SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXVII.—No. 23.] ESTABLISHED 1845. NEW YORK, DECEMBER 3, 1892. [$3.00 A YEAR. WEEKLY.

LOSS OF A GREAT SHIP OF WAR.

On the second of November a squadron of British war vessels, comprising some of the largest ships of the navy, entered the harbor of Ferrol, near Corunna, Spain. Among them were the Royal Sovereign, the Anson, and the Howe, one of the finest war ships afloat.

While rounding the Perreio shoal the Howe took too large a sweep and grounded. The rest of the squadron got in in safety and anchored. It was within an hour of high water. Every exertion was made to get her off, but in vain. Salvage operations on a very large scale have been commenced.

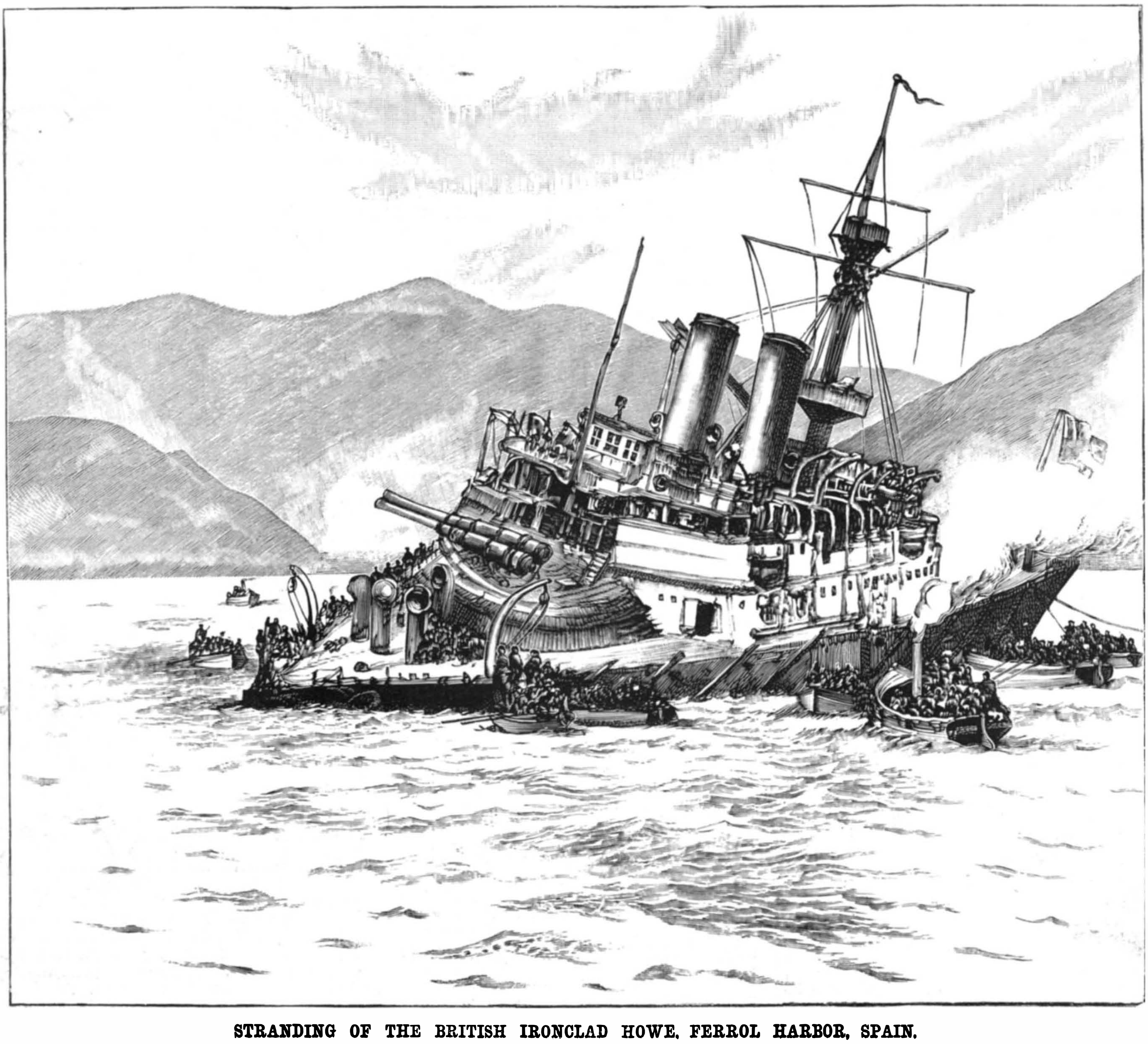
The water tight doors were, of course, closed, but the boiler compartments on the port side appear to have been pierced by the rocks, for, at last accounts, three compartments were full of water in the stoke-hole, and the fires put out. Divers were sent down to explore, anchors were laid out, and every effort was made to lighten the ship by the officers and men of the whole squadron, but as the tide fell the ship's bows settled down, and she was pivoted by the quarter on the rock. The sketch here presented is from the *Graphic*, London, drawn by C. C. Peaty, R.N.

The Howe is a first-class battleship, designed by Sir N. Barnaby, and launched at Pembroke on the 29th of April, 1885. Her displacement is 10,300 tons, and she carries at the water line 150 feet armor 18 inches thick. She is 300 feet long over all, 68 feet beam, and draws 27 feet 3 inches. Her engines, by Humphrys, indicate 11,000 horse power. Her speed is 16 knots; she carries two 67 ton breech loaders in each barbette.

Recent Important Additions to the British Navy.

By the launch of the Revenge from the works of Messrs. Palmer's Shipbuilding and Iron Company, Jarrow, on the 3d of November, and the floating of the Royal Oak from her building dock at Messrs. Laird's establishment, Birkenhead, the fighting strength of the British navy, says *Industries*, has been materially increased. These vessels belong to a class of eight, provision for the construction of which was made in the Hamilton Defense act of 1889, and they are considered on all hands to be, as regards strength and power for battle, superior to any first-class battle ships possessed by foreign powers. In their design all the elements upon which the efficiency of a battle ship depend have been embodied, in so far as the normal displacement of 14,150 tons permits. They are endowed with great offensive as well as defensive powers, with unusual protection for men, guns, and the vital parts of their structure, while their speed will be quite equal to that of some of the modern cruisers. In fact, speed, as well as handiness and power of maneuvering quickly, were made strong points in the original conception of the class to which these vessels belong. As the two ships are identical in design and arrangement, the following description of the Royal Oak—the latest addition to the navy—will apply with equal accuracy to the Revenge:

The Royal Oak is built of steel throughout, on the longitudinal system, and measures 380 feet in length between the perpendiculars, with an extreme breadth of 75 feet, and will have, when complete for sea, a displacement of 14,150 tons on a mean draught of water of 27 feet 6 inches. A double bottom extends throughout the engine and boiler rooms and main magazine spaces, and, as showing to what extent unsinkability has been considered in her design, the hull is subdivided into 220 watertight compartments. The upper deck extends from stem to stern without a break, and above this is a shelter deck with two conning towers, one forward and the other aft, from either of which the vessel may be commanded in action. At the load water line she is protected by a belt of steel-faced armor, 8·5 feet in breadth, extending over two-thirds of her length, and tapering in thickness from 18 inches amidships to 14 inches at the ends. This belt is terminated at either end by transverse armored bulkheads, surmounting which is a 3 inch steel deck, and before and abaft the belt the protection is completed by a strong underwater deck of steel, terminating forward at the ram. The broadside over the belt is protected to a height of 9·5 feet above the water by 5 inch armor, with screen



STRANDING OF THE BRITISH IRONCLAD HOWE, FERROL HARBOR, SPAIN.

bulkheads similarly armored inclosing a central battery.

At the fore and aft ends of the armor belt, and rising directly from the protective deck, are barbettes of steel-faced armor 17 inches thick, in which are mounted the main armament, comprising four 67-ton breech-loading guns, two in each barbette. The auxiliary armament includes ten 6-inch 5-ton quick-firing guns, six of which are carried on the upper deck and protected by shields, while four others are mounted in armored casemates on the main deck, sixteen 6-pounder and nine 3-pounder quick-firing guns, besides machine guns and seven torpedo tubes for launching Whitehead torpedoes. Four of the tubes are on the broadside, one at the stem, and two submerged. The magazines are situated on either side of the engine and boiler spaces, immediately beneath the barbettes, and, in view of the development of high explosives and quick-firing guns, precautionary measures have been taken for the protection of the ammunition supply during its passage from the magazines to the guns. The propelling machinery consists of two sets of triple expansion engines capable of developing, collectively, upward of 9,000 horse power with natural draught and 13,000 horse power with forced draught, producing speeds of 16 knots with open stokeholds and 17·5 knots with closed stokeholds. Each set of engines is contained in a separate compartment, the two being divided by a longitudinal middle line bulkhead extending the whole length of the magazine spaces. There are eight boilers, each supplying steam at a working pressure of 155 pounds per square inch. The auxiliary engines will number, altogether, sixty-nine, and will include steering engines, electric light engines, workshop engine, boat hoisting engine, and air compressing engines. Her bunkers will take 900 tons of coal, and with this quantity it is estimated that she will cover a distance of 5,000 nautical miles at a speed of ten knots. When fully equipped and ready for sea, the value of the Royal Oak and Revenge will be about £1,000,000 sterling or $5,000,000 each.

Treasures Found in Street Excavations.

In Rome the eighty-two miles of new streets made last year yielded the following "dugups:"

905 amphoræ.
2,360 terra cotta lamps.
1,824 inscriptions on marble.
77 columns rare marble.
313 pieces of columns.
157 marble capitals.
118 bases.
590 works of art in terra cotta.
540 works of art in bronze.
711 intaglios and cameos.
18 marble sarcophagi.
152 bass-reliefs.
192 marble statues.
21 marble figures of animals.
266 busts and heads.
54 pictures in polychrome mosaic.
47 objects of gold.
39 objects of silver.
36,679 coins.

Even this astonishing list does not cover everything, but embraces only those objects which were worthy of a place in the museums.

How a German Train is Started.

According to the *Railway Review*, an official of the Pittsburg and Lake Erie Railroad recently returned from Europe, referring to railway practice in Germany, says: "The roadbeds are about perfect, while the stations are simply magnificent, even in the most insignificant places being very fine. The roadbeds are quite rigid, but this is mainly due to the iron and steel cross ties that are used. The locomotives are fine pieces of mechanism, but their capacity is scarcely equal to those on this side of the Atlantic. Their entire passenger equipment is away behind that in use here. Their trains, however, run like clockwork, and the connections are perfect. The method of starting trains is altogether unique and peculiar, and will cause local agents and trainmen to smile. The agent is an imposing, dignified and solemn-looking official, attired in elaborate uniform, literally gilt-edged, and he acts as master of ceremonies on the imposing occasion. When the train arrives at a station he is standing bolt upright in an almost military position, and he is on dress parade. One minute before the train starts he reaches up and taps a gong three times. Then a strange scene takes place, and it would seem that he had pressed a button, for at the last tap the conductor, who has been at the rear car, comes galloping along the entire length of the platform, shouting in German the name of every station the train will stop at. When the engine is reached he wheels about, and on his return quickly closes and locks the car doors, darts back to the van to his perch on the rear car, whistles thrice on a tin or metal whistle, which is instantly repeated by the brakeman at the front end, and the train starts.

Scientific American.

ESTABLISHED 1845.

MUNN & CO. Editors and Proprietors
PUBLISHED WEEKLY AT
No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico.................$3 00
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One copy, one year, to any foreign country belonging to Postal Union. 4 00
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MUNN & CO., Publishers,
361 Broadway, New York.

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NEW YORK, SATURDAY, DECEMBER 3, 1892.

Contents.

(Illustrated articles are marked with an asterisk.)

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For the Week Ending December 3, 1892.

Price 10 cents. For sale by all newsdealers.

EXTENSION OF RAPID TRANSIT FACILITIES IN NEW YORK CITY.

In addition to the many first-class horse and cable street railways which gridiron the city in all directions, no less than four of the finest avenues of the city, running north and south, are occupied and darkened by hideous iron bridges, known as the elevated railways. On some of the avenues the tracks are supported on iron columns that stand on the sidewalks. In other examples two rows of columns are set in the middle of the streets, where they seriously obstruct the travel of ordinary vehicles, and are the cause of many accidents. The noise of the steam trains, the dirty droppings from the cars, the cinders, gas, and escaping steam, all conspire to render the presence of these elevated railways a serious nuisance. Still, as a convenience to the public, they are almost indispensable, and by many are regarded as a highly desirable sort of nuisance. This is proved by the hosts of people who travel upon them; also by the fact that large and valuable buildings have been erected on both sides of the lines of these railways. Many of these buildings are tenanted by families, who, strange as it may seem, appear to take pleasure in the din and dust raised by the steam trains close under their windows.

The New York elevated railways are probably the most largely patronized and most profitable of any railway works in the world, mileage considered. They have an aggregate length of about forty miles. Last year they carried over two hundred and fifteen millions of passengers. The gross earnings were almost eleven millions of dollars and the net earnings about five millions of dollars.

In the early days of these railways the man who appears to have most highly appreciated their value and foresaw their great future was Mr. Jay Gould, a Wall Street broker. He bought out the Tilden and Field interests and so gained control of the works. The roads are admirably managed, and their extension in various directions would greatly add to the public convenience. But so strong is the passion of envy in the municipal heart that no further privileges can be extended to Jay Gould; he is making too much money already, and for fear he should make more, he must not be allowed to improve or extend his roads, even if the people thereby suffer.

So great is the need of additional facilities for rapid transit that a new commission was appointed some two years ago, under legislative authority, to lay out new routes, designate the plans for construction, and inaugurate a new and independent system for faster rapid transit in the city.

The commission has lately completed its work, the plans have been drawn, and the franchise is soon to be sold at public auction.

As a whole the new system consists of railways to be built underground. The main line is to run under Broadway, which is one of the greatest thoroughfares of the city; from this as a stem branches are to extend in various directions. In the northerly parts of the metropolis the tunnels give place to elevated structures.

The purchaser of the franchise must pay 10 per cent cash to the city, and must also deposit $1,000,000 as a guarantee of full compliance with the terms of sale.

The company to build the road must be organized within two months. The capital stock of the company must be $50,000,000, divided into 500,000 shares at $100 a share. The company may mortgage its property for $50,000,000. The limit of fare permitted to be charged is 5 cents. The company must give a bond of $2,000,000 to protect the city and property owners from damages.

Work on the road must be begun within four months from the time the contract is awarded, and the road must be finished and in operation within five years of beginning it. The part between the City Hall and Fourteenth Street must be finished in two years, the part south of the City Hall and the parts between Fourteenth and Fifty-ninth Streets and between Fourteenth and Forty-third Streets on the east branch within three years, the part between Fifty-ninth Street and Harlem River within four years and the rest within five years.

In case the corporation fails to begin or finish the construction within the times limited, it forfeits its rights, and upon the forfeiture being adjudged by the court, the commissioners will have the power to advertise and resell the franchises of the road and so much of the road as shall have been constructed, and the proceeds of the resale will be applied to the payment of the expenses of the resale, then to the discharge of any liens which may have been created.

The articles of incorporation must be signed and acknowledged by not less than twenty-five persons. Books of subscription to the capital stock of the company must be opened at once. The capital stock must be held by not less than fifty persons, and the stockholders must choose thirteen directors. After the organization of the company and the sale of the stock the company must pay the State a tax of one-eighth of one per cent on its stock, and it will be deemed fully organized.

When in operation the company must start and run its cars for the transportation of passengers and property at regular times to be fixed by public notice, and furnish sufficient accommodations for the transportation of all such passengers and property as shall, within a reasonable time previous thereto, be offered for transportation at the stations.

The best and most efficient system of block, switch, and train signaling must be adopted when the road begins running.

The cars must be propelled by electricity or by some form of power not requiring combustion within the tunnel. This motor must be sufficiently powerful to readily start a train of eight cars, each weighing, in addition to its load of passengers, not less than 30,000 pounds, on a gradient with a rise of one and one-half feet per 100 feet of distance, and the motor must also be able to maintain the same train at a speed of not less than 40 miles per hour on a level gradient.

Should each car be provided with its own motor, such motor must be capable of exerting sufficient power to comply for each car with the above requirements.

Each car must be provided with suitable arrangements for heating and lighting, and must have ample and comfortable seating capacity for the number of passengers to be carried by the car. Each station must be provided with suitable waiting and toilet rooms, with all proper convenience for the use and comfort of passengers, including proper platforms and suitable arrangements for heating and lighting. The platforms and stations and the stairways, hallways, galleries, approaches, and passages must be of ample size.

At present the general impression is that the cost of building the gigantic works proposed by the commission will be so great as to leave little profit to the builders, and hence capitalists will refuse to take up the enterprise. If this should prove to be the case, then all the labors of the commission will have gone for naught, and another commission will have to be appointed to hatch out a better and more practical plan.

NOTES FROM THE GREAT FAIR.

THE WATER SUPPLY, DRAINAGE AND SANITARY ARRANGEMENTS OF THE WORLD'S COLUMBIAN EXPOSITION.

[SPECIAL CORRESPONDENCE OF THE SCIENTIFIC AMERICAN.]

CHICAGO, December 1, 1892.

The Water Supply.—The requisite supply of drinking water is accomplished by installing two pumping engines, each having a capacity of 12,000,000 gallons per day, in the 68th Street (Hyde Park) water works. The water is drawn from Lake Michigan at the two mile crib, and from the water works passes through a 36 inch main to Machinery Hall, from which point it is carried throughout the grounds in pipes of lessened capacity, ranging down to 8 inches, and distributed by laterals into every building and to each exhibit wherever desired.

This lake water will be supplied free of charge from 300 ornamental fountains, located at various points about the grounds, and from thousands of single faucets within the buildings. Each fountain will have four or more ⅜ inch faucets and twelve metal cups, thus accommodating at least 1,200 thirsty vistors at one time at the fountains alone. This lake water is contracted and paid for by the Exposition officials, and may be used for all purposes within the grounds.

