of the millions out of sight. After these liberal outflows there is a *short* relief, but only *short*. We wish to know:

1. Where is their original home?
2. How do they enter our body?
3. How many days' incubation?
4. How many days' life?
5. Are not the eggs laid inside as well as outside the bowels?
6. Is it certain that they occupy only about five inches of the rectum?
7. How to be rid of the few left for seed after every looseness?
8. If derived from food, why all persons are not infected?

Please let these eight questions be answered, and oblige, yours faithfully, AN OLD SUBSCRIBER.

Boston, June 6, 1881.

Reply.

To the Editor of the Scientific American:

I take great pleasure in giving your correspondent the benefit of a protracted investigation of pin worms, which resulted in their complete and permanent extermination in the case in which I was immediately interested.

Like all the myriad parasites which afflict humanity, the pin worm probably came to man by migration from some of his poorer relations of the strictly animal world; it is not reasonable to suppose that Adam had them all.

It is commonly held that transmission is now made by the mouth, the eggs being taken in water or on infected food handled by persons afflicted with worms.

The eggs have been found under the finger nails of children and others troubled with pin worms. It is also on record that the worms have been found in the intestines of infants dead *in utero*, indicating either spontaneous generation or the circulation of the eggs in the blood of the mother.

The period of incubation is uncertain, probably three or four days, as it takes about a week for the intestinal tract to become infested after a thorough evacuation of its contents.

The belief that the worms inhabit the rectum only is a mistake. The breeding place of the pest is the cæcum, whence the worms descend or are involuntarily carried to the lower bowels and rectum. For this reason ordinary injections and medicines taken by the mouth afford only temporary relief. To exterminate the pest they must be reached (and the females killed) in the cæcum, particularly in that portion not purged when the intestinal tract is cleared in the ordinary way.

The simplest means of killing the worms the writer discovered by experiment to be by their immersion in *pure water*. Used to the denser secretions of the intestinal tract, the worms absorb water by endosmosis until they burst. Hence the rational and effective remedy by drowning the pests with copious injections of tepid water after the intestinal tract has been thoroughly washed out, the injections being ample enough to surely flood the cæcum.

The injection should be made while the patient is lying on the back; perhaps most comfortably and effectively while lying in the bath. It is best not to depend upon a single irrigation of the cæcum, as some worms may escape in folds of the lining, or eggs enough may be left to perpetuate the pest. A second flooding should be resorted to in three or four days, and to make assurance doubly sure, the flooding may be repeated once a week for several weeks. With patience and care a perfect and permanent cure can be effected. If your correspondent's physician finds nothing to render the treatment suggested inadvisable in his case, he can count on certain and immediate relief. Respectfully,

EXPERIENCE.

Worms 300 Feet Under Ground.

The Gold Hill (Nevada) *News* reports the discovery of a queer species of worms in the face of the Lord Lorne mine, near Lower Gold Hill. The worms occur in a solid stratum of stiff clay, 700 feet from the mouth of the tunnel, and 300 feet below the surface of the earth, amid the vein matter of that portion of the Comstock. Superintendent McDougal found quite a number of them by soaking and washing the clay, and they are no defunct relics of antediluvian times, but are all alive and kicking, incredible as it may appear. These queer little subterranean worms are about three-quarters of an inch long by about an eighth of an inch in diameter, short and thick, resembling some species of grub. Each is incased in a very neat little shell of silicious material, corrugated and firm, of a bluish cast, like silver ore, with small round spots, having a metallic luster. At his forward end appears a vicious-looking little head, and six legs or feelers capable of being easily folded when he draws back into his shell. On top of his head is a small helmet or cover, of the same material as the shell, so that when he hauls in for a snooze or self-protection his top-piece or helmet just closes the hole nicely. Why this hard shell covering or protective armor, or how it is that these very peculiar worms are found alive at such a depth in virgin ground, is not easy of explanation. Their presence can be accounted for on the score of some deep crack or disturbance of the earth at some time, yet what they are doing there and wha supports them is a mystery, for the clay is no way rich, though it is wormy. They certainly are a great natural curiosity.

AGRICULTURAL INVENTIONS.

Messrs. August W. Brenner and James Fraser, of Coleman, Texas, have patented an improvement in cultivators for cultivating stubble, sugar cane, cotton, corn, and other plants planted in rows or drills, which will remove the soil from the sides of the rows without injuring the roots, and will throw soil around the plants.

Mr. Nelson Dulaney, of Lynnville, Ill., has patented a sulky cultivator, so constructed that the plows can be readily adjusted to throw the soil toward or from the plants, and so that the inner plows can be guided along crooked rows to avoid irregular hills.

Cure for Sea-Sickness.

As "all the world and his wife" seem to be going to Europe this summer, sea-sickness and its cure is one of the most general if not the most popular topics for talk. Three New York doctors were recently interviewed upon the subject. The Brooklyn *Eagle* thus summarizes their opinion. One said there is only one one remedy for it—to stay ashore. But he subsequently admitted that that is not a complete remedy, for he added that land-sickness, caused by riding backward and in railway cars, is the same as sea-sickness. But another doctor, Dr. George M. Beard, says that within a year there is no disease about which so much has been learned, and which is so perfectly curable. It is a disease of the nervous system, mainly of the brain and spinal cord, comes from a series of mild concussions, and produces, by sympathy, disorder of the stomach. The remedy is bromide of sodium, taken three times a day a few days before embarking, and kept up at sea until the danger is passed. It renders the system less susceptible to the disturbances caused by the movements of the ship. The drug must be taken intelligently and on consultation with a physician. Dr. Hammond says that in his own case he has found ten or fifteen drops of chloroform on lump sugar and the use of bromide of potassium beneficial. All three doctors agreed that there is no benefit to be derived from sea-sickness except for those who are in the habit of eating too much. And if people are "the better for it," it is because the sea makes them better in spite of sea-sickness. "No more benefit can be derived from it than from an attack of typhoid fever," says Dr. Beard. If, therefore, it can be prevented without causing any other or any greater harm to the system, people are entitled to the full benefit of remedies that are really such.

The Registration of Plumbers.

A bill for the registration of plumbers and the supervision of all plumbing work by the Health Departments of New York and Brooklyn has been passed by the Legislature at Albany and approved by the Governor. The law with regard to registration will go into effect next March; the more important provisions take effect immediately.

The following rules, drawn up by the New York Board of Health, after consultation with intelligent plumbers and sanitary engineers, will probably be substantially adopted under the new law:

"When the [plumbing] work is completed and before it is covered from view the Board of Health is to be notified, that it may send inspectors, upon whose report the board will act upon its final approval.

"All materials to be of good quality and free from defects; the work to be executed in a thorough and proper manner.

"All the plumbing in the house so placed as to be readily inspected.

"Every soil-pipe and waste-pipe of iron, and extending through and at least two feet above the roof, of undiminished size.

"No traps on vertical soil-pipes or vertical waste-pipes.

"The house drain of iron, with a fall of at least half an inch to the foot, and provided with a proper trap near the street, and with an inlet for fresh air just inside the trap. It should run along the cellar wall, and never be hidden under ground.

"These iron pipes to be sound, free from holes, and of a uniform thickness of not less than one eighth of an inch for a diameter of two, three, or four inches, or five thirty-seconds of an inch for a diameter of five or six inches. Before they are connected they should be thoroughly coated inside and outside with coal-tar pitch, applied hot, or with some other equivalent substance.

"All joints in the soil-pipes and waste-pipes so calked with lead, or with cement made of iron filings and sal ammoniac, as to make them impermeable to gases.

"When lead pipe or trap is connected with an iron pipe, the joint should be made through a metallic sleeve or ferrule, and calked with lead.

"Every sink, every basin, every watercloset, and every tub or set of tubs separately and properly trapped.

"All traps ventilated by a special pipe extending above the roof.

"Every 'safe' under a basin, refrigerator, or other fixture, drained by a special pipe not directly connected with any waste-pipe, drain, or sewer.

"Every watercloset supplied with water from a special cistern, and not by direct connection with the Croton supply.

"No overflow pipe from a cistern to be directly connected with any soil-pipe, waste-pipe, or drain.

"When the pressure of the Croton is not sufficient to supply the cistern a pump should be provided.

"No cistern for drinking water to be lined with lead."

THE PROSPECTS AND PRESENT STATE OF PHOTOGRAPHY IN NATURAL COLORS.

IN TWO CHAPTERS.

I.

From the fact that the production of photographs in natural colors has twice within the past few weeks been brought forward with some degree of prominence, once at a meeting of the Polytechnic Section of the American Institute, and also at the last meeting of the Association of Operative Photographers of New York, a brief glance at the nature, modes, and prospects of heliochromy may be useful. Already photographs are taken on plates prepared by modern processes possessing such sensitiveness as to enable one to depict the action of the horse's foot in trotting, or, as was shown at the recent fair of the above institute, the swift steamboat arrested as it dashes at full speed across the line of vision of the camera. It only now remains that the splendid discovery of photography be crowned by the further discovery of the means of obtaining pictures possessing all the colors of nature, and by means so simple and certain as to be within the compass of the powers of the average operator.

The fact that several wise men, who have been imperfectly acquainted with the subject, have shaken their heads at the idea of its being possible to produce photographs having the colors of nature, need not greatly distress the experimentalist. What scathing contempt was hurled by the College of Physicians at the head of the discoverer of the circulation of the blood when he announced the fact! With what keen point did the far-seeing Sir Walter Scott ridicule the idea of a street being lighted by gas! Who is unaware of the pity expressed for the mental condition of those who proposed ocean steam navigation, communication by telegraph, and indeed nearly every startling advance in the applications of science? Even the unreasoning bigotry displayed by the British Parliament when George Stephenson advocated railway traveling by steam, was insufficient to prevent his gifted son, Robert Stephenson, from ridiculing the French project of the now accomplished Suez Canal; while in the science of photography the late Sir David Brewster often declared the impossibility of producing an accurate photograph unless by a lens the size of that of the human eye. The true investigator, while not ignoring past experience, must march beyond it.

It is a fact, to which some of the earlier volumes of the SCIENTIFIC AMERICAN bear attestation, that photographs bearing the colors of nature have been taken, and this not by a happy accident, but by design. The beaten tracks in photographic chemical routine must be departed from to secure an end, in the accomplishment of which certain well accredited laws of physical science are overridden; for, as was remarked by a speaker at one of the meetings alluded to, heliochromic chemistry recognizes an entire change in the relative activity of the various colors of the spectrum. Blue or violet light, which in ordinary photography is synonymous with white in its actinic power, here acts in the most laggard manner, while the comparatively non-chemical red light, which produces so little change upon the sensitive plates in common use, here acts in the most energetic manner.

Two objections may reasonably be urged against such examples of heliochromy as up to the present time have been produced: It is an exceedingly difficult matter to fix the colors when once obtained; and when so fixed the colors are sadly deficient in beauty and brilliancy. True, they are sufficiently pronounced to render it easy to distinguish the colors from each other, but they are yet far from being able to satisfy the requirements of a utilitarian age. Their production is a scientific, but not yet a commercial fact. Owing, perhaps, to some imaginary innate difficulty in the operations, or possibly to a want of faith in ultimate success, the laborers in this field are indeed few, the progress being commensurate. The whole superstructure of heliochromy rests as yet upon the foundations laid in 1839 by the late Sir John Herschel, who observed that paper sensitized by chloride of silver and darkened by exposure to light was then in a condition to reproduce certain colors when again exposed to the action of light under pieces of glass of various colors. From his experiments he was led to declare his belief that photography in natural colors might reasonably be expected to be brought within the range of accomplishment.

For the guidance of those readers who may feel desirous of instituting researches in this direction, we shall give outlines of the most successful methods by which experimentalists have worked. A polished plate of silvered copper, as used for daguerreotype, is immersed in a mixture of one part of sulphate of copper, two parts of common salt, and five of water, three ounces of which, together with a like quantity of a saturated solution of common salt, are diluted with eighteen ounces of water. It will be perceived that bichloride of copper and sulphate of soda are formed by the mixture of these substances. Into this bath the plate when immersed is rapidly coated with a violet subchloride, and this, after washing and drying, is all the preparation the plate requires to enable it to receive the colors of nature. Another method of preparing silvered plates consists in attaching one to the positive pole of a galvanic battery, a piece of platinum foil to the negative pole, and then immersing in greatly diluted muriatic acid. In the course of a minute it will pass through several stages of coloration, including yellow, blue, green, rose, and violet, at which last it must be removed, washed, dried, and heated slightly till it becomes a red color. It is now sensitive, and becomes readily impressed with all the colors. There is reason for believing, although such fact has never been published, that by this method were prepared the plates upon which Becquerel produced his famous photographs of the spectrum showing the colors. When paper or glass plates are employed instead of the silvered copper the methods by which they are prepared are analogous to those described, at least in principle. A sheet of subchlorized paper having been floated upon a solution of bichromate of potash, chloride of potassium, and sulphate of copper, and then dried in a darkened room, is now ready for exposure. In one experiment made it required an exposure under a painted magic lantern slide for a quarter of an hour to print the colors, on which occasion it was noticeable how much sooner the reds printed than the blues. Modifications of this method of preparing paper, involving the employment of nitrate of mercury, with the subsequent use of chlorate of potash and dilute sulphuric acid, have yielded paper so sensitive as to receive impressions in less than a minute. When glass or porcelain are used instead of paper, a film of collodion should be the medium in which to form the sensitive subchloride of silver, a process now easy of accomplishment.

When making some experiments under the direction of M. Chevreul, M. Niepce de St. Victor, who tried his heliochromic experiments on a large doll bedecked with jewels and resplendent with colored silk, made the remarkable discovery that black is not the mere absence of light, but is entitled to be considered a color of itself, and has a special chemical action of its own. The color of the sensitive plate was violet, and on this the camera impressed all the colors of the doll, including white; but, as the blacks had also been impressed *as* black, it led to this experiment: A hollow tube, black from the absence of light, was presented to the camera, together with another article of a definite black color, with this result, that the former was represented by an unaltered state of the original violet color of the surface, while in the latter case a very deep black resulted. The philosophy of or deductions from this singular discovery do not now claim our attention.

If the present state of photography in colors by natural or chemical means is unsatisfactory, not so is that by artificial pigments, applied, however, by the agency of light itself. This phase of heliochromy will be treated in another article.

Completion of the Eddystone Lighthouse.

Within another month or so—much earlier than was originally anticipated—the actual building of the new Eddystone Lighthouse, so far as the masonry is concerned, will be completed, and the work of furnishing it with the lighting apparatus will then speedily begin. The whole of the stonework of the lighthouse is in fact not merely constructed, but in the hands of the actual builders, whose work consists in conveying the already prepared blocks to the reef, and fitting them in their places there. The contract for the provision of the stone for the construction of the lighthouse was, it will be remembered, taken by Messrs. Hugh Shearer & Co., of 21 Great George street, Westminster, the owners of the De Lank granite quarries near Wadebridge, and of granite quarrying rights away to Rough Tor, over an area of something like twenty square miles. The stones have been wrought in a yard at Wadebridge, where every one of 2,200 of which the lighthouse is composed—they weigh in all 6,000 tons—has been brought to the precise dimensions required and fitted to a hair's breadth, the whole of the structure being built up section by section preparatory to its shipment. This work has now been brought to a close by Messrs. Shearer & Co. six months before the expiration of the time allotted in their contract, and the last stone of the outward curve of the top gallery was dropped into its place in the presence of Mr. Douglass, the engineer of the work, who heartily congratulated Mr. Shearer upon the style in which the contract had been executed.

The completion of the work by the present date is a matter of great importance, as it saves very much more time in the erection than the six months gained on the contract, in consequence of the early period of the season, which will enable the fitting of the lantern, and is to be proceeded with almost at once. The lighthouses of the Great and Little Basses, Ceylon—executed at the Dalbeattie granite quarries of Messrs. Shearer, Field & Co.—were also carried out much to the satisfaction of all concerned, as in the present instance well within the time named in the contract. The stones for the Eddystone have, of course, varied somewhat in size, but those of the base may be cited as fair examples, and they are each 6 feet 6 inches deep, 2 feet thick, and 3 feet 10 inches on their outer circumference.—*Building News.*

Important Photographic Discovery.

At the meeting of the Photographic Society of Great Britain, London, May 10, Mr. Warnerke proceeded to give the details of a new discovery he had made respecting the action of pyrogallic acid on gelatino-bromide. This discovery consisted in the fact that a gelatine plate submitted to pyrogallic acid became insoluble in those parts acted upon by light, exactly in the same way as gelatine acted upon by chrome salts, the insolubility being in proportion to the amount of light and the thickness of the gelatine. This property Mr. Warnerke proposes to utilize in various ways. The drawback in the ordinary gelatine process being that, unless the exposure is very accurately timed, there is considerable danger of overexposure, and intensification being very difficult, pictures by the gelatine process are often inferior to those by collodion. By the new process he was, however, able not only to intensify, but also to overcome the drawbacks arising from overexposure. The latter he effected by using the emulsion on paper. He had found that no matter how much the paper was overexposed, the picture, provided the developer was restrained sufficiently, was not injured, while in the case of the emulsion on glass, there was not only halation of the image, but a reversal also. The transfer of the image from paper on to the glass is very easy. The paper is immersed in water, and placed in contact with a glass plate. The superfluous moisture being removed by a squeegee, the paper may then be stripped off, leaving the gelatine on the glass. Hot water is then applied, which dissolves all the gelatine not acted on by light, and the image is left upon the glass in relief. Intensification Mr. Warnerke effected by mixing with the emulsion a non-actinic coloring matter, and which is not affected by silver. Aniline colors he had found answered the purpose, and in this way special emulsion for special purposes could be prepared. This method of preparation he thought would be especially suitable for magic lantern slides. Mr. Warnerke claimed that by his discovery relief could be obtained far more easily than by the ordinary bichromatized gelatine, and therefore it was especially suitable for the Woodburytype process. By mixing emery powder with the emulsion it was rendered fit for engraving purposes, and by a combination with vitrified colors the image could be burnt in, and being so adapted for enamels. By using a suitable emulsion, however, so little gelatine could be employed as to obviate all difficulty in carbonizing. The process could also be adapted for collotype printing.

In the course of his remarks, Mr. Warnerke demonstrated the removal of a gelatine picture produced by his method from paper to glass, and showed that the mere immersion and washing in hot water fixed the picture by the dissolving of the gelatine unacted upon by light, which thus carried away the unchanged bromide of silver.

In conclusion, Mr. Warnerke stated that the sensitive paper could be used in the camera in lengths, wound on rollers, and exhibited a slide which he had made for the purpose.

MISCELLANEOUS INVENTIONS.

An improved ice house door fastener has been patented by Mr. Francis Keil, of New York city. The invention consists in a novel combination of latching and locking mechanism, and the combination therewith of mechanism for wedging the door to its seat.

An improved gate, which can be conveniently opened from a vehicle, has been patented by Mr. Henry Salisbury, of Newburg, N. Y. The gate consists of a series of horizontal rails or slats pivoted to end uprights, the inner one of which is hinged to a post, and has a beam pivoted to its upper end, the outer end of which beam is connected with the outer end of the gate by a pivoted rod, and the inner end of this beam is provided with a weighted roller and suitable stops, so that when a rope is pulled the latches will be raised, the inner end of the beam will be raised, and the weighted pulley will roll to the end of the beam, thereby raising the outer end of the gate, which can be swung open by pulling on the rope.

A simple, inexpensive, and efficient reflector, which may be readily applied to ordinary lamps or lanterns, and as readily detached when not desired, has been patented by Mr. Henry E. Haley, of Monroe, Me.

Mr. Henry W. Mattick, of Lawrenceburg, Ind., has patented a composition for filling the pores of wood, consisting of gum shellac cut in alcohol, kauri gum, spirits of turpentine, drying oil, raw linseed oil, and red lead.

An improved bail fastener, patented by Mr. John A. Marston, of Centre Sandwich, N. H., consists in combining with a splint basket and bail a metallic strip clasped about the bail, and having both ends then passed between two splints and bent divergently over them.

An improved corset has been patented by Imogene E. Banker, of Brooklyn, N. Y. The object of this invention is to furnish corsets that will give proper shape and can be worn without discomfort, and to dispense with paddings and other devices used to give form to ill-shaped persons.

Neckties and scarfs, as usually worn, are pinned to the collar, so as to be retained in place. Mr. Myer Hellman, of New York city, has patented an improved device, which is a substitute for pins for accomplishing the same object, and has the additional advantage of being more convenient in use, always at hand, and allowing adjustment after the collar and neckwear are put on the person.

A head rest, which can be folded compactly for transportation, and can be erected in a short time, has been patented by Mr. Heinrich Strauss, of Nüremberg, Germany. The head rest is formed of a sheet or piece of fabric attached to a frame, which is so constructed that the sheet is held inclined, and its tension can be regulated at will.

An improved tool for handling, opening, closing, and scraping boxes, barrels, bales, etc., has been patented by Mr. William H. Bickelhaupt, of New York city. The invention consists in a hook attached to a transverse handle, with a hammer head at one end and a claw at the other end, the hook being provided with a scraping knife projecting in the opposite direction of the hook.

Mr. Jean Escoubès, of New York city, has patented an improved shutter bower, in which a curved bar is used in combination with a catch.

An improvement in end gates for wagons has been patented by Mr. Matthew F. Allen, of Nashville, Tenn. The object of this invention is to facilitate removing the end gate of wagons for the purpose of discharging the load without removing either of the body rods. It consists in an end gate provided at one end with a sliding piece pressed outward by suitable springs, and provided with a hasp or handle, by means of which it can be withdrawn from between two cleats of the side of the wagon, so that the end gate is shortened sufficiently to be withdrawn from between the sides of the wagon.

An improvement in sewing machines has been patented by Messrs. William G. Wilson, George S. Darling, and Henry Wulff, of Chicago, Ill., assignors to Wilson Sewing Machine Company, of same place. The improvement relates to sewing machines of the class using oscillating shuttles; and it consists in certain novel features of construction that cannot be clearly described without engravings.

An improved mechanical movement has been patented by Mr. Joseph Harris, Jr., of Boston, Mass. This invention is an improvement upon the machine for changing a reciprocating into a rotary motion, described in letters patent numbered 7,902, which were granted to the same inventor January 14, 1851.

An improved spindle and bolster, in which the spindle is firmly supported, and, with its attached whirl, can be conveniently detached from the bolster when required, has been patented by Messrs. Joseph Duffy and Henry Whorwell, of Paterson, N. J. The spindle is constructed with oil chambers that facilitate the lubrication of the spindle bearings.

An improved machine for revolving cans in solder has been patented by Mr. David Klump, of Moorestown, N. J. The invention consists in a ring provided with set screws for securing it to a fire pot, and also provided with a slotted arm having the base plate of a perforated upright secured to it adjustably by a set screw, a standard secured adjustably in the perforated upright by a set screw, and having an adjustable collar clamped to its upper end, and a cylinder secured in the said collar and carrying a rotary shaft having arms attached to its forward end, and held forward by a spiral spring, so that the can will be revolved by rotating the shaft.

A glove fastener, which is durable and effective, and does not tear the glove, has been patented by Mr. Joseph Whitby, of Yeovil, County of Somerset, England. The invention consists in a hollow stud containing a spring which projects through slots in the sides of the stud and catches on a shoulder of an eyelet as the stud is passed through or into the eyelet, thus locking the two together, the eyelet and stud being fastened to the opposite lapels of the glove.

An improvement in stoves has been patented by Mr. William Clark, of Troy, N. Y. The object of this invention is to improve the construction of the stoves for which Letters Patent No. 122,156 were issued to the same inventor December 26, 1871, to adapt it for burning bituminous coal, and to allow the ashes to be more effectually shaken out of the fire box. The invention consists in constructing the fire box with offsets in the upper parts of its sides, and the case with openings provided with dampers in the upper parts of its sides through which air can be admitted to the upper part of the fire box, to adapt the stove to burn bituminous coal.

Mr. David Untermeyer, of New York city, has patented a finger ring so constructed that the shank can be detached from the heads and replaced with a larger or smaller shank

An improved vehicle wheel has been patented by Messrs. Charles W. Ball and Thomas Davis, of Macon, Ill. The invention consists in combining with the spokes of a wheel, a tire and metallic felly, forming a T-bar, and spoke sockets arranged on both sides of the felly, whereby strength and durability are secured to the wheel.

An improved gate latch has been patented by Mr. Albert L. Grayson, of Rutherfordton, N. C. It consists of a wire or rod of iron bent into a square loop, one end of the rod being extended to pass through the gate and have a knob or other means of turning or swinging the loop for unlocking the gate secured to it, the loop being adapted to catch over a triangular projection or keeper secured to the gate post.

A fireplace which will cause complete, or nearly complete, combustion of the gases and smoke produced by the burning fuel, and at the same time radiate the heat in a downward direction to heat the lower stratum of air, has been patented by Mr. Gerard R. Ricketts, of Quaker Bottom, O. The invention consists in an inclined radiator having current or gas arresters or deflectors on its front face, one of which may have a suitable draught passage.

Mr. William Taylor, of Chicago, Ill., has patented a device by which mops may be easily and conveniently wrung. The invention consists, principally, of two metal skeleton frames hinged together, each carrying a roller, one of the frames being curved to fit the bottom and the edge of the bucket or tub.

Mr. George C. De Lametter, of North Wolcott, N. Y., has patented an improved apparatus for drying fruit, the object of the invention being to obtain sufficient draught of heated air without the use of a blower, and to prevent the fruit on the upper trays from being sweated by the damp air rising from below.

An improved millstone sharpener has been patented by Mr. Patrick Graham, of Stockholm, Sweden. The invention consists of one or more toothed disks mounted upon or forming part of a radial arm connected with the driving spindle, to adapt the sharpener to break or sharpen the grinding surface of a millstone by being moved over the surface under pressure.

A cheap, durable, and efficient trace holder for harnesses, one which will hold the cockeyes in any position on the harness, and one with which the cockeyes may be engaged and disengaged without trouble, has been patented by Mr. Volney Stepp, of Manhattan, Kan.

Mr. Philip Thorpe, of New York city, has patented an improved pneumatic refuse-conveyer, whereby the refuse of the dwellings and the sweepings of the streets of cities may be deposited into proper receptacles and released therefrom into underground pipes, to be conveyed therein by pneumatic pressure to any desired discharging point.

A cultivator which shall be adapted for cultivating different kinds of grain, and for use upon stony or stumpy ground, has been patented by Mr. Clinton Mendenhall, of Martinsburg, W. Va. The invention consists in a wheeled frame having lugs and inclines on its forward end, and a system of levers and shafts, by means of which the plows may be lifted out of the ground.

Mr. Francis B. Snodgrass, of Harrisville, W. Va., has patented an improved root-cutting plow, so constructed as to rise and pass over obstructions that cannot be cut, and which will allow the colter to be adjusted and reversed.

An improved friction brake has been patented by Mr. Abraham O. Frick, of Waynesborough, Pa. This invention relates to improvements upon that form of friction brake in which two segmental sections or shoes are made to bear against the opposite sides of the periphery of a wheel to arrest the movement of the latter.

Mr. Napoleon Prince, of St. Boniface, Manitoba, Canada, has patented a windmill, so constructed that it can be adjusted to run at any desired speed and in either direction, which will adjust itself, as the force of the wind varies, so as to run at a uniform speed. It can be readily thrown out of the wind and can be instantly stopped.

The Engineer's Inspector.

In rolling mills and constructive ironworks a familiar and well-recognized personage is the engineer's inspector, whose duty it is, or ought to be, to test the manufactured iron, to inspect the quality of material and workmanship throughout its various stages during its progress of manufacture toward completion, and to insure their reaching the standard of perfection required. He is considered the *bete noir* of contractors, who are obliged, from policy, to hold the candle to him, and to adopt all kinds of ingenious devices to keep themselves in his good books and favor. There are inspectors and inspectors, in the same way that there are contract specifications and specifications. The *Design and Work*, London, thus classifies these personages: We have the gentlemanly inspector, whose object and pleasure it is to assist the contractor in carrying out the work intrusted to him in accordance with the common-sense terms of a fair specification. These gentlemen it is a pleasure to have about a works. They practically save the contractor the cost of an additional foreman, overlooker, or leading workman. Again, we have other inspectors, who are certainly not gentlemen in any sense of the term, whose only aim and effort appears to be to give the contractor as much trouble as possible, who continually interfere in every petty detail, and generally, as they say, have their pound of flesh. These men would have the contractor remodel and rearrange his works to suit their ideas and convenience—no two inspectors probably agreeing in their requirements, they would have the various operations and processes performed at a different time or place to that in which the establishment had been accustomed. This class of inspectors gives rise to great annoyance among contractors, and arouses a great amount of ill-temper in the workmen, who sometimes are irritated so far as to rebel and refuse to work under their inspection. When two or three of this type get together over their beer and tobacco, they laugh, chuckle, and relate anecdotes of how they have *done* this contractor, and made another one pull so much of the work to pieces as would satisfy their own sweet will—in fact, they appear to glory in the annoyance they cause.

If any of the foremen or higher officials belonging to the works offend one of this class, woe betide the unfortunate contractor. They revenge themselves upon the unoffending iron. More test pieces must be cut from the largest plates and longest angle and T-bars. Everything is rejected or objected to, if by any manner a pair of spectacles or a microscope can be found to reveal a flaw. Kirkaldy's chamber of horrors (museum of fractures, as it is euphemistically called) is invoked—and you may be sure that this inspector will have his pound of flesh, if man ever had it. The contractor may use strong language, sigh, or groan, to no effect, as the specification has him in a net, when it says, as is usually the case, that the work is to be done to the satisfaction of the engineer or his deputy.

Another class of inspectors may be termed the nervous class. These are perhaps more to be pitied than blamed, but they are perhaps more aggravating than any others. They cannot make their minds up whether a piece of work is good enough for them or not, so they keep pecking at it, first having one part pulled to pieces, and then another, until the whole is reduced to its original state of raw material; and then, perhaps Mr. Inspector adds at the last: "Ah, I think it would have done, after all!"

Another class is that of the thirsty inspectors. These are always in a state of chronic thirst, and continually throwing out hints that "this is a dry shop," or that "it is very hot to-day." They expect to be treated on every possible occasion, and of course, as it is in the power of the inspectors to hinder the execution of work, and cause the contractor extra expense, a system of judicious bribery is adopted toward them. In some works a small cellaret is kept stocked in the inspector's office with his choice liquor. In other cases constant adjournment is made to the nearest public-house or hotel, where the proprietor or his deputy gives him a "skinful," a tough old drinker being told off for his companion. In high-class works a butler is kept, and the inspector is dined *en règle*. In other works a kind of table d'hote is served for the chief officials, to which Mr. Inspector is invited, and it is curious to notice his visits are timed about meal times—he accidentally drops in just about lunch or dinner time. If late, he comes into the office with "Good morning," "How do you do?" "Oh, I am as hungry as a horse!" Or it is, "I have lunched, but I have had no whisky." To which the proprietor responds by calling John to take Mr. Inspector over the way to lunch.

Some inspectors require more positive bribery even than food and drink, and various devices are resorted to to find out the particular sum that is sufficient for the purpose. Numerous anecdotes, real and apocryphal, are current in many works. Thus we have an inspector finding fault with the work, when the manager comes up, and the conversation takes this line: The manager says: "I suppose if I were to put a sovereign over each of your eyes you could not see this?" To which the inspector replies: "No, I could not see it; and if you were to put another over my mouth, I could not speak about it." Another instance: The proprietor says to the inspector: "I say, do you think £200 would plane those edges and joints?" To which is replied: "I dare say it would." "Well, it's yours if you plane them." "All right," says the inspector. It is needless to say the joints and edges were never planed.

A continuous system of judicious bribery enables this class of inspector to save money enough to retire comfortably in old age. Many German and French firms, with their usual minute accuracy, include in their estimates definite sums for dinners and presents to the engineers and inspectors, but English firms leave these charges to go in with the working expenses. It is a difficult thing to know exactly where to draw the line between ordinary politeness and hospitality and deliberate bribery.

Another type of inspector is the occasional inspector, who is generally a pupil of the engineer. This young gentleman looks as if he had just come out of a bandbox. He is got up in lavender kid gloves, eyeglass, and clothes of the latest fashion; he comes down to the works in style; there is no getting over him, in his estimation, although, to judge from appearances, his knowledge of iron and steel is of a very remote character. He may have heard or read of such things, but it is questionable whether he has seen them often enough to recognize them without explanation. This type of inspector gives rise to much amusement, and affords scope for practical jokes and hoaxes of the "verdant green" style.

Many inspectors cannot trust a contractor or any of his workmen an inch further than he can see them. He will have the plates and bars cut out of the work itself, or have the test bars of castings out of the same ladle, and even in extreme cases will insist on the test bars being cast bodily on to the particular casting under inspection.

As a general rule the lower the status of the inspector the more troublesome is he to the contractor. The engineer, if the designer of a structure is satisfied with a plain, good, substantial job, will not object to the alteration of a section of iron, provided there is no loss of strength, nor will he object to small defects; but the small inspector is either too nervous, too particular, or too consequential to consent to any such deviation from the drawings and specifications as this. We are inclined to think that work is much overinspected at the present time, and very much question whether work has improved in quality in comparison with the increase of inspection. We don't think many great improvements have come from inspectors in the manufacture of iron and steel. We may point to two great examples in bridge structures—the Menai Tubular Bridge and the ill-fated Tay Bridge. The first was erected before the days of rigid inspection and engineering vagaries, the last was built when the modern system was in full bloom. We may remark that no amount of inspection will compensate for errors in design. We are not advocating the abolition of the inspector, but the judicious advocating the abolition of the inspector, but the judicious use of him, and careful selection of men for the office. Contractors before tendering for work always want to know who the inspector is, what sort of a man he is, and to gather some the inspector is, what sort of a man he is, and to gather some information about the inspection, as so much depends upon the individual that it constitutes to them a serious item—in fact, it is a question of profit and loss.

There is too frequently a species of unfairness about the drawing up of specifications and the interpretation of their clauses by the inspector. Looking at the other side of the question, the inspector is placed in a very difficult position. He stands between two stools. He has to do his duty to his superior officer, to see the work carried out with efficiency and correctness, and yet retain a character for amiability. Some contractors take a delight in irritating an inspector in every possible manner; and if he recriminates, they at once cry out, He is disagreeable, overstrict, unfair, etc.

The inspector is the outcome of the present age of commercial activity, and as such, concludes *Design and Work*, we have given him a place in our portrait gallery of working hands and working heads

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Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 380.

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Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

See Bentel, Margedant & Co.'s adv., page 412.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 10 Cortlandt St., N.Y.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

Gardiner's Pat. Belt Clamp. See illus. adv., p. 413.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

For Sequeira Water Meter, see adv. on page 364.

Clark Rubber Wheels adv. See page 380.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 381.

Safety Boilers. See Harrison Boiler Works adv., p. 381.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 381.

The Sweetland Chuck. See illus. adv., p. 396.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Soloman's Parallel Vise, Taylor, Stiles & Co., Riegelsville, N.J.

Skinner's Chuck. Universal, and Eccentric. See p. 397.

Steam Engines; Eclipse Safety Sectional Boiler. Lambertville Iron Works, Lambertville, N. J. See ad. p. 381.

Clark & Heald Machine Co. See adv., p. 413.

50,000 Sawyers wanted. Your full address for Emerson's Hand Book of Saws (free). Over 100 illustrations and pages of valuable information. How to straighten saws, etc. Emerson, Smith & Co., Beaver Falls, Pa.

Telegraph, Telephone, Elec. Light Supplies. See p. 413.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 412.

Elevators, Freight and Passenger, Shafting, Pulleys and Hangers. L. S. Graves & Son, Rochester, N. Y.

For the manufacture of metallic shells, cups, ferrules, blanks, and any and all kinds of small press and stamped work in copper, brass, zinc, iron, or tin, address C. J. Godfrey & Son, Union City, Conn. The manufacture of small wares, notions, and novelties in the above line, a specialty. See advertisement on page 413.

Gear Wheels for Models (list free); Experimental Work, etc. D. Gilbert & Son, 212 Chester St., Phila., Pa.

Diamond Saws. J. Dickinson, 64 Nassau St., N. Y.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. B. Dudgeon, 24 Columbia St., New York.

Gould & Eberhardt's Machinists' Tools. See adv., p. 414.

Blake's Patent Belt Studs. The strongest fastening for leather and rubber belts. Greene, Tweed & Co., N.Y.

Walrus Leather, Walrus Wheels, Pure Turkey Emery, Star Glue for Polishers. Greene, Tweed & Co., N. Y.

The Medart Pat. Wrought Rim Pulley. See adv., p. 413.

For Heavy Punches, etc., see illustrated advertisement of Hilles & Jones, on page 413.

For best Duplex Injector, see Jenks' adv., p. 413.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 414.

Drop Hammers, Power Shears, Punching Presses, Die Sinkers. The Pratt & Whitney Co., Hartford, Conn.

Catechism of the Locomotive. 625 pages, 250 engravings. The most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for a catalogue of railroad books. The Railroad Gazette, 73 Broadway, New York.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

The only economical and practical Gas Engine in the market is the new "Otto" Silent, built by Schleicher, Schumm & Co., Philadelphia, Pa. Send for circular.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 414 Totten & Co., Pittsburg.

4 to 40 H. P. Steam Engines. See adv. p. 414.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) C. B. C. writes: I am about painting my brick house, and a friend suggests using what is called "Brilliant Stucco Whitewash," that it was very much cheaper than oil colors, and, if properly put on, would be as durable as oil colors. He said one end of the White House, Washington, was painted with it and had proved a success. A. The stucco whitewash (see answer to O. E. C., page 375 (40), last volume), when properly prepared and applied, answers very well for out-of-door brick and wood work, and has been used with satisfaction on the north wall of the White House. It does not cover old painted walls so well.

(2) J. A. M. writes: I have a carriage which is trimmed with blue cloth, or rather cloth which has been blue, but now it is much faded. How can I put on some color without taking the trimmings off? A. Dissolve completely 1 oz. good cotton blue (aniline blue 6 B) in alcohol 1 pint, mixed with warm water, 1 quart. Apply with a full brush quickly, so as to obtain a uniform color.

(3) D. A. writes: In your paper, the SCIENTIFIC AMERICAN of May 21, you state the large steam cylinder cast at the Morgan Iron Works was made of gun metal. Will you please inform me through your paper if it was made of brass gun metal or iron gun metal? A. Iron gun metal.

(4) P. N. asks: What is the best method of ventilating an ordinary country school house, the usual size of which is 24x16 feet, and 10 feet high? Suppose the number of pupils to be twenty-five or thirty, and the room to be heated either by wood or coal stove, is the outside pure air heavier than the warm carbonic acid inside the school room? If the warm carbonic acid inside (which settles at the bottom of the room) is lighter than the cold outside air, how can it be forced or got out of the room? If heavier, how can the outside air get in the room near the bottom? Does an ordinary stove remove much more carbonic acid gas than is created by the combustion of the fuel, this on the supposition that there is considerable carbonic acid in the room resulting from breathing, etc.? A. The plan employed in the United States Army Hospitals is perhaps the best, namely: Have (1) under the stove a large opening through the floor, connected by an air shaft (say two feet square) with the outside air (not cellar); 2, openings for the outlet of foul air both around the baseboards of the walls and also near the ceilings; the openings being provided with shutters so that the escape of foul air may be regulated as the weather may require from near the floor or near the ceiling.

(5) P. S. M. writes: I am about setting up a horizontal tubular boiler, 8 feet by 2 feet, to heat my house. Could I attach a magazine similar in principle to that used in base-burning, self-feeding stoves, which would supply coal to the fire during the night, thereby keeping up a more equable heat and requiring less frequent firing? If such a thing is practicable how can it best be accomplished? A. A magazine cannot be readily attached to a horizontal boiler, but vertical boilers have been made with a central magazine extending parallel with the flues and provided with a ring at the lower end projecting into the fire box. Such boilers give good satisfaction.

(6) A. H. C. writes: 1. I have a telephone line, two miles in length, upon which I use the Blake transmitter and bell telephone and telegraph instruments for calling. How can I make condensers so as to get rid of the resistance and induction in the telegraph instruments, and how shall I connect them? A. It cannot be done with the ordinary telephones. See Professor Dolbear's telephone in last issue of the SCIENTIFIC AMERICAN. 2. Please give me directions for making a Leclanche battery (new pattern). A. See SUPPLEMENT, No. 159.

(7) Student asks: What is the height above sea level of Mount Mitchell, Mount Clingmans, Roan Mountain, and Bald Mountain, all in North Carolina? A. The twelve highest peaks of Black Mountains, North Carolina: Clingman's Peak, 6,701; Balsam Cone (Guyot's Peak), 6,661; Sandoz Knob, 6,612; Hairy Bear, 6,597; Cattail Peak, 6,595; Gibbs' Peak, 6,586; Mitchell's Peak, 6,576; Sugar Loaf, 6,401; Potato Top, 6,389; Black Knob, 6,377; Bowler's Pyramid, 6,345; Roan Mountain, 6,318.

English Patents Issued to Americans.

From May 27 to May 31, 1881, inclusive.

Electric wire supporter, W. C. Allison, Philadelphia, Pa.
Meter, fluid, B. Holly, Lockport, N. Y.
Musical instrument, C. G. Conn, Elkhart, Ind.
Ore crusher, H. H. Howland, San Francisco, Cal.
Railway signal, G. H. Roth, Boston, Mass.
Railway switch, W. T. Martin, Philadelphia, Pa.
Sewing machine, D. C. Smyth, Hartford, Conn.
Spring bed bottom, H. A. Dalrymple, Gardner, Mass.
Tricycle, J. A. McKenzie, Galesburg, Ill.
Weavers harness, Kendish Loom Harness Company, Providence, R. I.
Wire fabric, machine for making, W. C. Edge, Newark, N. J.

[OFFICIAL.]

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AND EACH BEARING THAT DATE

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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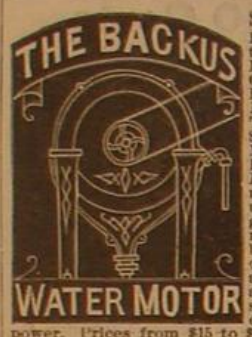

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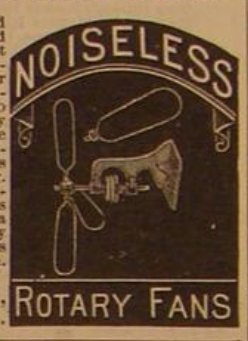

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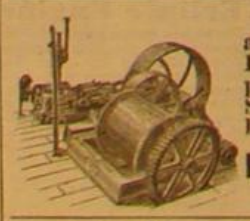

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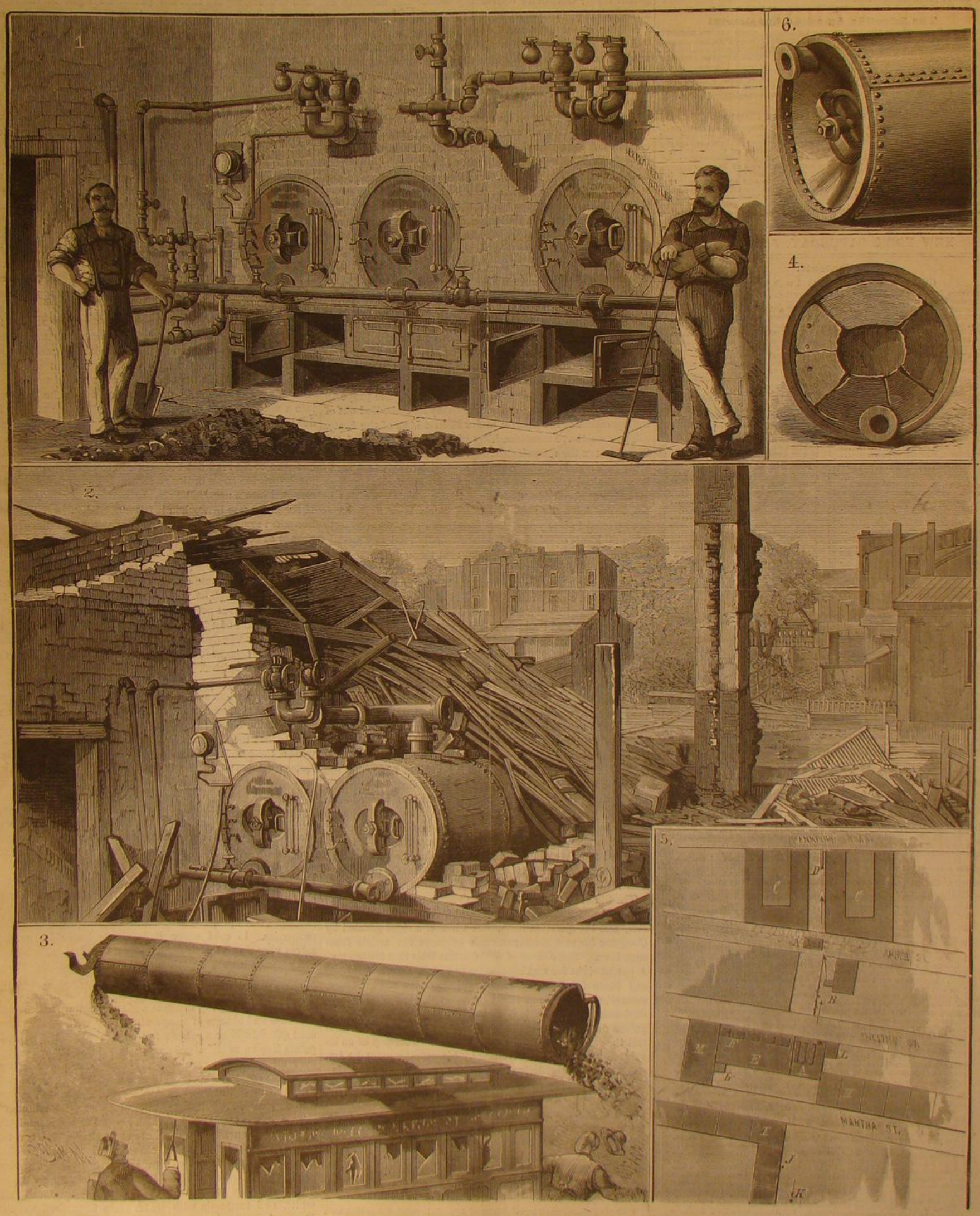

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STATE LAWS AFFECTING PATENTS.

Can the State legislatures exercise any control over dealings under patent rights? This question is one of increasing importance, and presents many aspects: one of which—the power of a State to tax goods manufactured under a patent—is instructively discussed in a very recent Supreme Court decision. Other aspects of the question are not unfamiliar. Every reader knows that the general subject of granting and enforcing patent rights is under the exclusive control of Congress, and that the States cannot directly interfere with a privilege which Congress has granted. But how far does this prohibition extend? Very clearly, just as a State cannot issue a patent, so it has no authority to decide whether one is valid or to punish infringements. On the other hand, the great mass of ordinary contracts may come under State authority, notwithstanding they spring in some way from a patent right; thus State courts may decide the meaning of an assignment, or entertain a suit for damages for breach of a contract about a patent.

As the States need to be constantly on the watch for new subjects of taxation from which they may derive revenue for their increasing expenses, and the development of invention under the patent laws is steadily embracing more and more of the lucrative manufacturing business of the country, a claim to impose taxes on patent rights and dealings under them has been very natural. The general result of the discussion has been that the patent right itself, being a privilege directly granted by Congress, although a species of property, cannot be taxed by a State; for if these rights might be taxed at all, they might be taxed so heavily as practically to crush them. No authority can be conceded to the States which might result in enabling a legislature to destroy a privilege which Congress has been authorized to grant. Thus, also, a State cannot, by taxes, hinder the sale of a patent right or the exercise, under it, of the privilege of manufacturing. The combination of different materials to produce a new result or an old result better or more rapidly, which constitutes the invention, cannot be forbidden by the State; and if it cannot be forbidden, it cannot be taxed; for to tax is to forbid unless the tax shall be paid. But somewhere here the restriction upon the taxing power ceases. The right conferred by the patent laws upon an inventor to exercise or sell to another the invention he has made does not extend to the manufactured article; it does not take the tangible property in which the invention or discovery may be embodied out of the operation of the general tax or license laws of the State.

The case above mentioned, by which the authority of the States to tax the manufactured article has been established, arose in Virginia, under a law of the legislature, which made it a criminal offense to sell anywhere in Virginia things manufactured outside the State, without obtaining a license fee, for which a tax must be paid. Such laws have often been passed in late years, and have borne somewhat heavily upon all kinds of sales, such as are usually made by agents, drummers, and traveling salesmen sent throughout the comparatively new regions of the country to represent the large manufacturing establishments in the older parts. They have been enacted chiefly in the West and South, and are there, no doubt, considered a healthful encouragement of domestic manufactures and trade; while the view at the East and in the Federal courts has been that they involve an objectionable interference with the uniformity and freedom of commerce. In Virginia a traveling agent for the "Singer sewing machines," representing the Singer Manufacturing Company in New York, continued his sales without complying with the law. He was prosecuted and fined $50. He contested this fine in the State court; one of the arguments urged in his behalf being that the State could not impose any burden upon the sale of a machine patented under the laws of Congress. The Virginia court decided against him, and the Supreme Court has now pronounced the decision correct, saying that the grant of letters patent for the invention of the sewing machine does not prevent a law imposing a license fee for making sales of particular machines made under it. It is, however, noteworthy that the Supreme Court pronounced the Virginia law invalid for another reason, viz., for taxing the machines merely because made in another State.*

The States have sometimes seen reason to legislate for the protection of their people against noxious or dangerous articles, and the question has arisen whether a right granted by Congress for manufacture or sale exempts the article from such laws. The course of decision has been that it does not. A patent right for making dynamite powder does not prevent any State from prescribing regulations for manufacture, storage, and sale, such as will protect the community from explosions. So, a patent right for the manufacture of a poison does not impair the right of a State legislature to control the sale and use of the article. The ownership of an invention secured to the inventor by his patent cannot be impaired by local legislation; but he must be contented to enjoy it in subordination to the general authority of the State over all actual property within her limits. A similar question has arisen in States which forbid or seek to hinder the sale of intoxicating beverages, where liquor dealers have claimed that the internal revenue licenses granted under the laws of Congress gave them a right to sell which the local law could not gainsay. But such claims have been repudiated in the courts. Neither the patent laws nor internal revenue laws were intended to displace what is called the "police power" of any State; by which term is meant that general authority, necessarily vested in every government, of providing for the health, good order, peace, and general welfare of the community.

A distinct decision upon this branch of the subject was rendered about two years ago relative to the "Aurora oil." This oil was manufactured under a patent right. There was, however, a law of the State (Kentucky) which required all coal oils and like burning fluids to be inspected before sale; and punished the offering for sale of any which the inspector condemned as below the standard for safety. A dealer who sold a parcel of the Aurora oil which had been condemned, claimed that he had a right under his patent to sell the oil in any part of the United States, and that no State could forbid him. But the Supreme Court pronounced this claim inadmissible, saying that the patentee's right in the manufactured article must be enjoyed subject to the complete and salutary power, with which the States have never parted, of so defining and regulating the sale and use of property as to afford protection to the common people. The ownership of the manufactured article is altogether distinct from the right to the invention or discovery; the invention is protected by national authority against all interference; but the use of the tangible property which is manufactured by means of the invention is not taken out of State control by the patent right.

In so far as the decisions treat a patent right as superior to State laws, they evidently throw upon Congress the duty and responsibility of passing all laws which the interests of the general public demand. And it is scarcely to be denied that the subject has not received proper attention. There is one class of frauds from which farmers and dwellers in rural districts, especially foreigners not well acquainted with our language and business customs, have suffered extensively. It has been common for agents to travel through small towns and villages, offering to sell county rights, or to appoint local agents, for some new and patented invention. There are various forms in which such business is done; sometimes the traveling salesman offers to furnish the manufactured article in quantities for sale; sometimes he offers a license to manufacture within a limited territory; sometimes an agency to sell rights. But his negotiation always tends toward obtaining a negotiable note, or something which he can turn into a note, from one of the "solid men" of the place. Indeed there are several instances on record in which a person who could not read has been led to sign a note by assurances that it was only a paper appointing him agent; or in which one who could read has been enticed to sign a paper ingeniously printed as an ordinary contract, but capable of being changed into a negotiable note by cutting off one end of it. If the note were held when it fell due, and sued by the agent himself, the honest villager who made it would have some chance of obtaining justice; for if he could prove the fraud he would be released. But the agent never keeps the note. When it falls due, the maker finds that the agent almost immediately got the note discounted and went on his way to parts unknown. The note is owned by "an indorser for value and without notice." Now a familiar rule of law forbids the maker of a note to make defenses which would be perfectly good against the payee, when the note is presented by one who bought it innocently before it was due. Thus the swindle is completed.

Congress has taken no pains to suppress these fraudulent dealings; yet when some of the States have endeavored to protect their citizens against these traveling patent salesmen, the objection has been made that their laws are unconstitutional; that the manner of selling a patent right is wholly within the care of Congress. This is probably true; but forms a reason why Congress should pass a proper law.

* The decision of the Virginia Court of Appeals is published as Webber's case, 33 *Gratt.*, 898; and that of the Supreme Court as Webber *vs.* Virginia, 12 *Cent., L. J.*, 488.

WATER GLASS.

In 1640 Von Helmont discovered that when in the preparation of glass from sand and alkali an excess of alkali was used the glass dissolved in boiling water, but it was not until 1828 that water glass as now known was prepared and practically utilized by Von Fuchs, in *stereochromy* or *solid color* painting, in mural and monumental decoration, and for the preparation of various cements and artificial stones. Water glass, soluble glass, or silicate of soda, as it is variously called, possesses, when properly prepared, many unique and valuable properties. In cold water it is nearly insoluble, or dissolves very slowly. In boiling water it dissolves with facility and remains in solution when the latter has cooled. Water containing 30 per cent of the glass in solution is of a sirupy consistence, and may be used as a transparent varnish on many substances; on drying it forms a glassy coating that resists moisture and change of temperature very well. It has been used extensively as a vehicle for certain pigments to form paints known as silica paints. These have the advantage over all paints or varnishes of being incombustible, and when used on woodwork serve in a measure to prevent sudden ignition of the wood by contact with flame. They are also serviceable in painting theatrical scenery, cloth saturated with a dilute water glass varnish becoming uninflammable. The pigments used in these paints are: zinc white, barytes, chrome green, chrome oxide, chrome red or orange, cobalt ultramarine, zinc yellow, ultramarine, cadmium sulphide, ocher, etc. Chalk mixed with water glass forms on drying a very compact stone as hard as marble; bone ash, zinc white, and magnesia with water glass form similar stones. Ransom's artificial stone is prepared by mixing sand with water glass solution to form a plastic mass which is pressed

into the required shapes, then placed in solution of calcium chloride; silicate of calcium is formed and cements the grains together, the chloride of sodium formed at the same time being removed by washing with water.

In connection with clay, lime, sand, cement, etc, soluble glass enters largely into the composition of many of the patented artificial stones, plastic tiles, slates, etc.

The detergent properties of water glass make it an excellent scouring material, and it enters largely into the composition of most of our common soaps.

Water glass is best prepared by melting together in a crucible powdered quartz or quartz sand and carbonate of soda. Usually a small quantity of charcoal is introduced, but if the materials used are free from metallic oxides and compounds this in unnecessary.

Fine infusorial earth is nearly pure silica and makes excellent water glass. Where quartz or sand is employed it is reduced by grinding together with the calcined soda to a powder, the whole of which will pass through an eighty-mesh wire-gauze sieve.

The following are the usual proportions in which the materials are mixed:

1.	Clear quartz	45 pounds.
	Carbonate of soda, calcined	23 "
	Charcoal	3 "
2.	Quartz sand	100 pounds.
	Calcined soda	48 "
	Charcoal	5 "
3.	Quartz sand, purified	65 pounds.
	Anhydrous carbonate of soda	34 "
	Powdered charcoal	4 "

The ingredients, thoroughly mixed, are put into clay pots and gradually heated to bright redness; carbonic acid and oxide escape and the mass gradually becomes liquefied. When effervescence ceases and fusion is complete, the contents of the pots are poured out on clean stone slabs to cool. When made of good materials and properly fused the glass closely resembles ordinary flint glass.

Cold water scarcely dissolves it at all, but if broken into small pieces and boiled in soft water it gradually dissolves. If the boiling is continued some time and a sufficient quantity of glass is added, a clear sirupy liquid or a nearly colorless jelly, according to circumstances, is obtained. These solutions may be diluted with hot water.

The solution containing about 30 per cent of the glass is in greatest demand. It is quoted at fifty cents per gallon, put up in barrels or kegs.

THE STEPHENSON CENTENARY.

One of the notable features of the celebration of the hundredth anniversary of the birth of George Stephenson, at Newcastle, England, June 9, was a parade of locomotive engines. To this the leading railway companies contributed typical examples of the best modern locomotives for passenger and freight traffic, besides a considerable number of early locomotives, or so much of them as remained after the numerous alterations and repairs they were subjected to while in use. In the latter class was the engine called "Locomotive No. 1," built at Newcastle in 1825 by Stephenson for the Stockton and Darlington Railway Company. Another was the "Billy," fourth of its class, built by Stephenson & Co. in 1830. This was a four-wheel coupled engine, as was a similar specimen engine from the Old Hetton Colliery, which contained only the cast iron dome on top of the boiler, the steam pipes, and the feed pump of the original, the rest having been removed when the engine was rebuilt in 1874.

The propriety of ascribing so much honor to Stephenson has been seriously questioned, and his right to the complimentary title, "Father of Modern Railroads," has been disputed. It is true that Stephenson invented neither the railway nor the locomotive engine; the distinctive features even of his successful engine may be ascribed to others; nevertheless Stephenson had so much to do with the genesis of the modern railway system, and his work was of such a vital character at the critical moment when the promise of the locomotive was being put in the way of fulfillment—at the moment when steam transit on rails was first made a practical and profitable certainty—that he is fairly entitled to have his name placed at the head of those to whom we owe the railway as it is.

Railways of a sort were in practical use before Stephenson was born, and for more than a century the steam wagon had been the dream of inventors. As early as 1698 Papin had constructed a small model locomotive engine. Fifty years later Cugnot was at work upon a steam carriage employing two open-topped high pressure steam cylinders, the piston rods working upon the same axis. In his patent of April 28, 1784, Watt describes an improvement on "steam engines which are applied to give motion to wheel carriages for removing persons, goods, or other matters from place to place, in which cases the engines themselves must be portable." In the same year (1784), when Stephenson was but three years old, William Murdock made a working model of a high pressure locomotive, which is said to have performed well; but he abandoned his experiments in that direction through the remonstrance of Watt. On the expiration of Watt's patent in 1801, Richard Trevithick made a steam carriage which ran very promisingly on a common road until, through bad steering, it was overturned in a ditch. In the meantime our own ill-appreciated inventor, Oliver Evans, had worked upon the same problem with such success that he confidently predicted that the child was then born who would travel from Philadelphia to Boston in a steam wagon. He also went so far as to design sleeping cars and other railway conveniences so far beyond the comprehension of his fellows that his reputation for sanity was grievously endangered.

In 1802 Trevithick and Vivian obtained a patent for improvements in steam engines and their application to the propelling of carriages, and two or three "puffing devils" were made by them that year and the year after for use in London. They were able to make five or six miles an hour on common roads, but the enterprise was, after all, a failure. The next attempt of Trevithick was a high pressure locomotive engine for railroads, built at Pen-y-darran, in South Wales, in 1804. It ran well and did good service, but its weight finally broke the cast iron plates of the tramway, and it came to grief with broken axles. In 1805 a similar engine was constructed at Newcastle. It ran backward and forward quite well on a temporary track, but for some reason it was never put upon the road. After many years' service as a stationary engine it was set aside, and finally found an honored resting place in the Patent Museum at South Kensington. In 1808 Trevithick was running another locomotive—the "Catch-me-who-can"—around a circular track in London, for exhibition purposes. In 1811 John Blenkensop patented a rack rail for a steam railway, and had constructed an engine in which, for the first time, there were employed two double-acting steam cylinders. It was built by the engine firm of Fenton, Murray & Wood, of Leeds, Trevithick's patent being still alive. This engine (with others) began running on the railway from Middleton Collieries to Leeds, August 12, 1812, and continued in use for many years.

Here was the real beginning of practical steam railroading. Within a year after the introduction of Blenkensop's engines, three different methods of effecting steam locomotion were patented in England. The smooth-wheeled engine "Puffing Billy," now in the Patent Museum at South Kensington, was put to work in 1813. Stephenson made his first engine in 1814, departing from Blenkensop's plan mainly in using smooth wheels. Springs were introduced in 1815. But little progress was made during the next ten or twelve years, though quite a number of engines were built by Stephenson and others. In 1827 Timothy Hackworth built the "Royal George," the first of a new type, the nearest approach to the modern locomotive that had been designed. In 1829 Robert Stephenson (not his father, as is commonly reported) built the "Rocket," in which the multitubular boiler appeared for the first time. It also had an improvement in the blast pipe arrangement of Hackworth. The "Rocket," came out ahead in the celebrated competitive trial of locomotives on the Liverpool and Manchester Railway, in October, 1829; and it was the successful application of steam locomotion on this road that insured the final victory of steam transport and inaugurated the modern railway system of Great Britain.

THE GREAT COMET NOW IN SIGHT.

The comet which made its appearance to the naked eye in the northeastern sky on the morning of June 23, and was seen from many points between Hartford, Conn., and San Francisco, Cal., is perhaps the comet lately reported by Dr. Gould, of Cordova Observatory in South America. It appeared, after its perhelion passage, in the constellation Auriga, about eight degrees from Capella, with a bright center and a tail fifteen degrees long. It promises to be a conspicuous object in the heavens this summer.

The new comer was almost simultaneously discovered in this country, by P. H. Thompson, Bluffton, Ga.; by T. L. Edwards, Haverford College, Pa.; E. L. Larkin, New Windsor, and several others. We are indebted to Mr. Thompson for a special telegram announcing his interesting observation.

A correspondent of the New York *Sun* reports the discovery of the comet at a little before 2 o'clock A.M., June 23, at Washington. This we believe is the very earliest sight of the stranger, and may entitle the observer to the Warren prize of $200. The first appearance of the comet is thus described by the *Sun* correspondent:

"Just before 2 o'clock this morning the writer was summoned to an upper story window by a night watcher in the hotel. Pointing to the horizon just east of the Georgetown Heights, the watcher said: 'Don't you see that distant fire?'

