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THE THERMOPHOTE, OR SELF-REGISTERING PHOTOMETER.

The apparatus illustrated in the cut accompanying this article has recently been invented by Dr. T. O'Conor Sloane, of this city. It is founded on the theoretical identity of radiant heat and light. By a long series of experiments it was found that the heat radiated by a gas flame varied in proportion to the illuminating power. Thus a differential thermometer properly arranged and adjusted was found to be a reliable instrument for indicating the candle power emitted by a gas flame.

This much being determined, the next step was to arrange for the production of a flame consuming a definite and regulated amount of gas. This was secured by the peculiar form of gas meter and regulator shown in the cut. To the back of a gas meter is attached a cylindrical case communicating with its interior, and containing a float. The case is so connected that the water contained within it stands at the level of the water inside the drum of the meter. As the water within the drum falls, carrying with it the float, a valve is closed cutting off the gas. If the water rises, the valve, by the opposite action, is opened.

To the drum shaft an escapement is geared, working a heavy pendulum. If the drum tends to go faster than permitted by the pendulum, the level of the water inside the drum falls and shuts off gas. If it goes slower, the water rises, and the reverse action raises the float, opens the valve, and admits more gas. Thus by the application of the world's time measurer, the pendulum, the meter is made to run at an invariable rate of speed, and with an almost unvarying water level inside the drum. The gearing thus kept in rotation is made to perform two additional services. It rotates a disk of paper, seen on the top of the meter, once every twenty-four hours. It also by a cam motion raises the hammer, seen extending from the bottom to a point above the meter case, every few minutes, letting it suddenly fall as drawn toward the paper disk by a spring.

The differential thermometer is a two-bulbed curved tube hermetically sealed, and containing a few inches of mercury. It is balanced on knife edges. One of the bulbs is blackened on its posterior surface, and occupies a position about one inch from the chimney of the Argand burner. If the mercury runs out toward the end, as the air in the blackened bulb expands under the influence of heat, the tube balances downward. If the heat is less, and the mercury runs back toward the center, the tube rises upward. The first of these effects corresponds in a general way to richer gas, the second to poorer gas.

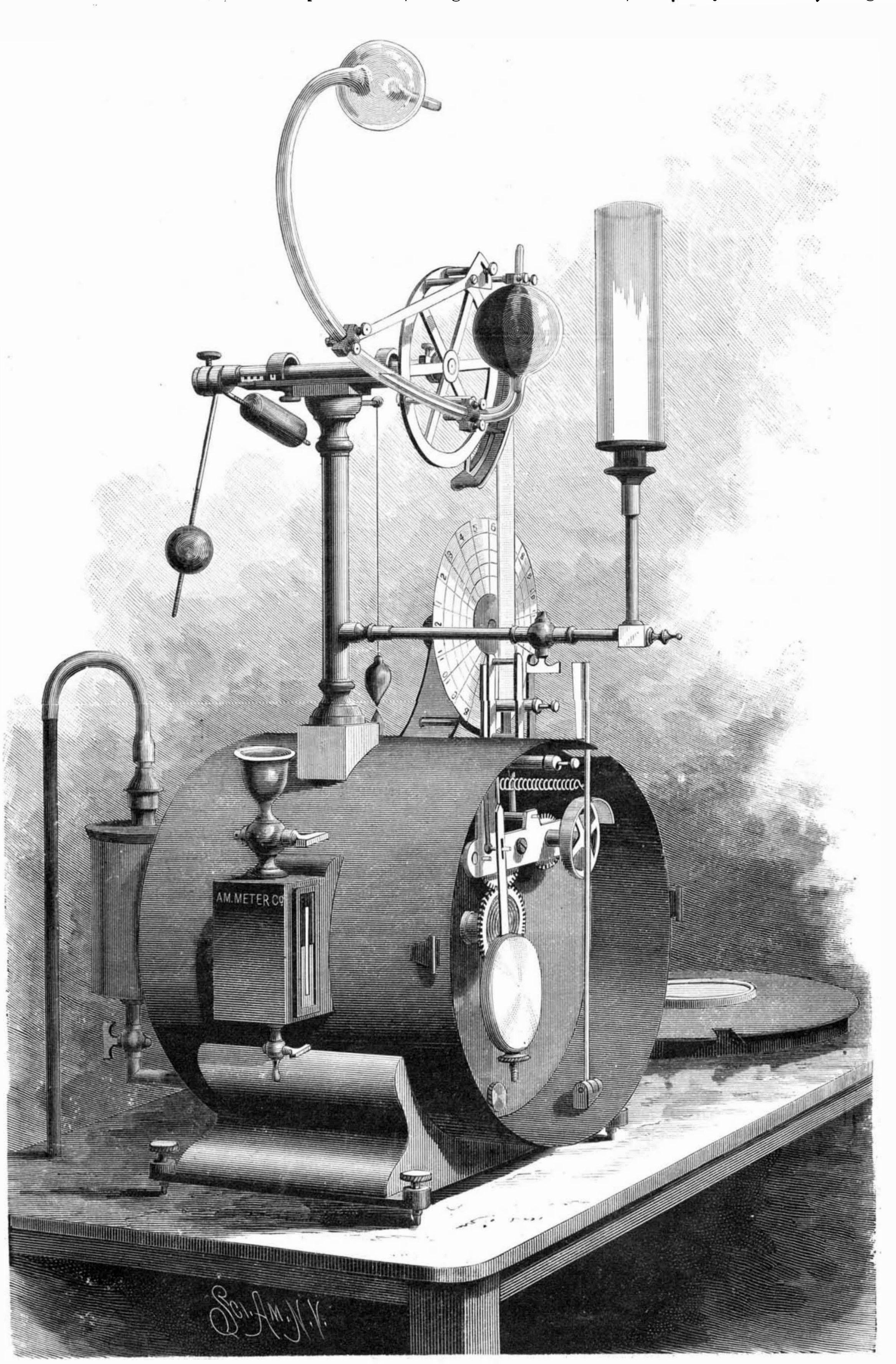
To register these movements the axis of the thermometer bears a quadrant. A ribbon working over this quadrant carries a needle contained in a socket. As the hammer alluded to above falls, it strikes the head of this needle, causing its point to perforate the card. Then the needle is immediately withdrawn by the action of a spring in its socket. As the position of the needle with reference to its distance from the center of the disk is, so is the candle power. Circles are drawn on the card corresponding to different candle powers. As the card rotates once in twenty-four hours, twenty-four radii are drawn, one for each hourly division. Thus the card, when removed at the end of the day, shows this candle power for all times of the day, by the positions of the series of punctures produced by the needle.