Hygeia Water.—For drinking purposes, water is also supplied that is piped direct from the Hygeia Springs, at Waukesha, Wis., a distance of 102 miles, where the overflow capacity of the springs exceeds 650,000 gallons a day. Steam pumps will force the water into a reservoir that is being built on a high ridge 200 feet above and eight miles distant from Waukesha, and ninety-four miles from and 416 feet above the level of the exposition grounds, and from this reservoir it is expected that the water will flow by gravitation through a 6 inch Maltby coated steel pipe, at the rate of 50,000 gallons a day, to the cooling reservoir located between the Transportation Building and the grand passenger depot. This great cooling tank has a capacity of 100,000 gallons, and will be covered by an ornamental structure 80×40 feet in size, containing a full refrigerating plant that will furnish 100 tons of ice daily. From this reservoir the water will be forced by a small pumping plant through the refrigerating coils to the twenty-five miles of 3 inch distributing mains and the small connecting laterals extending into each exhibit, from the faucets of which it will probably be drawn, at a temperature of about 38° F.; a water meter registering the amount drawn. In addition to the private faucets, there will be 250 fountains erected, within ornamental booths built to harmonize with the different forms of architecture of the buildings to which they are attached, where a half pint glass of Hygeia may be secured from one of the many female attendants at the cost of a penny a glass.

The water supplied to these fountains will be kept in circulation, so that an evenly cold temperature will practically be maintained. While the capacity of the main supply is 50,000 gallons daily, it can be largely increased by pressure, though it is believed that the demand on the Exposition grounds will not exceed 30,000 gallons, or 500,000 drinks of half a pint each, daily. At one cent each this alone will give the Hygeia Company an income of $5,000 daily, to say nothing of the advertising effect of this great enterprise. This plant is a concession controlled by the Hygeia Company, who pay a portion of the gross receipts to the Exposition.

The Sewerage.—What becomes of the waste water is almost as interesting to many as where the supply of water comes from. Thus, it is worthy of note that one system of piping carries all the storm water from the roofs of the various buildings into the lagoons, while a second system of piping carries all the surface water from the many catch basins, so it will not foul the lagoons, into two wells, from whence it is pumped into the lake by centrifugal pumping plants, consisting of Gould's pumps belted to line shafting driven by electric motors.

The construction department found the problem of how to quickly, economically, and effectually dispose of the discharges that will flow from toilet basins, closets, sinks, etc., not an easy one to solve. It was essential that a system should be adopted that would not only prove efficient as an odorless sewerage system, but also include a method by which the entire outflow could be chemically treated and both fluids and solids rendered inert.

The Shone hydro-pneumatic sewerage system was adopted by Mr. W. S. McHarg, chief of the department of water and sewerage, and forms the main sewerage system of the World's Fair grounds.

As installed at Jackson Park, the system consists of 26 ejector stations containing 52 Shone ejectors, there being a pair in each station, thus affording ample reserve capacity. The ejectors in service have a capacity of from 60 to 600 gallons each, and a total receiving and ejecting capacity of 17,000,000 gallons per diem. These ejectors are placed in cemented pits sunk to a depth of about 14 feet below the surface of the ground, and are placed either under the main buildings or at various points about the grounds. Thus under the Electricity building there is one pair of ejectors of 180 gallons capacity each, while under the Manufactures building there are two pairs, each of the four machines having a capacity of 600 gallons.

Each ejector has an inlet and outlet pipe for the sewage and an automatic valve for the compressed air by means of which the machine is operated. Through the inlet pours the waste water and other matter from basins, closets and sinks, till the machine is full, when a float automatically opens the compressed air inlet, and the pressure of the inrushing air (50 lb. to the square inch) instantly closes the inlet flap valve and ejects the contents into a branch pipe directly connected with the main discharge pipe. As the last of the fluid passes out the compressed air valve is automatically closed, and the ejector expanded down to atmospheric pressure through a muffler box, then the back pressure in the branch pipes closes the flap valve on the outlet, and, the pressure being released, the inlet flap valve opens, allowing the liquid washes to again flow in. This system was installed under contract by Mr. Urban H. Broughton, engineer and manager of the Shone Hydro-Pneumatic Sewerage and Water Supply Company, of Chicago. When the Exposition is well attended it is expected that each of these ejectors will fill and be emptied at the rate of about once a minute, and as the contents are ejected into the branch pipe the displacement of a similar quantity from the main discharge pipe flows into tanks, where it is treated with sulphate of aluminum, or other chemicals, which throw down the solids and leave the water comparatively innoxious.

The water, separated from the solids by filtration, flows from the tanks through pipes into the lake, while the solid matter, having passed through a Bushnell filter press, operated by compressed air, and been formed into small cakes, is burned under furnaces. This press consists of a series of round iron plates hung on rolls on the press rods, with filter cloths placed between the plates, thus forming chambers into which the material to be filtered is pumped through a center channel in the machine, when the application of pressure (about 700 lb. to the square inch) forces the liquid through the cloths to the surface of the plates, and thence through grooves or pipes into a receiver. The pressed cakes are then removed, thrown into furnaces and burned.

Toilets and Lavatories.—Each principal building on the grounds will have from one to four apartments devoted to toilet purposes, and placed in the most easily accessible portions of the structure.

The total number of closets on the grounds will exceed 3,000, of which 1,000 are free, and 2,000 are subject to the charge of five cents.

There will be nearly a thousand public lavatories, any one of which may be used on payment of five cents, this sum covering charge for a sufficient quantity of powdered soap, an individual towel, comb, and mirror.

The lavatories now being fitted up for women are as perfect as can be desired, and include a private room finished in English white enamel and containing chair, rug, towels, powdered soap, brush, comb and long plate glass mirror; all arranged to afford the utmost privacy and convenience, for which a charge of but five cents is made, including the services of a matron, and no room is to be used a second time till thoroughly cleansed by the attendant. This concession is controlled by J. B. Clow & Son, of Chicago, who will pay a portion of their receipts to the exposition. The same firm also controls the only advertising on the grounds, namely, the interior wall space in the rooms devoted to lavatories and closets. This was one of the first concessions granted and the World's Fair officials have since endeavored to repurchase it, in order to prevent advertising of any nature whatever on the grounds. Some idea of the value of this advertising space may be inferred from the statement that one house pays $25,000 for space in each room and another firm $12,500.

DE L.

Leather Dyeing.

The following particulars in regard to leather dyeing are from the *Leather Trades Circular*.

The tendency of leather to fix the aniline colors without the aid of mordants renders these dyes particularly applicable in leather dyeing. Fine grain leather cannot stand treatment with alcoholic solutions, so that the aqueous dyes are preferable, and if alcoholic solutions have to be used, they should be diluted to the verge of precipitation. Acid colors are more important than the basic. Tanned leather must generally be bleached by drawing it several times through a strong, warm, sumac decoction, or leaving it immersed therein for a few hours. Dyes which do not take uniformly on the leather must be mordanted; in nearly all cases they are best applied by painting them on. The most important of the saline mordants in this branch are the different soaps. A good, hard, white, soda soap is generally the best, Castile being recommended.

When the skin has been painted it is rinsed with cold water while upon the table, and well stretched with a brass slicker; another coat of the dye is applied, and again washed off with cold water; the skin is then rubbed until the water runs off clean. Colors that require to be darkened are brushed over with a solution of Salzburg vitriol (ferroso-cupric sulphate), a mixture of ferrous and cupric sulphates, 25·3 grms. of which are dissolved in 3 liters of water. The skin is finally washed with clean water, and dried.

Dark Brown.—Eight parts of fustic, 1 part of logwood, 2 parts of Brazil wood, 1 part of sanders, and ½ part of quercitron are boiled with soft water for one hour, and strained through linen. The vitriol treatment treatment serves to darken the shade; for light brown this is omitted and the skin primed with dilute potash.

Olive Brown.—Two parts of Hungarian fustic, 1 part of quercitron, and ¼ part of logwood are boiled, and the solution applied upon a strong potash priming; vitriol treatment follows.

Cutch Brown.—A docoction of ½ kilo. cutch, 60 grms. of copper sulphate, and 40 liters of water is applied upon a feeble priming.

Chestnut Brown.—The moistened leather is primed with a solution of 1 kilo. of copper acetate in 50 liters of water, slicked out, and then painted with a solution of yellow prussiate of potash in feebly acid water.

Chocolate Brown.—Brazil wood (1½ part) is boiled with water (45 parts) for two hours, and a little iron acetate added, according to shade.

Red.—Cochineal in a linen bag is boiled with water containing about 2 per cent. of aqua ammonia.

Alizarine Red.—A feeble flesh color is produced by brushing the leather with a solution of alizarin in dilute soda, and then rinsing with soap water.

Scarlet.—Zaffer extract, diluted with 60 parts of water containing 1 part of tartar, is painted on a feeble annatto bottom.

Ordinary Red.—A decoction of sanderswood is used upon a feeble priming of alum free from iron.

Dark Green.—Quercitron (4 parts) and logwood (1 part) upon a strong priming of vitriol.

Light Olive Green.—A decoction of fustic (1 kilo.), archil (¼ kilo.), and water (20 liters) is painted on a light bottom of Prussian blue. For *picric green* an aqueous solution of picric acid is substituted for the fustic and archil.

Lemon Yellow.—Turmeric (1 part) is digested in alcohol (4 parts) for twenty-four hours, diluted with water, and applied upon a feeble potash bottom.

Barberry Yellow.—One kilo. of barberry root, 30 kilos. of water, and 200 grm. of iron-free alum.

Orange.—A red priming is given by Brazil wood, and fustic applied to impart the yellow. Seventy-five of the former to twenty-five of the latter produce a red orange, equal parts an ordinary orange, and twenty-five to seventy-five a yellow orange.

Chrome Yellow.—The dye is first applied with a solution of 30 grm. red chromate of potash in ½ liter of water, and is next fixed by 30 grm. acetate of lead in ½ liter of water.

Para-amidophenol Citrate.

A solution of citric acid is, according to Liesegang, an excellent solvent of para-amidophenol — ninety-seven grammes of the latter being soluble in two hundred grammes of the citric acid solution of equal parts, the para-amidophenol being added little by little at a temperature of 18° to 20° C. The citrate of para-amidophenol so formed is employed as a developer in the following proportions:

Para-amidophenol citrate (concentrated solution)	1 c.c.
Sodium sulphite (concentrated)	4 "
Sodium carbonate	5 "
Caustic potash (ten per cent solution)	2 "
Water	50 "

This gives dense blue black images full of detail, the image, with normal exposure, appearing in about ten seconds. Brown tones are obtained if the para-amidophenol citrate is rendered alkaline with caustic potash. The citrate and sulphite are also applicable in aqueous solution as a developer for partly printed images on gelatino-chloride.—*British Journal.*

An American Grain Train.

The Pennsylvania Railroad Company recently ran a special grain train through from Chicago to Jersey City without uncoupling a car or changing locomotives. A distance of 824 miles was traversed, during which time the locomotive was not uncoupled from the train. The total length of the train was 1,602 feet, and it carried 2,640,000 pounds of grain, an average of 66,000 pounds to each car. The locomotive and cars were equipped throughout with Westinghouse brakes. The locomotive and tender weighed 88,500 pounds. The forty thirty-four foot box cars, with loads, weighed 3,824,000 pounds, and the caboose 18,000 pounds. The total weight of the train was 4,030,000 pounds or about 2,000 tons.

SWORD TRICK—A STAB THROUGH THE ABDOMEN.

A trick in which a sword is apparently passed through a person's abdomen and drawn out on the opposite side of the body is explained by a contributor to *La Nature.*

The sword employed is a simple, thin, flexible blade of steel, not at all sharp, and the plan of which is seen at A in the accompanying figure. The point is sufficiently blunt to prevent it from doing any harm.

As for the prestidigitator, whose body the sword will simply pass around but not pierce, he carries concealed beneath his vest a sort of sheath that consists of a tube of rectangular section, and semicircular in shape, and the two extremities of which are bent in contrary directions in such a way that they are situated in the same straight line, the two orifices opening in front and behind at right angles with the abdomen. This apparatus, B, is held in place by cords attached to two small rings at the two extremities of the tube.

It is the prestidigitator himself who, appearing instinctively to grasp the point of the sword as if to protect himself, directs it into the metallic tube. It makes its exit between the tails of the coat. It might be made to come out at the center of the back, but in this case it would be necessary to have an aperture formed in the seam of the coat.

The illusion produced is complete, seeing that the flexible blade straightens out on making its exit from the tube, on account of the form of the latter's extremity. It is necessary to operate rapidly, so that the spectators shall not have time to see that the length of the sword has diminished at this moment, the curved line that it

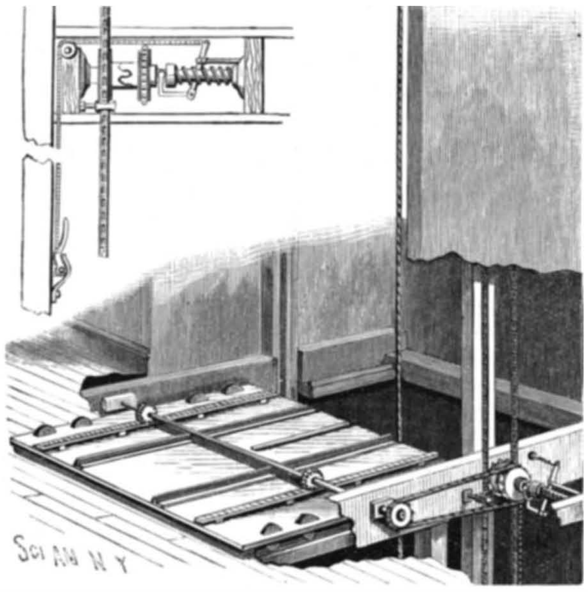
A SWORD TRICK.

follows not being the shortest passage from one point to another.

The figure represents a variant of the trick, in which the sword is provided with an eye through which a long red ribbon is passed, and which follows the blade when the latter is pulled out at the opposite side of the body.

AN IMPROVED SLIDING HATCH DOOR.

An efficient and durable non-combustible door, adapted to close tightly an elevator opening, and with mechanism for closing the several doors in a building simultaneously, or either one of them separately, are



KIBELE'S HATCH DOOR.

shown in the accompanying illustration, and form the subject of a patent issued to Mr. Cuno Kibele, of Bluffton, Ind. The door is preferably made of sheet metal stiffened by angle irons riveted to its top, and slides on grooved rollers running on tracks on supports between the floors, the side edges of the door projecting beyond the tracks, so that the door will close the well and the slots adjacent to the side posts on which the elevator car runs. The inner edge of the door is slotted, for the passage of the hoisting cable, the slot being normally closed by freely swinging leaves so arranged that the door may be readily pushed over the cable, which is held in the inner end of the slot and inside the leaves when the door is closed. On the top of the door, near its edges, are parallel rack bars meshing with pinions on a suitably journaled transverse shaft, the latter carrying also a sprocket wheel driven by a chain connecting with a loosely turning sprocket wheel on a shaft at one side of the elevator well. The latter sprocket wheel forms part of an interlocking clutch mechanism arranged at each floor, and shown in detail in the small view, whereby the gears connected with each door may be thrown into or out of connection with the endless chain extending vertically through the building, by means of which the various sprocket wheels are operated. With the clutch mechanism in normal position, it is only necessary to pull downward on one side of the chain to close all the doors, or to pull downward on the other side to open them all. By means of a lever connected by a cord or cable with the clutch mechanism, any of the doors may be thrown out of connection with the endless chain.

The Orchilla Lichen.

Interesting reports from United States consuls, in Lower California, Cape Verd, and Ecuador, dealing with the orchilla lichen, have recently been published by the State Department. It grows on rocks on the coast of the Canary and Cape Verd Islands, Sardinia, Minorca, and elsewhere, and in some places is described as a miniature shrub rather than a lichen. It yields the archil of commerce, which gives a rich and extremely beautiful purple tincture. It was extensively used by dyers when, in 1853, the discovery of the orchilla in America and on the Galapagos Islands is said to have created a commercial sensation in Europe, because of its superiority over any lichen in use prior to that time. In 1872 a ship's captain discovered it in Lower California, and after a few years a certain Mr. Hale succeeded in obtaining a concession from the Mexican government of the entire orchilla lands on the Pacific coast of that State—a belt six miles broad and comprising nearly eight degrees of latitude. About 3,000 men were employed in the industry; but since the Congo Free State has become the main source of supply the Californian industry has languished. In the Cape Verd Islands it is plentiful, but difficult to obtain, for it grows on the sides of precipices. The export amounts to about 120 tons, and goes mainly to Lisbon. In Ecuador it is gathered by hand, put in the sun to dry and cure, and is then pressed into bales. The demand at present is small.

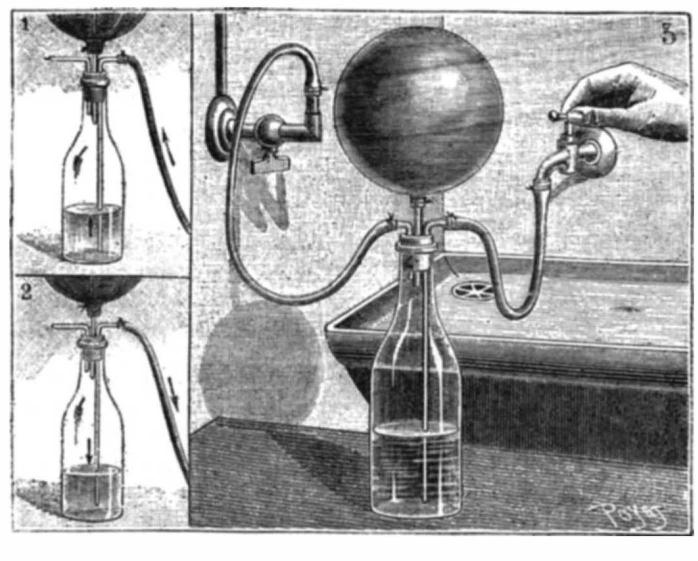
It is used in Europe, especially the Galapagos variety, because of the delicate color, luster, and tone that it gives to silk.