"Shooting up from the horizon was a bright, silvery, perfectly defined, and steady stream of light, fan shaped. It was wholly unlike the light of a distant conflagration. The stream seemed to reach further and further up, pointing to the pole star. The boundary lines were well defined, and converged. It was no fire. There were none of the waves of light suggesting an auroral display. The distant glitter of a moving electric light was the only explanation that could be given of the singular phenomenon. Suddenly there arose from the horizon a brilliant disk of light, bright as Venus at her brightest, and fully as large as that planet appears. Into this disk or nucleus the fan-shaped stream of light converged. There was no longer any doubt; it was the bursting into view of a comet, the like of which has not been seen since Donati's comet of twenty-three years ago.

"The comet rose rapidly and became a splendid object. At 3 o'clock it was about fifteen degrees above the horizon and forty-five degrees north of the moon. At this altitude the tail was about ten degrees long. It moved apparently rapidly in an easterly direction, and was visible until after sunrise."

At half past four it was seen at Bodie, Cal., where the nucleus was well defined and the tail brilliant. It was observed at Tombstone, Arizona, at four A.M., with the nucleus apparently half the size of a full moon, and the tail fan shape and very brilliant.

A dispatch from London says the new comet in the northern heavens can be seen by the unaided eye even in the morning twilight. It is predicted by astronomers that before the first of July it will be visible all night.

The identity of this remarkable body will doubtless be soon determined. Professor Lewis Swift thinks it may possibly prove to be the great comet of 1812, which has been expected to reappear in this quarter about this time.

Dr. Gould, of the National Observatory of the Argentine Republic at Cordoba, S. A., announced, June 1, the appearance there of a large comet which he suspects to be the great comet of 1807, though that comet was not expected to return for some fifteen centuries.

Concentrating or Storing up Electricity.

We give, on another page, extracts from an able review and criticism by Mr. Geraldy, of the performances and claims of the new Faure battery. We also present an illustration of the use of the battery in propelling a boat on the river Seine, at Paris. The battery has also been applied to drive a passenger omnibus in Paris, with promising results, so the newspapers state.

Mr. Geraldy points out very clearly that the battery is not capable of delivering such a large percentage of energy as has been claimed for it; and his conclusions seem to be well sustained. We also have a letter from a correspondent in Paris who tells us that the invention is classed there like the Keely motor, and that the most extraordinary efforts are being made to force the sale of stock shares in the patents, which no doubt accounts for the published inaccuracies which Mr. Geraldy mentions.

In London Professor Osborne Reynolds has deemed it necessary to publish a note, cautionary to the public not to be misled by the enthusiasm with which Sir William Thomson views the new battery. Professor Reynolds makes the point that in a pound of coal there are stored up eleven million foot pounds of energy, while in a seventy pound Faure battery there is only one half that amount of energy. He also reminds the public of other modes of transmitting energy, such as wires, ropes, compressed air, etc., which he thinks have been found wanting.

All this is very well. Let all possible deductions be made, and still we think it will appear that the new battery contains qualities and powers that promise to render it a most useful appliance in the arts. While it is true that coal is far superior in the quantity of stored-up energy, it is equally true that the coal must have the weight of a steam boiler added to render it available to drive a small boat or a carriage, for example. We are inclined to think that Sir William Thomson is doing the public a better service in practically experimenting with and trying to find out how the new battery may be best applied to the wants of man, than is Prof. Reynolds in discouraging these efforts of his colleague.

Exhibition in Orizaba, Mexico.

It is announced that a scientific, agricultural, and industrial exhibition will be held at the city of Orizaba, Mexico, in November next, under the auspices of the Government of the State of Vera Cruz. Arrangements have been made for all necessary space in the exhibition building for exhibits from the United States and all goods intended for exhibition are exempted by law from import duties. Reduced rates for passage and freight have been secured from points in the United States to Vera Cruz, and a cordial invitation has been extended to citizens of this country to participate in the exhibition, either as visitors or exhibitors.

A Large Belt.

What is described as one of the largest belts in the world was lately finished at Bingley, England. It is 132 feet long and 6 feet wide. It is two layers, the outer layer having three sections, of which the middle section is 36 inches wide and the two side sections 18 inches each. The inner layer is in five strips, in the following order, beginning at one edge: First, 14 inches wide; second, 8 inches wide; third and middle, 28 inches wide; fourth, 8 inches wide; fifth, 14 inches wide. The belt is both wire-stitched and hand-sewn, and the arrangement of the strips, it will be seen, breaks the joints very effectively. It is to work considerably under its power, being intended to transmit only 600 indicated horse power over a flywheel and drums of 71 feet and 7 feet respectively.

The Source of Much Noise.

At Granville Corners, Mass., a couple of men began the work of drum making in 1853. Now they have a five-story factory, 110x40 feet, from which they have turned out 79,000 drums. They were mostly toy drums, and were made of wood, tin, brass, and nickel. The drumheads have used up 30,000 sheep skins.

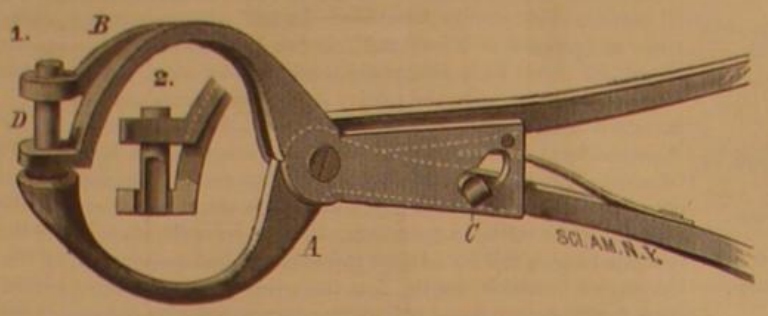
We are informed that the bending machine made by Messrs. Williams, White & Co., of Moline, Ill., and illustrated in our issue of June 11, is being extensively adopted in shops having considerable iron bending to do. It finds its principal application in the manufacture of plows, cars, wagons, and wherever a number of wrought iron pieces of the same form are required.

NOVEL CATTLE RINGER.

The engraving represents a new cattle ringer recently patented by Mr. Horace E. Barnes, of Lee's Summit, Mo.

A is the fixed jaw, which may be similar to the corresponding jaw in an ordinary punching tool. It is provided at the point where the punch engages it with a cushion of rubber or leather. The movable jaw is made in two parts, B, arranged to work side by side, and both pivoted to the jaw, A, as if made in one piece. The part, B, is extended into a handle, corresponding with the handle of the fixed jaw, A, and its tip carries the punch, D, which is similar to that of an ordinary punching tool. The movable part of the jaw, B, corresponds in shape with the fixed part for a portion of its length. The front portion or tip is extended beyond the tip of the fixed part and formed into a ring, through which the punch, D, works, and its rear portion is provided with a slot, of ellipsoidal form, in which works a thumb screw, C, the threaded portion of which screws into the part, B. The handles are thrown apart by a flat spring attached to one handle and bearing against the other.

In using the instrument the handles are pressed toward each other just sufficiently to prevent the punch from protruding beyond the surface of the ring. The screw, C, is then turned so as to place the thumb piece transversely across the widest portion of the slot, which holds the parts in such position that the distance between the ring and cushion on the opposite jaw corresponds with the thickness of the gristle between the nostrils of the animal. The instrument is then applied to the nose, and when the punch and ring are at the point where the hole is to be made the thumb screw is given a quarter turn, so that it can work in the slot. This allows the punch to protrude beyond the surface of the ring so as to punch the hole as desired when the handles are pressed toward each other. When the handles are released the spring forces them outward, so as to withdraw the punch, D, within the surface of the ring, and the thumb screw, C, is again turned so as to hold the parts in the former position. The tool is then partly withdrawn from the nose with one hand, and the nose ring placed in position with the other hand. By this construction provision is made for punching a neat hole and for inserting and withdrawing the instrument without unnecessarily cutting the animal or marring the extremities of the hole as punched, and also for clearing the punch from the hole by means of the ring.



BARNES' CATTLE RINGER.

IMPROVED FEED-WATER REGULATOR.

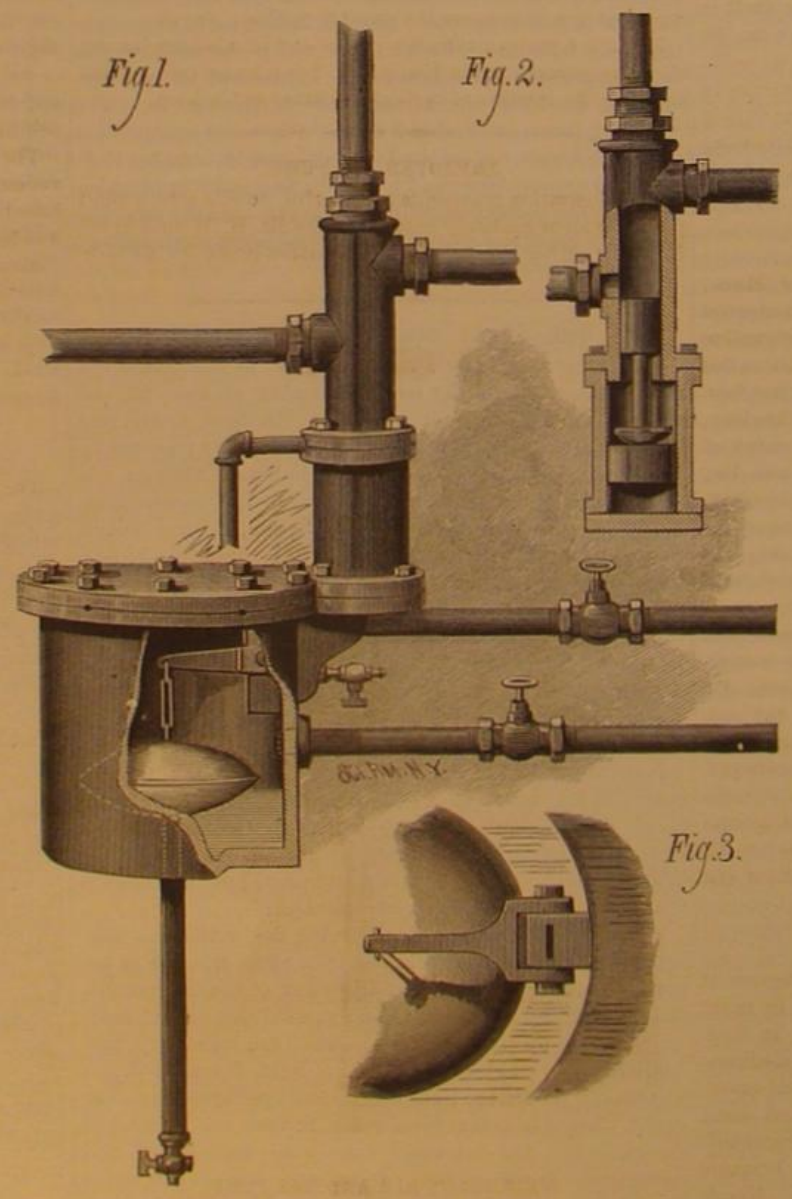
We give an engraving of an improved feed-water regulator, lately patented by Mr. Charles H. Kuhne, and is being manufactured and introduced by the Kuhne Regulator Company, Limited, of Corry, Pa. Fig. 1 is a perspective view of the regulator with a portion broken away to show internal parts; Fig. 2 is a vertical section of the steam and water cylinders; and Fig. 3 is a detail view of the steam valve which is operated by the float. The larger cylindrical vessel or float chamber is connected with the boiler above and below the water line by two horizontal pipes, each provided with a valve by which communication with the boiler may be stopped.

The float in this vessel is connected with a lever connected with a valve for opening communication between the float chambers and the larger of two cylinders, placed axially in line with each other and above and at one side of the float chamber. These two cylinders are accurately bored, and are each provided with a piston attached to opposite ends of a common piston rod. The upper cylinder is provided with a water-supply pipe at the top, and two lateral pipes placed one above the other. The upper of these two pipes leads to the water space of the boiler, the lower one is the over-flow. A guide rod extends from the float downward into a pipe terminating in a small cock, which may be opened from time to time to keep the pipe clear.

The apparatus is attached to the boiler, so that the float is on the water line. When the water in the boiler falls a small distance below the usual working level, the float drops, and opening communication between the steam space of the float chamber and the space below the piston in the larger cylinder above, the piston is forced upward and carries the smaller piston with it, closing the overflow pipe, when the water forced in by the pump passes through the upper or feed pipe into the boiler, and is retained by a check valve. When the float is raised by the increase of water in the boiler, so as to shut the steam from the lower side of the piston, the pressure of water on the smaller piston pushes it down so that the water passes out of the overflow instead of going into the boiler.

Should it be desirable to use water from the street mains the upper lateral pipe will be dispensed with, and the opening into which it is screwed will be plugged. The pipe which was used as the overflow will now be taken to the boiler, and the feed water will be taken in at the top of the and that the duty of the float is simply to turn the steam on and off from the actuating mechanism.

Further information may be obtained by addressing the Kuhne Regulator Company, P. O. box 606, Corry, Pa.



KUHNE'S FEED-WATER REGULATOR.

MECHANICAL INVENTIONS.

An improved milling cutter has been patented by Mr. Alfred Muir, of Manchester, County of Lancaster, England. This invention is applicable to cylindrical milling-cutters and globe-shaped cutters, and to cylindrical cutters having curved, rounded, taper, or flat ends, also to face cutters and to reamers. The teeth are formed on the cutter or reamer in the usual way, and then spiral grooves are made around it, thus dividing the faces of the cutting edges. In making the spiral groove the edge is undercut to make clearance at one side, and afterward the other side of the groove is cut out, thus giving clearance at both sides of the cutting edges.

Mr. John Grein, of Maine Prairie, Minn., has patented an improved wrench for use in oiling carriages and for other purposes, which is so constructed as to hold the nut when removed in such manner that it can be replaced without soiling the hands.

Mr. John Hyslop, Jr., of Abington, Mass., has patented a machine for cutting, shaping, or finishing the heads of tacks, nails, and rivets, which is so constructed as to make all the heads uniform in shape and size.

Summer Conventions.

Among the important conventions recently in session are several at such a distance that only the briefest accounts have been telegraphed.

The American Society of Civil Engineers began its thirteenth annual meeting in Montreal on the 15th. The members were welcomed by Mayor Beaudry and Principal Dawson, of McGill University.

The Associated Maltsters of the United States met at Niagara Falls the same day.

The American Railway Master Mechanics met for their fourteenth annual convention in Providence, R. I., June 14, nineteen States being represented at the opening session. The secretary's report showed a membership of 197. A paper was red from Reuben Wells, of Louisville, Ky., upon the manner of riveting boilers, favoring button-set riveting above hand riveting. The paper was generally approved. A report from Jacob Johann, of Springfield, Ill., favored a straight style of boiler rather than the wagon top. A committee was appointed to consider the propriety of adopting a standard gauge. A committee was appointed to report on the most economical plan for running locomotives. The next day Mr. James M. Boon, of Fort Wayne, Ind., reported for the committee on the best means of producing combustion of bituminous coal in locomotives. Mr. W. Woodcock, of New Jersey, for the committee on the best form of locomotives, reported in favor of the American eight-wheel as best for express passenger service.

The fourteenth annual convention of the Master Car Builders of the United States and Canada began in this city on the 14th. A large number of delegates were present. The first session was devoted chiefly to the discussion of proposed amendments to the constitution relative to membership. The chief interest centered on a proposition to make eligible for representative membership any person having a practical knowledge of car construction, and to give to such a member all the privileges of active members, and in addition thereto in all measures pertaining to the adoption of standards for car construction, or the expenditure of money, one more vote for each thousand cars owned by the company he represents. It was contended by those favoring the provision that it would gain for the association the active interest of the heads of the various railroad companies, and by those who opposed it that too much power would thereby be given to the wealthier corporations. The matter was finally referred to a committee of five, to be reported on at the next annual meeting. The remainder of the morning session was occupied by the discussion of the report of the committee on brake-shoes. The afternoon session was devoted altogether to discussion of the rules governing the interchange of freight cars between roads. The rules relate to the condition of cars, inspection at the time of interchange, and payment for repairs and for cars destroyed while in the custody of other roads. Among the important subjects to be reported on by committees appointed last year at Detroit, are, "How to Prevent Accidents and Injury to Train-men," "The Best System of Train Brakes for Freight Cars," "Standard System of Screw-threads for Nuts and Bolts." An interesting feature of the convention is an exhibition of recent inventions relative to improvements in rolling stock.

The American Pædological Society convened in this city on the 13th. President T. C. Duncan, M.D., of Chicago, read an important paper on "Pædology as a Specialty," in which he urged a larger attention to those diseases which occasion the terrible mortality of children under five years of age. Dr. S. Lilienthal, of New York, read a paper on infantile eczema. Other infantile diseases were discussed, such as tonsillitis, gastro-enteritis, capillary bronchitis, etc. The officers for the ensuing year are: President, Dr. S. Lilienthal; Vice-President, Dr. W. B. Chamberlain; Secretary, Dr. W. P. Armstrong; Board of Censors, Dr. George F. Foote, Dr. T. C. Duncan, Dr. M. Deschere, of New York; Dr. E. M. Jones, of Taunton, Mass.; and Dr. D. Foss, of Newburyport, Mass. The president then appointed the following gentlemen to prepare papers to be read at the next convention of the society: Prof. Dr. W. Owen, of Cincinnati, on chronic eczema; Prof. Dr. M. Deschere, on capillary bronchitis; Prof. Dr. W. C. Earle, of Chicago, on diphtheritic croup; and Prof. Dr. J. P. Mills, of Chicago, on elementary infantile foods.

The American Institute of Homeopathy began its thirty-eighth annual session at Brighton Beach, Coney Island, June 14, with a large attendance. In the usual address the president, Dr. J. W. Dowling, of Brooklyn, said that there were 6,000 physicians in the United States whose practice was according to the homeopathic law; there were 11 homeopathic medical colleges, no less than 38 homeopathic hospitals, 29 dispensaries, 23 State societies, 92 local societies, and 16 medical journals. In a paper on personal hygiene as to fluids drunk, Dr. George M. Ockford, of Burlington, Vermont, spoke of the need of caution with regard to the use

of ice water, as gastric troubles and insanity sometimes resulted from its careless use as well as from water polluted with sewage matter. The effects of alcohol on highly sensitive nervous organizations were considered at length, and an increase of insanity, epilepsy, and kindred nervous disturbances was traced to its use as a beverage. Dr. Ockford also lamented the increasing use of absinthe among the intellectual classes, and regarded it as rapidly ruinous to the constitution, productive of serious disturbance of the function of the brain and nervous system, and very dangerous as a habit. He considered tea as a better beverage than coffee in cold climates, and contradicted the current notion that tea tasters became broken down in nervous function by the pursuit of their business. Coffee could be used without disadvantage as a beverage in southern climates, but in the north once a day should generally be the limit, as dyspepsia and nervous derangement frequently followed the coffee habit when inveterately indulged. He recommended caution in the use of milk—one of the most valuable of beverages and foods when pure and clean, but exceedingly liable to pollution and a frequent agent in the propagation of diseases, having in a high degree the property of absorbing putrescent matter without its presence being detectable by the senses.

Advantages of Electric Railways.

In an extended account of the construction and working of the Siemens electric railway at Berlin the London *Times* mentions as first among the advantages which the electric motor has over steam or compressed air for passenger transport, the circumstance that no heavy machinery has to be carried about to set the train in motion. The carriages can, therefore, be built in a lighter manner, thus reducing the power necessary to move them, and permitting all bridges and other superstructures to be built more cheaply than usual. Several carriages, each with a dynamo machine, can be joined to one train, and by this distribution of motive power much steeper inclines can be overcome than when the same train is drawn by a single locomotive. In addition to the ordinary brakes, means can be provided to short-circuit the machines on the carriages, and to cause them to act as very powerful brakes. The use of large stationary engines reduces the amount of fuel necessary to develop a certain power on the traveling carriage, and if waterfalls can be utilized the cost of working these railways can be further diminished. It seems probable that such railways can be usefully and economically constructed to facilitate the traffic in crowded streets, or in situations where local circumstances favor their application. From all that has been done during the last few years it is evident that the art of transmitting power by electricity has advanced rapidly, and that its practical application is continually gaining ground.

A Vessel Wrecked by a Water Spout.

The brig Bogota recently arrived at New Bedford, Mass., having on board a party of shipwrecked mariners composed of the officers and crew of the wrecked British brigantine Florence May, who were picked up in the ocean, about 600 miles from this coast, their vessel having been almost torn to pieces by a water spout. Captain Cochran, of the May, says that he sailed from New York May 13, with a crew of eight men and one passenger; weather was good, and May 23 the vessel had reached latitude 35:42, longitude 65:26, and was lying becalmed; at 2 o'clock A.M., she was struck in the bow by a waterspout, which hit her so forcibly that she was opened forward, her jibboom and head gear were twisted off, and the vessel severely strained and her seams opened, causing her to leak badly. The pumps were at once started, and for three days she drifted about in an unmanageable condition. Fortunately the weather was good, and but little difficulty was experienced in keeping her free from water, but on the third day one of the pumps gave out, the water began to gain in the hold, and the boats were prepared for leaving the brig; but at this juncture the Bogota appeared and rescued the crew, with their personal baggage. The Florence May was 213 tons burden, and was loaded with a miscellaneous cargo, consisting mainly of flour and grain.

Quick Telegraphy.

The Direct Cable Company and the *Evening Telegram* of this city seem to be justly proud of a recent feat in rapid telegraphy, by which the result of the Derby race in England was announced here in advance of all other mediums of communication. The *Telegram*, with its usual enterprise, had an operator and instrument on the grand stand at Epsom. The remainder of the story is thus recorded: "Horses got away at 10:21:5, New York time. Iroquois passed winning post 10:23:55, New York time. Result reached New York 10.24. Time occupied in transmission, 5 seconds."

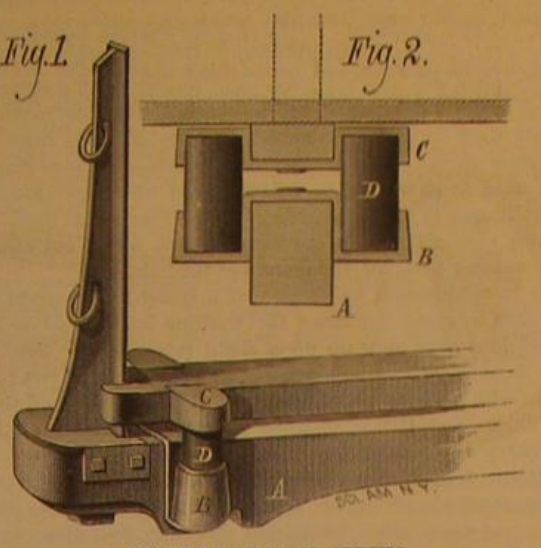
Electrical Light Patents.

About 175 patents have so far been granted for patents relating to electrical lighting, in this country, and about three hundred more applications for patents thereon are now pending.

When we consider the large number of patents now existing for telegraphing instruments, telephones, alarms, electrical batteries, switches, and the divisions of electrical devices, it will readily be understood that the Patent Office at Washington is rapidly becoming a great store house of novelties relating to electricity, and that this branch of invention is already one of extraordinary magnitude.

IMPROVED WAGON SPRING.

The engraving shows an improved wagon spring lately patented by Mr. Christopher Heinen, of Fort Laramie, Wyoming Territory, and designed to lessen the concussion between body and bolsters. The bolster, A, is supplied at the ends with removable standards, and with sockets, B, formed in one piece with a saddle plate fitted on the bolster. Inverted sockets, C, made like the sockets, B, but somewhat



HEINEN'S WAGON SPRING.

shallower, are secured to a bar extending parallel with the bolster, A, and guided by the standards. In the sockets, B, are placed springs, D, which may be either of rubber or steel. The upper ends of these springs are received by the sockets, C.

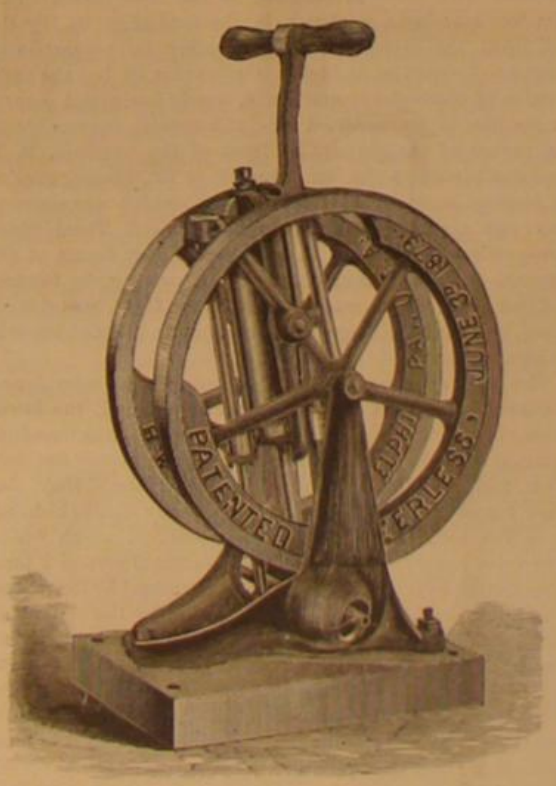
With this construction the body of the wagon has an elastic support, which relieves it from shocks and the running gear of the wagon, and at the same time relieved from the downward blows of the load.

This device can be readily applied to wagons already in use, and will not only break the concussion between the body and bolster, so as to avoid injury to the load by jarring, but it will increase the durability of the wagon.

Fig. 1 is a perspective view of one end of a bolster having the improvement applied, and Fig. 2 is a transverse section showing the relation of springs, sockets, and bolster.

IMPROVED AIR PUMP.

The illustration represents a powerful double-acting hand pump for air or gas lately brought out by Mr. H. Weindell, 405 N. Fourth street, Philadelphia. A smaller pump for air only



WEINDELL'S AIR AND GAS PUMP.

was illustrated in this paper on Oct. 15, 1876, in which the leading principle is the same as in the pump now illustrated. The present improvements made consist mainly in greater simplicity and different construction in the pumping cylinder to adapt the machine to more varied uses.

By moving the hand lever, consisting of the frame containing the slide rod, piston, and piston rod, the two flywheels are rotated, and the momentum acquired by these is sufficient to bring the cylinder to a point where the resistance of the compressed air is equal to that in the receiver. At this point the slide rod (on hand lever) and the crank (formed on the flywheels) stand at such an angle as to work like a toggle joint and compress and expel the air with great force.

The particular pump shown is expressly designed as exhaust pump. It, therefore, has a long stroke (6 inches) and very large and light inlet valves of 2⅜ inches diameter, consisting of leather plates backed by sheet brass. The flywheels are 15 inches in diameter, and the entire machine is very strongly built, weighing almost 70 pounds. It will, when compressing air at its regular working speed of about 110 revolutions a minute, readily give in its 2 5/16 inch cylinder 32 pounds pressure to the inch. In exhausting it will also quickly raise mercury within three-quarters of an inch of the barometric pressure. This is with valves actuated by air pressure only. The same pump is also built for a better vacuum yet, having for this purpose valves operated by friction only, and a simple contrivance connecting automatically for a short time at each stroke both sides, thereby answering as a Babinet cock, making very complete exhaustion possible.

The Lady Franklin Bay Colony.

The members of the Arctic expedition under the command of Lieutenant Greeley, have assembled at St. Johns, Newfoundland, intending to start July 4, for Lady Franklin Bay. The whaling steamer Proteus has been chartered for the conveyance of the enlisted men and officers detailed by the Signal Service Bureau for the expedition. The personnel of the expedition is as follows:

Lieutenant A. W. Greeley, Fifth Cavalry (in charge); Lieutenant James B. Lockwood, Lieutenant Frederick T. Kislinburg, Sergeants Edward Israel, W. S. Fewell, George W. Rice, and D. C. Ralston, of the Signal Corps; Sergeants D. L. Brainard and D. Sinn, and Corporals D. C. Starr and N. Sailor, Second Cavalry; Corporal P. Grimm, Eleventh Infantry; Corporal J. E. Elison, Tenth Infantry; Privates Black and Gardiner, Signal Corps; J. Frederick, Second Cavalry; J. Ryan, Second Cavalry; W. Ellis and T. M. Connell, Third Cavalry; Charles B. Henry, Fifth Cavalry; J. Bender, Francis Long, and W. Whistler, Ninth Infantry; J. H. Bredbrick, Seventeenth Infantry; and W. H. Cross, general service.

The expedition is intended to establish a permanent scientific colony at the most suitable point north of the eighty-first parallel and contiguous to the coal seam near Lady Franklin Bay. The official instructions provide that after leaving St. Johns, N. F., except to obtain Esquimau hunters, dogs, clothing, etc., at Disco or Upernavik, only such stops will be made as the condition of the ice necessitates, or as are essential in order to determine the exact location and condition of the stores cached on the east coast of Grinnell Land by the English expedition of 1875.

The main purpose of the colony is meteorological observation, the station being one of eight or more to be established for such work by the United States, Russia, Norway, Sweden, Holland, Denmark, Austria, and probably also by Germany, France, Great Britain, and Canada. The American colony engage in the work of geographical exploration by sledge parties, and will give careful attention to the collection of specimens of vegetables, animals, and minerals. Incidentally they will keep a sharp lookout for the Jeannette expedition, which may drift into that quarter.

Drifting Half a Year.

The following report of the rescue of nine Japanese sailors by the Pacific steamship City of Pekin, is printed in the San Francisco *Chronicle* of June 13: The Japanese had been blown out to sea in a storm which occurred December 9, 1880. They lost their masts and rudder in the storm, and had been drifting at the mercy of the winds, they knew not where. After their own provisions were exhausted they subsisted on their cargo, mostly beans and dried fish, and such rain water as they could catch during the six months which had elapsed since the typhoon occurred. They had burned most of the small woodwork, doors, berths, windows, etc., of their vessel for fuel, and were on short food rations, 40 beans per day for each man being the allowance. Their fire, when put out from time to time, they had rekindled by rubbing two pieces of wood together. They had given up all hope of ever seeing land or anything human again, when, on Saturday, the 28th of May, in latitude 36° 37′ north, longitude 143° 54′ east, about 300 miles from the Bay of Yeddo and Yokohama, they sighted the Peking on the wide waste of water. Captain Berry, in answer to their signals of distress, bore down and sent one of the boats off with an officer and the doctor to examine into their sanitary condition, and the poor souls were soon landed on her deck. One of their number had died the day previous from exposure, hunger, and anxiety.

Discovery of an Aztec Calendar Stone.

The *World's* correspondent at Mexico reports the discovery of a new Aztec calendar stone. It was found, June 2, by Captain Eavans under a dilapidated Indian hut, which stood on the place that once formed the favorite garden of the Texcocan "Poet Prince" Netzahualcoyotl. It is a stone slab, eight feet by six, covered with hieroglyphs, and near the center of it is a clearly cut calendar—similar to the far-famed "Aztec Calendar stone" which is now attached to the cathedral in the city of Mexico. The stone goes to the Mexican National Museum. Further excavations are to be made on the same site, and since King Netzahualcoyotl "the Wise" built his palace on a hillock on which the residence of the sovereign lords of a more ancient nation had stood, it is probable that further researches in that locality may lead to interesting discoveries.

EXPLOSION OF A PLAIN CYLINDER BOILER IN PHILADELPHIA.

BY S. N. HARTWELL.

The front page cuts illustrate the explosion of boiler No. 3 in the dye works of Gafney & Co., in Kensington, Philadelphia, which occurred during the noon hour, on the 1st day of June, 1881, killing three persons and injuring a number of others. The coroner's sensible and pertinent inquiries into the cause of death brought out the usual variety of opinions of the cause of the primary rupture from which the explosion arose.

THE CONSTRUCTION OF THE BOILER

was not new or uncommon, nor was the material or work unusually bad. The shell plates, which did not break, were marked at a fair tensile strength, and the head that did break was of a fair quality of cast iron where the rupture began. The type and principal dimensions are as follows: A plain cylinder, 30 feet long by 36 inches diameter, composed of No. 3 iron plates in nine courses, single riveted; the least observed thickness at the edge of plate was 0·255". The end plates or heads were flat cast iron disks having suitable flanges turned inward, with cored radial holes for the rivets that secured them to the shell plates. Thickness of disks, 1⅜ inches; flanges, 1⅝ inches. The pitch or spacing of the rivets was according to accepted American practice. A man-hole was cut in the center of the front head, 12¾ by 15½ inches, the form of which appeared to be not an ellipse, but of somewhat larger area. The gasket seat had been planed, but the corresponding seat on the man-hole plate was not planed, though it appeared quite as true as such castings usually are.

The arrangement of the boilers is shown in the engravings, by which it will be seen that two, namely, Nos. 1 and 2, were set over the same furnace, and No. 3 by itself over an adjoining one. The former, called the old boilers, had been in use two years, and the latter, the new boiler, had been working but two months prior to the explosion. Two pair of safety valves, one pair to each system, were fitted as shown, their connecting pipes coming through the wall of the steam dry house under which the boilers were set. The pair of boilers had a pair of 2½ inch, and the single boiler, No. 3, had a pair of similar 2 inch safety valves. The main steam stop valves, by which communication between the boilers and with the heating and drying systems of pipes was regulated, were also in front of the wall, as shown. The steam and water pipes were so arranged that the single boiler could be used alone.

These boilers were insured by the Hartford Steam Boiler Inspection and Insurance Company, and allowed to carry 70 pounds of steam. The usual working pressure appears to have been from 60 to 65 pounds *by the gauge*, the pressure increasing when the demand for steam was less than the supply, indicating that the safety valves did not fully relieve the boiler. The increase of pressure that might have occurred with all the distributing valves closed is therefore unknown.

The new boiler was inspected on or about the 7th of March, and no doubt the hydrostatic test (about 100 pounds) was applied according to law. The builder swears before the coroner that he applied a cold water test of 115 pounds, and found it all tight, etc.

This boiler, No. 3, was fitted with the usual gauges and other attachments, and fed by an injector, either separately or in common with the other two boilers. The steam was used for boiling dye-stuff and for drying.

The observed phenomena indicate unmistakably that

THE EXPLOSION

was due to a pressure a little in excess of the strength of the weakest point of the boiler. The course of the initial ruptures is clearly indicated in the engravings, radiating from the man-hole. The cast-iron head was not compensated for the loss of continuity. There was simply a slight chipping spot just raised above the general inner surface, for convenience in finishing a gasket seat upon the planing machine. The removal of the firm and tenacious skin of the iron by the planer reduced its strength. The slight sustaining power of the pinch on the gasket is an indefinite and variable factor, and a great strain falls upon the margin of the man-hole.

So far as the writer knows, there is no well defined and simple rules for determining the strength of flat disks with man-holes in them. To make this front head equal in strength to the rear one, omitting now all comparison with the strength of the cylindrical portion of the boiler, it seems evident that a rib is necessary around the man-hole of sufficient depth to fully compensate for the removal of so important a part of the disk.

But without a full line of ultimate experiments on the strength of these forms it would be difficult to specify the depth of the rib.

It may be said, and is strongly maintained by some engineers, that the concave form, shown in figure 6, is stronger than the flat; but how these two forms compare in strength when they have equal inward projections, experiment only can determine.

No respectable guess, therefore, can be made at how much internal pressure was required to break this boiler. Either of its heads had less resisting power than the cylindrical portion, on which form plenty of experiments have been made.

The arguments used against the hydrostatic pressure as a test of the strength of unequally heated and complicated boilers, do not so well apply to this case, for this head was in a fairly uniform condition of temperature throughout, so that unequal tension, except such as might arise from a badly fitted man-hole plate, is hardly admissible. Its strength, if uniformly heated to 350° or 400° Fah., would not differ greatly from its strength when the cold test of 115 pounds was applied. And here are its neighbors, cast from the same pattern apparently, that have held out for two years, while no doubt many of the hundreds of cast iron boiler heads now in use in Philadelphia and elsewhere in America, are no better and have stood longer and heavier strains than those now under consideration.

A defect is noticeable in the circular fracture, as much as 3 or 4 inches long by width of 0 to ⅛ inch, in the middle of the plate and near the lower part, consisting of confluent blow holes; but it is difficult to conceive how the rupture could start at any point in the circle from which lines of fracture should converge toward the manhole so as to break the head as shown. The rupture, no doubt, began almost simultaneously at the inner end of the four radial lines, in which case a defect in the circular line would not affect the weakest point at the margin of the hole.

It is not pleasant to think that a boiler which ought to be able to stand five times the working load would be so capricious as to blow up upon slight provocation. Scully, the fireman, stoutly and persistently denies having wet this head with his hose, although it was sought to be proved that he did so, and it was assigned as a sufficient cause of the breaking of the head.

Many of the steam valves were found to be closed when dug out of the *débris;* in fact the writer has not seen one that was open when found, but has seen four that were closed, and under such conditions that no amount of swearing by interested witnesses to the contrary would stand as truth.

The diagram, Fig. 5, is a plan of the neighborhood of the explosion. The buildings occupied by Gafney & Co. are (were) located between Martha and Collins sts., the boilers in the lower story of the three story brick building, A, adjoining the one story dye house, E. To the left is the shed building, M, on the roof of which the dyed material was sundried in fine weather. The dye tubs, F, were square wooden vats, heated by direct steam, admitted by branch steam pipes, in each of which was a steam stop valve, controlled by each dyer, according to his requirements. G is the small detached office building of the proprietors. H is the location of the two story dwellings, one of which was badly smashed and took fire, but it was soon extinguished. Beds, cooking stoves, and household utensils in the ruins, were painfully suggestive of the horrors that attend a first-class boiler explosion. The stable, L, was also destroyed by the falling of adjacent walls. The boiler gave out by the bursting of the front cast-iron head, which broke into four quarters, the fracture running from the man-hole radially, as shown in drawing; thence the break continued along the circular base of each quarter of the head, leaving the entire rim or flange outside of its junction with the disk attached to the shell plates. This rim was smashed, as shown in the cuts (Fig. 3), by the fall upon the ground at D, or possibly by contact with some solid object in its flight. On leaving its bed the main portion of the boiler took a direct, nearly horizontal, course in the line of its projected axis, and striking the terrace at the corner of the grapery in front of the dwelling, B, it rose and turned to the left, some 15° or 20°, passing over or in front of a passenger street car, at N, which was about to enter the station house of the Second and Third street horse railroad, shown at C, whence the cars depart at the opposite end on Frankford road. In striking the terrace, the rear head, which was foremost in the flight, was demolished, and the adjoining shell sheet torn and turned inward, as seen at Fig. 3.

The four quarters of the front boiler head were found scattered at various points in the foreground, the lower piece, in which was the feed water opening, was found on removal of a large mass of *débris*, about twenty-five feet from, and directly in front of its former site. Here also were found a 2½ inch steam pipe (easily distinguishable from the feed water pipe of same size), in which was a stop valve *closed ;* to this pipe was connected several 2 inch branches, and valves, also *closed* when examined by the writer, before they were touched by any person, after the explosion. Mr. Farran, of the Hartford Steam Boiler Inspection and Insurance Company, observed the same thing, and the attention of bystanders was called to this important fact. Mr. Williams, a member of the coroner's jury, was informed, and the valves shown to him before their removal. That gentleman remarked that other steam valves were also closed when found, notably the one in the pipe connecting this boiler with the others. In fact *all steam valves were found closed when taken from the ruins* so far as known.

The man-hole crossbar, a pretty heavy one, with its bolt, which engaged with the plate by means of a pocket in the plate, into which the head of the bolt fitted loosely, was detached when the boiler head was broken and its tension relaxed, and it flew to the front, crossing Martha street, to the second door on the cross street, where it struck the brick door jamb. A man was found dead or fatally injured at this point, marked J on the diagram, having been hit by this piece before it struck the brickwork. It made an indentation of a depth indicating that its force was far from being spent upon the body of the man. The man-hole plate itself flew a greater distance in the same direction, said to have been more than two squares, where it lodged on top of a building. This is the longest distance traversed by any of the pieces. A piece of the rear head bounded from D into Frankford road and landed in front of a boarding saloon where a number of people were taking dinner. This was warm, said to be hot, as well as the main piece of the boiler, which caused steam to arise from the damp manure heap on which it landed. A rumor gained circulation that the boiler flew through the air like a glowing meteor, red hot, but no evidence of an extraordinary temperature was found on any part of the fragments.

Some search was made for the steam gauge that was said to have been attached to this boiler, but its condition could have given no clew to the pressure at the time of the explosion, and it could not have contradicted other phenomena.

The fact that the plate and crossbar of the man-hole of the broken head were shot with violence as from a gun, indicates that the head, weak though it is acknowledged to be, resisted considerable pressure, and at last gave way with a snap. This wreck has been studied from a disinterested standpoint, and the

CONCLUSION IS

that the flow of steam from this boiler was stopped or obstructed by the defective condition of the safety valves, the distributing valves having been incidentally closed at the noon hour, by the several workmen who were in the habit of handling them according to their several demands for steam, and that the pressure gradually increased, the fire being active, till the boiler gave way at its weakest point, which was manifestly the front head.

RECENT DECISIONS RELATING TO PATENTS.

United States Circuit Court.—Eastern District of Wisconsin.

ROWELL *et al. vs.* LINDSAY *et al.*—PATENT CULTIVATOR.

Dyer, J.:

1. A patent for a combination of known parts is not infringed by the use of any number of the parts less than the whole.

2. Where some of the parts of a combination are new and others old, and where the new parts are distinctly claimed as inventions, the appropriation of a part which is new is an infringement.

3. Where a patentee claims as his invention only the combination which he describes, the separate constituent parts of such combination are to be regarded as old or common and public.

4. A combination must be maintained as an entirety. If one of the elements is given up the thing claimed disappears. The different parts may perform more or less important functions, but each and all are essential to make the thing which the patentee has claimed as his invention.

5. A combination is not infringed by the substitution of a new element or of one that performs a substantially different function, or by the substitution of an old element not known at the date of a patent as a proper substitute for the omitted ingredient, or by a new combination of the existing elements of the patented combination.

6. A patent for an improvement in cultivators claimed the combination of a slotted beam, shank, brace-bar, and bolt, when the parts were constructed and arranged to operate as and for the purposes specified: *Held*, that such patent was not infringed by a machine which contained such slotted beam, shank, and bolt, but did not include the brace-bar or any mechanical equivalent for the same.

United States Circuit Court.—District of Massachusetts.

PENNINGTON *et al.* vs. KING.—PATENT SPRINKLER.

Lowell, J.:

1. Letters patent No. 203,069, granted to Pennington and Beggs, April 30, 1878, for an improvement in lawn sprinklers, which describes, *inter alia*, "the rose C, provided with a number of discharge holes, *d*, at the outer circumference, which holes are placed in a plane passing preferably through the hole, B, but bored at a certain angle of inclination through the rose, so as to produce the revolving motion of the same by the forcible discharge of the water through the holes," is not anticipated by sprinklers having radial arms which are caused to revolve by the force of the water passing out through one and the same side of each arm, nor by sprinklers wherein the chamber or rose is caused to revolve by forcing the water through perforations in the same side of ridges formed on its convex surface.

2. In the absence of other evidence, a patented invention will be held to date from the time of filing the application, and not from the time of the grant.

Polar Observation.

It will be remembered that the ill-fated Gulnare left at Lady Franklin Bay a number of men to form a permanent colony for arctic exploration and meteorological and magnetic observation.

The Government has just chartered the Newfoundland sealing steamer Proteus to convey thither the relieving party under Lieutenant Greeley. The Proteus is described as nearly new, stoutly built for encounters with ice, of about 800 tons capacity, and with engines of 300 effective horse power.

Proposed Statue to Robert Fulton.

A monument to Robert Fulton is talked off, to stand on a prominence on Polipel's Island, situated in the Hudson River at the southern end of Newburg Bay. A heroic figure of Fulton will surmount the monument.

AN INTERESTING BOILER EXPERIMENT.

Numerous instances are on record of strong boilers, well made in all respects and handled with good care, having suddenly exploded with terrific violence, just at the instant when the valve was opened to admit steam to the cylinder; or at the moment when cold water was injected into the boiler. The usually received theory of this class of explosions is that by opening the valve or throwing in cold water, the pressure of steam on the surface of the water is suddenly reduced, whereupon the water, charged as it is with the tremendous energy of its heat, leaps from its place, divides, and strikes with the solidity and force of cannon balls against the interior walls of the boiler, tearing everything to pieces with its resistless momentum. Water may in fact be easily heated to such a degree that a pound of the liquid will equal a pound of gunpowder in energy. At sixty pounds pressure to the square inch every cubic foot of boiler water has the energy of a pound of gunpowder. Given the proper conditions for discharging that energy against the boiler, and it will be rent as if it were exploded with a corresponding weight of cannon powder.

In the SCIENTIFIC AMERICAN of July 3, 1880, we presented an engraving and description of an improved form of boiler, invented by Mr. Daniel T. Lawson, of Wellsville, Ohio, which was designed by him to promote safety in the use of steam by preventing all danger from explosions or injurious strains arising from the causes we have mentioned. In the article describing his invention Mr. Lawson's theory was fully set forth; it differs somewhat from that we have stated as ordinarily held. Mr. L. claims "that when water is superheated it becomes as explosive as gunpowder, exploding by bursting into steam from a reduction of pressure." This explosive formation of steam produces a concussion on every square inch in the boiler, much greater, Mr. L. thinks, than the regular steam pressure. "There is abundant reason to believe," he says, "that it is this concussive action which causes the numerous and mysterious boiler explosions, and which cause is wholly independent of the amount of water in the boiler; in fact the greater the amount of water in the boiler the more terrific the explosion."

We are not disposed at this time to question the correctness of Mr. Lawson's theory; but will only suggest that the other mentioned theory better explains the actual result, since steam has a yielding or gaseous action, whereas projected water acts like a solid.

Mr. Lawson has lately tried, at Pittsburg, Pa., a very interesting and important practical experiment, for the purpose of verifying his theory and demonstrating the advantage of his invention. His first step was to prove that boilers were liable to and did explode in the manner he asserted; and this he has apparently proved by actually getting up an explosion, which took place at the time and hour he named and in the way he said it would, namely, by simply opening the boiler valve and letting off some steam.

This experiment has been heretofore tried by various engineers, some of them very learned, but Mr. Lawson is the only one, so far as we know, who has succeeded. He has certainly taught us a good lesson in the boiler explosion art, which we think will result in great benefit. A letter in the *Tribune* gives the following particulars:

"The experiments were made in June, at Munhall Farm, on the Monongahela river, nine miles above Pittsburg, Pa., where the United States Government Commissioners made signal failures in their attempt to produce the same result a few years ago. The same foundations, furnaces, water supply, and bomb proofs were used on this occasion. The boiler was made of the very best iron, and showed a tensile strength of 624 pounds to the square inch, according to the United States standard. It was six feet in length by thirty inches in diameter. Before being taken to the ground it was tested by the boiler inspector of this county and pronounced one of the best and most perfect steam boilers he had ever examined.

"The cylinder of an old steamboat engine was connected with the boiler by means of a two-inch pipe, in which was fitted a quick-lifting valve. The steam was permitted by means of this valve to enter the cylinder in the same manner as it enters the cylinder of any ordinary engine, with the exception that it was not cut off suddenly, as in a working engine. Had it been, Mr. Lawson claims the explosion would have been still more certain. When the pressure reached a certain point the furnace was fed with petroleum by means of a small pipe connected with a tank located at a safe distance.

The majority of those who saw the boiler were of the opinion that it would safely stand 500 pounds pressure, and would not give way to less than 600. In order to save time no test was made until a pressure of 325 pounds to the square inch had been obtained. The valve was then lifted quickly, and the steam rushed into the cylinder rapidly, but with no other effect than to produce a shock distinctly noticeable by those in the bomb-proof.

The final test was made at a pressure of 380 pounds, a little over half the capacity of the boiler. At this time the water was eight inches above the fire line, the boiler being at least three-fourths full. No sooner was the cylinder filled with the rushing steam than a slight shock was felt, followed by a terrific report. Vast volumes of steam enveloped everything, but there were no signs of any hot water, it all having burst into steam when the pressure was removed. This accounts for the absence of water marks in the vicinity of boiler explosions, which has often led to the conclusion that they were caused by the extremely low water.

The report had scarcely died away before a shower of condensed steam began falling, accompanied by pieces of iron, bricks, steam pipes and other *débris*. Scarcely a vestige of the furnace or boiler was left. The latter had not merely given way at a single point, but was literally torn into fragments. One of the largest pieces yet found was about a foot and a half long and a foot wide. It had been blown fully half a mile. One of the heads was found nearly half a mile from the bombproof. The other one had not been found at last accounts. The most of the pieces picked up were of irregular shape, with very ragged edges, showing the iron to have been of excellent quality.

Mr. Lawson has invented a boiler which he believes to be proof against explosions of this kind. It is constructed with a partition intervening between the flues and the top of the boiler, thus creating a steam compartment over the water, to be supplied with steam from the water through valves in the partition, which valves, to insure safety, must be smaller in the aggregate than the port or valve through which the cylinder is fed from the steam compartment. By this means the pressure is kept approximately uniform upon the surface of the superheated water, thus preventing the dangerous effect which must follow the sudden reduction of pressure from its surface. Mr. Lawson's next step will be to show that his improved boiler cannot be exploded.

How to Tell Good Butter.

The Legislature of Ohio has just passed a bill providing for the inspection of butter and cheese, "and all substances having the semblance of butter and cheese," and of dairies and other places where milk is sold or butter and cheese manufactured; to be done by inspectors appointed by the State Board of Health. The superintendent of inspectors of butter and cheese, Mr. Robert Orr, has issued a circular of instructions to his subordinates giving information which may be of value to butter makers and buyers generally. He says:

"When butter is properly churned both as to time and temperature it becomes firm with very little working, and is tenacious; but its most desirable state is that of waxy, when it is easily moulded into any shape, and may be drawn out a considerable length without breaking. It is then styled gilt-edged. It is only in this state that butter possesses that rich nutty flavor and smell, and shows up a rich golden yellow color, which imparts so high a degree of pleasure in eating it, and which increases its value manifold.

"It is not always necessary when it smells fresh and sweet to taste butter in judging it. The smooth, unctuous feel in rubbing a little between the finger and thumb expresses at once its rich quality; the nutty smell and rich aroma indicate a similar taste; and the bright golden glistening cream-colored surface shows its high state of cleanliness. It may be necessary at times to use the trier, or even use it until you become an expert in testing by taste, smell, and rubbing."

Don't Whip a Frightened Horse.

It seems to be a characteristic failing of most coachmen to lay the lash upon a horse that exhibits fear at an object in the street or beside the road. Mr. Bergh, President of our Society for the Prevention of Cruelty to Animals, says in the organ of that society, what every reasoning being ought to know, and that is to never whip your horse for becoming frightened at any object by the roadside, for if he sees a stump, a log, or a heap of tan-bark in the road, and, while he is eying it carefully, and about to pass it, you strike him with the whip, it is the log, or stump, or the tan-bark that is hurting him in his way of reasoning, and the next time he will be more frightened. Give him time to smell all of these objects, and use the bridle to assist you in bringing him carefully to those objects of fear.

Velocity of Light.

Professor G. Forbes lately explained to the London Physical Society the experiments made by him and Dr. Young to determine the velocity of light. The method employed was that of Fizeau; but instead of having one distant reflector, and observing the total eclipse of the reflected ray by a tooth of the revolving wheel, two reflectors, one a quarter of a mile behind the other, were used, and two rays, which were observed when of equal brightness. This method was found more accurate than Fizeau's own plan, and gave curves of brightness. The speeds of the toothed wheel were adjusted until the two rays appeared of equal brightness. The general result was that the velocity of the light of an electric lamp is 187,200 miles per second. Corner found the light of a petroleum lamp to be 186,700 miles per second, and Michelson that of the sun to be 186,500 miles per second. The higher number of Professor Forbes is probably due to the bluer light of electricity, for further experiments made with colored lights and the spectrum seemed to prove that blue light travels probably over 1 per cent faster than red light. The experiments were made at Wemyss Bay, in Scotland.

An Invention Called For.

A prospecting drill is in demand in the mining regions of the West. A Colorado correspondent writes that such an implement is much needed in that State. It should be a simple affair, worked by hand, light enough to be carried by a man, and not cost more than $25 or $30, as prospectors are as a rule poor men. It should be capable of drilling an inch hole from 15 to 30 inches deep, thoroughly practical, and such as one man can operate easily. Such a machine, he is confident, will find ready and remunerative sale.

As this is not the first time that the demand for a portable drill for single-handed use has been made known to us, and as there is an obvious and increasing need for such an aid to individual prospectors in the development of our mining regions East as well as West, it is safe to say that the problem is worth considering by inventors and manufacturers.

The Periodical Cicada.

The anticipated appearance of the seventeen-year locust, so called, in Illinois (referred to in a notice of Prof. Riley's paper, page 408, SCIENTIFIC AMERICAN), has been justified by fact. The cicada began to appear at Carrolton, Ill., May 20, and in the forepart of June became very abundant. At Vandalia, Ill., the woods were filled with them before the 10th, the noise of them being audible above the rattle of the cars to travelers on the railway. In other parts of Southern Illinois and in Kentucky the insects swarmed in myriads. At Little Rock, Fort Smith, and Hot Springs, Ark., they appeared in large numbers, and also as far south as Mobile.

Mica and Asbestos in the Black Hills.

It is claimed that the finest mica obtained in the United States is now taken from the mines at Custer, Dakota Territory. An open cut has been run 150 feet and a shaft sunk 24 feet on the ledge. At the opening of the cut the mica was 4 feet wide. Now, at the rear end of the cut it is 23 feet wide, and the maximum of the ledge has not yet been attained. The largest sheets are 8 by 16 inches, while the average sheets are 5½ by 6 inches.

Another useful mineral lately discovered in quantity in the Black Hills is asbestos. The mine is about six miles from Deadwood. It is said that the croppings can be traced for nearly 300 feet, while a large body of it has already been unearthed. Tests have been made which prove that this body of asbestos is equal to any yet discovered in America.

A Dairy Scheme.

A heavy dealer in cheese in Canada projects a great dairy farm or farming community to be suitably located in the West. The plan involves the establishment of a group of 224 farms of 160 acres each, each farm to be provided with a good house and stocked with 30 cows. Each farm is to have 40 acres of plowed land. For a calf ranch, 75,000 acres of grazing land will be leased, in addition to the regular farms.

The plan further contemplates the erection of a large cheese and butter factory, and a narrow gauge (3 foot) railroad to connect the farms with the factory. The railroad will have to be from 30 to 40 miles long, with 58 stations. The milk is to be collected twice a day. A capital of $400,000 is named as the sum required for carrying out the project. The farms are to be leased or sold to tenants, as they may prefer.

The Newfoundland Seal Catch.

The sealing operations about Newfoundland have been very profitable the past season. Twenty-seven steamers and many sailing vessels were engaged, the steamers making two trips each to the ice floes, where the seals are taken, during the season which lasted from March 15 to May 15. The total number of seals captured by the steamers was 334,513, young and old; the weight of the blubber and skins exceeded eight thousand tons; the approximate local value of the steamer catch being $850,000. The entire catch was as follows:

	Number of Seals.
Captured by steamers	334,513
Captured by sailing vessels	63,500
Captured in the northern bays of Newfoundland	17,000
Captured on so-called French shore of Newfoundland,	21,000
Captured on west coast of Newfoundland by schooners there fitted out	19,800
Total catch around the island	455,813

Estimated value in European markets, $1,250,000.

Hall's Life Raft.

Mr. Thomas Hall of Newton, Mass., has just received a patent for a life-raft which is both novel and practicable. It consists of a double float or raft made of cork or other light material in such form as to fit the outside of any ordinary ship's boat. The raft is made in two parts secured to opposite sides of the boat by suitable lashings. On shipboard the raft may be carried on deck or suspended from davits. When launched it is impossible to either swamp or sink it. Life-lines are provided on all sides, so that it will not only float those actually in the boat, but as many as can hang on by the lines.

A raft of this kind if generally adopted would save many lives, as in times of intense excitement the ordinary boats are very liable to be overcrowded and swamped in launching; they are also in great danger of being overturned by people in the water in their attempts to save themselves.

A Correction.

By the accidental omission of the word "city," in acknowledging the source of Prof. J. D. Parker's article on "Heath's Discoveries in South America," in a late issue of this paper, the *Kansas City Review of Science and Industry* was deprived of the credit which was its due.

IMPROVED CAR TRUCK.

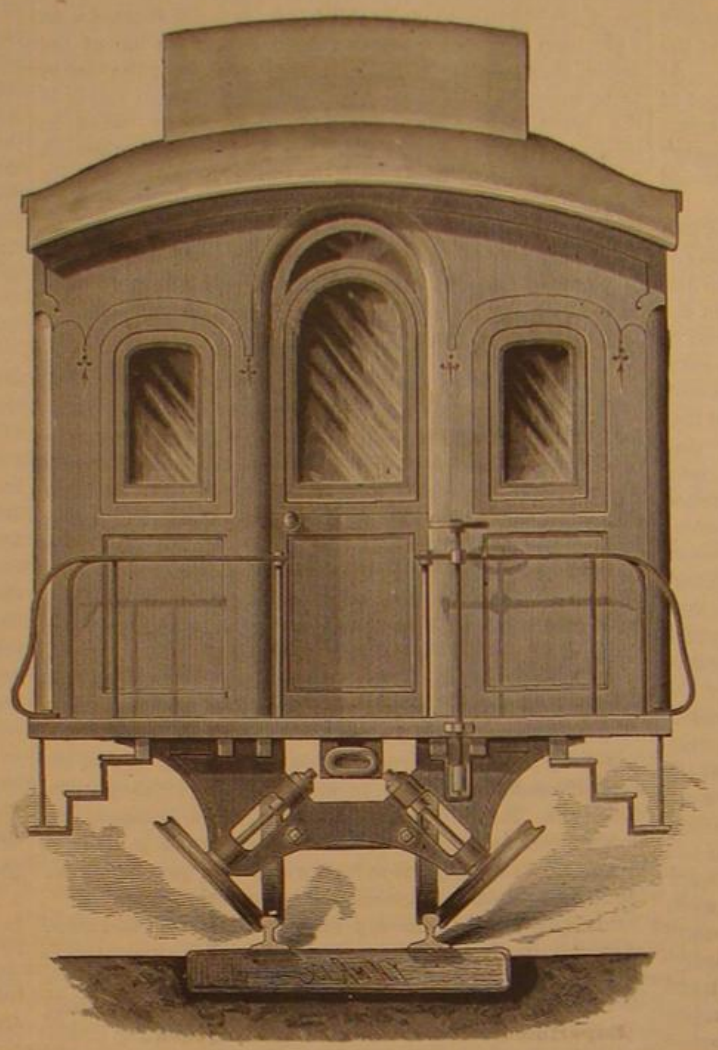
The annexed engraving represents an improved car truck recently invented by Mr. F. Beaumont, Jr., of San Antonio, Texas, which admits of greatly reducing the gauge of the road without diminishing the width of the car. It is easy to show that an immense saving can be made by using the narrow gauge instead of the broad gauge system of railroad building. With the narrow gauge all the heavier work of grading, embanking, tunneling, etc., costs far less, and an important proportion of land damages is avoided. Half the expense of rails is saved and shorter curves are practicable, which makes the constructive engineering both easier and cheaper. Roads of the ordinary narrow gauge of three feet cost about five-eighths as much as the broad gauge roads. And an equal degree of speed is also attainable with greater safety, as from the shortness of the axles the wheels slip less on the outer sides of curves, thereby diminishing the torsional strain on axles, which, as is well known, destroys the fiber of the iron, making the car axles useless after a time, and is frequently the cause of railway accidents.

A much larger saving in the cost of construction can be attained by the use of the improvements illustrated, without proportionately diminishing the size of the cars, as shown in the engraving, representing an end view of a car seven feet in width (usual width of narrow gauge cars) on a track of only eighteen inch gauge. The engraving so well explains the nature of the invention that but little need be said further, than that the improvement consists of the lateral wheels placed upon axles, inclined upward and inward at an angle of about forty-five degrees to the axles of the ordinary transporting wheels. These inclined axles have their bearings in the bolsters, one of which is placed at each end of the car truck. The inclined wheels run on the outside of their respective rails, their flanges projecting under the rail head, tending to keep the car in equilibrium, and permitting a much larger part of it than usual to overhang the rails in perfect security, thus enabling the gauge of the track, and consequently the road bed, to be greatly diminished in width, as shown in the engraving. When the car is seven feet the gauge is eighteen inches, and the tie is three feet long.

The inventor is fully aware of the necessity of some important modifications in switches, turnouts, etc., and has also invented a system of these, especially adapted to his method of narrow gauge, which makes it entirely practical.

The improvement is well calculated to cheapen the construction of railroads, so that they may be built in many instances where now it is impossible to build the present narrow gauge for lack of sufficient capital.

The invention has lately been patented by F. Beaumont, Jr., and Jno A. Fraser, assignee, of San Antonio, Texas, who may be addressed for further information.



BEAUMONT'S CAR TRUCK.

EXPANSION VOLTAMETER.

BY GEO. M. HOPKINS.

In the ordinary voltameter in which acidulated water is decomposed by electrolysis, and by which the strength of the current is determined by the volume of gas accumulating in a given time, there are several objectionable features which prevent it from coming into general use for the measurement of the strength of electric currents.

In the first place the electrolytic voltameter is incapable of indicating the strength of the current at any particular moment, and cannot, therefore, yield anything but a mean result. It offers considerable resistance in the circuit, its indications depend upon the acidity of the water, and the size and distance apart of the electrodes; and to secure accurate results the temperature and barometric pressure must be taken into consideration.

The voltameter shown in the engraving depends on the heating effect of the current on a thin wire of platinum or copper, the lineal expansion of the wire giving the index more or less motion, according to the strength of the current.

This instrument, like the electrolytic voltameter, is adapted only to strong currents, and, although it has one source of error to be compensated for—that is, the increase of the resistance of the wire with the increase of temperature—no account is taken of the environing temperature nor of barometric pressure, and the indication may be read at any moment; and, moreover, the increase of resistance due to increased temperature may be disregarded, since the normal resistance of the wire is almost nothing.

This voltameter finds its principal application in connection with the stronger currents, such as are employed in electric lighting, in electro-metallurgy, and in telegraphy, and it is a convenient adjunct to the dynamo-electric or magneto-electric machine. It must be adapted within certain limits to the current which is to operate it, but when the instrument is properly proportioned to its duties its indications may be relied upon.