In experiments made by the American Meter Co., of this city, the instrument was found wonderfully exact.

The bar photometer, though the standard now, and destined to remain such, is not scientifically accurate. The different colors of the lights, candles, coal gas, and water gas, that are compared, make its readings somewhat uncertain. Manipulation, too, may cause considerable errors. Thus it is on record that Dr. Letheby, in his day one of the highest authorities on gas testing, photometered gas at 17·36 candles which Dr. Hofmann testified was of only 14·63 candle power. The record is contained in evidence given on the Birmingham and District Gas Consumers' Bill before the Lords' Committee, March, 1864, in England. Dr. Letheby, it is said, had been using the same system for ten years.

To-day it is better. Gas on the whole is accurately examined. But in the thermophote is presented an instrument void of personal error. It creates a standard for itself, and in the case of very white gases, such as water gas, it is questionable if its readings are not more reliable than those of the Bunsen photometer. To carry its accuracy a degree farther, an alum or water cell may be placed between the flame and the thermometer bulb. For practical work this was felt to be a needless complication.

The use of such an instrument at the gas works enables the engineer to know whether his men are doing their duty, whether the exhauster is run properly, etc. At the office of the company, within the district, it gives the consumer the best guarantee that his interests are being looked after, and that the gas is photometered not only by day, but by night, during the hours of consumption.



THE THERMOPHOTE, OR SELF-REGISTERING PHOTOMETER.

Boring for Oil in Pennsylvania.

Enthusiastic oil operators are still boring away through granite near Pakesburg, Chester County, in search of oil. It is innocently stated that it will be "some time yet before they reach the depth for oil." According to a contemporary from that region, the borers have evidently taken no account of geological levels, or "horizons," but measure from the surface of the ground, whatever it may be. But, according to geologists, they started their drills below the surface for oil, and are simply going farther and farther away from it with every advance of their drills. They will probably end with a sufficient object lesson in geology to give them a little more faith in a very well established science, and considerably less faith in the "surface indications" so dear to the practical miner—dear alike to his heart and to his pocket.

F. A. Gower lately read a paper before the Royal United Service Institution on a "System of Air Torpedoes." The author proposed to launch against an approaching army aerostats carrying 100 pound shells of gun cotton, which would explode at a given time.

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NEW YORK, SATURDAY, JUNE 27, 1885.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 495,

For the Week Ending June 27, 1885.

Price 10 cents. For sale by all newsdealers.

ARRIVAL OF THE STATUE OF LIBERTY.

The French man-of-war Isere, bringing the famous gift of the French people to America, Bartholdi's Statue of Liberty, came to anchor in the Horseshoe, off Sandy Hook, early on the morning of the 17th. The weather was so foggy that she was not recognized until after crossing the bar, when she displayed her private signal, and the welcome news that the Isere had arrived was immediately telegraphed to the city.

General Stone, under whose direction the pedestal on Bedloe's Island is being constructed, was on his way to the works when the news came. He at once telegraphed an enthusiastic welcome to Captain De Saune, commander of the Isere, and prepared to visit the vessel. He was accompanied by President Sanger, of the Board of Aldermen, and Louis de Bebian, the agent of the French line of steamers. The William Fletcher took the party down the bay, and was soon alongside of the Isere. Headed by General Stone they went on board, and were given a cordial reception by Captain De Saune. The Isere, a bark-rigged vessel of 1,000 tons, had encountered heavy seas and rough weather during the first part of her voyage. Counting the two days spent in coaling at Fayal, in the Azores, she had been 27 days in making the passage. Captain De Saune presented General Stone with the official transfer of the statue from the French Committee to the American. It is handsomely engrossed on parchment, and bears the seal of the French Republic. It is decorated with a picture of the statue and pedestal, and, very appropriately, with the heads of Washington and Lafayette. Later in the day, Captain Selfridge, of the U. S. man-of-war Omaha, delegated a lieutenant to present his compliments to the French commander, and suggest that Gravesend Bay would afford a safer anchorage than the Horseshoe. The Isere accordingly changed her position during the afternoon.

Admiral Lacombe, with the French flagship La Flore, which had been in waiting at Newport, joined the Isere on the following morning. During the succeeding day many informal visits were paid to the French officers of both vessels, Commander Chandler and his staff of the Brooklyn Navy Yard being among the number. The official welcome did not occur until the 19th. The Reception Committee, composed of the Mayor, Aldermen, American Committee, and Committee of the Chamber of Finance, on board the new ferry boat Atlantic, left the pier at nine o'clock, and proceeded down the harbor to Gravesend Bay. They were received on board the Isere by Captain De Saune, to whom they delivered their message of welcome and tendered the hospitality of the city. The Committee then returned to their own steamer, and took their place in the naval procession then forming. This was headed by Commodore Chandler in the flagship Dispatch. He was followed by the Powhatan and the Omaha. The French flagship La Flore came next, thundering a continuous salute in answer to the surrounding forts. Immediately in her rear came the object of all this demonstration, the Isere and her precious burden. The Atlantic and a numerous retinue of gayly decorated craft completed the procession. At Bedloe's Island the French officers and the Pedestal Committee landed and inspected the work, while the "Marseillaise" and "Hail Columbia" were given by the French choral societies.

A reception was then tendered to the French officials at the City Hall, followed by a banquet at the Chamber of the Board of Aldermen. The statue is packed in the hold of the Isere in pieces ranging in weight from 150 pounds to 4 tons, each piece being well protected in a wooden casing. They will be stored in a building erected for the purpose on Bedloe's Island, where they will be quite safe from too inquisitive visitors.