INFLATION OF RUBBER BALLS.

Rubber balls, large or small, protected by an envelope of leather, gradually contract and thus lose all their elasticity, and from this moment are out of use unless one possesses the means of reinflating them. It is then necessary to carefully loosen the rubber that compresses their tubulure, to introduce air under pressure into them, and to reclose them. The pressure that can be exerted with the lungs is far from sufficing, and, for want of a force pump, it is necessary to seek for an arrangement capable of replacing that apparatus. We shall describe here the small installation that serves us for this purpose. It is, we think, within the reach of every one, and will be able to render service to some of our young readers.

A bottle of good quality is provided with a wired cork containing three apertures, designed to receive as many glass tubes. One of the latter extends to the bottom of the bottle, the second is provisionally corked, and the third is drawn out to a point and smoothed with a lamp so as to present no sharp angle. The first is put in communication with the water conduit and to the third is firmly attached the ball to be reinflated. After this, the water from the conduit is allowed to flow into the bottle, and this forces air under pressure into the ball. Then, when the ball is judged to be sufficiently inflated, the cock is closed; but, if the entire contents of the bottle are insufficient, the cock is closed a little before the latter is full of water. A provisional ligature is applied to the ball, then the rubber is detached from the conduit and the contents of the bottle are allowed to flow out after opening the tube No. 2.

The first operation is begun again, care being taken not to reopen the ball until a little water has been



METHOD OF INFLATING A RUBBER BALLOON.

allowed to enter the bottle. If there is a cock at one's disposal, it should be placed between the tube, 3, and the ball, and the latter need not then be reattached before the end of the operation.

In order to introduce illuminating gas into rubber balloons, it will suffice to lead it to tube, 2. The bottle being first full of water, and the balloon empty of air, one will siphon in allowing the gas to enter, then the cock of the latter will be closed, and the gas will be forced in by allowing the water to re-enter. This operation seems to be complicated, but in reality it takes less time to perform it than to describe it. Fig. 1 shows the arrangement of the apparatus for the compression of the air. In Fig. 2 the bottle is being emptied in order to give what may be called a second piston stroke. Fig. 3 gives a view of the installation as a whole for inflating a balloon with illuminating gas.—*La Nature.*

Fertilizers.

The usefulness of nitrogen and phosphoric acid in slowly available forms, as they exist in bone, has been amply proved in practice, especially for slow-growing crops, in orchards, meadows and in such other cases where a gradual increase in general fertility is regarded as important. A mixture of fine ground bone and muriate of potash, in the proportion of three parts of bone to one of potash, is used quite largely and has proved a very effective and profitable manure for general use in grain farming. It furnishes all the essential ingredients, it costs less per ton than the average complete fertilizers, and it contains quite as much nitrogen and very much more phosphoric acid and potash.

Under the present condition of the fertilizer trade and for the purposes indicated, the substitution of ground bone, in part at least, for the more expensive though more available complete fertilizers, is in the line of wise economy.—*N. J. Ag. Ex. Station Bul.*

THREE SYSTEMS OF ELECTRIC DISTRIBUTION.

Whatever effect patent litigation may have on the business side of an invention, it certainly is beneficial from a scientific point of view, as it brings out clearly and concisely the principles involved in such inventions. A case in point is the suit of the Edison Electric Light Company against the New Haven Electric Company, the subject being the three-wire system of electrical distribution.* Without going into the merits of the case, we extract from the testimony some diagrams and condense some of the descriptive matter to illustrate as clearly as possible three methods of electric distribution. The experts in the case have not only provided very clear electrical diagrams, but have furnished water analogues for each of the cases.

In Fig. 1 is illustrated the series system commonly employed in electric arc lighting, E being the engine; G, the dynamo or generator; *p* and *n*, the positive and negative conductors; and I, I^1, I^2, I^3, the arc lamps. In this case, as will be seen, the current passes from the dynamo through all the lamps in series.

In Fig. 2 is given the water analogue, in which E is the engine G the rotary pump, *p* and *n* the positive and negative pipes conveying the water, I, I^1, I^2, I^3, I^4, water motors arranged in series and operated one after the other by the water passing from the motor, I, to the motor, I^1, to the motor, I^2, thence to the motor, I^3, and to the motor, I^4, each motor using its proportion of the energy.

In Fig. 3 is represented the usual multiple arc or parallel arrangement of incandescent lamps, E, as in the other case, being the engine; G, the generator; *p* and *n*, positive and negative conductors; and I^1, I^2, I^3, I^4, lamps taking the current from the positive conductor and delivering it with a certain fall of potential to the negative conductor.

In Fig. 4 is illustrated the water analogue of the multiple arc system, E being the engine, G the generator or pump, I^1, I^2, I^3, I^4, water motors taking water from the positive pipe and delivering it to the negative pipe, with a fall of potential due to the amount of energy absorbed in the motors.

In Fig. 5 are shown two like multiple arc systems placed parallel with each other, with the positive conductor of one system adjoining the negative conductor of the adjacent system, the arrows indicating the direction of the current in each system. It will be seen that if the same amount of energy is absorbed in each of these two systems, the negative conductor, n^2, of the upper system must carry a negative current exactly equal to the positive current carried in the conductor, p^1, of the lower system, and the currents in these two conductors, being equal and opposite, would neutralize each other if carried on the same conductor, as indicated in Fig. 6, in which the negative conductor, n^2, and positive conductor, p^1, are merged in one. With the generators, G^1 and G^2, arranged in series, the electromotive force is 220 volts, which is suited to two 110 volt lamps in series. So long as equal resistances are placed in the two parts of the three-wire circuit, the central wire remains neutral, and no current passes in either direction; but as soon as this balance is disturbed by turning off or adding one or more lamps, a current due to the difference in resistance of the two branches passes over the neutral wire. This system is aptly, though not perfectly, illustrated by the water analogue shown in Fig. 7.

In this case, two generators or pumps, G^1, G^2, circulate the water in the system, the upper outside pipe representing the positive conductor, the lower pipe representing the negative conductor, and the central pipe the neutral conductor. Upon each side of the neutral pipe, and communicating with the outside pipes, are motors corresponding to the lamps in the electric circuit. So long as the quantity of water consumed by the motors on both sides of the central pipe remains the same, the water circulates by passing forward through the upper pipe, through the motors and transversely through the neutral pipe, and returning by the lower pipe; but so soon as the equilibrium is disturbed by shutting off one or more of the motors on one side of the system, the water which would have been required to run that motor must return to the pumps through the neutral pipe, or be forced outward through the neutral pipe, according as the positive or negative current is shut off.

The Edison company hold that the three-wire system effects a theoretical saving of 62½ per cent and an actual saving, due to the use of smaller neutral conductors in the feeding portions of the system, of at least 75 per cent in the cost of conductors. The conductors formerly represented the largest item in the cost of the completed plant.

The value of the invention is shown by the fact that almost immediately after the introduction of the three-wire system the electric lighting business increased enormously, and electric lighting was placed on a basis which enabled it to compete successfully with gas at the lowest price.

Fig. 1

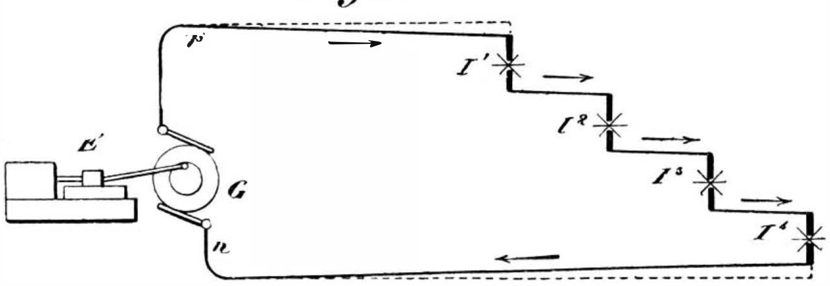


Fig. 2

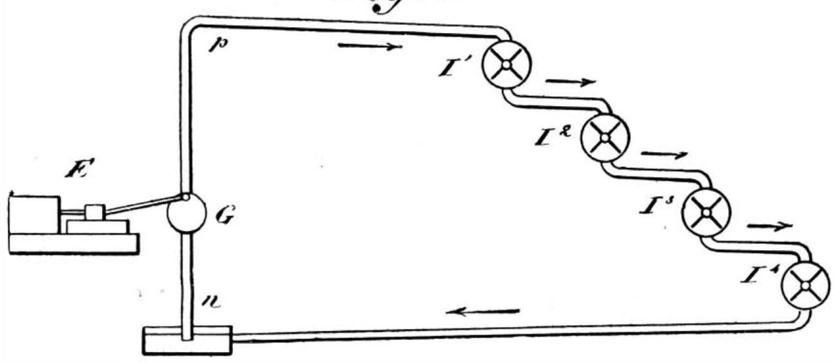


Fig. 3

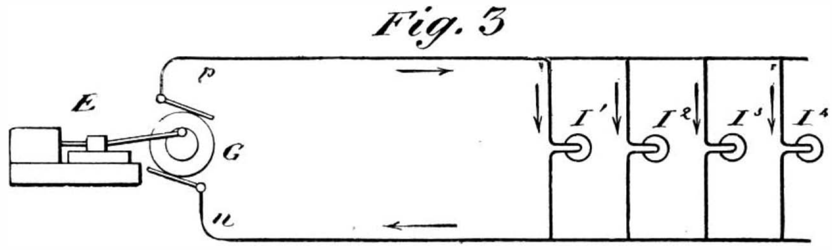


Fig. 4

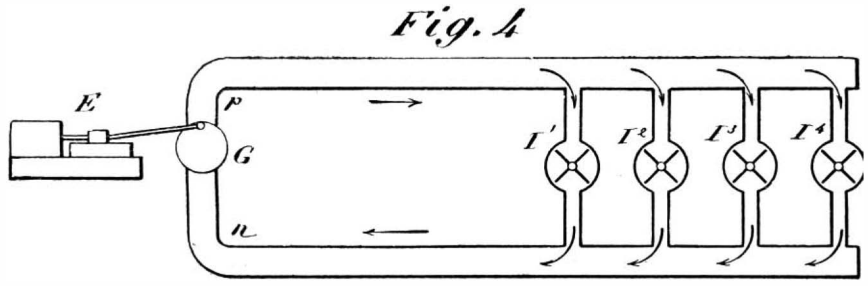


Fig. 5

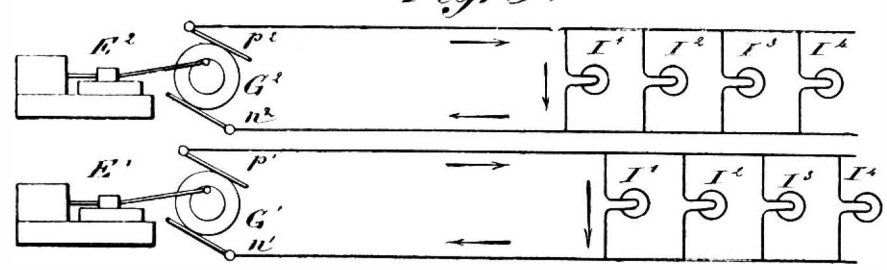


Fig. 6

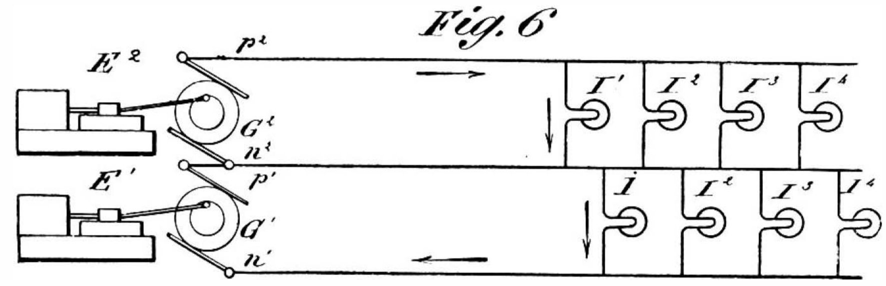


Fig. 7

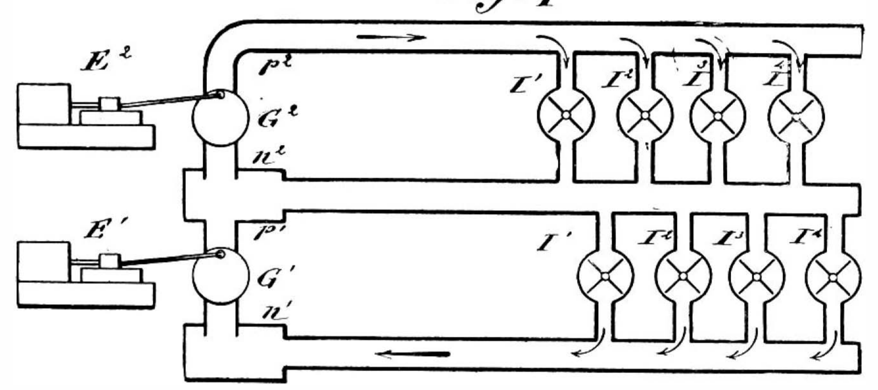


Fig. 1.—Arc Lamps in Series. Fig. 2.—Water Analogue of Series Arrangement. Fig. 3.—Incandescent Lamps in Multiple Arc. Fig. 4.—Water Analogue of Multiple Arc Arrangement. Fig. 5.—Two Multiple Arc Circuits arranged parallel. Fig. 6.—Two Multiple Arc Circuits merged into the Three-Wire System. Fig. 7.—Water Analogue of the Three-Wire System.

THREE SYSTEMS OF ELECTRIC DISTRIBUTION.

* For access to the record of this case we are indebted to Mr. R. N. Dyer, attorney for the prosecution.

How to Purify Mercury.

The method of cleaning mercury adopted at the Physikalischtechnische Reichsanstalt, at Berlin, is described in the *Zeitschrift fur Instrumentenkunde*. The raw material, says *Nature*, is brought in iron bottles from Idria. It is filtered and dried, and twice distilled in a vacuum to get rid of the heavy metals. Great care is taken to eliminate fatty vapors derived from greased valves and cocks, which is accomplished by means of a mercury pump working without a stopcock. Finally, the electro-positive metals, such as zinc and the alkalies, are separated by electrolysis. The mercury is precipitated from a solution of mercurous nitrate obtained by the action of nitric acid on excess of mercury. The solution, together with the impure mercury acting as an anode, is contained in an outside glass vessel, into which a current from a Gulcher thermopile is conducted by an insulated platinum rod. The cathode rod dips into an interior shallow glass vessel, in which the pure mercury is collected. On careful analysis it was found that no perceptible non-volatile residue was left by 200 grammes of the purified metal. Thus the mercury is well fitted for use in standard barometers and resistances.

Gigantic Flag Poles.

Ten large logs which will be used for flag poles for the Washington State building at the World's Fair, says the *Spokane Review*, will be carried to Chicago on a train of three sections, each consisting of fourteen cars. With the exception of the two largest of the logs, they will be placed two together on the cars. The length is equal to that of seven flat cars, and but two of the cars will carry the weight. The two largest of the logs, however, owing to their great weight, cannot be carried in this manner, and each will therefore have a string of cars to itself. The two end cars of each section will support the load upon a raised block working on a pivot, this arrangement being necessary to provide for curves. It is stated that when some curves on the road are passed, the middle of the load will be entirely clear of the car.

POSITION OF THE PLANETS IN DECEMBER.

JUPITER

is evening star. He takes the highest rank on the December annals for the third month in succession, as no other planet in its present aspect can be compared with him in size or brilliancy. Although he has been receding from the earth since October 12, he has lost but little of the superb luster that marks his presence in the heavens, and, although his diameter on the 31st is 39".6, against 47".6 when in opposition, his apparent size has but slightly diminished. Jupiter is stationary on the 10th, and then turns his steps eastward or in direct motion. There is scarcely an incident to diversify his path. If, however, there are no important epochs in his December course, the discovery of the fifth satellite has increased the prestige that surrounds the giant of the system, and will inspire observers to find other satellites or something else equally wonderful. It surely is a marvel when one thinks of a tiny moon only one hundred miles in diameter, revolving around its huge primary in twelve hours, at a distance of 26,000 miles from the planet's surface! Most of its time must be spent in making a transit on the disk or in being occulted in the planet's vast shadow that extends 50,000,000 miles out into space. These are facts that make one think, and impress the soul with the vastness of the scale on which our little oasis of a system has been evolved.

The moon, the day after the first quarter, is in conjunction with Jupiter on the 27th, at 9 h. 6 m. A. M., being 32' south. The conjunction is invisible, as it takes place below the horizon. It is an occultation for observers who see the moon in her geocentric position and are between the limiting parallels of 16° north and 75° south.

The right ascension of Jupiter on the 1st is 0 h. 58 m., his declination is 4° 37' north, his diameter is 43".7 and he is in the constellation Pisces.

Jupiter sets on the 1st at 2 h. 28 m. A. M. On the 31st he sets at 0 h. 34 m. A. M.

MARS

is evening star. He is in quadrature with the sun on the 9th, at 6 h. 22 m. P. M., being 90° east of the sun. He is then on the meridian at sunset and sets at midnight. Quadrature is the second epoch in the course of Mars if we commence with his opposition, which took place on August 4. The third epoch will be his conjunction with the sun, on September 4, 1893, when he becomes morning star, and is for months so small and near the sun as to be invisible. He will then swing round to his quadrature on the sun's western side, his fourth epoch, and, after that, in due time he will arrive at the opposition of 1894 and commence a new circuit. It takes Mars two years and about fifty days to accomplish this journey from opposition to opposition again. It is called his synodic period, for it is only at opposition that the sun, the earth and Mars are in line, with the earth in the middle. The synodic period may also commence with conjunction and is completed when conjunction is again reached, for Mars, the sun and the earth are then in line, with the sun in the middle.