A vertical plate of vulcanite supports a horizontal stud, upon which are placed two metal sleeves having a glass lining. To one of these sleeves is attached a counterbalanced arm, carrying at its upper end a curved scale, having arbitrary graduations determined upon by actual trial under approximately the same conditions as the instrument will be afterward subjected to in actual use. The other sleeve carries a light counterbalanced metal index, which moves in front of the curved scale. Each sleeve is provided with a curved platinum wire arm, dipping in mercury contained in an iron cup secured to the base. Two platinum or copper wires are stretched along the face of the instrument, and attached at one end to hooks passing through an insulating post, and after passing once around their respective sleeves on the index and scale, are attached to spiral springs, which in turn are connected with wire hooks extending through an insulating post projecting horizontally from the vulcanite plate.

Under each wire there is a horizontal meta bar communicating under the base with one of the binding posts. The two other binding posts are connected separately with the two mercury cups. It will be seen that with this construction the expansion of the rear wire will move the scale, while the expansion of the front wire will move the index. In order to apply the current to any required length of wire, there is upon each of the horizontal bars a clamp, which may be placed anywhere along the bar and screwed up so as to clamp both wire and bar.

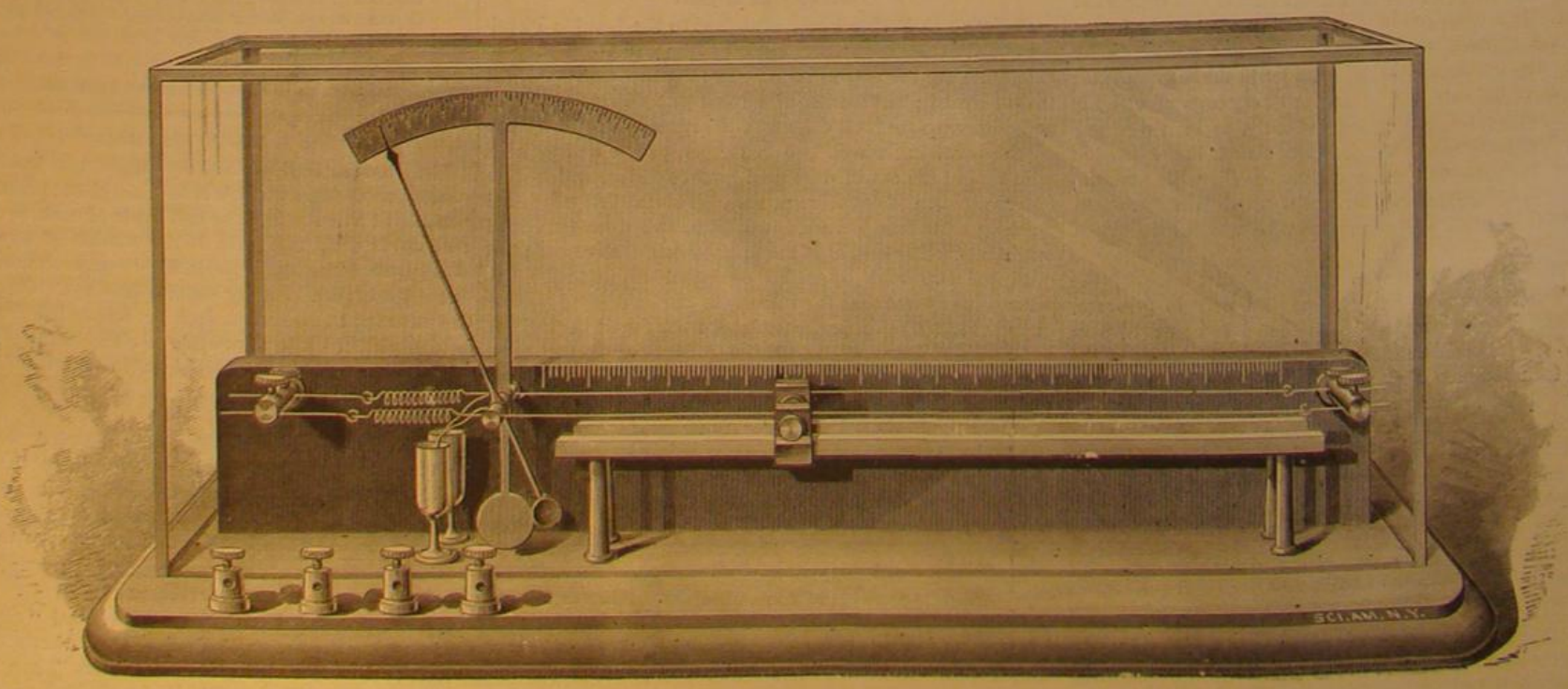
Usually the current to be measured will pass from the battery or machine to one of the binding posts, thence to the forward horizontal bar, thence through the expansion wire connected with the index, through the sleeve of the index, and finally through the mercury cup to the other binding post.

It will be observed that both scale and index will be moved in the same direction by the expansion of their respective wires, and that the atmospheric temperature affects both alike. This being true, it is unnecessary to take any account whatever of external temperature. The apparatus is inclosed in a glass case to prevent the cooling action of the draughts of air.

By connecting the index expansion wire with a battery having an electromotive force of one volt, the deflection is very slight, even with a very fine wire, but in a stronger current from a battery having an electromotive force of five volts and upward, slight variations will be readily indicated.

As mentioned before, the instrument must be adapted to the conditions under which it is to be used. For use with a moderate current, a No. 36 platinum wire, about the length of that shown in the engraving, answers a good purpose, but for heavier currents from a dynamo-electric machine, a larger and longer wire of copper will be required. It should be small enough to be heated somewhat by the current, but not so small as to offer any material resistance in the circuit. When the larger wires are used they are not wound about the sleeves of the index and scale, but are bent downward before reaching the sleeves, and the mercury cups are placed so as to receive their lower ends. Cords or small chains are attached to the angles of the wires and wrapped once around the sleeves and attached to the springs.

This instrument, placed directly in the circuit of a dynamo-electric machine, or in a branch circuit, will indicate the amount of current passing. When it is desired to compare two currents the expansion wire of the index is placed in one circuit, and the expansion wire of the scale is placed

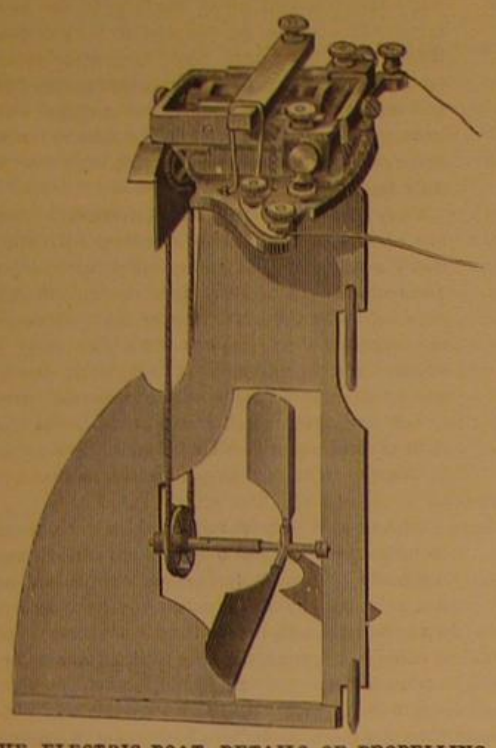


EXPANSION VOLTAMETER.

in the other circuit. In a delicate instrument of this kind the tension of the expansion wires should be only sufficient to keep the wires taut, as they are readily stretched when considerably heated.

THE ELECTRIC BOAT.*

Mr. G. Trouvé has just constructed an electric motor specially adapted to be used in a row boat or canoe. He made his first public experiment on the 26th of May, in Paris, on the Seine, in the presence of MM. Berger, Commissioner-



THE ELECTRIC BOAT—DETAILS OF PROPELLING MACHINERY.

General of the Exposition Universelle d'Electricité, Antoine Breguet, editor of the *Revue Scientifique*, and numerous other spectators, who were greatly astonished to see the boat moving against the current without oars or the smoke generally inseparable from the steam engine.

This electric motor is furnished with a Siemens armature connected by an endless chain with a screw having three paddles, and placed in the middle of an iron rudder. The motor is placed on the upper part of the rudder, so that both the motor and propeller follow the movements of the rudder.

This motor, with all its accessories, only weighed five kilogrammes, and was placed in the rear of a little barge about five meters fifty centimeters long, by one meter two centimeters in breadth, and weighing eighty kilogrammes.

In the middle of the boat were placed two secondary batteries weighing twenty-four kilogrammes. Mr. Trouvé prefers two batteries, as they are more easily managed and have the advantage that they can be used either together or separately; also that in the evening one can be used for propelling and the other for lighting the boat.

The secondary piles are connected with the motor by two cords that serve both to cover the conducting wire and to work the rudder, and are furnished with handles that can be used to regulate the electric current.

This electric motor is complete in itself, and can be placed on a small boat. It is arranged in such a way that it does not interfere with the action of the boat or the use of the oars.

The ingenious inventor, before deciding on the endless chain, made various experiments with the different ways of propelling by cog-wheels by an endless screw and by friction. He found the two first too complicated and too easily clogged by the sand, branches, etc., floating in the water to be advantageously used, while the latter system, though perhaps the better, presented numerous practical difficulties. The endless chains are the best adapted for actual use, as their slower movement is more than compensated by their greater strength and regularity.

Besides her experimental trip, this electric boat has at six different times easily navigated the Seine for a distance of 200 meters. It is found that the boat, containing three persons, stemmed the current at the rate of one meter a second, and descended with a speed of two meters five centimeters. The current of the Seine at this place runs about twenty centimeters a second.

These trials are very interesting from an experimental point of view, and will, we hope, be an incentive to more important works. These will assuredly take place when the supply of electricity is more easily procured, for it cannot be denied that the present electric pile is not an advantageous arrangement, as it is difficult to mount and its power is limited.

Three experiments recall those made by Jacobi in 1829 to navigate the Neva by electricity. We reproduce from the *Merveilles de la Science* the account of this interesting attempt, which well deserves to be called the origin of electric navigation.

The voltaic apparatus that furnished the electricity to Jacobi's motor was composed of two Grove batteries, each containing sixty-four pairs of cells, the whole covering thirty-two square feet. This furnished so powerful a current that a piece of platinum wire, 2 m. long and as thick as a piano string, was immediately heated to a red heat on being exposed to the electric current.

There was so much nitrous gas liberated by the pile that the operators were seriously incommoded, and were several times obliged to interrupt their experiment.

The spectators, who stood on the banks of the Neva, were also forced to retire on account of the suffocating odor of the liberated gas that the wind blew on to the shore.

The barge, which was made with paddlewheels, and was large enough to hold twelve persons, succeeded, however, in sailing several hours on the river against both wind and tide.—*La Nature.*

Large Flagstones.

It is said that the largest flagstone ever cut was laid in Chicago before the great fire. It measured 16x25 feet and was 12 inches thick. Lately one 15x25 feet was cut at Waterville, Oneida County, N. Y., and $5,000 have, it is said, been offered for it delivered in this city. The problem is to get it here, since it is too wide to pass railway bridges and tunnels, and would be too high if turned on edge. Equally great are the difficulties encountered by way of the Erie Canal.

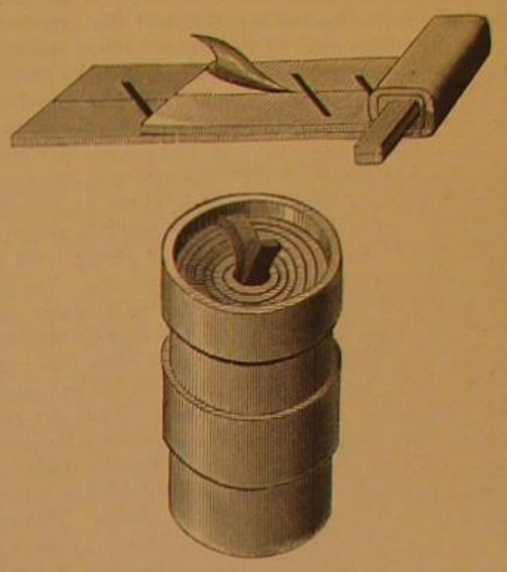
Experiments with Binoxide of Hydrogen.

M. Paul Bert, who, in spite of his election into the French Chamber, continues his scientific experiments, found some time ago that oxygen gas at a certain degree of pressure had the property of destroying all kinds of organized ferments, while it was without action on the chemical ferments of the saliva and the pancreatic fluid.

A young French chemist, M. Paul Regnard, has recently renewed these experiments, but instead of using compressed oxygen gas, he has employed binoxide of hydrogen, that is to say, distilled water containing one per cent of the binoxide. He has found that a few drops of this weak solution arrest the fermentation produced by yeast, prevent the production of mycoderms in wine, prevent the putrefaction of milk and white of egg, urine, and saccharated yeast, but have no preventive action whatever as regards the sugar-producing properties of the ferments of saliva and the pancreatic fluid when acting upon cooked starch.

THE FAURE BATTERY—STORED-UP ELECTRICITY.

The current number of *Le Journal Universel d'Electricité* contains, says *Engineering*, a very ably written article by M. Frank Géraldy upon the Faure secondary battery, to which we recently referred. From this article we find the space to make the following extracts: "The posters bearing the words 'Power and Light' in enormous letters, are still visible on the walls; the noisy articles that have appeared in certain journals are not yet forgotten; however, the bills are beginning to disappear, the effect of the articles to decrease, excitement is on the wane, and the scientific press can at last be heard. It has, indeed, been difficult to discuss this matter sooner, for it was essentially necessary to have data and information as exact as possible, and these have not been obtained without trouble."



THE FAURE BATTERY.

The author then refers briefly to the secondary battery of M. Reynier, and proceeds to describe the Planté battery, which he states to be almost identical with that of M. Faure, M. Planté having, except in one point, long ago anticipated what M. Faure has recently brought forward, and which has been received with so much popular excitement. He then continues: "We will now proceed to the Faure secondary battery. It is protected by two patents dated October 20, 1880, and February 9, 1881, respectively. In these patents M. Faure describes principally those batteries composed of lead plates laid on frames covered with red lead, and protected by leather, attached by means of lead rivets, an arrangement similar to the rectangular batteries of M. Planté. The actual batteries are not so made, being constructed as follows: Two sheets of lead are taken 7·87 inches wide; one of these plates is 23·62 in. long, and 0·04 in. thick; the other is 15·75 inches long and 0·02 inch thick. Each plate is covered on both faces with a layer of red lead reduced to a paste by water, 1·76 lb. being spread over the larger plate, and 1·54 lb. over the smaller. On each face thus prepared a sheet of parchment paper is placed, and the whole is introduced into a sheath of thin leather. One plate is then put on top of the other and rolled up, strips of rubber being interposed obliquely, as shown in the sketch. The roll is then placed in a cylindrical lead cell, the outside of which is strengthened with copper bands, and the inside covered with red lead and leather, so as to increase the useful surface of the battery. The latter then presents the appearance shown in the sketch, and one of the projecting stems from the lead plates is bent over and soldered to the inclosing cylinder, which is ready for use when it has been filled with water with about 10 per cent of sulphuric acid. The apparatus when charged weighs about 20 lb. It will be seen that this differs from the Planté secondary battery only in the employment of red lead. The material chiefly employed is the same, the mode of construction is precisely similar, the leather takes the part of the cloth previously used by M. Planté; it has no merit in itself; on the contrary, it is a cause of resistance, and is liable to deterioration, being useful only to keep the red lead in place. It is, in fact, this red lead which constitutes the new feature, and gives the special advantage to the apparatus.

"According to the inventor there are two advantages gained. The long and delicate operation necessary to prepare the Planté battery is not required. (This operation consists in passing through the battery an electric current,

THE ELECTRIC BOAT

* In a note lately presented to the Academie des Sciences, M. Trouvé claims to have improved the Siemens armature. The poles, instead of being portions of a cylinder whose axis coincides with the axis of the system, are so turned that they gradually approach their surfaces to the magnet until the moment when the under side escapes from the influence of the magnetic pole, and the repulsive action commences. By this device, the point of total rest is practically avoided.

M. Trouvé adds that they proved this by constructing two Siemens armatures of the same diameter, one of which he modified in the above manner. He used them successively in an electric motor, and with the same pile he obtained a much greater working power from the modified form. More ample details may be found in "Comptes rendus des Séances de l'Academie des Sciences."

when oxygen goes to one plate, and produces a thin coat of peroxide of lead, and hydrogen goes to the other plate.) The second advantage claimed is that the battery has a storage capacity much greater than that of Planté; the proportion, according to M. Reynier, being, as deduced from numerous experiments, forty times greater with equal weights of batteries. The first advantage claimed may be readily conceded, and it is one of considerable practical importance and value. The second cannot be admitted, as will be seen from what follows. M. Hospitalier and myself were very desirous to subject the Faure battery to precisely the same tests that we have made with the Planté battery.

"To do this we first addressed ourselves to the proprietors of the invention, who replied that they could not intrust us with the apparatus; that they would not object to trials, but only after some time. Since this communication we have heard nothing from them. In the absence of direct data we will reason on the figures supplied, and the experiments made by the proprietors of the Faure battery before the public. It has been said and repeated officially that in a Faure battery weighing 165 lb., there could be stored up a quantity of electricity able to produce an effort equal to one horse power, for one hour, or 3·28 foot-pounds per second and per pound of battery. We have only seen the apparatus producing power, on one occasion, at the Société d'Encouragement. Then it was far from giving this result; the battery weighed 326 lb., but instead of giving 1,070 foot pounds per second it only gave 339 foot pounds. The apparatus might have been working under unfavorable conditions; it might have been doing far less than its maximum. We do not wish to draw any deductions from this experiment, which was, however, a very unfortunate one, and we will for the moment accept the 3·28 foot pounds per pound of battery. We ought here to examine what is the duty of the apparatus. In reference to this M. Reynier made before the different societies an algebraical calculation which is published in the Transactions of the Academy. This calculation was met—at the Société de Physique—by many reasonable objections, the principal one being that it was useless, the only conclusion M. Reynier having drawn from it being that the more slowly the battery was discharged the better results that it gave, but no algebra was required to prove this. It is a general characteristic of the Planté secondary and of some primary batteries, as well as of dynamo machines. By using the battery very slowly, therefore, its duty is claimed to be 80 per cent, and as this proportion may be true of the Faure as well as of some other batteries, we will accept it. Admitting then this 80 per cent, 11,800 foot pounds of actual work per pound weight of battery would represent 14,750 foot pounds stored up within the battery. This figure is, up to a certain point, confirmed by an experiment made at the Société de Physique, where eight batteries, maintained, at a red heat during one hour and forty minutes, a platinum wire 13 feet long and 0·048 inch diameter. M. Reynier calculated that the total calorific work (interior and exterior) was equal to 253 foot pounds per second, or 1,518,000 foot pounds in all. According to M. Reynier, the weight of the batteries was 123 lb., so that the power stored up was equal to 12,341 foot pounds per pound of battery. There must have been a slight error here, because, as we have already seen, the useful weight of each battery cannot at the lowest estimate be less than 176 lb., giving a total of 140·8 lb., or 10,840 foot pounds per pound. According to the careful experiments we have made the useful storing power of the Planté secondary battery is 11,350 foot pounds per pound of battery, so that according to the different weights taken, the ratio of the latter to the former is 1·30, 1·08, or 0·95. This is a very long way off the forty times of M. Reynier. That gentleman, informed of this great difference, objected that the Planté battery we had employed must have been an exceptionally good one; those from which he had deduced his comparison had been furnished to him by M. Breguet. If this was the case these Planté cells did but little credit to the renowned maker who supplied. Besides, as a matter of fact, the batteries we experimented with were taken from those made by M. Planté for sale for medical and other purposes. Moreover it must be remembered that there are at present no Faure batteries made for sale, the ones already produced having been made by M. Faure's own hands or under his directions, and it is only just to institute a comparison between the Faure battery made by M. Faure, and the Planté battery made by M. Planté.

"The results we have given cannot be far from the exact truth; *a priori* there can be no reason why a battery in which the red lead is spread by hand, should be, weight for weight, superior to an apparatus in which the peroxide is furnished gradually by electricity, and experiments entirely confirm this deduction. The Faure battery is better adapted for industrial purposes, it has more solidity, and can, moreover, be made of larger dimensions; but these advantages might be obtained with the Planté battery if desired; the Faure cell does not require a preliminary electrical process to render it fit to receive the charge, which is a very great advantage, and besides it offers greater resistance for an equal surface, while it is less liable to damage than the other apparatus. But although the Planté battery has been in existence since twenty years, no one has ever suggested its employment as a means of producing power and light, and for several very good reasons, of which we will mention only one—that of transport—which has been treated in the company's prospectus as a detail of insignificance, and referred to only as it were in an excess of scrupulous minuteness.

"In order to furnish a force equal to one horse power during ten hours, ten batteries weighing 165 lb. each must be employed. This is throwing out of consideration the fact that a part of the charge only can be utilized on account of the fall of the potential below the necessary point, which would take at least 25 per cent off its utility. Making no allowance, however, for this, 1,650 lb. would have to be carried twice, that is to say, 1½ tons of battery would be transported daily, besides all other expenses, for a charge of 10 francs a day; we leave the reader to draw his own conclusion. In fact, to maintain that this mode of electrical distribution is more economical than by wires, where they can be used, is to maintain that the present system of distribution of water involves the sinking of an enormous capital in buried pipes, that in these pipes there is always a considerable loss, and that it would be cheaper to substitute a house-to-house system of water transport by means of improved barrels. But this is a point we do not press; it belongs to commerce, not to science, and this journal has nothing to do with money interests. But science suffers much from enterprises of this kind, it scares away confidence from serious undertakings, and exaggerated promises unfulfilled create the utmost distrust in subsequent undertakings of a cognate nature; the public not having obtained what they looked for turn away and refuse to have anything to do with more modest but useful applications which are offered to them. Will it not be thus with the Faure apparatus? The experiences obtained have much interest. The inventor mentions in his patents various special applications, especially for tramways, for which the battery may have a useful future. But why does not the inventor confine himself within the limits of possibility?

"Whatever future may be in store for it, we are at least indebted to it for having drawn special attention to the study of electrical accumulators. Since the announcement of the Faure battery, we know of four others in course of development, all of them of novelty and interest, and all promising a useful though less ambitious future.

"M. Reynier, at the last séance of the Société de Physique, remarked sadly that he did not ignore the relative imperfection of the apparatus he represented, but both M. Faure and himself had been unable to complete them themselves before bringing them before the public, and he trusted soon to be able to show far better results than those given up to the present time. It is an unfortunate position for a man of science to find himself exhibiting and praising without restriction an apparatus of which he sees and acknowledges the shortcomings; it is, in fact, a false position, and one which he would do better to avoid."

Roofing Slates.

Ten years ago the roofing slate industry in this country was not considered of sufficient importance to receive even a bare mention among the "special industries" of the census reports. Last year the capital invested in the manufacture of roofing slates in this country amounted to more than $8,000,000. Over 3,000 men were directly employed producing 600,000 "squares," or sufficient to cover 60,000,000 square feet. The quantity produced in the several States having slate quarries was:

Maine, 60,000 squares; Vermont, 130,000 squares; Pennsylvania, 320,000 squares; New York, 10,000 squares; Virginia and Maryland, 20,000 squares; other localities, 60,000 squares.

The Pennsylvania quarries, which produce more than half the slate turned out during the year, have been worked about 15 years. The largest quarry was opened in 1865. It contains 60 acres, gives employment to 200 men, and produces 40,000 squares a year. The most durable slates are those from Southern Pennsylvania (Peach Bottom) and the Maine slates. The latter rival the best slates of Wales. The dark blue or blue-black slates are most durable. The fancy colored slates—green, purple, red, variegated, etc.—do not hold their color. Red slate is most expensive: during the past season from $7 to $9 per square. The Peach Bottom slates have ranged from $5.50 to $6.50; Maine slate, $5.50 to $7.75; common Pennsylvania, $4.50 to $5.25; Vermont purple, $5 to $5.50; green and variegated, $3.50 to $4.50.

Elastic Adhesive Plaster.

Dr. W. P. Morgan, in a communication to the *Boston Medical and Surgical Journal*, states that he has been trying to obtain an elastic adhesive plaster, that when attached to the skin it should yield to the movement of the muscles and parts beneath it without the sensation of stiffness or an uncomfortable wrinkling.

Not being able to obtain an article of this description, I procured some India rubber, and giving it a coat of plaster, such as is recommended in Griffith's Formulary under the name of Boynton's adhesive plaster (lead plaster one pound, rosin six drachms), I found the material I wished. After using it as a simple covering for cases of psoriasis, intertrigo, etc., I extended its use to incised wounds, abscesses, etc., and found it invaluable.

Placing one end of the strip of the plaster upon one lip of the wound, and then stretching the rubber and fastening the other end to the opposite lip of the wound, I had perfect apposition of the severed parts, the elastic rubber acting continually to draw and keep the parts together. When I have been unable to get the sheets of rubber, I have used the broad letter bands (sold by stationers) by giving them a coat of the plaster.

Correspondence.

Iridium.—A Letter from Mr. Holland.

We have received from Mr. John Holland, of Cincinnati, a small section of a small bar of iridium, cast by his new process, which we lately described in the SCIENTIFIC AMERICAN. Here is a metal that looks to the eye like polished steel, but is heavier and harder than steel, will not rust, and is not affected by the ordinary magnet. It seems destined to occupy in the near future a very important place in the arts. Mr. Holland writes us as follows:

To the Editor of the Scientific American:

As you considered my discovery of a cheap and effectual manner of melting iridium worthy of several editorial notices in my old favorite paper, the SCIENTIFIC AMERICAN (I have been a subscriber for it since 1858), I take the liberty of presenting you with a specimen of the metal, which please accept with my compliments. This specimen I broke off from a bar 12 inches long, which was cast in an open ingot. The ore was Russian, which I find softer and less refractory than the California iridium; still I have melted all kinds of the ore, and made it run about as free as silver. I use a common draught furnace and a Hessian crucible.

I will add that I have spent over $10,000 in money and been twenty years experimenting almost daily on this metal trying to melt and mould it. I now feel thankful that I have lived to accomplish it in a thorough and practical manner. The quantity of the ore is quite large in Russia and in California.

I hope soon to see it extensively used in the mechanical arts. It is very hard, will not oxidize, and is not magnetic.

I have kept one piece of it, 8 dwts. in weight, on the negative pole of a dynamo-electric machine for five weeks. There was no loss in weight, and had it not met with an accident by falling while hot it seemed likely to last for a long time. The light produced was white in color, and as the iridium is a good conductor of electricity the light was fully one-third stronger than the lamp made with both poles of carbon.

Thanking you for your kindly notices, I beg to say that I feel more satisfaction in the realization of the benefits this metal will be to the mechanical world than for any money I may make by it.

JOHN HOLLAND.

Cincinnati, June 18, 1881.

The Pursuit and Destruction of Icebergs.

To the Editor of the Scientific American:

From accumulated observations during many years past there is reason to anticipate an unusually heavy flow of icebergs along and obstructing the steamship commercial zone of the Atlantic Ocean as the summer advances. During the last year, 1880, the iceberg drift was reputed to have been almost unprecedented, and in repeated instances marine disasters have been attributed to that cause. The severity of the recent winter throughout the high northern latitudes would seem to strengthen the apprehension of their impending recurrence. Recently in connection with the subject of Arctic exploration, I have suggested that when a ship becomes beset by ice floes and icebergs, torpedoes should be employed, charged with dynamite and other explosives, and in cases of urgency the artesian auger resorted to for the purpose of rending and demolishing formidable icebergs to, set ships free from their fatal embrace.

Considering the transcendent importance of a safe route of ocean transit, it would seem expedient that the great commercial powers should co-operate in the employment of explosives and every other resource of modern engineering to free the ocean of these leviathans of the Arctic zones. The pursuit would, perhaps, prove a pleasant recreation, stimulating the ambition of the gallant sons of the sea.

June 17, 1881. DANIEL RUGGLES.

Three Horses Abreast.

The American Express Company has introduced into New York the system of harnessing three horses abreast, after the fashion of the London omnibuses. The change has been made on two of the wagons for an experiment, with very satisfactory results. The wagons are supplied with two poles instead of one, and each of the three horses is attached to a separate whiffletree. This is found to be a decided improvement over the system sometimes used of putting one horse in shafts and another at each side. The harnessing is practically the same as with two horses, with two poles instead of one. The experiment is tried upon the wagons that deliver goods in the upper part of the city, not only because the loads are frequently too heavy for two horses, but to enable the drivers to make up for lost time with an increased rate of speed, when from any cause they are delayed at the start.

Alligator Leather.

The rapid increase in the demand for alligator leather in Europe makes it possible that alligator farming may become an important industry in our Southern swamps. The foreign demand already amounts to many thousand hides a year. The tanning of alligator hides began about twenty years ago. At first Louisiana furnished the skins and New Orleans was the center of the traffic. The general slaughter of alligators soon made them scarce in that State and now Florida is the chief source of supply. The tanning is done here at the North.

THE PROSPECTS AND PRESENT STATE OF PHOTOGRAPHY IN NATURAL COLORS.

IN TWO CHAPTERS.

II.

Of the various processes for producing pictures by photomechanical means only one has up to the present time been submitted to the ordeal of commercial application—that of Leon Vidal. Having departed entirely from the first methods proposed by himself when Secretary of the Photographic Society of Marseilles, he now, as director of a photo-chromic company in Paris, effects a happy combination of two previously well known processes, and examples of the results are at present in the office of the SCIENTIFIC AMERICAN, and challenge admiration on account of their technical merit.

Premising that it is now easy to prepare a printing surface similar to that on a lithographic stone, but which possesses a discriminative power of absorbing moisture and assimilating printer's ink in strict proportion to the intensity of the lights and shadows of nature, it follows that half tone may be produced by mechanical agency. Photochromy by Vidal's system consists in an application of this process combined with the essential principles of chromo-lithography. It differs from the latter, inasmuch as not only does it yield the most perfect gradation of tint or tone, but the drawing is effected by photography instead of by the skilled artist.

The principle underlying this method will be best understood by our giving a brief description of the method by which we saw produced a rose tree clad with foliage and adorned with numerous bright red blossoms. From the original negative were obtained three others, in one of which the trunk, branches, and leaves were entirely stopped out, leaving nothing but the flowers. From a second were stopped out all but the leaves, while in the third the trunk and large branches alone were allowed to remain. By methods well known to lithographic printers three printing forms were then prepared, one from each negative. These were made by coating a thick plate of glass with gelatine containing bichromate of potash, which, when dry and exposed to the action of light under a negative, acquires the property of absorbing and rejecting water in certain parts, and thus interpreting the action of the light when an ink roller is applied. The cliche from the leaves was inked with a semi-transparent green ink, and the prints from this showed faultless gradation of tint together with structural detail. When the whole of the greens had been printed, the form containing the flowers, inked with red, was then placed in the press and by means of careful registration the blossoms assumed their proper places among the leaves. A third printing, this time from the tablet containing the brown trunk and larger branches, completed the operation. The picture, the mode of producing which is now described, when shown to several artists evoked much surprise as to the method by which it could possibly have been made, but at that time Vidal's modern method was unknown and the experiment described was only a tentative one.

It will here be recognized that by the system of overlapping, secondary, tertiary, and indeed numerous colors and tints may be produced. The process applies to everything that can be reproduced by photography, including portraits and landscapes as well as rose trees.

But, query, cannot nature herself be made to do the stopping out part when preparing the several negatives for printing each its separate color? This problem was taken in hand recently by M. Ducos Duhauron, who based his experiments on the theory that the primary colors combine to form every known tint. It is enough to interpose between nature and the sensitive plate a transparent colored medium to insure that medium stopping from reaching the sensitive surface all rays which cannot be transmitted by it. But the method of M. Duhauron dips deeper beneath the surface than would be imagined by a superficial observer. He employs three colored glass plates or other transparent media the *complementaries* of the primary colors, each of which will transmit two of its constituents and debar access to the remaining unit—three primary colors being assumed for the sake of explanation to be theoretically correct. If for the production of each monochrome a screen were employed of the same color the negative would represent that color by black, and the two remaining ones by transparent glass, there being in the print none of the color in the part where it was desired it should exist, while it would be elsewhere present.

The screens found most useful for effecting the stoppage of certain rays of light are formed by first collodionizing a plate of glass, and then coating it with a lac or sandarac varnish containing one or other of the aniline dyes modified by other transparent pigments. The colors required in the finished masks or screens are green, orange, and violet, and the mask thus tinted is placed either immediately in front of the sensitive plate in the camera or in near juxtaposition to the lens. From three negatives obtained from nature, each under a mask of a different color, are printed by the carbon, or, more properly, the pigment-printing process, proofs, which, executed in pure colors, are then superimposed on each other and detached from the paper on which it was borne. The resulting picture shows every tint of nature. To prepare the three pigmented papers which are thus made to yield up their colors, Prussian blue represents the blues, carmine the reds, the yellow being produced by chrome yellow. Each of these is mixed with gelatine when applied to its special sheet of paper. The method of printing is essentially that employed in the carbon process, bichromate of potash forming the sensitizing compound. After printing, each integral portion of the picture is superposed and set off upon the other, the result being a photograph in the colors of nature.

It is important, of course, that the three negatives be taken not only simultaneously, but from the same standpoint, a condition of things which one at first sight would say cannot be attained. But here the ingenuity of M. Duhauron again steps in to indicate in what manner this seemingly impossible feat is accomplished. Three cameras, each fitted with its respectively colored glass mask, are ranged alongside each other, all in a row, facing a dark mass of velvet or other black material, and side on to the view or object to be photographed. Erected in front of the lens of the outside one is a faultless plate of glass placed at an angle of forty-five degrees. This acts the part of a reflector, throwing enough rays into its camera by which to enable a brilliant picture to be taken. But as the reflecting mirror is a transparent sheet of glass, a large volume of the light is transmitted through it as well as reflected by it; and the second camera, also fitted with a similar transparent reflecting plate of glass, catches up a portion of the rays thus transmitted, and reflects them through its own lens to its interior. What is not reflected by the second plate is received upon a third one attached to the third camera of the series. It, however, is a mirror proper, the glass being silvered, and the remainder of the rays not utilized by the other two cameras are here rendered subservient to the production of the picture. We may here observe that there is more ingenuity displayed in this, as well as more modifications and applications that may arise out of it, than is imagined by its ingenious originator.

Effective colored pictures have been produced by superposing transparent prints, such as those by Woodburytype, upon colored bases; this, however, belongs to the department of the mechanical application of pigments.

NEW INVENTIONS.

A simple and inexpensive combined hame and collar has been patented by Mr. James B. Law, of Darlington Court-House, S. C. It consists in a broad wooden hame strengthened by iron plates at the bottom, and provided with suitable means for protecting the horse's neck from injury.

Mr. Henry Dainty, of Brooklyn, N. Y., has patented an apparatus for burling wool and carbonizing cotton from mixed rags, so constructed that vegetable impurities and fibers can be removed or carbonized from the animal fibers in much less time and without any danger to the operator from the carbonizing gas when emptying and refilling the apparatus. The invention consists of a carbonizing chamber having slides, drawers placed upon the slides to receive the material, doors hinged at their lower edges, a furnace, a gas-generating retort having gas-discharge pipe leading into the carbonizing chamber, and a detached cover for removing the refuse without drawing the fire, a smoke flue surrounding the gas-discharge pipe, a steam jacket for heating and drying the gas, and an exhaust fan blower having its pipe provided with a valve for withdrawing the gas from the carbonizing chamber when opened, to protect the workmen.

An improved washing machine has been patented by Messrs. Henry Ruppert and John Mullerweiss, Sen., of Sebewaing, Mich. This invention consists in a novel arrangement, with a tub, of two curved oscillating and reciprocating rubbing surfaces, and devices for operating them.

An improved machine for boarding and breaking raw hides has been patented by Mr. William Coupe, of South Attleborough, Mass. This is an improvement on the machine for boarding and breaking raw hides for which Patent No. 202,414 was issued to the same inventor April 16, 1878.

Mr. Henry Cull, of Johnstown, Pa., has patented an improvement in stock cars designed to permit the ready feeding and watering of the animals while being transported over long railroad routes. The invention consists in the improved method of arranging the cattle in the car and holding them in their places.

An improvement in devices or apparatus for temporarily connecting the ends of a belt, so that the slack may be taken up without necessitating the detachment of the belt from the pulleys on which it runs, has been patented by Mr. Peter S. Graham, of Cumberland Mills, Maine.

The Manufacture of Cotton Seed Oil.

The census of cotton-seed oil mills discovered fifty-six, the most of them in the Southwest. Louisiana has nine, of which New Orleans has six; Mississippi has nine; Tennessee and Texas each eight; Arkansas four; Missouri and Alabama each two, and Georgia one. The amount of seed used is about 410,000 tons yearly. After being dusted and stripped of lint, the seed goes to a revolving cylinder set with knives, which cut the seed very fine. There the hulls are separated from the meal, and the latter is pressed between rolls and packed in woolen bags, which are placed between horse-hair mats and subjected to a hydraulic pressure of about 200 tons. The expressed oil is either barreled in the crude state or pumped to a refining room, where it is treated with caustic soda obtaining 82 per cent of fine oil.

The first product derived from this process is the lint, which amounts to about 5 per cent of a crop; that is, the country gin takes 95 per cent of the crop, and the seed retains 5 per cent, which the mills secure. The cotton is very white and clean, but very short, and the best of it sells at eight cents per pound. It is used to make cotton batting. The crop of the oil mills amounted to 5,000 bales last year.

Second. The hulls constitute about one half of the seed. They are used for fuel to run the mill, and thus the mills do not need to buy any coal. The ashes make a valuable fertilizer, and they are also leached for the purpose of obtaining lye to make soap.

Third. The oil amounts to about 15,000,000 gallons in the United States, and about 10,000,000 gallons are yearly exported to Europe, where it is used to adulterate olive oil. Three gallons of cotton-seed oil and one of olive oil make four gallons of the average olive oil, and the cotton oil can hardly be detected. The question naturally arises, If we have to eat olive oil which is made from cotton seed, would it not be well for home manufacturers to prepare it, and not allow the consumer to pay two freights across the Atlantic?

Fourth. The oil cake is of a rich yellow color, and is used principally to feed stock, for which use it is ground and fed like corn meal. It is shipped in sacks, each weighing 200 pounds.

Fifth. The deposit left when the oil is refined is used to make soap, and also for making dyes.

Ransom Cook.

Ransom Cook, who died at Saratoga, New York, May 28, was a representative American mechanic. When a young man he used to boast that he was the master of twenty-six trades.

He was born in Wallingford, New Haven County, Conn., November 8, 1794. His parents removed to Saratoga County, New York, in 1801, and in 1813 he began to work at the trade of a chairmaker. He owned the first shop using steam power in the county. His inventive faculty was early developed, and he took out many patents. One of the first, granted in 1842, was for an improvement in the manufacture of wrought iron and steel cannon. This idea was appropriated by Sir William Armstrong, who made both fame and fortune out of it. Other patents were for a lunch case, for a fan blower, for a hydraulic apparatus for producing a blast, for an improved hydraulic blower for furnaces, for an improved electro-magnetic ore separator (a very ingenious machine, made by Mr. Cook when he was 80 years old), an improvement in blast pipes for carrying heated air and gases to furnaces, an improvement in scissors, an improved boring instrument known as the "Cook auger," an improved machine for turning the lips of augers, an improved bit for boring wood, an improvement in ventilating and excluding dust from railway cars, an improved exhaust fan, and an improvement in the mode of straining saws for sawmills. There were several others of more or less importance.

Mr. Cook pursued this branch of mechanics for enjoyment rather than for the money to be derived from it, although some of his inventions, particularly the patent auger, were very profitable. He was making a machine and wanted an auger that would bore at an angle with the grain without starting with a gouge. He hit upon the idea of examining the lips of the worm commonly known as the wood-borer with a microscope, and from this model, furnished by nature, he made his auger, which was very successful. His workshop was a curiosity. He made all his own models, and had engines and machinery well adapted to the purpose. He had also accumulated one of the most complete and valuable collections of scientific and mechanical books in the country. His library contains more than 3,000 volumes, some of them very rare.

Sir Josiah Mason.

Sir Josiah Mason, the founder of the new Science College at Manchester, Eng., has just died. He began life as a street hawker, and, after trying many trades, he succeeded in establishing himself in the manufacture of split rings by machinery. Subsequently he added the manufacture of steel pens. In 1874 his pen works employed over a thousand hands, consuming half a ton of rolled steel a day. In addition to great business capacity Mr. Mason was remarkable for his practical wisdom and benevolence. In 1860 he established an orphanage, upon which he has expended $1,500,000. Nearly as much more was nobly invested in the Mason Science College.

Cod Fishing with Nets.

The Norwegian method of netting cod, which the U. S. Fish Commission have persuaded our New England fishermen to try, has proved of signal advantage over the old way of fishing with bait. Many more fish are caught, the fish are larger, and the cost of bait is saved. The first trial of the gill nets was made last winter in Ipswich Bay, north of Cape Ann, Massachusetts. As reported by Captain Collins, of the Fish Commission, the results were most satisfactory. On a trip ending January 11, 35,000 pounds of cod were taken by a smack, 8,000 pounds of which were caught in a single morning. Two other vessels, absent just the same length of time, but using trawls, only got 4,000 and 8,000 pounds. The same vessel using the nets made another trip, taking in four days 35,000 pounds of fish again, having caught in one single day 18,000 pounds. Now, on this same day another vessel set, quite close to the nets, 10 trawls of 1,000 hooks each, and only caught 2,000 pounds of fish. The total results of Captain Martin's enterprise, who was the first to use the nets, may be stated as follows: In not quite two months, from November to January, he took 111,000 pounds of cod, while no trawler, with the same luck, had landed one third of the quantity.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) S. L. R. writes: 1. We have a boiler 15 feet long, shell 41½ feet in diameter, having eighty 3-inch flues. We wish to burn shavings and sawdust. How much grate surface should we have? A. About 36 square feet. 2. What kind of grate? A. A thin, plain grate with narrow openings. 3. How high should the chimney be and what size the flue? A. 6 feet, and 30 inches square. 4. The engine is 14x30. What should be the size of the steam pipe leading to the engine, and what size the exhaust? A. Steam 3½ inches diameter, exhaust 5½ inches diameter. The furnace should be at least twice the usual depth for coal.

(2) E. J. C. writes: A well known writer on stationary engines says of the curved or coiled pipe that connects the boiler and steam gauge: "The cock which is placed at the lowest part of the inverted siphon pipe is designed to draw off any water which may have collected in it; if the water was not drawn off it would rise into the gauge and the steam pressure would be incorrectly indicated." Please explain. A. It would act like a siphon gauge, by the difference of height of column of the liquid *in* the two legs of the siphon; but as these siphons are usually made, the inaccuracy would be inappreciable.

(3) L. G. G. asks: What is the best and most economical way of producing a bright surface upon several iron pins, ⅞x1½x3, having the fire scale still on? A. Use emery wheels.

(4) A. D. W. writes: If your correspondent, J. A. D., will put a cock into the top of the air chamber of his Niagara pump and fill it with water it will be all right. Such at least is my experience with one of them. I take it the steam takes the place of the air, and then a current of air causes condensation, which produces a vacuum which tends to hold the valves.

(5) G. G. M. asks if there is not some mistake in reference to $500,000,000 gold weighing 4,500 tons, as stated in No. 24, late volume, under head "The sub-treasury gold wagon." A. Yes; it should be 1,000 tons.

(6) W. W. asks: Will the boilers used in ranges, some of which are warranted to stand 300 lb. pressure per square inch, answer for an engine 1½x3? How would you arrange it to obtain the best results? A. Yes; for moderate pressures, say, not over 40 lb.; we have seen them set in masonry; they may be set either vertically or horizontally.

(7) E. L. B. asks: Can you inform me how the hydrostatic press and jacks came to be commonly called hydraulic press and jacks? A. We cannot; either term is correct. When the pressure is being exerted, the fluid is in motion; it is then hydraulic. When the pressure is obtained, and the water is at rest, it is then properly hydrostatic.

(8) D. R. asks how to feed turtles and fishes? How often should fresh water be supplied? How long will a turtle live with nothing to eat? A. Feed the turtles and fish on earth worms after they have been placed in grass or moss over night to scour them of all earthy matter, then cut them up to one quarter of an inch and feed to the animals. Look out that none are left after the animals have had all that they require. Remove from the aquarium what are left, or decomposition will take place, which will spoil the water and turtles. Raw beef answers well as a food for fish. In a true self-supporting fresh water aquarium the water needs never to be removed if the proper kinds of plants are used for oxygenation. A good sized turtle will live three months without food, a young turtle one month.

(9) A. W. asks: How much steam pressure will a boiler stand, 15 inches diameter by 30 inches high, made of cold rolled copper, No. 21 English wire gauge? A. Not over 16 lb. per square inch. The heads should be braced with care, and it should be tested with water pressure to at least 80 lb. before using.

(10) E. F. J. asks if any benefit is derived from combining magnesium with steel. A. A half per cent of magnesium changes coarse-grained into fine-grained steel and greatly improves the quality. The magnesium is introduced through an opening in the cover of the crucible, after inserting some small bits of charcoal, in order to remove the free oxygen. Without this precaution there would be danger of an explosion.

(11) C. wants to know how to make shoe blacking. A. Mix intimately 1 pound of molasses, 1 pound of best bone black, in very fine powder, and ¼ pound olive oil; then add ¼ pound sulphuric acid, previously diluted with ¼ pound water. The whole is allowed to stand for three hours or longer, and afterward as much water is added as is necessary to give it the proper consistence.

(12) G. I. J. asks: Is there any device by which I may regulate the strength of the current from a powerful electric battery? The ordinary resistance coils will not do. I wish to change the strength gradually by means of a resistance placed at some point in the circuit. A. You can make resistance coils that will answer your purpose, by making a wooden reel in the shape of a cross, and winding uninsulated wire upon it so as to have an air space all around each convolution. If the current heats the wire so that it will burn wood, you may place strips of asbestos board along the edges of your reel.

(13) M. E. W. asks how to find the point at which to place the weight on a safety valve so that steam will blow off at the required pressure. A 1. Multiply the pressure per square inch by the area of the valve; the product is the total weight required upon the valve. 2. Divide this total pressure by the weight to be hung on the valve lever; the quotient is the number of "leverages" which you must give the weight from the fulcrum. Suppose 100 lb. steam and 12 inches area of valve; then total pressure on the valve is 1,200 lb.; and if the weight be 80 lb., then 1,200÷80=15 "leverages." Now, if the distance from fulcrum to center of valve be 3 inches, then the weight must be set at 3x15=45 inches from fulcrum, or 42 inches from center of valve. Of course this does not take into account the effect of the lever or weight of the valve.

(14) O. R. M. asks for a simple method of testing or assaying specimens of rock. A. Charge into a 6-ounce crucible, 1 ounce each of the ore and dry bicarbonate of soda, 2 ounces of litharge (free from silver), ½ ounce of argol, and cover with ¼ inch of dry salt. Heat the crucible until the contents are in a quiet state of fusion, remove from the fire, cool, break, and clean the lead button by pounding on an anvil. If the button weighs more than, say, half an ounce, scorify it down in a scorifying dish in an open muffle. Heat 1¼ inch bone ash cupel in the muffle, drop into it the button, and keep up the temperature of the muffle to a bright red heat until all the lead has been scorified off and absorbed by the cupel, and the small bead of gold or silver (if the ore contains any) becomes well rounded and clear. The ore must be finely powdered, and the whole of it passed through an eighty-mesh sieve.

(15) A. S. asks for information as to the direct determination of silver in galena on Volhard's principle. A. From two to five grammes of the galena, according to its supposed richness in silver, are very finely ground and intimately mixed in a porcelain mortar with from three to four times its weight of a flux composed of equal parts of soda and saltpeter, placed in a porcelain crucible, covered, and heated over a burner to thorough fusion, when the mixture is well stirred with a glass rod. It is then let cool and placed in an evaporating dish partly filled with water, in which the melted matter is softened, dissolved out of the crucible into the dish, which is then heated, and the watery solution is filtered into a flask. The residue on the filter, after being well washed, is rinsed back into the dish, very dilute nitric acid is added, and the whole evaporated to dryness. The dry residue is taken up in water acidulated with nitric acid, heated, and filtered into the same flask in which is the aqueous solution. The residue is washed with hot water, the filtrate is allowed to cool in the flask, ferric sulphate or iron alum is added, and the liquid is titrated.

(16) H. J. asks how to make a good quality of domestic grape wine? A. Put 20 lb. of ripe, fresh picked, and well selected grapes into a stone jar, and pour on them six quarts of boiling water. When the water has cooled enough, squeeze the grapes well with the hand; cover the jar with a cloth, and let it stand for three days; then press out the juice, and add ten pounds of crushed sugar. After it has stood for a week, scum, strain, and bottle it, corking loosely. When the fermentation is complete, strain it again and bottle it, corking tightly. Lay the bottles on their side in a cool place.

(17) A. W. asks: By what means can an enameled surface be gilt with a name, same as on a lead pencil? A polished pencil, having a coating of shellac, can be stamped with gold by aid of a heated dye; not so an enameled surface—the gold will rub off entirely. A. Use thin gold size and a hot brand.

(18) A. B. asks how to case-harden small articles. A. Make a paste with a concentrated solution of prussiate of potash and loam, and coat the iron therewith; then expose it to a strong red heat, and when it has fallen to a dull red, plunge the whole into cold water.

(19) R. W. inquires how to prepare emery for optical purposes. A. Mix four pounds of the flour emery of commerce with one ounce of powdered gum arabic, and then throw the powder into two gallons of clean water. Collect the deposits at the end of ten seconds, thirty seconds, two minutes, ten, twenty, and sixty minutes, and that which is not deposited by one hour's subsidence is thrown away as useless for grinding lenses. The use of the gum arabic renders the water slightly viscid.

(20) J. N. L. asks: 1. Is there any liquid fuel, sootless and smokeless, that could be used in bed chambers having no flue or means of keeping up an ordinary fire? A. We know of no cheap fluid that we can recommend for such purposes. Fires without flues to carry off the products of combustion should never be used in sleeping apartments under any circumstances. 2. If gasoline or other liquid will answer for such purpose, about what would be the cost per hour to heat 1,000 square feet 100° Fah.? A. Gasoline cannot be used in this way.

(21) R. W. S. writes: I have a telegraph line a few rods over one mile in length. Wire is No. 14, well insulated. Have two twenty ohm sounders on the line and six cups, gravity battery all at one end. When battery sets one way I get no current at all. Reverse it, and the sounders work faintly. What is the trouble? Is main line of too great resistance for battery, or are the grounds weak? Have had some experience in making grounds, and never before had anything which would not work well. I thought four cups would run the line. A. If your line wire is iron, the resistance is too great; you must use a larger wire or more battery. If your wire is copper, your grounds or connections must be at fault.

(22) C. W. R. asks how the magic solder wire is made, such as pedlars sell for mending tinware, copper, etc. It is some kind of composition of chemicals run together, then drawn out into wire, and is to be used without the acid, simply by holding the light or heat underneath the place to be mended, then simply let the solder melt. A. For an easily fused solder melt together in a crucible or iron pot, at a very moderate heat: bismuth, 1 part; tin, 3 parts; lead, 2 parts, and cast in slender sticks. For the common solder wire melt together equal parts of tin and lead and pour it through a vessel having a very small opening in it, into a tub of water. If the metal is the right temperature, and if the apertured vessel is supported the proper distance above the water, the stream of melted metal will be cooled, forming a more or less perfect wire.

(23) N. E. writes: 1. I am running a band saw, and have a great deal of trouble with the lap. We use common solder, but it will not hold the ends together but a short time. The saw is two inches wide by one-sixteenth thick. How long should I make the lap, and what is the best solder, or how can I braze it? Can you give me a receipt to make a solder better than the common solder that tinsmiths use? A. Make your lap about an inch long. Coat the adjacent surfaces well with borax paste, and wire the two ends together with iron binding wire. Support the joint over a large piece of charcoal, and apply pieces of silver solder to the edges of the joint, having previously coated the solder with borax. Now with a strong blow pipe flame heat the saw at the joint until the solder flows. 2. I have about 100 of the SCIENTIFIC AMERICAN I wish to bind. What is the cheapest and the best binding that I can get? A. We know of no cheaper way than to employ a bookbinder.

(24) W. W. C. asks: 1. How can I preserve some manuscript written on common paper and with an ordinary lead pencil so that it will not rub off, or in other words, how can I make the writing indelible? A. Lead pencil marks cannot be rendered indelible, but if the lines are washed over with a clear solution of ¼ oz. of gum arabic in 6 oz. of water they will not rub off readily. 2. Two bodies of exact size and shape, but of unequal weight, and each presenting an entirely smooth and non-compressible surface to the atmosphere, are dropped from a given height at the same time: will they reach the ground together? Some philosophers say they will, others say they will not unless they be dropped in a vacuum. A. In a vacuum, yes; in the air, no; the heavier body is capable of overcoming the resistance of the air more easily.

(25) J. J. S. writes: I wish to know something of the nature of nitro-glycerine. Please answer the following questions through SCIENTIFIC AMERICAN: 1. After being prepared, and coming suddenly or otherwise in contact with air, does it (the air) have any effect on its explosive properties? A. The air has little or no effect upon it. 2. In its liquid form for what purposes is it generally used and when so used? How is it exploded? A. Chiefly in blasting, in tunneling, and mining. It is used extensively for cracking the rock in the bottom of "dry" petroleum wells. It is exploded by fulminating or percussion caps by electric spark or fuse. 3. Where is it made, and what size cans is it generally put up in? Also the difference in explosive power while in liquid form, and such preparations as "giant powder," "dynamite," and other high explosives having nitro-glycerine as a basis. A. See article on nitro-glycerine, pages 344, 345, current volume of the SCIENTIFIC AMERICAN. The cartridges usually vary from four ounces to five pounds or more. With regard to the relative efficiency of dynamite, giant powder, and nitro-glycerine, consult Mowbray's "Trinitroglycerine." 4. I read of two empty glycerine cans being found in the woods somewhere in Pennsylvania by two small boys. A man to whom they were shown attempted to open them, causing an explosion, thereby losing his whole arm, tearing it from his body. Now, the cans being empty, how do you account for the explosion? What are the most serious objections to its being handled in liquid form? A. Such packages always retain a little of the explosive adhering to their sides after their contents have been poured out.

(26) W. C. R. says, in answer to N. J. A., who asks for the best method of preserving fence posts: "My experience is to bore a large hole in the end of the post that is to be put in the ground, fill it with salt, and then plug the hole tight with a wood plug."

(27) C. M. K. asks: Can you inform me of any means by which the flesh can be taken from the bones of small birds, leaving a perfect skeleton? A. The following method will answer in some cases. Put the bones in a strong, warm alcoholic solution of caustic potash for a short time, then immerse them in running water until clean.

(28) J P. F. asks: When ironing shirts, etc., what is the best way to put on a gloss? A. Raw starch, 1 oz.; gum arabic, 1 drachm; white of egg or blood albumen, ½ oz.; soluble glass, ¼ oz., water, q. s. Make the starch into a fine cream, dissolve the gum in a little hot water, cool and mix it with the albumen, and beat up the mixture with the starch liquid. Then add the water-glass (solution) and shake together. Moisten the starched linen with a cloth dipped in this liquid, and use a polishing iron to develop the gloss.

(29) G. A. C. asks if paper is saturated with cupric ammonia can metallic copper be reduced on the surface and in the fibers of the same, and by what process? Iron will not. Will an acid, hydrogen, or tin dust, will anything? A. Try exposing the paper for some time in a current of heated hydrogen; or dip the saturated paper in ammonium sulphide; rinse, spread on a plate of copper, dip in dilute sulphuric acid, connecting the copper by wire with the zinc pole of a good battery, the other pole being connected with a second strip of copper also immersed in the dilute acid. If the current is strong enough to decompose water it will reduce the copper on the paper.

(30) A. M. F. asks as to the average number of tons of coal consumed daily by any steamer of the following lines, on a voyage across the ocean: White Star, Cunard, Inman, Anchor. Also the number of firemen generally employed on any one ocean steamer. A. White Star steamers, 95 to 100 tons per day; 18 firemen. City of Berlin, City of Brussels, each 110 tons per day; about 28 firemen. Ansona, 120 to 130 tons per day; 24 firemen.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

F McL.—Nos. 1 and 2, calcite—carbonate of lime. No. 3 is quartz.—M. M. R.—It is a split leather—that is a thin sheet cut from thick tanned leather by appropriate machinery. It may be purchased from leather dealers.—J. M. P.—No. 1. Quartzose rock with horn silver—a rich ore. No. 2. Quartz rock with selvage. No. 3. Chiefly iron—copper sulphides.

COMMUNICATIONS RECEIVED.

On a Growth of Grain in Ice. By D. J. B.

Electric Light for Purifying Sewers. By J. G. S.

NEW BOOKS AND PUBLICATIONS.

THREE HUNDRED YEARS HENCE: OR, A VOICE FROM POSTERITY. By William Delisle Hay. London: Newman & Co.

A highly imaginative forecast of human affairs, in the guise of a series of lectures delivered by a Professor of History in the year A.D. 2180, tracing the progress of humanity from the beginning of the "Era of Development," A.D. 1880. The author has a curiously inventive turn of mind, and has filled his book with novel ideas and pictures at once original, whimsical, and plausible.

THE STUDENT'S DREAM. Published for the author. Chicago: Jansen, McClurg & Co.

If the author is, as he professes to be, a youthful student, his ambitious attempt to forecast the philosophy of the future is not a discreditable performance. When he is older and knows more he will dream less.

PEACE MAKER GRANGE; OR, CO-OPERATIVE LIVING AND WORKING. By Samuel Leavitt. New York: Published by the author, No. 5 Worth street. 25 cents.

A suggestive story, reprinted from the *Phrenological Journal*, describing the development and working of an ideal yet entirely human, thrifty, and practical community. Unlike most social reformers Mr. Leavitt sedulously conserves what is good in human experience, and seeks to reconstruct society by lifting life and labor to a higher, purer, and kindlier level, by sloughing off the barbaric elements of modern civilization, not by relapsing toward barbarism. The work is germinal and is worthy of a better dress.

DR. J. H. McLEAN'S PEACE MAKERS. By Dr. James Henry McLean, St. Louis, Mo., projector, inventor, and patentee, with Myron Coloney, New Haven, Conn., mechanical inventor and patentee. New York, 1880.

An illustrated catalogue of deadly engines, by means of which the inventors expect to command peace throughout the world, by making war so terrible and destructive that nations shall not dare to engage in it. How many of Dr. McLean's devices—which are as marvelous in number, variety, and scope, as they are threatening on paper—will prove of practical utility, remains to be seen.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

June 7, 1881,

AND EACH BEARING THAT DATE

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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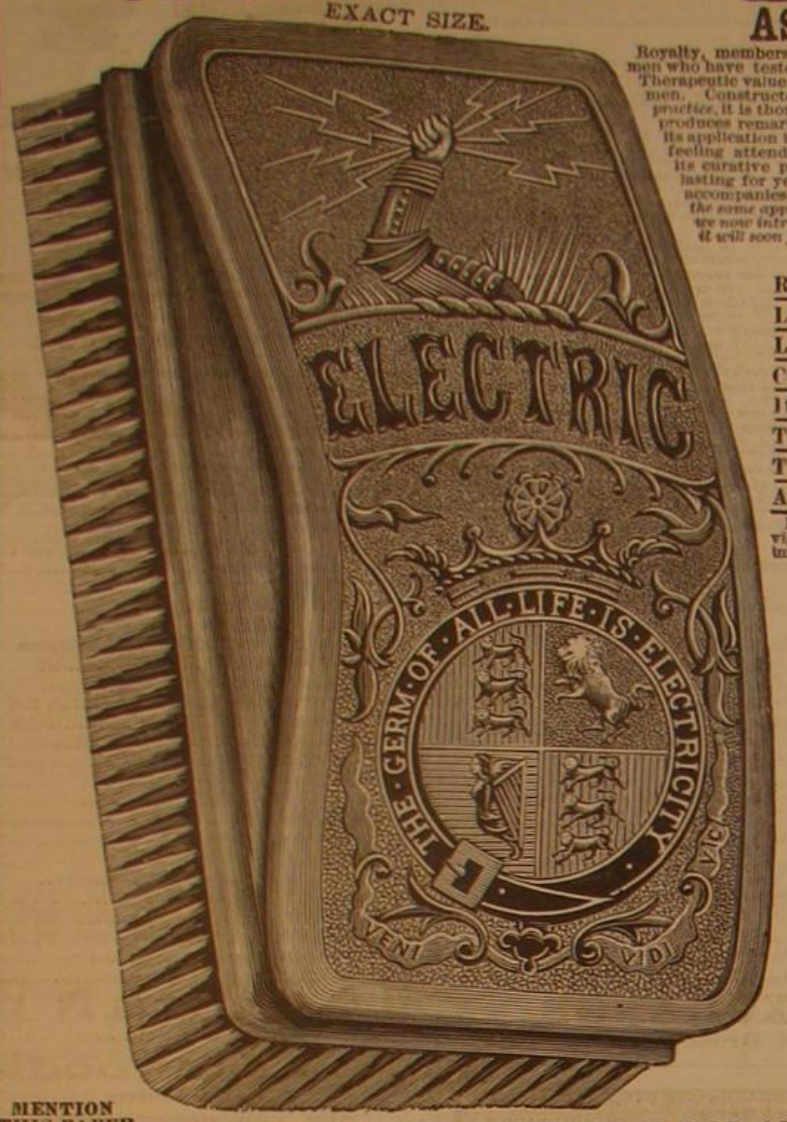

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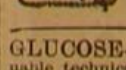

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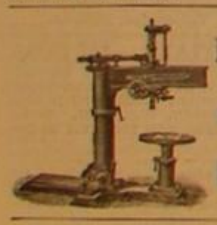
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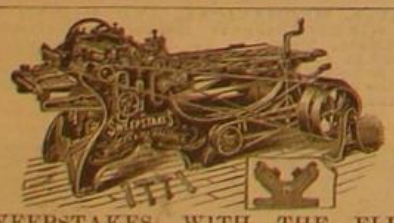
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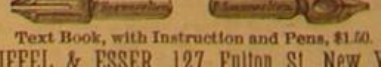
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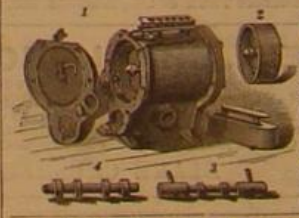
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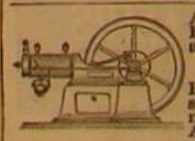
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RENEWAL OF NIAGARA SUSPENSION BRIDGE.

