SCIENTIFIC AMERICAN

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THE "LINOTYPE."

Twice before have we presented in these columns the evidence, in illustration and written description, of the completion of a machine that could be successfully put upon the market to supersede typesetting, as hitherto done by hand. As first described by us, nearly five years ago, the linotype was a wonderfully complicated and delicate piece of machinery, but it was even then in successful use, doing with such regularity as to be depended upon, all the composition of one of the largest daily papers in the country, and more or less of the work of a dozen others. But the linotype has, since that time, been vastly improved and greatly simplified, although it is not to be denied that it still presents a marvelously ingenious mechanism—one which the practical printer must have a fair examination and full test of before giving it his confidence. That it has "come to stay," however, may be inferred from the fact that it is now in regular use to supplement, or to entirely supersede, the work of the old-time compositor, or typesetter, in the offices of 150 of our largest daily newspapers, about 1,000 machines being thus at present employed.

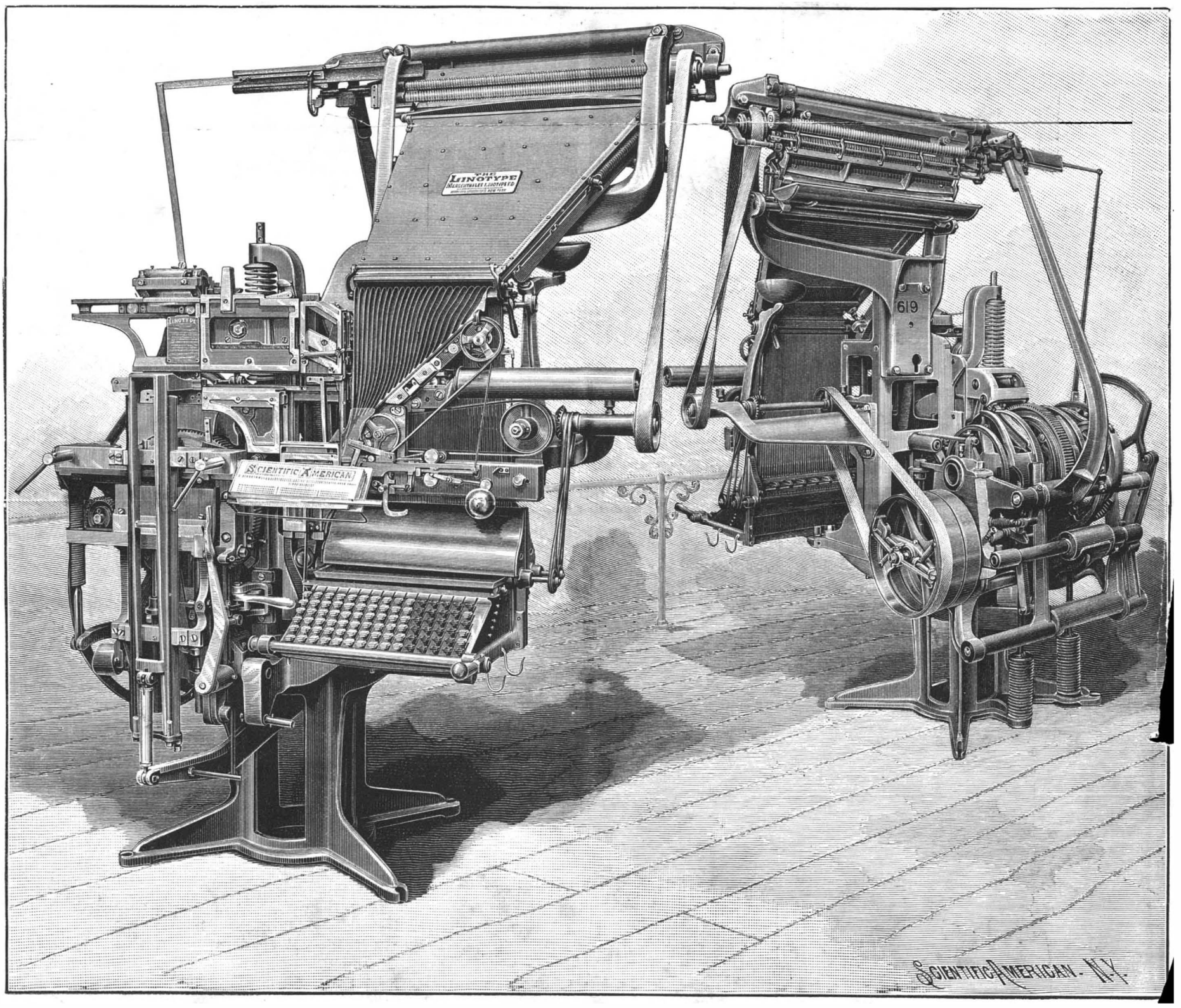
The illustration below is from photographs giving front and rear views of the machine as now built. A machine entirely similar was in daily operation at the Columbian Exposition, the "matter" thus set up for the purpose of exhibiting the machine being used in the columns of the "Daily Columbian," the official paper printed on the Fair grounds.

As will be apparent at a glance, and as suggested by the name, "linotype," the product of the machine is a casting representing a line of type, the assembling of the matrices for each letter or character in such line, and the proper placing of the spaces, being effected by touching in the proper order plainly marked keys, as in operating a typewriter, the rest of the work being automatically performed by the machine. There are in the keyboard ninety of these keys, this being the capacity of the regular machine as to the number of different types represented, in upper and lower case letters, figures, punctuation marks, etc. Each of these characters is borne upon a thin brass matrix, shown in one of the figures, the mold or matrix proper for forming the face of the letter being at "a," in one vertical edge of the piece, while in its upper end is a series of teeth, "b," by means of which the matrix is returned, after the casting is made, to the magazine.

The magazine consists of a casing supported in nearly vertical position at the top of the machine, the top and bottom plates of such casing being properly grooved to form channels in which the matrices lie loosely, on one edge, the bottom of the matrix touching the top of the one below it, so that they slide down freely when released by the key. There are two escapements at the mouth of each channel, at its lower end, connected by a rod with the key lever, their form being such as to insure very rapid operation and still prevent the release of more than one matrix on the key being touched. In leaving the mouth of the magazine the matrix drops down a vertical chute, whose front is covered by a glass door, the chutes at one side being of gradually diminishing length, so that the bottom of the chute section forms a slight incline, just below which, and at a corresponding inclination, is a fast running belt. The object of this arrangement is to increase the speed of the matrices that are not in a direct line vertically with the place of assembling, and by this means the matrices the farthest off come into position as quickly as those which are nearest, there being no transposition of the letters when the machine is worked at its highest speed.

The matrices, in the order in which the keys have been touched, are delivered to a slotted assembling block, G, where they are held loosely suspended by their shoulders, and gradually pushed along as the line is being formed, the spaces being dropped in position

(*Continued on page 24.*)



THE "LINOTYPE"—A MACHINE TO SUPERSEDE TYPESETTING.

Scientific American.

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(Illustrated articles are marked with an asterisk.)

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No. 941.

For the Week Ending January 13, 1894.

Price 10 cents. For sale by all newsdealers.

THE ALKALI METALS POTASSIUM AND SODIUM.—III.

MODES OF MANUFACTURE AND USES.

Some additional points will first be stated regarding potassium. In May, 1888, potassium was quoted in New York at $32 per lb.; in May, 1889, at $28. It remained at the latter figure till August, 1893, when the quotation in Europe fell to $27.50 per kilogramme, or $12.50 per lb. To this add costs of package, transportation, commissions, and duty (if any).

Comparison with sodium will serve to show how greatly the price of a commodity is influenced by demand. For sodium there is a market, though a small one. But potassium is as yet little more than a chemical curiosity.*

Potassium is a bluish-white metal, softer than sodium. It melts at 144° F. and boils at a red heat.

The liquid alloy of potassium and sodium, as is known from early experiments, already referred to, can be made *directly* by operating on a mixture of their carbonates. Here is another point for inventors. But the most important field now is the manufacture of these two metals and their alloys *by electrolysis*. Probably the only chemist since Davy who has achieved anything in this direction was Matthiessen (deceased). About 1855 he struck out quite a suggestive path, in operating to obtain potassium by electrolysis. It was based on the general principle that mixtures of solid bodies, especially of those chemically allied, melt much more readily than their components.

He electrolyzed, between carbon electrodes, in a porcelain crucible, with a current of ten to twelve volts, a fused mixture of two parts of potassium chloride with three of anhydrous calcium bichloride. This mixture fuses readily over a gas burner. The flame is so arranged that complete fusion, up to the surface of the mass, occurs only around the anode, where the chlorine can therefore escape freely. The potassium floats under a crust of a solid or pasty consistence, which protects it from the air and the chlorine. After twenty minutes the crucible is cooled and broken up under hydrocarbon oil, when a mass of pure potassium is found. Calcium does not appear to be isolated at this temperature and by this current.†

Repetitions of this experiment, with careful study, would doubtless suggest to any inventive mind plans of operating it on a large scale. If sodium chloride were also added, the melting point would doubtless be lowered further. In this case more calcium should be present, the proportions being now, in 100, 46· of calcium bichloride, 30· of potassium chloride and 24· of sodium chloride. The product here should be the alloy, in equivalent proportions, of potassium and sodium, liquid above 45° F. With 48· calcium bichloride, 31· potassium, and 21· sodium chloride, it will remain liquid at 32° F. Probably with stronger current and higher heat a little calcium might be reduced, but the liquid alloy might then be *distilled over*, the calcium remaining behind. The temperature for this would be a low cherry-red, about 1,500 F°. In this case, the cast iron or black lead melting pot should have a lid with a vertical diaphragm across it, dipping into the melted chlorides below. On the anode side of this lid a pipe is attached extending upward, to carry off the chlorine. On the cathode side there should be a tube extending downward through the bottom of the melting pot, terminating above between the molten chlorides and the lid, while dipping below into a bath of melted paraffine wax, the latter kept cooled below its vaporizing point. This wax should be of low gravity when melted, below 0·8, so that the warm alloy, of gravity about 0·85, should readily *sink* in this condensing bath. This manufacture would also produce *chlorine*, a valuable by-product, going far to pay the cost.

Of a number of *uses* that have been proposed for these metals and alloys, but one can now be explained, for lack of space. This use, which is for *blasting* purposes, is due also to Dr. Henry Wurtz, the chemist mentioned before in this connection. His most improved method is to fill a thin sheet metal cartridge casing closed at bottom, one-third or one-half full of melted sodium or of the liquid alloy. A flat spiral coil of fine iron wire is then suspended slightly above the surface of the liquid metal, there being attached to the inner and outer termini of said spiral two thicker copper wires. Then a thin layer of melted paraffine wax is poured on the spiral and allowed to solidify. When solid and cold, another thin layer of paraffine wax is poured in, not hot enough to melt the previous layer. The object is to fill up any defects in the first layer. Even a third layer may well be applied, for precaution. When the blast is to be made, the cartridge may be put into its place, the copper wires attached to others leading near a voltaic battery or other source of electric current, so that a circuit may be formed through the iron wire spiral. Then from a distance the bore hole is filled with water from a hose, and the circuit completed. The wax melts, rises, and is displaced by the water. The explosion follows. This mode of blasting is available only in the open air, not in mines or other inclosed spaces, by reason of the alkaline smoke. The energy may be greatly intensified by an additional device. Before the cartridge is introduced, a thin sealed elongated glass bulb filled with *nitric acid*, just large enough to pass easily into the casing between the vertical wires, is introduced. In this case, some other precautions are desirable, but no room remains now for further details.

* Since the figures for cost of sodium were given, in the issue of December 30, 1893, p. 418, a reduction has been announced by European manufacturers to about $1 per pound. Doubtless to this figure also, as in the case of potassium above, some additional costs must be added—certainly cost of transportation to this side of the Atlantic, and commissions

† *Journal* of the London Chemical Society, viii., 30.

PROGRESS IN TYPESETTING.

The facility with which events are now recorded in the printed page, to be multiplied in countless thousands of copies in time so brief as to be but barely appreciable, illustrates the march of modern invention. The art of printing from movable types is something over four hundred years old; but it is only within the last thirty years that the improvements have been such as to make possible the marvelous work now done by modern newspapers. There were fast printing presses before 1860, presses which would turn off twenty thousand copies of a paper an hour; but these presses printed direct from the type forms, for which the types were set by hand. The perfecting of rapid stereotyping processes, by means of which one type form would furnish duplicate plates for several presses, was effected between 1860 and 1865. This gave rise to the system now in vogue of printing from an endless roll, instead of the sheets being fed singly by an army of hand feeders. A far higher speed and a great saving in the cost of presswork were the immediate results. This lowering of the cost and making possible the largest desired issues in the shortest time, while the news was fresh, has stimulated newspaper production to a remarkable degree.

Notwithstanding the improvements made in other departments of the printing business, the typesetting—the work of picking up singly by hand each individual letter and character forming the printed page—has until recently remained unchanged. Work could be hastened by employing many hands, each one putting in type a few lines, but the process was slow and expensive. Thus, in all descriptions of printing, the largest item in the initial cost is that of putting the work in type. That inventors have long realized the importance of improvement in this direction has been plain enough, some two hundred patents having been issued from the United States Patent Office relating to typesetting and type-distributing machines. But the difficulties in the way of success have been enormous. Only two styles of machines have been put on the market in this country, and one in Europe, which have met with some degree of success commercially for a period of about fifteen years, and another and later candidate for favor forms the subject of our first page illustration. In the Mergenthaler or linotype machine, only one operator is required, and the rate of speed attained probably about four times the rate of typesetting by hand.

ANOTHER EXPLOSION OF A HIGH PRESSURE GAS CYLINDER.

A short time ago we had to chronicle the explosion of a high pressure gas cylinder upon a dock in Albany. On January 4 another explosion of the same kind of cylinder occurred at the factory of the Brin Oxygen Company, First Avenue and Twenty-first Street, in this city, where the gas is made and compressed. The company compresses oxygen gas and street gas in steel cylinders at 1,800 pounds pressure per square inch. The system adopted has been to first pump up to a pressure of 2,000 pounds and then to reduce to 1,800 pounds. Thus each filling operates as a sort of test of the cylinder. The gases used are pumped by Rand compressors into the cylinders lying horizontally on a filling table. A safety valve is provided to prevent the pressure being exceeded, and a pressure gauge is connected, so that the proper pressure can always be given.

On the day referred to, some of the operatives were engaged in filling three hydrogen cylinders. It is supposed that one of them neglected his work, which involved watching the gauge to see when the proper pressure was attained. Two cylinders, which were 100 foot ones, exploded. It is probable that the one struck the other and caused it to give way. A third one was merely dented. The fragments flew in all directions. One broken cylinder lodged in a small gas meter. The filling table was reduced to splinters, holes were blown in the roof, and altogether about $500 of damage to property was done.

One man was killed outright. He was the one whose special duty consisted in watching the pressure gauge and turning off the gas at the proper time. Whether he was guilty of carelessness or not, it would seem that the safety valve should have operated. It possibly was seated. Two other employes were badly injured.

Unfortunately it cannot be known whether the proper pressure was exceeded or not, as none of the workmen were watching the pressure gauge. This accident, following the Albany explosion, is, to say the

least, very unfortunate for the company. If it operates against the use of high pressure cylinders, it will be a matter of regret that so convenient a mode of dealing with gases must be abandoned.

The entire stock of cylinders has been recently called in and they have been subjected to the most rigid tests before being sent out, so that the company felt every security against so dreadful an occurrence.

Music and Longevity—Testimonial of an Octogenarian.

BY DR. P. H. VAN DER WEYDE.

My personal experience induces me openly to indorse what so ably and forcibly was expressed by Dr. Ephraim Cutter in an after dinner speech, published in the SCIENTIFIC AMERICAN SUPPLEMENT for September 16, and to offer myself as an example of the benign influence of the study and practice of music, and the great advantages I have derived therefrom.

Notwithstanding I will soon pass my eighty-first birthday, my mind and body are still in good condition; which I attribute to the fact that I have a variety of occupations, which induces me to give exercise to different parts of my brain as well as of my body, without overworking and exhausting one part.

I have collected some statistics about men occupied exclusively in one kind of mechanical labor, and found that they die before the average of the life of such as have to perform labor which does not require the continuous exercise of the same parts of the body, but who are occupied in labor which allows the exercise of almost all parts; so for instance men whose main occupation is the use of the sledge hammer are very short-lived and several crippled old men have testified to me that they were overworked in one certain pursuit without variation.

It is the same with the mind as it is with the body, and even more so; men occupied year after year with bookkeeping, or being cashiers, or teaching one exclusive branch of knowledge, or giving music lessons to beginners, or clergymen preaching orthodox sermons or praying according to the same system, break down early. Hence broken-down clergymen abound. When the mind is free to rove wherever reason calls it a better mental health results than is the case of a mind trammeled by theological dogmas.

But, as in the usual course of life men have frequently monotonous daily duties to perform, which wear out their mind and body, it may be a blessing to them when they can indulge in another occupation which is utterly different from any daily routine; and such an occupation is music, which has the double advantage that it can be enjoyed also by those who have not been musically educated, but whose tastes run in such a direction as to be able to enjoy good music.

This art has the great advantage to be eminently progressive, and causes the listener as well as the performer to satisfy the yearning of human nature for a higher and higher level of enjoyment, which, thanks to the successive labors of the men of inventive genius, has been provided for, by what may be called a musical literature, which is as rich in eminent names as is the literature of any nation either in prose or in poetry, while it has the enormous advantage not to be confined to any special language, but is written in the universal language of emotions, which the refined individuals of all nations understand and appreciate.

I will only recall a few of the names of the most eminent men in this roll of honor from Palestrina to Wagner; they are Corelli, Lully, Paradisi, Cherubini, Mehul, Martini, the five great Bachs—John Sebastian, Emanuel, Christian, John Ernest, Wilhelm Friedeman—Joseph Haydn, Mozart, Weber, Hummel, Beethoven, who is still at the head of them all both for originality and inexhaustible richness of new conceptions, so that he never repeats himself, as is the case with Mendelssohn.

Nathaniel Wheeler.

Nathaniel Wheeler, inventor of the patent rotary hook and stationary bobbin of the Wheeler & Wilson sewing machine, died at Bridgeport, Conn., Dec. 31, after an illness of two months. Mr. Wheeler had been president and general manager of the sewing machine company since 1875. He was born at Watertown, Conn., on September 20, 1820, and learned the blacksmith's trade. Subsequently he became interested in the manufacture of buttons and in machinery. In 1848 he began the manufacture of suspenders at Watertown with Messrs. Warner & Woodruff. Mr. Wheeler met Mr. Wilson in the New York *Sun* office, one day, and a partnership resulted for the manufacture of the sewing machine which is now so favorably known as the Wheeler & Wilson sewing machine. The works, which are located at Bridgeport, occupy ten acres and employ 10,000 hands. Mr. Wheeler invented many of the improvements which are now in use on the Wheeler & Wilson machine. He was a man of great vigor and exactitude in business, sagacity, and probity, generous, patriotic, useful in the community, and always ready to extend a helping hand where aid was necessary or desirable.

Orlando B. Potter.

The wealthy New Yorker and ex-member of Congress, Orlando B. Potter, was stricken with apoplexy and died on the evening of January 2. Mr. Potter was born at Charlemont, Franklin County, Mass., on March 10, 1823. He began life as a farm boy, and in this position managed to prepare for and in 1841 to enter Williams College. He was a remarkably bright student, but was forced to leave college on account of his health during his sophomore year. He then taught school on Cape Cod, and was finally able to enter Dane Law School, Harvard College, in 1845; was admitted to the bar in 1848. He was successful as a lawyer. In 1852 he took an interest in the Grover & Baker sewing machine invention, and under his direction the business rapidly increased. In 1853, Mr. Potter settled in New York. The company retired from business in 1876, their machine being superseded by improved inventions. Mr. Potter invested his fortune chiefly in real estate, and at the time of his decease it had risen in value to several millions of dollars.

Charcoal—its Uses and Utility.

W. K. Grayson, M.D., Florence, Texas, in the *Texas Sanitarian*, says that, as a general thing, there is less known among the laity and public generally about charcoal and its uses than any other article that is so common and so useful and so valuable. Charcoal laid flat on a burn causes the pain to abate immediately; by leaving it on for an hour, the burn seems nearly healed, if it is superficial. Tainted meat, surrounded with it, is sweetened; strewn over decomposed pelts, or dead matter, it prevents any bad odor or stench. Foul water is purified by its use. It is a fine and cheap disinfectant, and will sweeten offensive air if put in shallow dishes around the apartments of the sick. It is so extremely porous in its minute interior that it absorbs and condenses gases rapidly. One cubic inch of fresh charcoal will absorb about one hundred inches of gaseous ammonia. Charcoal forms an unrivaled poultice for malignant wounds and sores; in cases of what is called proud flesh, it is invaluable. It give no disagreeable odor, corrodes no metal, hurts no texture, injures no color, is a simple and safe sweetener and disinfectant. A teaspoonful of charcoal in half a glass of water will often relieve a sick headache; it absorbs the gases and relieves the distended stomach, pressing against the nerves which extend from the stomach to the head. It relieves constipation and heartburn.