Mars moves eastward or in direct motion, and is also traveling northward. When the month closes, his declination is 1° 2' north—a fact that would have greatly pleased northern observers if it had occurred at the time of his opposition, for then he would have been above the fogs and bad atmosphere of the southeastern horizon. Jupiter is 5° 2' north declination on the 31st and sets about an hour later than Mars.

The moon, on the day of the first quarter, is in conjunction with Mars on the 26th, at 2 h. 25 m. A. M., being 3° 7 south.

The right ascension of Mars on the 1st is 23 h. 0 m., his declination is 7° 27' south; his diameter is 10".4, and he is in the constellation Aquarius.

Mars sets on the 1st at 11 h. 45 m. P. M. On the 31st Mars sets at 11 h. 25 m. P. M.

VENUS

is morning star. She is slowly making her way toward the sun, rising when the month closes only two hours before him. Her light number on the 31st is 63.4, in comparison with 187.9 when at her greatest brilliancy. The illuminated portion of her disk is represented by 0.868 on the 31st, in comparison with unity or 1 at superior conjunction when her whole illuminated disk is turned to the earth. Her diameter on the 31st is 12".2, in comparison with 57".4 at inferior conjunction. These figures show that Venus is far from being in her best estate, but she is none the less a beautiful morning star, as, linked more closely to the sun, she heralds his near approach. Venus is in conjunction with Uranus on the 4th at 7 h. 49 m. P. M., being 1° 37' north.

The moon, three days before her change, is in conjunction with Venus, on the 16th, at 5 h. 5 m. A. M., being 3° 18' south. The conjunction is visible, but the actors in the celestial scene are very near the eastern horizon and low in the south.

The right ascension of Venus on the first is 14 h. 9 m., her declination is 10° 58' south, her diameter is 14".0, and she is in the constellation Virgo.

Venus rises on the 1st at 4 h. 1 m. A. M. On the 30th she rises at 5 h. 9 m. A. M.

SATURN

is morning star. He is a brilliant object in the morning sky, rising soon after midnight, and seemingly making his way toward Spica, the bright star on the southeast.

The moon, two days after her last quarter, is in conjunction with Saturn on the 12th at 4 h. 48 m. P. M., being 4' south. The conjunction is invisible, but moon and planet will not be far apart when they appear soon after midnight on the scene. The moon will occult Saturn for those observers who see her under the right conditions.

The right ascension of Saturn on the 1st is 12 h. 42 m., his declination is 2° 5' south, his diameter is 15".6, and he is in the constellation Virgo.

Saturn rises on the 1st at 2 h. 2 m. A. M. On the 31st he rises at 0 h. 13 m. A. M.

MERCURY

is evening star until the 11th, and then morning star. He reaches his inferior conjunction with the sun on the 11th at 11 h. 48 m. P. M., and then makes his appearance on the sun's western side to pursue his swift course as morning star. He moves with great rapidity in this portion of his career, and is at his greatest brilliancy on the 26th, when he is visible to the naked eye in the southeast as morning star.

The right ascension of Mercury on the 1st is 17 h. 54 m., his declination is 24° 49' south, his diameter is 8".2, and he is in the constellation Scorpio.

Mercury sets on the 1st at 5 h. 32 m. P. M. On the 31st he rises at 5 h. 39 m. A. M.

NEPTUNE

is morning star for nine hours, and then evening star, for he is in opposition with the sun on the 1st at 8 h. 52 m. A. M. This event changes his position from the sun's western to his eastern side, and ranks him with the evening stars. Neptune at opposition is most favorably situated for terrestrial observation, and if any new discovery is ever made concerning this faraway planet, it will probably be made in this part of his course. He is invisible to the naked eye, though some observers claim to have detected his presence with the aid of an opera glass. A small telescope will bring him into the field as a tiny disk of a delicate blue tint, and a powerful telescope will bring him to view with a small moon for an attendant. Discovered in 1846, it will take him until 2011 to complete a revolution.

The right ascension of Neptune on the 1st is 4 h. 34 m., his declination is 20° 22' north, his diameter is 2".7, and he is in the constellation Taurus.

Neptune sets on the 1st at 6 h. 59 m. A. M. On the 31st he sets at 5 h. 1 m. A. M.

URANUS

is morning star. The moon is in conjunction with Uranus, four days before her change, on the 15th, at 1 h. 26 m. A. M., being 41' south. She also occults the planet for the benefit of observers who see her under the right conditions. Three planets, Saturn, Uranus, and Jupiter, are occulted during the month.

The right ascension of Uranus on the 1st is 14 h. 25 m., his declination is 13° 54' south, his diameter is 3".5, and he is in the constellation Libra.

Uranus rises on the 1st at 4 h. 23 m. A. M. On the 31st he rises at 2 h. 32 m. A. M.

Jupiter, Mars, and Neptune are evening stars at the close of the month. Mercury, Venus, Saturn, and Uranus are morning stars.

Maple Hill Coal Mines.

The anthracite coal region of Schuylkill County covers about 230 square miles, and when the comparatively shallow districts are exhausted there are immense veins to be won by deep mining. Through the gap in the mountains, the Pennsylvania Railroad and the Philadelphia and Reading Railroad wind side by side. The latter climbs 603 feet in three and a half miles, attaining a summit elevation of 1,479 feet above sea level, and then winds down to the valley, 350 feet below; the bottom of the valley being surrounded by black, barren culm banks, and leveled off by a swamp of washed dirt and dust, with pools and streams of black water. At Maple Hill Colliery is a great coal breaker with a capacity of 2,000 tons per day. The shaft is 753 feet deep to the bottom of the sump, and is timbered from top to bottom. It is 23 feet by 11 feet 8 inches, subdivided into three compartments, two for hoisting and one for pumping, all 11 feet 8 inches by 7 feet clear. From the bottom of the shaft, tunnels, aggregating 800 yards in length, have been driven north and south, opening on two dips, with 400 yards breast on each, the following beds: Holmes, 10 feet 6 inches thick; Mammoth Top Split, 14 feet; Mammoth Middle Split, 14 feet 6 inches to 20 feet; Mammoth Bottom Split, 12 feet to 15 feet; Skidmore, 7 feet 6 inches; Seven Foot, 5 feet to 7 feet; Buck Mountain, 12 feet to 15 feet; total, 75 feet 6 inches to 89 feet.

The tracks at the foot of the shaft are arranged so as to work automatically, the loaded cars being delivered on one side while the empty cars run off by gravity, and are raised by a chain hoist to a common distributing point. The hoisting power is furnished by a pair of first motion engines, with cylinders 30 inches by 60 inches, connected to a 12 foot cylindrical drum, and are capable of hoisting eight mine cars in five minutes, or a total of 1,000 cars per day. Each mine car contains 116 cubic feet, and yields 2¼ tons of marketable coal. The shaft was begun in December, 1888, and finished in September, 1890, being sunk by power drills driven by compressed air.

The Engineer.

The experience of no one man, no matter how extensive his practice or how varied his opportunities, will cover much of the aggregate field of engineering. Think for a moment how little of your own knowledge of engineering is based upon your own unaided efforts and experience. How many of the rules which you use did you work out for yourself from data derived only from your own practice? When you have a piece of work to do that is entirely different from anything you have attempted before, what do you do? You hunt for an instance where somebody has successfully done such work before; or, if no such case exists, you lay out the work as best you can in the light of what has been done, taking the result of other men's tests as to strength of materials, proportions of parts, etc., and the failure or success of your work becomes a precedent to be avoided or followed by the next man who has a similar task to perform. It is the aggregate experience of the profession that constitutes engineering knowledge, and the more a man reads, the more of other men's thoughts and experience he absorbs, the more valuable he will become. Think of this the next time you hear a slur thrown at the "book engineer." It is not the function of books or papers to make engineers, but to record and disseminate the progress and experiences of the profession, thus adding to the aggregate knowledge of all. You can make up your mind, when you hear a man boast that he can get along and run his plant without reading, that he has not got along far enough to know how little he knows, or to be intrusted with the execution of work that requires any knowledge to speak of.—*Power.*

Turmeric.

This is a root of a plant growing in India, China, and Madagascar, and now chiefly cultivated in Bengal. The roots are long, and vary in thickness from that of a quill to about an inch in diameter. They are wrinkled and have joints or ring-like swellings at short intervals. Outwardly the color is a yellowish-gray, while inwardly it is of a deep yellowish-brown, darkest in the middle. When reduced to powder they appear of a bright yellow. The roots contain from 5½ to 6 per cent of mineral matter, moisture from 5 to 7, and 11 to 12 of coloring matter.

The coloring principle of turmeric is sparingly soluble in cold water, and dissolves freely in boiling. It is also soluble in alcohol. By alkalies it is turned brown, whence paper saturated with tincture of turmeric has long been employed as a test. Sulphuric, nitric, and hydrochloric acids turn the color of turmeric a kind of red, which, however, soon disappears. Alkaline chlorides for a time brighten the color, and solution of iron turns it brown.

The only adulteration to which turmeric is liable in commerce is common salt, which is sometimes added in quantity to the roots while going through the mill. This sophistication, besides adding to the weight, gives it a brighter appearance in the powder, at the risk of very seriously interfering with its uses in the dye house.

The detection of this fraud is easy. A small portion of the suspected powder is boiled in a test tube, with pure concentrated nitric acid, till the organic matter is destroyed. The remaining liquid is then diluted with pure water, and a solution of nitrate of silver added. If salt has been present, a copious white curdy precipitate will be formed.

The characteristics of a good turmeric are: it has a rich, deep, but bright, orange color, and a strong, aromatic, rather pungent odor. It should be perfectly dry. If damp it loses its brightness, turns a dull brown, and dyes only flat colors.

The best way of testing turmerics is to dye weighed pieces of woolen cloth with equal weights of the samples in boiling water. The swatches are compared for depth of color and examined for brightness overhand, *i. e.*, held up horizontally to the light and viewed along the surface. In this position it should have a beautiful golden luster, on the purity of which its value for many purposes depends.

Turmeric is a so-called substantive color, dyeing full shades without any mordant. It is, however, very fugitive, being affected by air and light as well as by acids and alkalies. A very remarkable circumstance is that no mordant hitherto known increases its permanency, while nearly all bodies of that class decidedly impair its beauty.

Correspondence.

Do Birds Eat Acorns?

To the Editor of the Scientific American:

In your issue of October 22 a letter from Dr. Gibbs, copied from *Science*, says that the woodpecker and bluejay eat acorns. I think, on closer observation, he will find he was mistaken.—perhaps in regard to all the birds named. The pigeon and dove I am not acquainted with.

It is well known that almost all fruits and nuts contain worms; those are what the birds want.

The red linnet (a seed-eating bird) resorts to the ash tree in the month of September, and to an ordinary observer would appear to be eating the ash seeds; but it is not so, as numbers of the seeds contain small worms, which the birds find a juicy, fat morsel, and never break a sound seed, but drop it immediately when they find it solid. The seeds containing worms are soft.

The gray squirrel, genuine nut cracker and eater, cracks the acorn for the same toothsome morsel, and leaves that part of it which is not eaten by the worm. I have seen this within the present month.

MATTHEW NIAL.

Troy, N. Y., November 17, 1892.

Good Prairie Roads Wanted.

To the Editor of the Scientific American:

Good roads on the prairie is a subject of great and growing importance.

The prairie roads are the *best*, when smooth and dry—better than the average city pavements.

I mean the black gumbo prairie mud, that will roll up and stall a four-horse team to an empty wagon at one time of year, and will at another time be hard as rock (almost), and smooth and free from dust.

Now what can be put on the road that will combine with the mud, or with the dry, hard surface to make it proof against frost and rain?

Or can some one make a solution of lime with other stuff that will petrify the surface to such extent as to make it less sticky, if not altogether free from the effects of rain and spring thaws? Perhaps the clay at a depth of three or four feet from the surface would be better material for preparation for the surface of the road than the black earth.

Or will some one make a fiery furnace that can be moved along, leaving a melting mass of this same tender clay; that is, the clay to be fed in at the top of the furnace, and coal lower down, an engine attached to elevate the clay, blow the fire, wind a cable, to move furnace and discharge the vitrified clay in the lower part of the furnace into a prepared bed in the surface of roadway.

Or shall this furnace and engine make some good vitrified bricks, at suitable places along the road, to be put in place by convict labor?

Or shall we take a plow and grader and make a shallow V-shaped ditch in the middle of the road, then dig in the middle and lay tile for drainage, cover with earth to protect, then fill the V-shaped ditch with broken rock, taken from the great Chicago sewer?

Now who can make good permanent roads for the least money? That is the rub, the money. Any one may have good roads for big money. And there is big money for some one for good roads.

Virginia, Ill. J. A. CUNNINGHAM.

Tight Rope and Slack Rope Walking.

To the Editor of the Scientific American:

Having read the opinion of Robert A. Hatcher as to what keeps a bicycle upright, in your issue of November 19, which I believe is correct, I thought it would not be out of place for me to also enlighten some of your readers as how it is for a person to keep upright on either a slack wire or a tight rope. I will here state that I have been a professional on the slack wire, and have also had the pleasure of walking on a tight rope. Now it would seem natural to suppose that a slack wire performer should also be able to walk on a tight rope, and that a tight rope walker should also find little difficulty in walking on a slack wire. But this don't happen to be the case, because the slack wire and the tight rope are the extremes to each other, and an altogether different means must be adopted in order to keep an equilibrium.

In the first place, the slack wire sways and the tight wire or rope does not, or should not; therefore, on the tight rope, in order to prevent it from swaying, guy lines are generally employed. Now, as our friend Mr. Hatcher says that the bicycle requires more space when in motion than the actual thickness of the tires, even if the rider wants to keep in a perfectly straight line, the same holds good for the slack wire performer. To the eye it appears that he is just walking on a wire about three-sixteenths inch in diameter, and finds that sufficient space to travel in. Now, if you were to stand under him while he is on the wire, you would discover that, instead of using only three-sixteenths of an inch space, it would not be long before you would be convinced that the performer requires from four to ten, and sometimes fourteen, inches in order to travel and keep his balance. In order to walk the slack wire the extended arms are a great service, and when the arms are folded or employed by performing a trick or juggling, then generally one of the legs is extended to perform the function which the arms did. Now, in order to keep an equilibrium, the wire under the performer is continually changing its position. If the performer feels that he is losing his balance, a skillful move will throw the wire under him, and the extended leg or arms help to facilitate throwing or swaying the wire directly on the line of the center of gravity. A slack wire performer would not be able to make three steps on a tight wire without considerable practice, for the reason that he has learned to throw the foundation he is standing on always immediately under him, and on the tight rope or wire this cannot be done, and, instead, he must depend on centering his body directly over the rope, just as it is necessary when walking on a railroad track.

It may somewhat surprise some of the readers to learn that a slack wire walker cannot, or can do very little, track walking, because it comes so natural to him to throw what he is standing on directly under him, and if it does not answer he must step off. The tight rope walker depends nearly altogether on his balancing pole. He stands upright, and when he finds he is apt to come off, or lose his balance on one side, he immediately runs more of his pole to the opposite side to gain an equilibrium, and if you were to observe closely, you would also notice that although he only occupies the space equal to the thickness of the rope, yet the pole is continually being moved from one side to the other, from six to twenty inches. Some of the more skilled do it with so much grace that it is hardly perceptible if not looked for. It is just as difficult for a tight rope walker to balance himself on a slack wire (if he never tried or practiced it) as any one of your readers that never tried it, because he is dependent on a firm foundation and balances on it, while the slack wire performer continually draws the foundation under him.

JOHN G. VON HOFE.

New York City, November, 1892.

How Photo Solio Paper and Films are Made.

The Eastman Company, of Rochester, N. Y., of Kodak fame, have established in England a great factory, covering seven acres, for the manufacture of their celebrated sensitive photographic paper and sensitive celluloid films. A correspondent of the *British Journal of Photography* describes as follows a visit to the company's factory at Wealdstone, Harrow. The title of the concern is the Eastman Photographic Materials Company.

In the Solio coating rooms are to be found huge rolls of paper, specially manufactured for this purpose. One of these rolls is lifted up to its suitable support, and having been unrolled to a sufficient extent, its end is brought under the domination of silver-coated rollers, and caused to pass across the surface of the gelatine emulsion with which it is to be coated. The machinery is then started, and the paper is coated, equalized, festooned for drying, dried, and finally brought out at the other end of the drying room in a state of perfect dryness, without having once been touched by the hand.

The mechanism by which all this is effected is of the most remarkable kind, seeming as if, when once started, it did all the thinking that was necessary, from the immersion in the emulsion up to the stage at which an attendant, with hands incased in white gloves, supplied it to another machine, by which, and with the aid of automatic guillotines, it eventually was presented as flat, cut-up sheets of various sizes, ready for transference to another department.

The Solio paper which we saw coated was twenty-four inches wide, and it was coated at the rate of about fifteen feet per minute, a *mile and a half* being the present output per day. It is all dried, cut up, and packed the same day as made, and is shipped off.

In the examining and packing room we saw a whole regiment of young ladies, deftly submitting each sheet, small and great, to an electric light lantern, faced with yellow glass, by which the slightest speck or imperfection, if such existed, could be at once seen. During our visit to this department no sheet was observed to come under the ban, but we were told that all such, when discovered, are summarily rejected and subjected to a further retrimming, in which the portion containing even the tiniest of spots is relegated to the waste room.

Mr. J. B. B. Wellington, the chief of the factory, who acted as our guide, informed us that they insisted from first to last on the sensitized paper or films never being touched by the ungloved fingers, as it was a well known fact that the exudation from even the cleanest hands set up an action on the sensitive surfaces which, sooner or later, proved detrimental, and hence the insistence upon the employment of gloves in all departments involving contact with such delicate surfaces. The result of this was all that could be desired, as they never experienced any stain from this source.