The magnificent day, the enthusiastic crowds, and the fine display of the tricolor and the stars and stripes made a pageant which will long be remembered in both the history of New York and of the United States.

JAPAN AT THE NEW ORLEANS EXPOSITION.

It is rather curious to note that of all the countries represented at the Exposition, our far Eastern friends, China and Japan, have presented the most careful catalogues of their exhibits. China has evidently thought that a cotton centennial meant cotton, and accordingly has sent nothing else; but in its way, it is one of the best things at the Exposition. Japan has read her invitation in a somewhat broader sense, and sends a more general display. The government is naturally the chief exhibitor, and has made a prominent feature of the educational display, which is very interesting, and shows a decided infusion of Western ideas. It sends, in addition, much of interest in the way of agricultural and industrial exhibits. Several private firms are also well represented, principally in the ceramic and art metal works department. The Japanese Commissioners have issued an admirable catalogue, giving a well systematized list of the exhibits, and have also added much interesting information in regard to that but little known empire. It contains many curious facts and much curious English.

It will be a surprise to many who are accustomed to think of Japan as a rather insignificant group of islands dotting the map to the east of the Chinese coast, that she contains, nevertheless, about 37,000,000 people, scattered over the four principal islands—Hondo, Kiushiu, Shikoku, and Yesso—and the hundred and seven smaller ones.

Agriculture, "a root of the country," as they call it, is much esteemed in Japan, and claims the services of two-thirds of her population. But the account of its condition and progress reads rather strangely to an American, accustomed as he is to thousand-acre grain fields and elaborate labor-saving machinery. As the entire empire contains but a little over 11,000,000 acres of arable land, and as it is self-food-producing, it will easily be understood that very careful husbandry is required to support three people from the produce of one acre; it is a problem we should hardly like to undertake in America. In consequence of these conditions, and the very cheap labor, the culture is nearly all by hand, an enlarged system of gardening, in which different crops are sown in alternate rows, so that while one is being harvested, another is maturing. Even wheat is treated in this way, and grows alongside of the upland rice. The culture of tea and silk, requiring such constant care and so many hands, gives employment to large numbers of women and children. With so many mouths to feed, and so little land, comparatively, to feed them from, but a small area can be afforded for live stock. In the entire empire, the horses and cattle together, according to the statement of the Commissioners, number less than 3,000,000, while sheep, which were only introduced ten years ago by the government, still count only a few thousand. Poultry, indeed, may be said to be the only abundant animals, and are found on every farm.

Japan has borrowed much from China, and notably from Corea, sharing with her that excessive love for landscape gardening and horticulture, so that every house, no matter how small, has something of a garden, with its miniature roads, ponds, and fantastic rock work.

Considerable attention has also, of necessity, been devoted to forestry, for, with very few exceptions, the houses are all built of timber, and wood is the general fuel. So long ago as the ninth century forest laws were in existence, and for the last three or four hundred years have been quite strictly enforced in several of the provinces.

The industries represented at the Exposition are chiefly in artistic lines. For many years the peculiar merits of Japanese art have been very generally recognized, and the *chef d'œuvre* of many a choice collection has come from the skilled and painstaking hands of a Japanese workman. We have undergone in this country what we have denominated as the Japanese "craze;" and though so many of our imitators have reproduced only the grotesque in that characteristic art, and have utterly lost its real beauties, the movement, as a whole, has been a benefit, for of all schools there is probably none truer and more realistic than the Japanese. As a nation, these quiet, almond-eyed people are both artists and workmen. They seem endowed by nature with an artistic temperament, and to combine with a strong love for the beautiful the nice eye and cunning hand to give their conceptions just realization. Their artists possess in a marked degree the power of producing the most realistic atmospheric effects, of indicating unmistakably the season of the year, the hour of the day, and the state of the weather—a power at once so rare and so essential to good results, that it is often the main criterion by which we judge our modern landscape painters. It is the common fault of chromos that they have no atmosphere.

The bronze industry in Japan is one of very ancient origin, and one of prominent rank. A huge statue of Buddha, fifty feet in height, was erected in the eighth century, and since then the course of the art has been continuously progressive. The product is usually denominated by its color, or by the maker's name; thus the green bronze is *seido*, and the black *udo*. In combination with the castings, the finest effects are produced by the delicate repousse work on the precious metals or the copper alloys. In the inlaid work, a great variety of material is brought into requisition by the workman: iron, copper, gold, silver, brass, pearl, ivory, all are combined into forms of wonderful beauty. The Japanese cloisonné has long been celebrated, and is still much sought after. It may be described as a mosaic of porcelain enamels on a foundation of copper. Of late years, a cheaper variety has come into vogue, in which the foundation is of pottery, and the cloisonné effect produced by the copper tracery on the surface, separating the different colored enamels, but, while very popular, it does not of course equal the genuine article.

Pottery is another very ancient art, and one in which great proficiency has been obtained. The product best known in this country is probably the "Sometsuki," or porcelain decorated with blue painting underneath the glaze, the color being obtained from a native cobaltiferous ore, or from a purer article imported from China. Several localities possess old established works, most of them directly traceable to Corean workmen, and their wares have a distinctive character. The Kaga ware is deservedly popular, and is characterized by the fine gold ornamentation on red or black ground, where open fields are left, decorated with flowers, birds, and people. The Japanese faience, the Satsuma ware, is another favorably known product.

The paper making industry, introduced from Corea in the sixth century, has sent its product in the shape of screens, panels, fans, parasols, and the like over the entire civilized world. It is characterized by its vivid coloring.

But of all these decorative industries, the Japanese lacquer ware is the most celebrated and the most distinctively national, if any distinction can be made where all products are so markedly characteristic. Its quality and beauty are recognized the world over. The lacquer is made from the sap of the *Rhus vernicifera*, a tree cultivated particularly for this product. The lacquer urushi, obtained from incisions made in the tree, is a dirty gray viscous liquid, which is refined by straining and decantation. It is a peculiarity of the process that it is absolutely necessary for the lacquered articles to be dried in a damp atmosphere, or they will not possess the requisite hardness. The Board of Industry have made a large exhibit in this department, in view of its distinctively national character.