The re-enforcement of the anchorage and the renewal of the suspended superstructure of the Niagara Suspension Bridge, without a moment's interruption of traffic, rank as one of the most prominent feats of modern engineering; and the fact that, with a slight exception, the wires forming the cables and suspenders were found by the inspecting engineers unimpaired, is most significant and reassuring.

We have taken extracts from the report of Mr. Leffert L. Buck, engineer of the work, and give engravings from the engineer's drawings and from photographs furnished by Mr. William G. Swan, superintendent of the bridge.

From the inception of the project of spanning the chasm of the Niagara River below the falls with a suspension bridge for railroad purposes, to the year 1853, when the bridge was completed and opened to traffic, it was considered a bold undertaking, and by some engineers, even, as an impracticable one. But the bridge has been in constant use for twenty-five years, and under constantly increasing traffic, demonstrating the adaptability of a wire suspension bridge to a locality requiring extremely long spans.

In spite of its success, however, it has been an object of constant solicitude to the traveling public. The frightful chasm that it spans would naturally excite the fears of most people, and this feeling has been greatly enhanced by doubts as to the condition of the cables and their anchorage.

The bridge consisted of two pairs of iron wire cables and the suspended superstructure, the cables resting on masonry towers at each end of the bridge, their ends being secured by means of chains to suitable cast-iron anchor plates bedded in the rock forming the banks of the river.

The suspended superstructure consisted of two floors, placed at a vertical distance apart of 17 feet, and connected by posts and rods in such a manner as to form a trussed tube, as shown in Fig. 2. At each five feet in the length of the trusses, two wire rope suspenders connect the upper floor with the upper cables. In the same manner the lower floor is suspended to the lower cables.

Each cable is composed of seven strands or bundles of wire. Each strand is made up of 520 scant No. 9 wires laid parallel, and at each end formed into a loop which fits into a groove in a U-shaped cast iron shoe. The seven strands are bound into one bundle of 3,640 wires, which is served closely with wire over the whole length, with the exception of about 13 feet at each end, and of about 10 feet of the portions resting on the towers, thus forming a cylindrical cable 10⅛ inches in diameter.

The tops of the towers are each covered with a cast iron plate, 8 feet square, bedded in mortar. The upper surface of this plate is planed to a true surface and supports a number of turned rollers 5 inches in diameter. On these rollers rest the saddles, consisting of heavy castings whose undersides are planed. The top of each saddle has a groove of semi-circular section in which the wires of the cable lie, each cable having a separate saddle. The planes of the curves of the cables, between the towers, are inclined in such a manner as to bring those of each pair nearer together at the middle of the span, to give lateral stability to the bridge. From the towers to the anchorage the cables diverge from the center line of the bridge sufficiently to make the plane containing the portion each side of the tower vertical. The wire forming the cables was boiled in linseed oil before it was laid, and as the cables were made the interstices at the shoes and towers were flushed with boiled linseed oil and Spanish brown paint. Then the whole length of the cable was flushed with the same as the serving progressed.

Each end of each cable had a separate anchorage, as shown in dotted lines in Fig. 3.

A rectangular pit or shaft, 3 ft. x 7 ft. in plan, was sunk vertically into the rock, to a depth of 25 feet, with the bottom enlarged to form a chamber 7 feet square. An anchor plate, 6 feet 6 inches square and having seven rectangular openings through it to receive the lower links of the anchor chain, is set in the chamber, the links put in position, and secured by a 3½ inch diameter pin passed through their heads and underneath the plate. From the plate the chain passes vertically upward to the surface of the rock. From this point the joints of the chain are at points of a vertical curve of 25 feet radius, the joint at the upper end of the curve forming the point of the tangency with the line of the cable.

Beyond this joint is another length of chain composed of nine links, each bar of which is 10 feet long and 7 x 1⅜ inches section. Four of these links alternate with the shoes of three of the strands of the cable, and are secured to them by a 3½ inch diameter pin passing through links and shoes. The remaining five links are in like manner connected with the remaining four shoes of the cable strands.

The anchor plates are secured in the chambers by means of neatly fitted stone blocks set in cement mortar, the whole pit being solidly filled with cement masonry, and the interstices around the bars grouted. Above the rock and up to the end of the chain the whole is inclosed in a solid wall of masonry, heavy blocks of which form supports of the joints of the curved portion of the chain. Formerly the strands were also covered with masonry and the whole grouted, the intention being to preserve them from corrosion.

Such, in brief, is the description of the cables and anchorages before the new work was begun.

The appearance of the old superstructure of wood, and wire suspenders and stay cables, is familiar to all who have seen the bridge, or pictures of it, and therefore need not be fully described in this connection.

In February, 1877, Mr. Thomas C. Clarke, Member Am. Soc. Civil Engineers, with a view to examining the condition of the portions of the cable strands embedded

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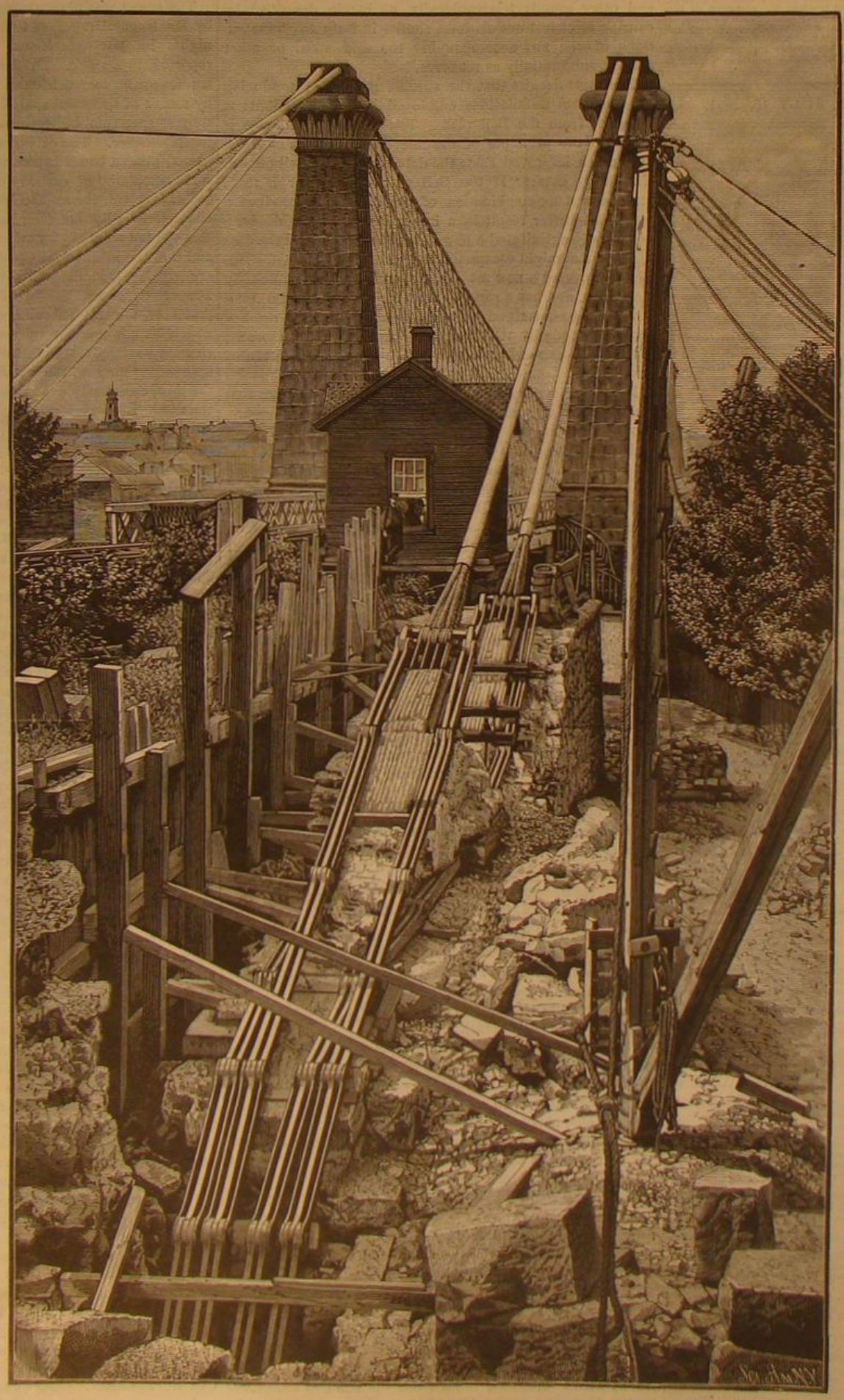

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Scientific American.

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IMPORTANT TELEPHONE DECISION.

Judge Lowell, of the United States Circuit Court, Boston, Mass., rendered an important decision on the 27th ult., in which he virtually confirms to the American Bell Telephone Company, *the exclusive right of talking over a wire by electricity*. If this decision is correct, then the Telephone Company is in possession of one of the most gigantic and extraordinary monopolies ever obtained by an individual or acquired by a private corporation. It will almost bear comparison with the patent issued by the Spanish sovereigns to Christopher Columbus for his discovery of the New World, by which the continent, its peoples, and their possessions, were placed under his thumb and that of his heirs forever. But the magnitude of that grant caused its ultimate downfall; and possibly the Bellonian patent may, with more justice, meet a similar fate when it reaches the Supreme Court of the United States.

If it does not, if this decision stands, what a marvelous honor belongs to Alexander Graham Bell! What an astonishing benefit he has conferred upon his fellow men! He is declared to be the original and first discoverer of the far-reaching art of speech transmission by electricity.

The suit in question was brought by the American Bell Telephone Company against Albert Spencer and others, and the decision, as we understand, is based on the fifth clause of Bell's claim, patent of February 14, 1876, as follows:

"5. The method of, and apparatus for, transmitting vocal and other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air, accompanying the said vocal or other sounds, substantially as set forth."

The court decides that the specific method of producing the electrical undulations employed by the defendants is different from the Bell plan. The defendant's device is made on the principle of the microphone, which has been very much improved since the date of the first Bell patent. The judge says: "If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art—that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to abstract right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed."

It has been heretofore supposed by electrical laymen that Bell's devices are simply improvements upon something previously done in the same line by others, such as Œrsted, Reiss, Gray; and that consequently Bell's broad claim to the art of transmitting speech by electricity was an absurdity, and would be so declared whenever it was submitted to a proper judicial examination. But a trial has been had, the laymen are defeated, and the hopes of hundreds of telephonic inventors laid low in the dust. It may be, however, that the near future has relief for them in store.

Judge Lowell pays a just tribute to the learning and ingenuity of Professor Reiss, but holds that his telephone of 1860 was an imperfect instrument, which, although some sounds of the voice could be sent, was still incapable of completely transmitting articulate speech. This differs from accounts we have had of the Reiss telephone, and perhaps the entire evidence in respect thereto was not brought out before the court.

It may equally be said of Bell's telephone, that while it is a good receiver it is a poor transmitter—so poor that its use has been almost abandoned in favor of superior instruments such as the Blake or the Edison. If we had to rely only on the Bell instruments the telephone would be a nuisance, and the wide-spread use of speaking telegraphy now enjoyed could never have been realized.

THE GREAT COMET OF 1881.

The comet whose appearance was announced last week continues to be the subject of much wonder, speculation, and scientific study. Though less striking in appearance than Donati's comet of 1858, it is one of the most brilliant and interesting of these erratic visitors to our skies that scientists have been permitted to study.

So far as heard from the comet was first observed in the northern hemisphere about four o'clock of the morning of June 20, by G. W. Simmons, Jr., of Boston, while camped at Moreles, Mexico, 30 miles west of Eagle Pass, west of the Rio Grande, about latitude 29.

It appeared in constellation Auriga, about 8 degrees from the star Capella, and from its proximity to the sun was at first visible each clear day only for a short time just before sunrise and again for a little while in the evening. Its northward motion, however, soon carried it to a position permanently above the horizon. At first the head of the comet shone like a star of the first magnitude, while the tail glowed like a streamer of the northern lights.

In the absence of a sufficient number of observations for the exact calculation of the elements of the comet's orbit the estimates of the dimensions of the head and tail and their distance from the earth are little better than guesses. At Harvard University, on the 24th, the comet was thought to be about 69,000,000 miles from the sun and 29,000,000 miles from the earth. The nucleus was estimated to be 1,000 miles in diameter, the coma or nebulous head 12,000 miles in diameter, and the tail 40,000,000 miles long.

On the 27th Prof. Lewis Boss, of Dudley Observatory, Albany, N. Y., calculated the comet to be about 34,000,000 miles from the earth, and receding at a rate of nearly 1,000,000 a day. At that date the nucleus was estimated by him to be 1,200 miles in diameter, and the first and brightest semicircular envelope of the head appeared about 14,000 miles broad. The largest branch of the tail measured, he thought, at least 35,000,000 of miles.

On the night of the 26th, as seen from the same observatory, the tail was traced for forty degrees. One branch of the tail passed in a perfectly straight line about two degrees to the East of the Pole Star. The other branch was shorter and fainter, and curved to the westward (eastward, astronomically), terminating at a point about five or six degrees southwest of Polaris. The air was wonderfully transparent, and the fine gauze-like tail became an object of delicate and fascinating beauty.

Thus far no agreement has been arrived at among astronomers touching the comet's identity and orbit. By some its (approximate) elements are thought to resemble most those of the comet of 1807; others find greater resemblance to the elements of the comet of 1684. The majority of observers hold that the comet is receding, having made its perihelion passage some time in June, various dates being given. Most probably the comet is the one observed by Dr. Gould in South America on the first of June.

The comet was photographed for the first time June 26, by Dr. Henry Draper, of this city, and on several succeeding nights its photograph was secured here, and also, it is reported, in Europe. Dr. Draper has likewise made careful studies of the composition of the several parts of the comet by means of spectrum analysis. The nucleus gives a continuous spectrum, indicating a solid or liquid body heated to incandescence. The coma, or cloud about the head of the comet, gives a banded spectrum indicating the presence of some compound of carbon in the gaseous envelope. The tail gives a continuous spectrum which is not crossed by the characteristic lines of solar light, from which it is inferred that the tail shines by its own light, not by reflected sunlight, and that the incandescent particles which compose the tail are solid. On the strength of these discoveries Dr. Draper expresses the belief that the nucleus is composed of mineral substances, partly, perhaps, of olivine, which is an ingredient of meteorites, and of some volatile element which yields to the influence of heat. As the comet approaches the sun, the volatile part is turned into gas by the heat, and flames out to form the coma. The fact that the coma is always on the sunward side of the nucleus strengthens this supposition. But after bursting forth on the side toward the sun, the vapor seems to be repelled and to stream away from the sun, thus forming the tail. The cause of this repulsion cannot be absolutely asserted; but in all probability electricity has something to do with it.

CHEMICAL ACTION IN A MAGNETIC FIELD.

Every student is familiar with the experiment in which fine iron filings are dusted over a plate and subjected to the influence of the poles of a magnet. The iron does not remain uniformly distributed, but falls into systems of lines which mark what are called the lines of magnetic force. Excellent illustrations of these curves will be found in connection with Professor Mayer's articles on magnetism (SCIENTIFIC AMERICAN, vol. xli., pages 211, 212, etc.). These lines of magnetic force occupy what Faraday named the magnetic field which surrounds the poles of every magnet to a distance greater or less according to the strength of the magnet. Recently Professor Ira Remsen, of Johns Hopkins University, has undertaken some novel experiments to ascertain whether the chemical behavior of a metal is in any way influenced by magnetic action, and has arrived at results which are of considerable interest.

His best effects were obtained by placing a shallow vessel of thin iron, containing a solution of copper sulphate, over the poles of a magnet. Out of the magnetic field the solution would deposit upon the iron vessel a uniform coating of copper. When brought within the field of a permanent magnet capable of supporting twenty-five kilogrammes (55 pounds) the copper was deposited in a fairly uniform way on the entire plate except at the lines marking the outlines of the poles. These lines were sharply marked as depressions in the deposit. When, instead of a permanent magnet, an electro-magnet was employed, the iron vessel and copper solution being the same as before, a more striking action was observed. There was no deposit of copper for a narrow space marking the outline of the poles. Within the outline (over the poles) the deposit was fairly uniform. Outside the blank outline marking the pole the copper was deposited in irregular ridges running at right angles to the lines of force and apparently coincident with the lines marking the equipotential surfaces. By increasing the power of the electro-magnet the action is intensified and the area affected is broadened, the largest circles obtained in Prof. Remsen's experiment being nearly four inches in diameter. The cause of the phenomenon has not yet been determined, though the effects are obviously to be ascribed to the influence of the magnetism on the iron plate, or on the liquid, or on both together. Further experiments will decide between these possibilities. A full report of the work thus far done will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT. The experiments are easily repeated, and open up a novel and interesting field of inquiry.

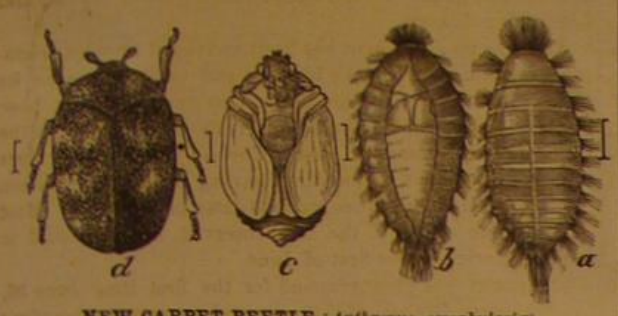
THE SPREAD OF THE CARPET BEETLE.

In the latter part of May, Master Fred. F. Richardson, of Tarrytown, N. Y., called our attention to the fact that the new household pest, the carpet beetle (*Anthrenus scrophulariæ*), had appeared on the blossoms of the field daisy. Further observation discovered the insects in considerable numbers on the flowers of the *Deutzia*.

A statement of the facts (with specimens of the beetles) was sent to Professor Comstock, U. S. Entomologist, at Washington, in a letter asking whether the beetles had before been discovered leading an outdoor life.

Professor Comstock's answer, dated June 7, ran as follows:

In reply to your letter of recent date I would state that the beetles sent were specimens of the imported carpet beetle (*Anthrenus scrophulariæ*), as you surmised. Since the beetles



NEW CARPET BEETLE (*Anthrenus scrophulariæ*).

of this group are known to generally feed upon the pollen of flowers in the adult stage, while their larvæ are miscellaneous feeders, there is nothing surprising in your observation; still it is of interest, as I am not aware that it has been recorded as yet in this country, except with regard to the California variety of the species, which Dr. Le Conte has called *A. lepidus*. Professor Lintner said, in 1878, "The insect has not yet become sufficiently abundant in New York to be found resorting to plants for its food," and I do not recall at the present moment that I have seen this statement corrected since.

Very respectfully yours,
J. HENRY COMSTOCK, Entomologist.

The inference to be drawn from this discovery is not encouraging to housekeepers. The beetles, in the larval condition, have already proved very destructive to carpets, and scarcely less so to woolen goods generally, wherever they have gained a footing; and now that they are multiplying out of doors there is little hope of their extermination.

It will be remembered that this latest and least welcome of immigrants from Europe was first discovered preying upon carpets by Professor J. A. Lintner, Entomologist of New York State, in 1874. In its native home it is said to have shown no such proclivity, whether from lack of carpets or an abundance of more attractive food it is impossible to say.

In the thirteenth annual report on the New York State Museum Professor Lintner gave a full description of the insect, with figures by Professor C. V. Riley. We copy the figures herewith for the information of housekeepers, who may not be aware that the pretty little beetles found crawling about the walls have anything to do with the hairy destroyers of their carpets, blankets, and woolen clothing. The tail like tuft of black hair radiating from the last segment of the larva has been clipped in the picture; naturally it is nearly as long as the whole body. The indicated size of the beetle is for the female; the male is about half as large, and is whiter. A full description of the beetle in its several stages was given in the SCIENTIFIC AMERICAN of October 5, 1878. At this time the pest is only too well known, and the chief question with regard to it is how to stay its ravages.

There is a remote possibility that the attractions of outdoor life may withdraw the pest from the domestic field and cure it of its newly acquired taste for carpets. But it is far more probable that, after multiplying outside during the summer months, it may swarm into our houses in the fall with vastly increased numbers and capacity for mischief. Meantime householders will do well to watch closely to see whether the female beetles do not leave the flowers and betake themselves to the house to deposit their eggs upon carpets and clothing. In this case the ravages of the larvæ may be kept up the year round, and not, as heretofore supposed, during a few months of winter or early spring only.

The remedies proposed for the pest are numerous, but most of them are disappointing when put to practical test. In the report referred to above Professor Lintner says that Persian insect powder, camphor, pepper, tobacco, turpentine, carbolic acid, and the like are powerless. He recommends the use of benzine or kerosene on cotton stuffed into the joinings of the floors and the crevices beneath the baseboards. An efficient but somewhat hazardous remedy is said by others to be found in the liberal use of naphtha around the sides of the room, along the seams of the carpet, and wherever cracks in the floor provide a runway for the larvæ under the carpet. Obviously great care must be taken to give the rooms a protracted and thorough airing before lighting lamps or fires, as the naphtha takes fire readily and the vapor mixed with air is dangerously explosive.

In view of the fact that the larvæ of a related species of beetle abhors tallow it has been suggested that a remedy for the carpet beetle might be found in the liberal use of tallow in the cracks of the floor and around the edges of the wall where an invasion is feared. In Europe, however, the insect is said to infest dried meat, in which it is liable to come in contact with fat; and it is such an omnivorous creature in the larval state that it might possibly betake itself to tallow as a relish. Its taste for carpet-stuff, as already noted, is of recent origin, and there's no telling but it might learn to like even Professor Lintner's cotton soaked in kerosene.

A Massachusetts naturalist proposes the soaking of the edges and seams of carpets with an infusion of cayenne pepper and strychnia—one-quarter pound of pepper and two drachms of strychnia powder to the gallon of water. We do not know of any actual test of this remedy, which is objectionable because of its hurtfulness to man. Another (theoretical) remedy is an infusion of cayenne pepper and quassia chips—two ounces of pepper and half a pound of quassia to the gallon of water—which has the merit of not being poisonous. These infusions can be applied to new carpets by dipping the ends of the rolls in a shallow pan containing the liquid; to carpets already down the liquid might be applied with an atomizer until the edges and seams are saturated.

The interests involved in this insect invasion are coextensive with the carpet and woolen industries; and it is clear that the inventor who shall devise some sure and simple treatment of carpets and clothing to make such articles proof against the pest, will not only make himself a public benefactor, but reap a suitable reward in cash. Thus far the naphtha and benzine applications seem to promise the best results; but they are somewhat hazardous, to say nothing of the disagreeable odor they leave. A pleasanter, safer, and more permanent preventive is needed.

GAMGEE'S ZEROMOTOR.

The SCIENTIFIC AMERICAN of July 2, 1881, contains an article on Gamgee's zeromotor, signed Valentine G. Bell, M.I.C.E., etc.

This writer expresses the opinion that the zeromotor will be able "to go on continuously during a given duty;" but that "a colossal engine will be required to do a very small amount of work;" and he suggests the following method for making an estimate of the size of the engine required, viz.:

"In a condensing steam engine there is a difference of about 1,000° Fah. [units?] of heat between the steam issuing from the boiler and the water returning to it. On the other hand, in Professor Gamgee's engine, this difference will not exceed 60°. Without going into the question of the relative specific heats of water and ammonia, we may say roughly that, for the two engines to indicate the same power when working at the same number of revolutions, they must have cylinder capacities in inverse proportion to the above differences of heat respectively."

Let us apply this rule for making an estimate for a zeromotor, to be substituted for the steam engine of a certain vessel, having two cylinders, 33 inches by 2·75 feet, working with a steam pressure of 60 pounds per square inch. The two pistons sweep through a space of 64·914 cubic feet per revolution of engines. According to Mr. Bell's opinion the pistons of the zeromotor should sweep through a space of $\frac{64 \cdot 914 \times 1,000}{60} = 1,082$ cubic feet per revolution of engines; and sixteen rotary engines, having cylinders 50 inches diameter by 5 feet long on an 8 inch shaft would be required, which, making proper allowances for cylinder heads, stuffing boxes, and couplings, would occupy fully 150 feet in the length of the vessel.

Mr. Bell's estimate, however, is based on wrong premises. The size of an engine for a given power depends on the indicated mean pressure of the working fluid, which is not dependent on the difference in temperature of, or units of heat contained in, the working fluid at its initial and final pressures. The following example will make this clear: Let us take two condensing engines, one working *without expansion* with steam of 100 pounds pressure, the other working with the same initial steam pressure, but *expansively*, so that the mean pressure in the cylinder is 20 pounds. Assuming the back-pressure to be the same in both cases and so small that it may be neglected, then the initial and final temperatures will be the same in both cases, but, with the same piston speed, the expansive engine must be five times larger than the non-expansive engine.

Mr. Bell's estimate of the size of the ammonia boiler is also based on wrong data. The mean difference of temperatures of the water and hot gases in a steam boiler is much less than 2,000° Fah.; this difference exists probably between the temperatures of the furnace and of the water; but when the gases leave the boiler their temperature is generally not more than from 200° to 300° higher than that of the steam.

It is doubtful whether Mr. Gamgee will derive much comfort from Mr. Bell's indorsement of his invention. The public, however, cannot be warned too much against this delusion. The utter fallacy of the principle on which the zeromotor is based may be illustrated in the following manner:

The heat stored up in a body is capable of doing a certain amount of work in the same manner as a mass of water stored up in a reservoir. To make the power of the water *available* for work, it must fall down to and flow off at a lower level. In the same manner the heat must fall down to, and flow off at a lower temperature; this is effected by the condensing water, or other refrigerating medium, of a heat engine. But as the zeromotor is to work without a refrigerating medium which carries off the heat contained in the working fluid at a lower temperature, it resembles a water power machine where the water falls from a reservoir into a well without an outlet at a lower level. The well will fill up, and the machine will stop.

Mr. Gamgee tries to remedy this evil by his high-pressure boiler, which is intended to supply the motive power of an injector by means of which the ammonia vapor and liquid is to be forced back into the working boiler. The operation of this high-pressure boiler may be likened to that of a high-pressure reservoir, lying above the working reservoir, and operating a water-ram which shall not only lift all the water out of the well back into the working reservoir, but lift the water which operates the ram back to its original height! Faith in the zeromotor must be stronger than that faith which will move mountains!

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WOOD WEAVING.

We take the following details concerning a very peculiar industry from a recent number of *Cassell's Magazine:* One of the busiest towns of the manufacturing district of the Austrian empire is Ehrenberg, lying close to the Saxon frontier, and distinguished from other towns and villages for its curious industry of wood weaving—*sparterie* work, as it is called—which was introduced something more than a century ago by a carpenter named Anton Menzee. The threads used for weaving are no thicker than writing paper, and vary in width from the fifth to the twenty-fifth part of an inch. The aspen is the only tree whose wood is sufficiently tough and pliable to supply these threads in the required lengths. This tree was formerly indigenous to Bohemia, but has now almost entirely disappeared, so that the raw material for the *sparterie* work has to be brought from Russian Poland. The wood used for the purpose of weaving must be free from knots, as the smaller defects or irregularity, such as ordinary persons would hardly notice, make the fibers quite unfit for working. Arrived in Ehrenberg, the wood is planed and divided into pieces nearly 2½ inches wide. When these have been made perfectly smooth they are divided again by an instrument resembling a plane, but furnished with a number of fine knife blades, which mark the wood at regular distances, according to the width the strips are to be. This process requires the utmost dexterity and nicety, as it is absolutely essential that the divider shall exactly follow the direction of the fiber, and for this reason, among others, it must always be done by hand.

The divider makes incisions one-fifth of an inch deep; the wood is then carefully planed and comes off in thin paper-like strips, some of them not wider than a stout thread. They are gathered up by women as they fall, and are examined and the defective pieces rejected. There is a good deal of waste in the process. The threads or fibers being ready, must be tied in couples at one end before they can be woven. This work is done by little children of four years of age and upward, who earn eight cents a day. The weaving is done chiefly by women, and on looms which differ considerably from those in ordinary use, the fiber being not more than 39 to 50 inches in length. The longer fibers form the warp, the shorter the woof, which are passed in and out by means of a little instrument with an eye like a needle. Until within a few years this concluded the whole process—the "foundations," as they are called, were complete, and nothing more was done except that a few hats and caps were made of them. These were of the simplest description, and anything but becoming; moreover, they were glued together, thus making them unpleasant to wear in hot or wet weather; accordingly they brought but 30 cents or 60 cents per dozen, and were worn by the very lowest classes.

Within the last few years, however, owing partly to the interest taken by the Government in the manufacture, a great change for the better has taken place. At present Ehrenberg sends out not only the raw material, but ready-made goods—fashionable hats of all kinds and a variety of fancy articles skillfully concocted out of the wood fabric; ladies' hats of every description and of the latest fashion, such as no one need be ashamed to wear, are made entirely of wood and sold at astonishingly low prices. Men's hats are to be had of all shapes, from the Panama hat—not a whit inferior to that bought in Paris—to the common hats exported in large quantities to China, and the linings or foundations of which give stiffness to the fez of the Turkish soldier. The export trade embraces all Europe, from Spain to Russia, extends beyond the Caucasus to India and China, and maintains active relations with North and South America as well as Australia. The manufacturers are in direct communication with the four quarters of the world, and their goods are being introduced into Africa by French and English traders.

Influence of Magnetism on Electrical Currents.

At a recent meeting of the Physical Society, London, Mr. Hall, of Johns Hopkins University, Baltimore, exhibited his experiment in which a current of electricity flowing longitudinally along a thin foil of metal is caused to yield a transverse or lateral current by inserting the foil between the foils between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil which yield no current before the magnet is applied. The results were that if iron is called + the series is iron +, silver —, gold —, platinum —, tin —, and, curiously, nickel, though a magnetic metal like iron, is —; but on inquiry of Professor Chandler Roberts it proved that the nickel employed was, perhaps, impure. Cobalt ranges between iron and silver, and is + like iron.

EXPLOSION OF A ROLLING MILL BOILER IN POTTSVILLE, PENNSYLVANIA.

BY S. N. HARTWELL.

The subject of this report was a plain cylinder boiler with cast iron heads, a type much used in almost all kinds of manufactories. Hundreds of them may be seen of about the same dimensions and construction set in triplets, etc., in the steam cotton mills of Fall River and Lowell, Mass., and Providence, R. I., and they are very common in iron mills in all parts of this country. The sample now illustrated exploded on the 10th of June, 1881, and killed three men. It was somewhat shorter than most of its kind, and was the right-hand one of a pair placed over a puddling furnace, known as No. 4, in the Fisbach Rolling Mill, owned by Mr. C. M. Atkins, and located about a mile from Pottsville. This boiler was 30 inches diameter by about 26 feet long, made, in 1870, of a good quality of iron plates; 11 single-riveted rings composed the cylinder. The brand "C. H., Pottstown, Pa.," is seen on the plates, but no figures indicating their tensile strength were found. The heads were flat cast iron disks, about 1¾ inches thick, the front one having a man-hole in its center of the usual size. The rear head had no man hole. The flanges of the heads turned inward to receive the shell plates. The boiler had the usual water gauges and a 3 inch diameter lever safety valve. The pair of boilers were supplied with water through a cast iron T-pipe attached to the nozzles cast on the lower part of each front head. This exploded boiler and its mate were suspended by hook bolts and riveted staples, A, beneath cast iron arched girders placed upon the side walls at each end of the boilers. They were also united by a cross pipe or small steam drum of cast iron having a nozzle for the safety valve and the steam pipe by which they were connected to the system of nineteen pairs of similar boilers and four upright ones.

Except the uprights and one pair of "starting" boilers they were all similarly heated by waste gases from puddling and reheating furnaces. The combustion of the fuel is urged by a large fan-blower, that delivers cold air, through a suitable system of suspended iron blast pipes, B, into the several furnaces, whence the gaseous products of combustion pass through the reverberating chamber, and rising through a flue at the extremity they return through the chamber beneath the boilers, traversing once their length in contact with their lower half, to the brick lined iron stack, C, supported on columns above the stoker's pit, as shown in Figs. 1 and 4. Steam in this system of boilers is maintained at from 60 to 70 pounds, blowing off at 70, as indicated by gauges at each of the three large engines. The steam thus generated is used to drive the works through a 44" x 44" upright engine for a 22 inch beam train, making 82 revolutions per minute; a 24" x 60" horizontal engine for the puddling machinery, 55 revolutions per minute; an upright 36" x 36" engine for the rail mill, making 85 revolutions per minute; together with several smaller lifting engines and the fan-blast engine.

THE HISTORY

of this boiler is fully given by Mr. Atkins, the owner, who has been many years in the iron business, and uses a great number of boilers, and he is very particular to procure the best of C. H. No. 1 plates for them. He testifies, referring to his admirable record books, that this boiler was made for him in March, 1870, put to work on the 28th of April, 1873, used interruptedly, the months and days in each year being designated, in all a total of 76 months, something over half the time since 1870 till the 10th day of June, 1881, when, according to the evidence, it exhibited its first symptom of weakness, a leak on the bottom, and within a half hour after it was discovered it broke in two, as shown at *a* in the engraving, Fig. 1, near the beginning of the third plate from the front end, where the hot gases from the furnace below first impinge on the iron shell.

Some evidence before the coroner goes to show that the bottom of the shell was only three sixteenths of an inch thick, and that the top was scant a quarter of an inch thick. This is probably an error, since each ring of the cylinder is composed of a single plate, as shown at *a* in Fig. 3, and it was observed by the writer to be of uniform thickness throughout. The iron measures 0·2100" just at the edge of the ruptured plate on the bottom.

THE COURSE OF THE EXPLOSION

is indicated by the illustrations; the irregular line, Figs. 1 and 3, is the location of the rupture. Here the leak on the bottom was discovered a few minutes before the boiler broke in two. The fire bars were promptly ordered out by the master mechanic, Mr. Sharpless, but the man who attempted to do it was driven from the stoker's pit beneath the stack by the steam formed of the water blown from the rapidly increasing leak into the white hot puddling chamber, whence a "heat" had just been drawn. The man left the pit (to shut off the blast which he thought had been turned on by some one), and saved himself from a horrible death in the pit, for just then the boiler broke down, and the parts separated and took directions indicated by the angle at which they were acted and reacted on by the expanding water. (See dotted lines, Fig. 1.) The shorter piece took an upward and westward course, making several back somersaults among the steam pipes, blast pipes, and timbers, and fell within 25 feet of its starting point. The main portion not having so great inclination from the horizontal, after breaking down recoiled horizontally eastward against the stack, C, which in falling to an inclined position among the timbers broke and knocked down the main blast pipe, B, and a large shaft that ran north and south across the mill.

The upper part of the furnace or boiler setting was demolished, and the boiler fell and remained upon the damaged lower portion not far from its original place, as shown in Fig. 2. A large area of roof was blown off and destroyed Pipes and timbers in the track of the flying piece of the boiler were broken and thrown down, and steam, bricks, and splinters filled the air.

The water from the main portion of the boiler was projected by its own expansion, carrying bricks and pieces of iron with it down the "race," a thoroughfare between the furnaces, where the three fatally injured men had been at work.

That the weakness that distinguished this boiler among its numerous fellows was the accidental location in its construction of an obscure or entirely hidden defect in a most trying spot, is a fair hypothesis. It is said that a flexible horse-nail was forged from a piece of iron cut from the plate *near* the fracture, but it is certain that *at* the fracture the iron was crystalline and brittle. No notable defects, either original or acquired, were found in the boiler. There were marks inside, not in the line of fracture, showing that scabs of deposit had recently been detached, and slight bulging appeared, but they were unimportant, and the boiler was practically clean and appeared to have been well cared for. It had never been patched or otherwise repaired, and no blame can justly be charged to its makers, owners, or managers.

The mildness of the accident is due to the direction of the weak line and the consequent gradual character of the break. Had the boiler opened instantaneously by the bursting out of a head or the breaking of the shell on a longitudinal line, from grooving, corrosion, or a ripped longitudinal seam, and had the three tons of superheated water been suddenly set free from the pressure due to its confinement, it would have expanded something as powder burns, and a greater effect would have been produced.

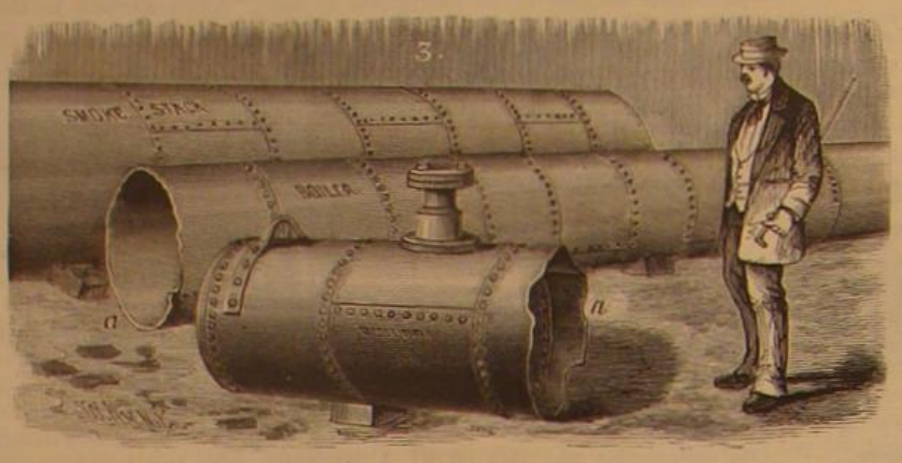
So far as the writer has observed during several years of study of this subject explosions from transverse defects have been confined to boilers in iron works, all similarly set and exposed to great and sudden changes of temperature. Some of the causes are obvious, but there may be others not yet traced.

It is believed that some safer method of setting gas-heated boilers can and ought to be devised. For example, a fire-brick arch or shield might be constructed to receive the first impact of the hot gases and the succeeding colder currents of air, protect the iron from the damaging thermal changes, and distribute the heat over a larger area of the boiler.

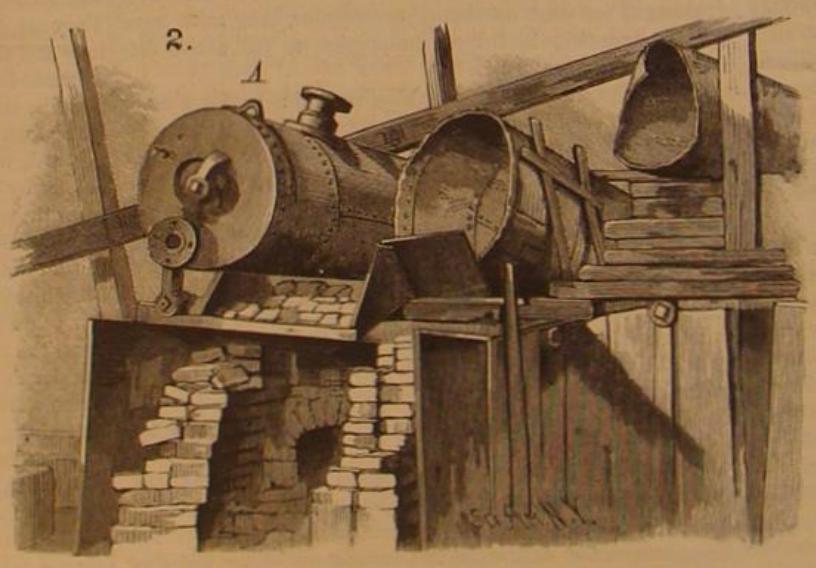
A jury of competent mechanics assisted the gentlemanly and zealous coroner, Dr. Will. C. J. Smith, of Pottsville, in examining this case. They rendered the following sensible

VERDICT:

"After visiting the mill at which the disaster occurred, and hearing the evidence relating to the death of Daniel Moran, Henry Lansberger, and James O'Neil, the jury find that the deceased came to their deaths from injuries received by the bursting or rupture of the boiler at Atkins' Fisbach Rolling Mill, on Friday, the 10th day of June. The jury are of the opinion that the accident resulted from the constant expansion and contraction to which all cylinder boilers are subject, destroying the fiber of the iron, reducing its normal strength to such an extent that when the fracture took place on the bottom of the boiler the metal remaining in the line of fracture was not of sufficient strength to resist the pressure to which it was exposed. These are circumstances over which neither owners nor employés have any control in this class of boilers. In our examination we found the iron to be of No. 1 character, with nearly its original thickness."



BOILER EXPLOSION, POTTSVILLE, PA.



BOILER EXPLOSION, POTTSVILLE, PA.

HATTERS say that the size of the human head in England and Scotland has been gradually diminishing in size within the last quarter of a century.

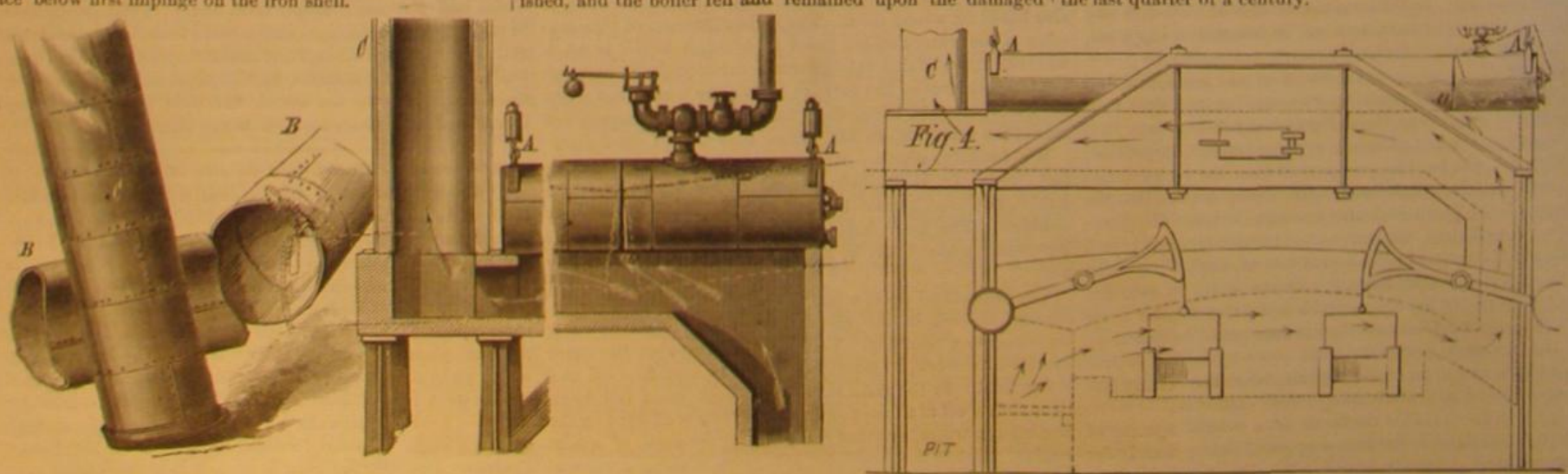


Fig. 1.—BOILER EXPLOSION IN POTTSVILLE PA.—SIDE ELEVATION, SHOWING COURSE OF FLAME AND HOT GASES.

RENEWAL OF NIAGARA SUSPENSION BRIDGE.

[*Continued from first page.*]

in the masonry, caused a small excavation to be made near one of the shoes. On reaching the first strand, two or three of the wires were found to be corroded quite through and others were partially corroded. Shortly afterward Col. W. H. Paine, of the East River bridge, visited the bridge, and gave orders for the removal of all the masonry covering the strands of each cable. He also made tests of the elongation of the strand portion of one of the cables, by means of a Vernier scale. He found in this way that the elongation under a given moving load, on the bridge, was no greater than the modulus of the wires would allow, supposing the total section to be the same as when the cables were new. He also cut out some pieces of wire and tested them for tensile strength, ductility, etc. Their ultimate strength was fully equal to that of the new wire per unit of section, and their reduction of ruptured section was satisfactory, but as the wires tested were etched in places, of course the stretch would be principally confined to the etched portion, hence rendering any measurement of the stretch a matter of extreme difficulty.

In March, 1877, Mr. Buck joined Col. Paine at Suspension Bridge to assist in examining the condition of the bridge and in repairing the defective wires. After the strands were thoroughly cleaned and the wire bands removed, they were opened, the paint removed from the interstices, and the inner wires examined. They were found to be in as good condition as when first put in. The outer defective wires were cut away so as to uncover the second layer of wire at the bend of the shoe, when the second layer, or course, was found to be sound and bright. Thus it was found that the only wires affected were the outer wires of the outside strands. Near the cylindrical portion of the cables, the outer wires were slightly rusted clear around the cable, but as the shoes were approached, the etching appeared to work toward the lower strands, till, when the shoes were reached, the principal corrosion was of the outer wires underneath the bottom shoes. The evident cause of this corrosion was the elongation and contraction of the strands under the passing loads, which had loosened the cement from the outside strands, allowing moisture to work in and finally reach the lowest point. The portion of cement among the strands would go and come in a body with them.

Fig. 2.

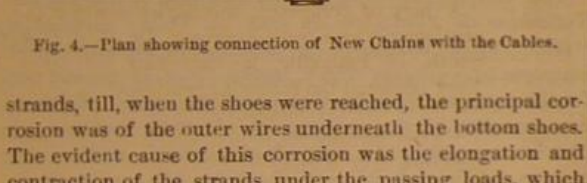


Fig. 4.—Plan showing connection of New Chains with the Cables.

While the examination was going on, the defective wires were cut out and new ones spliced in under strain. The greatest number of wires that required repairing at one end of any one cable was sixty-five, a number quite insignificant compared with the total number (3,640) comprising each cable.

This examination of the bridge resulted in the appointment by the bridge companies of a commission to examine the entire structure and to report upon its condition. After a very careful examination the commission reported that the repairs of wires, affected by rust, having been completed, the action of the wire portion of the cables indicated that they were in good condition. But regarding the anchor chains, it was believed that the strength of the bridge might be augmented by re-enforcing them.

The report was accompanied with plans for re-enforcement of the chains, and required that it should be made. The report also suggested the renewal of the suspended superstructure with iron, and submitted a general plan for that purpose prepared from data obtained from Mr. Roebling's published report on Niagara Suspension Bridge.

This plan was subject to such alterations as circumstances should require, and the engineer in charge accordingly made alterations which appeared to be necessary on getting to the surface of the rock.

In this plan the pits were located the same as in the other, but smaller. One anchor plate in each pit was made to answer for all the four chains. There were eight links secured in the plate by one pin, and the first joint, *e* (Fig. 3), was secured by one long pin. Beyond *e* each of the four chains was independent of the others, but had the same curvature and rested on the same stone supports. Two of the chains connected with the upper cables. The other two passed along grooves cut in each side of the wall, passing the supports of the old upper cable chains and fastened to the lower cable.

As will be seen by Fig. 3, the plan followed required a bend in the lower cable chain to bring it on to the line of the cable. This was done by dividing the change of direction among three points, and securing them in position by means of stirrups attached to the ends of the pins of the

Fig. 1.

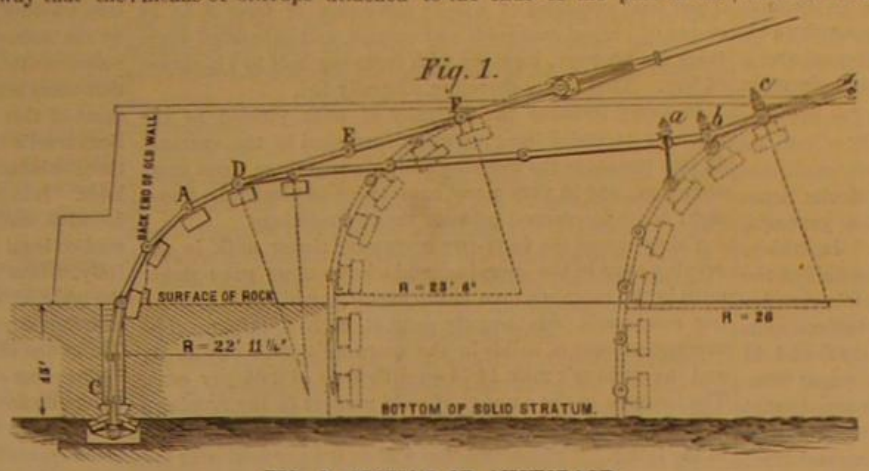


FIG. 3.—SECTION OF ANCHORAGE.

old chain, as shown at *a*, *b*, and *c*. In plan the pits are 6 ft. x 2 ft. 6 in. On the New York side they were sunk to a depth of 17 feet. On the Canada side to 23 feet. At the bottom the pits were chambered to 6 x 7 ft. in plan, for the reception of the anchor plates.

The anchor plates are of cast iron 5 ft. 6 in. square and strongly ribbed. Each plate has eight cavities cored into it for the reception of the lower heads of the links inclosing them perfectly. One pin passes through the whole eight links and all the partitions of the plate. After the plate was properly placed in the pit it was solidly concreted underneath. The stone blocks above the plate were cut to fit each place with thin joints, and the pieces as large as could be got into the chamber and notches. All vacant places were filled solidly with stone and cement, but no stone was permitted to come in contact with the chains.

After the new chains were adjusted the masonry was rebuilt and both new and old chains covered and grouted solidly, and the wire strands were covered with brick houses.

In renewing the suspended superstructure it was decided to use steel for the posts, chords, track stringers, and lateral rods, and iron for all other parts.

It was also decided to put the new iron beams in, nearly throughout, before commencing the work of erection proper. The work began at the middle and proceeded toward each end. When 150 feet of the new work was in place, the new chords were securely clamped to the old by means of oak and pine timber.

The portion of the new work thus put in place weighed about 1,100 lb. per running foot of bridge. Hence there were seldom over 90 tons of new material overlapping the old, but at the start, being in the middle, this was equivalent to about 150 tons distributed, or deducting the 80 tons, saved by stripping the bridge, there were 70 tons as the probable extra dead load upon it, but as the trains had at the outset been limited to 190 tons, it is not probable that the total weight of live and dead load ever exceeded that of ordinary usage.

While these changes were being made, the work of replacing the lower floor was going forward each way from the middle. After the work of replacing the trusses and floors was completed, that of renewing the track began at the middle and proceeded each way at the rate of 30 feet per day, or of 60 feet total. This could have been done without interrupting traffic, but as the Great Western Railway Company was to do the work of removing the old material of the track and put on the new timber, they preferred to take an hour each day, when there was no passenger train and scarcely any freight to cross, and make the change of 60 feet at one time.

The camber was made as nearly an arc of a circle as possible. The stress on the suspenders was adjusted by means of a hydraulic weighing machine.

In a suspension bridge of this sort, to make the overfloor stays (or those from the tops of the towers to different points of the floors) effective, a continuous iron truss is required, the middle point of whose length shall be as nearly stationary as possible. The trusses in this case are continuous from end to end. In order to keep the middle from moving toward either end the automatic device shown at the end of the lower chord (Fig. 5) was designed. In the prolongation of the line of the lower chord is an abutment casting, A, firmly secured to the masonry of the arch. This casting receives the end thrust of the chord. There is one of these castings at each end of each lower chord.

A bent lever, B, has its fulcrum, E, secured to A. At the end, D, of the short arm of the lever is hinged one end of a three-quarter inch diameter round rod, R. This rod extends through the lower chord to the opposite side of the river, where its other end is secured to the abutment casting

Fig. 3.

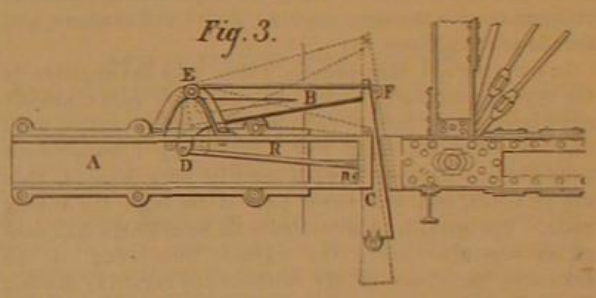


Fig. 5.—Automatic Truss Adjustment.

by a nut, *n*. At the end, F, of the long arm of B is suspended a cast iron wedge, C, which is interposed between the end of the chord and of the abutment casting. The action of the device is as follows:

The change in length of the chord, between extremes of temperature, is about 8½ inches. If the middle of the chord is stationary each end will consequently move 4¼ inches between extremes. The rod, R, which lies loosely in the chord, but otherwise is independent of it, is a little longer than the chord, and will change in length, between extremes, 8½ inches, or double the movement of either end of the chord. Hence the other end of the rod being fast, the end, D, will move 8½ inches, carrying the end of the lever with it at the same time that the end of the chord moves 4½ inches. Arm, E F, of the lever is three times the length of D E, hence F will move 25½ inches, or six times as far as the end of the chord moves. Consequently the wedge, C, is made with an inclination 1 to 6 of its length. There is one of these wedges at each end of each lower chord. When the chord contracts the rod contracts in the same proportion and at the same time, thus bringing a thicker part of the wedge between the chord and abutment.

There is half an inch of space at each end for the chord to go and come in before bearing upon the wedge, an amount which is very nearly constant for all temperatures.

The long rods lying inside of the chord, they both keep at nearly the same temperature with each other.

The wedge has two surfaces of friction, and hence its inclination of 1 to 6 is far within the angle of friction of cast iron. Hence no matter what the pressure of the chord, it brings no stress upon rod, R, except what is required to sustain the weight of the wedge.

The weight of the old wooden structure, at its completion, was estimated by Mr. John A. Roebling at 1,000 tons. But at the date of the inspection, there having been a large amount of timber added to it, it was esti-

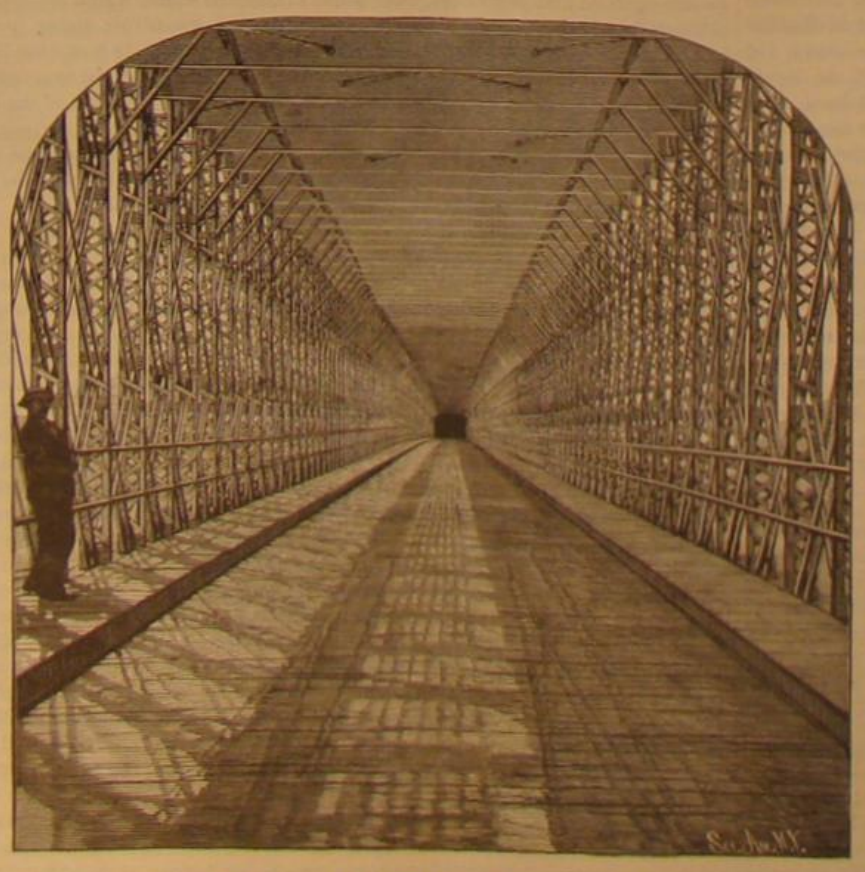


Fig. 2.—CARRIAGE WAY, SHOWING TRUSSES.

mated to weigh 1,130 tons. When the work of replacing the lower floor beams was in progress, Mr. Buck had one of them weighed, and found that owing to the amount of water that it held it was very much heavier than it had been estimated. He also weighed other pieces of the bridge, and from these made a new estimate, with the following result:

Total suspended weight between the towers: Old bridge, 1,228 tons; new bridge, 1,050 tons. Difference in favor of new bridge, 178 tons.

It is possible that the estimate of 1,228 tons is somewhat in excess. But as the new bridge is now higher in the middle than the old one for the same temperature, notwithstanding that the middle suspenders have been lengthened over 3 inches since its completion, that would indicate a decrease of considerably over 100 tons.

Cerebrology of Criminals.

A curious observation has been made by Dr. Moritz Benedict, of Vienna. He published a book about a year ago, "Anatomische Studien an Verbrechergehirnen," in which, among other notes, he states that in nearly one-half of the brains of persistent criminals the superior frontal convolution is not continuous, but is divided into four sub-convolutions, analogous to the disposition of the parts found in predatory, carnivorous animals. In a recent paper (*Centralblatt fur Med. Wiss.*, November 13, 1880), he argues that much of moral perversity may and must be the result of this deflection of the cerebral organs from the normal type, producing as it necessarily would, other arrangements of cerebral nutrition, and hæmostatic relations. It cannot be fortuitous that the mental characteristics of the most perverse criminals, and also the cerebral anatomy, both resemble those of wild beasts; this double analogy must be one of cause and effect.

Colored Photographic Prints.

This process consists in obtaining color photographs by means of two impressions from the negative, the first being a weak impression in order to give the outline for guiding the application of the coloring, and the second, after the colors have been applied, being an impression of sufficient strength to give the clear drawing, lights and shadows, and details of the picture.

In carrying out this process, I first take the negative in the ordinary manner. I then print on salted paper, already sensitized, a very light or faint proof of each negative, fixed and washed in the usual way. When dry I immerse the print for two or three seconds only in pure alcohol, then dry it again, and afterwards pass it through the rolling press. The print is then colored with an ordinary hair pencil in vegetable colors, the various tints being laid on smoothly, flatly, and lightly, without any regard to shading or softening off, but care being taken to have the tints brighter than they are intended to be finally. The colors are applied with the following mixture instead of with water:

Albumen of egg, 100 grammes; distilled water, 25 grammes; pure glycerine, 25 grammes; sal ammoniac, 5 grammes; liquid ammonia, 4 drops.

It will be found that the print will color more easily if it be slightly moistened and placed on a piece of glass. After the print has been colored, it is again passed through the rolling-press. When perfectly dry, the colored proof is immersed for a second time in pure alcohol, and is then albumenized in a bath composed as follows: Whites of eggs are beaten up with two grammes of very pure sal ammoniac added for every three whites of eggs, 20 per cent of distilled water, and about 4 drops of acetic acid for every 100 grammes of albumen. All is beaten up until the liquid attains a snowy appearance, when it is left at least eight days to stand. It is then decanted and ready for the colored print, which should be carefully passed over the bath and allowed to remain floating about sixty seconds. The print is then dried by heat, and finally passed through a sensitizing bath in order to be ready for the second impression. This bath is composed as follows: Distilled water, 1000 grammes; nitrate of silver, 100 grammes.

The proof is again dried, but this time not by heat, and a second impression, stronger than the first, is then taken by laying the negative very accurately over the first impression, so that all outlines, etc., rigidly correspond. This has the effect of establishing the picture, throwing out high lights, etc. The proof is then toned and fixed in the usual way, and can be afterwards enameled.

A CURIOUS fact, and one bearing on the value of submarine cables, was mentioned by Mr. Pender, January 27, in presiding at the half-yearly meeting of the Eastern Telegraph Company. It was that the company had been able, for £10,000, to pick up from a depth of 2,000 fathoms one of their cables which had been ten years in the water. The establishment of the fact that it was possible to raise a cable from such a depth of course gives an additional value to all telegraphic property.

BELGIUM promises to become the great industrial teacher of Europe. Many foreigners are now attending her schools. She has 59 technical schools, 32 industrial schools, and a higher commercial school—all receiving funds annually from the State.

Analyses of Cows' Milk.

During the winter quarter of 1880 analyses were made of the milk of forty-two cows kept at the Government Agricultural Institution, Glasnevin, County Dublin, by Charles A. Cameron, M.D., Professor of Chemistry.

The morning's milk and the evening's milk of each cow were each analyzed once; and an examination of the mixed milk of the forty-two cows was also made.

The cows, it may be mentioned, were good animals; they had from one to three crosses of the shorthorn breed. They were in the house during the period of the experiments. Their food consisted of a daily allowance of from 8 to 10 stones of pulped mangolds and turnips, and exhausted grain from the brewery, together with from one-half to 1½ stones of hay. They were, therefore, liberally fed.

In every instance the quantity of milk yielded in the morning exceeded the proportion furnished in the evening. In two instances the morning's supply was three times more abundant, and in very many cases twice as plentiful. About eight hours intervened between the two milkings.

Thirty out of the forty-two cows gave richer milk in the evening than in the morning, and eleven cows gave richer milk in the morning than in the evening, while the remaining cow's milk was equally good at both milkings. The average amount of solids in the morning's milk was 13·20, and the evening's milk 13·74—a difference of 0·54 per cent. The increase in the amount of solid matters in the evening's milk was due chiefly to the larger amount of fats contained in the latter. The amount was 4·22 or 0·4 per cent over the proportion (3·82 per cent) found in the morning's milk. In the case of the mixed milk of the forty-two cows, that yielded in the evening was richer by 0·56 per cent of solid matters, including 0·44 per cent of fats.

The results of the analyses of the milk of these forty-two cows show that the mixed milk of well-fed cows in houses, in the last quarter of the year, contains, when poorest—*i. e.*, in the morning—13·90 per cent of solid matter, including 4·20 per cent of fats. On the 2d of November the mixed milk of eight cows, which happened to be in the same house, was analyzed. One hundred parts contained: Total solid matters, 13·90 per cent; solids, *minus* fats, 9·75; fats, 4·15; ash, 0·72.

The Society of Public Analysts of Great Britain and Ireland have adopted, as a standard for the poorest pure milk, 9 per cent of solids *minus* fats, and 2·5 per cent of fats—a total of 11·5 per cent of solids. There is little doubt that milk containing less than 11·5 per cent of solids is watered or skimmed.