The same care was taken in the incasing of the cut sheets into the envelopes in which they are sent out. These envelopes, for the retail consumer, contain, as is well known, a certain number of sheets, which, no matter how large or small the size, is sold at a smaller price per packet, based upon the area of the paper contained therein, so that a packet containing only a few sheets equals with a wonderful degree of precision another containing a large number of those of smaller dimensions. These envelopes are all made on the premises, being cut out by machinery and closed by hand labor. In an adjoining room were being made the boxes in which the sensitive films for roller slides are packed. The great care taken in insuring uniformity and perfect equality throughout, coupled with that scrupulous cleanliness which was apparent at every stage, appeared to us to be a healthy outlook for the users of the productions.

Before leaving, we were privileged to examine the adjacent factory devoted to films, and in passing through some of the storage and chemical rooms we witnessed the whole operation of dissolving gelatine from a stock of three tons, which was on the premises at the time. The emulsion is mixed fifty gallons at a time in a tank, from which it is drawn by means of a four-way tap into reservoirs placed below.

What interested us probably more than all the rest was the preparation of the flexible films with which the firm's name is now so intimately associated. Twelve plate glass tables, each eighty feet long by three feet six inches wide, and occupying two floors of the factory, form the basis on which the celluloid is made. Eight men were in attendance in the conducting of this. First of all, each table was closely examined to see that it was absolutely clean; but, as if to render assurance doubly sure as regards this, a long plush brush, the width of the table, was placed in supports immediately in front and forming part of the coating machine, a reservoir in which was then filled with an oily-looking fluid by the attendants. This being done, and everything now being ready, a lever was pressed, and the steam engine did the rest, for the coating apparatus at once commenced to move with a uniform pace toward the far end of the table, leaving a beautifully even, but still fluid, film behind it. Arrived at the far end of its eighty feet of travel, the "button" was again pressed, and the engine was stopped for a few moments until the attendants had lifted the coating machine to the next table, where the reservoir was once more charged from vessels like those by which milk is sent to town per railway, after which all went on as before until the twelfth of the eighty-feet tables had been coated. When quite dry, and without any great delay, the celluloid was coated with emulsion in somewhat like manner, but in darkness so dense as to be almost painful, although relieved by a feeble glimmer of red light.

By special means, a difficulty occasionally encountered by some amateurs has here been entirely got rid of; we allude to the liability of a celluloid film when being stripped from glass giving an electric spark, and thus damaging the delicate bromide superstratum. The means adopted by the company for the prevention of this have proved quite effectual.

The Railway Telephone.

The Port Defiance, Tacoma and Edison Railway has in operation an appliance designed to prevent delays when an accident happens to any of the cars along the line, or when trouble of any kind occurs. The appliance is an ingenious telephone arrangement so connected with the main office that the conductor or motorman can telephone what the trouble is and all the details, so that arrangements can be made at the office to avoid delay of other cars on the line, thus discommoding patrons. Along the line between Point Defiance and Edison a telephone wire is strung, and there are special poles, down which proper wires run to an average man's height from the ground. Each car carries a telephone instrument, which can be connected with the wires and communication with the main office obtained. After notice of trouble is received the remaining cars on either side of the break can be operated by office orders through the telephone, and thus kept running on time. It would seem to be to the interest of almost every railway in the country to adopt such a telephone system.

Color Photography.

M. Lippmann has been pursuing with energy his investigations into color photography. He says that "on the layers of albumino-bromide of silver rendered orthochromatic by azaline and cyanina, I obtained very brilliant photographs of spectra. All the colors came out at once, even the red, without the interposition of colored screens, and after an exposure of from five to thirty seconds." He submitted photographs of stained glass windows, draperies, oranges, and a parrot, taken by electric light with five to ten minutes' exposure, in which the color is noticeable as well as the form.

THE HELIOCHROMOSCOPE.

Although photography in colors is not yet an accomplished fact, and although none of the experiments encourage the hope of its early accomplishment, yet by a very interesting, ingenious method and device invented by Mr. F. E. Ives, of Philadelphia, photographic pictures are shown with all the colors of nature. These wonderful effects are secured by means of photographs taken on orthochromatic plates through selective color screens. Three such pictures are taken on one plate, each one representing one of the primary colors. From the triple negative thus obtained a positive transparency is made by contact, each picture and its several portions having the true color values. The partial images are identical as regards point of view and size; each one, however, being transparent or semi-transparent only in those portions which represent the fundamental color belonging to the partial image. According to the modern theory of color vision, red, green and violet are considered the primary colors; consequently, the three pictures represent these three colors, and when viewed through an instrument provided with red, green and violet colored screens, and furnished with means for blending the three images into one, all the colors of the subject are shown.

The simple instrument by which these pictures are superimposed is shown in Fig. 1, and the arrangement of the internal parts is shown in Fig. 2. In the lower part of Fig. 2 is seen the triple transparency, or "chromogram," as the inventor chooses to call it. Above the three images are arranged three colored screens marked R, G, and V. The image below R is transparent to red, but opaque to other colors, except in so far as it enters into combination with the other colors to produce intermediate tints. The same is true of the image below the colored screen, G, this photographic image being transparent to green and to other colors only as green combines with other colors to produce intermediate shades. The same also applies to the picture under the violet screen, it being transparent to violet and opaque to the other colors.

After passing the colored screens, the images are superimposed by a series of transparent and opaque mirrors. By following the line of the light beam passing through the red color screen, it will be seen to impinge on an opaque mirror near the top of the instrument, whence it is reflected to the upper surface of a transparent mirror, thence upward through the eyepiece. The light passing through the green screen is received on an opaque mirror and reflected to another opaque mirror at the center of the apparatus, from which it is reflected through the two transparent mirrors above it to the eyepiece. The light beam passing through the violet screen is reflected by an opaque mirror to the transparent mirror at the center of the instrument, thence upward through the transparent mirror to the eyepiece. Thus by means of opaque and transparent mirrors the three colored images are superimposed, and by means of the transparent and semi-transparent portions of the picture, the amount of light from each portion of the image requisite for producing the colors and their gradations is thus made to pass through the screens, mirrors and eyepiece to the eye. A reflector is placed underneath each photographic image, so that each receives its quota of light. The effect produced is wonderfully beautiful, giving every color and every possible gradation of light and shade as faithfully as the object itself would do under the most favorable circumstances.

The inventor states that the chromogram is a photograph made in a special camera, with no more operations than are required to make an ordinary photograph, so that we are led to believe that before very long amateurs having the special camera and the instrument through which to view the pictures will be able to show pictures in natural colors as readily as they can now show stereoscopic views.

Mr. Ives, by means of different apparatus, has projected photographs in colors on the screen where they could be viewed by a large number of spectators.

It is an interesting fact that a triple negative placed in the instrument in place of the positive shows colors complementary to those belonging to the object.

Fig. 1.—HELIOCHROMOSCOPE.

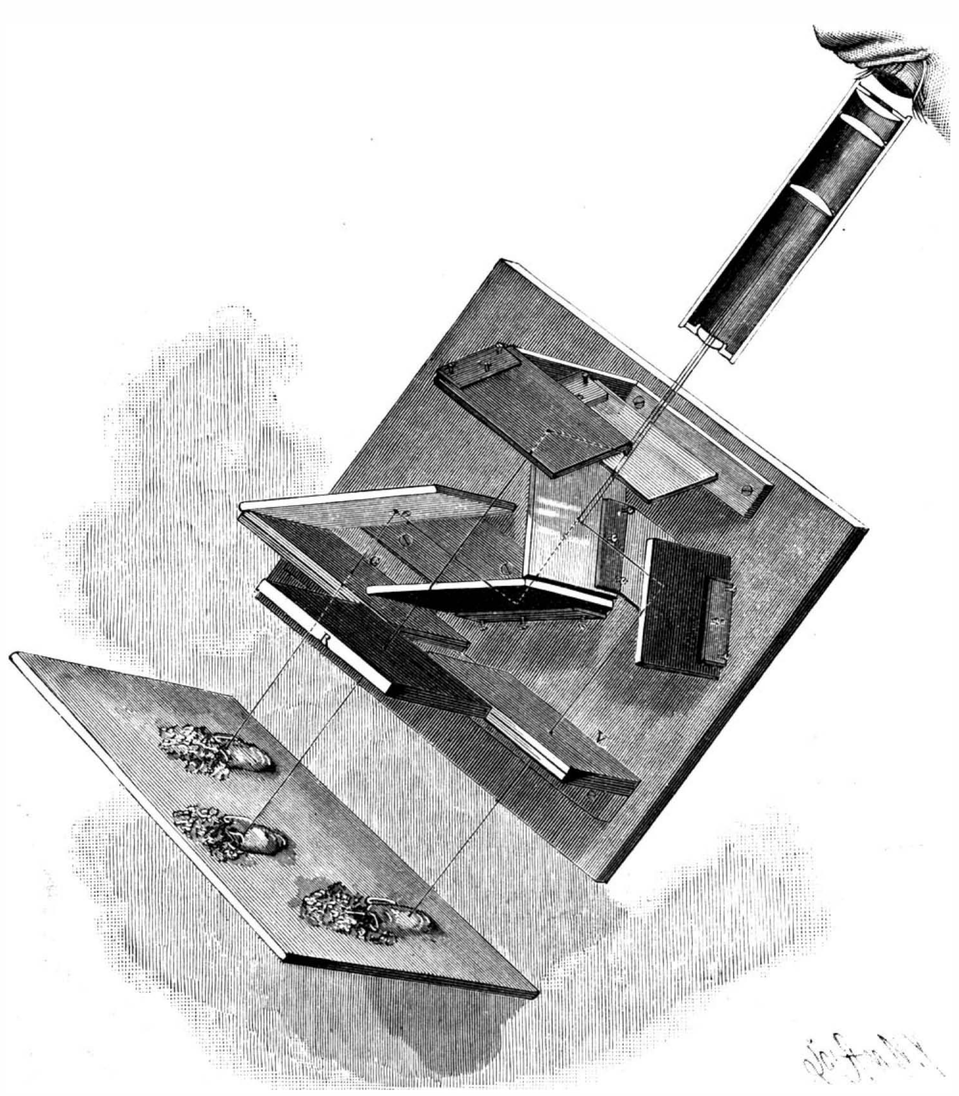


Fig. 2.—SECTION OF HELIOCHROMOSCOPE.

Metallic Sodium.

In the general process for the manufacture of metallic sodium, one of the greatest drawbacks at the present time is the difficulty of expelling the sodium in the form of vapor as quickly as reduced, insomuch that, for a considerable time after a most intense heat has been obtained, on viewing the inside of the converters, large globules of sodium are not unfrequently observed, which are only with difficulty volatilized.

Potassium, on the other hand, although presenting more difficulties than sodium as regards its preparation, melts and volatilizes at a much lower temperature; for instance, if 23 parts by weight of sodium be carefully alloyed with 29 parts of potassium, a fluid amalgam is produced which remains liquid at all ordinary temperatures. If this amalgam is now distilled in a non-oxidizing atmosphere in the first instance, potassium metal distills over, leaving a residue consisting of sodium containing about 5 or 6 per cent of potassium. This alloy, which resembles ordinary sodium in appearance, is much more energetic than that substance itself, taking fire when thrown upon the surface of water the same as potassium, but burning with the characteristic yellow flame of the former. Following these reactions various charges were next operated upon, obtained by the incineration of the alkaline tartrates, sodium tartrate in admixture with a sufficiency of potassium salt, so as to allow the above mentioned percentage of potassium to pass into the distillate, being among the first.

The distillate thus obtained possessed far more energetic properties than pure sodium, melting at a much lower temperature and being considerably more volatile. A series of small converters arranged in groups and containing various percentages of mixed calcined tartrates were thus operated upon, the converters at the termination of each reaction being cut longitudinally, and in no instance could any reduced metal be detected; the alkali metals thus formed having been entirely volatilized, producing the aforesaid alloy.

The calcining of tartrates on a large scale would naturally be entirely out of place; but the introduction of potassium could, as far as can be seen, be brought into play when employing any of the ordinary commercial methods, save that the percentage of the two would probably require a somewhat closer study, in order to obtain concordant results. H. N. WARREN.

The Corn Cob Pipe Industry.

Corn cobs are not only used as a fuel, but are also manufactured into tobacco pipes by Messrs. H. Tibbe & Son, of Washington, Mo., who have built up a large and novel industry by manufacturing tobacco pipes from corn cobs.

Mr. Henry Tibbe obtained, through Munn & Co., a patent on July 9, 1878, for a pipe made from a corn cob in which the interstices are filled with a plastic, self-hardening cement; and this patent was recently fully sustained by a decision of the United States Circuit Court for the Eastern District of Missouri in the suit of the H. Tibbe & Son Manufacturing Company vs. Lamparter.

In 1882, Mr. Tibbe formed a stock company to manufacture corn cob pipes under his patent, and now receives as a royalty alone $250 per month, and, in addition to this, draws about $10,000 per year as his share of the profits, which latter amount to about $50,000 a year.

The company has the immense advantage of requiring very little money to carry on the business, as the corn cobs are bought directly from the farmers by a St. Louis concern which delivers the cobs to the company and receives all the pipes the factory turns out.

The only difficulty experienced is that they frequently cannot get a sufficient number of cobs to supply the demand for the now very popular corn cob pipes.

The best cobs are the so-called Collier cobs, as they are very large and the grain is not so deeply seated in the cob as in the ordinary corn ears. Good cobs bring about a cent apiece, so that a farmer receives about $30 for a wagon load. The size required is about 1⅝ inches in diameter, and each farmer desiring to supply cobs receives an iron ring of this size to measure the cobs with. Rejected cobs are not usually carted back by the farmer, and furnish a cheap fuel for the boilers of the factory.

The ends of the accepted cobs are cut off by a circular saw, and a good sized cob is, in addition, cut in two pieces for making two pipes from a single cob. Each piece is then bored out by suitable boring machines handled by boys and serving to remove the pith.

Th hollow pieces are then turned on the outside to give the proper shape to the bowl of the pipe. A good turner usually prepares about 3,000 cobs in ten working hours and receives $1 a thousand as compensation.

The interstices in the turned pieces are then filled in with a plastic, self-hardening cement, after which they are dried, sandpapered and shellacked. A barrel of cement is sufficient to fill the interstices of 30,000 pipes and to shellac the same only a single gallon of shellac is necessary.

The present plant of Messrs. Tibbe & Son has a capacity of 350 gross of pipes per week.

A RECENT invention is a cradle which rocks by clockwork mechanism and at the same time plays baby tunes.

DE SUSINI'S ETHER MOTOR.

We were the first (it is now more than a year ago) of the scientific press to call the attention of the industrial world to the ether motor of Dr. Paul de Susini. Certainly, at that epoch, the application made by the inventor of his idea of substituting the vapor of ether for steam presented those imperfections and complications that are inevitable in the putting of an invention in practice, but it appeared none the less certain that it was in this direction that it was necessary to seek the solution of the problem that all mechanicians are pursuing, *i. e.*, the improvement of the steam motor from the standpoint of saving in water and coal—a problem whose importance is increasing every day by reason of the progressive augmentation of the cost of fuel. In fact, the efforts made in this direction with steam engines, and which have had for effect the creation of triple and quadruple expansion engines, have indeed permitted of effecting considerable saving in expense as compared with the old motors, and of reducing, for example, the consumption of coal from 4 and 3 kilogrammes to 1·5 and 1 kilogramme, and even, in exceptional cases, to 750 grammes per horse and per hour. These were very satisfactory results twenty years ago, but these figures, which represent the minimum of expense that can be laid claim to with the steam engine, are still much too high in the present economic conditions.

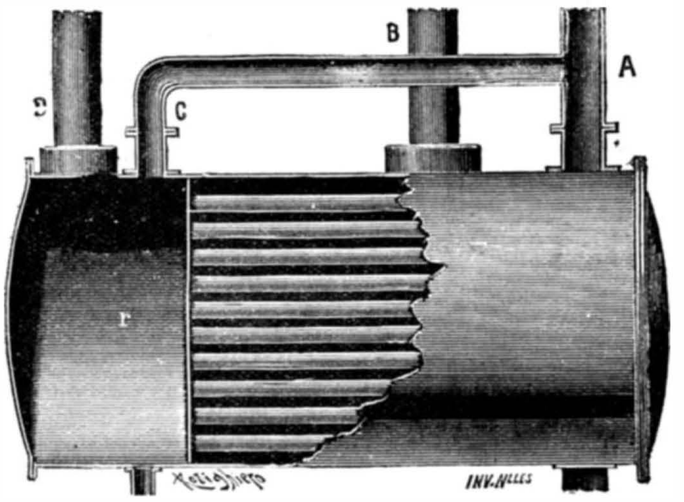


Fig. 1.—CONDENSO-GENERATOR.

Convinced of the impossibility of remedying this state of things, a certain number of mechanicians devoted themselves to the study of the gas motor, which, in recent years, has come into so extensive use, and they soon recognized the fact that the addition of a gasometer for furnishing the gas necessary for the working permitted of reducing the cost of coal per horse and per hour to the neighborhood of 600 grammes. But here again it was found that a limit had been reached that one could not think of going beyond. And yet in these two cases the calculations of thermodynamics establish in the most express manner that a feeble part only of the heat units produced by the combustion of the coal is converted into effective power. The heat lost is absorbed in great part, when it is a question of the steam engine, by the conversion of water into steam. This is what is called the latent heat of vaporization. In the case of the gas motor this heat is utilized both in consequence of the insufficiency of the expansion and of the high temperature (about 300°) of the gases on their exit from the cylinder.

In order to obtain a better utilization of the heat units produced by the combustion of the coal, it was therefore necessary to seek a liquid which should require a less quantity of heat than water does for its conversion into vapor, and which, under the latter state, might furnish the same sum of work in giving the same advantages as regards expansion, and which, after its passage to the cylinder, should be easy to bring back to a liquid state, in order to rebegin the same cycle indefinitely. Of all known materials, that which best satisfies such conditions is sulphuric ether, which boils at 35° and the vapor of which at 95° has a tension of six atmospheres, while steam has none at this temperature. Many inventors before Dr. De Susini had seen the advantages that might be derived from the use of the vapor of ether for actuating the piston of an engine, but none had succeeded in carrying out the idea in a practical manner.