The industries of Japan possess a particular interest to foreigners, on account of the unique materials employed and the dignity which old age bestows. At a time when England as a nation did not exist, when the progressive peoples of modern Europe were to the polite world as barbarians and strangers, these ancient people were patiently at work, by slow degrees perfecting the details of their art, until now they produce wares without a rival in the markets of the world, and to a large extent not capable of imitation elsewhere. The origin of most of these industries, as has been seen, can be traced back to China or to Corea, but they have been so modified in the hands of the Japanese artisan that they now possess an eminently national character. Like the agriculture, the work is most entirely by hand. There are but few workshops of any size, most of the manufacturing being done on small scale or even in the homes of the workmen. In a number of the industries, however, the division of labor has been carried out to a large extent. A peculiar feature of the social organization of Japanese manufactures is the descent of a trade from father to son. In the crystal factories this is particularly the case, and men there are doing exactly what their grandfathers did, only doing it a little better. And it is quite possible that their peculiar skill is due in a large measure to heredity, each generation making some little progress, and transmitting its accumulated acquisitions to the next.

A New Application of Electricity.

A new and interesting application of electricity, in a somewhat unexpected direction, has formed the subject of some recent investigations by Mr. Alfred O. Walker, of Chester, Eng.

Our readers may have noticed, the autumn of last year, says *Engineering*, reports of a lecture read by Professor Lodge, of Liverpool, on the subject of "Dust." Papers were first read by Professor Lodge* in this country, and the subject was afterward more extensively dealt with in a lecture which he delivered at Montreal, during the meeting of the British Association.

In the course of these lectures the Professor brought before his hearers the curious observations which he had made as to the effect of a discharge of high-tension electricity from a point, or points, into glass jars or other vessels containing dust of any kind in suspension. He also made interesting and striking experiments illustrating his remarks. Thus if a bell-jar be filled with a dense smoke of magnesia, by burning some magnesium wire inside it, a very long time elapses before the magnesia settles out and leaves the glass clear of smoke. But if a metallic point be introduced into the jar, connected by a wire to one of the poles of a good frictional, or induction, electric machine, it is only necessary to set the machine to work, and almost instantly an extraordinary effect is observed inside the bell-jar. The magnesia smoke commences to whirl about, and then forms itself into large flakes and strings, which rapidly settle on the bottom and sides, leaving the jar perfectly clear of smoke. What would have taken several hours to settle in the ordinary course, is completely cleared and deposited in a few seconds. The same effect is produced if the jar is filled with any kind of smoke, that from thick paper, or from a cigar, being acted upon exactly in the same manner as the magnesia. Professor Lodge told his audience that he and his assistant had made experiments on a very much larger scale than those in the glass jars. Rooms had been filled with dense smoke and rapidly cleared in the above manner.

A report of one of these lectures appeared in our contemporary *Nature*, and was read by Mr. A. O. Walker. This gentleman is one of the partners in the well known firm of Walker, Parker & Co., lead smelters and manufacturers, and it at once struck him that in these observations and experiments of Professor Lodge might be contained the means of solving one of the principal problems with which a lead smelter has to deal, viz., the condensation of the "fume," or volatilized lead, from the furnaces. Various forms of apparatus have been from time to time proposed as "fume condensers," but with little or no success, the best results being so far obtained by passing the fumes from the furnaces through long flues and chambers. At the large works belonging to Walker, Parker & Co., at Bagillt, in North Wales, the flues and chambers have a total length of over two miles, and still the condensation and deposition of the lead fume is far from complete.

Mr. Walker at once communicated with Professor Lodge on the subject, and the matter being considered very promising, it was decided at once to try experiments on a practical scale. These were carried out by Mr. Walker at the works at Bagillt, with the assistance of the manager, Mr. W. M. Hutchings. Professor Lodge himself gave scientific advice and assistance on special points. The results of the experiments, which were carried on during many weeks, were extremely satisfactory, and fully bore out Mr. Walker's hopes and expectations.

By means of large casks a wooden flue was constructed at right angles to one of the main flues of the works, and with a damper on the main flue it was possible to make any required amount of the fumes from a group of furnaces pass into and through the wooden experimental flue. This latter was provided with glass windows placed opposite one another for the purpose of observation. It also had dampers by means of which it could be filled with the furnace fumes and then closed at both ends, so that it formed a chamber representing the Professor's bell-jars on a very large scale.

The electric machine employed was on the Voss system, the glass disk being 18 inches in diameter. It was worked in a small shed erected close to the experimental flue. One pole of the machine being connected with the ground, the other was connected to an arrangement of metallic points placed inside the flue, and exactly between two of the windows above mentioned. A well insulated copper wire led from the pole to the top of a stout brass rod, which was fixed in the top of the flue, projecting some distance above it, and reaching so far into it as was necessary to sustain the discharge points in the desired position. This brass rod was fixed inside a glass tube of considerably larger diameter, in order to insulate it where it passed through the top of the flue. During the experiments several different arrangements of discharge points were used, as, for instance, a brass ball having spikes projecting from it all round, a ring with spikes fixed upon it pointing in all directions, a cross studded with spikes in a similar manner, etc.

The electric machine, being kept dry and warm in the shed, worked in a very satisfactory manner during all weathers, giving sparks some 4 in. in length.

The first experiments tried were upon the lead fume in a state of quiet; that is, the flue was filled with fume by allowing a strong current of it to pass through from the main flue, and then simultaneously closing the inlet and outlet dampers. The fume thus inclosed in the chamber, when viewed through the windows, appeared as a very dense fog or mist. Left to itself, it took many hours to deposit. But as soon as the electric machine was set to work, the same action took place as with the magnesia in the bell-jar. Through the windows could be observed the same whirling movement around the discharge points, and in a few seconds the fog was seen changing into little flakes, like snow flakes, which rapidly flew to the sides of the chamber, and were there deposited, till in an incredibly short time the "fume" had entirely disappeared from the atmosphere of the chamber, which was as clear as before the fume was let into it.