Among the numerous and varied properties of charcoal there is one—one, too, of the most wonderful—which seems to be inadequately recognized, probably from its being imperfectly known. It is that of being able to condense and store away in its pores many times its own bulk of certain gaseous bodies, which it retains thus compressed in an otherwise unchanged state, and from which they can be withdrawn. A systematic task of examination of this subject developed these surprising results.

Operating with blocks of fine boxwood charcoal, freshly burnt, it was found that by simply placing such blocks in contact with certain gases they absorbed them in the following proportions:

Ammonia	30	volumes.
Hydrochloric acid	85	"
Sulphurous acid	65	"
Sulphureted hydrogen	55	"
Nitrous oxide	40	"
Carbonic acid	35	"
Carbonic oxide	9·42	"
Oxygen	9·25	"
Nitrogen	6·50	"
Carbureted hydrogen	5	"
Hydrogen	1·75	"

It is this amazing absorptive process that renders of so much value a comparative slight sprinkling of charcoal over dead animal matter as a preventive of the escape of the odors arising from decomposition. A dead dog was placed in a box in a warm place and covered with charcoal to the depth of between two and three inches; no odor or smell was emitted during several months, after which time an examination showed that nothing of the animal remained but the bones and a portion of the skin. To the large excess of oxygen over the nitrogen in the atmosphere, which was absorbed by the charcoal, and which thus rendered harmless the various vapors given off by the carcass as they were being absorbed, is doubtless owing the facts as before stated and the further fact of the charcoal never becoming saturated. For the sake of experiment on the value of charcoal for storing oxygen, place in a box one cubic foot of charcoal, without mechanical compression. A little over nine cubic feet of oxygen, representing a mechanical pressure of one hundred and twenty-six pounds on the square inch, can be drawn by a small hand pump, indicating a most feasible means by which atmospheric air can be decomposed in such a way as to provide a cheap supply of oxygen. The condensing power of charcoal applied to ammonia is equal to what would be obtained by subjecting this gas to a pressure of nearly one thousand two hundred and sixty pounds on the square inch. One could hardly readily, and at first thought, recognize this wonderful property of charcoal, yet it is nevertheless one, and can be readily demonstrated by actual experiment by those who wish for actual demonstration.

Combined Water Heating and Hot Air Furnaces.

There are many furnaces not entirely satisfactory, by reason of failure to warm one or more distant rooms. Their owners do not care to sacrifice them for steam, but would be very glad to add a little to their cost if they knew how to do so with success assured.

There is not a furnace in use to which hot water heating cannot be successfully attached. I have known good results to be secured by merely coiling the water pipe once or twice around the outside of the fire pot, not even entering the furnace. In every wrought iron furnace there is room and opportunity, if desired, to double the work of the furnace by suspending a simple coil of pipe, one to two inches in diameter, above the fire. By drilling through the wrought iron, and afterward making a gas-tight joint by means of asbestos packing and lock nuts, a coil may be introduced through the feed door without even taking the furnace apart.

One point furnace men feel a lack of confidence about is the size of the coil required to heat a given radiator or room. As I am talking to furnace men and not to steam fitters, I may be pardoned if I give a few data of a simple sort. Without going into the question of exposure, kind of building, etc., I merely state that the *average* amount of surface in the radiator or coil required to warm rooms in dwellings is about one square foot to sixty cubic feet of space. If I am going to plan to keep the radiator hot from an attachment to a furnace, I must know how much surface to apply to the fire. This requires some judgment, and must be made right, or trouble may occur. The work a square foot of surface in contact with the fire or hot gases of a furnace is capable of doing greatly varies, according to its location in the furnace. If I make my heater so large that the radiators cannot give out their heat as rapidly as they receive it, the water will boil and "blow off." If I make the surface too little, insufficient heating will result. Unfortunately, I can give no positive rules, but merely suggestions. If the coil is around the inside of the fire-pot, where it is in contact with the fire, then, under usual conditions, one foot of heater will warm twenty feet of radiator. If the coil be suspended immediately over the fire, where it receives the direct rays of heat from the bright coal as well as the hottest gases, one to twenty is about the figure. That means that three lineal feet of one inch pipe in the hottest part of a furnace will take up heat as rapidly as sixty lineal feet in a room will give it out.

A coil in a furnace, when it receives only the heat from the gases, will run down in power as it leaves the fire to from one to twenty to one to ten, or even one to five.

A caution concerning safety is necessary to those unfamiliar with the use of hot water. Always leave some way open for the escape of steam or expanding water. This may be done by running to a tank above the highest point in the system, or by direct connection to the water supply, if the connection be so made that the supply pipe cannot be closed, and the street pressure be not over 40 pounds per square inch.—*Heating and Ventilation.*

Why Mankind Has to Learn How to Swim.

A writer named Robinson, in *Nineteenth Century*, brings forward a quite plausible explanation of the fact that, while most of the animal creation appear to swim by intuition, man is almost alone in requiring previous training to enable him to keep his head above water. He says it is merely a matter of heredity, and due to our descent from races who were cave and rock dwellers and rock and tree climbers. This theory does not necessarily imply Darwinism, or go so far as to demand the belief that man is but a highly revised edition of some anthropoid ape. He suggests that almost all mammiferous animals, when conscious of danger, use instinctively the means given them for flight and escape, which involve precisely the motions best calculated to keep them afloat in water. The hereditary instinct of the man, however, is unfortunately, he says, to *climb* out of the danger. Hence, unless he has a natatory education, he throws his arms at once above his head, thus increasing the weight upon the latter, which, of course, goes then under water.

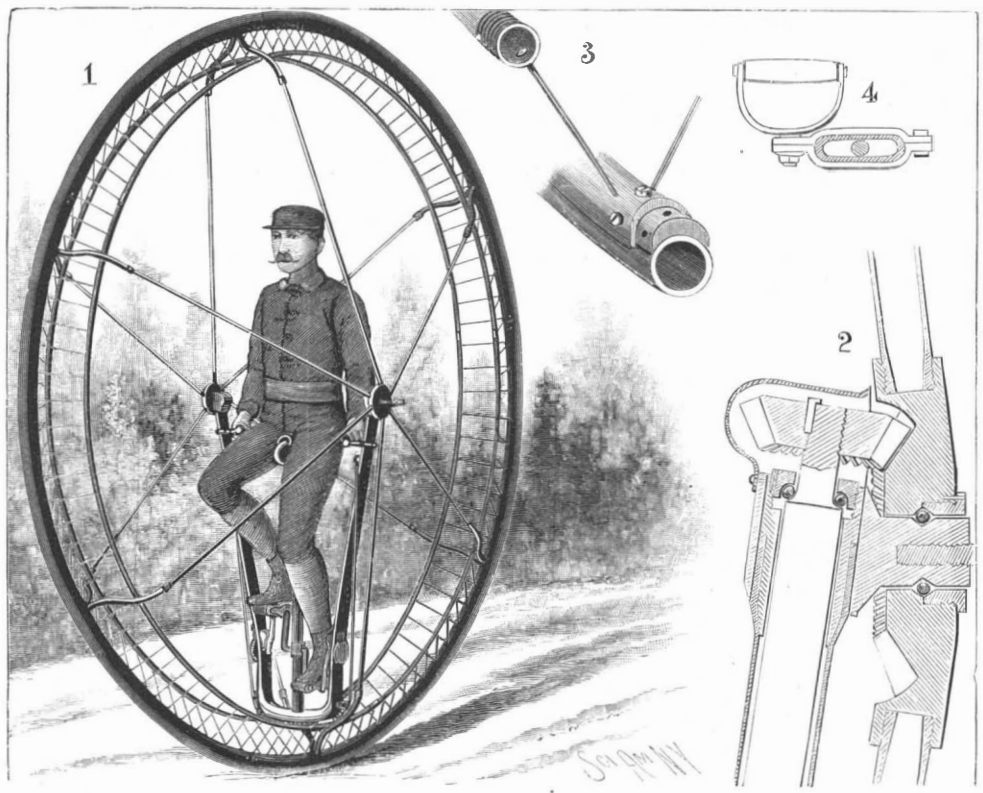
Thus the struggles of the untaught human being tend to his own destruction, as is well known to be the case.

It may be added that, admitting this view, we bar ourselves from any imputation of a *batrachian* element in our ancestry. Had there fortunately been such, we ought to have found ourselves swimming instinctively, when plunged into deep waters. Nevertheless, in any case, the frog has clearly been our preceptor or rather our examplar in this useful art, for man swims greatly like a frog, and by no means "like a duck" or "like a fish," as so often tritely phrased.

AN IMPROVED UNICYCLE.

In this machine the seat is arranged below the center, so that the wheel may be easily balanced, and provision is made for the lateral movement of the rider, whereby the wheel may be readily turned. It is light and strong in proportion to its size, and is made in readily detachable sections, to be easily taken apart and packed for shipment. It has been patented by Mr. Lewis W. Harper, of McHugh, Becker County, Minn. The large outer wheel, carrying the entire mechanism, has preferably a pneumatic tire, secured in a hollow jointed felly, as shown in Fig. 3, each joint being formed by inserting a plug in the abutting ends of the sections, and fastening the sections to the plug by set screws. Parallel hollow rings on opposite sides of the felly are connected with it by short spokes, the rings being also made in separable sections, and the spokes being screwed into the felly, while their inner ends terminate in heads held within the rings. Fig. 2 is a sectional view of that portion of the driving mechanism located at the hub. On the inner face of and integral with each hub is a bevel gear wheel, and the hubs have a central transverse opening to receive the axles on which the frame of the machine is suspended, each axle working in ball bearings, which are also provided for the other principal working parts. The inner end of each axle is formed as a head, which is secured to the upper end of the main frame, the latter being of substantially U-shape, and made of hollow pipe, elliptical in cross section. Extending longitudinally through each member of the frame is a countershaft having on its upper end a pinion which engages and drives the bevel gear of the hub, thus turning the main wheel, while the lower end of the shaft carries a pinion engaging a bevel gear on a short shaft connected with cranks provided with the usual pedals.

At the upper end of the saddle stem is a collar with set screw, for regulating the height of the saddle, and the saddle rod is a flat steel bar, permitting of bending from side to side, but preventing forward and backward motion. The machine has suitable brakes, which bear on the rings connected by short spokes with the felly, the brake blocks being operated by flexible rods or wires connected with a handle located near the main handles of the machine. The latter, of which one is shown in Fig. 4, project laterally from opposite members of the main frame, and by grasping them the rider may hold himself steadily in the machine, and throw his weight from side to side as necessary in steering.



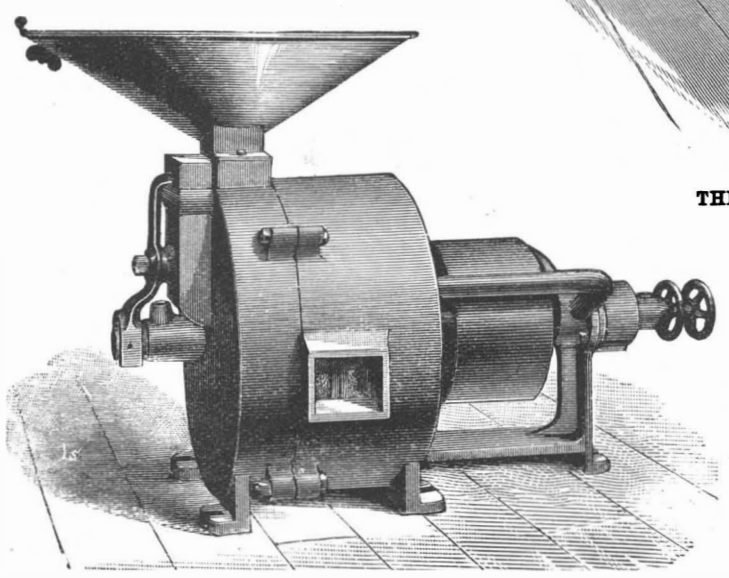
HARPER'S UNICYCLE.

THE HARRISON STANDARD BURR STONE MILLS.

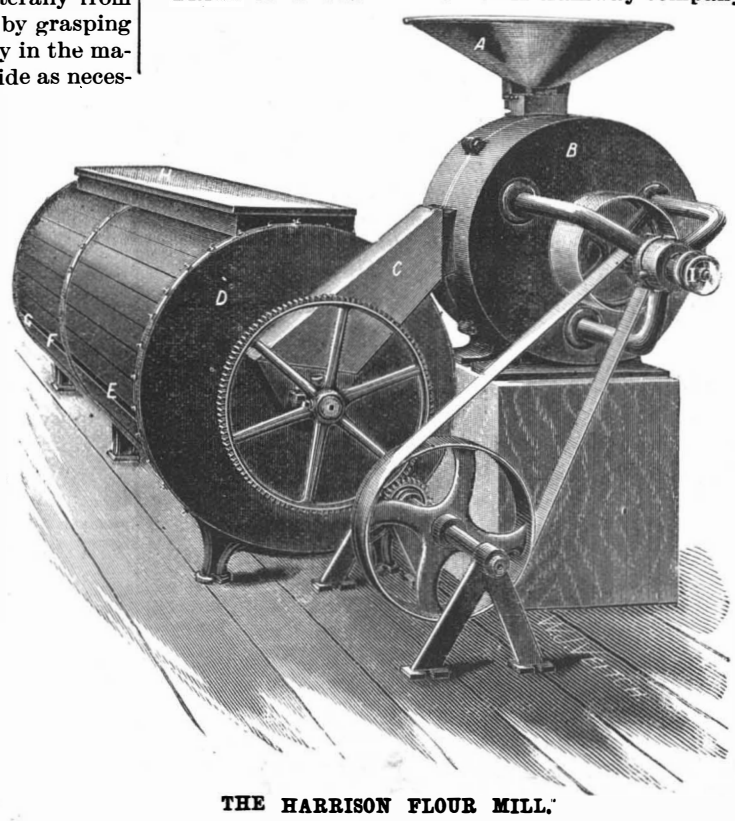
The Harrison mills have been on the market nearly fifty years, thus attesting their standard merit, while, as at present made, they contain the most recent improvements contributing to simplicity of construction and effective working capacity. The flour mill shown in the illustration is made in different sizes to have a capacity of from ten to twenty barrels of flour per day. It is especially designed for use in the Spanish-American countries, and is so made as to be readily taken apart and sent in small packages on the back of a mule. It does not get out of order easily, and the mill is sent complete, with pulleys, gearing, belt for moving the sieves, etc. The wheat is put in the hopper, A, and ground in the mill, B, from which the flour passes by the chute, C, to the bolter, D; the flour of the first grade passes out through E, of the second through F, and the grits through G, which is at the end of the drum. H is the door or ventilator through which the air enters to the bolter, and I is the hand wheel by which the stones can be adjusted when grinding.

The general grinding mill shown is made in sizes adapted to grind from 5 to 50 bushels of meal per hour, depending on the power and speed and the fineness of meal required. The mill should be run at the rate of 700 to 1,000 turns per minute. It is built entirely of steel and iron, has improved ball bearings, a spring attachment for preventing the stones from running together and is strong, durable and easily accessible in all parts. It was awarded a medal and diploma at the World's Columbian Exposition. The stones are of the best selected French burr, securely banded and balanced for high speed and fast work.

These mills are made by Leonard D. Harrison, No. 135 Hallock Avenue, New Haven, Conn.



THE HARRISON GENERAL GRINDING MILL.



THE HARRISON FLOUR MILL.

TRIAL OF A GAS TRAMCAR.—A tramway company near London is trying a new car on a portion of its route. The car is known as the Luhrig gas car, and is a German invention, propelled, as its name implies, by means of gas. It is self-contained and has a running capacity for about 15 miles. Refilling can take place in about 70 seconds through an ordinary India rubber delivery hose fastened on to a nozzle in the body of the car. There is no smell or vibration and very little evidence of the waste gas going into the atmosphere. From experiments carried on by Professor A. B. W. Kennedy, it has been found that in ordinary circumstances the cost of traction will be reduced by about 65 per cent. The gas is ignited by an electric spark, and the motive power, which consists of two double-action 7-H. P. gas engines, is completely hidden, together with the flywheel, at the back of the seats. Major-General Hutchinson, Board of Trade inspector, has expressed his approval of the car, and passed it, subject to the carrying out of certain minor alterations.

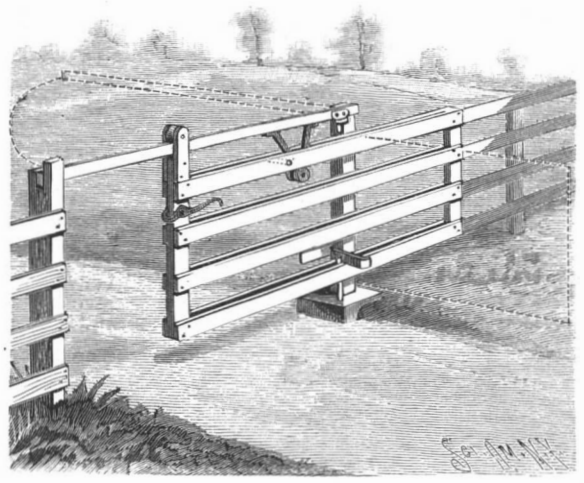
The Fisheries of Newfoundland.

The fisheries of Newfoundland are, as is well known, the object of incessant litigations between France and England, and are the cause of a continual exchange of diplomatic notes. At this moment, when the question of the reform of orthography proposed to the French Academy is calling attention to the utility or inutility of etymology, it is curious to remark that all those litigations relative to the fishery have for a basis a bad interpretation of a Latin word.

Mr. F. Mocquart, in fact, demonstrates by numerous citations in the *Naturaliste* that from the epoch at which Pliny wrote his Natural History up to that at which Linnæus published the first edition of his *Systema Naturæ*, that is to say, up to 1735, the majority of naturalists applied the term *fish* to all aquatic animals—to cetaceans, crustaceans, mollusks, etc., as well as to the fishes properly so called. The result is that at the signing of the treaty of Utrecht, in 1713, the lobster, crab and oyster were still considered as fishes with as good a title as the cod, and that, consequently, the right conceded to France to catch the fish of Newfoundland certainly includes the right to fish as well for the lobster as for the cod. —*Le Genie Civil.*

AN IMPROVED GATE.

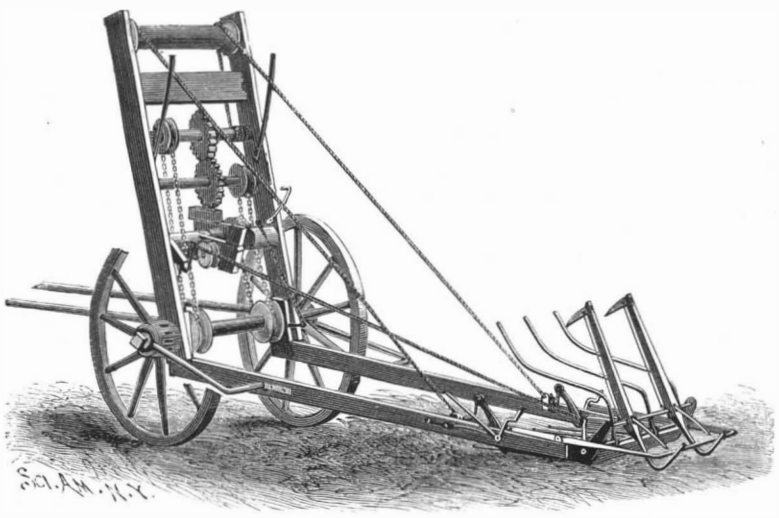
A gate which may be slid open to permit the passage of stock, or which may be swung entirely open for the passage of vehicles, the gate being easily operated in either case, is shown in the accompanying illustration, and has been patented by Mr. Levi W. Youngs. The swing post has at its upper end a socket which receives a pin on one end of a supporting bar, whose other end, when the gate is closed, rests in a notch in the top of the keeper post. The forward standard of the gate has at its top a roller resting upon the supporting bar, and a guide bracket extending downwardly from the under face of the bar carries rollers which engage the lower edge of the upper pair of rails of the gate. When the supporting bar is in engagement with both the keeper and the swing post, the gate may be slid backward to partially open it. When it is to be entirely opened, as indicated by dotted lines, it is slid backward until a pin in the upper pair of slats comes in contact with the depending bracket of the supporting bar. The gate will then be nearly balanced upon the bar, and by pressing downward upon the rear end of the gate the bar will be lifted out of its recess in the keeper post, and the gate may be swung around, rest arms or blocks low down on the swing post engaging the lower slats of the gate to guide and support it in the partially and fully open positions. A pin or short post, adjacent to the swing post, is also adapted to engage the bottom pair of slats of the gate, in guiding it to the open position. This gate may be readily set up on any kind of land, and may be opened or closed with but little exertion. Further information relative to this improvement may be obtained of Mr. W. H. Ayres, Sackett's Harbor, N. Y.