The difficulties met with are numerous: leakages of vapor, involving considerable losses of a very costly liquid; difficulty of keeping the cylinder at a temperature sufficient to prevent the condensation of the vapor before it has produced its entire useful effect; dangers of explosion of the generator, due to the fact that the least elevation of the temperature immediately results in a considerable increase of the pressure of the vapor, etc. Dr. De Susini has surmounted all these difficulties, after numerous experiments that lasted for several years, and during which he gave proof of those qualities of perseverance and energy that are the characteristics of the true inventor. It must be added that he was valiantly sustained in this everyday contest by Mr. Digeon, the inventor who had undertaken the construction of the motor.

In order to get an idea of the multiple phases through which the putting in practice of Dr. De Susini's invention has passed, it will suffice for our readers to refer to the figures of the motor of a year ago that we published in our number of October 5, 1891.* This engine, which was itself only the resultant of numerous anterior tentatives, was evidently much too complicated for an industrial motor. It consisted essentially of four simple-acting cylinders coupled in pairs and inclosed in a cast iron chest filled with glycerine. Beneath this chest were arranged two cylinders, one above the other, containing water and heated by a furnace situated beneath the lower cylinder. This latter was traversed throughout its entire length by two tubes connected by a series of bent tubes and containing ether. These, as a whole, constituted the vapor generator.

In the upper cylinder were hung a large number of vertical tubes ending at the base of the chest containing the glycerine. The latter was heated in these tubes and rose to the upper part, where it replaced that already cooled, which descended to the bottom. Finally, the two cylinders were connected by two tubulures so as to constitute a water thermo-siphon, which heated the glycerine thermo-siphon constituted by the vertical tubes and the chest. One had therefore a continuous circulation of the two liquids, and it was possible to keep the temperature of the whole nearly constant—an important point, as we have before said.

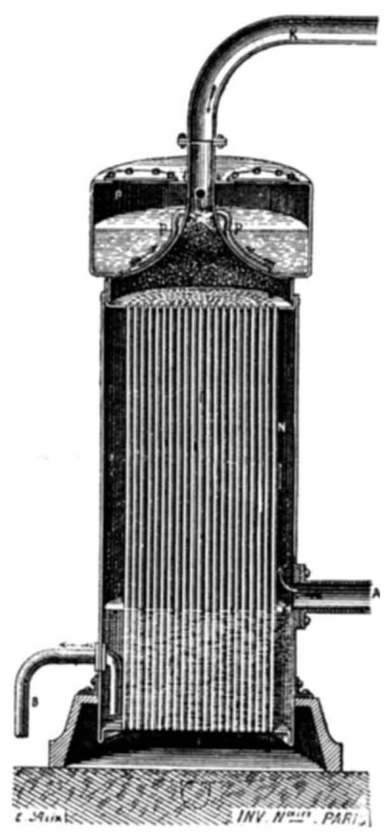


Fig. 2.—AERO-CONDENSER.

On making its exit from the cylinders, the ether vapor went to an aero-condenser, which is the sole part of the old motor that we find in the new, and which it is therefore well to describe again in this place. It consists of a number of vertical tubes, J (Fig. 2) inclosed in a jacket and debouching at their two extremities in two chambers, K and L. The upper chamber receives the conduit, *k*, of a blower moved by the engine. The lower chamber receives the exhaust pipe of the projected air that has traversed all the tubes. This conduit is figured in dotted lines at the base of the apparatus.

The ether enters the cylinder, N, through the pipe, A, and becomes condensed in contact with the tubes cooled by the current of air, which is moistened by means of a spray of water at O, due to the meeting of small convergent jets issuing from a series of capillary tubes, *p*. A reservoir, P, contains the water for supplying these tubes, and it is the pressure of the current of air coming from the blower and entering the reser-

* SCIENTIFIC AMERICAN SUPPLEMENT, No. 828, p. 13223.

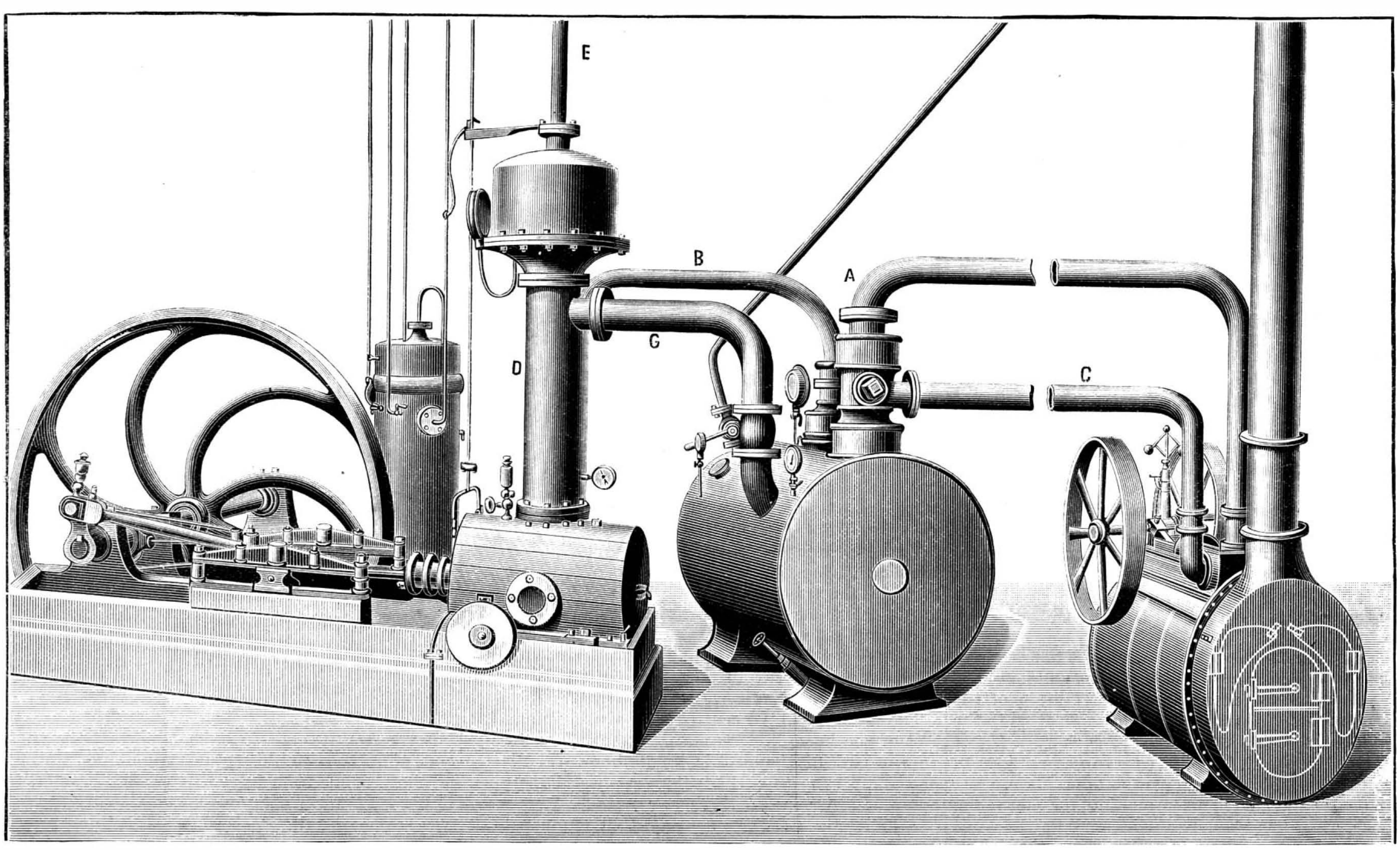


Fig. 3.—GENERAL VIEW OF THE ETHER MOTOR OPERATING WITH THE LIVE STEAM OF A MOVABLE ENGINE.

voir through the apertures, q, that causes the water to rise in the tubes, p, and makes it spurt in convergent jets which come into collision at O. The atomized water is drawn into the tubes, J, by the current of air and thus notably augments its refrigerant power. The condensed ether collects at the lower part of the cylinder, N, and flows through the tube, B, to return to the generator, thus forming a complete cycle, and, so to speak, an indefinite one.

The new machine, represented in Fig. 3, solves in an absolutely practical manner all the conditions already indicated for the perfect working of a motor of this kind. As may be seen, it has the form of an ordinary steam engine, and it differs therefrom in reality only by the arrangement of the steam jacket, stuffing box, valve rods and piston. The generator of ether vapor (Fig. 1) is an ordinary surface condenser filled with ether, and in the tubes of which circulates the steam derived from a boiler. In the present case, the generator is that of an Olry & Grandemange movable steam engine of five horse power, arranged in a basement in the vicinity of the room containing the ether motor, but that we have supposed on the same level in the engraving.

The operation comprises two complete cycles; one for the steam which starts from the boiler through the pipe, A, and enters the tubes of the aero-condenser, where it gives up its heat to the ether, condenses and returns to the boiler through the lower pipe; and the other the cycle of the ether vapor, which starts from the condenso-generator through the pipe, B, goes to the motor, makes its exit therefrom after having worked, goes to the aero-condenser (not figured in the engraving), and returns in a liquid state to the reservoir, R, whence a pump forces it into the condenso-generator.

As may be seen, there could be nothing simpler than this installation. The only places where it could be possible for leakages of ether to occur are the two stuffing boxes of the valve rods of the piston. In order to render them absolutely impermeable, the stuffing boxes have been arranged as in Fig. 4. They are, in reality, each composed of two stuffing boxes (the external one is not represented in the figure) separated by bronze washers, between which is arranged the packing.

The tightening of the external stuffing box, therefore, produces that of the entire system. The lubrication is produced by the glycerine contained in the external annular space, and which is capable of penetrating freely all around the shaft through apertures formed in the body of the stuffing box. The vapors of ether that may have entered the intervals between the washers cannot escape laterally, by reason of the great difference between the density of the ether and glycerine. They rise, therefore, to the upper part of the annular space, whence a copper tube leads them to the receptacle, R.

The steam issuing from the cylinder rises through the pipe, D, to flow to the condenser, which, as we have said, is not represented in Fig. 3. In its course it traverses a separator (Fig. 5) composed of plates, each containing an aperture, now at the upper and now at the lower part. In this passage the steam is entirely freed from the traces of glycerine that it may have carried along and reaches the aero-condenser perfectly pure, while the glycerine falls back into the valve box.

In the engine under consideration, which is a model of demonstration, the steam may be taken directly from the boiler or at the exhaust after working in the movable engine. In both cases the cycle is the same, but the installation is a little more complicated by the pipes that it is necessary to add to lead the steam coming from the exhaust into the condenso-generator in passing through the steam jacket of the ether motor. But, of course, in practice, one can content himself with either of the installations. That is to say, have only one steam boiler when it is desired to operate with live steam (which is the most practical arrangement), or take the exhaust steam of an engine whose power may be increased without installing a new generator, and, consequently, increasing the output of coal.

The important point in the two cases is to first cause the steam to pass into the jacket of the cylinder of the engine, in order to prevent the condensation of the vapor of ether. In order to avoid complication in the engraving, the piping as a whole for each case is not represented in Fig. 3, but it is easy to get an idea of the manner in which the circulation takes place.

The trials which have been making for more than a month, every Tuesday, Thursday, and Saturday, at the works Mr. Digeon, and at which a large number of engineers and manufacturers have been present every time, establish in an undeniable way the immense saving resulting from this new method of utilizing the work of steam.

When one works with the live steam of the engine at a pressure of 2·5 kilogrammes, corresponding to a pressure of ether vapor of 10 kilogrammes, a power of 18 horses is developed upon the ether motor.

The quantity of water vaporized per horse and per hour is 6·66 kilogrammes, while in good steam engines it is at least 12, and the heating surface necessary to the generator is reduced to 0·27 square meter per horse. This diminution by one-half in the weight of the water vaporized evidently corresponds to an equal reduction in the weight of the fuel burned. It may, therefore, be asserted that under such conditions of pressure the saving in fuel is at least 50 per cent, and it may be added that it would be still more sensible if, instead of working at a pressure of 10 kilogrammes, one worked at 25, corresponding to that of 5 for steam, the tension of the ether vapor increasing more rapidly than that of steam.

When one works with the exhaust steam of the engine, the steam reaches the condenso-generator at a temperature of 95° and produces ether vapor at a pressure of 5·5 kilogrammes. The power collected upon the shaft of the ether motor is that of 10·52 horses. Now the engine running with free exhaust gives 5·9 horse power at the brake, and the passage of the steam into the condenso-generator gives rise to a slight counter pressure, which reduces the useful effect, measured upon the shaft, to 5·21 horse power.

If such diminution be taken into account, the supplementary power obtained is yet 9·83 horse, representing a saving of 63 per cent in the consumption of water and coal.

Supposing a condenser has been added to the steam engine, one would have simply increased its power by about 1·7, and it would have then given 5·74 horse power. The saving resulting from the use of the ether motor remains therefore nearly 60 per cent.

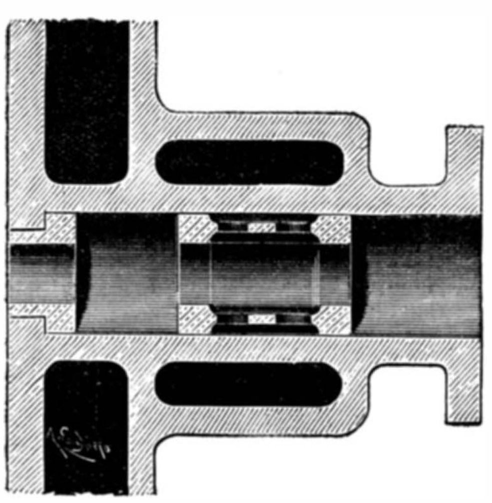


Fig. 4.—DETAILS OF THE STUFFING BOX.

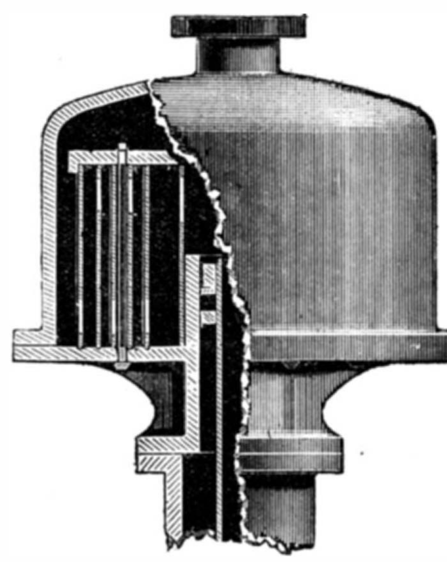


Fig. 5.—HALF ELEVATION AND SECTION OF THE SEPARATOR.

As may be seen, the results are most remarkable. They will, however, be notably surpassed when, instead of utilizing the exhaust of a steam engine, there will be made to circulate in the condenso-generator the gases derived from a gas motor.

In fact, as we have above said, such gases come from the cylinder at a temperature of about 300°, that is to say, more than double that of exhaust steam. There will, therefore, be obtained at the condenso-generator a pressure much higher than that given by steam, and consequently an increase in the work furnished by the ether motor. It would be easy to calculate the saving resulting from this combination, but for fear of appearing too favorably impressed, we prefer to await the results of the experiments that are to be made before long in this direction.

It is scarcely necessary to dwell upon the important bearing that Dr. De Susini's discovery will have upon the future of the steam engine. We shall simply say a few words regarding two of the most interesting applications—the production of electricity and the use of the ether motor on ocean steamers.

What has retarded the general application of electric lighting to cities is solely the much too high net cost of this system, which, despite all the improvements introduced into the apparatus for producing electricity, remains sensibly greater than that of lighting by gas or kerosene. But if, in order to produce electricity, we substitute an ether motor for the ordinary engine, the conditions differ all in all.

The saving of 50 per cent or more realized upon the cost of the horse hour is naturally found again upon the cost of the electric candle hour. The latter becoming less dear than its various competitors, and presenting, moreover, the advantages that every one knows, it is very evident that all municipalities will hereafter address themselves to it. What is true of lighting is equally so, and to the same degree, of electric propulsion, which is already so widespread, notwithstanding its high net cost, and which will be still more so when the electric horse hour shall cost less than the steam horse hour.

As for the marine, that will find in the use of the ether motor a solution of the three sole difficulties that limit the field of action and power of a ship, to wit: the supplying with coal and water and the impossibility, in the present state of steam engines, of increasing the speed of ships. The ether motor will permit either of reducing the quantity of coal to be carried by more than one-half, or, what amounts to the same thing, of more than doubling the voyage that a ship can make without being obliged to take on new supplies. It completely suppresses the need of a supply of fresh water or the substitution of it by distilled sea water, as that contained in the boilers serves indefinitely. Finally, it permits of running, if need be, at pressures of 25 and even 30 kilogrammes, corresponding to a temperature less than that of steam at 9 atmospheres, and consequently not presenting, as regards the heating of the parts, the inconveniences attending the use of steam at 12 or 15 atmospheres. We shall therefore be able to further increase, to a certain degree, the speed of ships, or, inversely, to reduce the dimensions of the motors.

What we have just said will suffice to demonstrate the interest that Dr. De Susini's motor presents.

Let us add that its introduction into practice is only a question of days. The inventor has already made arrangements with Mr. Lombard (the great manufacturer whose chocolate works are known to every one, and who will thus have the honor of attaching his name to the first application of Dr. De Susini's discovery) for the installation in his manufactory of a motor that is to utilize the exhaust steam of an engine that has become inadequate. Other negotiations are in progress in France as well as in England. Finally, Mr. Digeon's works are actively engaged in the construction of a double expansion motor of fifty horse power, which is to figure at the Chicago Exhibition, where it will certainly astonish our neighbors of the other side of the ocean (who are not very easy to excite, however), and show them that old Europe is not yet resigned to cede to them the precedence in the domain of great scientific and industrial discoveries, and that France, in spite of the crises that she has passed through and the reverses that she has endured, intends to keep her rank at the head of the army of progress.—*Les Inventions Nouvelles.*

Agavose.