Further experiments were then tried as to the action of the electric discharge upon the fume in rapid motion as it is in the flues of the works. The damper in the main flue being closed, the whole of the pressure of the furnace gases was turned through the experimental flue and allowed to stream out into the air. Then the electric machine was worked as before. No effect could be seen through the windows, because the rapid current swept the fume onward too fast to allow of any change being observed at that point. But at the outlet into the atmosphere, a few seconds after the discharge of electricity commenced, the effect was again very striking, the issuing fume again changing from fog into flakes. A glass plate held in the current before the discharge from the machine began was only coated, after considerable time, with a thin film. A similar plate held in the current during the working of the machine was instantly coated over with flakes and large separate specks of fume. So much was the fume agglomerated by its passage past the discharging points, that on some occasions in perfectly calm weather some of it would fall to the ground immediately on leaving the exit opening of the flue. In short, the series of experiments proved that what took place under the bell-jar took place equally in the flue of a smelting works, with all the attendant circumstances of heat, moisture, and acid vapors.

The trials of various arrangements of discharge points seemed to show that, within certain limits prescribed by the power of the machine in use, the more points employed the better was the result, the points being spread as uniformly as possible over the cross section of the flue through which the fumes are passing. On the strength of the satisfactory results above stated, Mr. Walker decided upon taking measures to apply this new process of fume condensation on a full working scale at the Bagillt Works. The necessary plant is now in course of erection, and nearly completed. The electric machines used will be on the Wimshurst system, with disks of 5 feet diameter. Two such machines have been constructed especially for the purpose by Mr. F. J. Cribb, engineer, of Chester. They will be driven by a small steam engine, the whole plant being placed in a small building close to the main flue of the works, through which pass all the gases and "fume" from nineteen furnaces.

Mr. Walker proposes to extend the process in England and most European countries and in the United States. It is intended to apply it to other branches of metallurgy besides lead smelting, as, for instance, the condensation of zinc oxide in the manufacture of zinc white, and the condensation of arsenic. But its principal field of usefulness will doubtless be in lead works, where so far all the proposed systems of condensers have either failed outright or proved so costly to erect and to work that the very imperfect results obtained did not render it worth while to continue their use.

The outlay for the requisite machines, etc., will be a very moderate sum, and the cost of running the apparatus, even for large works, will be limited to the wages of one man per twelve hours, and fuel for a boiler to develop the insignificant power required to drive the Wimshurst machines. There will be little chance of anything getting out of order, and in case a temporary breakdown of any kind takes place, the work of the furnaces will be in no way interfered with. This is perhaps the greatest recommendation of this process in the eyes of managers of works. Any one who has a run a works, the draught in which depended on mechanical arrangements, as is the case where fume is to be condensed by sucking or forcing through water, knows what a constant succession of breakdowns and stoppages has to be encountered. Mr. Walker's process causes, of course, no interruption of the proper draught in the flues under any circumstances. Fume which is now carried forward through the longest flues, and escapes from the chimney, will be rendered so much denser by the action of the electric discharge that it will not be carried anything like so far by the draught, and will rapidly deposit itself. Thus works which have now considerable flues may look forward to obtaining a greatly increased yield of condensed fume, while others which have not as yet considered it worth while to erect flues for the partial condensation to be obtained by their use will probably find it advantageous to do so, when by so simple a process as the one in question they can obtain from a moderate length of flue a greater yield than could otherwise be looked for from a very great length.

New German War Ship.

An addition to the German navy was made on the 18th ult. by the launch, at Dantsic, of the fast cruiser corvette Arcona, which took place in the presence of General Von Caprivi—chief of the German Admiralty—Admiral Jachmann naming the vessel. The Arcona is a sister ship to the Alexandrine, launched in February last at Kiel, and is of the following dimensions: Length between perpendiculars, 72 meters (237 feet); breadth of beam, 13 meters (42 feet); displacement, 2,370 tons. She is built of iron and steel throughout, and has a double planking of teak, sheathed with copper. Her draught of water when completely fitted up and fully armed will be 4·60 meters (somewhat over 15 feet) forward and 5 meters (16 feet 6 inches) aft. The vessel is divided into 8 watertight compartments by cross bulkheads, the two largest ones containing engines and boilers. She will have two compound engines, working independently of each other, placed side by side in the direction of the keel, and developing together 2,400 horse power. Steam will be supplied by 8 cylindrical boilers, 4 to each engine, placed in two separate boiler rooms. The estimated speed of the Arcona is between 14 and 15 knots (16 to 17 miles) an hour. She will be armed with twelve 15 centimeter (5·85 inch) and two 8·7 centimeter (3·39 inch) guns, one light gun, and four Hotchkiss guns. She will also be fitted with a launching apparatus for Whitehead torpedoes.

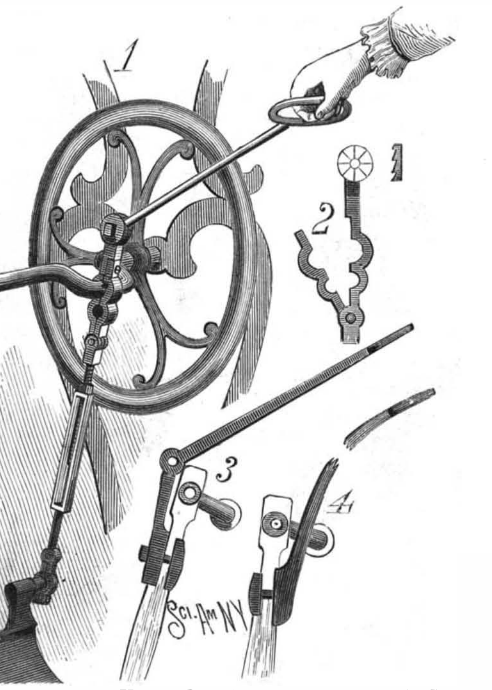
The Electric Light in Venice.

One of the most recent innovations of modern science is the introduction of the electric light into the old, primitive city of Venice. It was considered a sacrilege when boats propelled by steam were a few years ago introduced upon the canals of that quaint city, but the people became accustomed to them, and they will soon get used to the electric light, which will add brilliancy to the city, if not picturesqueness to a gliding gondola.

* See SCIENTIFIC AMERICAN SUPPLEMENT, No. 443.