YOUNGS' GATE.

A HAY LOADER FOR FIELD WORK.

This loader, when drawn over the cocks of hay, is designed to gather up the desired quantities and automatically raise the rake to deliver the hay into a wagon to which the loader may be attached, a trip mechanism opening the rake for the delivery of its contents, and the rake being then automatically lowered to receive another load. The improvement has been patented by Mr. Fletcher M. Bird, of Wenatchee, Washington. The body frame of the loader consists of two uprights pivotally attached to the axle, to



BIRD'S HAY LOADER.

which is likewise pivoted a loading frame consisting of two parallel side bars. On the body frame is a drum shaft carrying two cables which extend upward over a friction roller, and are secured to the side bars of the loading frame. On the drum shaft is a gear meshing with a gear on a shaft below it, which carries near one end a pulley, connected by a belt or chain with a pulley on the axle, while another pulley on the axle is also connected by a belt or chain with a pulley on the drum shaft, both of these belts being so loose that they will be inoperative in the absence of a tightener. A cam shaft, carrying a block-like cam and weighted arms and tightener pulleys, acts as such tightener to control the movement of the drum shaft, whereby it is revolved in one direction or the other to elevate the loading frame and return it to loading position after the load has been dropped. The rake frame, pivoted in the loading frame, has lower stationary teeth, and in the back of the frame is journaled a shaft carrying movable teeth, a crank arm connected with a shifting lever being attached to the shaft. As the rake receives its load, the movable teeth are pressed upward until the complement of hay has been received, when the shifting lever is disconnected from its keeper, and the drum shaft elevates the loading frame and the rake, a trip yoke engaging lock levers, whereby fingers enter the hay to keep it from slipping. When the point of delivery is reached, the lock levers release the yoke and the fingers are raised out of the hay to permit it to drop into the wagon, after which the loading frame is again automatically lowered to the ground.

NEW BRITISH WAR BOATS OF GREAT POWER AND SPEED.

The British government is making renewed efforts to increase its naval forces and maintain its long-boasted supremacy on the seas. New war ships are being built, and especial attention is being given to the increase of the number of comparatively small but very powerful and swift torpedo boats—torpedo catchers they are called. Among the latest examples of new vessels in this line is the Havock, of which we here give, from the *Graphic*, London, an illustration.

The Havock was lately completed by Messrs. Yarrow for Her Majesty's navy, and on a recent trial yielded remarkable speed results. On the three hours' run in rough weather—the wind blowing 30 miles per hour—a speed of over 26 knots was reached. On the measured mile the mean of four runs was 26·78 knots. The fastest mile run was at the rate of 27·565 knots, and the mean of the best two runs was over 27 knots. This is believed to be the fastest craft afloat. The indicated horse power was 3,400, and the engine revolutions 362 per minute.

The boats have twin screws, and generally resemble the first class torpedo boats built by this firm. The length is 180 feet and the width 18 feet 6 inches. There is the usual hood or turtle-back forward, although some modifications have been introduced with a view to getting a drier deck when the vessel is steaming into a head sea. The propellers are three-bladed. The engines are of the usual tri-compound type adopted by the firm, having cylinders 18 inches, 26 inches, and 39½ inches in diameter by 18 inches stroke. The boilers, two in number, as stated, are of the locomotive type, and have copper fireboxes with copper tubes. The total grate surface is about 100 square feet and the total heating surface about 5,000 square feet. The dead weight load on board was 35 tons.

A further trial was subsequently had for eight hours at an economical speed, with a view to ascertain the distance the Havock would steam with the fuel supply she can carry on board, upon which depends her radius of action. It was found that at a speed of 11·2 knots the consumption was under a quarter of a ton an hour, and at 10 knots 3½ hundred weight an hour; and as the bunkers have a capacity of 60 tons, it follows that the distance the Havoc can steam without coaling is about 3,500 knots.

These vessels, with their high speed and considerable armament, would be likely to play an important part in a naval engagement.

Thirty-six of these boats have already been ordered, and six more, it is thought, will soon be ordered. The cost is about $200,000 each.

It is to be hoped Congress will not be backward in providing for the construction of a sufficient number of similar vessels to assist in the defense of our harbors.

THE IMPROVED "MONITOR" INCUBATOR.

An incubator which has stood the test of many years' experience, and proved highly successful in a practical and economical way for the artificial hatching of chicks and ducklings, is shown in the accompanying illustrations. It is manufactured by A. F. Williams, 61 Race Street, Bristol, Conn., and was awarded two medals and two diplomas at the World's Columbian Exposition. The case has double top, bottom, side and back, affording a dead air space all around, and it has two doors, the inside one being of glass, the whole being so put together as to prevent warping and shrinking, to last a long time without getting out of repair, and preserve an absolutely uniform temperature in the egg chamber.

The heat is regulated by a rubber rod, 1, that lies over the eggs in a trough, 2, the end of the rod farthest from boiler having an adjusting thumb screw, 3, and a block, 4, and spring forcing the expansion on the other end of the rod. On the other end is a double lever, 7, pinned to a frame, 5, through which the end of the thermostat is pinned. On the bottom or lower lever is another frame which the lever is pinned through, all very evenly balanced, so that the slightest change of the thermostat will force the double levers to throw the bottom in or out. The brass connection, 8, pinned to bottom of lever, is connected to lamp burner, lever and damper, 9. This lever is so sensitive that even a hair will turn it, and the damper is set

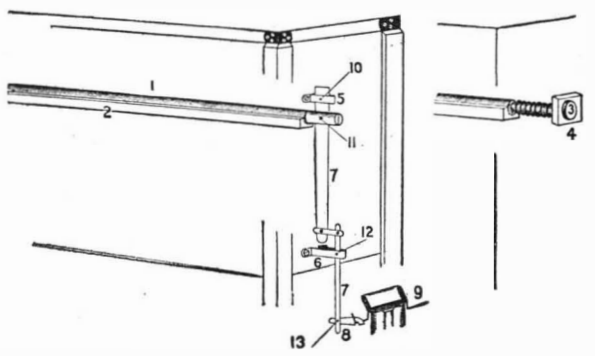
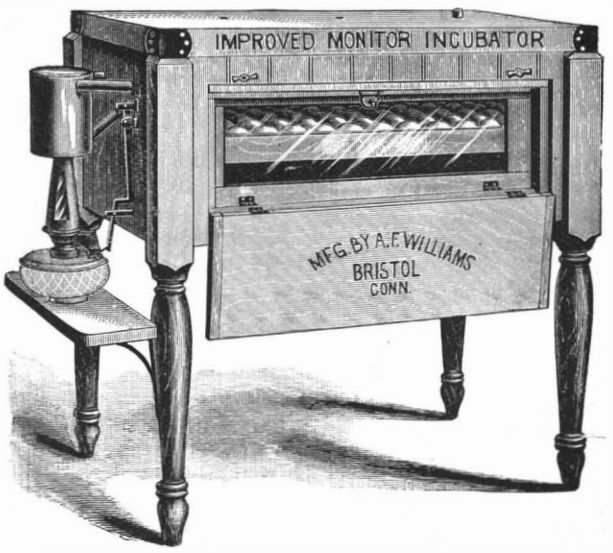


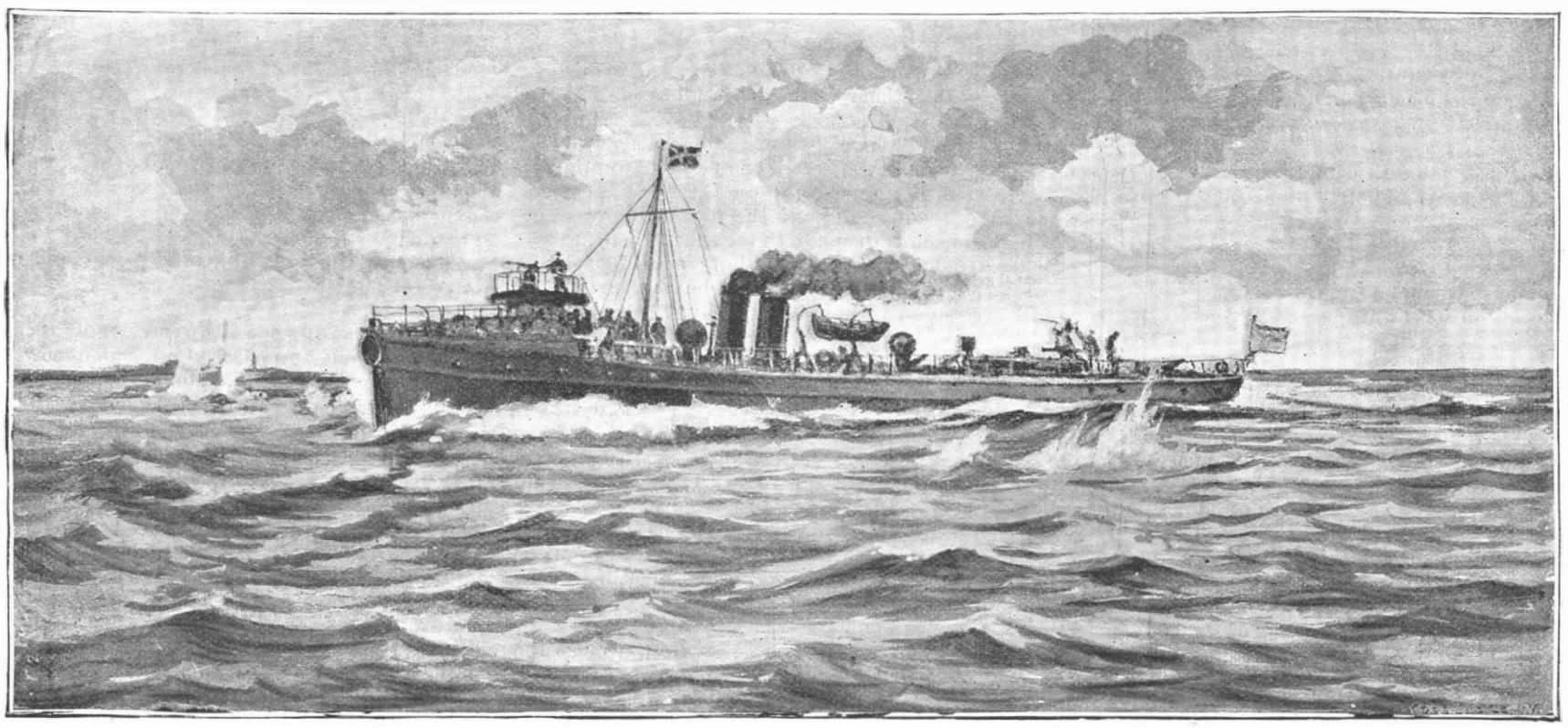
DIAGRAM SHOWING PARTS OF INCUBATOR.



A SIXTY-EGG INCUBATOR EXHIBITED AT THE FAIR.

close to the cone of lamp burner, but so that smoking is impossible.

It is said that on a recent trial of a 150-egg incubator it was locked up in a room alone for forty-eight hours and the temperature varied only one-half of a degree in that time. The air entering the incubator is warmed before reaching the egg chamber, and there is no direct draught upon the eggs. The air chambers and the evaporating pans are so arranged that the amount of moisture in the air is always under perfect control, the degree of humidity being registered by a hygrometer. The eggs are quickly turned without taking out the egg drawer, and the whole operation of the incubator is extremely simple.



THE NEW BRITISH TORPEDO BOAT HAVOCK—THE FASTEST WAR VESSEL AFLOAT.

The Speech of Animals.*

That animals have a means of communication among themselves through certain vocal sounds is a well established fact; that these vocal sounds are of sufficient range to express other than mere physical ideas, and thus to assume the importance of a language, is probable, although as yet unproved. It is toward the final settlement of this question that I wish to add my mite, and, while there is much that might be said, in the present instance I will confine my observations to a field but little explored—the attempts of animals to communicate with man.

For the last three years I have had a tame fox squirrel of which I have made a great pet. Polly has occupied a cage in the laboratory where she has been, for the most part, shut off from the sights and sounds of the outside world. Although at times the laboratory has had other tenants in the shape of squirrels, rabbits and guinea pigs, she has formed no particular attachment for any of them, but when I am about she is usually close to me, either on my shoulder or following me about like a dog.

Unconsciously at first and later with a definite purpose, I have talked to her much as one would talk to a young child. About a year ago she began to reply to my conversation. At first it was only in response to my questions as to food, etc, but later her "*talk*" has assumed larger proportions, until now she will, of her own accord, assume the initiative.

Her vocabulary appears to be quite extensive, and while, for the most part, it pertains to matters of food and personal comfort, there are times when it seems as though she were trying to tell me of other things.

When I first go out where she is in the morning she immediately asks for food, and until that want is supplied she keeps up a constant muttering. Later when her hunger is appeased she will ask to be let out of the cage. Often when playing about the room she will climb onto my shoulder and "*talk*" to me for awhile in a low tone and then scamper off. Unless she is sleepy, she will always reply to any remark made to her.

Her speech is not the chattering ordinarily observed in squirrels, but a low guttural tone that reminds one both of the low notes of a frog and the cluck of a chicken. Some of the notes I have been able to repeat, and invariably she becomes alert and replies to them. Unfortunately the effort to reproduce her tones produces an uncomfortable effect on my throat, and I have been obliged to desist from further experiments in that direction. The sounds that she makes are quick and in low tone; so the attempt to isolate words is very difficult, yet there is as much range of inflection as in German.

Another reason why I believe she is endeavoring to communicate with me is that she has used the same sounds toward other squirrels confined in the same cage, and that, while she will answer any one who addresses her, she voluntarily will only talk at length to me. That she understands what is said to her is beyond question, and, furthermore, she will distinguish between a remark made to her and one made to some one else.

I have had many pets that would answer in monosyllables to a question asked them or indicate by actions their desires, but this is the first instance that has come under my observation in which an animal has attempted more than that.

When Polly first commenced "*talking*," I regarded it merely as idle chattering, but further observation shows that it is not such and that the sounds she makes have a definite meaning. Moreover, the sounds she makes in "*talking*" are not the shrill notes of anger or alarm, but low, clear sounds that are unmistakably articulate.

In my fondness for my pet, have I overestimated the value of the sounds she makes, or am I right in assigning to them the characters of speech? Why should an animal not attempt to communicate with man? The higher animals are possessed of a well formed larynx and vocal chords. Why, then, should we deny or ever question the possibility of articulate speech? And, if they can converse among themselves, why may they not attempt to communicate with man?

Any one who has owned a well bred dog can relate numerous instances in which his dog has clearly understood what was said to it, and the readiness with which a dog learns a new command shows an intelligence of a high order. Although a dog's vocabulary is of limited range, it has certain definite sounds that possess an unmistakable meaning. There is the short, sharp bark that expresses a want, the low, nervous bark that means discomfort, the sharp, quick bark of joy, the low whine of distress, the growl of distrust, the deep growl of anger, the loud bark of warning and the whimper of fright. When to these is added the various movements of the body, cowering in fear, crouching in anger, the stiff bracing of the body in defense, leaping in joy, and many special actions, as licking the hand of the master or pulling at his clothes, we find that a dog can express his likes and dislikes, his wants and his feelings, as clearly as though he were human. Any one who, in a time of sorrow or depression, has had his dog come to him and lay its head in his lap and has looked down into those great brown eyes so full of sympathy and love, can never doubt that the dog understood all, and in its own way was trying to comfort.

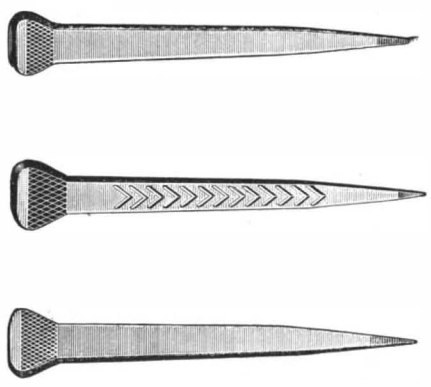
A friend's cat has an unmistakable sound for yes and no. The former is a low meyouw, while the latter is a short, sharp m'yoww. If Tom wants to go out, that fact is made manifest by a quick meyouw'. If, perchance, any one should be in the chair Tom regards as his especial property, no regard for propriety restrains him from indicating that fact and unceremoniously ordering the intruder out. His me'youw' on such an occasion cannot be mistaken. Instances of this sort are not uncommon and ordinarily fail to attract attention, but is there not here a field that will well repay a careful investigation?

Until my pet squirrel commenced her performances I regarded these things as a matter of course, but her chattering has raised with me the question, Is it not possible that our animal friends are endeavoring in their own way to talk to us as we talk to them?

*By Howard N. Lyon, M.D., Chicago, in *Science*.

THE CAPEWELL HORSE NAILS.

The Capewell Horse Nail Company, with factories at Hartford, Conn., and London, England, has experienced a steady and rapid development of its business in all sections of the country, notwithstanding the dull times which have been so prevalent. The company has lately built a fine new factory at Hartford. This nail is made from the best Swedish iron rods, improved in tenacity and uniformity of temper by the Capewell process, forming a nail of great strength. These nails are made in two styles of head, styled the "regular" and the "city" head, as shown in the illustration, and in both cases, as more plainly shown in the small cut, there is a distinct angle, and not a curve, where the head joins the blade. The nail has a gentle convexity on its flat surface, and on the opposite surface a distinct bevel at the point, the point of the nail being reasonably sharp and the edges of the tapering portion near the point sharp and keen. This nail has been in use about twelve years, and has proved itself eminently adapted for both heavy and light work. The corrugated nail is a recent introduction which finds much favor, the slight ridges on its surface forming no obstruction to the passage of the nail through the hoof, but forming a secure hold without the necessity of clinching. The American factory of the Capewell Horse Nail Company is at No. 41 Governor Street, Hartford, Conn.



THE CAPEWELL HORSE NAILS.

A Revolution in Telegraphy.

The *Boston Commercial Bulletin* says the days for the use of the primary battery for telegraphy in this country are numbered. It will not be long before the batteries that are now used in the various stations of the New England States will be relegated to antiquity. At the main Boston office, where 14,000 cells were employed for sending messages the first of the year, occupying one-fifth to one-sixth the space, there are now motor dynamos which take up but a small room in the basement. The advantages of the motor dynamo or transformers, as they are generally called, are many.

The saving alone over the old system is said to be between 40 and 45 per cent. This remains to be demonstrated, however. Then, again, the new practice has the great advantage of cleanliness and steadiness.

With the use of the cells the voltage varied from 26 to 36 points from the standard of 180 volts supposed to be delivered. With the motor dynamo as a generator of current, there is hardly any variation; at the most, two or three volts. The motor dynamo transforms or reduces the ordinary direct incandescent light current into one of small volume for the telegraph business.

In the Western Union Company's Boston office the current is taken in a commutator on one side of the machine and sent out from a commutator on the opposite side, the transformation being effected by two different windings on the armature.

The Boston plant has at present nineteen of these transformers in use and will put in addition probably ten more. Of the machines now in use five are of three horse power each, three are one horse power, two are one-half horse power, two are one-quarter horse power, and seven are one-sixth horse power. The potential of these machines varies anywhere from 25 up to 260 volts.

The farthest point to which a message has to be sent from Boston is Buffalo, N. Y., and this can be accomplished by throwing one large machine of 260 volts into service or several connected in tandem or in series. The small machines which are wound for from fifty to seventy volts are thrown into what is known as the loop from New York to Portland, thus necessitating the sending of but one message.

Aerial Ropeways.

At the San Andreas de la Sierra Mines, in Durango, Mexico, there is an aerial ropeway, furnished by the Vulcan Iron Works, of San Francisco, Cal, which is one of the boldest structures of its kind attempted thus far. The line is 15,517 ft. long, not being so remarkable in that respect, but the inclination is over 4,000 ft. in that distance, and two single spans are over 1,600 ft. between supports. This ropeway was put in to carry wood and charcoal to the mill. A great saving is made by this system, as the material had to be packed over a very circuitous route on mule-back. The country over which the line travels is exceedingly rough, and it crosses gorges 600 ft. deep. At one place the grade is at an angle of 48°.