In a recent number of the *American Chemical Journal* a report is given of researches on the sugar of the *Agave Americana*, by Gustave Michaud and Jose Fidel Tristan, of San Jose, Costa Rica. This is the plant from which the Mexicans make a species of whisky called pulque:

The results of the investigations may be stated in the following conclusions.

The *Agave Americana* contains a sugar of the formula $C_{12}H_{22}O_{11}$. This sugar differs from all other sugars of the same group, except synanthrose, by its inactivity. It differs from synanthrose by its power of crystallizing, by its action in Fehling's solution, and by the rotatory power of the products of its inversion.

We propose for this sugar the name of *agavose.*

Photos that Yield Colors.

At the last meeting of the Paris Academy of Sciences some colored photographs of the spectrum on albumen and bichromated gelatine, by M. G. Lippmann, were exhibited. It was stated that albumenized and gelatinized plates soaked in bichromate of potash may be employed for photographing in colors. They are used like silver salt plates, being placed so that the mercury is in contact with the film. The colors will appear immediately after immersion in water, which develops and also fixes the image. It disappears on drying, but reappears as soon as the plate is soaked. The colors are very brilliant, and visible at all angles. Those of gelatine plates are brought out by simple breathing. The theory is analogous to that of silver plates, the maxima and minima of interference producing hygroscopic and non-hygroscopic layers with varying refractive indices.

MATT ALUMINUM.—In order to impart the appearance of matt silver to metallic aluminum, the object is plunged, for from fifteen to twenty seconds, in a 10 per cent warm solution of caustic soda saturated with common salt. It is then washed and brushed, reimmersed in the same bath for half a minute, and finally washed and dried in sawdust.

Fruit Acids.

It is well known that the acids to which different fruits, etc., owe their flavor have been the subject of chemical investigations, which have revealed the following facts: The acid of the rhubarb stalk arises from the malic acid and binoxalate of potash which it contains. The acidity of the lemon, orange, and other species of the genus *Citrus* is caused by the abundance of citric acid which their juices contain; that of the cherry, plum, peach, apple, and pear from the malic acid in their pulp; that of gooseberries and currants, black, white, and red, from a mixture of malic and citric acids; that of grapes from a mixture of malic and tartaric acids; that of the mango from citric acid and a very fugitive essential oil; that of the tamarind from a mixture of citric, malic, and tartaric acids; the flavor of asparagus from aspartic acid, found also in the root of the marshmallow; and that of the cucumber from a peculiar poisonous ingredient, called fungin, which is found in many species of fungi, and is the cause of the cucumber being objectionable to some persons.

It will be observed that rhubarb is the only product which contains binoxalate of potash in conjunction with an acid. It is this ingredient which renders rhubarb so wholesome at the early commencement of the summer, though in certain cases, known to medical men, its use may be injurious.

The following table, compiled from some analyses by Professor Berard, shows the percentage average chemical composition of five unripe fruits and of eight ripe fruits, comprising apples, pears, gooseberries, grapes, plums, cherries, apricots, and peaches:

	Unripe.	Ripe.
Water	85·7	78·7
Albuminoids	0·7	0·6
Sugar	4·0	12·9
Vegetable acids	1·5	1·3
Pectose and gum	4·3	3·7
Cellulose, etc	3·8	2·8

The data thus given show that there is a considerable decrease in the watery particles of fruit as it approaches its full ripe character, resulting in a difference of 7 per cent, while the sugary constituents increase during maturation in a corresponding degree, rising from an average of 4 to nearly 13 per cent.

There is very little actual decrease in the percentage of acids from the green to the ripe stage of fruits, but the acidity becomes neutralized by the increase of sugar as the fruit approaches maturation.

Many persons know from experience how much more pleasant and agreeable fruit is when gathered and eaten direct from the tree. This is undoubtedly in part due to the freshness and briskness of the vegetable acids contained in the fruit, which, when so gathered and eaten, have not time to change into any other substance. Stale fruit, on the other hand, is unpalatable from the very fact that it has lost this pungent and brisk taste.

Pectose forms the substance known as vegetable jelly, and it is to this constituent of fruits that jams owe their firmness. Cellulose is the fibrous part of fruits, and this portion contains the largest proportion of mineral salts.—*Chem. Tr. Jour.*

The Best Education for Young Men.

"I believe that in the schools of applied science and technology, as they are carried on to-day in the United States—involving the thorough and most scholarly study of principles directed immediately upon useful arts, and rising, in their higher grades, into original investigation and research—is to be found almost the perfection of education for young men. Too long have we submitted to be considered as furnishing something which is, indeed, more immediately and practically useful than a so-called liberal education, but which is, after all, less noble and fine. Too long have our schools of applied science and technology been popularly regarded as affording an inferior substitute for classical colleges to those who could not afford to go to college, then take a course in a medical or law school, and then wait for professional practice. Too long have the graduates of such schools been spoken of as though they had acquired the arts of livelihood at some sacrifice of mental development, intellectual culture, and grace of life. For me, if I did not believe that the graduates of the institution over which I have the honor to preside were better educated men, in all which the term educated man implies, than the average graduate of the ordinary college, I would not consent to hold my position for another day. It is true that something of form and style may be sacrificed in the earnest, direct, and laborious endeavors of the student of science; but that all the essentials of intellect and character are less fully or less happily achieved through such a course of study let no man, connected with such an institution, for a moment concede!

"That mind and manhood alike are served in a preeminent degree by the systematic study of chemistry, physics, and natural history has passed beyond dispute. The haste with which the colleges themselves are throwing over many of their traditional subjects to make room for these comparatively new studies, shows how general has become the appreciation of the virtue of these, when combined with laboratory methods, as means of intellectual and moral training.

"I have spoken of the characteristic studies of the new schools as the best of all available means of both moral and intellectual training. I believe this claim to be none too broad.

"The sincerity of purpose and the intellectual honesty which are bred in the laboratory of chemistry and physics stand in strong contrast with the dangerous tendencies to plausibility, sophistry, casuistry, and self-delusion which so insidiously beset the pursuit of metaphysics, dialectics, and rhetoric, according to the traditions of the schools. Much of the training given in college in my boyhood was, it is not too much to say, directed straight upon the arts which go to make the worse appear the better reason. It was always an added feather in the cap of the young disputant that he had won a debate in a cause in which he did not believe. Surely, in these more enlightened days, it is not needful to say that this is perilous practice, if, indeed, it is not always and necessarily pernicious. Even where the element of purposed and boasted self-stultification was absent, there was a dangerous and a mischievous exaltation of the form above the substance of the student's work, which made it better to be brilliant than to be sound.

"Contrast with this the moral and intellectual influence of the studies and exercises I am considering. The student of chemistry or physics would scarcely know how to defend a thesis which he did not himself believe. In that dangerous art he has had no practice. The only success he has hoped for has been to be right. The only failure he has had to fear was to be wrong. To be brilliant in error only heightened the failure, making it the more conspicuous and ludicrous."—*Francis A. Walker, President of the Massachusetts Institute of Technology.*

The Uses of Magnesium Oxide.

Magnesia, formerly chiefly valued on account of its medicinal properties, has recently risen into great commercial importance, owing to its infusibility and its employment as a lining for converters used in the basic process of steel manufacture. Caron, whose process was in the first instance followed, used calcined magnesite. This was made up with one-sixth of its weight of tender-burned magnesia and from ten to fifteen per cent of water, into a plastic state. It was then compressed into bricks in iron moulds and burned at a dull heat. Prof. Ehrenworth has pointed out that, if the refractory properties of the magnesia are to be developed to the full, it is of the utmost importance that the whole of the magnesia should be dead-burned; the process, moreover, being carried so far as not only to expel the whole of the carbonic acid, but also to cause the full amount of shrinkage which this material is capable of attaining. This extreme amount of calcination is very difficult to effect, owing to the tendency of the magnesite to fly into splinters, and to drop to pieces when subsequently touched, and, in consequence of its being such a bad conductor of heat, the stone is very hard to burn in large pieces.

Recently dolomite, which is a double carbonate of lime and magnesia, has been used instead of magnesite. In order to prepare this material there are two processes before the public: those of Closson and of Scheibler. Under the former plan the calcined dolomite is mixed with chloride of magnesium, the chlorine in which separates from the magnesia and combines with the lime, yielding a soluble calcic chloride, which can readily be washed out, leaving behind the insoluble magnesia. Under the process of Scheibler the calcined dolomite is treated with dissolved sugar, leading to the formation of sugar of lime, and depositing the magnesia. The solution of sugar of lime is then exposed to carbonic acid gas, which separates the lime as a carbonate, leaving the sugar ready for re-use. Both these systems of producing magnesia have the advantage of relative cheapness in their favor, owing to the low price of dolomite. Prof. Frank, of Charlottenburg, has advocated the use of magnesia as a substitute for plaster of Paris for casts, and Grundmann has recently shown the advantage of employing a mixture of magnesia and powdered marble for this purpose. It has also been found that by following the direction given by Hirzel a mixture of benzole and magnesia is the very best possible substance for the removal of grease from drawings or from any other material.

Detaching Gelatine Negatives from Glass.

Herr Liesegang's method of detaching gelatine films from the glass supports without employing the hydrofluoric acid plan is to introduce between the gelatine and the glass carbonic acid gas, which will effect the separation. The negative or positive, after development, etc., is plunged into a bath made feebly acid with either citric, hydrochloric, or sulphuric acid, and then, without washing, is placed in a concentrated solution (25 to 30 per cent) of carbonate or bicarbonate of soda. The carbonic acid gas thus formed puffs up the gelatine, which can then be easily removed. The film undergoes some enlargement, which could probably be obviated by a bath of absolute alcohol, and when dry the film is perfectly flat, and can then be attached to a collodion or gelatine support, as may be desired.

Baldheads, Young and Old.

Our illustrious American electrician Edison is now studying the subject of baldheadedness. He maintains that bald pated people die young, while people who are well roofed with hair live long, and he believes that, as he himself has a fertile scalp, he will live to a ripe old age.

We cannot believe that Mr. Edison has ransacked the pages of history for proof of his hirsute theory. We are confident that, if he can be induced to examine the portraits of the great, he will change his mind on the subject. We are able to tell him that very many of the eminent personages of the world who were short of hair, even in their early manhood, lived to a green old age, and we can show him the pictures of inventors, commanders, sages, statesmen, saints, and nabobs who began to grow bald when young, and grew steadily balder as they grew older right straight along. Where shall we begin with our illustrations? Socrates the Greek and Cæsar the Roman were both disposed to baldness in their prime, yet the former lived for over seventy years and the latter for nearly sixty. From Cæsar's time to that of Peter the Hermit, from Columbus' time to that of Voltaire, from the "Sage of Kinderhook's" time to that of Gen. Ben Butler, we can name numerous persons of eminence whose locks began to fall long before they reached middle age, yet who lived to be as old as Mr. Edison himself will be when he is an octogenarian. Not a few of our revolutionary sires were bald, having begun to shed their hair while yet colonists, and we must ask Mr. Edison not to be deceived by the pictures of that period, but to bear in mind that, up to the opening of this century, the large bottomed wig was used by many of the gentlemen of our country. What does Mr. Edison know about the baldness of the three Adamses or about the locks of Jefferson, Hamilton, and several of their compeers? Can he tell us whether the Father of his Country wore artificial hair? Did he ever see a man adorned with a toupee, to say nothing of a peruke? We forewarn Mr. Edison that, in ransacking history for facts bearing upon baldheadedness, it is necessary to proceed with caution. He will find, by the allusions of ancient and modern authors to the habit of wig wearing, that very many notable men have had very much less hair atop than they were credited with.

Even in our own times, alas! there are not a few distinguished Americans from thirty to eighty years old who are as baldheaded as the Hebrew prophet Elisha was. Let Mr. Edison go to the city of Washington and look down upon the heads of the members of the United States Senate. He will see senators there who are as lively as crickets, though they have been more or less bald for the greater part of a half century. Let him then go abroad and find out for how many years Gladstone's hair has been growing ever sparser, or Bismarck's, or a hundred other great men's. Let Mr. Edison prosecute his researches around the world, and send us the baldheaded news from China, Japan, and other countries.

The truth is that Mr. Edison cannot possibly sustain his contention that long-lived men always have "thick heads of hair." He says that his own father, who is yet vigorous at eighty-three—and long may he flourish!—has a "wonderful head of hair;" but we can offset this case by that of a citizen of New York over ninety who has been bald since he was in his twenties. We are prepared to affirm and to prove that the abundance of a man's hair does not surely betoken long life, and that the baldness of a man's head does not betoken his early death. We can give piles of facts upon this subject. We have just elected a President who is rapidly growing bald, though yet far from old age. Several of the ancient sages regarded early baldness as a sign of early wisdom. We admit that it has not been so in Edison's case, for he has lots of hair on his head; but Edison must not judge all mankind by himself.

The baldness of some people is due to heredity. In this city there is a family of three generations, all the members of which are beyond maturity, all of whom began to grow bald when about twenty years old; and the grandsires' father was as bald when young as he is when old. In other cases the loss of the hair is caused by solar heat, or by febrile maladies, or by the action of parasites, or by erythematous affections of the scalp, or by the wearing of tightly fitting and unyielding hats, or perhaps by deep thought. The learned French barber of this city, who has made scientific study of the hair of the heads of his customers, says he could make an immense fortune if he knew how to cause the hair to grow upon those bald scalps in which the epidermic cells are closed. He has striven for a lifetime to invent something that would be potent in this line, or that would give the promise of potency; but he confesses with sorrow that his labor has been in vain.—*N. Y. Sun.*

RECENTLY PATENTED INVENTIONS.

Engineering.

FURNACE PLANT.—James H. Welch, Pittsburg, Pa. This invention relates to puddling and other furnaces heated by gas, but not using the regenerative system, a conduit connected with a single chimney being formed with a horizontal partition dividing the flue into two flues, located one above the other, the lower one conducting the waste gases from the furnace to the chimney and the other one affording a supply of heated air for the several furnaces. It is thus designed to utilize the waste heat of each individual furnace to heat the air necessary for the combustion of the gases, promoting economy, consuming smoke, and doing away with the necessity of building a stack for each furnace.

FEED REGULATING VALVE.—William K. Farrand, Brooklyn, N. Y. This is a valve especially adapted for use in regulating the feed of low pressure boilers in which the boiler pressure is less than the street or supply pressure, the valve being also adapted for regulating the supply of water in receptacles other than boilers. Combined with the float-actuating regulating valve and the water column held beneath it is a float held within the water column and connected with the valve stem, the float having an air chamber in its bottom. The device is simple, positive in operation, not liable to get out of repair, and is designed to automatically preserve the exact correct height of water in the boiler.

DAMPER REGULATOR.—Charles C. Koster, New York City. When a certain pressure of steam is reached in the boiler this improvement provides that the damper shall be automatically acted upon, and partially or entirely closed, while it will be again opened when the steam falls below the required pressure. The invention covers novel features of construction and the combination of parts, the device being very simple and durable, and adapted for connection with any boiler.

Railway Appliances.

CAR COUPLING.—David A. McCollum, Eagleville, Mo. The drawhead of this coupling is forwardly recessed and transversely slotted at two points, and has a spring-actuated latch bar in the forward recess, a spring-pressed presser bar in the rear transverse slot, means for lifting the latch bar, and a device for locking the presser bar, which normally engages the end of the draw bar in a yielding manner, while the latch bar has a similar contact, so that vertical and lateral play is allowed in the coupling to compensate for the unequal height of cars and curvature of the track. The coupling is effected automatically, and the uncoupling may be effected from either the side or roof of the car.

RAILWAY SPIKE. — Samuel Emrich, Reno, Nevada. This spike has a longitudinal bore, in the sides of which are mortises where rest locking plates having their lower ends formed into edges and their upper ends bent outwardly, while a spreading wedge is adapted to enter the bore of the spike and extend between the upper portions of the locking plates, thus forming a spike which, when driven home, cannot possibly work loose. When it is to be withdrawn the locking plates are forced outward through the mortises, leaving the body of the spike free.

Electrical.

TROLLEY FOR ELECTRIC RAILWAYS.—Augustus H. R. Guiley, South Easton, Pa. According to this invention the conductors are placed in a conduit below the surface level, so that the current may be conveyed to the motor and returned without any of the connections being accessible to pedestrians or animals in the street. The slotted conduit has sectional hinged covers opening outwardly, the trolley rods projecting through the slot, having at their lower ends wheels traveling on the conductors, while, by means of a hand lever, the trolley is pushed down into contact with the conductor with more or less force, the trolley being withdrawn when the car is to be stopped.

ELECTRIC ALARM.—Henry A. Hull, New Brunswick, N. J. This is a device more especially designed for use on doors, to give an alarm for a short time only on the opening of a door, without giving a continuous sound as long as the door is open. Combined with a contact spring having two faces, one of which is insulated, is a rod provided with a pin adapted to slide, the pin passing in contact with one side and then the other side of the spring when the rod is reciprocated. When the door is opened the spring moves the rod so that the contact pin completes the circuit to sound the alarm, which sounds until the door is opened far enough for the pin to be disengaged from the contact spring.

REGULABLE ELECTRIC LAMP.—George W. Hall and Joseph J. De Marr, Georgetown, Col. This lamp is more especially designed for use in hospitals, bedrooms, halls, etc., where the full light is not required continuously. Combined with the lamp is a resistance, preferably in the form of one or more concealed lamps, or a concealed lamp having several carbon filaments of different resistance, with a switch for throwing in the different resistances and also for short-circuiting them.

ELECTRIC LAMP SIGN.—Edwin W. Clay, Louisville, Ky. A ring embracing the upper portion of the lamp frame has transverse braces on its opposite sides, while a sign frame is supported by rods attached to the ring, the frame having paneled sides in which the letters of the sign are engraved. With this improvement a sign may be easily attached to an ordinary arc lamp and held so that it may be distinctly seen by night or day.