The mixed milk of 100 cows kept on the dairy farm of Mr. E. M. Russell, Pery Square, was found to contain at the evening's milking 13·85 per cent of solid, including 4·60 per cent of fats and 0·72 per cent of ash. The solids, *minus* fats, were 9·25 per cent. The analysis was made in March, 1881.

I think there is the strongest proof that milk on the average contains more than 13 per cent of solid matters. During the last sixteen years I have examined an immense number of specimens of this liquid, and whenever I was certain that it was pure, I invariably found it to contain more than 12 per cent of solids. I am quite satisfied that the milk of Dublin dairy herds contains from 13 to 15 per cent of solids.

METHOD OF ANALYSIS.

Ten grammes of milk were kept in a shallow capsule in the water bath at 212° Fah. until thoroughly desiccated; the residue showed the amount of total solid matters. The 10 grammes, dried and pulverized, were boiled in about 80 cubic centimeters of ether for several hours, an upright condenser being placed over the flask containing the ether to prevent a waste of the latter. The ether containing the milk fats in solution was filtered (a very small piece of filtering paper being used) into a light tared flask. The ether was distilled off, and the last traces got rid of by passing a current of hot dry air through the flask and condenser. The flask and its fatty contents were then weighed. The amount of the ash was determined by igniting at a low temperature in a platinum dish the residue obtained by evaporating 10 grammes of the milk to dryness.

It is perhaps, in part, owing to the great care taken to extract every particle of the fat that such high percentages of that ingredient were obtained.

In every instance the amount of solids was determined by two independent experiments. Many of the weighings of the fats and ash were repeated.—*The Analyst.*

Ultra Gaseous Matter in America.

On the occasion of Professor Carhart's exhibition of the Crookes experiments illustrating the ultra gaseous state of matter, before the New York Electrical Society, May 5, it was erroneously stated that the experiments had not before been publicly exhibited in this country. As shown in our issue of June 18, the same lecture, with the same experiments, had been presented to the Chicago Electrical Society, by Professor Carhart, January 24, 1881.

The Secretary of the Franklin Institute recalls to our recollection the fact that another early presentation of the subject, with illustrative experiments, was made in Philadelphia, February 17, 1881, by Mr. Alexander G. Outerbridge, Jr., of the U. S. Mint, whose lecture was published in the Journal of the Institute for April last. A still earlier exhibition of some of the Crookes tubes was made before the Franklin Institute, September 15, 1880, by Mr. Walton, of the house of Queen & Co., opticians, Philadelphia, through whom the apparatus was imported for Mr. Outerbridge's exhibition.

Cadaveric Alkaloids.

MM. Brouardel and Boutmy have communicated to the Académie des Sciences some further observations on the alkaloids developed in the animal body during decomposition—alkaloids which M. Selmi has termed *ptomaines*. According to Bouley and Lussana these substances may be developed not only after death but during life. It is still uncertain whether they are formed by simple chemical action or by the influence of minute organisms. The latter appear concurrently, but they may possibly be merely an indication that these alkaloids furnish a favorable soil for the development of this or that organism. The special object of M. Brouardel's researches was the discovery of means by which these substances may be distinguished from vegetable alkaloids. It is probable that the two have been sometimes confounded, and that this confusion has led to grave errors in medico legal investigations. It was so in a recent case in Italy, where an expert believed that he had discovered, in the body of a deceased general, evidence of delphinine; the reactions supposed to be proof of it were, however, certainly due to one of these cadaveric alkaloids.

The most effective method of distinguishing between the vegetable and the animal alkaloids is by making a complete examination of the chemical and physiological properties of the suspected substance; and if any one of these proper to a vegetable alkaloid is absent, it is probable that the substance is not this alkaloid, but a ptomaine which resembles it. This method is, however, tedious and difficult, and is only practicable when a considerable quantity of the suspected material is available. A more convenient method of distinguishing them is by the employment of ferricyanide of potassium. This substance is unaffected by the pure organic bases of the laboratory, or those extracted from the body of a person who is known to have been poisoned. The cadaveric alkaloids, however, instantly transform it into ferricyanide, and it becomes capable of forming prussian blue with salts of iron. The iodomercurate of potash gives similar reactions with both classes of substances, but the ferricyanide enables them to be distinguished. A few drops of a solution of the sulphate of the alkaloid are added to a solution of some of this salt in a watch glass, and then a drop of a neutral solution of iron determines the formation of prussian blue if the base is a ptomaine, and not if it is a vegetable alkaloid. Unfortunately there are two important exceptions to this test: morphia produces a similar effect, and so also does veratrine, but in a much less degree.—*Lancet.*

Sulphate of Ammonia from Gas Liquor.

The *Comptes Rendus* of the last meeting of the Société Technique de l'Industrie du Gaz en France contains a "Note" by M. Marché on the manufacture of sulphate of ammonia by a process which, unlike those in general use for this purpose, is applicable to small gas works. The process consists of the employment of crude sulphate of alumina, or alum cake, instead of sulphuric acid, as the reagent. This material costs about 2s. 6d. per hundredweight in the centers of production, and the authors of the process assert that in consequence of the high tariff imposed upon acids conveyed by rail, sulphuric acid would be less costly in the form of sulphate of alumina than in that of chamber or concentrated acid. The apparatus employed consists of (1) a wooden vat which is filled with liquor, to which the reagent is added in the proportion of 4·5 kilos per degree per hectolitre, and after standing from ten to 12 hours the liquor is converted into sulphate of ammonia; (2) an evaporating pan of sheet iron, in which the concentration of the liquor is effected by means of the waste heat from the ovens; (3) a small cask in which lixiviation is effected—the mother liquor returning into the pan and mingling with the liquor of other operations. The reaction is as follows:

The liquor contains sesqui-carbonate of ammonia, and in feebler proportion, hydrosulphate of ammonia. On coming in contact with the sulphate of alumina, the two salts are brought into the state of sulphate of ammonia, which remains in solution in the liquor. A precipitation of hydrate of alumina takes place, which completely purifies the liquor, while the carbonic and hydrosulphuric acids are liberated. The alumina is precipitated completely in twelve hours, and increases so rapidly in density that it may be taken out with the shovel when the cask is half empty. Therefore it is sufficient to remove, every three days, the excess of dense precipitate, which really contains but little sulphate of ammonia—not more than two per cent in fact.

The reaction is, therefore, complete. The advantages of the process are that the expense of fitting up the appliances is extremely trifling: there is not any expense for fuel, no supervision is needed, there is no wear and tear of plant, nor is any manipulation of the acid required, while the weakest liquors are utilized. The process is applicable to the smallest works, and also to those of the farthest removed from the works where the acid is produced, and with it there is the possibility of obtaining sulphate from the first distillation, owing to the purification effected by the reagent. With the same apparatus may be produced chloride of ammonium containing 30 per cent of ammonia, while the sulphate contains only from 24 to 25 per cent.

Correspondence.

An Inventors' Congress.

To the Editor of the Scientific American:

The magnitude of the interests involved in our governmental patent system demands protection and the fostering care of the nation.

It extends to the whole field of our great and rapidly expanding industries—agricultural, commercial, manufacturing, mechanical, mining, chemical and mechanical philosophy, and the broad range of the scientific developments of the world's industries.

It calls in trumpet tones upon the host of toiling inventors to rally and to concentrate their mental force for the equitable protection of their rights.

It has become, apparently, expedient to convene an *Inventors' Congress*, at Washington or New York, on or about the 15th day of November next, to take such action as may be deemed advisable, in anticipation of the meeting of the national Congress.

Among the questions for consideration by the *Inventors' Congress*, the following may be entitled to some degree of prominence:

I. The reformation and equitable establishment of our patent system.

(1) The classification of patents in conformity with a stringent rule of discriminating charges, scaled according to relative importance and periods of continuance.

(2) Adjusting and limiting the revenues to the legitimate expenditures of the Patent Office.

The present accumulation of revenue on the operations of the inventive genius of citizens is abnormal to our doctrines and system of government, and oppressive to the indigent inventor.

(3) A competitive system of premiums for indicated or prescribed inventions of national importance, and also the bestowal of moderate "*bounties*" on deserving indigent inventors.

II. The expediency of petitioning the Federal Congress to convert the Patent Office into an executive department of the national government.

The vast arena for the emulation and development of the inventive genius of our citizens would find a more expanded scope under an independent autonomy.

III. The question may be thus summarily considered as to the expediency of *inviting the nationalities of the world* to participate in an *Inventors' Congress*, at Paris, London, or Washington, to deliberate on the adoption of a plan for co operation in the administration of the great interests involved in the field of invention.

In the trite adage that "*necessity is the mother of invention*," there is, doubtless, some truth, but it is *capital and not necessity* that profits by invention abroad, and very often at home!

The above noted interests involve a policy of national concern, inviting prompt consideration. About 243,000 inventions have authentic record, and have been already illustrated in the vast sphere of our national industries, imparting vigorous action evolved by inventive genius.

IV. The question is also presented as to the expediency of establishing a *stock exchange for patented inventions* at New York, as early as September ensuing, with branches at the great commercial centers at home and abroad, thus giving solvency to the productions of inventive genius among the world's industries.

V. It is respectfully suggested that inventors favoring these views organize in each State at the earliest practicable moment, and select delegates to an *Inventors' Congress*, to meet on the 15th day of November, 1881, on the *ratio of two at large and one for each five hundred inventors for each State represented.*

It is also suggested that the SCIENTIFIC AMERICAN—the publishers consenting—be made the organ for communication for the development of this subject.

DANIEL RUGGLES.

Fredericksburg, Va., June 25, 1881.

Comments on Letter of Mr. Daniel Ruggles.

For nearly forty years the SCIENTIFIC AMERICAN has been an earnest advocate of inventors and inventors' rights. On every proper occasion it has set forth the just claims of inventors to popular appreciation, public honor, and that pecuniary reward which is secured by the legal recognition of their property rights under letters patent. If, therefore it fails to sympathize with the movement which Mr. Ruggles proposes, its readers will understand that it is not for any lack of desire to advance in the fullest degree the lawful interests of the pioneers of material progress.

With all respect to our correspondent's judgment, we are compelled to take issue with the very first proposition he lays down, inasmuch as it implies that the interests of inventors have not hitherto enjoyed the "protection and fostering care of the nation."

The Patent Office has not always been administered as wisely as might be desired; our present legislation has been more or less defective from the first; our courts have not always been free from prejudice and error in adjudicating patent cases; nevertheless, our patent interests are and always have been under the fostering care and protection of the nation to a degree not attained or even aimed at in any other country. There is room for improvement, as there is in the administration of all human affairs; but that improvement is not likely to be furthered by denying to the nation the credit which is justly its due for its not unsuccessful efforts to encourage inventors and protect the rights of patentees.

The expediency of calling a convention of inventors, national or international, may safely be left to the decision of the vast and honorable body of men and women deserving the name. The probability of such a convention's accomplishing much, even if held, is, to say the most, very slight. Certainly Mr. Ruggles' call to reform the patent system, without a more specific indication of what is to be changed, and in what way, and for what purpose, is not likely to be responded to with any great enthusiasm, except, perhaps, by certain associations, whose interest in the "amendment" (so-called) of the patent laws has thus far boded little good to inventors.

This is not the first time that a general convention of inventors has been proposed. That such propositions have never been put into execution is not surprising when we stop to consider how narrow is the basis of common interest on which inventors and patentees can come together, calling to mind at the same time the circumstance that the troubles of inventors arise quite as often from the opposition of other inventors as from that of the public at large.

As citizens it is easy for A, B, and C to unite in all heartiness in agreeing that the public good demands the fullest encouragement of invention. As inventors representing the three tenses of the verb "to invent"—past, present, and future—it is as easy for them to find themselves in an attitude of mutual hostility. A's invention is finished, patented, introduced, and is the basis of a profitable industry. What A specially wants of the patent laws is that they should protect his monopoly, make its duration as long as possible, and not encourage overmuch the efforts of B and C to supplant him. B's invention is before the Patent Office for recognition. He has a horror of grasping monopolies. He feels it a moral duty to protect the public from the extortions of A. He would, therefore, have A's patent construed most rigorously, and the utmost latitude allowed to his own claims. If A or any other inventor has forestalled him in any particular he regards it as somehow a personal wrong, and is apt to blame the patent laws for discouraging invention or accuse the patent examiner of working in the interest of some "bloated monopolist." C is an inventor in the future tense. He wants to accomplish a certain end, and is provoked to find that A and B and possibly others have patented the very devices he wants to use. The interests which he has in common with them are apt to be overshadowed by those interests which conflict, certainly if he is at all inclined to be selfish.

In times past, when novel inventions were few, the inertia of popular habit and popular prejudice was the chief hinderance to the immediate success of new inventions. Now, improvement, progress, or whatever it may be called, is the rage; novelty is grasped at and fought over, and too often the inventor's worst opponents are those of the household of invention—his brother craftsmen.

It may be that a union of inventors would bring peace by arbitration; but we are inclined to think that such a union would have to be the product of much fighting.

The special ends which Mr. Ruggles would have the proposed convention work for do not, as a whole, impress us as altogether feasible or desirable. If the charges for letters patent were to be graded, as he proposes, according to the importance of the devices covered, there would at once arise the impossible task of deciding the relative merits of inventions. The natural tendency of inventors is to exaggerate the value of their inventions; the tendency of the officials of the Patent Office is the reverse; and it often happens that both fail to appreciate the real significance of particular inventions, the working value of which may not become fully apparent until years after the patent is granted. On the other hand, inventions which seem to be, and really are, of signal value when made, may be supplanted by better devices almost immediately, and so lapse into insignificance. Only omniscience and infinite impartiality in the Patent Office could keep the proposed discrimination from being an instrument of injustice to inventors and the source of immediate dissatisfaction to all. The suggested system of premiums and bounties to indigent inventors would be as impossible to carry out fairly, as it would be certain to open the door to corruption and scandal. Besides, the same determined effort which would secure to the deserving inventor financial assistance from a government office, would be much more likely to obtain the needed help at the hands of clear-sighted or speculative individuals. With our abundance of capital seeking opportunity for investment a promising invention need not suffer for lack of means for its development.

The proposition touching the establishment of a stock exchange for patented inventions is, in its present form, simply incomprehensible. The development of properties is in no way furthered by stock exchange operations, nor is their solvency; and we fail utterly to see how inventors could be benefited by the institution suggested—barring, of course, those of the Keely and Gamgee sort.

The propriety of adjusting the revenues of the Patent Office to its legitimate expenditures has been repeatedly urged by the SCIENTIFIC AMERICAN. On this point our agreement with Mr. Ruggles is complete.

We should be glad to see an international convention looking to a unification of the patent laws of all nations on the basis of the American system; but we see little reason to anticipate such progress on the part of foreign governments for many long years.

Rye Roots in Ice.

To the Editor of the Scientific American:

I send you a vegetable growth that I think possesses some botanical interest as an illustration of the anomalous conditions under which certain forms of vegetation can germinate and grow. These are the facts: Two years since Mr. John Gruel, a prominent confectioner of this place, called my attention to the fact that rye grains germinated and threw out long rootlets embedded in ice in his icehouse. At the time I saw a number of the grains with rootlets attached that were reported as growing in the solid ice. I did not doubt his word, but as I did not see the grains *in situ* I passed it by. Last year he did not use rye straw as a lining to his icehouse, hence there was not a recurrence of the anomaly. Last winter he again used rye straw to line his house, and last night he notified me that on removing ice he found a number of the sprouted grains. He told me I should be present to-day when he removed the ice. I was, and was witness of the following details: On removing a thick bed of ice from the wall, between which and the ice there was a packing of rye straw, I found a large number of the grains with their rootlets penetrating the solid, clear ice in various directions. The one I inclose I detached from a large lump of ice, the rootlets twining through the detached ice. The grain was contained in an ellipsoidal cavity of three-eighths inch major axis sunk in the smooth face of the ice resting against the wall. The plumule (I take it to be) ascended along a slight cavity, a prolongation of the receptacle of the grain. From the grain the rootlets spread out through the transparent ice, their track being plainly visible through the ice. Though following devious tracks, what was strange to me, the rootlets were drawn from the ice by a slight pull on the grain, as if they were not rigidly embedded in the ice.

At the same time I saw a number of similar instances, some with a greater number of rootlets and longer, but they were injured in extraction.

D. J. BENNER.

Gettysburg, Pa., June 16, 1881.

Ants as Fruit Growers' Friends.

Many of the leading orchard proprietors in Northern Italy and Southern Germany are cultivators of the common black ant, which insect they hold in high esteem as the fruit grower's best friend. They establish ant hills in their orchards, and leave the police service of their fruit trees entirely to the tiny colonists, which pass all their time in climbing up the stems of the fruit trees, cleansing their boughs and leaves of malefactors, mature as well as embryotic, and descending laden with spoils to the ground, when they comfortably consume or prudently store away their booty. They never meddle with sound fruit, but only invade such apples, pears, and plums as have already been penetrated by the canker, which they remorselessly pursue to its fastnesses within the very heart of the fruit. Nowhere are apple and pear trees so free from blight and destructive insects as in the immediate neighborhood of a large ant hill five or six years old. The favorite food of ants would appear to be the larvæ and pupæ of those creatures which spend the whole of their brief existence in devouring the tender shoots and juvenile leaves of fruit trees.—*Prairie Farmer.*

Harrison's Moon Pictures.

We have examined with great pleasure the lithographic copy in color of Mr. Henry Harrison's painting of the crescent moon, just published. It represents the moon the third day from new, with the terminator at Messier. In the earth shine on the shadowed surface several of the more prominent features of the moon are visible. The picture, 24 inches square, shows the moon 18 inches in diameter; the background is dark blue, the color of the field in the telescope an hour after sunset. The accuracy of the work is attested by our best astronomers and students of the moon, and its value to students and institutions of learning is unquestionable. The entire surface of the moon will be similarly represented in a series of six pictures, showing the moon at three days old, at five days old, at seven days old or first quarter, at last quarter, sunset at Copernicus; and the last three days of the old moon, sunset at Aristarchus. Each plate is accompanied with an outline drawing and a descriptive pamphlet. The price is $3 a plate; to be had of Henry Harrison, New York.

Fresh Water Sponges.

Mr. Potts, of the Philadelphia Academy of Natural Sciences, states that the order *Spongida* has many more representatives in our fresh waters than has generally been supposed. He recently described before the academy three species of *Spongilla*, which he detected in a small stream near Philadelphia. Since then he has found the *Spongilla fragilis* of Leidy plentifully in the Schuylkill below the dam, and a lacustrine form above the dam, and has obtained a very slender green species, which appears creeping along stems of *Sphagnum*, etc., in a swamp near Absecum, New Jersey, a beautiful species from the Adirondack lakes, another lacustrine form from the lake near the Catskill Mountain House, and four species from an old cellar at Lehigh Gap, Pennsylvania.

Burroughs Price Brunner.

Mr. Burroughs Price Brunner, who died in San Francisco, June 4, at the age of 52, was an engineer and inventor of some note. When but a youth he invented a linseed oil press which is still in use and substantially unimproved. Before the war he was for twelve years superintendent and engineer of the Charleston, S. C., Gas Works. Losing his property in the South he made his home in San Francisco in 1864. He constructed the gas works in King street in that city; planned and constructed the Pacific Rolling Mills —an institution which now gives employment to from 400 to 500 men—and invented a great deal of the machinery used in it, notably that employed in utilizing old steel rails. He also planned and built the Pacific Oil and Lead Works, and the construction of the Virginia City and Truckee Railroad as a steam road was largely due to his influence. At the time of his death he was superintendent of the Gas Works, Rolling Mills, and Pacific Oil and Lead Works.

IMPROVED HOISTING APPARATUS.

We give an engraving of an improved apparatus for lifting variable loads which is both safe and portable. The invention consists in a block provided with differential gearing of novel construction, provided with a safety-stop device and automatic brake acting by the weight of the load.

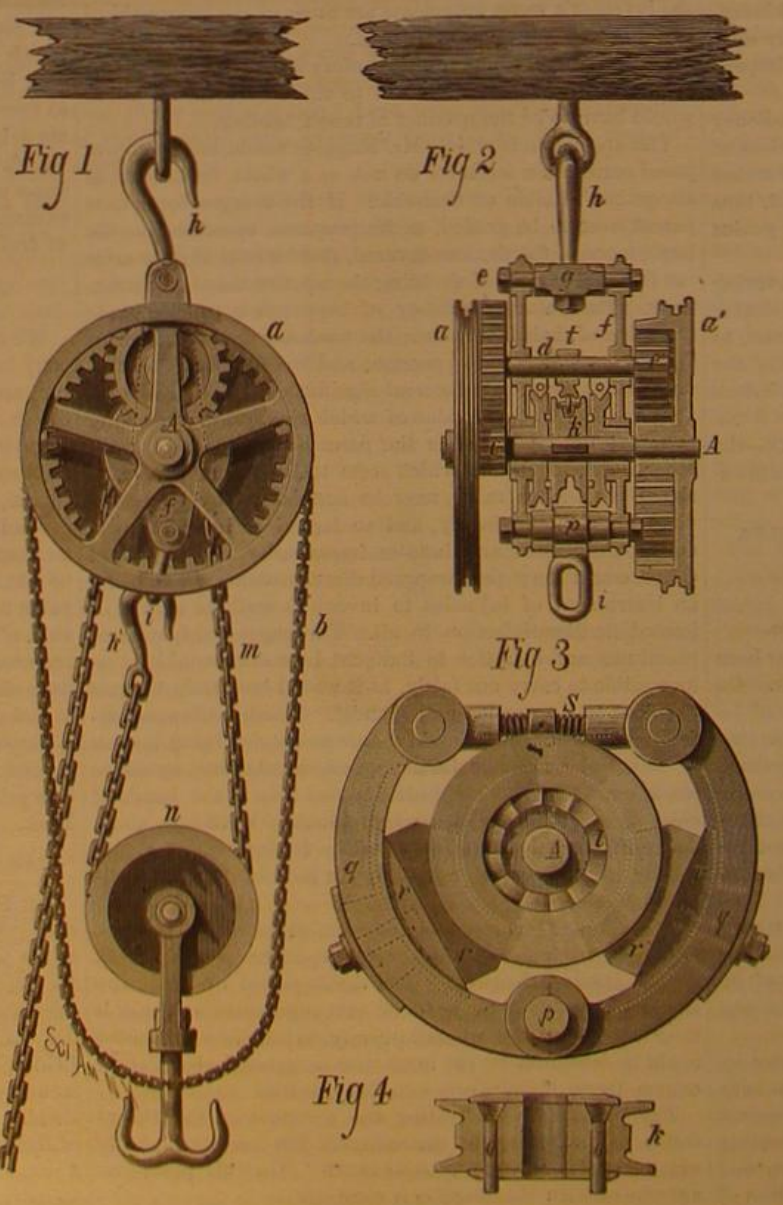
In the engraving Fig. 1 is a side elevation of the apparatus; Fig. 2 is a central vertical section; Fig. 3 is a vertical section showing the brake mechanism, and Fig. 4 is a detail view of the chain wheel.

A is the main shaft of the mechanism, having at its ends chain wheels, *a a'*, on which are endless hand chains, *b b*. The wheel, *a*, is loose on the shaft, and has on its hub a pinion, *c*. The wheel, *a'*, which is fast on the shaft, is formed with a rim flange and internal gear. *d* is a secondary shaft carrying fast pinions, *e e'*, that mesh with pinions, *c*, and wheel, *a'*, respectively. The shafts, A *d*, are journaled in cheek plates, *f f*, which at the upper end are connected by a yoke or bar, *g*, that is fitted with a hook, *h*, for suspension of the apparatus. At the lower end, the cheek plates, *f*, are connected by a bar, *p*, on which is hung an eye-piece or ring, *i*. On the shaft, A, between the plates, *f*, a chain wheel, *k*, is keyed, on opposite sides of which there are two wheels, loose on the shaft, having their hubs extended through the plates, *f*. On the shaft, *d*, is loosely hung a bent guide piece, *t*, that laps over the chain wheel and prevents the chain from rising. The hoisting chain, *m*, passes around the wheel, *k*, and its end having the hook, *k'*, may be attached to the load, or when double power is required the chain carries the block, *n*, and has its end connected to the ring, *i*. The brake wheels, *l*, have their faces next to wheel, *k*, formed with ratchet teeth, and the wheel, *k*, is provided with four spring pawls, *o*, two on each side, consisting of straight pins set in mortises, with spiral springs behind them, so that they are projected and engage the ratchets. The rims of the wheels, *l*, are formed with V-grooves.

There are two curved toggle bars, *q q* (Fig. 3), hung on the lower crossbar, *p*, beneath each wheel, *l*, and extending around them at opposite sides. The upper ends of each pair of bars are connected by a right-and-left-hand screw rod, *s*, to allow of their adjustment, and the bars carry brake blocks entering the grooves of ths disk, *l*. The brake blocks are in two portions—the outer portions, *r*, that are attached to bars, *q*, by bolts passing through slots, as shown in Fig. 2, and the loose V-shaped portions, *r'*, placed between the portions, *r*, and brake wheels, *l*. The adjustments of these parts may be made so that the brake blocks shall give exactly the pressure required to hold the load suspended from the shaft, A.

The load is raised or lowered by operation of either hand chain, according to the power required. The chain on the wheel, *a'*, gives the greater speed, and with heavy loads may be first used to tighten the hoisting chain and the other hand chain then used. As the chain wheel, *k*, turns in raising the load, its pawls engage the ratchets of wheels, *l*. The load on shaft, A, is sustained by brake wheels, *l*, resting on blocks, *r'*, which, in turn, are supported by bar, *p*, so that the brake is continuously applied and the chain wheels arrested by the ratchet devices the moment the hand chains are left free. In lowering the load the hand chains are to be run backward, and the chain wheel, *k*, will then give revolution to the wheels, *l*. The load will thus be at all times under the control of the operator.

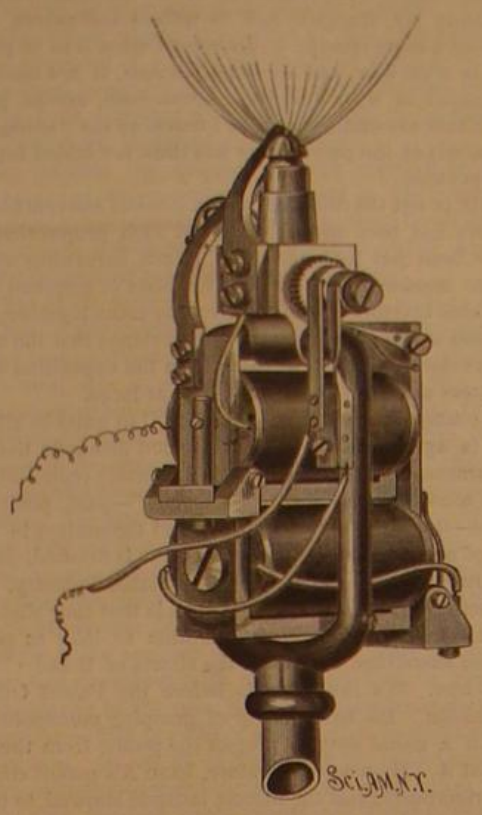
It will be seen that with this apparatus four rates of speed are attainable. The apparatus is also safe and portable, and can be made of comparatively small size and used for heavy loads. The brake wheels have sufficient holding power, though made of small size, for the reason that the whole load resting on the axle is taken by the brake blocks at opposite sides of the wheels. The resistance can be varied by shifting the blocks to change the angle of resistance. This invention was recently patented by Mr. George Speidel, 933 Buttonwood street, Reading, Pa.



SPEIDEL'S HOISTING APPARATUS.

LIGHTING GAS BY ELECTRICITY.

Undoubtedly the quickest, safest, and cleanest method of lighting gas is by means of electricity; but before the invention of the electric lighter shown in the engraving, attempts to make a lighter which could be used to light either a single light or a large number of burners did not prove altogether satisfactory. Two electro-magnets are connected with a cock and with ratchet wheels and circuit springs, arranged in such a way that one circuit and magnet turn the cock around until it is open, and the spark is produced at the same time to light the gas. The ratchet wheel has blank spaces, so that after the gas is fully on the cock cannot be turned any farther by that electric circuit, no matter how many times the spark-producing lever is operated. The second line-wire and magnet are employed for turning off the gas, and in so doing the other ratchet wheel is brought to the position where the first pawl can act upon it, when the same is moved by the first magnet in turning on the gas and lighting it. When the gas has been turned off, the circuit to the second magnet is broken, so that the further rotation of the cock is arrested.



RHODES' ELECTRIC APPARATUS FOR LIGHTING AND EXTINGUISHING GAS.

The upper magnet operates an armature lever carrying a pawl, which acts upon a mutilated ratchet wheel on the plug of the cock, and rotates the plug until a blank space in the wheel is reached, when the plug will not be turned further by the vibration of the armature; but each movement of the latter breaks the circuit at a point opposite the slit in the burner, and the spark of the extra current which passes at this point ignites the gas.

The vibration of the armature of the lower magnet closes the cock by a similar operation, and puts the ratchet wheel by which the cock is opened into position to be engaged by the pawl carried by the armature lever of the upper magnet. With this construction all that is necessary to be done is to gently press the button belonging to the particular burner to be lit, when the gas will be turned on and ignited instantly; by pressing another button the gas is extinguished.

The action of the device can be made entirely automatic, so that the opening of a door or window will turn on the light. Used in this way it forms an effective safeguard against the attacks of burglars.

In the sickroom or nursery, or wherever it is desirable to have a light occasionally through the night, this invention is very desirable; and it must be admitted that the device does away with great risks from fire, since no matches, tapers, or lighters are required.

For particulars, address the inventor, Mr. T. H. Rhodes, 638 Monroe street, Brooklyn, N. Y.

Behavior of Metals in Solidifying.

For some years it has been well known that water is not—as was formerly supposed—the only substance that expands in solidifying. The recent investigations of Nies and Winkelmann go to show that it is rather the rule than the exception for metals to expand in solidifying.

The fundamental experiment was putting the solid metal into the fused metal. In some cases the difference of density could be measured. They found then that tin in solidifying is increased in volume 0·7 per cent; zinc is increased 0·2 per cent; while solid bismuth is as much as 3 per cent less dense than the fused metal. The fact of expansion in solidifying was also demonstrated for antimony, iron, and copper. With lead and cadmium the results were indecisive; the former presented difficulties in the probably very small difference of density as a solid and as a liquid, its small heat conductivity and heat of fusion; the latter in the fact that in fusion it passes first into a viscous state. Thus, of the eight metals examined, six showed distinct expansion in solidifying, and the same may occur in the two others.

Cutting a Railroad along a Cliff.

The passengers on the Hudson River steamers have lately been entertained by the sight of gangs of workmen swarming along the face of a bold cliff jutting into the river near Cornwall, many of them suspended by ropes. A *Sun* reporter says:

The cliff was crowded with men, who, clinging like lizards to the face of the rock, were working seventy-five feet above the surface of the water; and here and there were laborers hanging (for the foothold they had obtained was hardly worthy of the name) by ropes fastened many feet above their heads, and circling their waists. All the passengers gazed with amazement at the singular spectacle; and when one of the men, turning toward the steamboat, waved his hand, cheered, and, falling off, swung for a moment, and then, getting his feet to their former place on the rock, renewed his work at cutting into its face, the spectators from the river sent back an answering cheer, as the boat swept around the point that hid the workmen from their sight, and left them discussing what they had just seen.

Greatly interested by the sight the reporter left the boat at Newburg and returned to Cornwall to inquire about the mid-air workers. He found that they were employed by the Ontario and Western Railroad Company, constructing the new North River Railroad. It is under contract to be completed by June 1, 1882, and is to run from Jersey City to Cornwall, and thence west to Middletown. The country through which it passes is so rocky and mountainous that much of the work has to be done by blasting, and this is especially the case between West Point and Cornwall. At West Point a tunnel 150 feet deep and 500 feet long has been cut through Target Hill, and many other bores, nearly as extensive, have been made. But the point already mentioned, near Cornwall, presented, perhaps, the greatest difficulties to the engineers and contractors. About eighty men are employed there, and they were selected on account of their activity and freedom from nervousness.

"They are not active enough, however," one of the surveyors said to the reporter, "to retain their foothold in every place, and at

certain spots it is necessary for them to work bound, as it were, to the rock, for a drop of seventy-five feet into the river below, or possibly upon some of the straggling stones that rise above the surface of the water at the base of the cliff, would undoubtedly serve to reduce our staff of workmen. Had they been sailors they might, perhaps, have managed better so far as clinging to the rock is concerned, but they could not have done the work."

The workmen are, for the most part, Italians, although a few of other nationalities are employed. Italians, however, are best adapted to the peculiar work, not only because they are lithe, light, and active, but on account of their ability to stand the fierce heat that beats down on the exposed face of the rock.

Population and Temperature.

A census bulletin shows the distribution of population in the United States in accordance with temperature. Arranging it in groups by 5 degrees of mean annual temperature, it is found that no less than 98 per cent of the total population live between lines marked by 40 and 70 degrees Fah. The cotton region is above 55 degrees, sugar and rice above 70 degrees, and tobacco between 50 degrees and 60 degrees. The prairie region of the Mississippi valley lies almost entirely below 55 degrees, while the great wheat region of Minnesota and Dakota is mainly below 40 degrees of mean annual temperature. The highest maximum temperature is in southwestern Arizona and southeastern California. Of the entire population, 89 per cent are found in the classes which have a maximum temperature between 95 degrees and 105 degrees. In considering minimum temperature, it is seen that 95 per cent of the inhabitants of the United States live between the lines of 35 degrees below zero and 10 degrees above, for extreme cold.

From this it is evident how population tends to increase in regions rather north of medium temperature; or, more correctly speaking, between isotherms of low degree.

PANEL DECORATIONS FOR EATON HALL.

The Duke of Westminster has recently made extensive additions to what was already an immense mansion, known as Eaton Hall. In the decorations for these new apartments great expense has been incurred to produce novel effects, and the designs for some of the rooms possess rare novelty. A small drawing room has been ornamented with twelve painted panels by Mr. H. S. Marks, R.A., who took for his models rare and curious birds from the Zoological Gardens of London. Our engraving represents a specimen of the panels produced by the artist. The *Art Magazine*, from which we take our illustration, says of the artist and his subjects:

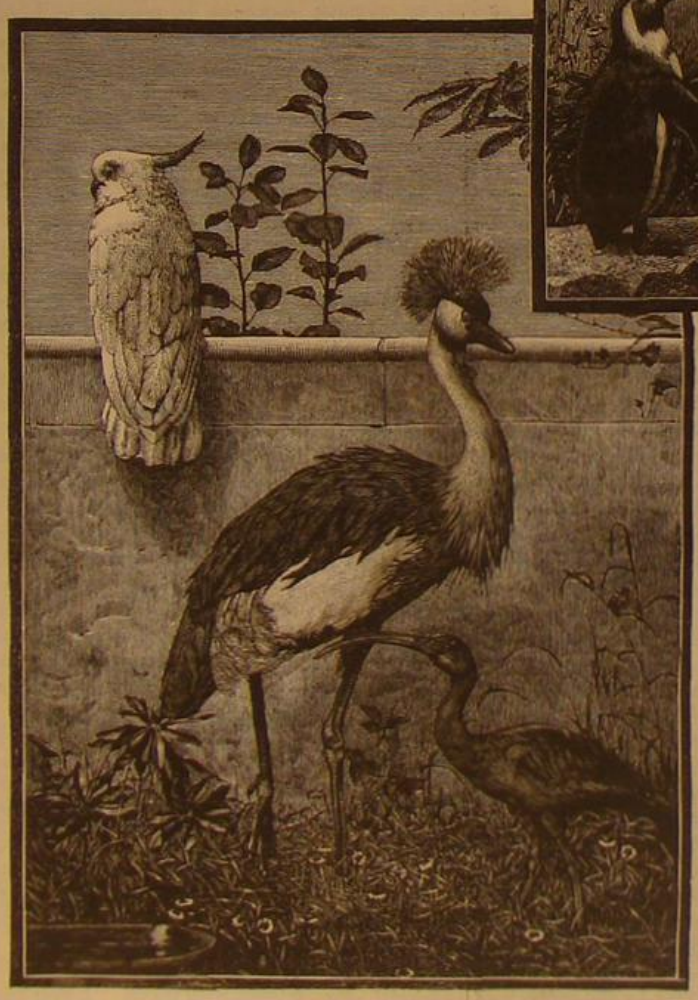
"The birds which Mr. Marks loves to give us are those which serve best to illustrate his peculiar humor. They are all funny birds with strange characteristics, fond of quaint attitudes, and given to odd ways.

"There are no more comic birds than the crowned crane, the bird of all others Mr. Marks delights in painting. It is obvious from their manner that they possess in themselves the keenest sense of humor. Now upon one leg, the other tucked up close and out of sight, they rest quietly and solemnly brooding over affairs of state; next, they commence an absurd and ridiculous dance, threading the giddy maze in and out, and round and round, as keen and excited as any bipeds indulging in intricate quadrilles. To the dance will succeed a stately and majestic walk; after which, apparently without any rhyme or reason, they will range themselves against the fence and start off on a wild foot race.

"Compared with this extraordinary bird, the scarlet ibis, although a curious bird, has nothing very remarkable about it except its shape and color, the latter being of a glowing scarlet, which commends it to the artist for purposes of decoration. For the same reason he has selected the flamingoes which figure in the upper wood-cut. These splendid creatures, which measure from five to six feet in height, are magnificent in color, ranging from a deep scarlet to various tones of a blush pink and faint red.

"The skill of the artist has been further proved by the other birds introduced in these two panels, which have been cleverly selected, make a strong contrast, and strengthen the effect. Nothing more appropriate could well be conceived than the funny puffy little penguin looking up at the giant flamingo; or the modest robin, a bird of home affections, looking at these strange looking foreigners.

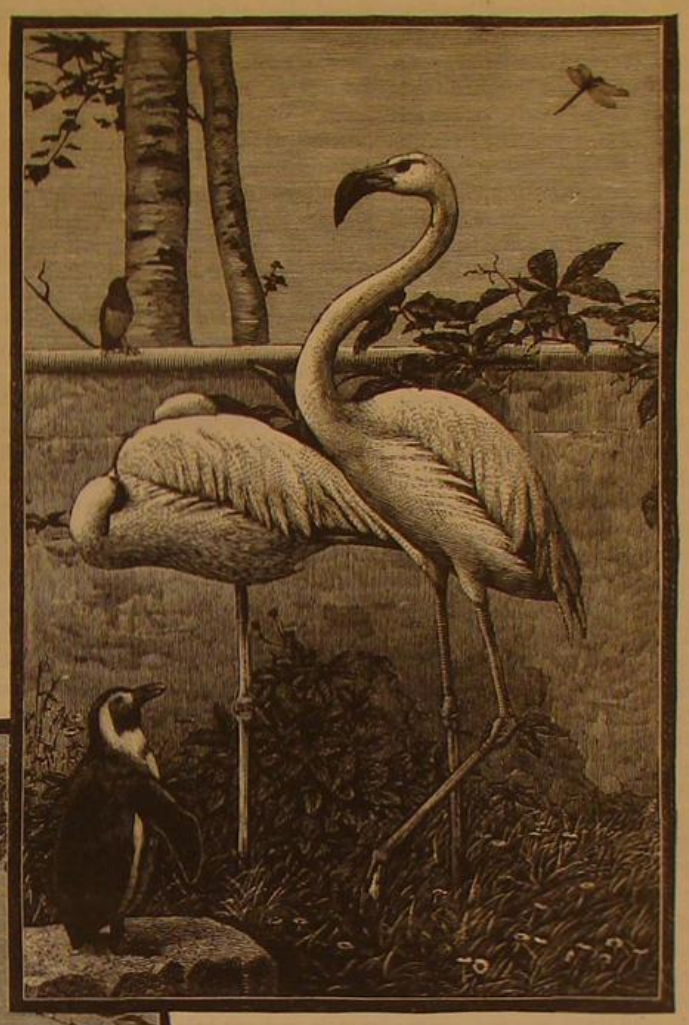
"Bird lovers, no less than lovers of art, must be grateful to Mr. Marks for these his last and most charming efforts in decoration."



PANEL DECORATIONS FOR EATON HALL.

Antiquarian Research in Mexico.

The *World's* intelligent correspondent at the City of Mexico says, in a recent letter, that the American explorer, Captain Eavans, had just returned from San Juan Teotihuacan, and had brought some Toltec relics and other antique objects, which he believes belong to an earlier civilization. These antiquities are, according to an agreement made with the Mexican Government, to be placed in the National Museum, in this city. After a thorough examination of the pyramids of "The Sun" and "The Moon," Captain Eavans commenced excavating on the site of the ancient city of Teotihuacan. The ruins of that place consist of heaps of stones and *débris* placed on some 20,000 little mounds, which formed the bases of the dwelling houses. That this city was destroyed by fire is clearly demonstrated by the heaps of charcoal and ashes found on the mounds. The walls of one building excavated and traced out were 140 by 120 feet. The stucco on the inside wall was very fine, of a bright red (which fades by exposure) and elaborate design. A piece shown your correspondent was of a beautiful crimson and white color, interspersed with mica or powdered quartz, which must have made an apartment "light up" beautifully.



You may recollect that when Mr. Charnay made excavations in Teotihuacan about a year ago he reported the finding of strata of pavement or stone work which he decided indicated three different epochs of occupation or civilization. Captain Eavans differs materially from the French explorer. He said to me: "Actual excavations and careful examination have fully convinced me that these three strata, or the 'pavements,' as Mr. Charnay called the layers, which in one place are but two feet apart, and in others only separated by six inches of earth and pebbles, are simply the foundations on which the city was built. I found beneath these layers of stone several sepulchers. Some of these tombs contained human remains interred in a manner similar to those discovered in Indian mounds in the United States. In them were also vases in which food had doubtless been deposited for the dead. There were also implements, etc., made of obsidian." Last week Captain Eavans examined the Pyramid of Cholula. He differs from others who have described it, and says: "There is no natural hillock or elevation; the entire structure is made of adobe, stone, and the *débris* of a former civilization." In conversation to-day, as on former occasions, Captain Eavans expressed a decided opinion that the Aztec civilization has been greatly over-estimated. He believes that many monuments attributed to them, for instance the "Calendar Stone," belong to the Toltecs, or even a more ancient race.

At Teotihuacan some skulls were taken from the sepulchers, and it was found that they corresponded with those discovered in the Indian mounds of the United States, not only in size, but in the peculiar flattening of the occipital region. Captain Eavans mentioned that the pottery, especially the circular dishes, in these Mexican ruins were almost identical with those found in Arkansas, and he entertains the idea that the great Toltec Empire was overrun by Indians from the north as well as by the Aztecs and by tribes from Central America. He remarked various indications that communication had existed between these races. Among other things he said: "This can be proved by implements of obsidian being discovered in the mounds of the United States, and as that substance does not exist in those northern regions the probabilities are that it came from Mexico."

A Census of the Rocks.

The Census Bureau has undertaken an interesting and valuable work in collecting information relating to quarries of building stone and the like in all parts of the country. The inquiries cover not only the location and extent of building, roofing, flagging, ornamental, and other stones and rocks, but the amount of capital employed, the annual output, methods of quarrying and dressing the stone, the number of hands employed and wages paid, methods of transportation and their cost, the number of structures of all sorts made of each sort of stone, and so on.

The aim has also been to secure duplicate samples of four inch cubes of rough rock from each quarry, for physical and chemical examination. This part of the work is being done jointly by the Census Office and the National Museum, and is in charge of Dr. Geo. W. Hawes. "One of the objects of this investigation," said Dr. Hawes to a reporter, "is to find out what minerals each one of the building and ornamental stones contains, to ascertain how each will act under different conditions as to temperature, etc., to discover the strength of each—in a word, to know all about our rock resources. Here are a half dozen different kinds and colors of granite, all unlike in structure and yet all called granite. Quarrymen and stonecutters can tell nothing about them except what you can see for yourself. Now here," said the Doctor, turning to a large block of coquina from Florida, "is a stone which answers admirably for a building stone in Florida, but if you were to build a house of it in New York it would soon tumble down. On the other hand, those granite blocks which are apparently indestructible and which are so valuable a building stone in New York, would soon deteriorate—rot, so to speak—in the Florida climate. Of course, in a scientific investigation like this we naturally solve some important economic questions and make some discoveries which will be of very great practical interest and value. For example, we know that Portland sandstone when quarried and set on edge, as it is in the walls of so many buildings in New York, will in a few years begin to scale off and give the building a ragged appearance. Again, we received some samples of rock from the only quarry in Florida—a kind of sandstone. Well, after a thorough examination and analysis of this stone we found that it contained about sixteen per cent of phosphoric acid. It is consequently a great deal more valuable as a fertilizer than it is as a building stone, but that fact had never before been discovered."

In the workshop where the stones are being polished and tested the correspondent was shown examples of the more familiar stones. A piece of Quincy granite was seen, under the microscope, to be full of pentagonal cells containing air and water. Under the action of heat the water is converted into steam and bursts the stone; hence the tendency of Quincy granite to fly to pieces in a fire.

In polishing the different faces of the sample cubes many important discoveries have been made. Sandstones and limestones, which have never been thought worthy of any better place than in the foundation or wall of some rough structure, have been smoothed and polished, and it is found

that the quarries from which they were taken contain material adapted to the most elaborate and elegant structures. Dr. Hawes declares that from the samples already received he is convinced that no country in the world is better supplied with stone for both building and ornamental purposes than is the United States; and he thinks that when all our native resources become known, as they will after the census work has been completed and its results published, the United States will cease to import stone from foreign countries.

Fish Plagues in the Gulf of Mexico.

The occurrence of areas of poisoned water in the Gulf of Mexico, causing the death of fish in vast numbers and threatening at times important industries, has been the occasion of special inquiries by the Fish Commission. As early as 1844 Mr. Benjamin Curry, of Manatee, described the effects of the plague. It appeared again in 1854, and in a milder degree on several occasions until 1878, when in several localities the marine fauna of was completely destroyed. The fatal areas are described as strips of greenish discolored water, a mile or more long, and from fifty to two hundred yards wide, strongly marked by the numbers of dead sponges and fishes floating in it. The sponges, which are usually white when the animal dies, turn black in the poisoned water; and the gills of many of the fish are covered with a froth or slime.

The latest plague followed the terrible hurricane of August, 1880, and extended from Tampa Bay to Shark River, Bahia Honda passage, and in patches by Key West, the Marquesas, and East Key, the Tortugas group.

The following account of the plague at Egmont Key is given by the agent of the Fish Commission there:

"The first dead fish we saw was on Sunday, October 17, as the tide came in. There were thousands of small fish floating on the water, most of them quite dead. I saw only one kind the first day; they were small fish, four or five inches long; the Key West smackmen called them 'trim.' They were new to me. The next day other kinds were dying all along the shore; the pompano was about the next to give in, and by the 25th of October nearly all kinds of fish that inhabit these waters were dying except the ray family. I don't remember of ever seeing any stinger or whipper ray, or the devil fish, as we call the largest ones of the ray family. From the 25th of October to the 10th of November was the worst time; during that time the stench was so bad that it was impossible to go on the beach. I sent my family to Manatee, and the assistant keeper and myself shut ourselves up in our rooms and kept burning tar, coffee, sulphur, rags, etc., night and day, in order to stand it. It was warm, damp, and calm weather. They continued to die for about six weeks; they kept getting less every day. I counted seventy sharks within eighty yards, all small; I never saw a shark over four feet long dead. The cowfish and eels were about the last to die. In regard to the cause of their dying, I have made up my mind it was caused by the fresh water, as there were immense quantities of fresh water coming down the bay, and the water here was nearly fresh on the surface, while the water underneath was perfectly salt. Now, if the fresh water could have passed off into the Gulf without being disturbed by winds it would have naturally spread out thinner and thinner as it would have rolled on toward the Gulf Stream, and once it got there then there would have been no trouble. But on the 7th of October we had a heavy gale from the southwest, and it continued to blow from the south and west until the 11th of October, and a very heavy sea running at the mouth of the bay, and it churned the fresh and salt water all up together, and the strong southerly winds set this mixed water back and kept it here for several days. I noticed a few days before the fish commenced to die a peculiar smell on the water, something like the smell of bilge water, and the color of the water was a dirty green, mixed with small sediment. I noticed the fish while they were dying, when they first came in shoal water; they would act crazy, dart around in every direction, but in a short time they would give up and float ashore. On examining them I found their gills all glued together with a slimy substance and of a whitish color, and in a short time the gills would turn green, and the fish bloat very large I cannot make any correct statement as to the number that died, but thousands of barrels floated up on this island There are no fish dying now; all we catch are fat and nice.'

Joining Together of Glass Tubes.

In order to fuse together two pieces of glass of the same diameter they must have the ends evenly cut off. They are then both held in the flame and slowly turned, without touching each other, in order that both ends may become uniformly heated. Then they are taken out of the flame, and carefully but truly placed together. The thickening which is formed at the point of junction is removed in the following manner: The end of the tube which has been joined is either melted together or closed with a cork; then the thickening is heated in the flame, while at the same time it is very evenly rotated; after softening it is slightly blown out; then again heated, and so somewhat compressed; then blown out again. This operation is repeated until the thickening has completely disappeared. It is particularly essential that during this operation of removing and blowing out, the axes of the two tubes form a straight line. This requires some skill and dexterity of manipulation. If one wants to join a narrow tube to one which is wider, the latter is first closed at one end, and this end softened by careful rotating in the flame; then blowing into the open end, a bulb is formed at the heated end; this is broken by strong blowing. By means of a file the ragged edge is removed; often it may be cut with a pair of scissors; only a narrow rim then remains, which is rounded as much as possible by turning in the flame. In this way the end of the larger tube has been reduced to about the size of the smaller one. Both pieces are now heated at the same time in the flame, as has been previously described, due precaution being taken that the two ends were of equal diameter before they were heated together. If one of the openings is still too wide, its size is reduced by heating it a little stronger than the other, until it contracts sufficiently. The two ends being then of equal size, and having been uniformly softened, they are joined, and treated as has already been mentioned.

When it is desired to join the pieces of tubing at right angles (T-shaped), one of the tubes is closed at one end and heated by means of a small sharp pointed flame, which is blown tangentially against the tube. In this way a small, round piece of the wall of the glass tube becomes very hot, and precaution is taken that the heated portion is as much circular as possible. As soon as the glass appears to be sufficiently soft, one blows into the open end of the tube, the flame, however, being still kept directed at the heated circle; this then is blown out with a slight snap. The open end of the tube which is to be joined is now placed in the flame, and when both tubes have become sufficiently softened, they are brought together and joined, as has been described. In the same way a tube may be joined to the side of the bulb.—*M. B., in Journal of Education.*

Strawberries and Garden Truck by the Barrel.

The following method of growing strawberries in barrels is not novel, but it has been recently vouched for as a practical and profitable success. It would seem to offer many advantages for people in villages with little or no garden space. Bore fifty holes in a barrel with an inch auger, and sink the bottom of the barrel an inch or two in the ground. Fill the barrel with rich loam to the level of the first row of holes; then insert the strawberry plants, taking care that the roots are well secured. The row completed, fill up the barrel to the second row of holes, and set out another row of plants, and so on till the barrel is full. For watering and fertilizing, set into the top of the barrel an old tin can with a perforated bottom, filling the can with proper fertilizers. The barrel of plants can be kept irrigated by water enriched by passage through the can; or good results can be obtained by irrigating with soapy wash water without fertilizers. Fifty well nourished plants will furnish a family with many messes of berries, and three or four barrels covered with plants would be equal to a good sized strawberry bed. The plants should be set out in the fall, and might be covered for protection during the winter.

A modification of this plan is strongly recommended by the *Prairie Farmer*, Appletons' *Home Garden*, and other authorities, for growing melons, cucumbers, tomatoes, etc., in places where regular gardening is not practicable.

What is needed is a few barrels. Bore holes around the middle, and one hole large enough to admit the nose of your watering pot. Fill the barrels with stones as high as the rows of holes, and fill in with good, rich, fine earth to the top, in which plant cucumbers, melons, squashes, tomatoes, etc. One barrel will be enough for each kind. Be sure to have one large flat stone lean over the large hole where you will pour in water until it runs out of the holes you have made, and which will prevent the earth from filling this large hole up. Range the barrels around your yard and plant your seeds. Keep the barrels filled with water up to the holes, and you have all the requisites for rapid, healthy growth—air, heat, and moisture. You can raise all the vegetables you will need in the greatest perfection, and they will last until late in the autumn, as they can easily be covered on frosty nights. Cucumbers and tomatoes may hang over the barrels, cutting them off when they reach the bottom. Melons may be tied to the wall fence. The stones have an important service in holding up the earth, and in absorbing the heat during the day, which they give out at night, keeping the water at an even temperature. You will be astonished at the result, if you have never tried it.

Interesting Ring Trick.

Some years ago great stress was laid upon the ability of certain spiritual mediums, so-called, to pass upon the arm of another person an unbroken iron ring, the person's hands being clasped all the time by the medium's two hands. Mr. W. I. Bishop lately showed a gathering of scientific and literary people in London how it is done. He bandaged the eyes of Mr Sime, saying that it was for that gentleman the same as if the gas was turned out. He then caused Mr. Sime to place his hands together on his knees, brought his own hands from each shoulder of Mr. Sime to his hands, placed one of his hands on Sime's two, and said: "You feel now that both of my hands are touching yours." "Certainly," said Mr. Sime, "I feel both of your hands." Bishop had one hand perfectly free, and slipping it through an iron ring placed the free hand back. The ring was thus held on their joint arms, Mr. Sime having no idea that Mr. Bishop's right hand had left his for an instant. He said the illusion was perfect. So much can be done with a remarkably shrewd Scotchman in the dark while every one else is smiling at the simple process. Mr. Bishop then got Henry Labouchere to write five names and roll them up in pellets, *à la Foster.* After they had been written and placed by Mr. Labouchere in an envelope, Mr. Bishop came upon the platform and sat opposite him at a table. Mr. Labouchere was then requested to lay the pellets out on a table, and Mr. Bishop wrote out successively on a sheet of paper every name that had been folded up. Mr. Labouchere had watched every movement very keenly, but was entirely deceived. Mr. Bishop then showed that it was done by holding between his fingers a dummy pellet which he substituted for each of the five in turn, so that five should always appear on the table, while really one of the real pellets was in his hand to be read.

Influence of Minute Traces of Impurities on the Properties of Metals.

That alloys have often properties quite different from those of the component metals is a well known fact. But the remarkable effect of some impurities—they cannot be called alloys—on metals is not so familiar to most people. In a recent lecture by W. C. Roberts, before the Royal School of Mines, in London, the following interesting illustrations were given:

The presence of only one three-hundredth of one per cent of antimony in a mass of molten lead, the surface of which is exposed to the air, will cause it to be rapidly oxidized, while a similar mass of lead of equal surface, but free from the minute quantity of antimony, will be but slowly acted upon; and it has been shown that seven one-thousandths of one per cent of copper is detrimental to the lead employed in the manufacture of white lead.

The presence of one-twentieth of one per cent of lead or certain other metals in standard gold will render a bar an inch thick so brittle that it may readily be broken by a slight rap with a hammer. Less than one-half of one per cent of iron in metallic copper will reduce the electrical conductivity by about sixty per cent, while a far smaller quantity will render it quite unfit for manufacture into telegraph cables, or for other electrical purposes.

Dr. Fleitmann has recently shown that nickel, which breaks under the rolls, may be made perfectly malleable by the addition of a little over one-tenth of one per cent of magnesium. An ingot of a certain variety of steel containing no manganese will break into pieces at the first blow of the hammer, whereas a similar ingot containing eight one-hundredths of one per cent of that metal will forge readily.

Certain plates of Swedish puddled iron exhibited in the Paris Exhibition of 1878 were found to have a far higher resistance to fracture by impact than certain other plates compared with them; and yet analysis proved that the main difference between them lay in the fact that the good plates contained only two one-hundredths of one per cent of phosphorus, whereas the inferior plates contained one-tenth of one per cent more.

Carbon, it is well known, gives to iron fusibility, and renders it capable of being cast in moulds. The results of very many experiments appear to show that the presence of fifteen one-hundredths of one per cent of carbon converts iron into steel, rendering it capable of being slightly hardened; with more than one and a half per cent of carbon the metal ceases to be malleable, and it is known as cast iron.

The influence of carbon on the tensile strength of steel is very remarkable. Two samples under identically favorable conditions as to their amount of sulphur and phosphorus, but containing fifteen one-hundredths and eighteen one hundredths of one per cent of carbon, respectively, will differ by six tons per square inch in breaking strain, or by an increase in the latter case of twenty-seven per cent.

Nickel can be made malleable by the addition of three-tenths of one per cent of phosphorus. M. Nyst, of the Brussels mint, has lately found that the presence of fifteen one-hundredths of one per cent of silicon in standard gold will so affect its molecular groupings as to render it possible for a thin strip to bend by its own weight, as zinc would, in the flame of a candle.

Pin Manufacture.

The pins used in this country are made by fourteen factories, chiefly located in New England. Their annual production for several years past has been about 7,0 0,000 pins. This number has not varied much for some years, the demand remaining about the same. Two years ago the competition among the nine principal companies then existing for the manufacture of toilet pins led to such a cutting of prices that the business became unprofitable, and the market was flooded with goods. A year ago a combination was formed of three wire companies, and now all of the pins made by them are shipped to New York, and handled by the head agency of that city. From their common warehouse they are sent to every part of the country. The importations of English pins are small, and the exportation of pins from the United States is confined to Cuba, South America, and parts of Canada. England supplies almost the whole world outside of the United States, although the American pins are not inferior in quality. The raw material—the brass and iron wire from which all American pins are made—is from the wire mills of this country, and much of the machinery is of American invention and patent.—*North American Manufacturer.*

BEETLES AS A TEST OF WOOL.—A French entomologist asserts that the wool of different countries can be distinguished in market by the beetles which frequent the bales. He has identified 47 species in Australian wool; 52 in South African wool; 30 in South American wool; 16 in Spanish; and 6 in Russian wool.

LUBRICANTS.

In answer to a number of correspondents we publish the following:

The desirable features of a good lubricant or unguent may be briefly stated thus: It should, first of all, reduce friction to a minimum, should be perfectly neutral, and of uniform composition. It should not become gummy or otherwise altered by exposure to the air, should stand a high temperature without loss or decomposition, and a low temperature without solidifying or depositing solid matters. The question of cost and adaptability to the requirements of light or heavy bearings are also important considerations.

The finest lubricating oils in the market—those used for watch, clock, and similar delicate mechanism—are chiefly prepared from sperm oil by digesting it in trays, with clean lead shavings, for a week or more. Solid stearate of lead is formed, and remains adhering to the metal, while the oil becomes more fluid and less liable to change or thicken on chilling.

Sperm oil is used for lubricating sewing machines and other light machinery. Some of the oils sold for this purpose contain cotton seed oil and kerosene, and others are composed largely of mineral, sperm, or signal oil—a heavy, purified distillate of petroleum

Good heavy lubricating oil is made from heavy paraffine oil (a distillate of petroleum). Owing to "cracking" (decomposition of the vapors of the heavy distillate into lighter products), which takes place in the still, the crude oil contains a large per cent of light offensive oils, too thin for lubricating purposes. In Merril's process these are separated by blowing superheated steam through the oils, heated just short of its boiling point in the still, the lighter oils being driven off, a neutral, nearly odorless, heavy oil, gravity 29° B. to 26° B., and boiling at about 575° Fahr., remaining. When mixed with good lard oil it makes an excellent and cheap lubricant.

Common heavy shop and engine oils are commonly variable mixtures of heavy petroleum or paraffine oils, lard oil, whale or fish, palm, and sometimes cotton seed and resin oils. There are nearly as many of these composite oils in the market as there are dealers in such supplies. The following is one of them.

Petroleum	30 per cent.
Paraffine oil (crude)	20 "
Lard oil	20 "
Palm oil	9 "
Cotton seed oil	20 "
	99

Solid or semi-solid unguents, such as mill and axle grease, etc., are prepared from a variety of substances. The following are the compositions and methods of compounding a few of these:

Frazer's axle grease is composed of partially saponified rosin oil—that is, a rosin soap and rosin oil. In its preparation, one half gallon of No. 1, and two and one-half gallons of No. 4 rosin oil, are saponified with a solution of one-half pound of sal soda dissolved in three pints of water, and ten pounds of sifted lime. After standing for six hours or more, this is drawn off from the sediment and thoroughly mixed with one gallon of No. 1, three and one-half gallons of No. 2, and four and two-third gallons of No. 3 rosin oil. This rosin oil is obtained by the destructive distillation of common rosin, the products ranging from an extremely light to a heavy fluorescent oil or colophonic tar.

Pitt's car, mill, and axle grease is prepared as follows:

Black oil or petroleum residuum	40 gallons.
Animal grease	50 pounds.
Rosin, powdered	60 pounds.
Soda lye	2¼ gallons.
Salt, dissolved in a little water	5 pounds.

All but the lye are mixed together and heated to about 250° Fahr. The lye is then gradually stirred in, and in about twenty-four hours the compound is ready for use.

Hendricks' lubricant is prepared from whale or fish oil, white lead, and petroleum. The oil and white lead are, in about equal quantities, stirred and gradually heated to between 350° Fahr. and 400° Fahr., then mixed with a sufficient quantity of the petroleum to reduce the mixture to the proper gravity.

Munger's preparation consists of:

Petroleum	1 gallon.
Tallow	4 ounces.
Palm oil	4 "
Plumbago	6 "
Soda	1 ounce.

These are mixed and heated to 180° Fahr. for an hour or more, cooled, and after twenty-four hours, well stirred together.

A somewhat similar compound is prepared by Johnson as follows:

	Liquid.	Solid.
Petroleum (30° to 37° gravity)	1 gall.	1 gall.
Crude paraffine	1 oz.	2 oz.
Wax (myrtle, Japan, and gambier)	1½ oz.	7 oz.
Bicarbonate of soda	1 oz.	1 oz
Powdered graphite	3 to 5 oz.	8 oz.

Maguire uses, for hot neck grease:

Tallow	16 pounds
Fish	60 "
Soapstone	12 "
Plumbago	9 "
Saltpeter	2 "

The fish (whole) is steamed, macerated, and the jelly pressed through fine sieves for use with the other constituents.