The Vulcan system of ropeway consists mainly of an endless wire rope supported at convenient intervals on grooved sheaves, which are elevated on supporting structures, the height and construction of which will vary with the character of the ground; and passing around large grip wheels at ends of line. Carriers of suitable shape to hold the material to be transported—such as ore, wood, sugar cane, or any other similar material in sacks or in bulk—are fastened to the rope at intervals dependent on the amount to be transported. The ideal ropeway is one with sufficient grade to run by gravity, the loaded buckets pulling the empty ones back to the base of supplies. In any case, however, the power required to operate a very long ropeway is very small, for the friction is low. The surplus power generated on gravity lines is taken up by friction brakes at the terminals, which are automatic in their action.

Fireproof Floors.

In a paper recently read before the Civil Engineers' Club of Cleveland, Mr. Wm. Sabin describes the forms of fireproof flooring most commonly adopted in America. The oldest method was to place floor beams about 5 feet apart and turn a 4-inch brick arch between them, the beams being tied together to resist the thrust of the arches. The space above the arches was leveled up with concrete, in which were bedded strips of wood for the flooring. The plastering was applied directly to the bottom of the arches and over the flanges of the supporting beams. When exposed to a fire, however, it soon cracked off, and a special tile skewback is now used. Such a floor weighs about 70 pounds per square foot, exclusive of the weight of the floor beams. Its cost in America is about $1.44 per square foot. A similar floor in which the brick arch is replaced by one of corrugated iron has also been tried, but as the metal is exposed to the heat, it has no advantages. Its weight is 70 pounds and its cost $1.39 per square foot. The next improvement was the use of flat arches of terra cotta. In this case the beams were placed 6 feet to 7 feet apart, the tiles being 10 inches deep, and the weight of the floor was reduced to 40 pounds per square foot and its cost to $1.34. A further reduction of weight was effected by the use of porous terra cotta, obtained by mixing sawdust with the clay. The weight of floor was thus brought down to 35 pounds per square foot, while its cost was $1.36. In a test made at Denver an arch of porous terra cotta 4 feet wide and having a span of 5 feet bore a load of 15,145 pounds with a deflection of 0·65 inch, and it took 11 blows of a weight of 134 pounds falling from a height of 6 feet to 8 feet to entirely destroy the arch. Both systems of terra cotta floor have successfully withstood severe fires. In a method of construction now being largely adopted, the span of the floor is increased to 12 feet and it is supported by 12-inch I-beams. Between these beams is strained a galvanized wire net, said to be capable of carrying 1,000 pounds per square foot. A center board is fixed below this net, and the space between it and the top of the floor filled with a very light concrete, made with crushed coke, cork, cement and a little sand. This floor is 8 inches deep, the bottom flanges of the I-beams being protected by carrying the cement around them. Its weight is only 18 pounds per square foot, and it has been tested with a load of 580 pounds per square foot, the deflection being only one-half inch. Its cost is about $1.05 per square foot. In connection with the above prices, it should, perhaps, be mentioned that I-beams are very costly in the States.

Electric Towing on the Bourgogne Canal.

There has just been inaugurated upon the Bourgogne Canal, which connects the Seine and the Saone, the first system of electric towing, properly so called, that is to say the first system in which the motive power is furnished by an electric current. This system, established by Mr. Gaillot, government engineer, has, for about two months past, replaced the old system of steam and chain towing, which has been employed upon the canal since 1867. This canal, 3½ miles in length, connects the two sides of the English Channel and the Mediterranean. The electric energy by which the towing is effected is furnished by water falling from two sluices at each extremity of the junction canal. The fall on the Seine side is 24½ feet in height and discharges one and a half times more than that of the Saone side, whose fall is 26 feet. The powers disposable thus have a ratio of 11 to 8, with a feeble variation according to the needs of the canal's supply—a variation that does not practically affect the ratio.

Each plant actuates a Gramme dynamo, the powers of the dynamos being in the same ratio as that of the powers of the falls. These dynamos are excited in derivation and mounted in tension, that of the Seine side having to furnish normally 380 volts (1,200 revolutions per minute) and that of the Saone side 270 volts (900 revolutions per minute). The mounting in tension is effected through a bronze line three-tenths of an inch in diameter connecting the positive pole of one generator with the negative pole of the other. The two other poles are connected with two wires stretched parallel above the canal and open at their other extremities.

The motive series mounted upon the tow boat is branched between these two wires through the aid of two trolleys mounted upon poles 20 feet in length and that press upward against the wires, as in American tramways. The electric motor, by means of a belt, actuates a train of gear wheels, the last of which controls the chain pulley.

The discharge varies according to the load of the convoy in tow. Use is then made of a second train of gearings of slow speed, giving for the same velocity of the receiver a running speed of nearly half that that would correspond to the high speed gearings.

The receiver of the boat is constructed for making 1,000 revolutions per minute, normally. It does not differ much from this figure in practice.

The current is rendered regular by means of accumulators, which are capable also of storing up the electric energy produced during the stoppage of the towing. The accumulators are of the type of the Societé pour le Travail Electrique des Metaux. There are 250 elements capable of discharging 15 amperes. The regulation of the turbines is done by the generators. The induction current passes through a solenoid whose armature takes a position which is variable according to the intensity of the said current, that is to say, according to the electromotive force of the machine. In changing position it establishes contacts that send the current of a Lalande battery of four elements of wide surface into Bovet magnetic clutches. The gate of the turbine opens or closes according as the dynamo produces too much or too little.

The illumination of the three thousand yard tunnel is effected through a derivation established upon the line, and that is now provided with automatic arrangements for keeping it constant despite the variations in discharge resulting from the towing. Such are the principal arrangements of this original installation, due to the initiative and studies of Mr. Gaillot. It will effect a great saving in the consumption of coal, which is done away with, as well as in the cost of labor, since there is no longer any need of stokers, and the sluice keepers can occupy themselves with the small hydraulic and electric plants situated at each extremity.—*L'Industrie Electrique.*

History of the Calla Lily.

This was first introduced to Europe from Southern Africa in 1687, and has become a great favorite with cultivators all over the world. It does not like a very warm temperature nor a very cold one. It will live out in American waters, provided it is deep enough to be below the reach of absolute ice. It fills the ditches and narrow creeks in Cape of Good Hope, much the same as our spatterdock would here. It was removed, by Kunth, from the genus *Calla*, and called *Richardia Africana*, but it is not easy to get rid of a name which once gets into general use, hence it still goes by the name of *Calla*. The spotted one, common in cultivation during the last few years as the *Richardia albomaculata*, was also introduced from Southern Africa in 1859. This is well known by its spotted leaves. Another one was brought from the same country in 1857, under the name of *Richardia hastata*—the spathe being of a yellowish color, but very small, and is not yet much known. On account of the common calla blooming most freely in the spring of the year, it has come into general use for Easter decorations; and not unfrequently receives, with a number of other plants, the common name of Easter lily.—*Meehans' Monthly.*

Correspondence.

CARRYING LINES ASHORE FROM WRECKED VESSELS.

To the Editor of the Scientific American:

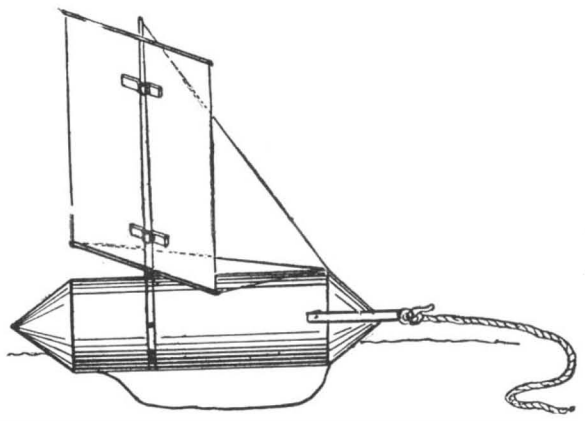
I read an article in your latest paper, that is last week's, on the wreck of the Louise H. Randall, which was cast ashore on Long Island last week. Now, according to the article in your paper, she lay about six hundred yards from shore. The paper says the crew took to the rigging and stayed there. In the meantime the United States life saving crews were exerting their utmost power to get a line to the wreck. According to the account in the paper, they failed. The last resort was a tug from New York to the rescue.

What I want to say is this: I have lived on Jersey's shore for the past twenty years and have experienced the most severe storms. During this time I have witnessed every vessel which struck Jersey's shore from the Highlands to Asbury Park, and in all cases the United States life saving crews have had all they could do to get a line to the stranded vessel, unless she came ashore in fog, when the sea was so smooth one could go off in a flat bottomed boat. In all cases when a vessel is blown ashore on this coast the wind blows so hard that it is almost impossible to stand on the bluff.

Now, when a mortar is placed in position to throw a line, it must and will have to throw straight in the wind, which never blows less than forty miles per hour. Now, it is a hard matter to get a line off under these circumstances.

Now, my idea is this: Why not let vessels carry an arrangement which can be thrown overboard as soon as a vessel strikes, attach a line to it, and let the wind and waves bring it to shore? It can be done. I witnessed the wreck of the Germania off West End, Long Branch, and she was loaded with kerosene barrels. The vessel broke into pieces, and I noticed that the barrels were on shore in a very short space of time.

Now, why not rig an arrangement for vessels to carry on board ship, and in case a crew on shore fails



to get a line off, let this be thrown overboard with a line attached and let wind and wave bring it ashore, which would be in a short space of time?

Referring to the diagram, the main body is a round iron can about the size of a large copper boiler used in connection with a range; it is air tight and the bottom is weighted with lead, so that no matter how rough it is handled it will stand up to wind and sea. It is all made of iron. CHAS. L. HOWLAND.

Long Branch, N. J., December 10, 1893.

Artesian Wells in South Dakota.

To the Editor of the Scientific American:

Thinking something regarding artesian wells in Jim River valley, South Dakota, might be of interest to your readers, and having had about two years' experience in drilling wells in that country, I thought I would inform them of a few points of interest that have come under my observation. I have tested a number in regard to pressure and volume and found the largest volume is an eight inch well at Chamberlain, 640 feet deep; volume, 3,500 gallons per minute, with 90 pounds pressure to the square inch closed, and with a three inch opening it will throw a stream of water 150 feet high and holds 60 pounds pressure.

The well is now used to run a large flouring mill. This well is estimated to develop 60 horse power. This well is shallow for that country, which is accounted for by its being near the bed of the Missouri River. The wells further up the valley have a higher pressure, as high as 175 pounds to the square inch, and run in depth from 800 to 1,000 feet. We have what is called the first or lighter flow, with a pressure from 75 to 145 pounds to the square inch. This water is, as a general thing, soft and first class for domestic purposes. The second flow is the heavier, with a much larger pressure. The geological formations are about as follows: First drift, shale, with layers of iron pyrites from 4 to 12 inches thick. The water-bearing rock is mostly pyrites in the sea shell form, and layers of sand and porous rock. These wells derive their supply from the northwestern mountains.

There is one well at Pierre, S. Dak., which has a volume of 500 gallons, the temperature of the water being 92° and perfectly soft. This well is no doubt fed from the same veins which feed the celebrated geysers in the Yellowstone Park. All these wells could be used for power, irrigation, farm use, etc., and many of them are being utilized right along. Hoping this may prove of interest and profit to some one, I am, respectfully yours, PHIL. EYER.

A Good Suggestion for Short Telephone Lines.

To the Editor of the Scientific American:

The patent covering the use of the permanent magnet in combination in the Bell receiving telephone will expire January 30, 1894.

The use of the magneto-telephone as a transmitter, as at first established, was discontinued because the backward currents from several electromagnets in the same line, as in the bells, rendered the battery transmitter very desirable if not absolutely necessary on account of its greater current.

A plan to remove this difficulty and render the use of the magneto-transmitter available has been devised for a line here about 20 miles long, having about eight offices upon it. This plan is to run an extra line upon the same poles and use one line for the bells and the other for the telephones—transmitters and receivers. All telephones will be automatically, or otherwise, switched out of the talking line and remain so normally. When a call is rung on the independent call line and answered thereon, the two parties, *only*, who desire to communicate will take down their telephones, and thus have a clear line, without either bells or telephones (other than their own) in circuit. The slight resistance of the line will make the magneto-transmitters preferable to the battery transmitter, which latter is still held by the Bell Company by later patents. This segregation of the functions of the telephone into a call-bell line and a talking line, it will be seen at a glance, simplifies the matter. M. L. BAXTER, M.D.

Derby Line, Vt., December 25, 1893.

The Best Preservative Paint for Ironwork.

Mr. W. Thomson recently read a paper before the Manchester Association of Engineers, on "The Influence of Some Chemical Agents in Producing Injury to Iron and Steel," in which reference was made to the effects of different paints and varnishes used for the preservation of structural iron and steel from rust. From experiments made by himself, Mr. Thomson has arrived at the conclusion that red lead paint is the best preservative. This result had struck him as remarkable, because red lead is a highly oxidizing substance; but the reason was found to be that the red lead had the effect of producing a skin of the unoxidizable and protective black or magnetic oxide on the iron itself under the paint. The author has also found that other oxidizing agents, such as manganese dioxide, form a paint which preserves iron from rusting; and this discovery he regards as of great industrial importance. Mr. Thomson explained that, having been required some time ago to make a considerable number of experiments to ascertain the most suitable paint for protecting a large iron structure from the action of sea water spray and rain, he arrived at the conclusion that red lead paint was the best he could find for the purpose. Mr. John West, a vice-president of the society, who presided on the occasion of the reading of the paper, supported the statements and views of Mr. Thomson that red lead is the best preservative paint for iron work. The chief novelty brought out in the paper was the reason why red lead is so efficient in protecting iron.

How to Preserve the Natural Colors of Flowers.

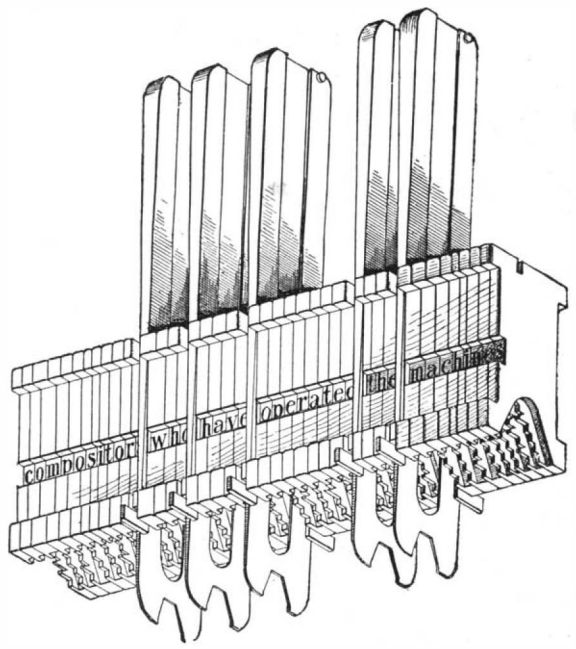
It is over a quarter of a century since the following appeared in the *Gardeners' Monthly*. Coming back again to America after its long travel, it is still worth republishing.

"The following ancient method, which comes from America as new, may be worth repeating and trying: Take very fine sand, wash it perfectly clean, and when dry sift it through a fine sieve into a pan. When the sand is deep enough to hold the flowers in an upright position, take some more sifted sand and carefully cover them. A spoon is a good thing to take for this, as it fills in every chink and cranny without breaking or bending the leaves. When the pan is filled solidly, leave the flowers to dry for several days. It is a good plan to warm the sand in the oven before using it, as the flowers will then dry more thoroughly. In taking the sand off, great care must be taken not to break the leaves, as they are now dry and brittle. Pansies preserved in this way will keep their shape and brilliancy of color all winter, and many other flowers can be equally successfully treated—anything, in fact, where the full pressure of the sand comes on both sides of the leaf; otherwise they will shrivel. To fill in flowers with cup-like shapes it is better to lay them on the sand, and with small spoon fill in and around each flower. Ferns when preserved in this way have a more natural look than when pressed, and the maiden hair fern looks almost as well as when it is freshly gathered."

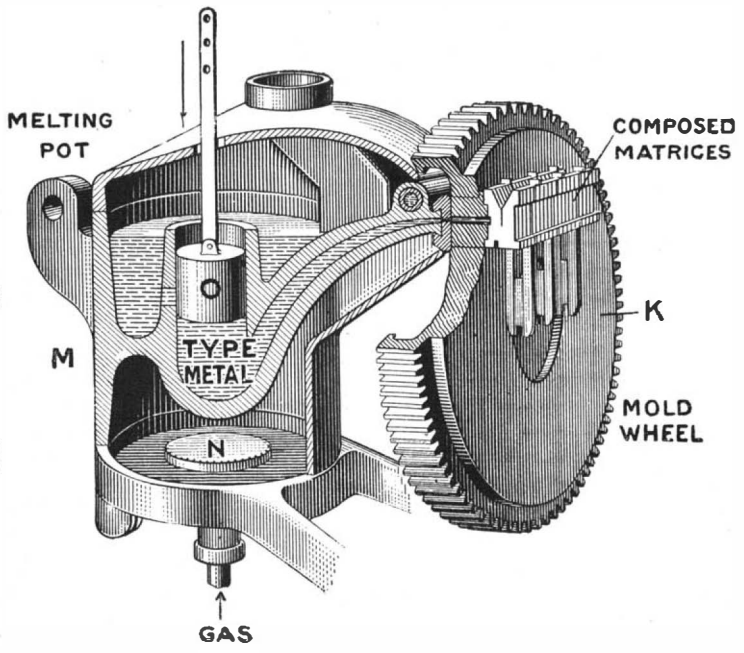
THE "LINOTYPE."

(*Continued from first page.*)

from the space box, H, by touching the space bar, J, in the same way as the type keys. As the different characters drop into place the operator can readily read and correct the matter as he proceeds, each matrix having on its back an impression corresponding with the female die it bears on the opposite edge. The spacing, however, presents one of the most interesting features of the machine. Each space bar is a composite wedge, and by sliding its top and bottom parts together its thickness is increased, while it still remains of an even thickness at the top and bottom of those portions bearing against the matrices. When, therefore, the operator sees that the line is so nearly full that it will not hold another word or part of a word, he simply presses upon a lever at his right, and the space bars do all the work of justification, all of them being simultaneously closed up sufficiently to lengthen the line to its full predetermined measure, with absolute certainty that the spacing will be entirely "even." At the same time the line of matrices is automatically engaged by clamps and transferred, as shown by the arrows, to the face of a vertical mold wheel, K, through which extends a slot, or body mold, opposite the face of which the row of characters in the matrix line is presented. The pot of type metal behind the mold wheel is kept in proper condition by a flame from a gas burner, and a channel from the pot leads to the rear face of the mold, into which the molten metal is forced by means of an automatically working plunger, when the line of matrices is presented and locked against the face of the mold. The metal is easily kept at the proper temperature by a simple device, but rarely requiring any looking after when once adjusted, and the cast body, being but a thin piece of metal, solidifies almost as soon as it touches the mold. The mold wheel then makes a partial revolution, when a blade or plunger pushes the linotype out, and between trimming knives, depositing it on a galley at the front of the machine. As this is done the knives leave shallow vertical ribs on the side of the linotypes, or slugs, and it has been found that these ribs serve a valuable purpose, giving air spaces, facilitating the drying of the papier mache stereotype molds now used by most of the large daily newspapers. A vibrating arm advances the linotypes along one after the other upon the galley, so that they thus come together in column form.



ASSEMBLED LINE OF MATRICES.



CASTING THE LINE.

After the casting of the line comes the distribution of the matrices again to the magazine, the operation being entirely automatic, and being one in which the eminent superiority of this machine is most conspicuous. For this purpose an arm lifts the line vertically, and then shifts it laterally until the teeth at the top of the matrices engage teeth on a carrier plate, R, as shown in dotted lines, this plate, with the line of matrices, being then raised to the distributor bar at the top of the magazine. The spaces remain behind when the matrices are carried up, and are transferred laterally to their box or holder. The distributor bar occupies a fixed position above the open upper ends of the magazinc channels, and on its lower edge are formed longitudinal teeth or ribs adapted to engage the teeth on the tops of the matrices. But a matrix bearing any given letter differs, as to the number or arrangement of its teeth, from a matrix bearing any other letter, and the ribs of the distributor bar vary correspondingly in number and arrangement at different points in its length, the ribs being such in cross section, over each magazine channel, that they will not, at this point, hold up the particular matrix designed for such compartment. The matrices, when they are placed in suspension at one end of the bar, are pushed along it by means of longitudinal screws, each matrix remaining in engagement with the bar until it arrives over its proper magazine channel, into which it drops, ready for use again in the formation of another line. The work of distribution is thus carried on continuously, simultaneously with that of assembling the matrices. The number of pieces with which each magazine is furnished, to render it certain that there shall always be enough of each character for the line being composed,

A LINOTYPE.