PITMAN ATTACHMENT FOR SEWING MACHINES.

The pitman attachment herewith shown is so constructed that the machine can be operated by the feet or by hand as may be desired. The pitman shown in Fig. 1 is formed of an upper and lower section united by a turnbuckle; pivoted to the lower part of the lower section is a clamp, and at some distance from the top of the upper section is a second clamp. These clamping pieces, Fig. 2, have semicircular grooves in their inner sides, and with corresponding grooves in the sections form apertures for receiving the pivot on the treadle and the crank of the shaft carrying the hand wheel; the top clamp has two recesses of different sizes to adapt it to shafts of different diameters. On the end of the upper section is a disk, Fig. 2, against the inner toothed face of which is pressed a similarly formed disk on the end of a bar having a handle on its outer



PITMAN ATTACHMENT FOR SEWING MACHINES.

end; a bolt holds the disks together. The handle bar can thus be held and locked at any desired inclination. By means of the turnbuckle the length of the pitman can be increased or diminished as required. The crank shaft can be revolved either by working the treadle with the feet or by means of the rod. In case the machine is not provided with this pitman, a bar is clamped on the usual pitman near its top, Fig. 3, the handle bar being pivoted to this bar; the joint is made with toothed disks for holding the handle at any desired angle. If necessary, the curved handle bar shown in Fig. 4 may be clamped directly on the pitman.

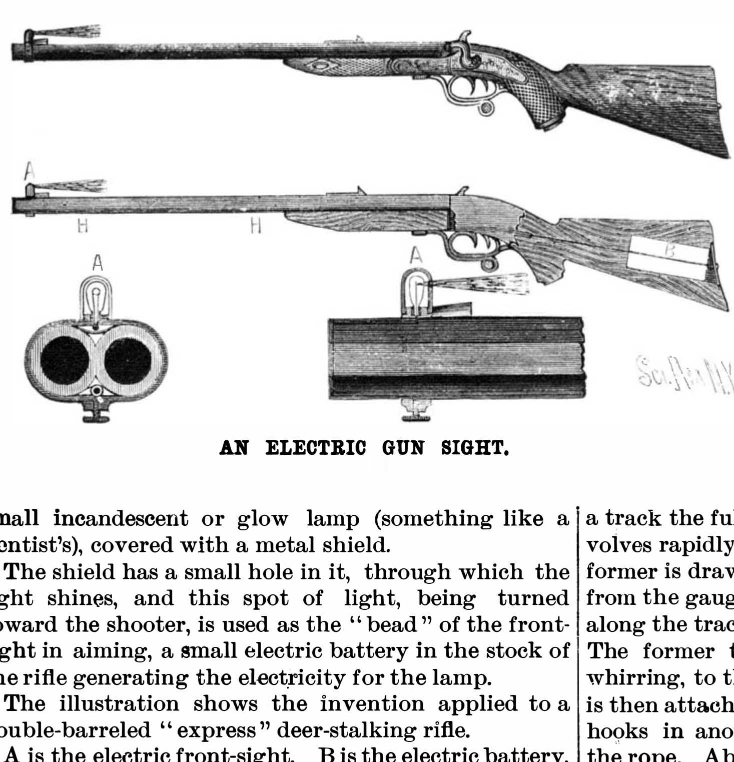
This invention has been patented by Mr. P. S. Roy, of 26 North 15th Street, Denver, Colorado.

AN ELECTRIC "FRONT-SIGHT" FOR FIREARMS.

In shooting deer or other game for which the rifle is employed, there is often a difficulty in getting an aim in the early morning or evening (which is the best time for getting a shot) on account of there not being light enough to enable the front-sight of the rifle to be seen.

This invention is designed to overcome this difficulty by means of a temporary front-sight, to be fixed to the rifle when the light is not good enough to see the ordinary fixed front-sight properly.

This temporary front-sight consists, briefly, of a very small incandescent or glow lamp (something like a dentist's), covered with a metal shield.



AN ELECTRIC GUN SIGHT.

The shield has a small hole in it, through which the light shines, and this spot of light, being turned toward the shooter, is used as the "bead" of the front-sight in aiming, a small electric battery in the stock of the rifle generating the electricity for the lamp.

The illustration shows the invention applied to a double-barreled "express" deer-stalking rifle.

A is the electric front-sight. B is the electric battery, inclosed in the stock of the rifle, a "push button," C, in the butt of the rifle causing the front-sight to glow when the butt is pressed against the shoulder in taking aim.

The conducting wires between the battery and the lamp are laid in a groove in the stock, and where they emerge are protected by a metal tube, H H.

A silver battery, of not more than 5½ cubic inches capacity, is enough, as the lamp need only glow, like the wick of a candle freshly blown out.

The invention would be of great use also for military rifles, and especially for machine guns on board ship, where no electric battery on the gun would be required, as the electricity for lighting the ship could be laid on to the guns by wires.

It has been patented in the United States and in England by Mr. Walter Winans, 2 Clarendon Terrace, Brighton, Sussex, England.

Rope Making.

The word rope probably signifies an article exceeding an inch in circumference, smaller descriptions consisting of cords, lines, twines, threads, etc., made of yarns, which are the first product of the spinning. A given number of yarns, more or less according to the kind of article required, are twisted together to form a strand, and three of these make a rope, while a similar union of three ropes makes a cable.

Rope making is not what it used to be. Nowadays a girl at a spinning machine can do more work than eight men could do in the old fashioned way, and where one man could comb one bale of hemp, one machine can now comb seventy-five bales. The product of the largest ropewalk in the United States, according to the N. Y. *Sun*, is 150 tons of rope and twine a week, as compared with 16 tons when it was built, 56 years ago.