Chard's preparation for heavy bearings consists of:

Petroleum (gravity 25°)	12 ounces.
Caoutchouc	2 "
Sulphur	2 "
Plumbago	4 "
Beeswax	4 "
Sal soda	2 "

This composition is stirred and heated to 140° Fahr. for about half an hour.

The following are a few of the compositions for lubricating that have been patented:

Petroleum residuum, alkali, ammonia, and saltpeter.
Graphite, oil, caoutchouc.
Asbestos and grease.
Lignumvitæ and spermaceti.
Ivory dust and spermaceti.
Tin and petroleum.
Zinc and caoutchouc.
Plastic bronze and caoutchouc.
Tallow, palm oil, salts of tartar, and boiling water.
Oil, lime, graphite, castor oil.
Shorts, soapstone, and castor oil.
Petroleum residuum, salt, caustic potash, sal ammoniac, spirit of turpentine, linseed oil, and sulphur.
Petroleum residuum and flour.
Petroleum residuum, lard, sulphur, and soapstone.
Mixed heavy and light petroleum.
Oil, wax, caoutchouc, rosin, and potash.
Petroleum residuum, sal soda, sulphur, and kerosene.
Glycerine, graphite, asbestos, kaolin, manganese, soapstone, sulphide of lead, carbonate of lead, and cork.
Saponified resin, wheat flour, petroleum, animal fat, and soda.
Type metal and caoutchouc.
Anthracite coal and tallow.
Tin oxide and beeswax.
Soapstone, magnesia, lime, and oil.
Sulphur and petroleum.
Vulcanized caoutchouc, petroleum, and tallow.
Paraffine oil and milk of lime.
Asbestos and tallow.
Spermaceti and India-rubber.
Tallow, petroleum, soda, and hair.
Mercury, bismuth, and antimony.
Petroleum, sal soda, lime, tallow, lard, salt, pine tar, turpentine, camphor, and alcohol.
Sulphur, plumbago, mica, tallow, and oil.
Palm oil, paraffine, tallow, alkali, and asbestos.
Tallow, oil, paraffine, and lime water.
Flax seed oil, cotton seed oil, tallow, and lime water.
Petroleum, tallow, beeswax, soda, and glauber salt.
Animal oil, croton oil, spermaceti, tallow, soda, potash, glycerine, and ammonia.
Sheets of paper or woven fabrics impregnated with graphite, steatite, paraffine, tallow, size, and soluble gums.

Tissue Negatives from Gelatine Plates.

BY WILFRED BAILEY.

The method of removing the films from collodion plates by means of a coating of transfer collodion, and subsequently either remounting them upon the glass in a reversed position to be utilized in processes requiring "reversed negatives," or preserving them as "tissue" negatives, in which form they may be printed from either side, will probably be familiar to most readers of the *News*. I am not aware, however, that any method has been made known for the application of the process to gelatine plates, which present somewhat more difficulty, so a few particulars of the treatment which I have found successful may not be unacceptable.

The collodion is prepared from one of the usual formulæ for the purpose, as follows: Ether, 5 ounces; alcohol, 0·805, 10 ounces; castor oil, ¼ ounce; pyroxyline, ¼ ounce.

The gelatine negative (in a dry, and, of course, unvarnished condition) is flowed liberally with the collodion, leveled, and allowed to dry. The film is then cut through to the glass at a short distance from the edges, and the plate left to soak in water for some twenty-four hours, after which it will be found that the film may be lifted by a corner, and easily detached from the glass. It may then be reversed, and laid upon the glass under water in a similar manner to that adopted with carbon tissue, the superfluous water being afterward gently pressed out, care being taken not to injure the gelatine surface, which is somewhat tender at this stage. The plate should then be allowed to dry (not too quickly, or the film will have a tendency to peel off the glass). If only a reversed negative is wanted it is now ready for use; but if a tissue negative is desired, the plate should again be flowed as before with the collodion, dried, cut round, either at the edges where previously cut, or to any size and shape desired, and then soaked in water until it can be easily removed from the glass, which will be the case in a few minutes. The film may then be dried in blotting paper, and preserved between the leaves of a book (one interleaved with tissue paper will be found convenient for the purpose).

To print, the film may be laid upon a piece of glass in the printing frame, and will be found to lie flat without difficulty in a dry state; but, if desired, it may be mounted as before with the aid of water and dried. In the latter case it will be generally found necessary to soak the plate a few minutes in water when the film is to be removed from the glass. In all stages of the process where soaking in water is required, be careful to continue it long enough, as if any adhesion exists between the film and the glass, damage to the former will ensue on attempting to remove it.

I was led to employ this method chiefly for the purpose of printing my negatives by the single transfer carbon process, which I consider the best and most convenient (for an amateur especially) that exists, but I find also great advantage in the small space occupied by the tissue negatives, and their portability. The tissue is very tough, and cannot easily be torn (unless a cut or tear has begun at the edges, in which case great care is requisite). The second coating of collodion acts as a protection to the inclosed gelatine film, and adds substance to the tissue, while it prevents the "cockling-up" which the sensitiveness of the gelatine to moisture causes if it is attempted to use the film as a tissue on its first removal from the glass, without a second application of the collodion as directed. Of course the same treatment may be applied to transparent positives, and might be useful for other purposes.—*Photographic News.*

The Treatment of Sea Sickness.

The *Tribune* has been making inquiries among prominent physicians touching the cause and cure of sea sickness:

"What advice in regard to sea-sickness would you give a patient going to sea?" was asked of Dr. Alonzo Clark.

"I should tell him to take a wash basin into his stateroom," responded Dr. Clark, cheerfully.

"Then there is no remedy?"

"One remedy, yes—to stay ashore." Dr. Clark continued: "I think people will be sea-sick until the millennium comes. The disorder is in a way a puzzle to doctors. It is caused by a disordered action in the brain and nervous system, and the stomach feels it as a part supplied with nerves. There is no perceptible change in the nerve tissue, but a nerve disturbance, and probably all the brain is affected. It is unaccountable that the practice of going to sea cures the disorder, although this may be owing to a circulatory accommodation. I have never made use of the various remedies suggested. Sea-sickness is modified by a low diet, and if health is much depressed the patient should keep his bed. Food should be taken as constantly as possible, and the best form is soup with toasted crackers. Any alcoholic drink will soothe some stomachs. The supposed benefit to be derived from sea-sickness amounts to very little, except, perhaps, in the case of large feeders. Of course, land sickness, caused by riding backward and in railway cars, is practically the same as sea-sickness. An instance has been lately related of a woman cured by wearing a sheet of paper over her chest, which illustrates the power of faith."

Dr. George M. Beard said: "A year ago there was no disease of which so little was known and which was so incurable as sea-sickness; now there is no disease of which so much is known and which is so perfectly curable. It is a functional disease of the central nervous system, mainly of the brain, but sometimes also of the spinal cord, and comes from purely mechanical and physical causes, being the result of a series of mild concussions. No more benefit can be derived from it than from an attack of typhoid fever. Infancy and old age are least affected by it, and it is most frequent and severe with the nervous and sensitive. In some cases there is simply congestion of the brain. The chief symptoms are headache, backache, nausea, vomiting, pain in the eyes, mental depression, neuralgic pains, sleeplessness, and nervous exhaustion. Dr. F. D. Lente, of Florida, first suggested the use of bromide of potassium as a preventive of sea-sickness in voyages between the North and South, and it was used with good results. This had also been recommended by Dr. Barker, who carefully studied the subject. My experience had led to my developing this treatment for long voyages and suggesting bromide of sodium in large doses instead of bromide of potassium. The former is less irritating to the stomach and contains more bromine than the latter, but when not procurable bromide of potassium may be used. The patient should take thirty, sixty, or ninety grain doses of bromide of sodium three times a day a few days before embarking and keep it up at sea until the danger seems to be past. The result aimed at is a mild bromization of the central nervous system, rendering it less susceptible to the disturbances caused by the movements of the ship. There is a great difference in people about the effect, and the great point is to know when to stop taking it, avoiding an excess, and not to take too little. A few people have an idiosyncrasy against bromide, but there is little or no danger from its use if patients will carefully watch for the sleepiness and indisposition for exercise which are the symptoms of mild bromization. I have known of but one failure from the proper use of bromides, and I have here several letters from persons who have crossed safely by their use, although always sick before. Of course the drug should be taken intelligently and under competent directions, as there is a great difference in different people, and every case ought to be studied separately so far as possible."

"What is sea sickness?" was asked of Dr. William A. Hammond.

"Well, I should call it a disorder of the nervous system."

"Is there any remedy?"

"I can't lay down rules for other people, but I can tell what I have found beneficial in my own case, and that is ten or fifteen drops of chloroform on lump sugar, and the use of bromide of potassium."

CHEMICAL PARADOXES.

We are accustomed to associate the idea of combustibility with paper. If it be wrapped tightly around a metallic rod it can be held in a gas flame without burning. The metal carries the heat away from it as fast as applied, becoming hot itself. After a while it will reach a temperature, provided the flame is large enough, at which the paper will burn.

This same phenomenon can be more strikingly exhibited by making a vessel of paper, filling it with water, and applying heat. No matter how hot the flame over which it is placed may be, it will not burn. The water will boil, and the heat be absorbed, or rendered latent, in the production of steam. An egg can thus be boiled in a paper saucepan—quite in the Easter vein if we were a little earlier in the season.

A sieve may be made to hold water or to float. If the interstices are very fine and the wire bright and dry, the water will not wet it, because a film of air will adhere to the wires. The lower surface of the water is divided by the meshes into a number of little spheroidal projections, in which the capillary force or internal gravitation and also cohesion come into play. These hold the water together so that some considerable power is required to force the water through the meshes. Thus we can put quite a quantity of water in a fine sieve, or place one in water and it will float. If the wires are not perfectly bright we may distribute over their surface some powder which water will not wet. The dust of bituminous coal is excellent. Carrying out this principle, needles, if bright, may be made to float without the least trouble, and will float for a long time.

Water is to be made to boil by cold. A flask half full of water is maintained at ebullition for some minutes. It is removed from the source of heat, corked, inverted, and placed in one of the rings of a retort stand. If cold water is poured on the upturned bottom of the flask the fluid will start into violent ebullition. The upper portion of the flask is filled with steam which maintains a certain pressure on the water. By cooling the upper portion of the flask some of this is condensed, and the pressure reduced. The temperature at which water boils varies with the pressure. When it is reduced water boils at a lower heat. By pouring the cold water over the flask we condense the steam so that the water is hot enough to boil at the reduced pressure. To assert that water boils by the application of cold is a chemical sophism.

It seems paradoxical to see a genuine metal melt in boiling water. It is a general rule that alloys melt at a lower temperature than any of their components. By making an alloy of cadmium, bismuth, lead, and tin, in proper proportions, we form a compound that will melt far below the boiling point of water, or about 160° F. Yet the melting point of tin, the most fusible of the four, is over 450° F. A good way to exhibit this is to make teaspoons or punch ladles of it so that they will melt in the hot fluid. It would be an illustration of the old proverb, "There is many a slip 'twixt the cup and the lip."

Double decompositions are responsible for many of our titular experiments. By mixing solutions of ferric oxide and potassic ferrocyanide we obtain Prussian blue. The solutions may be so dilute as to be colorless. So two colorless solutions produce a colored one, the suspended precipitate coloring the mixture. So may chrome yellow, or lead chromate, and mercuric iodide, and hundreds of other reactions be made to repeat this phenomenon. The acid radicals in these cases change places with each other. By proper succession very pretty effects may be produced. Thus five colorless solutions may be made to produce a colorless, a red, a colorless, a white, and a black mixture, all that is necessary being to pour from the first vessel into the next, the second into the third, and so on. Numberless other combinations can be made.

To make two colored solutions produce a colorless one we may avail ourselves of the power possessed by nitric acid of bleaching indigo. Two solutions of indigo are made; one contains a good quantity of sulphuric and hydrochloric acids, the other contains potassic or sodic nitrate. On pouring them together and warming a colorless solution results, as the sulphuric acid sets free nitric acid and chlorine, which destroys the indigo.

Two liquids are to produce a solid. This is another double decomposition. Saturated solutions of calcic chloride and potassic carbonate are poured together, when a very heavy precipitate of calcic carbonate or chalk is thrown down. At the present time this seems rather a weak affair, but in its day it was called a chemical miracle. It is for this reason that I show it to you. It is historic.

Two gases may produce a solid. This is effected by a simple combination. Ammoniacal gas and hydrochloric acid gas are both absolutely gaseous at ordinary temperature and pressure. If brought together they combine, forming a white solid substance called ammonic chloride or sal ammoniac. It is the substance used by tinsmiths to brighten the faces of their soldering bolts before tinning them.

If we immerse the bulbs of two thermometers, one in quicklime and the other in ammonic nitrate, and add water to each, contrary effects are produced. The quicklime has a strong affinity for water, and combines with it eagerly with evolution of much heat. The nitrate of ammonia, on the other hand, without much affinity for water, is very soluble, so it dissolves quickly, and in its passage from the solid to the liquid state renders latent or absorbs a great quantity of heat, causing a fall in the temperature, if rightly managed, of forty degrees. It is a very instructive experiment. To make it really impressive the water should be added from the same flask, so that there can be no fear that water of different temperatures is made to effect the result.

We now come to some phenomena of combustion. As we generally see it, it takes place in the air, which supplies the oxygen. But we can substitute for the oxygen of the air that of a highly oxidized salt such as potassic chlorate. If we mix this with sulphur, which is very combustible, and rub the two in a mortar we get a series of quite violent detonations. By the use of phosphorus instead of sulphur we have a still more violent explosive, which has to be handled with more care. The products of these reactions are primarily sulphurous and sulphuric and phosphoric oxides.

If we mix this same chlorate of potash with a proper proportion of sugar we have a mixture that the touch of a match will ignite and burn with great splendor. The carbon of the sugar unites with the oxygen of the salt. But it is quite unnecessary to use fire to start it. A drop of oil of vitriol or sulphuric acid will start the reaction, so that the deflagration will take place by decomposing the chlorate. Thus we have a solid set on fire by contact with a liquid.

We have already used phosphorus in an experiment which showed its great affinity for oxygen. By boiling it with a strong solution of potassic hydrate a mixed phosphureted hydrogen is set free which is spontaneously combustible. In practice it is made to bubble through water, and each bubble as it bursts produces a flash and spontaneous combustion. In oxygen the explosive is very violent. This gas has a special interest, as the *ignis fatuus* has been explained by it—whether truthfully or not is not certain. It is one of the most beautiful exhibitions of spontaneous combustion in all chemistry. It is susceptible of many modifications.

As a finale I propose to exhibit to you fire under water. We select as two suitable substances phosphorus and chlorate of potash. These are placed in the bottom of a flask and water poured over them. To start and maintain the combustion we add sulphuric acid. A highly oxidizing compound is formed, and the phosphorus begins oxidizing or burning with a bright light. To make it more beautiful we can add phosphide of calcium, when, in addition to the white glow of the phosphorus, we have an elegant emerald green glow added to our fire under water. It is not a safe experiment by any means, as there is danger of breaking the vessel by the violent heat caused by the reaction. S.

FIREWORK FORMULÆ.

COLORED LIGHTS.

These fires serve to illuminate, hence intensity of light with as little smoke as possible is aimed at. In the preparation of such mixtures the ingredients, which should be perfectly dry, must be reduced *separately*, by grinding in mortar or otherwise to very fine powders, and then thoroughly but carefully mixed together on sheets of paper with the hands or by means of cardboard or horn spatulas.

The mixtures are best packed in capsules or tubes about one inch in diameter and from six to twelve inches long, made of stiff writing paper. Greater regularity in burning is secured by moistening the mixtures with a little whisky and packing them firmly down in the cases by means of a wooden cylinder, then drying. To facilitate ignition a small quantity of a powder composed of mealed powder 16 parts, niter 2, sulphur and charcoal each 1, loosely twisted in thin paper, is inserted in the top. The tubes are best tied to sticks fastened in the ground.

WHITE LIGHTS.

Saltpeter	4 ounces.
Sulphur	1 ounce.
Black sulphide of antimony	1 "

YELLOW LIGHTS.

I.

Chlorate of potash	4 ounces.
Sulphide of antimony	2 "
Sulphur	2 "
Oxalate of soda	1 ounce.

II.

Saltpeter	140 ounces.
Sulphur	45 "
Oxalate of soda	30 "
Lampblack	1 ounce.

GREEN LIGHTS.

I.

Chlorate of baryta	2 ounces.
Nitrate of baryta	3 "
Sulphur	1 ounce.

II.

Chlorate of potash	20 ounces.
Nitrate of baryta	21 "
Sulphur	11 "

RED LIGHTS.

Nitrate of strontia	25 ounces.
Chlorate of potash	15 "
Sulphur	13 "
Black sulphide of antimony	4 "
Mastic	1 ounce.

PINK LIGHTS.

Chlorate of potash	12 ounces.
Saltpeter	5 "
Milk sugar	4 "
Lycopodium	1 ounce.
Oxalate of strontia	1 "

BLUE LIGHTS.

Chlorate of potash	3 ounces.
Sulphur	1 ounce.
Ammonio-sulphate of copper	1 "

For colored fires, where the mixtures are ignited in shallow pans and maintained by additions of the powders, the compositions are somewhat different.

WHITE FIRE.

Niter	16 ounces.
Mealed powder	4 "
Sulphur	8 "

YELLOW FIRE.

Niter	2 ounces.
Sulphur	4 "
Nitrate of soda	20 "
Lampblack	1 ounce.

RED FIRE.

Niter	5 ounces.
Sulphur	6 "
Nitrate of strontia	20 "
Lampblack	1 ounce.

BLUE FIRE.

Niter	8 ounces.
Sulphur	2 "
Sulphate of copper	4 "

GREEN FIRE.

Niter	24 ounces.
Sulphur	16 "
Nitrate of baryta	48 "
Lampblack	1 ounce.

BENGAL FIRE.

Sulphur	4 ounces.
Mealed powder	4 "
Antimony	2 "
Lampblack	16 "

COLORED STARS FOR ROCKETS.

	White.	Yellow.	Red.	Blue.	Green.	5 points.
Niter	16	—	—	—	—	—
Sulphur	8	1	—	—	2	7
Mealed powder	4	—	—	—	—	10
Charcoal	—	1	—	—	—	—
Nitrate of soda	—	6	—	—	—	—
Chlorate of potash	—	—	5	8	3	—
Nitrate of strontia	—	—	20	—	—	—
Gum dammar	—	—	4	4	—	—
Sulphate of copper	—	—	—	4	—	—
Nitrate of baryta	—	—	—	—	6	—

The materials are separately reduced to fine powders, mixed with the hands, moistened with whisky containing a little gum, moulded into small lumps, and dried. A small quantity of the following composition placed beneath the ball serves to throw it out of the tube:

Niter	3 ounces.
Sulphur	1 ounce.
Mealed powder	8 ounces.
Charcoal	3 "

The tubes are usually made by winding and pasting over a half inch mandrel a dozen turns or more of heavy straw paper. One end of the tube is plugged with clay or clay and plaster, and the other primed with a quick match as described under colored lights.

"Flower pots" and "fountains" are usually made in a similar manner, only the diameter and capacity of the tubes are greater. These tubes should be made of metal.

ROCKET COMPOSITION.

Niter	26 ounces.
Sulphur	5½ "
Charcoal	19 "

The head of the rocket is usually charged with a number of vari-colored stars similar to those used in Roman candles.

Lances are small paper cases, two to four inches in diameter, filled with composition, and are used to mark the outlines of figures. They are attached endwise to light wooden frames or sticks of bamboo and connected by streamers or quick match. The following are some of the compositions used in these:

	White.	Yellow.	Red.	Blue.	Green.
Niter	96	—	16	8	96
Sulphur	9	4	10	2	64
Mealed powder	5	4	7½	—	—
Nitrate of soda	—	16	—	—	—
Lampblack	—	2	-	—	8
Nitrate of strontia	—	—	30	—	—
Sulphate of copper	—	—	—	4	—
Nitrate of baryta	—	—	—	—	192

Sun cases are cases made like rocket tubes and filled with the following composition:

Niter	1 ounce.
Sulphur	1 "
Mealed powder	16 ounces.
Charcoal	4 "

They are attached to wooden frames to give long rays of sparkling light.

COMPOSITIONS FOR PIN-WHEELS, ETC.

	Common.	Brilliant.	Chinese.	White.
Niter	6	1	1	6
Sulphur	1	1	1	7
Mealed powder	16	16	7	16
Charcoal	6	—	—	—
Steel filings	—	7	—	—
Cast iron filings	—	—	7	—

Streamers or quick matches, used for communicating fire quickly from one tube to another in display pieces, are composed of the following composition packed in slender continuous paper tubes:

Niter	2 ounces.
Sulphur	1 ounce.
Mealed powder	16 ounces.
Charcoal	4 "

The mixture for golden rain is composed of:

Niter	16 ounces.
Sulphur	11 "
Mealed powder	4 "
Lampblack	3 "
Flowers of zinc	1 ounce.
Gum arabic	1 "

All the materials used in fireworks must be in the state of fine powders and perfectly dry.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) M. T. asks (1) how liquid gold is made such as is now sold in the picture frame stores. It is put up in small bottles at a high price. It is evidently gold powder in naphtha with some light varnish, enough to hold it. Would like to make it for large use. A. Send a sample of the "liquid gold" referred to. 2. Sulphuric acid has been recommended for bleaching bristles. Would like to know the process—with the usual process of sulphur fumes or without it? A. Sulphuric acid is boiled together with half its weight of sulphur in large stoneware retorts, and the sulphurous anhydride given off is passed into cold water which absorbs it. When nearly saturated with the gas this liquid sulphurous acid is used for bleaching.

(2) J. W. C. asks: What process will I have to use in order to keep the curl in false hair from being affected by perspiration or weather? A. Flaxseed water is commonly used.

(3) W. T. asks: What is the best solution for making cotton duck for awnings mildew-proof? A. Saturate the cloth in a hot solution of soap (a quarter of a pound to the gallon of water); wring out and digest it for twelve hours or more in a solution of half a pound alum to the gallon of water.

(4) P. & E. ask how to convert rancid butter into a sweet pure article fit for table use. A. 100 lb. of the butter is mixed with about 30 gallons of hot water containing ½ lb. of bicarbonate of soda and 15 lb. of fine granular animal charcoal, free from dust, and the mixture is churned together for half an hour or so. The butter is then separated; after standing, warmed and strained through a linen cloth, then resalted, colored, and worked up with about half its weight of fresh butter.

(5) W. J. asks: What is the best and cheapest way to make liquid laundry bluing? 1. A. Dissolve indigo sulphate paste in cold water and filter. 2. Dissolve good cotton blue (aniline blue 6 B) in cold water. 3. Dissolve fine Prussian or Berlin blue with one-eighth part of oxalic acid in water; or use ferrocyanide of potassium (one-twelfth part) in place of oxalic acid.

(6) B. W. G. asks: What is the best gum composition for emery wheels? Are there any works that treat on the manufacture of emery wheels? A. Vulcanized caoutchouc is one of the best binding materials; glue, shellac, vitrified borax, water-glass, and zinc oxide, litharge and glycerine, and vulcanized mixtures of gutta percha, bitumen, and oil, etc., have also been employed with some success. We know of no book giving much information on the subject. Consult "Knight's American Mechanical Dictionary."

(7) C. S. W. S. writes: Wrinkles have formed over the whole surface of my diploma (parchment). How can I remove without injury to that which is written and printed thereon? A. Place the paper face downward upon a clean piece of blotting paper. Beat up to a clear froth, with a few drops of clove oil, the whites of several fresh eggs, and with the fingers spread this over the back of the sheet and rub it in until the parchment becomes uniformly soft and yielding. Then spread it out as smoothly as possible, cover it with a piece of oiled silk; put on it a piece of smooth board, and set it aside in a cool place, with a weight on the board, for twenty-four hours. Then remove the board and silk, cover with a piece of clean fine linen cloth, and press with a hot smoothing iron (not too hot) until all signs of wrinkles have disappeared. The heat renders the albumen insoluble and not liable to change.

(8) R. H. S. asks how to bronze iron castings (by dipping). A. Clean the castings by pickling them in sulphuric acid diluted with about 10 parts of water, and scouring with sand; then dip them momentarily into a solution of 3 oz. of sulphate of copper and 5 oz. sulphuric acid in a gallon of water. Rinse in cold water immediately after dipping, and dry in sawdust. See copper plating and brass plating, pp. 33 and 3, vol. xliv.

(9) C. E. asks if there is any other way to melt glue than by first soaking it in water? A. Glue can be dissolved in acetic and in dilute nitric acids, but these solutions are not applicable for ordinary gluing. Glue can be dissolved directly in hot water, but it requires some time to obtain a solution free from lumps, so that it is preferable to soften the glue first in cold water. 2. Is there a way to bleach glue, that is, to make dark glue of a lighter shade? A. Glue may be bleached to a considerable extent by means of sulphite of soda or sulphurous acid and alum. If the color is due to carbonaceous matter, as is sometimes the case, it cannot be bleached.

(10) J. M. D. writes: I have some old zinc from Smee cells, which I would like to melt and cast into zincs for gravity cells. Can you tell me of some simple method of melting so as to save the mercury with which they are covered? A. The only practical way is to distill off the mercury by heating the zinc scrap in a retort. An iron retort is usually employed, but the following simple substitute can be made to answer: Select a large clay flower pot and tray (of the same material) free from cracks or holes. Rub uniformly over the inside bicarbonate of soda (baking soda) made into a thick paste with a little molasses, then put it into the oven and let it get thoroughly hot. Fill the pot with the zinc, broken into small pieces, invert the tray over it, as a cover, and then turn the pot bottom upward and fill in between the rim of the pot and tray with a stiff luting of clay moistened with a strong solution of sal soda. A short bent iron tube is then luted into the hole in the bottom (top) of the pot, and when the luting has dried the pot is gradually heated by immersing it in hot charcoal or otherwise, the open end of the delivery pipe dipping just below the surface of a dish of water, at the bottom of which the distilled mercury collects. The mercury all distills over below a red heat; any portion of it that lodges in the delivery pipe can be washed down after the pipe has cooled.

(11) H. S. asks for a recipe for a deep navy blue dye. A. See wool dyeing, in SUPPLEMENTS, Nos. 55, 74, 75, 76.

(12) W. E. asks for the best method of extracting tan from hemlock so as to get the essence for exportation. A. The crushed bark is put into upright copper cylinders called extractors, with removable brass bottoms, and submitted to the action of boiling water and steam. The liquid is then drawn off and passed into the next cylinder in the series, and so on to the last; there are usually three or more working "in battery." The partly exhausted bark is then treated once or twice again with fresh hot water, and is finally dropped out by opening the bottom of the extractor and fresh bark put in its place. The liquid is concentrated by boiling it down in a copper vacuum pan or in a series of vacuum pans.

(13) W. D. H. asks: With what preparation can drawing paper be covered, without discoloration, so that I can paint on some portions of the sheet with oil colors without having the oil spread or sink? A. Dissolve a quarter of an ounce of fine, clear gelatine in 6 oz. hot water, strain, and apply to the paper, and let it get dry before painting.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

M. M.—The quartzose rock contains much sulphide and carbonate of copper and is quite rich in silver. An assay would be requisite to determine its value.—M. W. C.—It is coal.—W. C. R.—Quartz crystals—no value.—W. A. M.—It is an ore of copper—a mixture of copper sulphide and carbonate, with some iron and probably a little silver. A fire assay would be requisite to determine the presence or absence of the latter.—S. L.—It is galena—sulphide of lead—the principal ore of lead.—W. S.—A silicious clay containing a large quantity of iron oxide (which imparts the color) and probably a little mercury—worth an assay. Such ferruginous clays, when properly ground, bolted, and (lightly) calcined, make good cheap paints.—S. H. H.—An analysis would be necessary to determine the value of your ore. It appears to be of good quality and worth working.—R. C.—Chiefly clay and carbonate of lime, with a little lead carbonate and quartz—sand.—J. S. D.—An argentiferous galena containing a little antimony.—J. R.—The phosphorescent powder does not compare favorably with that of the French manufacturers. It contains a slight excess of sulphur and moisture. Try drying it thoroughly and mixing it, while hot, with a small quantity of anhydrous lime soap. See late numbers of the SCIENTIFIC AMERICAN for formulæ and notes on this subject.—J. G. B.—An alloy consisting chiefly of antimony with a small percentage of lead. Not native.—B. G. N.—1. Argillaceous lime rock veined with quartz; 2. Ferruginous quartz rock; 3. Conglomerate; 4. Flint; 5, 6, 7, 9, 10, and 12, quartz pebbles; 8 and 11, rose quartz pebbles.—A. F. C.—A fine silicious clay—it might be useful to porcelain manufacturers.—J. M. P.—The clay is very impure, contains a large per cent of silica, and is not valuable for porcelain making.—S. E. M.—The batting is sized with an aqueous solution (hot) of British gum and soap appropriately colored with a little logwood and chrome.

COMMUNICATION RECEIVED.

On the quantity of solar heat. By C. F.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

June 14, 1881.

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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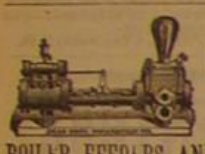

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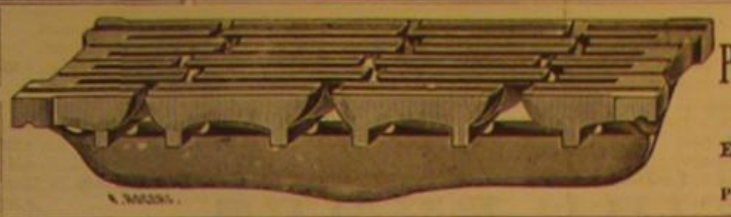

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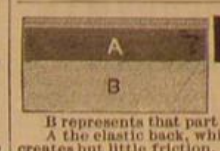

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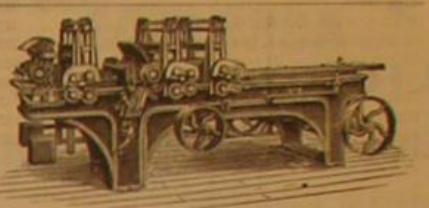

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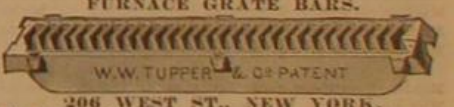

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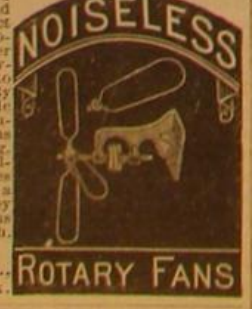

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UNION ARCH, WASHINGTON AQUEDUCT.

In its latest edition the American Cyclopædia states, under the head of masonry bridges, that there are comparatively few of any great size in the United States, and instances as perhaps the finest example the High Bridge of the Croton Aqueduct, over the Harlem River, with its eight arches of 80 feet span, and five others of 50 feet span. Probably the majority of well-informed Americans would accept the statement as correct, and few, even among engineers, would hear without some surprise, that by far the largest masonry arch in the world is in this country, and that it forms a part of one of the most important engineering achievements that have been accomplished during recent years—namely, the aqueduct by which the City of Washington is supplied with water.

Unfortunately for its own fame, this work was completed during the most exciting period of the civil war, when the security of the national capital against the assaults of the Confederate army was a matter of infinitely greater popular interest than any improvement of its water supply. Possibly, too, the inadvisability of calling the attention of the enemy to a work of such importance to the beleaguered city may have had something to do with the singular absence of information with regard to it in the popular prints of the time and in later publications. At any rate one will have to search a long time to find more than a casual mention of the work, where one would expect to find the fullest description of it. The splendid masonry arch shown in the accompanying engraving carries the aqueduct over the Cabin John Creek, with a span of 220 feet. The height of the arch is 101 feet, and the width of the structure 20 feet. The arch forms an arc of a circle, having a radius of 134·2852 feet. When the center scaffolding was removed, the arch (unlike all other works of the kind) did not settle, the keystone having been set in winter, and the center struck in summer.

Two other remarkable structures are included in or form a part of the Washington Aqueduct. From the distributing reservoir the water is conveyed in two thirty-inch pipes. There were two streams to be crossed, College Branch and Rock Creek. Instead of building bridges and laying the pipes on them, the pipes themselves were in each instance cast in the form of an arch and constitute the bridge. The Rock Creek bridge has a span of 200 feet, with two forty-eight-inch pipes; the College Branch bridge has a span of 120 feet, with two thirty-inch pipes. The arch over Rock Creek is so strong that it is used for a roadway, continuing Pennsylvania avenue to Georgetown.

The other notable masonry arches of the world are the Chester arch across the river Dee, at Chester, England, with a span of 200 feet; the famous center arch of the new London Bridge over the Thames, with a span of 152 feet; Pont-y-Prydd, over the Taff, in Wales, 140 feet; the bridge across the Seine, at Neuilly, France, with five spans each of 128 feet; the nine spans of Waterloo Bridge, London, each 120 feet; and the celebrated marble Rialto bridge in Venice, with a span of 98½ feet.

Washington Aqueduct was begun in 1853, and finished in 1863. The engineer in charge of the work was Gen. Montgomery C. Meigs.

The Japanese Fan as an Audiphone.

At a late meeting of the New York County Medical Society, Dr. Samuel Sexton read a paper on the use of the lacquered Japanese fan as an aid to hearing. The fan is constructed on the same principle as the audiphone, being composed of lacquered material that receives any ornamentation that may be desired. Its cost is from 25 cents to $1, whereas, when first presented to the public, the audiphone was a high-priced article, ranging from $5 to $25. By using the model of the human skull Dr. Sexton showed how the sounds of the human voice were transmitted to the auditory nerve, and illustrated how the instrument assisted the defective sense of hearing. He had brought a couple of deaf-mute subjects, by means of whom he gave some illustrations of the advantage of the instrument, which proved very satisfactory to the audience. The best distance for conversation was about three feet. When the distance was less the voice was too loud, and when greater it was indistinctly heard.

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Scientific American.

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SEPARATION OF THE COMET.

As Professors Stone and Wilson of the Cincinnati Observatory were watching the comet, on the night of July 6, it was seen to separate into two parts. The report of the observation says that a jet was seen to proceed from the nucleus in the direction of the tail, and gradually form a separate nucleus, the division being sharply defined.

This is not the first known splitting of a comet, Biela's comet having divided, probably in a similar manner, some time between 1845 and 1846; but this is the first time that the actual separation has been observed.

This spontaneous division of the comet into two comets gives peculiar interest to certain speculations as to the identity of the present comet and the possible fate of all comets.

In a communication to the *Herald*, dated July 1, Prof. Lewis Boss, of Dudley Observatory, Albany, N. Y., discusses the striking similarity of certain elements of this comet's orbit to the corresponding elements of the orbit of the comet of 1807. That the two comets are not the same body—that is, that the comet of 1881 is not a premature return of the comet of 1807—he is quite sure; but, he asks, could these bodies have originally formed a part of the same body?

For illustration he refers to the comet discovered by Biela in 1826, whose splitting has already been mentioned. This comet was found to revolve around the sun in the comparatively short period of seven years. It was not seen again, however, until 1845, when it presented its usual appearance.

On the 12th of January, 1846, Professor Hubbard, of the Washington Observatory, on looking at the comet through his telescope, was surprised to find not one, but two distinct comets in the same field of view. The distance between the two bodies was small, but went on increasing night after night, until in March the distance apart had become 200,000 miles. At its next return in 1852 this distance had become more than a million miles. What became of the comet in subsequent years can only be conjectured, for it has never since been seen, unless an observation of a strange body by Pogson, in Madras, is held to be authentic as a view of this comet of Biela—a matter about which opinions are divided.

Professor Boss continues: "What has happened once may happen again. It is known that great forces of mutual repulsion exist in the particles which constitute a comet. It is to this that we probably owe the varied appearances in the head of a comet as it approaches to or recedes from the sun. By able astronomers this force of repulsion is held to explain the existence of the gigantic tails which are seen projected from the heads of comets on the side opposite the sun.

It would seem possible that the two comets of 1807 and 1881 may have formed a single body in distant æons of time, and that at a certain period the original body separated into two, diverging more and more widely, until now we have them, the one following nearly but not quite in the wake of the other at an interval of about seventy-four years. It is a question well worth the close examination of astronomers. If the present comet should prove to have a period of from 1,100 to 2,200 years, the reasonableness of the above conjecture will be almost demonstrated."

The observed division of the comet now in sight gives peculiar significance to these suggestions. It also shows that the natural subdivision of a comet is no longer to be considered—as the splitting of Biela's comet has been—an astronomical anomaly. And the question arises: To what extent can this process of subdivision go? The hypothesis suggested by the behavior of Biela's comet, namely, that meteoric belts or streams may be due to cometary disintegration, certainly receives additional plausibility from this repetition of (so far as positive observations go) the primary act of division. With a few more splittings the comet might entirely cease to be visible.

FULMINATING COMPOUNDS.

In answer to a number of correspondents respecting fulminating compounds and mixtures, we give the following:

A fulminating composition is one that detonates by percussion or friction. There are a large number of substances, chemical compounds and mixtures, that come within the scope of this definition, but for various reasons only a few of these have found any practical application as primers. Nitro-glycerine, nitro-cellulose (gun cotton), and the chloride and iodide of nitrogen are fulminating compounds, though not usually classed with percussion mixtures; but their detonation takes place with extreme violence, and so quickly that in many cases they do not ignite gunpowder when detonated in contact with it. Chloride of nitrogen is so exceedingly sensitive to friction or percussion, that its preparation is rarely attempted. It can only be prepared and used safely in minute quantities. The following are some of the metallic fulminating compositions:

Fulminating Antimony: Tartar emetic (tartrate of antimony and potassium), 100 parts; charcoal, finely powdered, 3 parts.

The mixture is well triturated together and put into a crucible, capable of holding one-fourth more than the charge, and covered with a layer of charcoal. The cover is then luted on and the crucible exposed to a bright red heat for three hours, then covered with clay and allowed to stand for seven hours, after which the contents is carefully transferred to a wide-mouthed, glass-stoppered bottle, where, after a few hours, it crumbles into a powder. This powder contains much metallic potassium as well as finely divided antimony, and fulminates violently when brought into contact with water, or when moistened with a drop of that liquid.

Fulminating bismuth is prepared in a similar manner from bismuth, 120 parts; cream of tartar, 60 parts; niter, 1 part.

The tartar is heated until it begins to blacken before mixing. This compound is rich in potassium and fulminates violently.

Fulminating copper is prepared by digesting precipitated copper with fulminate of silver and a little water. It explodes by percussion with a great flame. Fulminating zinc is prepared from zinc filings in a similar manner.

Gold fulminate is formed by digesting the terchloride of gold in a slight excess of aqua ammonia. It is a brownish-yellow powder, and can be safely made only in very small quantities at a time, as it explodes with great violence on the slightest friction or sudden increase of heat.

Platinum fulminate is similar to the gold salt—it may be prepared by digesting platinum sulphate with ammonia.

There are several methods by which fulminating silver may be prepared. The following is one of the best:

Dissolve 1 part of silver in 10 parts of hot nitric acid (sp. gr. 1·37), and add the solution to 20 parts of alcohol of 85°. Gradually heat the mixed liquid to the boiling point, then set it aside to cool. The fulminate of silver deposits in lustrous white crystals. They are washed with a little cold distilled water and distributed upon separate pieces of filtering paper in portions not exceeding 2 grains, and left to dry in the air. This fulminate dissolves in 36 parts of boiling water, but the solution deposits the greater portion of it on cooling. It is exploded when dry with great violence by slight percussion or friction, or by contact with a drop of sulphuric acid. When wet it is not quite so explosive, but under any circumstances it can hardly be handled or kept with safety.

Fulminate of mercury, the material now almost universally employed for the priming of gun-cartridge caps. The most convenient way of preparing this substance is as follows:

Dissolve by aid of gentle heat 1 part of mercury in 10 parts of nitric acid (sp. gr. 1·40), and pour the solution at a temperature of about 131° F. into 8¾ parts of alcohol (density 0·83), contained in a capacious glass flask—at least six times larger than is necessary to contain the volume of liquid. A few minutes after there begins at the bottom of the flask a light disengagement of gas, the quantity increasing until a quick ebullition is produced. The inflammable white vapors given off are very poisonous, hence the operations are performed with the vessels in the draught of a chimney or out of doors. When the ebullition and disengagement of vapors have stopped, the contents of the flask are turned out upon a filter, and the precipitate is washed with pure cold water until the washings have no action upon litmus paper. The filter paper containing the washed fulminate is then spread out on a copper plate, and heated by hot water or steam to about 200° F. The dry fulminate is separated into portions of about 1¼ drachms, wrapped up in soft paper, and kept in large stoppered bottles. The powder, when properly prepared, is composed of small brownish-gray crystals.

It is decomposed with flame and explodes by a shock or when heated to 370° F. The largest crystals detonate most easily. When it is mixed with thirty per cent of water it may be ground on marble without danger of explosion.

POISONOUS REFRESHMENTS.

The need of especial care in the preparation of refreshments for picnic parties and the like has been shown with painful emphasis in several instances recently.

At Decatur, Georgia, thirty-five persons are reported to have been seriously poisoned, June 21, by a salad prepared in a brass kettle. All suffered seriously; but, thanks to prompt medical service, no lives were lost.

Less fortunate were a party of 500 or more who attended a picnic at Warrensburg, Missouri, July 4. The caterer provided lemonade, so called, in which some unwholesome acid was substituted for lemon juice. A press report—possibly exaggerated—dated the following day, said that eight drinkers of the spurious lemonade had died and a hundred more were in a critical condition.

Ice cream made in a copper-bottomed boiler is similarly charged with poisoning painfully two hundred persons, near Keota, Ill., on the 4th. Possibly indiscretion on the part of the cream eaters may have occasioned serious gastric trouble without any mischievous agency on the part of the alleged copper-bottomed boiler; and similar indiscretion may have occasioned the illness charged to poisoned salad in Georgia. Still it should be borne in mind that badly prepared refreshments are a too frequent attendant of popular merry-makings, and people cannot be too careful with respect to their eating and drinking on such occasions.

THE MANUFACTURE OF CELLULOID.*

Celluloid, a complex combination formed by mixing gun-cotton and camphor, is to-day well known, as it is an industrial product. It is being manufactured in France, at Stains, near Paris, whence it is sent out ready to be worked like wood, ivory, or tortoiseshell. It can be turned, sawed, moulded, polished, etc. We have, on a previous occasion, stated that it originated in America, having been invented by the brothers Hyatt, as long ago as 1869.

Much care is necessary in preparing it. A recent com-

**Revue Industrielle.*

munication made to the Société d'Encouragement gives us the following details in relation to the subject.

The manufacture embraces several important operations: (1) the manufacture of the nitro-cellulose or pyroxyline; (2) forming the mixture into slabs and then rolling them; (3) pressing and heating the rolled product in order to form blocks; (4) cutting the blocks into sheets of various thicknesses, according to the purpose for which they are to be used; and (5) heating the products.

The pyroxyline is obtained from cigarette paper of very good quality. This paper, in rolls 13 inches in width and 33 to 35 lb. in weight, is unrolled mechanically and immersed in a mixture of 5 parts of sulphuric acid of 66° with 2 parts of nitric acid of 42° B., kept at a temperature of about 35 degrees. The cellulose of the paper, after twelve or fifteen minutes' immersion, becomes changed into nitro-cellulose, which is soluble in a mixture of alcohol and ether. The solubility is tested by a hasty trial. The product is then removed from the acid bath, the liquid is expressed from it, and it is thrown into water. After a preliminary washing it is placed along with water in a pulp vat and triturated from two and a half to three hours in order to obtain a homogeneous paste. The pyroxyline then has to undergo bleaching, the operation being effected by the use of a solution of permanganate of potash. When contact with this reagent has been sufficiently prolonged, the excess of permanganate is eliminated by washing. Then the mass is treated with a solution of sulphurous acid in order to dissolve the oxide of manganese, and the operation is finished by a series of washings in water. The whitened pyroxyline is put into boxes lined with filtering cloths and then submitted to mechanical drying. On being taken from the hydro-extractor the material still retains about 40 per cent of water and is found to be in a state fit for the preparation of celluloid.

It is then passed through a mill having metallic runners, first alone, and afterwards mixed with the proper quantity of camphor (which has been first rolled), and with coloring matters if it be proposed to make opaque celluloid. After a dozen successive grindings, the mixture is moulded in a metal frame, by hydraulic pressure, so as to give slabs that are arranged and pressed between 10 to 12 sheets of thick bibulous paper. The water in the mixture is then gradually absorbed by the paper, the latter being renewed 12 to 15 times. The slabs thus dried and reduced to a thickness of about one-tenth of an inch are broken up between bronze cylinders armed with teeth. The pieces are allowed to macerate for about twelve hours with 25 to 35 per cent. of alcohol of 96°, and then the coloring matters soluble in alcohol are added if it be proposed to have transparent, colored celluloid. The mixture is then passed through the rolling mill, the cylinders of which are heated to about 50°.

The operations are performed upon from 20 to 28 lb. at once. The rolling takes from 25 to 35 minutes and terminates when the material has become homogeneous. There is then obtained a sheet of about half an inch in thickness, which is cut into pieces of 23½ by 31½ inches. The latter are superposed on the table of an hydraulic press in a metallic box having double sides and being tightly closed, and allowing the heating to be done by a circulation of hot water. The box is heated to 60° during the whole duration of compression, which lasts about four hours. At the end of the operation a current of cold water is passed into the box, the pressure is removed, and there is then obtained a very homogeneous block of celluloid about five inches thick. The blocks are then taken to the planing machine and shaved into sheets varying from 0·008 to 0·12 of an inch in thickness, according to the purpose for which the product is designed. These sheets are next placed in a ventilated stove, heated to 55°, where they remain for from eight days to three months, according to their nature and thickness.

In this description it has been only a question of celluloid of a uniform color, either transparent or opaque, imitating pale tortoise shell, coral, ebony, turquoise, etc. When it is desired to obtain a product to imitate amber, jade, spotted tortoise shell, etc., each of the ingredients of uniform color which is to compose the material is prepared separately, and then mixed to be afterwards united by pressure.

As the principal properties of celluloid are well known, we will not recall the numerous applications which may be made of it; but there is one, however, which has been pointed out by Colonel Goulier, that is of interest to engineers.

In passing from dryness to extreme humidity, celluloid elongates very little, and much less than the thin horn which is used in making the protractors that are occasionally employed in topography. There is every inducement, then, to make these instruments of celluloid, since they will prove less fragile than those made of horn, and more confidence can be placed in the scales and the angular divisions.

STEAM BOILER NOTES.

The dilemma with which the Philadelphia steam user is now struggling is becoming serious, while the situation occupied by the boiler inspectors is scarcely less grave and perplexing. The scare began with the Gaffney & Co. explosion, which occurred on the first day of June, 1881, and which was fully illustrated and explained in No. 2 of vol. xlv., of the SCIENTIFIC AMERICAN. It was discovered very suddenly, when this event took place, that cast iron was a dangerously treacherous material for boiler construction. This fact should have been in the possession of the designer, the maker, and the engineer, and more emphatically and above all others, the city and insurance inspectors, whose special business and duty it is to know, should have known whether or not this particular boiler was up to their standard of strength, namely, four or five times the stipulated load. And they not only should, but they do know, or have it on record, whether cast iron boiler heads of this diameter and thickness are in the habit of blowing out at the pressure stipulated in their certificates. If these inspectors now decline to pass all cast iron boiler heads at a desirable pressure they seem to stultify themselves. If they refer the matter to the city attorney, as is reported they have done, or to any other lay authority, their dilemma is complete, as they thereby acknowledge their ignorance of the whole subject. In the mean time the owners of similar boilers are in a state of mind not to be envied. If they decline to insure their boilers they take a risk that they now know less about than ever before. If they insure at the present pressure they seem to have little of the protection to their lives that is promised by insurance certificates, and they are, moreover, liable to suits at law if it can be shown that they have broken the contract. If they reduce their working pressure for the sake of insurance and safety, they will at once require additional boiler capacity, and not only that, but loss in working low steam in the engine will also follow.

The inspectors and the jury searched in vain for a defect in the broken head after rupture, when it should, if it existed, have been so plain that a runner could read it. In casting about for a plausible argument they charged the fireman with wetting the head with cold water from his quenching hose. They treated the gaping crowd at the wreck with stories of anomalous and exceptional cases of fractures that had been seen or heard of in their experience, all of which does not reassure either the owner or the workmen whose lives are daily exposed to such accidents.

Now it naturally occurs to the thoughtful practical engineer to inquire what has so suddenly brought about this state of things in a city justly noted for the number of its celebrated engineers and manufacturers. He remembers to have seen hundreds of such boilers, and he cannot believe that he has all the time been so near destruction as would now seem when in their vicinity. For forty years past cast iron, when not exposed to the direct action of fire or to a similar violence, has shown itself as reliable a structural material for boilers as for any other engineering device, and for that length of time 60 to 65 pounds of steam per square inch have been a common load for land boilers of this size. The common sense conclusion therefore is that more than the supposed load existed upon the Gaffney boiler head, or that the inspectors and experts are all deceived as to its soundness and dimensions.

The boiler in J. H. Richardson's mill, near Terrell, Texas, exploded June 20, killing two men outright and crippling four others.

An elevator boiler at Arkansas City, Ark., exploded June 6, killing John McCullough, the engineer, and seriously wounding Pat Boland, the fireman, and Amos Ramsey and Jacob Wallace, carpenters.

To all therefore a careful perusal of the report referred to above is earnestly recommended. It is a simple statement of stubborn facts, and the lesson will be obviously to take care of the safety valve and search for inevitable deterioration so that the supposed margin of safety may actually exist. Whether your boilers have cast iron heads or not these precautions are imperative.

CENTRIPETAL AND CENTRIFUGAL MOTIONS IN ANIMALS.

In a memoir published in the *Revue Scientifique*, last June, on "Writing Regarded from a Physiological Point of View," the author, M. Carl Vogt, after a lengthy discussion of centripetal writing (from right to left) and centrifugal (from left to right), drew the conclusion that the direction of the lines does not depend upon a physiological necessity, but only upon external conditions. Dr. G. Delaunay, who has for a long time been making researches on the same subject, has an article in a recent number of the same journal in which he endeavors to prove, on the contrary, that writing, as well as all motions and gestures in general, are dependent upon a physiological, and consequently an anatomical necessity.

The motions of quadrupeds can only take place horizontally or laterally; yet there are a few that perform centripetal movements—the cat, for example, which strikes with its paw by bringing the latter toward the axis of the body. Monkeys make centripetal motions mostly; but these animals hold a place between quadrupeds and man. Man alone is capable of making centrifugal motions. This physiological evolution of motions, which are successively vertical, then lateral and centripetal and then centrifugal in measure as we proceed from quadrupeds to the human species, is only the result of an anatomical evolution. According to Dr. Delaunay's researches, motions are rather centripetal than centrifugal in primitive or inferior races, and rather centrifugal than centripetal, in superior races. A centripetal motion in a primitive race becomes centrifugal in measure as that race evolutes. Sanskrit, Persian, and Greek were written from right to left before being written in the opposite direction. So our chronometers were wound up from right to left before they began to be wound in the other direction. The English, however, are behind the age in this respect, since in the screws manufactured by them the threads still run from right to left, and most of their watches, like those of our ancestors, are wound from right to left. On the other hand, the people of the United States, who are in great part transformed English, and who without doubt are more advanced in evolution than those of Europe, use watches only which are wound from left to right, and repudiate the old system still in use in England. Writing was centripetal among the ancient inferior races and is still so among those of modern times: Semitic, Phenician, Hebrew, Assyrian, Arabic, Chinese, Japanese, Negro, etc. Among the superior races not only is writing executed from left to right, but plans, sketches, shading, etc., are begun in the same manner. A circle is always drawn centrifugally, that is, in the direction of the hands of a watch. In our designs and on our monuments the symmetrical ornaments are, starting from the median line, centrifugal. To consider other motions: we turn a door knob, door key, screw, stopcock, corkscrew, as well as tools for drilling, cranks of mills, wheels, etc., from left to right. In all trades and professions work is performed in a certain direction, which is generally centrifugal. To sum up, centrifugal motions, characterizing the superior races, are a sign of superiority marking the last term of evolution. As for sex, centripetal motions characterize woman, while centrifugal motions are characteristic of man. A woman, for example, strikes with her palm, while a man gives a blow with the back of the hand. Every article of woman's clothing, from the chemise to the cloak, buttons from right to left, while man's garment's button from left to right. When a woman puts on a man's coat she buttons it with the left hand, centripetally, doubtless being unable to button with her right centrifugally.

As for age, the motions of children are centripetal rather than centrifugal, therein resembling women.

From a psychological point of view centripetal gestures mark primitive, egoistic, retrograde ideas. On the contrary, centrifugal gestures express ideas and passions which are generous, altruistic, and expansive. From a psychological as well as from other points of view then, centripetal gestures characterize inferiority, and centrifugal, superiority. As a result of his studies the author draws the conclusion that the centrifugal motions of abduction and of supination prevail in organisms most advanced in evolution, as the superior human races, men, adults, intelligent beings, etc.; while, on the contrary, the centripetal motions of adduction and pronation predominate in individuals less advanced in evolution, as the inferior human races, women, children, people of little intelligence, monkeys, quadrupeds, etc.

Finally, the physiological evolution of motions, which is a consequence of the anatomical evolution of the limbs, proceeds from the centripetal to the centrifugal. Comparative anatomy and physiology, then, explain why not only writing, but also other motions, are at first centripetal during the first phases of organic development, while the adductor muscles predominate over the abductor, and became centrifugal by very reason of the progresses of evolution which bring about the predominance of the abductors over the adductors.

Objections to Telegraph Wires in Sewers.

The Superintendent of Police and Fire Alarm Telegraph, the Chief Engineer and Surveyor, and the Chief Commissioner of Highways, of Philadelphia, under instruction from Councils, held a conference recently as to the practicability of running electric wires through the sewers of the city. The *Record* states that the three officials agreed to report adversely to Councils. One objection to the plan was that the sewers were much too small to be put to any such use, as men could not work in them with any degree of safety. It was also argued that the dampness of the sewers is so great that the wires could not be operated without insulation, which would be expensive and bulky. Another evil which was pointed out was the breaking into the sewers, which would become necessary to make connections. In their report the committee will call attention to these points, and also to the fact that the telegraph and telephone companies must make other provisions for the future, and not depend upon or expect to use the sewers as conduits for their wires, for the reason that in a few years the ordinary increase of the business of these institutions would result in the occupation of sewers to the material damage of the city's interest.

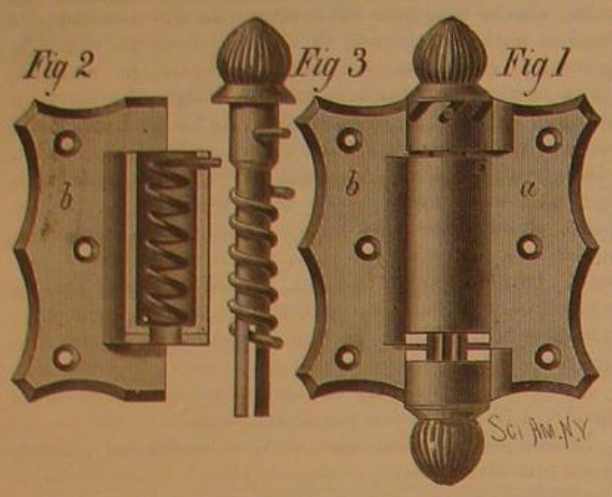
A Patent Pigeon.

The recent pigeon shooting "tournament" was varied by a special contest in which artificial pigeons were used. They were earthen projectiles sprung from a trap, and similar in shape to the clay saucers used for flower pots. The motion of this projectile is much more like that of a real pigeon as it rises from the ground than that of the gyro pigeon. When it is thrown from the trap it receives a violent rotary motion which compresses the air within its rim, and gives the "pigeon" more stability, while the convex shape causes it to sail or skim along very swiftly and settle lightly, when not hit by the shot, without breaking. The motion of this new substitute is very similar to that of an oyster or clam-shell when thrown by hand in such a manner as to skim through the air. The clay is light and brittle, and the rapid centrifugal motion causes it to fly in pieces easily when struck by the shot. There were few contestants entered in this match, but the men who did shoot and others who have practiced at this new projectile say that is the best substitute for live pigeons that they had yet seen. The pigeon and trap from which it is thrown are the invention of Mr. George Legowsky, Cincinnati.

IMPROVED SPRING HINGE.

The annexed engraving represents a new spring hinge lately patented by Mr. George M. Lane, of Asbury Park, N. J. It is adapted to blinds, shutters, screen doors, etc., and is so constructed that it may be easily and quickly adjusted to any required tension, and it admits of readily unhinging a shutter or door.

Fig. 1 shows the hinge complete; Fig. 2 is a section through the spring chamber; and Fig. 3 shows the hinge pintle. The leaf, *a*, is formed with an upper and lower knuckle, the upper knuckle having in its upper edge a series of ratchet teeth surrounding the central vertical hole through which the pintle passes. The lower knuckle is formed with a sliding surface and shoulders or stops on its upper



LANE'S SPRING HINGE.

edge and opposite each other, as shown in Fig. 1. The leaf, *b*, has a central chamber which fits between the two knuckles of the leaf, *a*, and has sufficient vertical play to permit the shoulders formed on its lower end to pass over the shoulder on the lower knuckle of the leaf, *a*, when the shutter is closed. The shoulders on the lower end of the spring chamber are arranged to correspond with those on the lower knuckle, and are locked together by the dropping of the shutter when the latter is opened. When locked in this way the shutter is held against any ordinary force of wind. The lower end of the pintle opening in the spring chamber has a shoulder on which the free end of the coil spring rests. This shoulder protects the lower end of the spring from injury and holds it in place when the shutter or door is lifted off the hinges. The pintle has a milled head by which it may be drawn out of the hinge, and on its shank near its upper end there is a pin that will engage the ratchet teeth when the head is pressed down. In the lower end of the pintle there is a longitudinal slot the inner end of which is within the spring chamber. The upper end of the coil spring is fastened to the spring chamber, and its lower end is left free and rests on the shoulder at the bottom of the chamber, as shown in Fig. 2, and is bent and received by the slot in the pintle. The pintle is retained in the hinge by its own gravity, and it may be raised or lowered or entirely removed at pleasure without affecting the position or fastenings of the coil spring.

Further information may be obtained by addressing E. L. Richards & Co., 733 Broadway, New York, or the inventor as above.

NEW MECHANICAL MOVEMENT.

The engraving shows a new mechanical movement for changing a reciprocating motion into a continuous rotary motion, the device being capable of producing rotary motion at every point in the revolution of the crank.

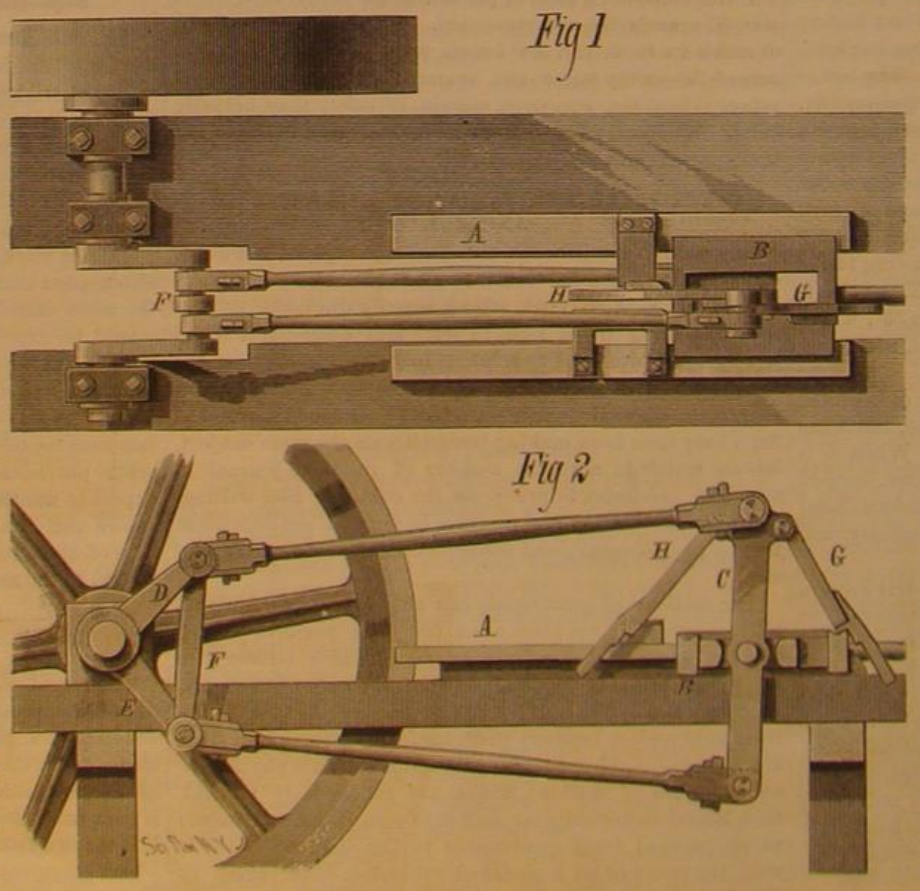
Fig. 1 is a plan view, and Fig. 2 is a side elevation, partly in section, showing the relation of the various parts. The device is represented as connecting the crosshead and crank shaft of a reciprocating steam engine, but it is capable of application to any kind of machinery in which reciprocating is converted into rotary motion. The ways, A, support the crosshead, which is attached to the piston rod of the engine and reciprocated in the usual way. The crosshead carries a lever, C, having at its ends connecting rods connected with the cranks, D E, the latter being connected together by the tie rod, F, so that they stand at right angles to each other. Pawls, G H, jointed to opposite sides of the upper end of the lever, C, are fitted to engage notches in the ends of the auxiliary crosshead, B, and are arranged so that during the stroke one of them may be engaged by an arm attached to one of the ways, A, and the other will be engaged by an arm projecting from the other way.

With the device arranged in this way the engine will turn only in one direction, but by attaching a set of pawls, G H, to the lower end of the lever, C, the engine may be made to turn in either direction, depending of course upon which set of pawls is allowed to operate.

The auxiliary crosshead is of such length relative to the length of the main crosshead that has an independent long stroke—that is, a longitudinal movement at the ends of the stroke which is independent of the movement of the main crosshead, and the ends of the auxiliary crosshead are provided with the grooves with which the notched ends of the pawls, G H, alternately engage while the crosshead is traveling the space of its independent movement. By this means the force during the independent movement of the auxiliary crosshead is transferred through the pawls, G H, to a point above the plane of reciprocation, and applied to the cranks of the shaft through the oscillating lever, C, and the connecting rods at a point above the line of dead-center It will be understood that durirg this time the main crosshead remains at rest, and that the motion of the oscillating bar is only upon its pivot.