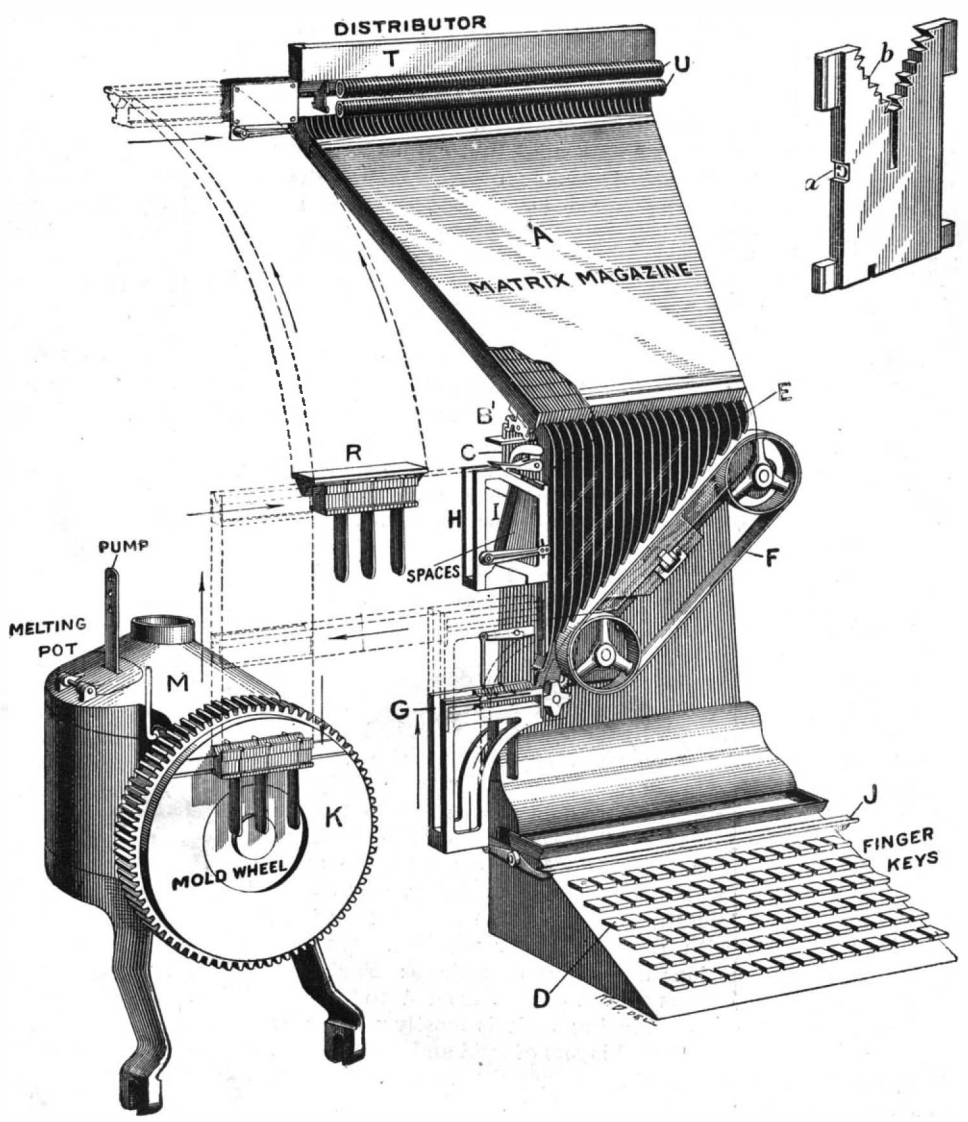
the one being cast, and the one being distributed, is fixed upon the basis of a supply of 26 matrices bearing the letter "e," all the other characters of a fount being provided in proportionate number, according to the well understood practice in the trade. There is, therefore, no such thing as being short of type, because of an excessive amount of "standing matter," in any office where the machine is employed. Any good stereotyping metal may be used in the machine, the metal being remelted and doing duty over again almost indefinitely, although it is recommended occasionally to add thereto a small quantity of bismuth. As the linotypes are used but once, the publisher is enabled to have a new dress each day, instead of being compelled to use old and dull faces as in the case of ordinary type required to do service for long periods of time. The usual heavy investment demanded in purchasing and renewing type is also wholly avoided, as is the great loss from the breakage and wear of type. The mold wheel, in the illustration, is represented as having but one mold slot, or mold proper, but these wheels are now being made with two and four slots, or molds, each representing a different size of type. The number of "faces" made for the machine includes all the regular type sizes, from agate to small pica, the magazine being complete in all particulars for each face. To change one magazine for another on the machine is the work of less than five minutes, when it is desired to change to larger or smaller type, the mold wheel being at the same time turned to a different position to bring into proper place the body mold corresponding to the face on the matrices in the magazine. One idea, however, in making the increased number of molds in the mold wheel, has been to enable the same machine, with one magazine, to produce both "solid" and "leaded" linotypes, this being effected by using a body proportionately larger than the face, as a brevier face on a long primer body, etc., such change from one to the other being then effected by simply readjusting the mold wheel.

A recent feature in the development of the machine, and its adaptation to newspaper needs, consists in the furnishing of a magazine specially adapted for the composition of display heads. This magazine has one fount of capital letters, large sized type, say a pica gothic condensed, and another of upper and lower case in comparatively small size, as nonpareil full face. With this magazine the regular "display" heading, as seen in many newspapers, may be quickly formed with linotypes.

The power required to run the machine is very small, only about one-third of a horse power, and may be supplied from any suitable source, such as a steam or gas engine or an electric motor. The cost of gas to keep the metal in proper molten condition is placed at about fifteen cents per day for each machine.

The speed at which the machine can be and is regularly and continuously operated varies considerably in different offices, according to the ability of the operators, but, taking good and bad workmen together, in many offices having each several machines, the averages by the month of the workmen equal 4,000 ems per hour for each machine, while there are some offices in which these averages, according to carefully kept records, reach as high as 5,000 and 5,500 ems per hour. Many individual compositors have made much higher records for long continued periods. The time required by beginners and the period necessary to attain the highest efficiency, varies widely, say from a month to four and six months, one who is a good compositor to start with naturally having a great advantage in quickly learning to operate the machine with facility.

The Mergenthaler Linotype Company has three factories for the manufacture of the machine and its parts, one in Brooklyn, N. Y., one in Montreal, Canada, and one in Manchester, England. The machine is, as is well known, based upon the



THE LINOTYPE—DIAGRAM SHOWING OPERATION OF MACHINE.

highly novel original patents of Mr. Ottmar Mergenthaler, though many valuable practical features, embraced in other inventions, are now embodied in it. The principal factory of the Company is in Brooklyn, and is a large fire-proof structure containing a great amount of very valuable machinery and tools, specially invented and designed to make the various parts of the machine with precision and economy. The general offices of the Company are in the Tribune building, New York, Mr. Philip T. Dodge being the President and general manager, and Mr. Frederick J. Warburton, Secretary and Treasurer. Mr. W. H. Randall is the Superintendent of the Brooklyn factory.

This article is printed from plates made from linotypes used in our forms in the same way as the types are used for the other matter.

Medicine as Practiced by the Lower Animals.*

It would seem as if man were surrounded by danger, seen and unseen, throughout his entire life. From the cradle to the grave it is a struggle. In the vegetable kingdom also the same struggle for existence is seen. Every flower has its destroying insect; for every shrub there is a worm, and for the ripening watermelon the little colored boy lies in wait. But if disease threatens man on every hand, equally close at hand is the remedy with healing power, and not only do the so-called inferior human races appear to recognize this, but even dumb animals, and it would seem as if the latter, in an empirical way of course, practiced medicine.

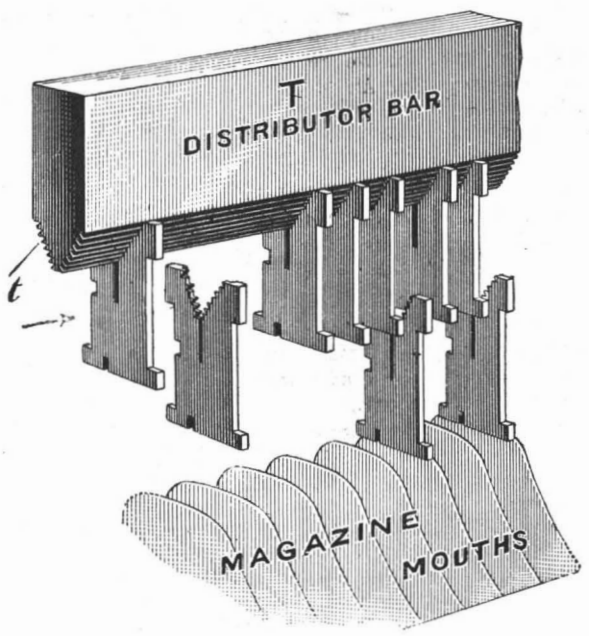
Animals instinctively choose such food as is best suited to them, and to a certain extent the human race also shows this instinct, and medical men are sometimes at fault in not paying sufficient respect to the likes and dislikes of their patients. Women, as a rule, are more often hungry than men, and they do not like the same kinds of food; nevertheless, men and women are generally put on precisely the same regimen, especially in public institutions. Infants scarcely weaned are given a diet suitable to adults, which they dislike, and which disagrees with them. Some years ago Delaunay investigated this question in the different asylums of Paris, and ascertained that children, although they will generally eat it, do not like meat before they are about five years of age. People who like salt, vinegar, etc., may generally be allowed to satisfy their tastes, within moderation. Lorain always taught that, with regard to food, people's likings are the best guide.

A large number of animals, such as elephants, stags, birds, and ants, wash themselves and bathe. Launay lays down as a general rule that there is not a species of animals which voluntarily runs the risk of inhaling emanations arising from their own excrement. If we turn to the question of reproduction, we find that all mammals suckle their young, keep them clean, wean

OLD TIMEPIECE OF JOHN BUNYAN.

them at the proper time, and educate them—maternal instincts which are frequently wanting or rudimentary in women even of civilized nations. In fact, man may often take a lesson in hygiene from the lower animals. Animals get rid of their parasites by using dust, mud, clay, etc. Those suffering from fever restrict their diet, keep quiet, seek darkness and airy places, drink water and sometimes even plunge into it. When a dog has lost its appetite, it eats that species of grass known as dog's grass (*chiendent*), which acts as an emetic and purgative. Cats also eat grass. Sheep and cows, when ill, seek out certain herbs. When dogs are constipated they eat fatty substances, such as oil and butter, with avidity. The same instinct is observed among horses. An animal suffering from chronic rheumatism always keeps as far as possible in the sun. The warrior ants have regularly organized ambulances. Latreille cut the antennæ of an ant, and other ants came and covered the wounded part with a transparent fluid secreted from their mouth. If a chimpanzee be wounded, it stops the bleeding by placing its hand on the wound or dressing it with leaves and grass. When an animal has a wounded leg or arm hanging on, it completes the amputation by means of its teeth. A dog on being stung in the muzzle by a viper was observed to plunge its head repeatedly for several days into running water. The animal eventually recovered. A sporting dog was run over by a carriage. During three weeks in winter it remained lying in a brook, where its food was taken to it; the animal recovered. A terrier dog hurt its right eye; it remained lying under a counter, avoiding light and heat, although habitually it kept close to the fire. It adopted a general treatment, rest and low diet. The local treatment consisted in licking the upper surface of the paw, which it applied to the wounded eye, again licking the paw when it became dry. Cats also, when hurt, treat themselves by this simple method of applying continuous irrigation.

* By Dr. R. E. Anderson, Rockville, Maryland, in the *Mass. Medical Journal*.



THE LINOTYPE—DISTRIBUTION.

Four Different Lights from Molecular Vibration.

Mr. Nikola Tesla has demonstrated that the phenomenon of light is producible in four different ways by the action of high frequency electricity upon suitable media. One of these methods is the incandescence of a solid, consisting of a small carbon button mounted upon a platinum wire in an exhausted bulb. When Mr. Tesla connected his body with one of the terminals of a high-tension transformer, and took an arrangement of this kind in his hand, the button became luminous. Next he took a highly exhausted bulb, containing a strongly phosphorescent body, above which was mounted a small plate of aluminum on a platinum wire leading to the outside; and the currents flowing through his body excited intense phosphorescence in the bulb. Thirdly he took in his hand a simple exhausted tube, and in the same manner the gas inside the tube was rendered highly incandescent or phosphorescent. Finally, he took in his hand a metallic wire, which appeared covered with a luminous film through the intensity of the electrical vibration. Mr. Tesla is now engaged upon the problem of producing these effects with less expenditure of energy than was employed in the operation as first arranged by him. Either method of converting molecular bombardment into light without heat, provided that it could be done economically, would be a considerable step forward in the direction where "the light of the future" is supposed to await its fortunate discoverer.

HISTORIC EXHIBIT OF THE WALTHAM WATCH COMPANY AT THE WORLD'S COLUMBIAN EXPOSITION, AT CHICAGO.

The Waltham Watch Company displayed over six hundred historical and antique watches at the World's Columbian Exposition, illustrating the various types of watches and movements extending over a period from 1610 to the present time. Many makers famous in the development of the watch were represented in the collection.

SIR ISAAC NEWTON'S WATCH.

The most primitive timepiece was the sun dial. This is of solid silver and was made by Le Maire, of Paris, before the year 1700. The workmanship is very perfect, and the dial is elaborately engraved and in good condition to-day. On the base is a small compass, and on the face and elesewhere are the names of Paris, Rouen, Marseilles and other cities, with the declination of each. The arm is marked with the declinations, so that the proper angle for the dial face to rest against this arm can readily be made. The instrument is so made that it can be folded up and carried in the pocket. It was brought to this country by a Frenchman who went to Oregon to live. On his decease, among his effects was this sun dial. Recently it came into the possession of Mr. H. E. Duncan, of the Waltham Watch Company.

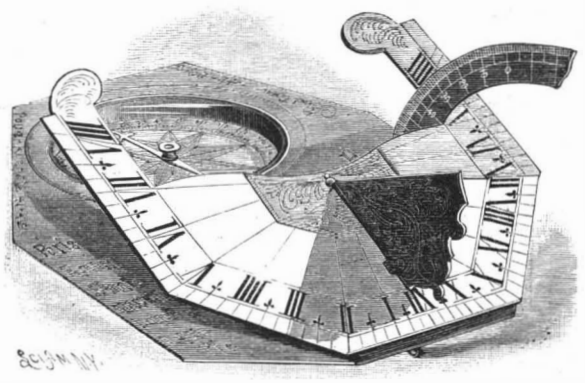
The skull watch is a grewsome timepiece, made at a time when the skill of the watchmaker was exerted more to make a striking-looking case than an accurate time-keeping watch. This case is of silver, oxidized by age. In order to tell the time, the lower jaw of the skull is dropped to expose the dial. The movement which occupied the skull cavity is lost. The dial contains Roman numerals and is delicately engraved. This watch was made soon after the year 1600, but its maker is unknown. The feature of the engraving on the dial is a picture of the day of judgment.

The watch used by the poet Milton is shown in one of the engravings. This is an instance of a case within a case, the watch proper being inclosed in an outer case. This is what is called the Nuremberg or egg-shaped watch. The watch proper is readily removed from the outside case, which is made of silver. A raised point is placed against each hour on the dial, and this, together with a heavy hand, made it easy for the poet to tell the time approximately by the sense of touch. On the back of the inner case is the name of John Milton. The movement has no hairspring, but has the fusee with string, which in this case is a piece of catgut. The movement bears striking evidence of a high quality of workmanship upon the part of its maker, Bouguet, of London. The watch was made about the year 1600.

John Bunyan's watch was made some years later than Milton's watch, and bears the name of Fitter, London. This watch has a second hand placed on the back of the movement, instead of on the dial. The dial is of silver and the entire watch is inclosed in a leather case ornamented with silver. On the back of the watch the following calendar is engraved:

Mar.	Nov.	1	8	15	22	29
Augus.		2	9	16	23	30
May	Jan.	3	10	17	24	31
Octob.		4	11	18	25	
Apr.	Jul.	5	12	19	26	
Sep.	Dec.	6	13	20	27	
Jun.	Feb.	7	14	21	28	

The watch is very elaborately engraved. The movement is of the same style as the Milton watch, but is more elaborate in its workmanship.

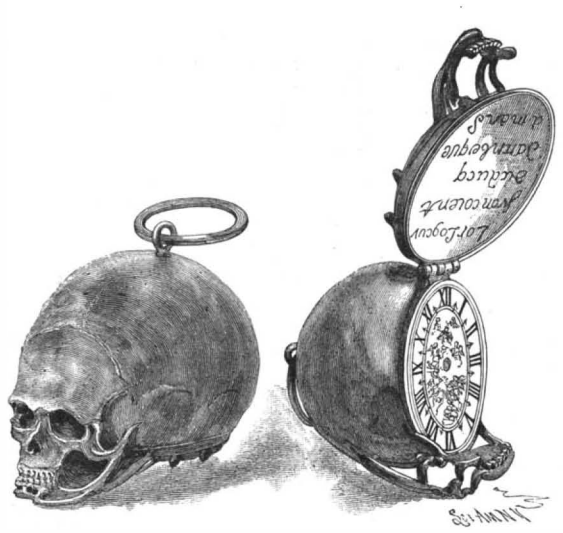


ANCIENT POCKET SUN DIAL.

It was evident that only the latest achievements of the watchmaker's art would satisfy Sir Isaac Newton, for his watch, which is shown on this page, is an elaborate mechanism. It was made by Girod, of Paris, in the seventeenth century, and is an astronomical watch inclosed in a shell enameled case. On the face are three dials. One is an hour dial, underneath one section of which is a little disk which tells whether it is day or night, the day being designated by the sun and rays of light and the night by the stars and moon. The dial is ⅝ of an inch in diameter. The calendar dial has thirty-one gradations, one for each day in the month, and near by is a little aperture in which the name of the month is shown, with the number of days in the month. As the watch lay in the showcase, but not running, this little recorder indicated "Aug. 31." The third dial represents the lunar month and is graduated for 29½ days. A little aperture near this dial shows the changes in the moon. The entire face of the watch is gold, while the dials are silver. The case is also of silver. The outer case is of enamel and shell, the pieces of shell being riveted by silver rivets

arranged in an artistic manner. On the back of this outer case is an enameled painting representing Paris taking leave of Helen. The movement in this watch is of the same type as the Milton and Bunyan watches.

In order to show what can be done in the line of handwork in these modern days, the Waltham Company exhibited a watch in a case of quartz crystal, from Brazil, ground, polished, and all the work upon it was done at the works of this company at Waltham,

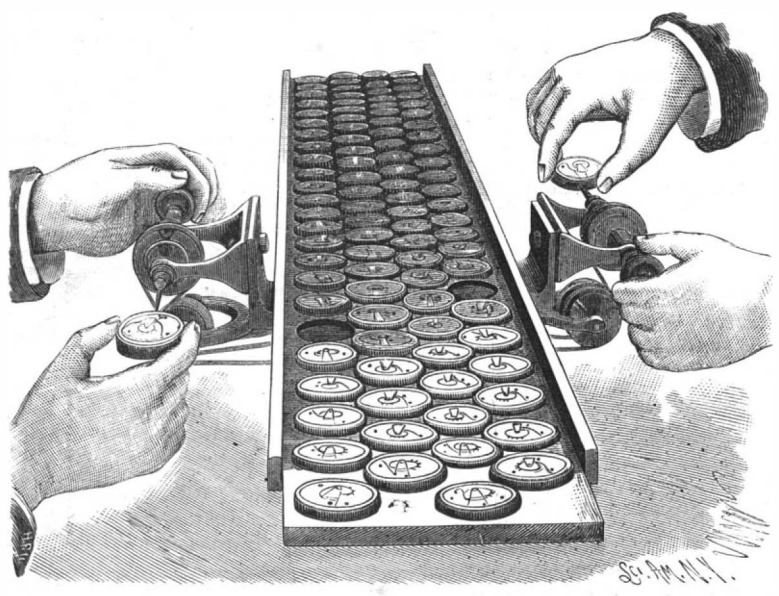


THE SKULL WATCH.

an American workman being employed about two years and a half in completing the work. The lower plate is a thin sheet of agate, and as the only metal in the movement comprises the wheels and springs, the full richness of the agate is had by holding the watch to the light and looking through it. The effect is fascinating. The jewels are rubies set in recesses ground on a taper in the crystal case. The minute circle on the dial is marked with a ruby at each interval, and at every five minute period is a sapphire, while the figures and other ornamental work on the face are outlined in gold, and attached to the agate plate, giving a richly colored dial. This watch is a stem winder, the movement first quality grade, the latest achievement in American watchmaking.