For best qualities of ropes, hemps and flaxes and sound cotton are used. Of the 12 kinds of hemp used Russian is the best. The hanks are bound into bales that can be readily handled. Separating the hanks is the first process in rope making. Men do it. The hanks are unbound and tossed one side, where men stand ready to pick them up and oil them. The oiling machines are large revolving drums of wood that absorb and hold the oil kept in the troughs below. They are inclosed in wooden boxes, each with a hole about as large as half an ordinary window. Taking a hank, an oiler spreads it out and dashes it through a hole and against the oily surface of the drum. It clings and is drawn upward, but before the end is reached the man draws it back, and repeats the motion until the fiber has been oiled. From the oiling machines the hemp goes to the combing machines, of different sizes and capacities. Five combings are necessary. The combing machines are very ingenious. Endless bands with cross rows of long fine teeth seize the fibers, and carry them along until other teeth on a band moving faster comb through them, and straighten and draw them. After the combing the fibers become roping, and endless yellow streams of it flow from upper stories to stories below for the spinning machines. Each stream flows faster than several machines can spin it when everything is in good working order, and piles of roping stand ready for use. Roping after going through the spinning machines becomes spun yarn. The combing, straightening, and spinning used to be done by hand.

Spun yarn for tarred rope goes through a process as old as the hills. Through long troughs nearly filled with hot tar the yarn is drawn until it is thoroughly saturated. On coming out it passes through squeezers, and any excess of tar is pressed out. Then it passes through the air for a considerable distance to dry, and finally is wound on bobbins. The machinery for making large ropes, or cables, shows that very little change has been made in the half century. It is crude but substantial. The bobbins of spun yarn are placed upright on iron pins on a series of shelves. The ends of the threads are drawn together and put through the holes of a gauge plate, from which they go to an iron tube in the tube board, the size of the hole being gauged by the size of the rope to be made. Ninety-eight threads make a six inch cable.

The friction of the threads going through the tube makes the iron so hot that the hand cannot be kept on it. After being drawn through the tube, the end of what is now a strand is attached to a hook in the former, an upright machine on wheels that runs on a track the full length of the ropewalk. The hook revolves rapidly, and makes the twist in the strand. The former is drawn along by ropes, and as it moves away from the gauge plate, arms are swung out from pillars along the track to hold up the strand from the floor. The former travels slowly, but with a good deal of whirring, to the upper end of the track. The strand is then attached, with as many others as necessary, to hooks in another former on another track, forming the rope. About 100 sizes of rope are made, running from one-sixteenth of an inch to 24 inches in diameter.

SCHOOL DESK AND SEAT.

The desk is supported by two slightly inclined corner legs secured to the floor by angle irons. The upper end of an inclined brace bar is attached near the middle of each leg, the lower end being fastened to the

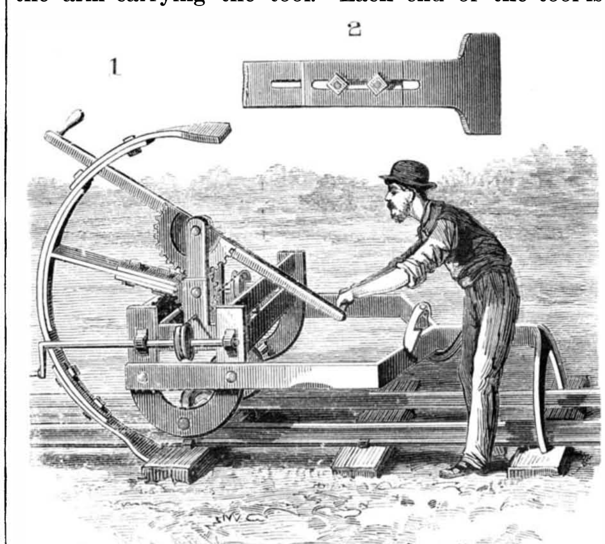
HAMEL'S SCHOOL DESK AND SEAT.

floor. To the upper end of the brace, which bends and projects rectangularly from the edge of the leg, is pivoted the bracket supporting the seat. Each bracket is provided at its inner end with an inwardly and downwardly inclined lug, the end of which rests against the corresponding leg when the seat is lowered, thus preventing the free edge of the seat from swinging down too far. The back of the seat is secured to the legs.

This combined desk and seat is simple in construction, strong, and durable. This invention has been patented by Mr. Gustavus Hamel, of De Soto, Missouri.

RAILWAY TAMPING MACHINE.

The machine herewith illustrated is used for tamping or packing the earth under the ties of a railroad. The main frame of the apparatus rests on an axle fitted with two wheels to run upon the rails; by means of set screws the wheels may be adjusted to different widths apart to suit different railroad gauges. The frame carrying the tamping tool moves between parallel slotted cross plates uniting the sides of the main frame. On the tool frame is a shaft, parallel with the main axle, carrying the tamper proper, which may be set in or out from the shaft to give the proper stroke. The shape of the tamper is that of a half or part circle, thereby leaving two exposed ends on opposite sides of the arm carrying the tool. Each end of the tool is



BRYANT & GILLILAND'S RAILWAY TAMPING MACHINE.

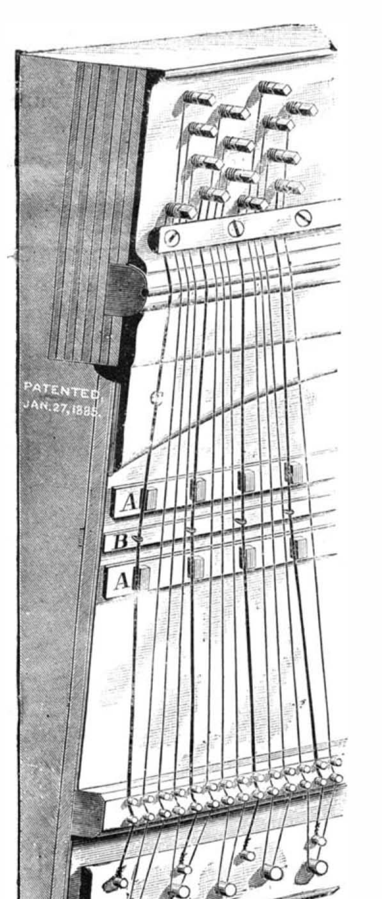
fitted with a tamping hoe-like blade, Fig. 2, adjustable along the body of the tool to adapt the tamper to its work, and to provide for the easy removal of the blades. The tamper is rocked to and fro to pack the earth alternately from opposite sides under the tie by means of a double cross handle attached to a gear having its bearing on an upright of the sliding frame and engaging with a gear on the shaft. The tool frame is moved back and forth transversely by means of a chain attached to the frame, and passing around a pulley mounted on a shaft at each side of the machine, one of these shafts being provided with a crank. When at work, the forward part of the apparatus is supported and anchored by a forked rest pivoted to the end of the frame. This rest is formed with a back arm terminating in a hook which, when the rest is thrown forward, engages with a pivoted slide catch. When it is necessary to move the machine along the track to any distance, the rest is thrown up so as to be out of the way, and to expose a hook for attachment to a hand car. With this tamper a very large amount of work may be done with but a comparatively small expenditure of labor.