When the main crosshead and oscillating bar begin to move, the pawls, G H, are thrown out of engagement with the notches by coming in contact with the arms or projections, which are secured in proper position for that purpose upon the ways, A, as shown in the plan view.

After sufficient motion has been obtained to carry past the dead-center, the auxiliary crosshead is brought to its short stroke by placing blocks between the crossheads or by the employment of a device actuated by a lever, which locks the two crossheads together, when they act as a single crosshead.



HARRIS' MECHANICAL MOVEMENT.

Preservation of India-rubber Tubing under Water.

Mr. Mareck relates his experience of having met with serious annual losses, in consequence of certain kinds of India-rubber tubing soon becoming brittle on exposure. After many experiments, he has adopted the plan of preserving them under water, which he renews from time to time. He found that even the thickest kind of tubing will thus remain soft and pliable without losing elasticity; nor has he found any other drawback by adopting this plan, except this, that they undergo a change in appearance. Red or brown tubing gradually fades, and becomes brownish or grayish-yellow; gray tubing becomes darker and browner externally. A section of tubing reveals the fact that about one-half of the thickness of the rubber, from the outside toward the middle, appears bleached and fatty; but the change is one which is rather of benefit for their practical use. The author adds that very thin rubber bands, with which other goods were tied, became so soft that they could be rubbed to small crumbs with the fingers.—*Dingler's Polyt. Jour.*, 239, 325.

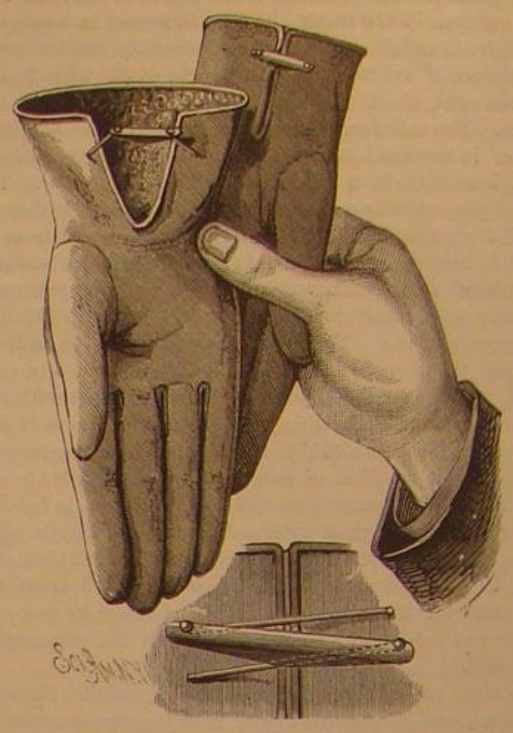
A Stray Balloon.

Mr. John W. Tobias, of the whaling brig Rosa Baker, which arrived at Boston on July 1, reports that on June 17, at noon, in latitude 27° 50′, longitude 67° 30′, he observed a large balloon in the westward. It was apparently about one mile in elevation and about five miles distant, and proceeding slowly in a northwesterly course. We set our colors, but could get no signal from it. The aerial traveler remained in sight until 3 P.M., when the weather became cloudy and it was hidden from our view By the aid of our glasses we could distinctly see the car that was attached to it swaying to and fro as it moved along, but could not observe any occupants. The balloon seemed to be of a white or cream color, and of large size. It was proceeding in the direction of Cape Hatteras, the nearest point of the American coast, distant upward of 600 miles.

NEW GLOVE FASTENER.

An improved glove fastener lately patented by Mr. Frederick Schramling, of Sabula, Iowa, is shown in the engraving.

The invention consists in a metal strip or plate with side lugs or flanges, connected with two wires attached to the opposite lapels of a glove or mitten, the other ends of the wire being bent and passed loosely through apertures in the ends of the strip, and are prevented from being drawn out of these apertures by knobs or buttons at the ends of these wires. The glove is closed by turning the flanged strip in



SCHRAMLING'S GLOVE FASTENER.

such a manner that the wires will be crossed longitudinally between the flanges or side lugs of this strip or plate.

Figure 1 shows one of the gloves with the fastener open, while the fastening of the other glove is closed. Figure 2 shows the fastener in detail.

When the fastener is opened it gives ample room for the insertion of the hand, and when it is closed it is self locked and holds the glove properly in place.

MECHANICAL INVENTIONS.

Mr. Frank W. Kepner, of Houlton, Me., has patented an improved mill-feeding device, the object of which is to prevent choking of the mill feed. It is impossible to clearly describe this invention without engravings.

An improved wood-sawing machine has been patented by Mr. William H. Mellott, of Ray's Hill, Pa The object of this invention is to facilitate the sawing of wood and promote convenience in operating sawing machines.

Mr. John H. Boren, of Haubstadt, Ind., has patented an improved water elevator which is so constructed that when the filled bucket is raised an empty bucket is lowered. The invention consists in a chute or gutter passing through the frame of the water elevator, and provided with a parallel rod a short distance above it, on each side, against which projections on the buckets catch, thereby tilting the buckets so that their contents will flow into the chute.

Much difficulty has been experienced in running millstones from backlash from the face of the stones getting out of relative position, and consequently irregular grinding. To overcome these difficulties Mr. Frederick Mayo, of Zanesville, Ohio, has patented a millstone driver having arms with adjustable springs, to compensate for backlash, to prevent irregularities in the running of the stone and insure the best results otherwise.

An improved table for wood-working machinery has been patented by Messrs. Michael Lally, of North Lawrence, Ohio, and John J. Kehoe, of New York city. The improvements relate to the tables of band, jig, and other saws, and the tables of other wood-working machinery upon which the material is required to be moved by hand. In this apparatus the work moves upon a series of balls adjustably supported and capable of turning freely in any direction.

An improved lathe attachment has been patented by Mr. Harry C. Barnes, of Vallejo, Cal. The object of the invention is to combine with a lathe an attachment by which teeth may be cut in gear wheels with accuracy and rapidity.

Mr. Robert Rutter, of Dillon, Montana Ter., has patented an improvement in the construction of the wagon brakes known as the "California" or "roller" brakes in such a manner that they can be reversed to bring the brake lever upon the right or left side of the wagon, according as the brake is to be "put on" by a man riding on the left-hand wheel horse or by a driver riding in the wagon.

AGRICULTURAL INVENTIONS.

A novel combination, with the seed dropping slide of a corn planter, of a pair of rimless wheels, a shaft, a series of elastic arms, and a cam, whereby provision is made for dropping the corn at regular intervals, has been patented by Messrs. Nimrod J. Curtis and W. J. T. Curtis, of Martelle, Iowa.

An improved combined harrow, seeder, and roller has been patented by Messrs. Robert Lang and James B. Lang, of Lindsay, Ontario, Canada. The object of this invention is to till or mellow the soil, sow the seed, and smooth or roll the land at one operation.

Mr. John C. Waddell, of Union City, Tenn., has patented a broadcast seed sower for sowing clover seed and other fine seeds, so constructed as to sow the seed in uniform quantities; and so stop the escape of seed automatically when the mechanism comes to a state of rest, and which can be readily adjusted for sowing any desired quantity of seed per acre, and finer or coarser seeds, as may be desired.

A New Exhilarating Substance.

Dr. Luton, of Rheims, calls attention in a French medical paper to the exhilarating properties of the tincture of ergot of rye when associated with phosphate of soda. The circumstances of the discovery were as follow: A woman of 62, at the infirmary of the *Maison de Retraite*, in Rheims, was receiving tincture of ergot of rye for disease in the knee. Fearing an unfavorable turn, the doctor thought to strengthen the action of that medicament with phosphate of soda, and accordingly combined a little of the two substances in a quarter of a glass of sweetened water. The patient, about three-quarters of an hour after taking this, surprised the inmates by bursting into loud laughter, without obvious reason, and this continued for more than an hour, with brief intervals. The laughter seemed to be associated with merry ideas, and to indicate a kind of intoxication. For some time after it died down the woman was in great spirits and good humor. Dr. Luton had not witnessed the scene, but the consequences to the patient being good, he administered the substance again, and a third time, observing the same effect. The experiments were further repeated on seven or eight women and girls with like results. In the case of men the action of the substance is less marked: it appears only in coloring of the face, giddiness, and slight headache. The effects in question have probably a common origin, it is thought, with those from eating rye bread when, in rainy years, the cereal contains as much as five per cent of ergot. A sort of intoxication is produced which the consumers by no means despise.

Increased Occupation for Women.

Mrs. Mary A. Livermore says that one evening twenty years ago a few ladies, interested in the welfare of women, discussed the employments open to women. They counted eleven and could think of no more. Recently the same ladies repeated the enumeration, and were able to point out 287 employments which women could engage in.

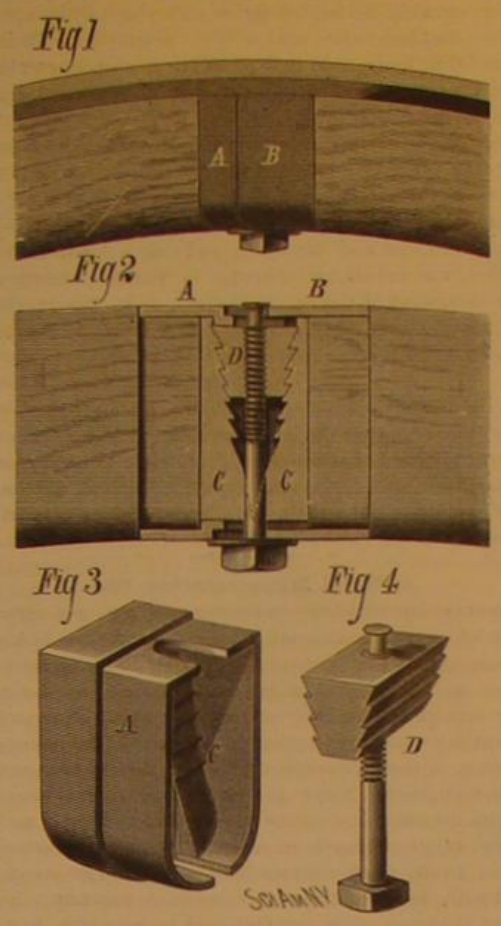
A Gift to the Museum of Natural History.

Mr. Robert L. Stuart, President of the Metropolitan Museum of Natural History in Manhattan Square, has presented to the museum the valuable "De Morgan" collection of prehistoric stone implements from the river gravels and peat beds of Northern France. The series of specimens representing the Stone Age in Denmark at the Centennial Exhibition were already in the possession of the museum; and the gap between that collection and the one just acquired is filled by the magnificent collection deposited by Mr. G. L. Feuardent, which in itself includes a series of objects belonging to the period of the river man in England, the cave man of Southern France, the latter from excavations made by the Marquis de Vibraye, from the tertiary and quaternary habitations of the Lovie Valley. The lacustrine period is fully represented in the Feuardent collection by the finds of Dr. Gross in the Swiss lakes, comprising stone implements with their original handles of stag horn, jade axes, chisels, etc., pottery of all sorts, and finally, numerous tools and ornaments of the bronze age from the same locality. This collection is completed by the ovidian implements from Greece. Prof. Spencer F. Baird, speaking of these two collections, says that no museum on this continent, the Smithsonian included, possesses anything equal to those now brought together at the Museum of Natural History. The museum is also rich in American antiquities.

CARBON tracing paper is prepared by rubbing into a suitable tissue a mixture of 6 parts of lard, 1 part of beeswax, and sufficient fine lamp-black to give it a good color. The mixture should be warm and should not be applied to excess.

NEW TIRE TIGHTENER.

The engraving represents a novel device for expanding the fellies of wagon wheels, so as to tighten the tire and prevent the wheels from being wrecked, as they frequently are when the tire becomes loose.



WILKIN'S TIRE TIGHTENER.

A, B, are telescoping metallic ferrules, provided with recesses, into which the ends of the felly sections are fitted. These ferrules are provided with diagonal toothed faces, C, having between them a wedge-shaped opening, when the ferrules are fitted together. An endless screw carries an elongated nut, D, having diagonal toothed edges, the inclination of which corresponds with the incline of toothed faces, C. The screw is fitted through the ferrules, as shown, so that it has a bearing in the upper plate of ferrule, B, and a projecting head on the inner side of the felly, by which the screw may be turned.

When the wheel is constructed the device is inserted at the joint with the ferrules, telescoping as far as possible, and with the nut at the top of the wedge-shaped opening. When the felly needs tightening the screw, D, is turned, and the nut, E, travels toward the head of the screw and forces the ferrules apart, and with them the felly-sections. As the nut travels along the faces, C C, of the ferrules, the teeth on its edges ride over the teeth on the faces, the teeth interlocking when the nut is stationary, so preventing it from being moved back toward the tire by jar or vibration. The expansion of the fellies caused by forcing apart the ferrules tightens the joints of the wheel and expends it so as to tightly fit the tire.

This invention was lately patented by Mr. Alfred Wilkin, of Toledo, O, who may be addressed for further information.

COLLAPSE OF A STEEL BOILER FLUE.

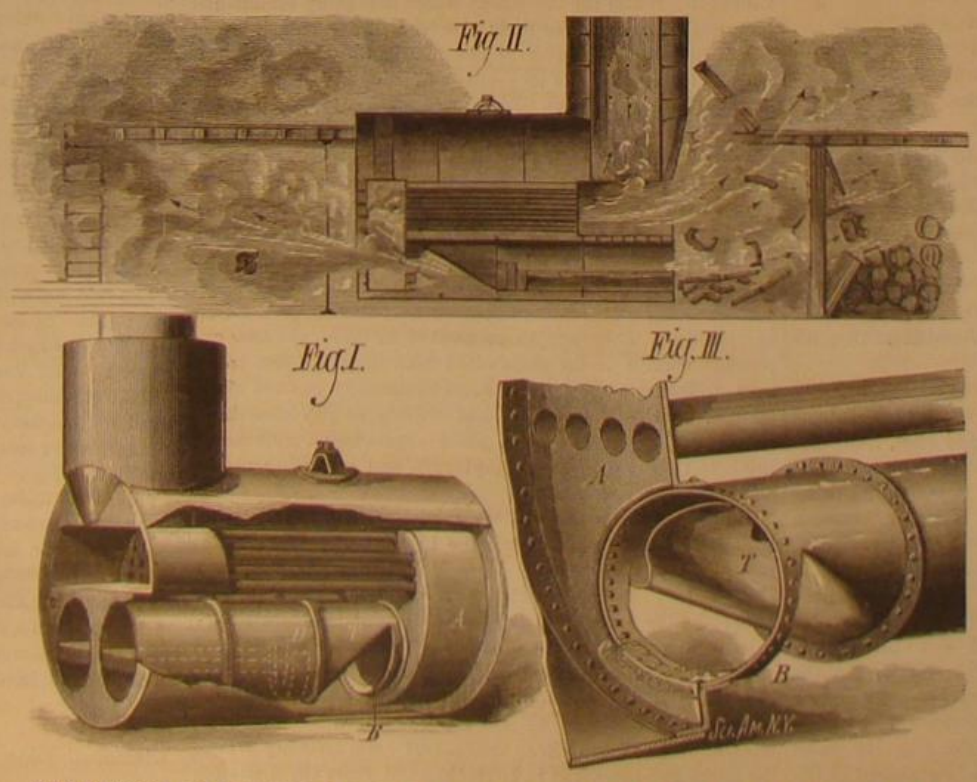
BY S. N. HARTWELL.

On Sunday morning, the 12th of June, 1881, one of the large flues in the boiler of the wrecking steamer B. & J. Baker collapsed while the vessel was lying at anchor off the coast of Virginia. The accident resulted in the death of three men and the scalding of one or two other men. Very little damage was done to property other than to the boiler itself. The vessel was owned and used by the wrecking firm of Baker & Co., of Norfolk, Va., but with other property of that company it is believed to have since changed owners. The vessel is described in the government certificate of inspection, which expires January 22, 1882, as a small passenger steamer, built of wood at Baltimore, in 1864, 212·67 tons register, rebuilt at Norfolk in 1870, having one low pressure (?) engine, 22 x 24 inches, and one iron and steel boiler, built in 1877, 16 feet long by 7 feet diameter, and allowed to carry 50 pounds steam pressure per square inch. There were on this boiler, according to the same authority, the usual safety appliances, namely, two safety valves, three gauge cocks, two steam gauges, and a fusible plug. This vessel is a propeller, and was used for towing and lightering.

It was a tugboat boiler, of the return tubular type, shown in Fig. 2, where the boiler is represented with its port side toward the observer, part of the shell being omitted to show the broken furnace tube. The diameter and length of the boiler are given above. It had two 27 inch round furnace tubes, straight from the boiler front to the back connection, each made of three steel plates about quarter inch thick, which were secured together by outward-turned riveted flanges. A fire-brick bridge wall in each tube at about two-thirds the length from the front, upon which the fire grates abut, divides the tubes into furnaces, ash pit, and flue leading into the back connection, whence the gases return to the up-take chamber and chimney above the furnaces through seventy-five small tubes. Cast iron doors, with door frames bolted to the front boiler head above the grate level, formed the front walls of the furnaces.

The facts contained in this report were obtained through the politeness of the owner, Mr. J. Baker, who gave the writer permission to examine the interior of the vessel and the broken boiler, which was done before anything involved in the explosion had been moved. Men and means to facilitate the examination were placed at his disposal, in the belief that something would be brought to light in explanation of the accident that came upon them so unexpectedly after having done all in their power to make the vessel safe and efficient.

Fig. 1 is a sectional view of the boiler and fire room. It is intended to explain the course of the escaping contents of the boiler, and the effect on objects in the vicinity. The engraving, by means of the arrows, sufficiently explains the direction taken by the broken objects, which consist of the boiler hatch beam, the bulkhead forward of the boiler, which separated the fire-room from the forward storage room in the hold, the cast iron doors and their frames, all burst off and broken from the front head. The bridge wall and grate bars from the port furnace, and the back connection door from the rear end of the boiler. Hatches and skylights were blown off. The whole interior of the vessel's hold bore marks of the force with which things were driven before the scalding torrent that was impelled by its contained heat with terrible velocity.



EXPLOSION OF THE BOILER OF THE WRECKING STEAMER B. & J. BAKER.

Fig. 3 is a sketch on a larger scale showing the rear end of the collapsed tube and a part of the tube head in section. Also the patch upon the lower part of the tube.

The thickness of the plate, T, at the thickest margin of the rupture where a gauge could be applied, was found to be 0·220 of an inch, near the extremity of the torn edge, about half way up the side of the tube. From there to the point, B, the lowest part, the thickness decreased, the metal having wasted by corrosion on the water side, so that after rupture it showed a ragged knife-edge. Near the edge, on the bottom, holes were corroded entirely through. On the lower exterior surface of the other tube were found broad shallow pits of irregular shape extending over a large area, indicating that this tube was thin also, but not as far gone as the port one.

The patch at C, Fig. 3, covering the lower part of the flanged seam, and the rear end of the longitudinal seam of the broken tube, is sufficient proof that the engineer had been warned by a leak that a weakness, or at least a defect, existed here, and it was his duty to have tested with proper tools the surrounding parts before applying a patch. Drilling his bolt holes in the flue should have shown him that the plate was too thin, and he should have reported the deterioration that was going on to his owners and the local inspectors. It is obvious that the man in charge of the boilers should watch for and report dangerous defects to the proper officers, otherwise how can they know of their existence and

be responsible for results that may occur in the interval between regular inspections?

The *Tribune* has the following relating to this explosion:

"The report of the United States local inspectors of steam vessels at Norfolk, Va., upon the accident to the wrecking steamer B. & J. Baker, was received by Superintendent Inspector-General Dumont on the 23d of June. It states that the accident was the collapse of the port flue caused by over-pressure. The evidence of one of the deck hands shows that the engineer on watch was asleep in his berth at the time of the accident, and this evidence is corroborated by the fact that his body was found in his berth. The condition of the boiler shows that all the doors were closed."

This is the whole of it; overpressure meaning a pressure a little too great for the weak flue. It may, however, have been within the limit of fifty pounds per square inch allowed by the certificate, which was written less than five months before, or else what good were the safety valves, which should have been automatic in their action whether the engineer was asleep or awake? No theory is therefore necessary in this case to account for the immediate cause of the accident. The remote cause from which the deterioration of a strong flue of the best quality of homogeneous metal that is known to modern engineers, arose is not so clear, although much has been written and some indirect experiments have been made by the British Admiralty Boiler Commission for the purpose of finding a remedy for the rapid deterioration of boilers in the Royal Navy, since the introduction of surface condensation. Rear Admiral C. Murray Aynsley, a member of that Commission, contributed a paper to the Journal of the Royal United Service Institution, which was printed by Van Nostrand in November, 1880. From the part of the paper in which the Admiral summarizes the report of the Commission's Ocean Plate Experiments, it appears that a set of plates of bright but not polished steel and iron, four inches square by ⅜" thick from different makers in England were sent to "men of war in the Mediterranean, West Indian, Pacific, Australian, China, Brazil, Cape, and East Indian stations, troop ships of the home and foreign service, tugs in home ports, and merchant vessels belonging to as many as forty-five of the principal steam ship companies, trading in every part of the globe." A blank form was supplied with each set of plates to be filled in by the chief engineers. The following table is made from forty-two sets of these papers, all that were available when the paper was prepared, showing the loss in grains per square foot for each ten days the plates were in the boilers. The table is rearranged, so as to be intelligible as far as may be without the balance of the paper, space for the whole of which is not now available.

The point made by the author of this paper related to the effect of the presence or absence in the boiler, used in conjunction with surface condensation, of air (gas) which would be brought in with the feed water used to make up the waste in blowing off, and by leakage. The table is arranged from his data in groups such as they were divided into by him.

	Loss in grains per square foot in 10 days.
Group (1). Those that do not change any of the water at sea, mean of 10 sets of experiments	66·49
Group (2). Those that change 3 inches in depth of water in the boiler in 24 hours; mean of 9 sets of experiments	26·49
Group (3). Those that change between 3" and 12" in 24 hours; mean of 7 sets of experiments	149·87
Group (4). Those that change more than 12" in depth of water in the boiler in 24 hours; mean of 6 sets of experiments	323·75

From this it will appear that where the greatest amount of water was daily changed, involving the introduction of air, which contains the very active corrosive agent carbonic acid gas, then the experimental plates suffered most from corrosion.

The author of the paper states what does not appear in the table, that the plates in those boilers of group 1 that were emptied at the shortest intervals suffered more than the others in that group.

He next compares steel with iron plates as regards rapidity of corrosion, and the different brands of English steel, from which it appears that crucible steel suffered least, Bessemer next, and Siemens-Martin most under like exposures, while Staffordshire iron suffered least of all, Lowmoor ranking next to crucible steel. The extremes, however, between Staffordshire iron, 123, and soft steel, 155 grains per square foot in ten days, was not so decided as when they were exposed in boilers in connection with jet condensation, when the figures were, iron 119, and steel 179 grains.

Then fresh and sea water are compared as to their corrosive action, with the following results referring to the groups in the table. Group 2, fresh water, loss 49 grains; sea water, 102 grains; group 3, fresh, 73; sea, 166, while in the first group, no blowing off, fresh water was the most active as 28 is to 20. From all of which the author of the paper concludes that when no change of water is made sea water has the advantage, but when from 3 inches to 12 inches of the depth of the water in the boiler are daily blown out; then fresh water has the advantage. He cites a case of comparison of a boiler and a feed water heater where the loss in the heater was 93 grains, and in the boiler only 16½ grains, the air (gas) having been trapped in the heater. Without attempting to explain the corrosion that occurred on board the Baker, the writer desires to call attention to the practice that there prevailed, according to a letter recently received from her gentlemanly and obliging master, Captain Charles L. Nelson, in answer to inquiries. The substance of his answers are that the boat is fitted with a surface condenser, from which the water is returned to the boiler, entering the back head on each side a little below the center; that the habit was to blow twenty-four inches in twenty-four hours, and that when lying at anchor water was fed from the sea and passed through a heater entering the boiler at 80° to 100° Fah.

The *Norfolk Virginian* of current date printed the following: The investigation into the causes of the accident to the boiler of the wrecking steamer B. & J. Baker, off Cape Henry, on Sunday morning last, by which three colored men were killed and one white and one colored man were scalded, was concluded yesterday in Berkley, the coroner's jury consisting of George T. Hodges, J. R. Humphries, R. D. Cornick, G. W. Stell, Nathan Jones, and J. N. Etheredge, who rendered the

VERDICT

that the victims came to their deaths by an explosion of a flue of the boiler of the steamer B. & J. Baker, caused by an over pressure of steam resulting from gross neglect of the engineer, and, from the evidence elicited, we the jury fully exonerate the remaining officers and owners of said steamer.

A Model Manufacturing City.

Great manufacturing establishments are generally the result of growth from small beginnings. A shop is located in some cheap and undesirable region, the workmen find homes as best they may anywhere around, or sometimes hasty structures are erected for their occupancy, and the enterprise commences operations. There is no pretense of elegance, or taste, or comfort, either in the establishment or its surroundings. Noise, dirt, and discomfort characterize it from the start, and as the establishment grows, and the number of its employés increases, the same characteristics extend to the whole surrounding region. The streets are filled with cheap unattractive cottages or vast unwholesome tenement houses. The gutters overflow with filth, in which unwholesome children endeavor to find amusement. No spot of green grass, no bough of green tree is seen, a pall of smoke hangs over the settlement, and grime and squalor, and often disease, accompany the development of the great industrial establishments where labor finds employment and support. While it is true that there are many manufactories where the result of prosperity has been shown to some degree in the construction of excellent buildings and the adornment of the surroundings, still the vast number of our industrial works are anything but inviting to the eye, or indicative of care on the part of their proprietors for the happiness and the health of their workmen. Indeed, when a place has been started, as most manufactures are, without regard to appearances or comfort, and its growth has taken the same form, it is almost impossible ever to regenerate it.

To build up a modern manufacturing village, the work must be begun at the bottom. While there are examples in this and other countries where this has been done, there is nothing anywhere to compare, either in perfection and breadth of plan or rapidity of execution, with the new town of Pullman, which, within a few months, has sprung up on the shore of the little lake Calumet, a few miles south of Chicago. While the car works which are being established here are remarkable for their size and perfectness, it is not the manufacturing aspect of the matter of which we wish here to speak. It is in its relation to such a village or city as is here being built up by a single organization, to the army of men whom it will employ, to their families, and to society, of which they form a part, that this enterprise shows its grandest phase. Here we are to have an illustration of what a man with unlimited means, and actuated by a broad philanthropic sentiment, which at the same time is backed by an eye to business prudence, can accomplish.

The town of Pullman is not a public charity. Its workmen are not to be supported as paupers or amused as children. They are to be treated as men who can appreciate what it is for themselves and their families to be surrounded with the comforts and luxuries of modern civilization, and who are glad and willing to pay something for it, and who will show their appreciation by rendering better service to their employers, and becoming useful and self-respecting citizens.

June, 1880, the site of this model town was a broad stretch of prairie over which the high grass waved undisturbed by wheel or foot. Here Mr. George M. Pullman, President of Pullman's Palace Car Company, decided to undertake the grand work of founding a model manufacturing town, which had been for years his dream.

The work once commenced was pushed with extraordinary energy. All through the bitterly cold winter the walls were arising, when the workmen were obliged to have fires burning upon them to keep themselves from freezing, when the stone and brick had to be picked out from the drifts of snow and the packing of ice in which they were buried, and when the workmen, to the number of a thousand or more, had to be carried to and from the city a dozen miles every day. But in spite of the elements the work went on, and to-day there stands a group of vast and imposing buildings, forming a manufacturing town for workmen such as is not seen anywhere else. The houses are handsome, even elegant, brick structures with stone trimmings and slate roofs, and from one to two and three stories in height, supplied with perfect sewerage, running water, gas, baths, marble fireplaces, and many other forms of modern improvement in dwellings, equally as complete as those which a millionaire can obtain. A beautiful park adorned with trees, choice shrubs, and winding walks fronts the new city. A little lake whose bed was formed by excavating the earth for filling other portions, shines like a gem in front of the great manufactory. The railway station where the visitor gets his first impression of the place is not a dingy weather-beaten shanty, but a gothic structure of brick, itself a model of taste and elegance. There are rapidly arising a hotel 100 feet square; a market house of equal size, where various articles of food can be cheaply obtained; an arcade building, which will contain a public library, art gallery, association rooms, and some fifty stores and business offices. Plans are being devised by one of the leading educators of the country for school accommodations, and churches will quickly appear.

On the whole vast tract of some 3,500 acres owned by Pullman's Palace Car Company and the Pullman Land Association, where this great scheme of a model manufacturing city is to be worked out, not a single liquor saloon will be tolerated to corrupt the morals and deplete the pockets of the inhabitants. The character of the enterprise itself removes the excuse which is often urged for the existence of saloons—that they afford the poor man his only place of amusement and his only solace. When the day's work is over the workman will not be tempted to seek refuge in the saloon from filth and disease and discomfort at home. His home itself, the beautiful surroundings of park and lakes and shady groves, the library, the reading room, the indications all about of peace, order, cleanliness, and health, will tend to make repugnant to him the thought of the squalid saloon and its imbruted frequenters. All his surroundings will impel him to take high views of life in its possibilities and move him to set a worthy example to his children.

Before the first year shall have elapsed, not far from two millions of dollars will have been poured out in the development here of this remarkable and philanthropic scheme. At the same time it is not a Utopian enterprise. While the workingman can obtain a charming home for from $9 to $16 a month, with all the conveniences and luxuries of modern house architecture, the rental will pay a handsome interest on the cost of the building and also on the value of the land at a figure vastly enhanced over the original cost, so that in helping the thousands of workingmen and their families who will form the nucleus of this new city the projectors will at the same time receive a fair return for their financial risk and expenditure.

The result of this remarkable enterprise will be watched with great interest as inaugurating a new era in the foundation and development of manufacturing industries, in which the condition of the workingman will play a far more important part than it generally has hitherto. It will show that it is not only a kind and benevolent thing for employers to make the workingman comfortable and contented, but a profitable thing, because it makes him a better workman and removes from him the feeling of discontent and desire for change which too often characterizes our working population. The town of Pullman is an exemplification of practical philanthropy based upon business sagacity. May its leading characteristics and the motive which prompted its public spirited projector prove examples which shall have many emulators!—*Railway Age.*

A Durable Whitewash.

To the Editor of the Scientific American:

In regard to the query of C. B. C., in your last number, in relation to whitewashing, I believe I have tried every known wash. The so-called White House stucco wash is no better than any ordinary whitewash. No brick wall that ever is intended to be painted should be whitewashed. All washes absorb water, and in damp weather lose their color.

The best wash that I have ever heard of is made as follows: For one barrel of color wash—Half a bushel white lime, 3 pecks hydraulic cement, 10 pounds umber, 10 pounds ocher, 1 pound Venetian red, quarter pound lampblack.

Slake the lime; cut the lampblack with vinegar; mix well together; add the cement, and fill the barrel with water. Let it stand twelve hours before using, and stir frequently while putting it on.

This is not white, but of a light stone color, without the unpleasant glare of white. The color may be changed by adding more or less of the colors named, or other colors. This wash covers well, needing only one coat, and is superior to anything known, excepting oil paint.

I have known a rough board barn washed with this to look well for five years, and even longer, without renewing.

The cement hardens, but on a rough surface will not scale.

T. G.

Cincinnati, Ohio, July, 1881.

THE trust fund created by Professor Tyndall upon his departure from this country has accumulated sufficiently for the purpose to which he devoted it: The assistance of needy American students in physics who should show aptitude for original study and should wish to complete their education in Germany. The fund will now furnish a moderate income to two students.

RECENT INVENTIONS.

Mr. Eugene Wessells, of Peekskill, N. Y., has patented an improved automatic mechanism for feeding animals. It is designed to be operated by a heavy weight, and its movements are controlled by a clock.

An improved chamber vessel has been patented by Mr. Arthur Bird, of Jeffersonville, N. Y. The object of the improvement is to provide means for tightly sealing vessels used in sickrooms, hospitals, and other places, so as to prevent escape of gases and odors. The invention consists in swinging covers fitted for being opened and closed by hand or by movement of the seat.

Mr. Henry Eitenmüller, of Butler, Pa., has patented an improved beehive of handsome appearance, which affords ready means for the inspection of its interior, and an easy and convenient removal of the upper comb boxes and the improved comb racks in the brood chambers, means being also provided whereby the honey made in the hive shall be made more secure against marauding bees.

Mr. Samuel B Knapp, of Osceola, Iowa, has patented a device for attracting insects, which drop into a poisoned liquid in the apparatus, and are thus destroyed.

An improved billiard table on which a game can be played with two or more balls, has been patented by Mr. Edmond J. Sause, of Brooklyn, N. Y. The invention consists in a billiard table provided with the ordinary cushioned end rails, and with a central cushion attached to a stud projecting from the table.

PHOSPHORESCENT SUBSTANCES.

Phosphorescence, or the emission of light without flame or sensible elevation of temperature, is a phenomenon exhibited in a greater or lesser degree by many substances—mineral, animal, and vegetable—and is developed under a variety of conditions. In a few substances the light is developed by chemical change or a process of slow combustion, as in the case of phosphorus, from which the name phosphorescence has been derived. In others the substance suffers no appreciable change, only requiring exposure to a strong light to shine themselves when taken into the dark. The diamond and many mineral substances develop light in this way, and it is supposed that these substances have the property of absorbing light in the same way they do heat, and of slowly parting with it when taken into the dark much in the same way that hot bodies part with their heat when removed from the source of heat.

With some of these substances the application of heat causes the development of a brighter light (though for a shorter time than would be otherwise required to exhaust the supply); and again, there are some substances, such as fluorspar, that absorb light, but do not give it out until heated.

Many substances also become phosphorescent while crystallizing.

The color of the light developed by many of these substances varies with their nature and the degrees of heat to which they have been exposed. A certain scale of light and color may, therefore, be produced by grouping together different substances or samples of the same substances previously heated at different temperatures.

The following are methods for preparing some of these pyrophors:

BARIUM SULPHIDE.

Finely powdered barium sulphate, free from iron, is formed into balls with gum tragacanth; the balls are dried at a moderate temperature, then placed in a crucible with a luted cover and kept at a red heat for an hour. They are then allowed to cool slowly, and while still warm are transferred to glass stoppered bottles.

A better light is developed from the following charge:

Barium sulphate (C. P.)	32 parts.
Magnesium carbonate (C. P.)	1 part.
Sulphur (C. P.)	1 "
Gum tragacanth	q. s.

This is heated in the crucible as before described.

STRONTIUM SULPHIDE.

Strontium sulphate (C. P.)	22 parts.
Sulphur (C. P.)	1 part.
Gum tragacanth	q. s.

Proceed as before.

CALCIUM SULPHIDE.—(CANTON'S PHOSPHORUS.)

Calcine clean oyster shells to whiteness in a crucible, separate the clearer portions, reduce these to a fine powder, and place in layers with intermediate layers of flowers of sulphur in a crucible, cover, and heat to dull redness for about half an hour. Cover the crucible tightly and let it cool slowly in the crucible.

Another method of preparing this phosphorescent sulphide is to heat bisulphide of lime—obtained by boiling lime in a little water with twice its weight of sulphur—in a covered crucible at a low red heat for one hour.

CALCIUM AND ANTIMONY SULPHIDES.

Calcined oyster shells	3 parts.
Flowers of sulphur	10 "
Antimonic acid	1 part.

Mix intimately, in fine powder, and heat for half an hour in a covered crucible at low redness.

CHLORIDE OF CALCIUM.

Fuse chloride of calcium in a crucible and pour it out on a clean iron plate. As soon as it becomes cold enough break it into pieces and transfer to well stoppered bottles.

CALCIUM NITRATE.

Dissolve chalk or marble dust in nitric acid, evaporate to dryness, and fuse in a porcelain crucible.

These substances, when properly prepared and exposed to any strong light for a short time, exhibit phosphorescence for some time after removing to a dark place. A calcium sulphide has been prepared that, after a short exposure to sunlight, will continue to give out light for ten hours in the dark. When, by keeping in the dark, one of these substances has ceased to give out light, it may be made to give a series of fresh exhibitions by heating it first with the hand, then over a water bath, and finally on a hot stone plate.

A remarkable phosphorescence is developed in quinia and some of its salts by heat. Spread quinia or its sulphate on a sheet of paper, and spread the paper on a plate of hot metal in a dark room—a strong phosphorescent light develops at the edges and spreads to the center. A similar display is observed in sprinkling finely powdered fluorspar (calcium fluoride) over a plate of hot metal in the dark.

Boracic acid fused and allowed to cool breaks into small pieces, and along the cracks a phosphorescent light appears, which is sometimes strong enough to be visible even in daylight. Potassium sulphate fused with cream-of-tartar shows the same phenomenon.

PHOSPHORUS.

Phosphureted oil is the best means of exhibiting the luminous properties of phosphorus. A small piece of dry phosphorus, about the size of a pea, is placed in a test tube with a little pure olive oil. The test tube is held in the waterbath until the oil becomes heated and the phosphorus liquefies; it is then shaken until the oil will take up no more phosphorus, and, after allowing the oil to become clear, it is poured off into a small glass vial provided with a glass stopper. Only a small quantity of this oil in the bottom of the vial is necessary. When it is shaken about so as to coat the sides of the vessel, and the stopper is removed so as to let the air get in, the oil-coated sides of the glass become at once luminous, and continue so as long as the stopper remains out. Characters written on paper with oil thus prepared (freshly), appear in the dark very brightly.

Phosphureted ether is prepared by digesting phosphorus in ether for some days in a tightly stoppered bottle. A piece of sugar dipped into this ethereal solution and then thrown into water makes the surface of the latter appear quite luminous in the dark.

Young experimenters must remember that phosphorus is very dangerous to handle when out of water, and often inflames spontaneously when exposed dry in the air.

The Storage of Electric Energy.

Sir William Thomson, in a recent note to *Nature*, confirms the favorable results of his previous experiments with the Faure battery. He says: "I am continuing my experiments on the Faure accumulator with every-day increasing interest. I find M. Reynier's statement, that a Faure accumulator, weighing 75 kilogrammes (165 pounds), can store and give out again energy to the extent of an hour's work of one horse power (2,000,000 foot pounds), amply confirmed. I have not yet succeeded in making the complete measurements necessary to say exactly what proportion of the energy used in the charging is lost in the process of charging and discharging. If the processes are pushed on too fast there is necessarily a great loss of energy, just as there is in driving a small steam engine so fast that energy is wasted by 'wire drawing' of the steam through the steam pipes and ports. If the processes are carried on too slowly there is inevitably some loss through local action, the spongy lead becoming oxidized, and the peroxide losing some of its oxygen viciously, that is to say, without doing the proper proportion of electric work in the circuit. I have seen enough, however, to make me feel very confident that in any mode of working the accumulator not uselessly slow, the loss from local action will be very small. I think it most probable that at rates of working which would be perfectly convenient for the ordinary use of fixed accumulators in connection with electric lighting and electric transmission of power for driving machinery, large and small, the loss of energy in charging the accumulator and taking out the charge again for use will be less than 10 per cent of the whole that is spent in charging the accumulator; but to realize such dynamical economy as this prime cost in lead must not be stinted. I have quite ascertained that accumulators amounting in weight to three-quarters of a ton will suffice to work for six hours from one charge, doing work during the six hours at the uniform rate of one horse power, and with very high economy. I think it probable that the economy will be so high that as much as 90 per cent of the energy spent in the charge will be given out in the circuit external to the accumulator. When, as in the proposed application to driving tramcars, economy of weight is very important, much less perfect economy of energy must be looked for. Thus, though an eighth of a ton of accumulators would work very economically for six hours at one-sixth of a horse power, it would work much less economically for one hour at one horse power; but not so uneconomically as to be practically fatal to the proposed use. It seems indeed very probable that a tramcar arranged to take in, say, 7½ cwt. of freshly charged accumulators, on leaving headquarters for an hour's run, may be driven more economically by the electric energy operating through a dynamo-electric machine than by horses. The question of economy between accumulators carried in the tramcar, as in M. Faure's proposal, and electricity transmitted by an insulated conductor, as in the electric railway at present being tried at Berlin by the Messrs. Siemens, is one that can only be practically settled by experience. In circumstances in which the insulated conductor can be laid, Messrs. Siemens' plan will undoubtedly be the most economical, as it will save the carriage of the weight of the accumulators. But there are many cases in which the insulated conductor is impracticable, and in which M. Faure's plan may prove useful. Whether it be the electric railway or the lead-driven tramcar, there is one feature of peculiar scientific interest belonging to electro-dynamic propulsion of road carriages. Whatever work is done by gravity on the carriage going down hill will be laid up in store ready to assist afterward in drawing the carriage up the hill, provided electric accumulators be used, whether at a fixed driving station or in the carriage itself."

Electrotype of the Brain.

A brain, preserved and metallized by the galvanoplastic method, was lately presented to the French Academy of Medicine, on behalf of Dr. Oré, of Bordeaux. Dr. Oré's method (which preserves the brain entire) is briefly as follows: The brain having been so arranged that circumvolutions are well separate, by introducing cotton wicks into the fissures, and so that the preserving liquid may penetrate the ventricles, is kept about a month in alcohol at 90°, so as to acquire good consistency; the wicks are then taken out. The brain is now plunged for ten minutes in an alcoholic solution of nitrate of silver (100 gr. per liter of alcohol), and carefully drained in air. Next, it is transferred to a case in which sulphureted hydrogen is liberated, and it takes a dark hue owing to formation of a surface deposit of sulphide of silver. In about twenty minutes it is taken out, and after exposure a quarter of an hour in air, it is put in the galvanoplastic cell, where it soon assumes a fine metallic aspect.

A Boiler Water Safety Valve.

According to the *Revue Industrielle*, M. Barbe has successfully introduced a guard safety valve for steam boilers, to be brought into action only on emergencies. This valve is placed in a suitable position underneath the boiler shell, and is essentially an ordinary weighted lever safety valve turned upside down. When the valve is opened, therefore, water is blown off instead of steam. M. Barbe argues that, useful as ordinary safety valves undoubtedly are, there are occasions when a sudden and explosive evolution of steam takes place, and at such times these valves are of little service, since the steam cannot escape with speed equal to that at which it is formed, and the pressure consequently rises to the bursting point. In all such cases, in addition to what must be reckoned a possible failure of the ordinary valve for other reasons, M. Barbe's valve would be a complete safeguard, as it would instantly discharge a large quantity of water. It is known that a cubic inch of water increases in volume about 1,700 times when transformed into steam, and therefore the escape of the water would naturally be more efficacious in reducing the danger of explosion than the discharge of an equal bulk of steam. The idea, of course, is not new, but M. Barbe's apparatus for effecting the desired object is very simple and compact, although some objection might be urged against the awkward situation of the valve and the practical impossibility of examining it or keeping it in order during ordinary working; and all experience shows that fittings intended for use solely on emergencies are seldom in working condition when the event for which they are intended arrives. It is, however, stated that experiments have been made with the guard safety valve, under conditions similar to those of actual but dangerous working, and it has answered so well that many have been fixed in French factories.

Lemon Juice in Diphtheria.

Dr. J. R. Page, of Baltimore, in the New York *Medical Record*, May 7, 1881, invites the attention of the profession to the topical use of fresh lemon juice as a most efficient means for the removal of membrane from the throat, tonsils, etc., in diphtheria. In his hands (and he has heard several of his professional brethren say the same) it has proved by far the best agent he has yet tried for the purpose. He applies the juice of the lemon, by means of a camel's hair probang, to the affected parts, every two or three hours, and in eighteen cases on which he has used it the effect has been all he could wish.

Tartaric Acid in Diphtheria.

The topical use of tartaric acid in diphtheria has been successfully resorted to by M. Vidal, who, in one of the foreign medical journals, remarks upon the necessity of thus making use of topical agents against the false membrane, as it has a great tendency to spread by a sort of auto-inoculation, comparable to what occurs in certain cutaneous affections. His formula is ten parts, by weight, of tartaric acid, fifteen of glycerine, and twenty-five of mint water. The acid acts upon the false membrane, converting it into a gelatinous mass, and favors its expulsion.

The Lady Franklin Bay Expedition.

The Arctic expedition for meteorological and geographical exploration left St. Johns, Newfoundland, at noon, July 4, for the station selected for it near Lady Franklin Bay. The party will call at Disco or Upernavik, Greenland, for Esquimau hunters, dogs, clothing, etc., and then hurry on to the end of their journey. The steamer will at once return to Newfoundland. The expeditionary force is commanded by Lieut. A. W. Greely, Fifth Cavalry.

Varnish for Gelatine Negatives.

Collodion, by itself—even the ordinary porous collodion employed in negative work—answers admirably, says the *British Journal of Photography*. As a protection against damp its effect is simply marvelous; for, should the moisture penetrate it and reach the gelatine film, it possesses sufficient elasticity to withstand the strain put upon it. It exhibits little tendency to absorb silver from the damp printing paper, and in the event of actual moisture being accidentally present when in contact with the paper there is no fear of adhesion. For portraiture the film will bear working on with the pencil in retouching, though from its hardness and smooth surface it is usually desirable to use a "medium" to give a "tooth" which will take the pencil.

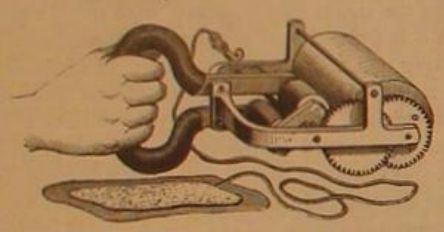
In preparing a special collodion for the purpose we should select a good, tough—not necessary "horny"—sample of pyroxyline, and use it of the strength of not more than four grains to the ounce, with two or three drops of castor oil. The best protective medium we have used consisted of a collodion made from celloidine, which gives a remarkably clear and structureless film, and may be used stronger than ordinary pyroxyline. Five grains of celloidine and two drops of castor oil to each ounce of solvents will answer well. There is a slight advantage in employing a small excess of ether over alcohol in dissolving—say nine parts of ether to seven of alcohol—both being as free from water as possible, and the negative very thoroughly dried before application.

ELECTRO-MASSAGE.

A large portion of electrical treatment that hitherto could only be carried out by specialists by using elaborate apparatus, by the proper use of a new mode of treatment, by employing the apparatus shown in the engraving, can be intrusted to the hands of those who are not so skilled.

By means of this simple machine the manipulator transfers the mechanical motion used in rubbing the patient into an electrical current, and the current as it is generated is transmitted through the part while being rubbed, and it fulfills the requirements of a treatment including rubbing, kneading, pounding, flexing, etc., combined with the application of the electric current.

The instrument consists of a metallic roller covered with chamois leather or other suitable material, an electro-magnet, and a permanent magnet set in a strong frame, which holds the instrument together. The roller, besides acting



DR. BUTLER'S ELECTRO-MASSAGE INSTRUMENT.

as the driving wheel of the machine, is so arranged that it also acts as one of the electrodes by which the current is transmitted, and is connected by gearing with the electro-magnet so as to cause the poles of the latter to revolve opposite those of the permanent magnet which forms the handle of the instrument. Each revolution of the roller produces twenty five revolutions of the electro-magnet, which is magnetized and demagnetized at each revolution, and thus induces a current of electricity which is ample for all purposes for which it is intended. The circuit is completed by connecting any required electrode by the binding post at the side of the instrument, the roller acting as the other electrode; both are brought into contact with the surface of the body of the patient, and as the roller is moved about over the surface, the current is established and transmitted through the part over which the roller is made to revolve.

This machine includes in itself an electric generator, a rubber, kneader, a manipulator, and a set of electrodes, all in one. Any person of ordinary intelligence can be taught to use it under the direction of the attending physician. It is portable, being quite capable of being carried in an overcoat pocket.

The inventor finds in practice that it has far exceeded his expectations, inasmuch as by its use he gets greater tonic effects than from the employment of both faradism and massage separately. It fulfills most of the requirements of the induction current in general practice and every-day cases. As the current is generated by motion, no acids or liquids of any kind are necessary. The instrument is at all times ready for use, a matter that will be appreciated by all who use electricity.

This treatment has been used with great success in cases of nervous exhaustion, debility, neuralgia, rheumatism, paralysis, etc., and we are informed that it is recommended by the medical profession generally.

This invention has recently been patented by Dr. John Butler, of New York city. Communications in regard to the instrument may be addressed to the New York Dynamo-Electric Manufacturing Company, 907 Broadway, New York city.

NEW REFLECTOR FOR SUSPENDED LAMP.

We give an engraving of an improved reflector for suspended lamps recently patented by Mr. John J. Smokey, of

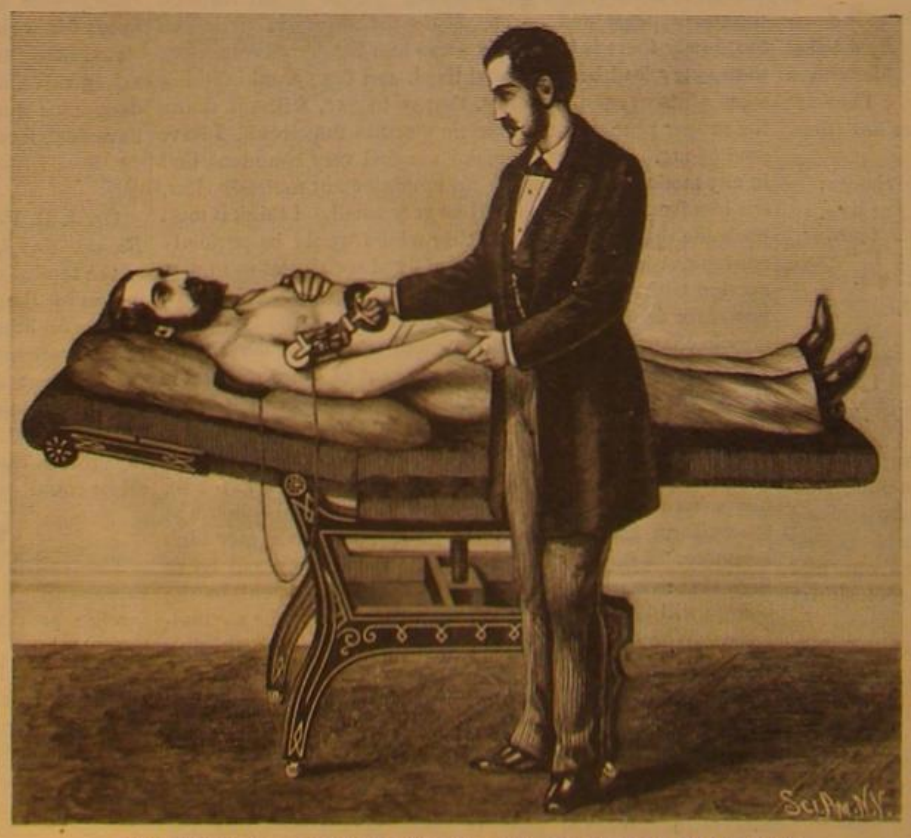
SMOKEY'S LAMP REFLECTOR.

Natchez, Miss. It is designed to increase the effectiveness of lamps by throwing down the greater portion of the light and preventing the shadow of the body of the lamp. The lamp is suspended by chains from a wire loop which also supports the reflector, and above it a small concave plate for receiving the heat that escapes through the opening in the center of the reflector.

The reflector is made in the form of a low cone from two to five feet in diameter according to the size of the room to be lighted, and is placed from nine to thirteen feet from the floor. It is made from tin, brass, or copper, and nickel plated to give it a bright and permanent reflecting surface. The device is inexpensive and adds greatly to the efficiency of the lamp.

The Bray of the Mexican Donkey.

The New Orleans *Democrat* recounts the many good qualities of the Mexican burro that has lately been introduced into that city as a child's horse, who, it seems, can banquet on splinters and scraps, carry immense loads, and is faithful, uncomplaining, docile, and tireless; but "we regret to say," continues the *Democrat*, "the burro brays. Amazing as is his strength, his stamina, his amiability, his courage, these things are as nothing compared to his bray. That such a tremendous and far-reaching sound should emanate from so small a source constitutes the eighth wonder of the world. When the little blue burro—they are nearly all blue—concludes to celebrate his scanty period of relaxation by a good, healthy, whole-souled bray—when he humps his little back, and shuts his appealing little eyes, and lets his ears lie along his back, and then gathers himself into one ecstatic note, it is enough to make one envy the sainted dead and long for the cold and silent grave. The sleepers for a mile around start up with the sweat of terror on their furrowed brows, children fall down in fits, the sick believe they have heard Gabriel's horn, and the very atmosphere shudders like a human creature. Burros don't often bray, because they haven't much time for braying; but they bray sometimes, and that is what keeps them so low in the scale of animated nature. Without his bray the burro would be little short of an angel. As he is, however, he is an animal to be admired at a distance and in the abstract."



PRACTICAL APPLICATION OF ELECTRO-MASSAGE.

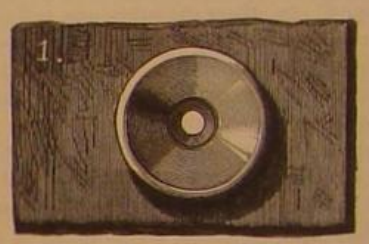
Toughened Glass.

From the results of a large number of experiments it is found that the elasticity of toughened glass is more than double that of ordinary glass, and that toughened sheets bend much more readily than ordinary sheets. Single toughened glass has a resistance 2·5 times, and demi-double toughened glass a resistance 3·1 times that of ordinary double glass. Polished toughened sheets, of thickness varying from 0·006 meter to 0·013 meter, have a resistance 3·67 times as great as that of ordinary sheets of the same thickness, and the resistance of rough toughened sheets is 5·33 times that of ordinary rough sheets.—*De la Bastie.*

IMPROVEMENT IN BUTTONS.

The annexed engraving represents an improved button recently patented by Mr. Oscar Ericsson, of Sioux Falls, Dakota Ter., and designed for various uses, but more especially for men's garments. It is strong, quickly and conveniently attached, and is inexpensive.

The head of the button has a tubular shank, which rests on a concaved and serrated clamping disk, and is clamped in place by the elongated shank of a similar disk placed on the opposite side of the fabric. This shank, as will be noticed, enters the end of the tubular portion of the button, and is set down after the manner of an eyelet upon an inter-



ERICSSON'S IMPROVED BUTTON.

nal flange, holding all three of the members securely in place, and clamping tightly the cloth of which the garment is composed.

MISCELLANEOUS INVENTIONS.

Mr. William W. Batchelder, of New York city, has patented a novel article of manufacture which he calls a "continuous match," for the reason that the entire length or body of the match is made of the explosive compositions, which are so arranged as to flash at will without continuously burning.

The same inventor has heretofore patented devices for lighting the gas in which the lighting was effected by the union of two kinds of composition arranged in sticks side by side, which would not explode when separated in bulk, but when scraped up and mixed formed a pulverulent charge, which was exploded by friction.

The present invention comprises a novel and simplified device for carrying out this principle, which is designed to utilize a peculiar continuous match, which is constructed on the above-described principle. Mr. Batchelder has applied the same device to cigar lighters. He has also devised and patented a novel attachment to be applied to a gas-burner for the purpose of lighting the gas or to be used in any other connection desired.

Mr. Charles H. Starin, of Brooklyn, N. Y., has patented an improved ash-sifter, which consists in a box with an inclined top provided at the lower end with a hinged door, and at the upper end with a chute closed by a balanced gate, through which the ashes are dropped upon an inclined sieve or grating, down which they slide, the ashes dropping into a box below the sieve and the cinders accumulating in the lower end of the box.

An improved combined ruler and rotary blotter has been patented by Mr. Arthur R. Hall, of Prompton, Pa. This invention relates to that well known class of blotters which rotate in a case and are sometimes made with a paper cutter in front and a ruler strip on the rear of casing. It consists in making the case of a strip of sheet metal extend in the rear to form a handle, and made with a straight-edge in front supported on two side flanges.

VOLUMETRIC ASSAY OF BULLION, ALLOYS, ETC.

Probably no quantitative analytical process is susceptible of a higher degree of accuracy than that by which the quantity of silver in bullion, coin, plate, etc., is now usually determined, and in point of simplicity as well as accuracy is a good illustration of the volumetric method as applied to the analysis of many other substances.

When a neutral or acid solution containing silver is brought into contact with a solution containing a sufficient quantity of sodium chloride (common table salt) the whole of the silver is precipitated as silver chloride.

A given quantity of pure salt always thus precipitates a certain definite quantity of silver (1 grain of salt corresponding to $1\frac{88}{100}$ grains, nearly, of silver.)

If one grain of salt, silver, or any other substance is dissolved in a quart of liquid, and the quart is then divided into ten, one hundred, or one thousand equal parts or volumes, each of these will contain just one-tenth, one-hundredth, or one-thousandth, as the case may be, of a grain of the dissolved substance. So that, in the case of silver, if it is known just how much salt is dissolved in a given quantity of water it is easy to calculate how much there is in any volume of the solution, and just how much dissolved silver any volume of it will precipitate.

The several pieces of apparatus necessary in preparing, standardizing, and applying this liquid measurer are shown annexed. The glass burette, A, is secured in position by the wooden clamp, B, adjustable on the iron rod of the stand, C. The ground glass stop-cock, *a*, controls the flow of the liquid from the tube. The burette is accurately graduated to one-fifth or one-tenth cubic centimeter by an etched scale.

In the burette, D, the expensive glass stop-cock is dispensed with, a piece of pure gum rubber tubing and a brass wire clamp, *b*, being substituted. The small delivery neck of the burette is joined by the tubing to a small piece of glass tube drawn out at one end to a fine delivery. The wire clamp (quetchon or pinch-cock) retains the liquid by pinching the rubber tube. E and F are pipettes. In using them the lower end is dipped in the liquid, the mouth applied to the upper end, and the liquid drawn up until the tube is nearly full. The mouth is then removed, the finger quickly placed over the end, as shown at G, and a small portion of the liquid allowed to escape until the liquid fills the tube just to the containing mark, *e*. When the finger is removed the liquid runs out. The flask is used where larger quantities of the liquid are to be measured. The containing mark is at *e* on the neck.

The titration bottle, H, is of fine thin glass, the glass stopper being ground to accurately fit the neck, and terminates in a point. These bottles usually have a capacity of about 250 c.c.

In analytical work of this kind the decimal or French system of weights and measures is nearly always used, as they are much more convenient than other systems. The gramme equals 15½ grains, nearly; the milligramme (mg.) $\frac{1}{1000}$ of a gramme; the liter about 1¾ pints; the cubic centimeter (c.c.) $\frac{1}{1000}$ of a liter.

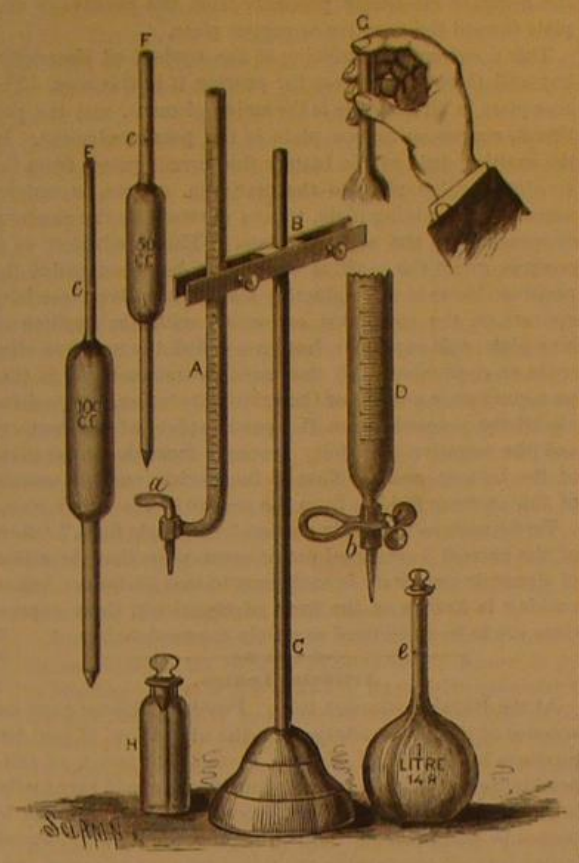
In preparing the salt solution 5½ grammes of chemically pure, dry salt is dissolved in a small quantity of distilled water, the solution diluted to one liter with cold distilled water, and put into a clean glass bottle labeled "*Salt No.* 1." Fifty c.c. of this solution is drawn off with a pipette, diluted with cold distilled water to 500 c.c. (half liter), and put into another clean bottle marked "*Salt No.* 2."

These solutions are then *standardized*—that is, tested to determine just how much silver a given measure of the liquid will precipitate.

One-half gramme of pure silver is dissolved, by aid of gentle heat, in about 3 c.c. of pure nitric acid, and the solution is then diluted to one-half liter with cold distilled water; so that 1 c.c. of the liquid contains just 1 mg. of silver. Fifty c.c. of this solution, drawn off with a pipette, is placed in the titration bottle, and the burette (A or D) is filled to zero with the salt solution No. 2. This solution is then allowed to drop from the burette into the silver solution in the bottle, the flow being discontinued from time to time and the bottle closed and agitated to facilitate the subsidence of the flocculent precipitate. A little experience enables the operator to tell when the silver solution is nearly saturated, and then the contents of the bottle is shaken and allowed to subside between the addition of every two or three drops, so that when at last the drops of salt solution fail to produce any more precipitate in the silver solution, then the total quantity or volume of salt solution used may be accurately read off on the scale of the burette. To avoid any error the test is duplicated, and the results of the two tests, when compared, should agree very closely. If it is found, for instance, that 50 c.c. of the salt solution corresponds to 50 c.c. of the silver solution, then the solution in bottle No. 2 is marked "1 *c.c.*=1 *mg. silver;*" and bottle No. 1, "1 *c.c.*=10 *mg. silver,*" as its contents contain ten times as much salt.

Thus standardized the salt solutions become, when properly used, accurate measures of the amount of silver in a liquid.