The automatic machinery for making different parts of the watch movement exhibited by the Waltham Company attracted much attention. It is a fact not generally understood that one operative, with a set of this machinery, can do as much work as twenty operatives could do with the best appliances that were used in watchmaking at the time of the Centennial in 1876. The antique watches described in this article were none of them made with much less than a year's steady work by the watchmaker, while infinitely superior watches, so far as time-keeping is concerned, were shown in this exhibit that were made at the rate of about two thousand a day.

The Waltham Company had among its exhibits at the Columbian Exposition a case containing one day's output of the factory, consisting of 2,000 perfect movements, well regulated and in good running order. It



METHOD OF WINDING 2 000 WATCHES.

became a serious question as to how to keep this large number of movements in motion, as the winding of 2,000 watches per day is no small matter. The ingenious mechanicians of the company therefore devised a winding machine by means of which two watches could be wound at once by two expert operators, each operator winding at the rate of 62 watches per minute.

As shown in the engraving, a tray containing about 100 movements was placed upon a standard between the operators, and each removed a movement and placed the winding stem in the chuck at the end of the revolving mandrel. The mandrel was carried by frictional connection with a power-driven pulley, and the back end of the mandrel was provided with a friction wheel embraced by the thumb and finger of the operator. The connection between the mandrel and the pulley was so delicate that when the watch was wound, the mandrel stopped. It was held by the thumb and finger of the operator while the movement was removed and another one placed in position for winding, when the frictional wheel was released and the watch wound within the space of a second.

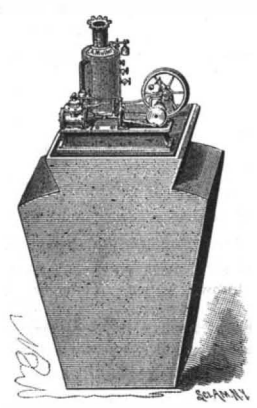
In addition to the display of historic and recent timepieces, this company exhibited a piece of mechanism which shows that notwithstanding the improvements in watchmaking which materially modify the practice of modern jewelers and watchmakers, skillful mechanics are not wanting among them.

The exhibit to which we refer was a minute steam engine, made by Mr. A. Muller and loaned to the Waltham Watch Company. It is of the exact size of the annexed engraving, complete with boiler and governor; well proportioned and made in the same way as larger engines. This is probably the smallest power plant in existence, and yet it doubtless develops much more power than is needed to run a watch.

The Otis Elevator in Scotland.

Between Finnieston and Govan, says *Engineering*, two tunnels have been laid under the Clyde, side by side, one for vehicular traffic going north and the other for that going south. Above these two, and over the point of junction, there is a third tunnel for foot passengers. At either end of these tunnels, and close to the riverside, vertical shafts have been constructed, each 80 feet in diameter. In each of these shafts there are to be six powerful lifts, designed to lower and lift the largest vans, lorries, etc., with their horses, just as they are. On being lowered to the bottom, they will go, as on a road, through the tunnels, and be raised at the opposite end. The lifts will work at a good speed, and will thus be enabled to handle a very large traffic.

The contract for the lifts was given to the American Elevator Company, of Mansion House Buildings, 4 Queen Victoria Street, which has since become the Otis Elevator Company, Limited; the contract is being carried out by both companies conjointly.



MINIATURE STEAM ENGINE. (Actual size.)

The tunnels are practically completed, and the shafts are nearly so; the fixing of the lifts will shortly commence. The machinery has been constructed by Messrs. Otis Brothers & Co., of New York, and has been specially designed by Mr. Thomas E. Brown, Jr., who designed the two elevators fixed in the Eiffel Tower in Paris, and also the very large elevators used in connection with the North Hudson Railway Company, near New York. The machinery has been completed and the safety fixtures tested; the results of the test are given in the following report by Mr. Brown:

"On September 21 we made a test at Yonkers of the safety devices for the Glasgow Harbor tunnel. For this purpose we used the testing frame got up for similar tests of safeties for the Weehawken elevators and Catskill Mountain incline. This frame is a heavily timbered gallows frame about 20 feet high, in which is suspended a temporary cage, arranged to be dropped by the pulling of a trigger. This cage was loaded with 30,221 lb. of cast iron, and the cage, with its attachments and safeties, weighed 1,630 lb., making a total of 31,851 lb.

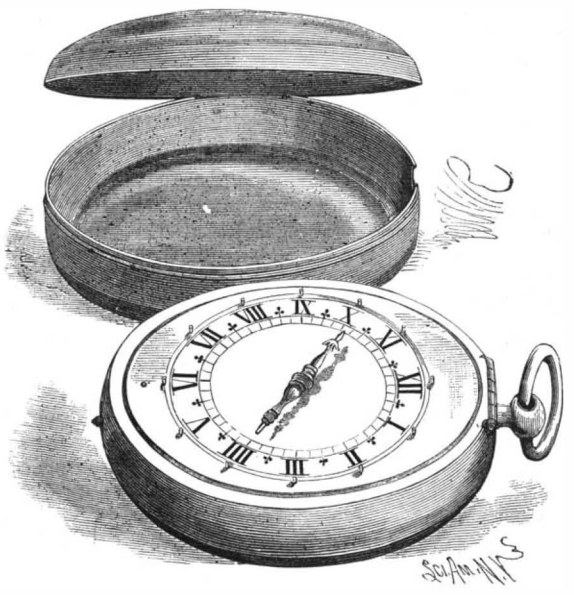
"Two light cords were attached, one to each safety dog, in a manner to represent the action of the governor rope, and so that while possessing strength enough to pull in the dogs, they would immediately afterward break. These cords were left slack enough to allow the cage to drop freely about 13 inches. When tested, the cage dropped a total distance of 2 feet 10 inches, at which point it came to rest. The north side of the cage fell freely 1 foot 1¼ inches, and was stopped in a further distance of 1 foot 8¾ inches; the south side fell freely 1 foot 1¾ inches, and was stopped in the further distance of 1 foot 8¼ inches; or making an average free drop of 1 foot 1½ inches and an average stop of 1 foot 8½ inches; total run, 2 feet 10 inches. From this it is evident that at the moment of the safety going into action the cage was traveling at the rate of about 8·4 feet per second.

"The work done by the falling cage was 31,851 lb. multiplied by 2·833 feet, equal to 90,234 foot pounds, which, divided by the length of stop (1·708 feet), gave a resistance for the pair of safeties of 52,830 pounds, or 26,415 pounds each.

"The safeties brought the load to rest without the slighest shock, the foreman in charge of test being upon the gallows frame when the weight fell, and reporting that he felt no jar or vibration."

The Earthquake of November 27, 1893.

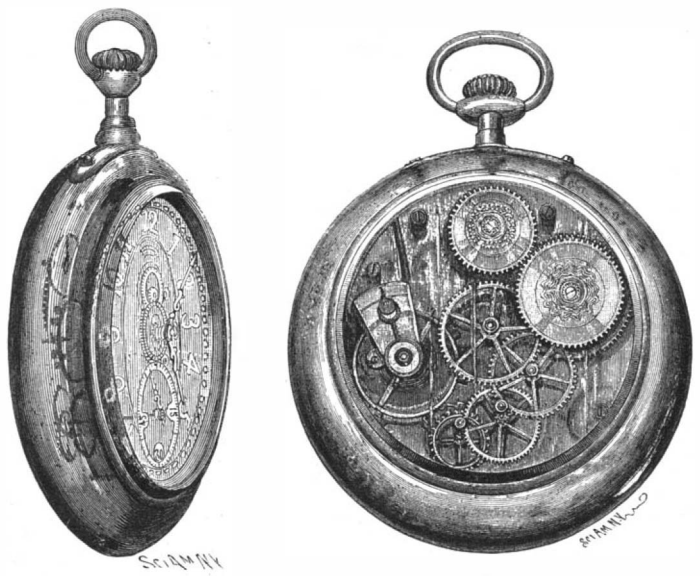
It is unusual for this portion of the country to be disturbed by shocks of earthquake, and we feel that the one of November 27 is worthy of more than passing mention. It was felt throughout northern New England and eastern Canada and was noted as far south as Taunton and Palmer, Massachusetts. The time of



JOHN MILTON'S WATCH.

occurrence varies from 11:42 a. m. at West Milan, N. H., to 12 noon at Taunton, Mass. The center of the disturbance was probably not far from the city of Quebec, as the greatest energy was developed in that vicinity. This would appear to confirm the theory that there is a region extending from fifty to one hundred miles northeast of Quebec in which an almost extinct volcano is slowly expiring, occasionally making known its existence by some such disturbance. Some years ago an earthquake in that region was so closely localized as to leave little doubt that its center was in that vicinity.

In the shock of November 27 last it is very difficult to determine the probable motion of the earth, as many widely different opinions are expressed. The majority, however, report an east to west movement or *vice versa*. Some report that the shock was accompanied by a "loud, rumbling sound," while others state that the tremor was almost imperceptible. At Malone, in northeastern New York, the shock was like "two successive blasts of dynamite," and in other northern points similar effects were produced. In some cases panics were narrowly averted and many persons rushed into the streets, fearing the buildings would be thrown down. The duration of the vibration varied from three seconds to one minute, with an average of about fifteen seconds.—*Bulletin N. E. Weather Service.*



WATCH MADE OF ROCK CRYSTAL.

NATURALISTS asserts that a healthy swallow will devour 6,000 flies every day.

RECENTLY PATENTED INVENTIONS.

Engineering.

LOCOMOTIVE.—William J. Tripp, New York City. This invention provides an improvement on a former patented invention of the same inventor, whereby extra large driving wheels may be employed, and the boiler be located as low down as possible. The driving wheels have their axles extended exteriorly of the boiler, either above, in the front, or in the rear, the wheels having hubs, each journaled in the side frames, and each carrying a crank pin for connection with the engines or the front or rear driving wheels, by means of a pitman or connecting rod.

ROTARY ENGINE.—George I. and Gottlieb Jorda, New York City. A revoluble piston connected with the driving shaft is held to turn in a two-part case, in which are connected chambers registering with parallel chambers in the piston, a steam inlet connecting with one of the outer case chambers and an exhaust port connecting with one of the inner piston chambers. The construction is inexpensive and very simple, the steam acting continuously to turn the piston, and the engine being designed to utilize to its greatest extent the expansive force of the steam.

Railway Appliances.

RAILROAD CROSSING.—Michael J. Keenan, Galveston, Texas. This is a simple and durable crossing, readily set up and connected with the main and crossing track rails. It comprises a center piece and two side pieces, the crossing track rails forming an integral part thereof, and the two side pieces serving to clamp the main track rails on to the center piece.

CAR FENDER.—George E. Cates and Diederrech Reuschenberg, Brooklyn, N. Y. This is a semicircular device pivotally connected to a fixed support beneath the car, springs connecting the fender with the car in advance of its pivotal connection. The device is so connected with the brake lever and the brake-applying mechanism that the fender will be lowered close to the ground whenever the brakes are applied, the fender automatically raising itself when the brakes are taken off.

CAR FENDER.—James W. McKinnon, New York City. This device is adapted for pivotal or hinged connection with the car, spring cushions being interposed between it and the car, while an adjusting device for raising and lowering the fender is adapted to be operated from the car. The lower forward portion of the fender has a brush surface, designed, when the fender is lowered, to sweep away any obstructions from the track.

CAR STAKE.—Peter Anderson, Prentice, Wis. Attached to a platform car, according to this invention, is a stake socket, in which is an adjustable stake provided with rack teeth, a pinion on a shaft having a hand wheel engaging the stake. The arrangement is such that a pair of stakes may be at any time lowered by the operating mechanism to the level of the car, or raised to the desired height and there locked.

Mechanical.

SAW FILING MACHINE.—Ben. Tholen, Texarkana, Ark. This machine is adapted to rapidly and accurately file and sharpen cotton gin or similar saws. A rocking bearing mounted on a suitable support carries a turning and sliding shaft having at its rear end a driving gear, and on its outer end a sharpener, the arrangement being such that the entire cylinder of a gin, having the whole series of saws attached, may be hung in the machine and the saws quickly ground, the grinders being adjusted so as to register with the teeth of the saws before the machine is set in motion, and the saws being then automatically advanced tooth by tooth.

CLOTH NAPPING MACHINE.—Ernst Gessner, Aue, Germany. This invention relates to machines in which teaseling rollers are arranged around and rotated by a drum, the rollers constituting alternating series revolving at different speeds and having teeth working in different directions. The rollers required to be cleaned or stripped by brushes while the drum is rotated, and this invention provides a new device therefor, consisting of two cleaning brushes arranged outside the drum, and having two different motions in opposite directions, arranged so that each brush will strip the alternate series of teaseling rollers.

Agricultural.

CORN HARVESTER.—Linus G. Stewart, Sawyer, Neb. This machine has a vertically reciprocating cutting sickle, at an angle to which is located a feed bar having a rotary reciprocating movement, to alternately approach and recede from the sickle in feeding the corn thereto. As the machine is drawn over a field the ears of corn are cut from the stalks and delivered to a carrying belt, by which they are taken to a conveyor or elevator, to be loaded in a vehicle following the harvester, or distributed in rows upon the ground. It is said that this machine will pick a load of good corn in twenty minutes, and an acre an hour.

POTATO DIGGER.—David J. Roush, Groveton, Pa. This is an improvement in diggers having rotary fingers arranged in series and actuated from the drive wheels to dig and elevate the potatoes, depositing them on a sereen or in a receptacle. The invention provides a special form of finger, which is strong and adapted to dig and elevate the potatoes without injury.

SCRAPER PLOW. — Aaron J. Burr, Griffin, Ga. This plow is formed of a single piece having rearwardly and upwardly inclined wings at opposite sides of a straight middle portion, the outer face of the scraper being beveled from the middle line to the bottom edge. The implement is designed to facilitate the cultivation of cotton, corn, and other grain, the cutting edges of the scraper remaining sharp longer than with the ordinary construction, and the refuse being discharged from the plow better than is now possible.

KNIFE ATTACHMENT FOR PLOWS.—Edward Murphy, Yellow Bud, Ohio. According to this improvement a knife is attached to the plow beam in advance of the shovels, the knife being raised and lowered at will, and adjusted to any position desired. With this object the knife is so placed and shaped that it will cut loose and in pieces pea vines, or other vines that may be twisted around the corn, any vines that may cling to the stalks being severed while the shovels are cultivating the roots.

Miscellaneous.

BLEACHING CANE JUICE.—Leon F. Gaudé, deceased (Emelie Gaudé, Thibodeaux, La., administratrix). This invention covers a simple and inexpensive apparatus for effectively bleaching sugar cane juice. It consists principally of a closed box connected at one end with a juice supply and having at its other end an outlet for the bleached juice, while a perforated pipe passed through the box and immersed in the cane juice is connected with a sulphur vapor supply and a steam pipe. The arrangement for supplying the sulphur vapor is very simple, and all portions of the flowing cane juice are subjected to this vapor, with thorough bleaching effect.

FENCE WIRE REEL.—William J. and John M. Opper, Kenesaw, Neb. Combined with a reel in a suitable frame is a sliding block having a guide eye for the wire, a pivoted lever moving freely with the block, while a link connects a rock shaft with the lever, means being provided for rocking the shaft. The device is adapted for attachment to and to be operated from a moving wagon, to pay out and stretch or take up and smoothly reel wire that has previously been stretched.

COAL CHUTE.—Gustavus L. Stuebner, Long Island City, and Philipp Nies, Brooklyn, N. Y. The construction of this chute is such that the coal may be delivered from it to a given point from any desired elevation without danger of the coal being broken during its passage. As each load of coal is dumped in the chute, one of a series of doors is automatically opened and the coal is discharged, the discharge being effected through the medium of the coal delivered to the chute at the receiving end. The discharge attachment may be readily connected with or disconnected from any one of the doors.

KEYHOLE GUARD.—Oscar J. Davidson, Kingsburg, Cal. This is a simple device to close the keyhole whenever the bolt is shot out, and comprises two plates fitted to slide in the lock and engaging opposite sides of the bolt, so as to be moved thereby, with means for disengaging one or both of the plates from the bolt. The improvement is designed to be especially useful on the doors of bedrooms in hotels, doing away with the brass bar now commonly found on such doors, while it may also be employed on any house doors.

BURGLAR ALARM.—Joseph F. Stirsky, Nelson, Canada. This is a simple, durable, and inexpensive device for ready application to a window or door, where it may be fixed in such position that the opening of the window or door, or the making of an attempt to open either, will cause an alarm to be sounded. The device may, if desired, be set to sound a continuous alarm.

NUT LOCK.—Robert Holmes, Canon City, Col. This device is more especially designed for locking the nuts on the spindles of wagon axles, serving to retain a washer in loose contact with the true end of the spindle box and permitting the free rotation of the wheel hub in the box. The spindle has a threaded end, behind which is the washer, a polygonal nut threaded oppositely to the thread on the spindle having teeth interlocking with teeth on the washer, while a locking nut fits within the polygonal nut and upon the threaded end of the spindle.

GATE.—Richard T. Mulcahy, Rosenberg, Texas. This is an improvement in farm gates centrally supported on a pivot post and adapted to be swung in either direction by levers and pull cords. A latch at each end of the gate engages a keeper on a keeper post, the latches being both disengaged and the gate opened by manipulating a lever, the gate being closed and latched, after a person or team has passed through, by manipulating the lever.

CHART BOARD.—James S. Shepherd, Cambridge, Md. This is a holder or frame for charts usually kept in a roll, whereby they may be spread or opened and kept so displayed as to be always ready for reference. The frame has on each side keepers to embrace and hold the roll, and the ends of the keepers are connected in pairs across the board by guides or wind strips.

GARBAGE AND ASH CAN.—Henry E. Wolcott, Syracuse, N. Y. The can proper, according to this improvement, has a base supporting it out of contact with the floor, and bars arranged horizontally beneath the can body project through the base flange to form journals for a wheel at one side, the can being moved by being tilted and then rolled about on one wheel.

NOTE AND ACCOUNT BOOK, ETC.—Alfred W. P. Livesey, London, England. This improvement consists in a peculiar cutting of the leaves of a book, to facilitate turning over the leaves rapidly and easily. The cut-out portions are of uniform shape and length and commence and terminate in a different position in each, beginning with the first leaf.

PANTALOONS HANGER.—Andres Beracierto, Matanzas, Cuba. This is a device capable of carrying a great number of pantaloons, and consists of a central rod or bar from which project brackets in which are journaled bars or rollers so arranged as to form a polygon when viewed from above. Each of the bars carries a pair of pantaloons, which are hung on the bars at their middle portions, so that the depending parts counterbalance one another. A further patent of the same inventor provides a frame which may be suspended, and in which may be hung several pairs of trousers or pantaloons.

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.

PLUMBING, DRAINAGE, WATER SUPPLY AND HOT WATER FITTING. By John Smeaton. London: E. & F. N. Spon. New York: Spon & Chamberlain. 1893. Pp. 236. Price $3.

The English practice in plumbing is always of interest to Americans, and in this work we have an excellent treatise upon it, which shows that our neighbors are not at all behindhand in their ideas of external and internal plumbing, and it is evident that we, by studying their methods, can obtain useful points. In examining the book it will be found, however, that the writer has not neglected American practice. It is profusely illustrated and should be a welcome contribution to our sanitarians' libraries.

HOW TO FRAME A HOUSE, OR BALLOON AND ROOF FRAMING. By Owen B. Maginnis. New York: Owen B. Maginnis. 1893. Pp. 31. Price $1.

This pamphlet is devoted to the balloon frame, as regards the main structure of a house, while the roof framing forms the other of its topics. It is liberally illustrated, but is destitute of an index.

TABLES FOR THE COMPUTATION OF RAILWAY AND OTHER EARTHWORK. Computed by C. L. Crandall. Second edition. New York: John Wiley & Sons. 1893. Pp. 18. Price $1.25.

This eminently practical work will, we are convinced, be warmly received as tending to save much labor in the calculations of irregular fillings and excavations. It naturally does not lend itself to a review, but noting that this is a second edition with sundry additions, we see that it has already been well received, and the second edition should naturally meet a still better reception.

AN EXAMINATION OF WEISMANNISM. By George John Romanes. Chicago: The Open Court Publishing Company. 1893. Pp. ix, 221. Price $1.

This contribution to the theories of what may be termed the post-Darwinian period of science, involving an examination of heredity, which is perhaps the most effective antagonism that Darwinism has had to encounter in the scientific field, will be welcomed by all biologists. The book is characterized by an excellent glossary, as well as by a sufficient index. It is arranged more or less chronologically, and in one of its titles purports to bring Weismannism up to date, *i. e.*, 1893. As frontispiece a portrait in photogravure is given, whether of Weismann or of Romanes is not elucidated, as far as we have seen in the book.