Miscellaneous.

WRENCH.—George W. Scheid, Fort Recovery, Ohio. This is a tool of simple and durable construction, more particularly designed for conveniently and rapidly screwing up or down nuts on eaves trough supports or hangers and similar objects. The tool has a jaw adapted to engage the nut and a transverse slot to engage the cross bar of the trough. The wrench handle has a claw at its outer end.

FLOOD FENCE. — Henry D. Merrill, Middlebury, Ind. This is an improvement in farm fences crossing streams and low places liable to overflow in time of floods. The fence is designed to bar the passage of all stock when the water is at or below its usual height, but when an overflow takes place the fence inclines sufficiently to permit the drift to pass over without damaging the fence, which rises automatically to its normal or vertical position when the water recedes.

GUN SWAB. — George H. Garrison, Sumas City, Washington. This swab has a cylindrical rubber core or cushion, completely covered with a wire gauze cylinder, in such manner that the entire cleaning surface of the swab acts at one time upon the interior of the barrel. The device may be quickly and conveniently manipulated to adjust it to the bore of any gun barrel, and it may be employed to clean rifle barrels as well as smooth bores.

PLASTER COMPOUND.—Henry R. English, Jackson, Mo. The basis of this compound is kaolin, or china clay, and the inventor is the owner of a large body of land containing an inexhaustible supply of this material. The other ingredients consist of silicate of soda, glue, and sand, and the improved plaster is designed for use as an inside covering for walls and other surfaces, and as an artificial stone or exterior coating.

PROCESS OF TREATING SPEISS.—Paul Flury, El Paso, Texas. This by-product of lead furnaces, composed of iron and arsenic, or nickel-iron and arsenic, usually contains silver and gold, the process of obtaining which from the speiss forms the subject of this invention. The speiss is crushed to grain size, calcined, and mixed with sulphur, the mixture being then gently heated as a current of air is passed over it to carry off arsenious acid and sulphide of arsenic, which is condensed in flue dust chambers.

DOUBLE PIANO STOOL.—John J. Hering Seattle, Washington. The two seats of this stool are movable toward and from each other on a vertically adjustable base, each seat also having an independent vertical adjustment. It may be used as an ordinary single stool, or may be quickly adjusted to form two seats, each of a different height if desired.

VALVED BOTTLE STOPPER.—William H. Ricker, Cambridge, Mass. This stopper has a filling and outlet bore, a lateral opening extending from the bore outward through the stopper, a lever carrying a valve extending through the opening and pivoted to rock vertically. The valve may be easily operated from the outside of the bottle, and the moment it is released from pressure it will automatically return to its seat.

BOTTLE STOPPER.—Thomas C. Booth, New York City. This stopper has tubes extending through and turning in it, the upper ends of the tubes being bent outward, so that they may be turned to overlap each other, and caps closing their outer ends. This stopper is especially designed for use in ink bottles, the ink being poured out without removing the stopper and the flow of the liquid being under perfect control.

TOBACCO PIPE.—Ignatz Pfortner, New York City. This is a corn-cob pipe designed to be cheaply manufactured and be very ornamental in appearance, the invention being an improvement on a former patented invention of the same inventor. In the bottom of the bowl is a plug, preferably of wood, to prevent the rapid burning out of the bowl, and there is also a wood core and mouthpiece for the corn-cob stem, the parts being so put together as not to be liable to separate.

BAG LOCK.—Frank and Lewis S. Depuy, Portland, Pa. A mail pouch lock has been devised by this patentee, a lock of simple and durable construction, which will close and lock the mouth of the pouch throughout its length. The invention consists principally of a series of connected locks operated simultaneously from a central locking mechanism, the several locks and the mechanism having the back plates of their casings riveted to the front of the pouch, while the fronts of the casings are covered by a strip riveted at the top and bottom of the front.

WAGON GEAR.—Evert Takken, Holland, Mich. A flat spring having one end secured to the center of the rear axle is bent upward and centrally secured to the under side of the body, its forward end being secured to the king bolt, while two spring bars similarly bent are rearwardly secured to the outer ends of the rear axle, their front ends uniting and engaging the king bolt. The invention also covers other novel features, the improved construction being designed to promote easy riding in the body, relieving the axles of all undue strain, and facilitating the ready turning of the wagon.

TABLE LEG FASTENER.—James W. Thompson and Robert Golling, Lenoir City, Tenn. This fastener is more especially designed to conveniently and quickly secure the leg to the table frame or permit its removal for convenience in shipping or storing the table. An L-shaped casing is secured to one corner of the frame, a cam lever being pivoted on the casing and engaging a piece of soft material held in the table leg.

SCREEN FOR LAMPS OR GAS LIGHTS.—Theophilus A. Brouwer, Jr., East Hampton, N. Y. This screen consists of an arm having at one end an attaching device, the opposite end of the arm projecting through apertures in a series of folding panels, which may be held in any desired position. The device may be quickly attached to a gas burner or lamp, the screen being opened to a greater or less width as desired, or it may be folded up as a fan and dropped down out of the way.

ARTIST'S SKETCHING SCREEN.—This is another improvement of the same inventor, consisting of a device especially adapted as a substitute for the umbrella employed to shield artists while sketching. The screen and its support are so constructed that the screen may be so held as to shield the artist from either the morning, noon, or afternoon sun, while the different portions may be taken apart and rolled up in the cover of the screen to form a small bundle, which may be conveniently carried.

PUZZLE.—Robert Watt, Akron, Ohio. A gameboard, not unlike a checkerboard, has in its face a series of numbered apertures arranged somewhat in cruciform order, and in connection with the board are employed movable pieces, each of which has in its top a central depression and in its bottom a stud adapted to fit in the depressions of the pieces or the apertures of the board. In playing a game, or using the board as a puzzle, a portion of the pieces are used to crown other pieces, according to certain rules, and a solitaire game may also be played, designed to be amusing and interesting as well as somewhat difficult.

Designs.

CARPET.—William F. Brown, Newark, N. J. The body of this design consists of floral figures in groupings of a festoon order and simulating roses, pinks and daisies, with buds, stems, and leaves, while the border has floral figures in harmony with the body, and an outer margin of bar, scallop, and arched figures of composite type.

RUFFLING.—Adolph Cohen, New York City. A skirt figure, with fluted or ruffle-like appearance, seemingly drops downward in graceful folds from the base of a crowning figure, curving slightly outward, but having also a fluted or ruffle-like appearance.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

MY HORSE, MY LOVE. By Dinah Sharpe. Illustrated. New York: Orange Judd Company. 1892. Pp. ix, 155. Price, paper 50 cents, cloth $1.

This book is more or less in the order of "Black Beauty," being a work written by a lover of a horse, and one which recommends kind treatment for our valuable domestic servant. It contains several illustrations and is quite graphically composed.

MECHANICAL DRAWING. Progressive exercises and practical hints. By Charles William MacCord, A.M., Sc.D. New York: John Wiley & Sons. 1892. Pp. 100. Price $4.

Professor MacCord is an author with whom our readers are already familiar. It has been our privilege to publish a number of his contributions in the SUPPLEMENT, and we are glad to see, in the present work, the subject of drawing so well presented, both as regards the author and as regards the work of the publishers. The printing, paper, and general tone of the work, from the publishers' standpoint, are most elegant, and we are convinced that it will meet with a warm appreciation.

MODERN LOCOMOTIVE CONSTRUCTION. By J. G. A. Meyer. Fully illustrated. New York: John Wiley & Sons. 1892. Pp. vi, 658. Price $10.

The great success achieved by the American locomotive, and its very distinctive construction, as compared with the English or Continental engines, have given it an individuality which it would seem should entitle it to a fuller treatment in scientific literature than it has heretofore received, but at last it looks as if justice had been done it. Mr. Meyer's work is admirably complete, is very fully illustrated, and brings the subject up to the times. The most practical details of fitting and construction meet with due attention, the work not being limited to the purely machinery part of the structure. Even the bell and its mountings, proportions and constructions are very elaborately given. The wooden pilot, iron pilot, bumper beams and all such points are described and illustrated. These we cite merely to show the thoroughness of the work. Another excellent feature is that on the drawings dimensions are very generally quoted, thus obviating the necessity of applying a scale or rule for the determination of sizes.

A TREATISE ON HIGHWAY CONSTRUCTION. By Austin T. Byrne, C.E. New York: John Wiley & Sons. 1892. Pp. xxxiv, 686. Price $5.

At the present time, when it is proposed to establish a department of roads at Washington, when agitation for good roads is going on all over the country, and when governmental encouragement is, in many cases, already extended to the work, this book appears peculiarly timely. It is an exceedingly full treatise on all sorts of roads, on their construction, qualities, maintenance and general statistics. Even the law points and forms of documents are spoken of the many illustrations and exceedingly full index adding materially to the value of this book. In his preface, the author quotes the authors and publications referred to, thus supplying, to some extent, a bibliography of the art.

LIGHTNING CONDUCTORS AND LIGHTNING GUARDS. By Oliver J. Lodge, D.Sc., F.R.S., LL.D., M.I.E.E. London: Whittaker & Co., George Bell & Sons. 1892. Pp. xii, 544. Price $4.

Professor Lodge's recent work in upsetting preconceived ideas of electrical protection of buildings will be remembered by our readers. In the present book Professor Lodge supplements his position as a destroyer by appearing in the constructive role, figuring as the exponent of how proper protection can be afforded. The alternative path is quite elaborately treated of, and a very excellent feature of the work is the subject of lightning guards or protectors to be applied to electric systems to prevent lightning stroke from reaching the instruments or operators.

TELEGRAPHIC CONNECTIONS. Embracing recent methods in quadruplex telegraphy. By Charles Thom and Willis H. Jones. New York: D. Van Nostrand Company. 1892. Pp. 59. Price $1.50. No index.

This work, by the preface, is directly dedicated to the members of the telegraphic craft. It treats of duplex and quadruplex telegraphy, the troubles and faults, the balancing and other practical details, and will, we have no doubt, be found a most excellent contribution to the field of recent telegraphy. We note the Wheatstone automatic duplex as receiving special treatment, illustrating how well up to date the book has been made.

RECENT PROGRESS IN ELECTRIC RAILWAYS. Compiled by Carl Hering. New York: The W. J. Johnston Company, Ltd. London: Whittaker & Company. 1892. Pp. 389. Price $1. No index.

The title page declares this book to be a summary of current periodical literature relating to the subject. Professor Hering is well known to the electrical world as an eminently satisfactory writer, and this work, despite its contemporaneous character, will be found of value to the engineer. It naturally has the aspect of a compilation, and its value would be much added to by an index.

LAND DRAINING. A handbook for farmers on the principles and practice of farm draining. By Manly Miles, M.D., F.R.M.S. Illustrated. New York: Orange, Judd Company. 1892. Pp. iv, 199. Price $1.

The drainage of soil in its practical and scientific aspect, including the effect produced by it on the ground, the means for carrying it out, and the scientific basis of the operation, are the subject matter of this handbook. It appears a very excellent contribution and one which should be in the hands of the advanced farmer. In the treatment of tools, the illustrations of recent approved tools are not only given, but also a plate of obsolete draining tools, thus presenting, by contrast, the proper mode of dealing with the subject in the field. Numerous illustrations and a full index are the features to be noted with approval.

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Mr. Johan Koopmans, of the firm of Johan Koopmans & Co., commission merchants and agents of American manufacturers in Amsterdam, Holland, will be in the United States this month to solicit the representation of manufacturers and exporters. Would also solicit the agency of an American flour mill. For reference or further information, apply to Jos. Agostini, 62 Broad St., New York.

The *Engineering Record*, the recognized authority on municipal and building engineering, has recently been enlarged by the addition of a department in which notable industrial plants are regularly described and illustrated, the steam and power plants being a conspicuous feature. Recent publications include the great Ivorydale plant of Messrs. Proctor & Gamble, described in 23 columns and illustrated by 57 drawings. The steam plant at Ivorydale is separately treated in 13 columns and 31 drawings. The new foundry of Henry R. Worthington, at Elizabethport, N. J., 16 columns, 26 illustrations. National Meter Company's foundry and brass finishing shop, Brooklyn, 13 columns, 29 illustrations. Niagara Power Plant (now in process of publication), 6 columns, 6 illustrations. Steam power plant of the Dwight Manufacturing Co., Chicopee, Mass., 9 columns, 7 illustrations. Published Saturdays. 12 cents a copy. The *Engineering Record*, 277 Pearl St., New York.

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(4603) W. I. S. asks: 1. What is the strongest electric battery known to science? How made? A. Practically the storage battery. For high voltage a battery using sodium as the positive element may be cited. A couple has been described which is supposed to give nearly 4 volts E. M. F. 2. What is the platinotype photographic paper coated with, and what is the developer used composed of? A. Platinotype paper is coated with an iron and platinum salt and developed on cold solution of oxalate of potassium. It is a patented process. The prepared paper can be obtained from Willis & Clements, Philadelphia, Pa. 3. How may blue prints be copied with the camera? A. Blue prints may be copied by inserting an orange red glass screen in the camera behind the lens and giving three times the usual exposure. 4. How may I make good black ink suitable for a fountain pen? A. Try following: Concentrated borax solution, 4 parts; shellac, 1 part; aniline black, q. s. Or try an aqueous solution of aniline black. 5. How may I plate small articles without a battery, in silver or gold? A. For gold and silver plating try the following: *Solution for Gilding Brass and Copper.*—The following formula has been adopted for water gilding, as it is termed. Fine gold, 6¼ dwts. Convert the gold into chloride and dissolve in 1 quart of distilled water, then add 1 pound bicarbonate of potassium and boil the mixture for two hours. Immerse the articles to be gilded in the warm solution for a few seconds up to one minute, according to the activity of the bath. *Silver Wash.*—Mix 1 part chloride of silver with 3 parts pearlash, 1½ parts common salt, and 1 part whiting, and rub the mixture on the surface of brass or copper, previously well cleaned, by means of soft leather or a cork moistened with water and dipped into the powder. When properly silvered, the metal should be well washed in hot water, slightly alkalized, and then wiped dry. 6. I inclose a substance which I found on breaking open a piece of anthracite coal. Please tell me what it is. A. The substance is a piece of shale or slaty coal. It seems intermediate between a true slate and coal.

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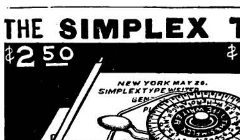

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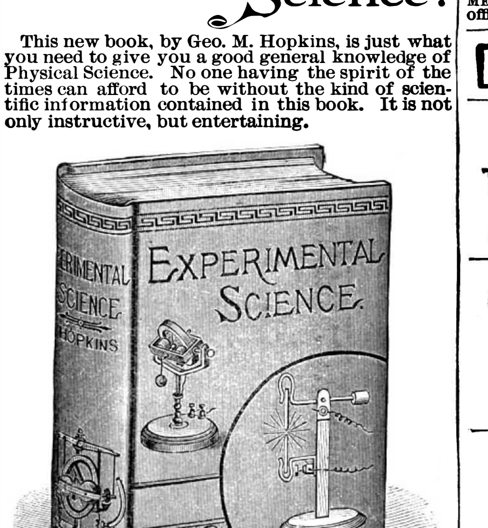

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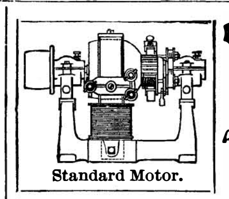
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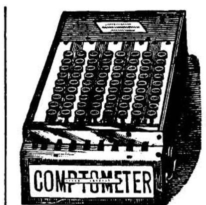

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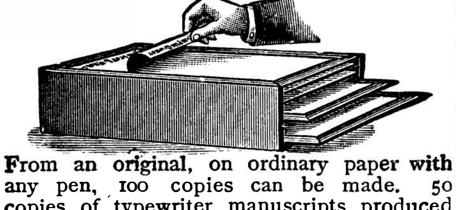

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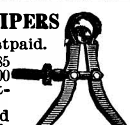

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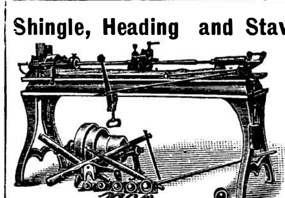
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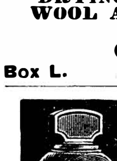

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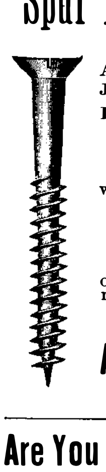

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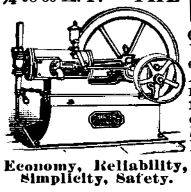

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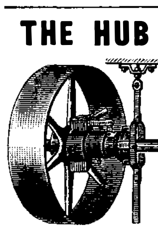

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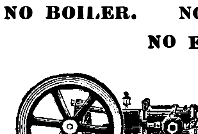

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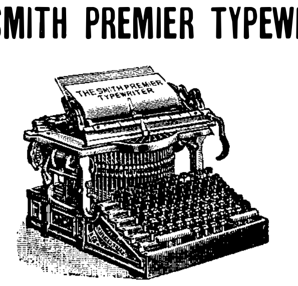

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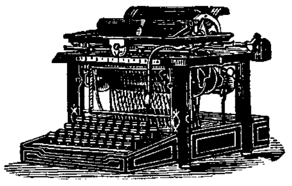

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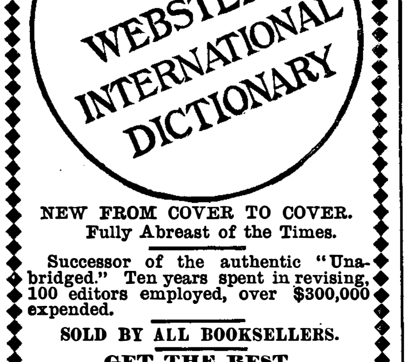

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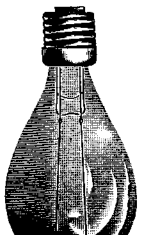

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