In the actual assay of a silver alloy from half to one gramme of the metal is weighed out, put into the titration bottle with 4 or 5 c.c. of nitric acid (of sp. gr. 1·2), and the contents heated by placing the bottle obliquely in a hot water bath. From time to time the nitrous fumes are blown out and the bottle frequently shaken to promote their expulsion. When solution is complete the bottle is removed and its contents allowed to cool. If the alloy contains gold, a small quantity of pure sulphuric acid is added, and the liquid boiled until all the gold has separated. The liquid adhering to the stopper and neck of the bottle having been rinsed down with a small jet of distilled water, salt solution No. 1 is gradually let in from a burette until the silver solution is, as before described, nearly saturated; then salt solution No. 2, from another burette, is added until the exact point of saturation is noted. The readings from the two burettes properly reduced will then indicate how much pure silver the alloy contains.



VOLUMETRIC ASSAY OF BULLION, ETC.

Tests of this kind should always be made in duplicate to avoid error.

In testing photographic silver baths the total quantity of bath is measured, and a clean burette is filled to the zero mark with a definite portion of it, previously diluted with distilled water to about ten times its volume, and well shaken. About 50 c.c. of standardized salt solution is mixed with just enough of a strong aqueous solution of pure potassium chromate solution to distinctly color it. Then the dilute silver solution is gradually let in from the burette, the mixture being agitated after every few drops. As long as there is an excess of salt the orange-red silver chromate formed when the drops of silver solution strike the salt liquid is quickly decomposed and decolorized. When the point of complete saturation is reached this decomposition no longer takes place, and the solution assumes a distinct orange-red color.

The quantity of silver solution required to saturate 50 c.c. of the standardized salt solution is then read off on the burette. As the quantity of silver this volume of salt solution corresponds to is known, the rest of the calculation is is easy.

DYNAMIC ELECTRICITY.

BY GEO. M. HOPKINS.

GENERATION OF THE ELECTRIC CURRENT.

When two dissimilar metals, such as pure copper and pure zinc, are placed in contact in acidulated water, evidences of activity immediately appear in the form of a cloud of microscopic bubbles constantly rising to the surface of the water. If the metals are individually capable of resisting the action of the acid solution, it will be noticed that on separating the metals the action ceases, but it will commence again as soon as the metals are brought into contact. The same action is noticed if the two metals are connected by a wire, which may be either wholly within or partly out of the acidulated water.

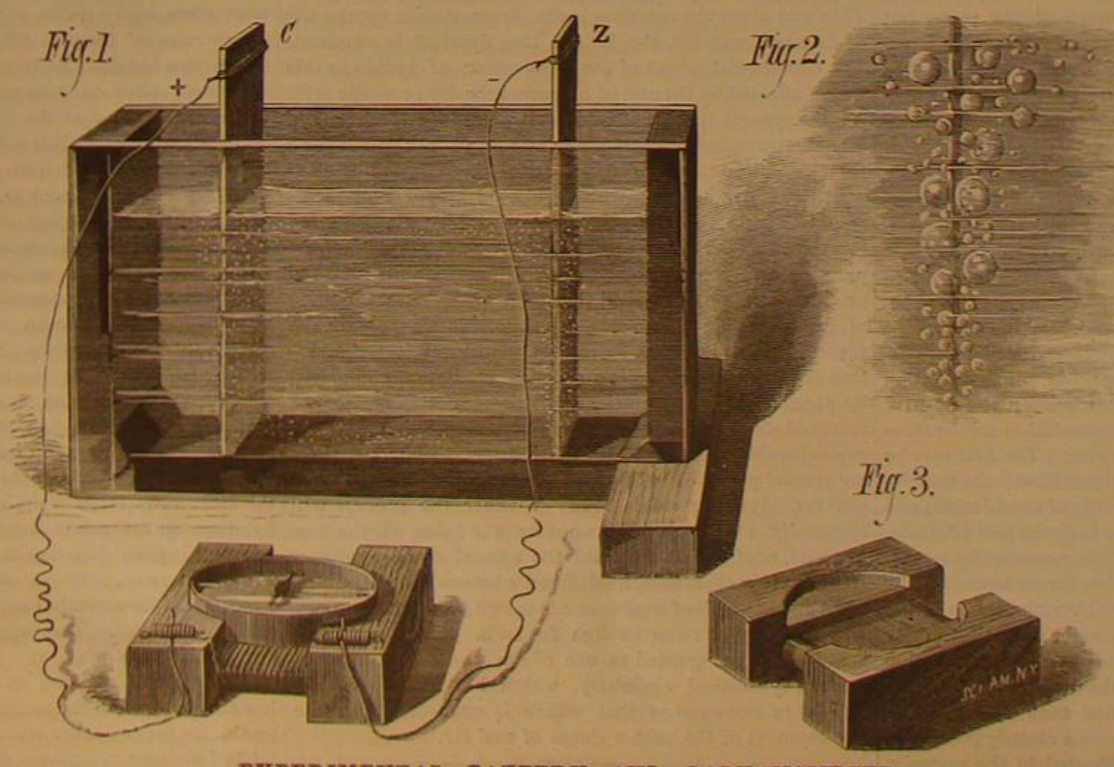
The bubbles which are noticed in this experiment are hydrogen resulting from the decomposition of the water and escape from the copper, and the oxygen resulting from the analysis unites with the zinc, forming zinc oxide.

The copper is scarcely attacked while the zinc slowly wastes away. If the wire connecting the zinc and copper be cut and the two ends placed on the tongue, a slight but peculiar biting sensation is experienced, which will not be felt when the wires are disconnected from the metals.

A piece of paper moistened with a solution of iodide of potassium and starch placed between the ends of the wires exhibits a brown spot, showing that between the ends of the wires there is a species of energy capable of effecting chemical decomposition. If a wire joining the copper and zinc is placed parallel with and near a delicately suspended magnetic needle, it will be found that it is endowed with properties capable of affecting the needle in the same manner as a magnet. This form of energy is dynamic or current electricity, generated in this case by chemical action and confined to, and following a continuous conductor, of which the two metallic elements and the acid solution form a part, the whole comprising a complete electric circuit.

For the purpose of studying the generation and behavior of dynamic electricity the elements referred to may be formed into an electric generator or battery, and the magnetic needle and conducting wire may be combined to form an electrical indicator or galvanometer.

The engraving shows convenient apparatus for making the primary experiments in dynamic electricity. The glass tank or cell is built with special reference to projecting the visible manifestations of the phenomena exhibited in the cell, upon a screen, by means of the lantern, to enable a number of persons to observe simultaneously.



EXPERIMENTAL BATTERY AND GALVANOMETER.

The cell consists of two plates of transparent glass 4 by 6 inches, separated by a half inch square strip of soft rubber, which is cemented to both glasses by means of a cement composed of equal parts of pitch and gutta percha. The cell is nearly filled with the exciting liquid, consisting of dilute sulphuric acid (acid 1 part, water 15 parts), in which are placed two plates, the positive plate consisting of a strip of zinc about one-sixteenth of an inch thick, the negative plate being a strip of copper.

As commercial zinc is so impure as to be violently attacked by the exciting liquid, it is well to dip the zinc strip into the solution, and then apply to it a drop or so of mercury, which amalgamates the surface of the zinc and prevents local action.

When these two plates are brought into contact with each other in the exciting liquid, hydrogen gas is given off copiously at the copper or negative plate, while the action at the zinc or positive plate is almost unnoticeable. If the plates are connected together by a conductor outside of the solution, the same phenomenon is observed.

The plane flat surfaces of the cell offer facilities for the

examination of the plates by means of the microscope, and if so examined it will be found that so long as there is no metallic connection between the electrodes they will remain unaltered, and no action is discoverable; but when the circuit is completed, the first visible indication of action is the sudden whitening of the copper plate as if it were frost-covered; the next indication of action is the formation over the entire surface of the plate of myriads of minute silvery bubbles, which grow until they become detached, when they rise to the surface and escape into the air. These bubbles may be discharged into the mouth of a small test tube, and when a sufficient quantity of gas has accumulated it may be ignited, showing that it is hydrogen.

The appearance of the negative plate when the cell is in action is shown in Fig. 2 greatly magnified. The gas bubbles formed on the surface of the copper are at first very minute, but they rapidly increase in size and begin to merge one into another, taking an upward course. When a large bubble has absorbed a large number of the smaller bubbles and becomes sufficiently buoyant to overcome its adhesion to the plate it rises to the surface and is dissipated.

The bubbles of hydrogen are very bright, appearing and acting much like globules of mercury. Often an equatorial belt of very small bubbles will be seen surrounding a larger one.

The accumulation of hydrogen on the negative plate seriously affects the strength of the current. To ascertain to what extent and at what time this happens, a

SIMPLE GALVANOMETER

like that shown in Fig. 1 will be required. This instrument consists of a common pocket compass, a wooden frame or spool, and about 20 feet of No. 32 silk covered copper wire. The wood spool (Fig. 3) has a recess cut in the top at either end to receive the compass, which is placed a short distance from the flat body of the spool, and the wire is wound evenly around the body back and forth until the spool is full. Then the terminals of the wire are connected with two spiral springs fastened to the ends of the spool and forming "binding posts" for receiving the wires from the battery.

In regard to the adjustment of the compass, it should be arranged with the line marked N S parallel with the wires of the coil, and the instrument should be turned until the N S line is exactly under the needle, then a weak current should be sent through the coil and the deflection noted. The current should then be sent in the opposite direction, when the needle will be deflected in the opposite direction. If the amount of deflection is the same in both cases the galvanometer is in condition for use; but if the deflections differ in degree, the compass must be turned in its socket until the proper adjustment is secured. The only precaution necessary in the construction of this instrument is to select a compass whose needle is delicately poised and vibrates freely.

By connecting the galvanometer with the cell as indicated in the engraving it will be noticed that after a limited time the galvanometer needle begins to fall back toward 0°, a point which it ultimately reaches if the circuit is kept closed; and the shorter the circuit the sooner the cessation of the current. This

ENFEEBLEMENT OF THE CURRENT

is principally due to three causes, one of which has already been noticed, that is, the accumulation of hydrogen on the negative plate. The film of hydrogen not only prevents contact between the exciting solution and the plate, but it actually renders the surface to a certain degree positive, and consequently in nature, although not in degree, like the positive plate. Another cause of enfeeblement of the current is the reduction on the copper, by the hydrogen, of a portion of the sulphate of zinc accumulating in the liquid. This increases the similarity of the two plates, and consequently assists in diminishing the current. The reduction of the strength of the exciting liquid of the cell and the oxi dation of the zinc contribute still further toward the dimi nution of the current. All this results in making the two plates similar in their action, and in a consequent weaken ing of the current; but this chemical action cannot be avoided, as to secure any action in a galvanic cell the exciting fluid must be capable of decomposition. The oxidation of the zinc, the accumulation of hydrogen on the positive plate, and the weakening of the exciting solution are the three great causes of inconstancy in batteries. The first may be remedied in a great measure by amalgamation; the remedy for the last is obviously the strengthening of the solution; and the second, the accumulation of hydrogen on the positive plate, or the polarization of the plate, can only be remedied by removing the plate from the exciting solution for an instant, or by brushing it while in the solution, or by violently agitating the exciting solution. The galvanometer needle faithfully indicates the result of either treatment. The polarization of the electrode may be strikingly exhibited by allowing the copper plate to become polarized and then replacing the zinc with a clean copper strip like the one already polarized. The galvanometer needle will be deflected in the opposite direction, showing that the polarized copper plate acts in the same manner as the zinc; that is, it is positive to the clean copper plate. Now by removing the polarized cop per plate and wiping and replacing it, the deflection of the needle will be much less, and it will not fall back to 0°, until the very slight coating of zinc which has been deposited on the copper is removed from the polarized plate by means of emery paper or otherwise. Precisely the same effect is noticed when a newly amalgamated zinc plate is opposed to an oxidized zinc plate. The oxidized plate in this case will act as the negative.

This method of showing the effect of the polarization of the plate is much more conclusive and convincing than to employ a secondary battery, or to treat the element under examination as such by connecting it with another battery, as the phenomenon attributed to the polarized plate manifests itself in an unmistakable manner while the plate remains in position and under the conditions of actual use.

Although the zinc is called the positive plate of the battery, and the copper the negative plate, the positive electricity proceeds from the copper through the external portions of the circuit toward the positive or zinc plate, and the negative electricity proceeds from the positive or zinc plate toward the negative or copper plate.

This is extremely confusing to the student of electricity, but still there is a reason for putting it in this way. The zinc plate in all batteries is the active element, and the platinum, copper, or carbon plate is the passive element. In the exciting fluid of the battery the current passes from the zinc or positive plate to the platinum, copper, or carbon, negative or receiving plate, thence outward by the conductor attached to the negative plate. This conductor, as it conveys away the positive electricity, has been called the positive electrode or conductor; and as negative electricity appears on the conductor connected with the positive or zinc plate, this conductor has been called the negative electrode or conductor. All that need be remembered is that on a conductor outside of the exciting solution, the positive electricity proceeds from the passive plate of the battery, and the negative electricity proceeds from the active plate of the battery, and the flow of the electric current outside of the exciting fluid is from the passive to the active plate.

Terms such as "electric current," "electric fluid," "flow of the current," are based on the assumption that the action of dynamic electricity is analogous to that of fluids; but as nothing is known of the form of electricity, these expressions are to be considered as purely conventional.

Artificial Indigo.

At the Royal Institution lately, Professor Roscoe gave an account of the latest advance in the utilization of coal tar products by Baeyer, of Munich, in the fabrication of artificial indigo, which the lecturer considered would eventually become of great commercial importance. At present, it cannot be said that the competition of artificial and natural indigo is at all comparable with that between alizarine and madder, by which the last named dyestuff has been driven out of the market; on the contrary, artificial indigo from coal tar is as yet dearer than the vegetable product from the East. It appears that native indigo was decomposed by Fritsche so long ago as 1840, and aniline was then obtained from it. Subsequently a crystalline substance called isatin was procured from indigo; and, later, indigo was made from isatin. The next step was the production of isatin from an independent source, and this has been done in three different ways, two of which are too costly for commercial use. Baeyer has alone carried it out in a practicable manner. He commenced with cinnamic acid obtained from oil of bitter almonds, but this was much too costly. It has been found by Dr. Caro and Mr. Perkins that cinnamic acid can be obtained from toluene, which is a product of coal tar. From cinnamic acid, however obtained, a complex acid can be produced which is now for brevity called propiolic acid. This acid gives the colorless isatin, from which, by the use of suitable reagents, the indigo blue dyestuff is obtained. The commercial aspect of the production of indigo in this way is affected by the cost of preparing the dry propiolic acid. At the present time the materal is placed in the hands of Manchester calico printers at the rate of 6s. per pound for a paste containing 25 per cent of dry acid. The acid itself is worth 50s. per kilo, of which only 68·58 per cent yields actual dye, so that the price of artificial indigo, being not less than 73s. per kilo, is more than twice the value of the pure natural color. Hence competition with the Oriental product is not possible until the makers can reduce the price of dry propiolic acid to 20s. per kilo, and also obtain the theoretical yield of dye therefrom. Still the fact remains that the artificial process is a chemical reality, only hindered by economical considerations, which may at any time be removed, from taking a good commercial position. At the present exhibition of woolen fabrics, etc., in London, there are several pieces of stuffs dyed with indigo obtained from coal tar. It is impossible to say whether the process will eventually exert much influence on the value of the raw material, or if it will supplant the natural dye. Professor Roscoe thinks there is such a difference between the characteristics and methods of treatment of the two products that there will probably be room enough for both. The new process is at least to be regarded as one of the greatest triumphs of modern synthetical chemistry, which has had no field so fruitful in successes as that which is connected with the development of the hidden riches of coal tar.

Artificial Refrigeration.

The production of cold and even ice by artificial means is now a necessity in many industrial processes. According to the continental systems of brewing, great cold is required not only during the actual brewing process, but also for months afterward while the beers are maturing in the cellars. In this country the natural production of ice is very uncertain, and some winters may pass without sufficient being formed to be worth collection, and even when ice is plentiful here we have no suitable arrangements at hand for storing and preserving it for use in warmer weather. For these reasons many ingenious contrivances have been devised for the artificial production of ice, and it may not be uninteresting to give some explanation of the theories on which these machines are founded. When a volatile liquid evaporates, a large amount of heat is necessarily absorbed by the resulting vapor, and is rendered latent or imperceptible to the senses and the thermometer. This heat is taken either from some of the remaining liquid or else from the medium in which the liquid is in contact. The cold produced by evaporation is very evident with a volatile fluid like ether; when a little of this liquid is placed in the palm of the hand an intense feeling of cold is observed; the ether, in evaporating, must absorb heat, and therefore takes it from the nearest body, which is the hand, and thus produces a corresponding reduction of temperature. The evaporation of volatile liquids is greatly assisted by a reduction of pressure; and, thus, if a little ether be placed in a shallow dish, floating on a thin layer of water, and the whole be placed under the receiver of an air-pump, there is not much difficulty in freezing the water by a rapid exhaustion of the air; in this case the vapor of ether is renewed almost as fast as it is formed, and fresh quantities of liquid ether are thus volatilized. The various ice-making and refrigerating machines are constructed so as to utilize this property possessed by all volatile fluids. If the ether be placed in a metallic vessel exposing a large surface to water or any other fluid which requires to be cooled, all the heat necessary for the volatilization of the ether must be taken from the water; the volatilization of the ether is assisted by means of an air-pump, and the ether vapor is then conveyed through pipes to another vessel also surrounded by cold water, where it gives up the same amount of heat again, and is thus converted back into a liquid. In this way a comparatively small quantity of ether will cool or even freeze an indefinite quantity of water, and the whole of the ether can be condensed again into the liquid state. Instead of ether, liquid ammonia, sulphurous acid, or other very volatile substances may be used, and a variety of complicated mechanical arrangements are introduced to assist in the volatilization, condensation, and preservation of the volatile agent used. These mechanical arrangements have been so far perfected that even water itself has been used as the evaporating agent, and ice has been successfully produced by such means. Great cold and even ice has also been produced by the expansion and contraction of atmospheric air by machines constructed on a similar principle to those we have just referred to. For brewery purposes ice is not actually required, but rather a reduction of temperature equal to about 25° F. A machine (says the *Brewers' Guardian*, from which we derive the above) that will effect this successfully and economically will probably be required in every brewery of importance before many years have elapsed.

Speed of Locomotives Then and Now.

From the comments of the Philadelphia *Ledger* on the Stephenson centenary, it appears that a greater speed than ten miles an hour for the then projected Liverpool and Manchester Railway was not to be thought of for fear of alarming the people and so defeat the charter. Such breakneck speed was "grossly in the teeth of all experience," fifty years ago. The *Ledger* says:

"The reminiscences are both interesting and curious now, when heavy trains are carried over long distances at steady rates of forty to fifty miles an hour, and when the locomotive has attained to a speed for experimental purposes of seventy miles on good tracks. It is to the steady gait of the railway engine at the forty-mile speed that we desire to invite attention. This is a regular rate on several railways radiating from Philadelphia, but for our present purpose we shall select express trains on the West Jersey Railroad. Suppose a passenger, starting at Cape May at seven o'clock in the morning for Philadelphia. He may have that delicate and accurate piece of mechanism, a chronometer watch, in his hand, and the ponderous locomotive of his train is in front of him. The watch may weigh five ounces, the locomotive thirty tons; yet the leviathan of iron is as precise in its movements and as true to time as the smaller instrument of steel, brass, platinum, and gold. As the passenger, with watch in hand, looks first at its dial, then at the watchful conductor, with his eye on his own timepiece, regulated by standard, he sees the signal to start the moment the hand on the dial shows seven o'clock. Then the engineer, with his hand on the lever, lets loose the pent-up steam, and away goes the engine. It is due at the end of the track in Camden, 81½ miles away, precisely on the moment when the same hand marks the arrival of nine o'clock. Not a minute earlier or a minute later. The engine is to go over the eighty-one and a half miles while the chronometer watch marks precisely one hundred and twenty minutes. When that time has exactly elapsed the engine is at the Camden end of the track; for the instances when this is not accurately accomplished are rare exceptions, and seem to weigh on the minds of conductor and engineer. The wheel that turns the minute hand of the watch has turned 120 times, and traversed about 180 inches, while the five-foot driver of the engine has turned 27,394 times, and has traversed 430,320 feet, or 5,163,840 inches! This, as already said, is done daily with the utmost regularity, and, considering the steadiness with which it is done, and the varying load drawn by the machine, it may be considered as well a marvel of mechanical skill as an eloquent comment on the doings and sayings before that parliamentary committee when the project for the Liverpool and Manchester Railway was under consideration."

NEW INVENTIONS.

An improved monkey-wrench has been patented by Mr. Allen K. Sheppard, of Camden, N. J. It consists of a wrench in which one jaw is attached to a shank that slides within a hollow handle to which the other jaw is fastened, the handle having a cam-dog that acts upon a block resting against the sliding shank, which, with its jaw, can be locked in any desired position or released by turning the cam-dog.

An improved air compressor and faucet has been patented by Mr. Samuel A. Livingston, of East New York, N. Y. The object of the invention is to aerate beer, as well as create a pressure by forcing air up through the liquid, and also to allow a keg to be tapped without permitting the natural gases of the liquid to escape.

A simple and convenient device for preventing a door from swinging back against the wall and for holding the door open, has been patented by Mr. John J. Schlueter, of San Francisco, Cal.

An anti-freezing closet has been patented by Mr. John B. Gordon, of Cutler, Ill. The object of this invention is to furnish anti-freezing closets so constructed as to prevent the freezing in the coldest weather of canned fruits, meats, and other articles, and thus preserve them in good condition.

An improvement in wash basins has been patented by Mr. Chas. E. Robinson, of New York City, N. Y. The invention relates more particularly to that class of basins known as the "Wellington," which consist of two concentric basins, the inner one of which overflows over its top edge into the outer one, both of which discharge through a central opening at the bottom into a circular trap suspended in a circular trap-chamber, which is detachably held to the bottom of the outer basin and coupled to the waste-pipe.

A French Photographic Salon.

A handsome salon on the first floor is a fitting reception room to the studio, which of late years has attained such high reputation, both in Paris and in Milan, as that of MM. Benque et Cie. Fluted columns, draped with rich maroon curtains, are at the entrance to this apartment, into which not a ray of direct sunlight enters. All is soft and somber within. There are extensive windows, but these are hidden by loosely festooned drab silk, so that while there is plenty of illumination, it is subdued and yet refulgent. The walls are of chocolate brown, the damask, chairs, and furniture gold and black, the fittings rich and handsome. This fine carbon portrait in frame complete, standing a meter high (39 inches), is a specialty of the firm Benque et Cie., and sells for a thousand francs. These pictures on the table are what is termed the "Paris portrait," similar in height to the panel or promenade, but half an inch broader, a very attractive size, but still, to our thinking, not so elegant in its proportions as the promenade. Of cabinets, there is also a collection, not large, for we believe that there are not more than a score of photographs in the whole salon. Two or three cartes are here also, but during the past three months, our host tells us, not a single carte picture has been taken in the establishment. Here, too, we find Madame Nilsson, not in a frame, but in the flesh; she is looking at some portraits of sister artistes, after undergoing a lengthened sitting. "We have just taken one hundred clichés," our friend whispers, "and within the space of an hour and a half."

Before we walk upstairs, we are presented with a card of terms. Here it is:

12 Cartes-de-visite, 30 francs; the dozen following, 20 francs; 12 cabinet portraits, 80 francs; 6 cabinet portraits, 50 francs; the dozen following, 60 francs; 12 Paris portraits, 120 francs; 6 Paris portraits, 80 francs; the dozen following, 100 francs.

In the Benque establishment, gelatine reigns supreme. "Do you develop at once, or in the evening?" we ask. "Always in the evening—we are now so confident of our results; of those hundred clichés just taken of Madame Nilsson, not one will be developed till to-night." The development is done by artificial light, by means of a gas-burner behind ruby glass, a convenient tap permitting the photographer to heighten and lower the jet at will. The developing, too, for the most part is done mechanically. As soon as some idea has been obtained of the exposure of the plate, and the time and strength of development, half a dozen clichés are put together into a rocking tray. The developer is poured over the films, and then the tray rocks to and fro by itself, kept in motion by a heavy pendulum that swings underneath. It saves a world of trouble, our host tells us, and produces very uniform results. We always like to take the sense of photographers on the development of dry plates, and we put the question whether pyrogallic or oxalate treatment is preferred. "*Oxalate toujours—Oxalate toujours*" is the energetic reply.

The studio is large and roomy—the largest in Paris, our friend says; at any rate, it measures fifteen meters (nearly fifty feet in length). There is nothing particular to be noted about the lighting; top-light is the dominant light. The walls are of very dark brown, and we remark upon this. They are dark, admits our host; but when they are again painted, we shall color them darker still. Large plates are in general use at the Benque establishment, and large cameras. As a rule, six poses are taken on one plate. We mentioned the other day the circumstance of Madame Judic being portrayed 132 times in this studio at one sitting. She was at the atelier for two hours only, and, during that time, changed her dress four times. Twenty-two poses were taken, of each six clichés, with an exposure of about three seconds. The negatives were developed at night, and there were only two technical failures. "Elle ne voyait plus," when she went away after the ordeal, our host remarked of the fair comedienne. Certainly, such rapid work could not have been undertaken before the days of gelatine. There is no dark room adjacent to the studio; the plates in their slides are sent up a shaft from the laboratory below, and delivered close to the assistant's hand in the studio, after the manner of Messrs. Window & Grove's studio, which we described the other day. The exposures are made by means of the ordinary pneumatic-Cadett shutter.

In the enlarging-room there is one point worthy of mention. The camera is disposed pretty well as usual; but just in front of the transparency is placed a swing looking-glass or mirror, perhaps twenty inches high. This permits, in a most convenient manner, the concentration upon the transparency of light that comes through a small opening in the wall, and if the mirror is turned to its proper angle by hand, the hand being never quite steady, no partial lighting is likely to ensue.

There are two printing rooms, and MM. Benque send the negatives to one or the other, according to their density. Thus in the top printing room, which is on the roof, the denser clichés are to be found, and those which will bear strong light; while in the more subdued light of the lower printing room are located such clichés as require more delicate treatment. From 1,200 to 2,000 prints are produced here every day, for the firm has now a large publishing connection, and their portraits go to every capital in Europe. Printing to this extent would be impossible in a London atmosphere, and for this reason our big metropolitan firms have usually an establishment in the suburbs for the purpose. But in Paris they burn charcoal more than they do coal, and, moreover, when this is used, it is of a much less sooty character than that employed in this country.

Starch, prepared fresh every day, is invariably employed for mounting at the Benque establishment; where so much publishing is done it is a matter of imperative necessity that the mounting should be depended upon, especially as black mounts are largely used just now. We are glad to hear, by the way, that of late these black mounts are more satisfactory than was the case a short time ago. Numerous cases of fading were then rife, and the cause, as our reader knows, Mr. Spiller was able to trace to the presence in the mount of a considerable quantity of sodium chloride, or common salt. The test to discover this—namely, the adding of a few drops of nitrate of silver solution to water in which one of these has been steeped for some hours, and observing whether any turbidity results—is so simple that any photographer can make use of it for himself.

Besides making itself known through its publications, the firm also adopts the practice of exhibiting its works largely in Paris. The Boissy d'Anglas, although a turning out of the Faubourg St. Honoré, is not a very frequented thoroughfare, and hence visitors to Paris might well escape seeing the studio. MM. Benque et Cie. have therefore opened an exhibition in the Rue Royale, that familiar street leading from the Madeleine to the Place de la Concorde, and here a display of the firm's finest work is exhibited. A *pièce de resistance* is always present in the form of a scene from one of the Paris plays. Whatever happens to be popular on the boards for the moment is here illustrated. The boat-scene from Michael Strogoff is the present attraction, a fine enlargement from nature, measuring perhaps three feet across, and including the portraits of half a dozen favorites. Any scene is chosen in which many characters are grouped, and the photograph being well executed, it naturally draws considerable attention. A magnificent portrait of Gounod, another of Judic, and a forcible picture of that Swedish professor with the hard name who discovered the North East passage, are also attractions at the little exhibition in the Rue Royale.—*Photographic News.*

Ventilating the St. Louis Tunnel.

The annual report of the St. Louis Bridge Company has the following in regard to the ventilation of the tunnel which forms part of the western approach to the bridge:

"The increasing number of trains passing through the tunnel has rendered its ventilation a serious question, as the peculiar arrangement of grades and lateral archways makes it almost impossible for natural ventilation to take place. For some months past it has been almost impossible to keep the track gangs long enough in the tunnel to properly repair the track; and, in addition, the great quantity of smoke pouring out of the openings at St. Charles and Second streets has caused us to be threatened with numerous damage suits on account of this nuisance. There remained, therefore, but one course to pursue, to put up a shaft and mechanical ventilator, to thoroughly exhaust the gases from the tunnel, and to discharge them at a sufficient height not to annoy the public.

"Col. C. Shaler Smith has devoted a great deal of time and attention to this problem, and the very ingenious plan devised by him is now in the course of being carried out. The requisite property has been condemned and acquired, and the iron for the chimney (which is of boiler plate, and will be 15 feet in diameter and 125 feet high), is now on the ground, and the erection has begun. A 120 horse power engine is under construction, and a pneumatic screw, having a capacity of 400,000 cubic feet of air per minute, will be placed in the base of the shaft and worked by this engine. To enable the repair gangs to work continuously in the tunnel, and to silence the complaints made as to the smoke at Main and Second street bridges, a small air screw on the same principle as the large one has been put up at the St. Charles street opening, and is now exhausting the gases at the rate of 30,000 cubic feet per minute. The effect of this small model, which is only 4 feet in diameter, leaves no doubt as to the success of the large screw when it shall be placed in position. Room is being prepared in the engine house for a 16-light electric machine, should it be considered advisable to light the tunnel in this manner. No extra power will be needed, as the engine ordered will be of sufficient capacity for both fan and electric light."

A Railway Tunnel through a Volcano.

The rocks which constitute the southern island of New Zealand are for the greatest part of the archaic type, consisting principally of gneiss, granite, mica schist, phyllite, quartzite, and felsitic rocks. They are partly covered by palæozoic strata, which are folded up into innumerable troughs and saddle-backs throughout the province of Canterbury, and which partly belong to the carboniferous period, so that there are prospects for a future discovery of coal beds. By far the greatest interest, however, is offered by the extensive volcanic phenomena of the island, and among them the extinct volcanoes upon the Banks peninsula, east of the town of Christchurch, are prominent. This peninsula, now only connected by bands of low and recent deposits with the mainland, was once a complete island, only formed by volcanoes, which rose up from the bottom of the sea. The special construction of such an extinct volcano has been made visible by a tunnel of 2,620 meters' length upon the railway between Christchurch and Littleton, which has pierced through the walls of a volcanic cone and thus has laid bare its structure of successive streams of lava and beds of scoriæ, ashes, and tufæ, which are again intersected by dikes of younger volcanic rocks. This is perhaps the first volcano through which a railway has been constructed.

Another peculiarity of New Zealand is the extremely frequent occurrence of bones of those large wingless birds, which by the aborigines were called "moa," and which belong to the family of the Dinornithidæ, of whom the largest representative, *Dinornis maximus*, has reached the considerable height of ten and a half feet; the largest deposits of these bones were found in the Point cavern and the marshes of Grenmark. There is now do doubt that these gigantic birds were contemporaneous with man, and that an early human race were moa hunters in these islands, who lived upon the flesh of these birds at a time when the glaciers extended still very much below their present boundaries, for bones, tools, and other remnants of these early moa hunters are frequently met intermingled with bones of the now extinct Dinornithidæ.

Earthworms and Anthrax.

An important report was presented to the Académie de Médecine, at its meeting on the 17th inst., by M. Villemin, in the name of a commission appointed to investigate the statements of M. Pasteur as to the presence of the germs of anthrax-bacteria in the soil, and their transportation by earthworms, statements which had been contradicted by M. Colin, of Alfort. In the investigations of the commission they first inoculated five guinea pigs with earth taken from the soil over a trench in which animals dead of anthrax had been buried twelve years previously. All the guinea pigs died, the first four from septicæmia, the fifth from well marked anthrax, and the latter presented numerous bacteria in the blood of the heart and the spleen, which organ was considerably enlarged.

A second similar series of guinea pigs were inoculated with earth from above a pit in which animals dead of the disease had been buried for three years. The first four of these also died of septicæmia, and the fifth of anthrax, with characteristic bacteria. A third series were inoculated with "virgin soil"—*i. e.*, earth from a spot in which, "within living memory," no animal dead of anthrax had been buried. All of these continued well, presenting only at the point of the inoculation a small nodosity the size of a nut, and consisting of an abscess inclosed in a pyogenic membrane. The first two of these experiments with the suspected earth were repeated, six guinea pigs in all being inoculated. Of these all died, five of septicæmia, the sixth of anthrax. Two other guinea pigs were inoculated with blood from the animals to which anthrax had been communicated in the first two series of experiments, and both died of the same disease. A drop of blood taken from the ear of one and "sown" in some decoction of fowl, reproduced pure and abundant anthrax-bacteridia.

Some worms were also taken from the earth over the pits in which the animals had been buried three and twelve years before, and their excrement (the worms being still alive) was diluted with a little distilled water, and with it three guinea pigs were inoculated. Of these two died from septicæmia, and the third from anthrax. Other three guinea pigs were inoculated with the excrement of worms taken from soil beneath which, during the Commune, human bodies had been interred. One of the guinea pigs died from septicæmia, the other two continued well. Lastly, the excrement of worms collected over the trench in which the animals had been buried for twelve years, and treated by "cultivation," gave rise to a rapid production of bacteridia, which, inoculated into two guinea pigs, caused the death of both by anthrax. The experiments and report thus give a triumphant corroboration to the assertions of M. Pasteur.—*Lancet.*

Compressed Gun Cotton.

BY M. EISSLER.

Through the systematic study of Abel, an eminent chemist, this material has now attained quite a position in England, as by means of his analytical and synthetical researches he has found the causes of the instability observed in that substance, and has traced its occasional liability to undergo spontaneous combustion to the presence of minute quantities of foreign substances of comparatively unstable character, produced by the action of nitric acid upon resinous or fatty substances retained by the cotton fibers.

Some parts of his mode of manufacture may be considered comparatively safe, as he carries it on with the material in a wet, therefore uninflammable state. His mode of converting it into a minute state of division is the main improvement which he introduced, as it allows of a more perfect cleansing, and then its conversion into highly compressed masses is the main feature of his mechanical modifications; otherwise, he admits, one has only to follow Von Lenk's plan, and adhere to his rules.

The process of manufacture, as pursued by Prentice & Co. or the Liverpool Cotton Company, is as follows:

Clean cotton, picked as free as possible from foreign matter, is brought into a uniform and open condition, by being passed through a carding engine.

The rolls thus obtained are dried in a triple cylinder, by means of a steam jacket.

When completely dried it is placed in large tins and carefully covered.

After standing in these till quite cold, the cotton is weighed out in quantities of 1 pound each, and carried by a boy to the dipping vessel. Here each pan is charged with about 12 gallons of a mixture of 3 volumes of sulphuric acid, 1·84 specific gravity, and 1 volume of the strongest nitric acid, the whole being kept cool during the action by currents of cold water, which circulate around the vessel.

In this mixture the cotton is dipped, and after it has been in about three minutes the workman lifts it on to a grating, just above the acids. Then, with a movable lever, he gently squeezes it until, roughly speaking, it retains about ten times its weight of the liquid.

Thus saturated with the acids, it is allowed to remain in well-covered earthenware pots for twenty-four hours, the pots during this time standing in a shallow trough containing water to keep down the temperature, sufficient acid being added to cover the cotton. The chemical change in the cotton is now complete, and the further processes are for washing and pressing.

First, the large excess of acid is driven off by a centrifugal machine, and the waste acid is caught by a jacket surrounding the revolving portion of the machine, and collected in a receiver. These machines are on the principle of the wringing machines employed by laundries to dry clothes (whizzer).

On leaving the centrifugal machine the gun cotton has to be washed. This operation also requires great care, because the acids which the gun cotton yet retains would give rise to a considerable development of heat if mixed slowly with water. At such an increased temperature the gun cotton would be decomposed, or "fired," as it is technically called. Therefore it has to be brought at once in contact with a large body of water.

To perfect the washing, the cotton is subjected to the action of water for one, two, or three weeks, and afterward boiled in large vats by the injection of steam. By this latter operation the less stable compounds are destroyed and extracted, and the purified gun cotton is transferred to the beating tanks.

This is a simple contrivance for converting the gun cotton into pulp. It is a machine similar to the one used in paper mills and called Hollander.

The pulp is now removed from the tank to a poacher, where it is agitated with a large quantity of water by a wheel, and here it has to be washed till it answers the heat test, which the chemist now applies.

When his report is favorable, the pulp is transferred to a vat and mixed with a small quantity of caustic soda.

The further processes of abstracting the water and moulding the pulp into cartridges or other shapes, is performed by hydraulic pressure or other pressing machines, which are very ingeniously arranged, and great credit is due to the manufacturers for the nice and elaborate machinery they have adopted for the treatment of their products.

Where the cartridges are made under light pressure they are put on perforated trays, and dried in chambers heated with hot air.

In establishments where the gun cotton is mixed with oxidizing salts, these are mixed in regular gunpowder incorporating mills, of light but very elegant pattern.

The great difference between the process of manufacture described above and that of Von Lenk consists in the introduction of the pulping operation devised by Abel. This improvement admits of very searching purification, and also of more reliable testing, and of the subsequent compression.

PROPERTIES.

Before it has been reduced to pulp, gun cotton has the same appearance as the original fiber, but it is harder to the touch; it has neither taste nor smell.

It is insoluble in water, ether, or alcohol. Dilute acids and alkalies have no action upon it, but a lower substitution product is formed by the action of nitric acid of the specific gravity, 1·45.

Strong sulphuric acid dissolves it with difficulty. Caustic potash dissolves it.

Much uncertainty prevailed for a long time as to whether gun cotton was liable to spontaneous combustion or not. As I have shown in my former articles, it had been used in Austria for twelve years, where it underwent the severest tests, and was held by the best authorities to be perfectly safe, but it was at last rejected on account of its instability, and also that other governments abandoned it after experimenting with it extensively. Prof. Abel, in his valuable researches, ascribes the reason of its decomposition to be mainly due to impurity, generally resulting in the process of manufacture, from the action of the acids on resinous matter in the imperfectly washed cotton, and certainly the experience of the last few years speaks in favor of his theory, as no accidents from that score are on hand.

It is only in late years that the true cause of chemical instability, which belongs to the whole class of nitrated organic compounds, has been clearly defined, it being the life question of our modern high explosives.

After their nitration a certain portion of acid—sulphuric, nitric, and hyponitric—always adheres to those compounds, more or less, according to their form and structure. From a liquid explosive substance like nitro-glycerine, the acids are easily washed out by churning it with water first and then with alkaline solution. But a granular, flocky, or fibrous material, like cotton, retains the acids with far greater tenacity, particularly the nitrous and hyponitric acids, which every nitrated organic compound has a strong tendency to retain.

It is quite clear that if there is hyponitric acid present, that highly corrosive material, which attacks almost every organic compound, even at the ordinary temperature, must be removed; if not, it will slowly but surely lead to an incipient decomposition, which, acting on a nitrated substance, sets free portions of dioxide of nitrogen or hyponitric acid.

From nitro-glycerine the corrosive acid is washed out with the utmost facility, and from the moment when the importance of that operation became fully appreciated it has never been neglected. Hence the chemical stability exhibited by dynamite under all conditions of climate.

Although nitro-glycerine has exhibited, upon the whole, greater chemical stability than gun cotton, yet it acquires that superiority only after being thoroughly purified from acid at the factory. When it contains free hyponitric acid it cannot be stored at all in hot weather, and even during the course of its manufacture it has several times given rise to a decomposition, ending with explosion and loss of life. The instability of the crude article contrasts so strongly with the stability of the pure nitro-glycerine in dynamite as to remove every trace of doubt regarding the decomposing influences of the adhering acids.

FUMES.

Among the most grievous complaints of miners about modern explosives is the poisonous nature of the fumes emitted, which exposes them to most serious inconveniences.

The gaseous products of the explosion of gun cotton differ from those of nitro-glycerine, as gun cotton lacks 24·24 parts of oxygen in 100 for the complete conversion of its carbon into carbonic acid, consequently we have the following to be the percentage composition of the resulting gases:

Carbonic oxide	28·55
Carbonic acid	19·11
Marsh gas	11·17
Nitric oxide	8·83
Nitrogen	8·56
Aqueous vapors	21·93
Total	98·15

The large amount of carbonic oxide is very deleterious and even dangerous when pure gun cotton is exploded in a close place.

It is very clear to my mind why English manufacturers have adopted the admixture of oxidizing salts (saltpeter, nitrate of baryta) with gun cotton, as the oxygen contained in the salts effects a more complete combustion, rendering the resulting gases less obnoxious than those resulting from pure gun cotton.

GUN COTTON IN MINING OPERATIONS.

In the compressed form gun cotton is susceptible, like nitro-glycerine and its preparations, of explosion through the agency of an initiative detonation (cap). Compressed gun cotton may therefore be applied with the same facility as dynamite and analogous substances in all mining and blasting work. On a whole the mixture of gun cotton and salts is not as sensitive to concussion as dynamite, consequently an extra strong cap is required to detonate it. As the highest nitrated product of cellulose (trinitro) still demands 24·24 parts of oxygen for the conversion into carbonic acid of the carbon in 100 parts, it is evident that the most explosive gun cotton producible must be inferior in explosive power to nitro-glycerine, which contains a very slight excess of oxygen. Some authorities claim that, in spite of its high state of compression to which English manufacturers have brought it, its strength is much less than dynamite.

Here, also, it is clear why the English manufacturers have adopted the use of an admixture of oxidizing salts, as stated before; but the question will present itself: Is not the quickness of the explosion less rapid through this admixture than of pure cotton?

Where great local action is required, nitro-glycerine or dynamite competes advantageously with those substances. Some careful comparative experiments made by the German engineer corps, at Graudentz, with Nobel's dynamite and Abel's compressed gun cotton (made at the English government works), demonstrated that dynamite produced somewhat greater local or shattering effects than gun cotton.

The plastic condition of dynamite and similar preparations gives them an advantage over the rigid, compressed gun cotton in blasting operations, as plastic powders may be inserted more readily into rugged and uneven bore-holes, and may be made, by application of pressure, thoroughly to fill the part charged. Every miner is aware of the importance of having his charge well home in the bottom of his hole, filling the whole cavity. And this can only be accomplished with a plastic powder.

The increased effect derived from this mode of applying plastic explosives is far greater than is generally believed.

Volume for volume, it is impossible to put the same weight in a bore-hole for a certain given space; or, in other words, if one has a cartridge of dynamite, say one inch diameter and four inches long, and one of compressed gun cotton of the same size, the dynamite cartridge will weigh more; consequently one has more explosive material in the same space, owing to the higher specific gravity of dynamite, and as a consequence larger bore-holes are required when using gun-cotton, which increases the cost of mining.

The cartridges of compressed gun cotton are rigid, stiff, and every miner knows there should be no air chamber round the charge, for the expansion which it causes not only lessens the power in proportion to its dilution, but actually decreases the tension of the gas in a much greater measure. Stiff cartridges cannot be introduced into a bore-hole without leaving a considerable air chamber round the charge, particularly as bore-holes generally deviate a great deal from the circular shape.

It is difficult to calculate even approximately the relative proportions of the unoccupied space and the charge, but certainly the loss will amount to considerable. When a loose mass of gun cotton is ignited in the air it burns rapidly away without any explosive effect. But if the ignition takes place in a closed chamber, the gases first produced immediately penetrate the mass of the cotton, and the whole is instantaneously decomposed. According to some authorities gun cotton will not explode below a temperature of 280° Fah.

Gun cotton has the great advantage over dynamite that it does not freeze, and therefore needs no thawing out, which is appreciated in cold climates. It does not suffer from exudation, and when properly made has good keeping qualities.

One great advantage again of nitro-glycerine and its preparations is that they remain unaltered under water, and can be used in wet bore-holes with the same facility as in dry holes, and although compressed gun cotton, when containing 10 per cent or 15 per cent of water, can be exploded, it requires a very strong exploder or a dry primer to accomplish it, consequently for work under water dynamite is preferred.

The cost of these two materials also differs greatly; the expense of producing gun cotton must be 20 per cent or 25 per cent higher than dynamite; therefore, when the question of competition arises, the latter has the advantage.

In the last six or seven years there have been brought forward in England (since Abel perfected his system of reducing gun cotton to a fine state of division and compressing it) several special preparations of gun cotton, for which peculiar merits are claimed by their advocates. One of those preparations, manufactured by the Gun Cotton Company, is a mixture of finely divided gun cotton and saltpeter. Another, the Tonite Company, at Faversham, mixes gun cotton with nitrate of baryta. Which of these is the best practical experience alone can form the estimate.—*Mining and Scientific Press.*

ENGINEERING INVENTIONS.

An improved bridge has been patented by Mr. August W. Brenner, of Coleman, Texas. The object of this invention is to construct substantial bridges of wood adapted for long spans, and which can be put up where iron bridges would be too expensive. The invention consists in a bridge composed of arches having a central trussed portion, and ends formed as trusses that support the central portion and sustain the end thrust.

An improvement in ore washers has been patented by Mr. Burrall A. Peirce, of Mouth of Wilson, Va. The invention consists in combining guides and swinging shovels on the ends of blades, the latter arranged on the rotary shaft of an ore washer.

TEN years ago a blast furnace which would make 400 tons of metal per week on 600 tons of fuel was considered a big thing. We have blast furnaces in Pittsburg which produce 1,500 tons of metal per week on less than 1,500 tons of fuel. The old method of heating permitted the flame to pass out of the furnace stack at a temperature of 3000° F. We are now using the regenerating stoves in Pittsburg, and do not let the gases out until we have utilized all the heat except 300°.

THE International Geographical Institute of Berne has put forward a project for the establishment of an international school for training travelers. The programme of study is a formidable one, and is divided into two distinct divisions. The first includes instruction in numerous branches of knowledge more or less necessary for a traveler, and the second practical training in the field.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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Cook's Infusorial Earth. A superior quality. Apply to D. Judson Cook, Drakeville, Morris County, N. J.

Wanted—To trade territory of my patent Buggy Top for second-hand engine boiler and machinery. J. F. Fowler, Alliance, O.

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Persons having Patented Specialties they want placed on the market, address "Agency," P.O.Box 985, Prov., R.I.

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Light Tramway Locomotives for wood or iron rails. Steam Street Cars. W. A. Gilday, 54th St., Phil'a, Pa.

J.J.Callow's new grain'g and letter'g catal'g, Clevel'd, O

18 ft. Steam Yacht; also 2 H. P. Engine and Boiler. Geo. F. Shedd, Waltham, Mass.

Second-hand Engines, Boilers, and Machinery. Send for price list. D. Stevenson, Jr., Harrisburg, Pa.

Parties owning Patents relating to Light Hardware, that wish the goods manufactured in quantity, or have patterns made for same, will find it to their interest to address Geo. Van Sands, Lock Draw 132, Middletown, Ct.

Peck's Patent Drop Press. See adv., page 14.

Houghton's Boiler Compound contains nothing that can injure the iron, but it will remove scale and prevent its formation. Houghton & Co., 15 Hudson St., N. Y.

Tarred Roof'g, Sheath'g Felts. Wiskeman, Paterson, N.J.

Long & Allstatter Co.'s Power Punch. See adv., p. 13.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Abbe Bolt Forging Machines and Palmer Power Hammers a specialty. S. C. Forsaith & Co., Manchester, N. H.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 12.

List 26.—Description of 2,500 new and second-hand Machines, now ready for distribution. Send stamp for the same. S. C. Forsaith & Co., Manchester, N. H.

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The Eureka Mower cuts a six foot swath easier than a side cut mower cuts four feet, and leaves the cut grass standing light and loose, curing in half the time. Send for circular. Eureka Mower Company, Towanda, Pa.

Saw Mill Machinery. Stearns Mfg. Co. See p. 13.

Pure Oak Leather Belting. C. W. Arny & Son, Manufacturers, Philadelphia. Correspondence solicited.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

For Machinists' Tools, see Whitcomb's adv., p. 12.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

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Turbine Wheels; Mill Mach'y. O.J.Bollinger, York, Pa.

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Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 414.

Clark Rubber Wheels adv. See page 28.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 29.

Safety Boilers. See Harrison Boiler Works adv., p. 29.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 421, Pottsville, Pa. See p. 29.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 28.

For Sequeira Water Meter, see adv. on page 30.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Co., Buffalo, N. Y.

Brass & Copper in sheets, wire & blanks. See ad. p. 44.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Clark & Heald Machine Co. See adv., p. 413.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

Cope & Maxwell M'f'g Co.'s Pump adv., page 45.

Wren's Patent Grate Bar. See adv. page 45.

Machine Diamonds, J. Dickinson, 64 Nassau St., N. Y.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

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Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 45.

Houston's Sash Dovetailing Machine. See ad., p. 45.

Steam Engines; Eclipse Safety Sectional Boiler. Lambertville Iron Works, Lambertville, N. J. See ad. p. 28.

Pat. Steam Hoisting Mach'y. See illus. adv., p. 45.

New Economizer Portable Engine. See illus. adv. p. 46.

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Rowland's Vertical Engine. Wearing parts of steel. Broad bearings. F.C.& A.E.Rowland, New Haven, Conn.

The Sweetland Chuck. See illus. adv., p. 46.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Soloman's Parallel Vise, Taylor, Stiles & Co., Riegelsville, N.J.

Skinner's Chuck. Universal, and Eccentric. See p. 46.

Don't buy a Steam Pump until you have written Valley Machine Co., Easthampton, Mass.

Use the Vacuum Oils. The best car, lubricating, engine, and cylinder oils made. Address Vacuum Oil Co., No. 3 Rochester Savings Bank, Rochester, N. Y.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'f'rs, 23d St., above Race, Phila., Pa.

Lightning Screw Plates and Labor-saving Tools. p. 45.

Berryman Feed Water Heater. See illus. adv., p. 46.

NEW BOOKS AND PUBLICATIONS.

THE JOURNAL OF THE AMERICAN AGRICULTURAL ASSOCIATION. Vol. I. No. 1. 75 cents. Published by the Association. Jos. H. Reall, Secretary and Editor.

Contains the proceedings and papers of the national convention in this city in 1879, the proceedings of the meetings of December, 1880, and February, 1881, with some other special contributions on subjects related to agriculture.

THE ROCKY MOUNTAIN LOCUST. By C. V. Riley. Author's edition.

Comprises that portion of the second report of the U. S. Entomological Commission in which Professor Riley sets forth the permanent courses which the Government should adopt to lessen or avert locust injury. The descriptions of the geographical, topographical, and botanical characteristics of the several areas of mountain, plateau, plains, basins, etc., have a distinct value independent of the locust question.

STATISTICAL ABSTRACT OF THE UNITED STATES. Third number. Washington: Government Printing Office. 1881.

A collection of tables in regard to finance, coinage, commerce, immigration, tonnage, and navigation, education, postal service, population, public lands, railroads, agriculture, and mining of the United States in 1880, prepared under the direction of the Secretary of the Treasury.

ON ENSILAGE. By H. R. Stevens. Published by the author. 50 cents.

In this little book the proprietor of Echo Dale Farm, Dover, Mass., recounts his very satisfactory experience with silos, and adds the confirmatory experience of twenty-five other practical farmers as given in letters to him, describing their methods of storing and feeding ensilage, and their conclusions with respect to the economy of the new method of preserving forage.

RESOURCES OF SOUTH-WEST VIRGINIA. By C. R. Boyd, E.M. New York: John Wiley & Sons. 8vo, pp. 321.

Mr. Boyd reviews, county by county, the agricultural and mineral resources of fifteen or more of the south-western counties of Virginia, his purpose being to call attention to the advantages and opportunities which that part of Virginia offers to settlers and capitalists. The mineral deposits include iron, coal, zinc, copper, and lead. This region bids fair to become one of the richest and most desirable for residence in the United States.

IMAGINARY QUANTITIES: THEIR GEOMETRICAL INTERPRETATION. Translated from the French of M. Argand. By Professor A. S. Hardy. New York: D. Van Nostrand. 50 cents.

This is No. 52 of Van Nostrand's series of scientific reprints. The work of M. Argand is notable as having presented a pretty full discussion of the theory of imaginary quantities a quarter of a century before the idea was developed by Gauss, to whom the theory is commonly accredited.

INDUCTION COILS: HOW MADE AND HOW USED. New York: D. Van Nostrand. 50 cents.

No. 54 of Van Nostrand's science series. A reprint of the eighth English edition of Dyer's compact and generally admirable manual of experimental illustration of the nature and applications of intensity currents.

LEFFEL'S CONSTRUCTION OF MILL DAMS, AND BOOKWALTER'S MILLWRIGHT AND MECHANIC. Springfield, Ohio: James Leffel & Co. Pp. 283. 50 cents.

In this handbook the publishers have presented in convenient form the two well-known and very useful works named in the title. In the first part forty or more types of mill dams are illustrated by full page engravings.

A LECTURE ON THE PROGRESS OF THE NEW IMPROVED BED OF THE DANUBE AT VIENNA. By Sir Gustave Wex. Washington: Government Printing Office. 1881.

In this lecture the chief director of the improvement of the Danube at Vienna discusses not only the work but the lessons taught by it, and adds a description of the catastrophe produced by the ice gorge of 1880.

I COMPLETE COURSE IN GEOGRAPHY. By William Swinton. II. GRAMMAR SCHOOL GEOGRAPHY. By William Swinton. New York and Chicago: Ivison, Blakeman, Taylor & Co.

Mr. Swinton's "complete course" has been before the public for five or six years, and has won, by its practical merits, an exceptionally extensive use in common schools throughout the United States. The author's idea of the inseparableness of physical and political geography is the true one, and the prominence he gives to industrial and commercial interests is much to be commended. The maps are many and well suited to their purpose; and the numerous illustrations have evidently been inserted for purposes of instruction. The new grammar school geography is intended to mark a higher grade of school requirement, and does mark a higher if not the highest level of text book making. The book has manifestly been prepared without stint of labor or cost on the part of author and publishers, and shows throughout a clear appreciation of what is needed in the better class of schools. It is admirably adapted also for family use.

THE MERCANTILE REGISTER. Issued by McKillop, Walker & Co.: New York. 1881.

Contains a list of the banks and bankers of the United States and Canada with whom the publishers have business connection, and also a corresponding list of attorneys and their references; together with a summary of the collection laws of the different States and other information of value to merchants

The final issue of the *Harvard Register* comprises the numbers for April, May, June, and July, 1881. The *Register* has been discontinued to avoid possible competition with the official publication which the authorities of the University have decided to issue. The publisher and editor of the *Register*, Mr. Moses King, has made it a magazine of such superior quality that its ceasing to be is a loss that will be regretted by many besides the graduates of Harvard University.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) J. M. B. asks: 1. What is papier mache and how is papier mache work made? Have been told that it is made from old postage stamps. A. Papier mache is made from paper pulp with sizing; sometimes clay, chalk, and pigments are added. 2. Is there any market to be found for old postage stamps? I have several thousand of them, and would like to find a market for them. A. See column of Business and Personal. A small advertisement inserted therein would probably put you in communication with dealers in such things.

(2) A. A. S. asks: Can you give me a reliable method of removing mildew from cotton goods of light texture, lawns, muslins, etc? A. 1. If the goods are colored soak them for twelve hours or more in sour milk, or buttermilk, then rinse in water, and wash in strong soap suds. 2. If the goods are uncolored moisten the spots repeatedly with javelle water diluted with three volumes of cold water; a brush can sometimes be used with advantage; rinse in plenty of running water, then wash in strong soap suds, not too hot.

(3) A. B. asks: If two slabs of inch glass be ground air tight and then an air chamber be sunk between them, would the suction be stronger if the air chamber were completely exhausted than if the chamber were not there? We think not, because the square inches of atmospheric pressure are the same whether the air chamber be there or not. A. Your opinion is correct.

(4) T. D. writes: I have occasion to buy large quantities of green oak staves, and have to have them piled in the yard for about a year before they are fit to work. They are exposed to all weathers. It is not desirable to use a kiln to dry them. Do you think they would dry quicker if piled under a shed, keeping the rain and sun off, but allowing the air to circulate freely through it, all the sides being open? A. Yes.

(5) C. S. B. & S. writes: We have been making a number of heavy steel dies for hammering purposes, and have had considerable trouble in hardening them. Have used prussiate of potash and also tried them thoroughly in charcoal fire without the potash, but have not been able to make them stand. By hard use they will sink in spots just as though they were soft, but a file will not touch even the sunken spots. It must be they do not harden through. A. Probably the trouble is due either to unequal heating or unequal exposure in hardening. The heating should be done in a "dead" fire, that is, not forced by a blast; and in hardening, great care should be used, by constant agitation, that all parts may be equally exposed to the hardening liquid. It is possible your steel may not be homogeneous.

(6) E. D. asks: What becomes of the air in a boiler when steam is generated? A. It escapes with the steam, either through the engine or safety valve, as either is taking the steam from the boiler. A good engineer, when getting up steam, leaves his safety valve open to allow the air to escape when the steam is first generated.

(7) J. Y. S. asks: Is it the weight of water or the pressure from the dam and creek that runs these old kind wooden water wheels. For example, I build a wheel 20 feet in diameter, and have a waterfall 10 feet high, a box 4 feet square inside, and a flume 10 feet long and 6 feet square: would I have the same power (that is, if I would keep this box and flume as above filled with water) as if I get it direct from the dam? A. It is the weight of water that gives the power. You would have the same power in either case if the water is kept at same height.

(8) P. R. S. writes: I have an upright tubular boiler, four years old; has been unused three years. I wish to use it, and would feel safer if it was tested. Now, if I fill it full of water, heat the water till the steam gauge marks 125 lb. (the boiler is 24 inches by 6 feet, iron $\frac{7}{16}$ inch thick, and tested 160 lb. when new), will it not be safe to make steam in it at 100 lb.? A. We would not advise over 80 lb. pressure. Your proposed mode of testing is dangerous, and should only be done by a very careful and competent engineer.

(9) W. M. M. asks: 1. Will an arrow shot perpendicularly into the air attain the same force or velocity in its descent as when it left the bow? A. No; the friction of the atmosphere both in the ascent and descent will reduce it. 2. Is there any rule to compute accurately the height to which an arrow has been shot if the time of its flight is known? A. We know of none.

(10) F. & C. write: I wish to construct a Faure secondary pile, and need a little more knowledge than is contained in No. 26. Are not the plates in Fig. 1, page 406, connected for a quantity current, and therefore not suitable for electro motive use? A. They are connected for quantity, but a number of such elements may be joined for intensity. 2. Does it make any difference in charging the secondary pile whether it is connected for intensity or quantity current? A. In charging the elements should be connected for quantity. 3. Will a small magneto machine such as are used in telephone signaling, be powerful enough to charge properly? A. No; you should use two or three Bunsen elements. 4. Does the secondary pile give current of same tension until all is gone, or does it weaken at the last? A. The current gradually weakens from first to last, and of course much quicker on a circuit of low resistance than it does on a circuit having considerable resistance. 5. Are either Edison's or Swan's incandescent lamps in the market, or can they be procured? A. We believe they are not in the market yet.

(11) C. E. J. asks how to use a fast speed in reaming wagon boxes. A. You cannot use a fast speed if the boxes are hard, as they should be. A very openly grooved reamer with fine cutting edges will probably work best.

(12) A. W. G. asks how to make cement to mend a cut in the rubber tire of a bicycle. A. The rubber companies sell a cement for mending rubber. It is composed of a semi-liquid solution of gum caoutchouc in naphtha. The rubber is cut fine and digested with the naphtha, warmed, over a water bath (away from fire), with occasional agitation until it softens, swells up, and forms a smooth pasty mass. No more than is requisite should be used in the joint, and plenty of time should be allowed for the cement to get dry. See cements, SUPPLEMENT, No. 157.

[OFFICIAL.]

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June 21, 1881,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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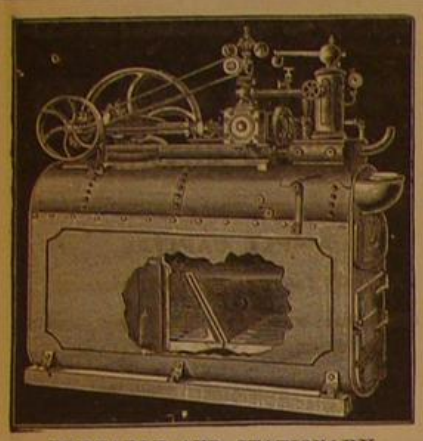

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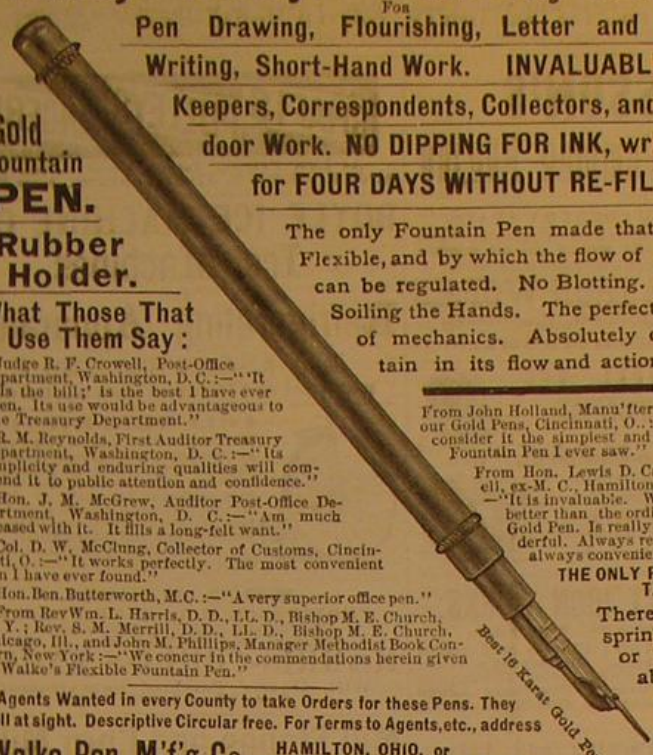

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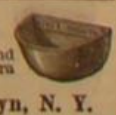

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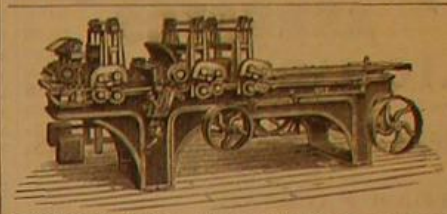

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