DAS EISENBAHN-GELEISE. By A. Haarmann. Leipzig: Wilh. Engelmann. Two volumes. Pp. 852, 1837 wood engravings. Paper. Price $13.35.

This publication on "The Railroad Track," by the well known general manager of the George-Mary mine in Osnabruck, Germany, is no doubt the most extensive work that has ever been published on the subject. The first volume treats of the general history of the railroad track. In the first chapter we find a short but exceedingly interesting history of the building of roads from the time of the Assyrian Queen Semiramis to the first wooden railroads for coal mines, built under Queen Elizabeth in the second half of the sixteenth century. The author brings us to the present era, and treats in the first volume of the different forms of rails, the ties, means for fastening the rails in place, the rail joints and the switches. The second volume is devoted to a special history of the track systems and the construction of the railroad beds. Under the track systems we find chapters on single tie systems, wooden longitudinal ties, the stone tie systems, the wooden cross ties, the various iron tie systems, and tie rails. The construction of the railroad bed embraces the gauge, the profile, the bed and the preservation thereof. The text is very well written, and the illustrations are very creditable. Much of our information in the article on railroad construction in all ages, in our issue of December 9, may be found at greater length in this book.

MAXIMS AND INSTRUCTIONS FOR THE BOILER ROOM, USEFUL TO ENGINEERS, FIREMEN AND MECHANICS, RELATING TO STEAM GENERATORS, PUMP APPLIANCES, STEAM HEATING, PRACTICAL PLUMBING, ETC. By N. Hawkins. New York: Theo. Audel & Co. Pp. x, 331. Price $2.50.

This work, containing a great many practical points in connection with the evolution of steam, with numerous illustrations, will be found acceptable to many young engineers. One feature of the book is a chapter of "don'ts" which quite impressively presents maxims for the engineer's and fireman's consideration.

INIGO JONES AND WREN; OR, THE RISE AND DECLINE OF MODERN ARCHITECTURE IN ENGLAND. By W. J. Loftie. New York: Macmillan & Co. 1893. Pp. xiii. 284. Price $4.50.

This really elegant work is devoted to a peculiarly interesting period in the art history of England, the time when a national school of architecture, whether we consider it handsome or ugly, was definitely formed. The impressions of Wren's work upon the world are visible to-day in some of the churches of New York City, and much is there which is criticised by the disciples of Ruskin. Yet these buildings have from their history and associations acquired a certain degree of respect. The present work is most elegantly illustrated and is a veritable *edition de luxe*.

POOR'S DIRECTORY OF RAILWAY OFFICIALS. 1893. Compiled from official information. Poor's Railroad Manual, New York. London: Effingham Wilson. Pp. 511. Price $3.

Poor's Manuals have acquired a national standing. In the present one we find copious indexes, including directories of railroad officials in the United States and Canada. An index to railway and affiliated industries is given, and this matter is indexed in so many different forms as to be easy of reference under very different captions. Thus the officials are arranged by States and cities in one index, and in others they are indexed under the names of railroads or under their titles. Street railways and traction systems, with interesting statistics, are included. The statistic pages of the street and traction railroads at the present day are of the utmost interest, and are so thoroughly subdivided as to make quick reference for specific data very easy.

UNIVERSITY CORRESPONDENCE COLLEGE TUTORIAL SERIES. The Tutorial Physics. Vol. II. A Text Book of Heat, with numerous Diagrams and Examples. By R. Wallace Stewart. London: W. B. Clive, University Correspondence College Press. Pp. vi, 286. No index. Price $1.40.

This book, the second of the Tutorial Physics, very acceptably treats of its titular subject, giving numerous problems and examples of calculations. It bears throughout the aspect of thoroughness, something which the system of examinations in England has done much to impair in English literature. The value of the work would be greatly enhanced by an index.

ELEMENTARY PALEONTOLOGY FOR GEOLOGICAL STUDENTS. By Henry Woods. Cambridge: at the University Press. 1893. Pp. vi, 222. Price $1.60.

This little work may be termed a manual of natural history of invertebrate fossils. It is an admirable supplement to a general geology. It makes no attempt to treat of the identification of strata, but treats the natural history of fossil remains only. A reasonably full bibliography of the science is given. The work may be recommended to geological students.

ROMANCE OF LOW LIFE AMONG PLANTS, FACTS AND PHENOMENA OF CRYPTOGAMIC VEGETATION. By M. C. Cooke. London: Society for Promoting Christian Knowledge. New York: E. & J. B. Young & Co. 1893. Pp. vii, 320. Price $1.60.

Algae, fungi, and lichens, together with ferns and their allies, are the general subjects treated of in this work. It is most interestingly written and furnishes an example of how natural history, while scientifically and correctly treated, can be made to read as interestingly as fiction. The section on fungi especially treating of all the curiosities of mushroom life is most interesting.

THE LOCOMOTIVE. Published by the Hartford Steam Boiler Inspection and Insurance Co. New Series. Vol. XIII. Hartford, Conn. 1892. Pp. iii, 192.

This serial publication of the Hartford Steam Boiler Inspection and Insurance Company has been received by us as usual. We find it in considerable matter of interest. Some very interesting illustrations and notes of practical engineering incidents, with other material form the body of the text.

ELEMENTS OF HANDICRAFT AND DESIGN. By W. A. S. Benson. London and New York: Macmillan & Co. 1893. Pp. xv, 151. Price $1.60.

This exceedingly attractive book is designed for the manual training of children, both boys and girls. As simplifying the methods by which articles can be produced and showing how to do really good work in mechanics it is to be warmly recommended. The very numerous illustrations and the highly characteristic nature of the designs lend great attraction to a work in any sense most meritorious. It should be considered and used both as a school and also a home manual.

LES EAUX-DE-VIE ET LA FABRICATION DU COGNAC. Paris: Librairie J. B. Bailliere et Fils. 1893. Pp. 278. Price 80 cents.

ROUND THE WORKS OF OUR GREAT RAILWAYS. By various authors. London: Edward Arnold. Pp. vii, 232. No index. Price $1.40.

The American engineer interested in English practice can do no better than study such works as the present. Its numerous illustrations and very graphic text tell of present practice in English locomotive works and also treat of old time railways. The work we can warmly recommend to our readers who are interested in the construction of locomotive engines.

THE CHILD PHYSICALLY AND MENTALLY. Advice of a mother according to the teaching and experience of hygienic science. Guide for mothers and educators. By Bertha Meyer. Translated by Friederike Salomon. Revised by A. R. Aldrich. New York: M. L. Holbrook Co. London: L. N. Fowler & Co. All rights reserved. Pp. x, 155. No index. Price 50 cents.

This pamphlet, without index, but with a satisfactory contents, is devoted to the care of infants. It will, we believe, be useful in many homes, in which too much negligence of the proper care of children is found. It was written originally in German and is dedicated to Victoria, Empress of Germany.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY. By A. E. Kennelly. Vol. I. New York: D. Van Nostrand Company. London: E. & F. N. Spon. 1893. Pp. 87. Price $1.50.

Mr. Kennelly in this work presents a collection of a series of articles which have already appeared in the *Electrical Engineer*, of New York. His desire and intention, he states, has been to develop the applied or arithmetical theory of electro-magnetism for the use of students, so that they will find just the necessary amount of mathematics without going into the intricacies of

purely theoretical formulæ. This promise is of course not rigorously carried out, as we find the calculus is used throughout, while the formulæ involve elementary algebraic knowledge on the part of the users. We are very glad indeed to see such a book produced, tending to remove the atmosphere of mystery from calculations.

CONTINUOUS CURRENT DYNAMOS AND MOTORS. Their theory, design, and testing, with sections on indicator diagrams, properties of saturated steam, belting calculations, etc. An elementary treatise for students. By Frank P. Cox, B.S. New York: The W. J. Johnston Company, Ltd. 1893. Pp. 271. Price $2.

The specialization of dynamo work is illustrated in this contribution, where all the calculations are kept down to the practical ones required in constructing the machines. It will be found a most excellent contribution to the subject, and one in line with the work reviewed in the preceding notice.

PRIMER OF PHILOSOPHY. By Dr. Paul Carus. Chicago: The Open Court Publishing Company. 1893. Pp. vi, 232. Price $1.

Philosophy in this book is treated of from the standpoint of experience. Experience by the writer is made the sole base of philosophy. The methods of philosophy are said to be derived from experience and the problems of life are to be solved by the methods of philosophy. This is the abstract of the scheme of the work.

PRACTICAL DYNAMO BUILDING, WITH DETAIL DRAWINGS AND INSTRUCTIONS FOR WINDING. By L. C. Atwood. St. Louis: Nixon-Jones Printing Company. 1893. Pp. vi, 143. No index. Price $3.

The title of this book exactly describes its contents. It consists of a description of a number of dynamos, the details of construction of each one being given without any attempt to theorize. At the end of the book are given appendices of tables, underwriters' rules and regulations for wiring, and a chapter on how the electromagnet is produced, another on the history of electricity and the electric light, and one on the incandescent system, and a final one on the economy. The lack of an index is a bad feature.

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Business and Personal.

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Notes & Queries

HINTS TO CORRESPONDENTS.

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.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(5666) M. T. asks: 1. What is the best way to leave boilers that have been using salt water and now are not to be used for several months? A. If there is any fresh water to be had, the boiler should be thoroughly cleaned out and washed out with fresh water, then filled with fresh water and steam got up, a few pounds pressure, and air blown out at the safety valve; the boiler pumped full of water while steam is on, allowing the safety valve to be blown enough to get rid of all air inside of the boiler; then close all valves and cocks on the boiler to keep out air. The airless water will preserve the inside of the boiler from rust. The flues and shell should be thoroughly cleaned. 2. I have two tandem compound engines, working with 100 pounds steam pressure. I would like to know if it would not be more economical to run the pressure down when I have only half load, *i. e.*, would I not get better work from the low pressure cylinder if the high pressure were to carry the steam longer and exhaust into the receiver as a higher pressure, thereby making the low pressure piston do more work? A. You have only to set the cut-off to suit the work required; or, if the load is variable during the day or night, throttling by the steam valve is preferable. This may vary the relative work of each cylinder; but as the vacuum may be constant under the varying conditions, there can be no material loss of steam, whether less pressure is carried in the boiler or the cut-off carried back; but probably both are advisable in our uncertainty as to the present position of the cut-off. 3. Why is zinc used in boilers using salt water, and what is its action? Is it a benefit or not? Is there any substitute? A. Zinc is used for removing scale by its galvanic action, its proper connection being by copper wires with the stays at the top of the boiler. 4. If I were to run a 100 horse power engine with 100 pounds steam, and only have 25 horse power of work, would not the low pressure piston form a vacuum on the steam side, owing to the other cylinder cutting off so early with the high pressure, thus making the low work against the high pressure cylinder? A. There should be no vacuum in the low pressure cylinder until the cut-off has been reduced to one-tenth and under, and then only a partial vacuum at end of the stroke. There is no harm in this practice for a tandem compounded engine. 5. Please state at what pressures I should carry the steam to get the best results. Both the engines are working with about 26 inch vacuum. A. The most economical pressure for running a tandem compound condensing engine cannot be stated without a knowledge of its proportions; but assume that 60 pounds pressure and a proper change in the cut-off will be your best practice. 6. How much economy is there in a slow speed Corliss engine over the high speed class? A. The economy of slow or high speed is mostly in the wear of the engines and their size. For engines of 100 horse power, 100 revolutions per minute is the best speed.

(5667) J. A. asks: 1. Can I enlarge the small motor described in SUPPLEMENT, No. 641, to one-half horse power? A. You can, but it is better to follow SUPPLEMENT, No. 844. 2. How can I make the one described in No. 600 small enough for one-half horsepower? A. As the size given is a little less than a horse power, it will answer probably as it is. Or you may reduce its dimensions in the ratio of the sixth roots of 1:2. (See answer 5, below.) 3. How many storage cells will it take to run the last named motor as one-half horse power? A. Twenty-five. 4. Can I charge the same with gravity batteries? A. Yes, if you allow enough cells of gravity battery. A series of ten gravity cells will charge four storage cells, but very slowly. The series of gravity cells may be parallelized to increase the rapidity of charging. 5. If not, can you tell me where I can get directions for making one-half horse power motor? A. A very slight reduction in size (about 98:89, or $\frac{9}{10}$ the dimensions of No. 600) will be right. The size of wire and number of turns depends on the voltage to be employed. Calculate as if for a dynamo. Calculations will be found in Sloane's "Arithmetic of Electricity." $1 by mail.

(5668) G. R. C. asks: 1. Does combustion in common air vary in rapidity in proportion to pressure; *i. e.*, for instance, would a fire burn half as fast in a one-half vacuum or four times as fast in compressed air, at a pressure of 60 pounds per square inch, as it would at common pressure of 15 pounds per inch? A. No exact experiments have been made determining any ratio between the rate of combustion and the density of the air fed to any kind of fire. The result will vary with the combustible; but the combustion increases faster than the pressure with many combustibles; that is, within certain limits. 2. Please to inform me at what temperature or pressure hydrogen gas is liquefied. Is oxygen liquefied at same temperature? Also at temperature of 212° F., what pressure is required to liquefy CO_2? A. Hydrogen is known to have been liquefied. Oxygen has been liquefied by several chemists, among them Pictet, Cailletet and Hautefeuille, Wroblewsky, Olszewski, and Dewar. Olszewski determined the boiling point, which is close to that at which it begins to liquefy, 294½° F. below zero. The liquid oxygen has, at this temperature, a maximum density of 1·137. Wroblewsky cooled it to 392° F. below zero, without solidification. At 212° F. carbon dioxide cannot exist in the liquid form. Andrews discovered, some thirty years ago, that what is called the "critical point" of carbon dioxide is as low as 87° F. At this point it begins to gasify gradually, under any pressure, and at a few degrees higher passes wholly into a transition state, independent of pressure. For valuable articles on the liquefaction of gases, we refer you to our SUPPLEMENT, Nos. 489, 896, 878, 932; also SCIENTIFIC AMERICAN, No. 2, vol. 67, and No. 11, vol. 68.

(5669) S. A. D. asks: 1. Should the shutter in a detective camera be in a certain place, or will it give good results in the rear of the lens inside of the box? A. A shutter placed between the lenses is supposed to be in the best position; but practically it makes no difference whether it is placed in front or behind. 2. Is it necessary to have the aperture in the shutter the size of the lens, or would it work the same if it were as large as the largest stop in taking instantaneous exposures? A. It is advisable to have the aperture in shutter fully as large as the lens opening, in order to obtain the advantage of all the illumination.

(5670) C. E. P. says: The inclosed piece of wood I broke from a common split basket that was used for holding clothespins, the same being frequently set in the yard during the summer season on wash day. Will you kindly explain whether it is larvæ or excrement, and from what kind of an insect? Reply by Prof. C. V. Riley.—The flattened, ovoid objects attached to a bit of wood broken from a split basket, the one overlapping the other, are the eggs of one of the common katydids. This is the angular-winged katydid (*Microcentrus retinervis*), which is found throughout the South and West. It feeds upon the foliage of various plants, but is not abundant enough to be specially injurious. These eggs have been variously referred to different insects by older authors, and their true nature is fully set forth in an illustrated article in the "Sixth Report on the Insects of Missouri." The first notes of this katydid are heard about the middle of July, and are made by the male, the wing covers being partially opened by a strong jerk and the noise produced by the gradual closing of the same. The song consists of a series of from 25 to 30 raspings, as of a stiff quill drawn across a coarse file, and strongly recalls the slow turning of a child's rattle, ending by a strong jerk of the same. The female responds by a single sharp chirp or tschik. The young katydid issues from the egg in early summer, but leaves little evidence of hatching, as it issues from the side and the two parts of the shell contract again. There frequently issues instead a characteristic little parasite (*Antigaster mirabilis*, Walsh), which gnaws a smooth round hole, about the size of a large pinhead, through the shell.

(5671) J. L. says: I have two large mirrors which are spotted; *i. e.*, the quicksilver is coming off in spots. Is it caused by roaches or what? Have you a receipt of any kind that I can use on them to advantage? A. Remove the silvering from the glass around the scratch, so that the clear space will be about a quarter of an inch wide. Thoroughly clean the clear space with a clean cloth and alcohol. Near the edge of a broken piece of looking glass mark out a piece of silvering a little larger than the clear space on the mirror to be repaired. Now place a very minute drop of mercury on the center of the patch and allow it to remain for a few minutes, clear away the silvering around the patch, and slide the latter from the glass. Place it over the clear spot on the mirror, and gently press it down with a tuft of cotton. This is a difficult operation, and we would advise a little practice before trying it on a large mirror.

(5672) N. A. C. asks: What is the proper and quickest way to tell whether a glass fruit jar is air tight? A. At the time of putting up fruit in glass jars the jars should be turned neck down while hot, when if not tight air bubbles will be seen rising among the fruit through the sirup as they cool. After fruit has been put away in glass jars any leakage of air will create mould on top or cause the sirup to ferment.

(5673) A. W. S. asks for a good recipe for belt glue; something that does not require more than four hours to dry and will hold after it is dry. What is "Buffalo frozen glue"? A. For a good, quick-setting glue for belts, select the best amber-colored glue that can be found and test its toughness by breaking the pieces, which, if of good quality, will bend and spring back, and finally break with a splintered edge. Make up the glue in the usual way by soaking cold and then heating. For a pint of thick glue prepare an infusion of gall nuts (strong) and add half a gill, hot, to the pint of hot glue just before using. Use quickly, with good wooden clamps to press the belt laps close. The tannic acid properties of the gall nuts make the glue elastic and tough. The "Buffalo frozen glue" is made by freezing the glue gelatine as soon as sliced, causing it to become spongy in drying.

(5674) R. J. L. asks: How can canvas or duck used for wagon covers and for belts be treated so that it will not be eaten or torn by mice or rats, and at the same time leaving the canvas uninjured? A. Soak or wet the canvas and belts with a strong solution of alum in water and dry; or, if the color is no object, wet the goods with a decoction of wormwood or aloes.

(5675) G. W. S. asks: What will remove stains on cotton cloth produced by a toning solution? The solution is that sold by dealers, which had been used until yellow. A. First try boiling the cloth in an ordinary clothes boiler for half an hour, then set out in the sun to dry and bleach. If this does not succeed, moisten the cloth with warm water until it is thoroughly softened; then try rubbing the stain with a dilute solution of nitric acid, one-half an ounce, mixed with twenty ounces of water, rinsing the cloth in warm water after each application.

(5676) G. D. C. writes: I wish to light a small sleeping room a half hour each night in week with an Edison six candle power lamp, incandescent. How may I make primary and storage batteries with quart and pint cells, which I have at hand? What number of each and how arranged for lighting above lamp; also how connected? A. You will need twelve volts and one and a half amperes. A six cell plunge battery, such as described in SUPPLEMENT 792, connected in series will answer. Be careful never to leave the plates immersed except when using. Storage batteries are described in several of our SUPPLEMENTS, but we do not advise you to try to make one yourself.

(5677) S. G. M. writes: I have a one horse power motor of 500 volts running in my shop. The power is furnished me by the street railway company. I would like to burn some incandescent lamps in my place, the electricity for these to be furnished by batteries; storage batteries I suppose to be the most preferable kind. Could I charge those batteries from that motor while it is running and driving my machines? How many batteries would it require for four, eight, or twelve lights to burn at an average one to two hours a day? What voltage would those lights require? How much more power does the motor require in order to charge the batteries and run my machines? Understand, while I have a one horse power motor, I hardly use over one-half horse power when running, or rather don't need more than that. What other batteries can you recommend, outside of the storage system, to burn four or eight incandescent lights? Will they last (the batteries)? Can you advise me how to arrange the batteries for said purpose? A. If your motor uses only 1½ amperes of current, you will have slow work charging a storage battery. For twelve 16 candle power lamps of 24 volts each, allow 13 cells of storage battery. If you run them two hours, the battery at the rate of 1½ amperes will require thirty-two hours to be charged again up to the starting point. If you run them only one hour, half the given number of hours will be spent in the charging. The charging will absorb about 30 volts, representing, at 1½ amperes, one-fifteenth horse power. The batteries will last a long time, with careful usage. We do not advise the use of primary batteries. Arrange batteries in series. Consult our advertising columns for addresses of electric supply firms.

(5678) B. B. W. asks: 1. What is the voltage of a single storage battery cell? A. Two volts on the discharge. Two and a quarter volts are required to charge it. 2. How many cells will it take to run fifteen 16 candle power 110 volt lamps for ten hours? A. Fifty-six. 3. How many amperes of current will that amount of cells require to run said amount of lamps, and how large will they require to be? A. 6·75 amperes, requiring rather more than one foot area of positive plate. 4. Have you a book on storage batteries for good practical use in lighting? A. We can supply Salomon's "Electric Light Installations and Management of Accumulators," price $2; Reynier's "Voltaic Accumulator," price $3 mailed. The first named is exceedingly practical.

(5679) R. M. P. asks: 1. Can you advise me, at earliest convenience, the object of evaporating oil to burn the gas, in lieu of burning from a wick, in the "gas-generating" devices being introduced in stoves, etc.? A. More rapid combustion, with greater freedom from smoke, is obtained. 2. Is anything gained in increasing the temperature of the gas before ignition? A. This is a gain in intensifying the heat, and if waste heat is employed, an absolute gain may be reached. 3. Is anything gained by increasing the temperature of the air (that joins the gas) before it reaches the gas for combustion? A. The same applies, but in a much greater degree. Air, however, is hard to heat, as it is very diathermic. We recommend as authorities on heat the following books, which we can supply by mail at prices given: "Thermo-Dynamics, Heat Motors, and Refrigerating Machines," by De Volson Wood, price $4; "The Principles of Thermo-Dynamics," by Rontgen, price $5; Peabody's "Thermo-Dynamics of the Steam Engine," price $5 mailed.

(5680) E. R. A. asks: 1. What sizes, lengths, and weights of insulated wire (copper and German silver) will be necessary to produce following resistances: 1 ohm, 9 ohms, 40 ohms, and 150 ohms? The wire is for tangent galvanometer described in "Experimental Science." A. Consult a table on resistances of wire. These are given for copper wire, and you may multiply the given resistances by 13·1 to get the resistance of corresponding sizes of German silver wire. Only an approximation can thus be obtained. See Sloane's "Arithmetic of Electricity," page 128, $1 by mail. 2. What weight and length of No. 40 insulated copper wire

to produce 150 ohms resistance will be necessary for reflecting galvanometer described on page 434 of "Experimental Science"? A. This wire is exceedingly fine and needs great care in working. One hundred and forty feet will give approximate resistance desired; 33,333 feet weigh one pound.

(5681) W. B. S.—Answer by Prof. C. V. Riley.—The insects sent are the male and female of the common wheel bug or "devil's coach horse," as the species is called by children in the South, *Prionidus cristatus*, Fab., referred to in most of the older treatises on insects as *Reduvius novenarius*. It is a very common predaceous insect throughout the Southern States, but I have never known it to occur as far north as New York City. Was it collected by Mr. Sargent or was it sent to him by a correspondent? The eggs of this insect are laid upon the bark of trees, the sides of buildings or on fences, and resemble little leather bottles standing on end and side by side in groups of a dozen or more. The young wheel bug, when it first hatches from the egg, is distinguished by a bright crimson abdomen, which it erects in such a way as to give it a threatening appearance. Upon reaching full growth and acquiring wings it becomes a uniformly dark gray color, resembling in general the color of the bark of a tree. It lives upon caterpillars, grasshoppers, and other soft insects, and its strong beak enables it to pierce even a hard-bodied insect. It captures its prey by stealth, as it is a slow and awkward creature.

(5682) W. S. E. asks: 1. Will you kindly inform me how much hydrogen gas will be liberated by the consumption of one pound of zinc in sulphuric acid? A. Two sixty-fifths pound, measuring about 10,000 cubic inches. 2. Would gas so made be as suitable for use in a gas engine as ordinary illuminating gas? A. It would answer, but would be very expensive. 3. What proportions of such gas and air would give the most explosive mixture? A. Two volumes of hydrogen to five of air.

(5683) K. F. asks: Will two ounces of No. 33 cotton-covered wire produce a stronger electromagnet than No. 24 cotton-covered wire, same amount of wire? A. No general answer can be given. It all depends on the conditions. At maximum capacity, with similar cores and potential to suit, the power would be equal.

(5684) N. N. asks (1) how to find about the right time of day by a compass when he knows the longitude. A. For such problems we refer you to Gillespie's "Surveying." 2. Winding an electric motor, say ¼ horse power, to a 110 volt circuit, it would take about 187 watts; the total resistance would be about 64 ohms, if series wound; the field magnet a little less resistance than armature, say field 26 and armature 38 ohms, 26+38=64. If shunt wound, the field magnet would be 14 times more than armature; but as the circuit is divided in two, I don't understand how much resistance field and armature could have to make its total resistance 64 ohms. A. Make your field of resistance sufficient to keep the current within safe limits for the wire used, or make it so as to pass the desired current, giving a resistance in this case of 64 ohms. The winding of the armature is based on the desired speed, not on the resistance. Enough turns must be contained to generate counter electromotive force enough to keep the speed down. In other words, it must be wound so as to generate 110 volts at the maximum speed. Calculate as if for a 110 volt dynamo. 3. One pound of water decomposed into oxygen and hydrogen. What explosive power has it in comparison to common dynamite? A. About 37 atmospheres or 550 pounds per square inch of pressure is given by the exploding gases, about $\frac{1}{1800}$ the power of 75 per cent dynamite. 4. How long a time will it take to decompose one pound of water by a dynamo capable of giving a current of 10 amperes and 6 volts? A. One ampere will decompose 92 micrograms of water per second at 32° Fah. and standard barometer. This is 0·00073 pound avoirdupois. If you use three decomposing cells in series it would give three times this quantity at 10 amperes. 5. About how many vibrations does the armature of an induction coil like the one described in "Experimental Science" make per second? A. 200 to 500 per second. 6. Have you a book about practical geometry, plain and practical for a beginner? A. We recommend and can supply at price given by mail: "First Steps in Geometry," price $1.25; "Plane and Solid Geometry," by Bowser, price $1.75.

(5685) F. F. M., Newton Falls, Ohio, says: 1. Many wells here are dug to the rock and then drilled through the rock, the water rising several feet in the dug portion. What causes the water to become soily before a storm? Soundings show that it is not low water. A. The nature of the soil and methods of finishing the wells should be known to properly assign a reason for the stated action of the wells. It is well known that barometric changes in the pressure of the atmosphere affect some wells. Many blow or draw air and have a disturbance in the water level. As the soil above the rock is subject to water soakage, a change of level in the water by change of air pressure may cause a circulation into and from the soil, carrying the loam into the well. 2. What can be used as sizing or paint for the inside of soft or hard wood pails, so that they will hold gasoline or benzine? A. Coat the pails with glue having 10 per cent of glycerine, all boiled to consistency that will allow it to be elastic when cold. Apply hot with a brush. 3. Does steaming second growth hickory to hasten seasoning injure the wood or make it less valuable for stone cutters' mallets? A. Steaming will not injure the wood, but second growth or young hickory makes poor mallets. Oak is better. 4. Is there any other way to hasten seasoning without detriment to the wood? A. Slow air seasoning in logs with the bark on is best.

(5686) L. C. K. writes: I would like to know the efficiency in foot pounds of the best forms of the steam injector, as ordinarily used in supplying steam boilers with water. That is to say, for a given amount of work performed, will the injector compare favorably or otherwise with a compound or triple expansion steam engine? Or to put it in another form, supposing an injector performs 10 horse power per hour work, what amount of coal per horse power per hour would it require to do the work? A. The efficiency of the injector cannot be stated as a positive amount, from the various conditions of their use. The exhaust injector may be safely quoted on the positive side of 100 per cent, for it not only derives its power entirely from the waste heat of the engine, but also puts the water into the boiler at the usual temperature from other injectors, and when a heater is also used is equal to adding 150 heat units for each pound of water sent to the boiler. The ordinary injector takes from the boiler more heat units than it returns by the amount of radiation and leakage. Its efficiency may be from 90 to 95 per cent. It cannot be compared to a steam engine, even of the best type, which returns no more than from 16 to 18 per cent of the work value of the steam received from the boiler. As a pound of good coal is equivalent to 330 horse power, in heat units, per hour, the 10 horse power injector will represent 1-33 of a pound of coal per hour theoretically or without loss of any kind.

(5687) F. B., Naples, Italy, writes: In all the books treating the dried fruits I read that it is better for a great deal of reasons the fruits be dried with evaporators or other similar means instead to be dried in the sun. Will you kindly let me know through your respectable columns of the SCIENTIFIC AMERICAN your opinion about this question, since I know there are several American firms which have contracts here for dried cherries which must be dried in the sun. A. In all countries having a moist climate or cloudy and rainy weather at the fruit-drying season, a whole crop may be ruined or injured by a few days of bad weather, so that on any extended scale of business the use of evaporators becomes a necessity in the United States and some parts of Europe. In the sunny climate of Italy and the East the dry air and long terms of cloudless skies, as also old custom, has given the sun-dried fruit a reputation, which is no doubt at the bottom of the preference for that method by American fruit houses. We have never seen finer fruit, either in appearance or flavor, than is produced by the artificial driers in the United States.

(5688) M. S. Y. asks: 1. In the small Gramme ring motor described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 783, would not any very soft iron do, instead of Norway iron, for the field magnet? A. Any iron will do. 2. What size wire is to be used on field magnet? A. No. 20. 3. Would solder make a suitable Babbitt metal, and is sheet brass fit for commutator springs? A. Solder would not answer. Use copper for commutator brushes. 4. What horse power does the motor develop? A. It has never been computed. It is a very small fraction. 5. Can the parts be enlarged so that it will run a sewing machine for light work? A. They can, but we do not recommend it. 6. How many cells of plunge battery would be required to run a sewing machine? A. Six or eight cells.

(5689) T. W. S. asks: What size and shape of nozzle will give the greatest power under an 80 foot head, using an 8 inch pipe which is 120 feet long? Would there be any change in nozzle if the head were 100 feet, with pipe 170 feet long? What horse power should we get at 80 feet head? A. The nozzle should be slightly taper, after the form illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 792, 3⅛ inches diameter, which will give you a spouting velocity of over 4,000 feet per minute, and if applied to a 6 foot Pelton wheel should furnish an available 45 horse power. With the longer pipe and higher head a 3 inch nozzle will give best results and about the same power.

(5690) H. T. asks: How high ought a pump lift water at an elevation of 8,000 feet? What is the difference for each 500 feet from sea level up to any height? How many inches of vacuum will an air pump maintain at 8,000 feet, and what is the difference for each 500 feet? A. The loss in pump lift at an elevation of 8,000 feet is 9 2-10 feet with the barometer at mean pressure, or a little over 27 per cent. Assuming the lifting height of ordinary pumps at sea level to be 28 feet, 21⅛ feet would be the lift at 8,000 feet elevation. The variation is not a constant for each 500 feet elevation. It is a decreasing ratio. The loss of lift at 500 feet is 1·017 feet, at 1,000 feet 1·64 feet, at 2,000 feet elevation 2·84 feet.

(5691) G. A. L., Mont., says: I want to pipe a small spring 6,000 feet away, having a fall 40 to 50 feet. What proportions of pipe would give the strongest flow, ending with half inch, and would it produce any power? A. The flow of water for long distances through small pipes is of no practical value for power, as the friction absorbs most of the value of the head. With a division of the distance into three parts, with 1 inch, ¾ inch and ½ inch, will give an open flow of 1½ gallons per minute, from which no power of any value can be obtained with the low head stated.

(5692) L. G. asks: 1. What change is necessary in motor No. 641 to run on a 110 volt circuit? A. Wind field with 4 pounds No. 25 wire. It would be better to use 5 pounds if you can get it on. The winding of the armature depends on the speed you desire. For a high speed use No. 32 wire on the armature, using the full quantity specified in weight. Finer wire will reduce the speed. 2. Can I make the armature of sheet iron washers with paper between each sheet in place of iron wire? A. Yes. 3. How can I make lard oil out of old lard? A. Purify the lard as far as possible, and extract the oil by hydraulic pressure of 1,000 pounds per square inch, the lard being contained in sacks.

(5693) T. S. R. asks if the brush holder (not the brush) of an electric street car motor were to touch the commutator of the armature, would that necessarily "ground" it? A. If the brush holder of the ground brush did this, it would make a ground; if of the trolley brush, it would make a short circuit. It is not easy to see how any such contact could be brought about except by a piece of metal bridging the interval between brush holder arm and commutator.

(5694) W. H. writes: 1. I have made the small hand power dynamo given in SUPPLEMENT, No. 161, and although it seems to give quite a strong current, it will not run a No. 3 Porter motor with 3 pole armature. Can you explain why I run the Porter motor with 6 cells plunge battery and it gives good satisfaction? I have tried the dynamo on a call bell, and it will ring it louder than the 6 cell battery. Can you tell me whether I can wind the motor so that the dynamo will run it, or wind the dynamo differently? A. It is all a matter of resistance and potential being properly related. We presume that the Porter motor is of too high resistance. Slightly finer wire on the dynamo might effect the purpose. But it may be the other way. 2. How many storage cells will it take to run the Porter No. 3 motor, and how long will they run it and give as much power as the 6 cell plunge battery? The plunge battery cells have 4 carbons, such as are used in a compound Fuller battery and compound Fuller zinc. A. A storage cell will give 2 volts potential and 10 to 35 amperes, according to size of current, for 10 hours. Two cells should run the motor for a number of days. Five storage cells would give about the same voltage and five to ten times more current than the plunge battery on low resistance. It depends on the size of the cell used. 3. Can I make a plunge battery with less cells and larger plates that will run the motor as well as the six? A. We have no data as to your motor, and cannot answer the question intelligently. Possibly a large two or three cell plunge battery would run it. 4. How many storage cells would it take to run five or six 16 candle power lights for three or four hours per day, and how much current would it take to charge them? How large a dynamo and how much horse power if the dynamo were running eight or ten hours per day? A. Allow 60 cells and on charging 1-20 horse power dynamo of 135 volts potential.

(5695) A. B. C. writes: I have just received a splendid Charcot compound magnet. What must I do in order to maintain its present strength? I have heard that it is not good to detach the armature suddenly, yet I would like to do that very thing, for I want to test its strength by adding weight to the armature until it is pulled off? A. Detaching the armature suddenly does no harm. It is the replacing it with a click or jar that injures the magnet. Slide it into place most carefully, and when you pull it off, do so sharply and clearly, so as to prevent any click or jar. Always keep its armature in position when it is laid aside and not in use.

(5696) B. T. S. writes: 1. I am thinking of making a pocket storage battery to last five hours without recharging it, and I would like to know if one gravity battery would be sufficient to charge it. If not, how many would be required, and how long would it take to charge the storage battery? I have some salt batteries which I run on my telegraph line and are as powerful as a gravity battery. I would like to know whether or not they would charge as well as gravity, if so, how many cells would be required? A. Three gravity cells in series will charge your storage battery. How long depends on its size; probably the same time will be required to charge as to discharge. The salt batteries will not answer, as they will polarize too quickly. 2. I have a very powerful magneto-machine, and I would like to know if it would run a one candle power incandescent lamp. If a number of these machines were joined in series, do you think it would light a miniature arc light? A. You can try your magneto on a lamp, but we are certain that it will not light unless specially built to give plenty of current. The effect of joining in series depends on the winding of the armature. 3. How much wire and what number should there be on the receiver of a telephone and state how to make one? A. Use No. 36 wire wound to 80 ohms resistance. See our SUPPLEMENT, No. 142, 10 cents by mail.

(5697) Sister C. asks: Why should the ocean be coldest at the bottom? Why should the Red Sea be warmer than Indian Ocean? A. The waters of the oceans are at the greatest density at a temperature of 39° F. The difference in density causes the warm water at the equator to flow toward the poles on the surface of the ocean, while the return current from the polar regions flows toward the equator along the bottom of the ocean by its greater density. By the great heat of the sun the surface water of the equatorial regions becomes warm, and flowing away toward the poles, allows the cold water at the bottom to gradually rise to the surface and become warm, thus keeping up the continued circulation of the waters of the great oceans. The warmth of the water of the Red Sea is due to the influx of a warm surface current from the Indian Ocean through the shallow straight of Babelmandeb and the return of a denser salt current, from excessive evaporation, along the shallow bottom and out into the Indian Ocean, thus making the entire circulation of the Red Sea to be derived from the surface warm water of a tropical ocean, and isolated from the cold polar waters flowing at the bottom of the deep oceans. Its tropical location adds the full force of the solar heat to the warm water circulation, making it the warmest of all the arms of the great oceans.

(5698) W. F. W. writes: I want to light one or two rooms by a dynamo, driven by a water motor. 1. Suppose the dynamo will light six lamps of 10 candle power each and three of them should be turned off without change of current, will the other three be injured? A. Not if the dynamo is self-regulating to a sufficient extent. But a dynamo at fixed speed only works well at its true capacity. 2. Would not lamps of 16 candle power give an 8 or 10 candle power light and last longer with this current? A. Yes; they will last longer, but cost more to run. 3. How many hours ought a low resistance lamp to give a satisfactory light with a suitable current? A. 600 hours upward. 4. Are lamps of any value after having become exhausted? A. The platinum is worth something. 5. What size wire should I use for carrying the current, the farthest lamp being about 50 feet from the dynamo? A. It depends on the amperage of the lamps, which can be deduced from the voltage and candle power. These factors you do not state. 6. If the wire is insulated in the ordinary way, is it necessary to provide any additional insulation where it passes through wood or plaster? A. Not if gutta percha insulation is used. 7. Is there any simple method for determining the number of revolutions per minute of a water motor? I wish to find the velocity of a ½ horse power motor with a water pressure of 80 pounds. A. Attach a pencil near its center of rotation. Move a paper mounted on a board in front of and touching the pencil. Keep the board moving for ten seconds and count the circles. 8. About how many gallons of water would pass through such a motor per hour? A. About 1,500 gallons. 9. In experimenting with blue prints I find that a dilute solution of ammonia will give them a very fine purple tone, but they soon change to blue or grayish blue. Can you give me any method by which I can fix and make permanent any desired ammonia tone? A. You cannot make it permanent.

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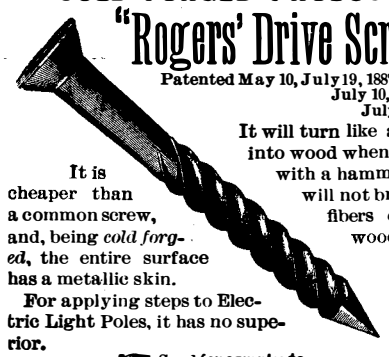

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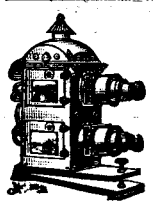

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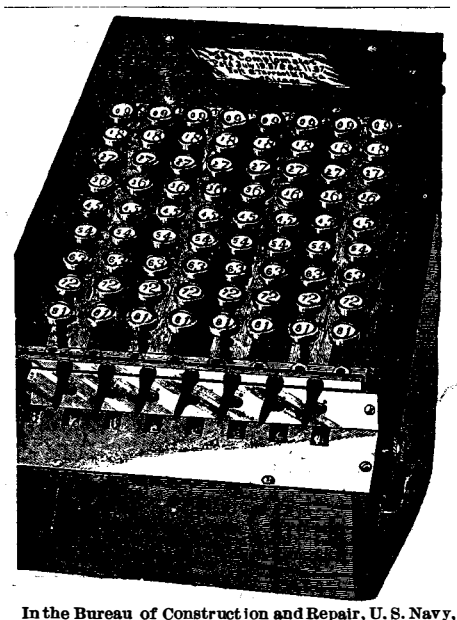

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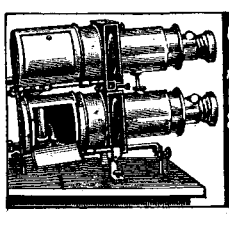

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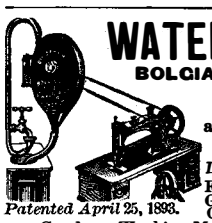

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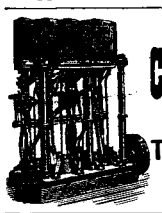

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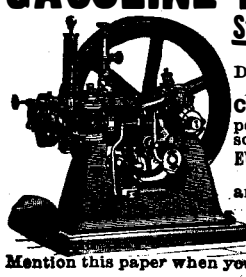

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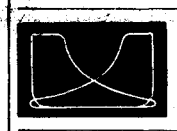

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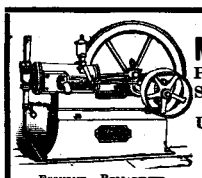

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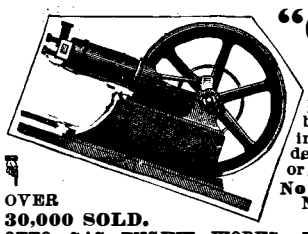

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