This invention has been patented by Messrs. R. P. Bryant and J. H. Gilliland; information can be obtained from Messrs. Linder & Montgomery, sole agents, Jacksonville, Ala.

IMPROVEMENTS IN UPRIGHT GRAND PIANOS.

Very many people who would like to have grand pianos are deterred therefrom on account of the large space the instrument takes up in an ordinary parlor; and the ungainly triangular shape in which most of them are made renders it extremely difficult to place them to advantage in any ordinary apartment as usually arranged. An upright piano, which hardly takes up more room than a bookcase, does away with this difficulty, but in such instruments it has been almost impossible, until a comparatively recent period, to obtain the purity and permanence of tone and the volume expected from a grand piano. Manufacturers of pianos have for years devoted much attention to this branch of their business, and we herewith illustrate some recently patented improvements, especially designed for this class of instruments, which have been introduced by Messrs. Behr Bros. & Co., of New York city. The firm make a specialty of upright pianos, but its members have not been content with the instrument as it was originally made, and the history of their manufacture has been marked by the introduction of numerous new features and a steady progress in improvement.

One of the most important of the recent inventions incorporated in these pianos is that of the harmonic string scale, which originated with Mr. Paul Gmehlin, a member of the firm, and which is shown in one of our illustrations. The invention consists of an extra string (C) next to the three strings of the tri-cord, but on a lower plane, and consequently not struck by the hammer. This extra string vibrates in common with three strings of the octave above it, the prime vibrating with its octave and super-octave producing the correct overtone vibrations. The volume of tone thus produced is remarkable, the reverberations of the notes giving the piano a most singular singing capacity. The extra string passes through an agraffe attached to a bridge (B) fastened upon the sounding board, dividing the string into two equal parts. The bearing of the extra strings being in the opposite direction of those of the scale proper gives the sounding board additional firmness. A buff damper (A), operated by a separate pedal, stops the vibrations of all the strings except those that are struck by the hammers, consequently avoiding confusion of tones. The resources of the piano are greatly increased by this ingenious invention of Mr. Gmehlin. Neither are the tuner's labors enhanced, as the additional string can be easily drawn up, being so placed as to be readily reached.



HARMONIC STRING SCALE.

In connection with this point it is important also to notice the patent string bridge and pin block, likewise invented by Mr. Gmehlin, and which has much to do in contributing to a sustained singing quality of the instrument, at once removed from a dull wooden tone or a sharp metallic ring. To this end the bridge over which the treble strings pass is made of end wood maple, instead of wood used in the ordinary way by other makers.

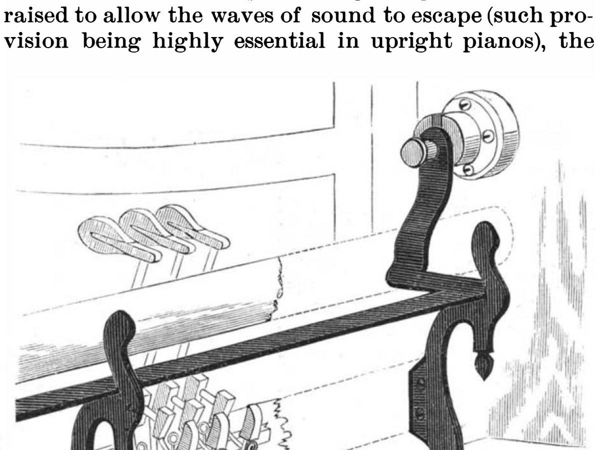
The pin block is peculiarly constructed, being made out of eight thicknesses of maple veneer, vertically crossing and recrossing each other, which firmly hold the tuning pins, and enables the piano to remain longer in tune than is the case with the ordinary construction.

The Bessemer steel action frame, also an invention of Mr. Gmehlin, is simple and strong, as well shown in the engraving, holding the action with such absolute firmness that no unfavorable condition of the atmosphere can in any way affect it. This, it is hardly necessary to say, is one of the most important elements in the piano manufacture in contributing to evenness of touch and tone; for without such strength and stability in the action frame all other work on the instrument could be of little permanent value. This action frame is also comparatively light of weight, and its position, with regard to the action and case, is such as to admit of easy inspection without necessitating its removal from the case.

NEW UPRIGHT GRAND PIANO.

Another improvement, which cannot fail to be appreciated by all experienced piano players, consists of a patent finger-board protector, to be found only on the pianos made by this firm. It consists of a nickel plated strip, so attached to the concave name-board that it effectually precludes the possibility of marring the front of the piano with the finger nails. Scratching of the woodwork just above the keys is so common on pianos that have been much used that this improvement will be welcomed by all who take pride in keeping their instruments looking well.

The unique case and the cylinder top, which are distinctive features of these pianos, are well represented in the illustrations. The construction of the cylinder top is very simple, consisting of a segment, or curved panel, *c*, swinging under the flat top, *t*, on two small arms or brackets, *a*, which are pivoted to the sides of the case at *p*. To open the piano requires but a gentle pressure applied at the lower edge, *m*, of the cylinder top, which then takes the position indicated by the dotted lines, and leaves an opening between the upper frame, *u*, and the lid, *t*. Its object is primarily to utilize the top of the upright piano as a mantel, by making it possible to leave the same intact when increased volume of sound is desired. In the ordinary construction, consisting of a hinged top, which can be raised to allow the waves of sound to escape (such provision being highly essential in upright pianos), the turning over of the lid upon the rear half of the top necessitates the removal of all books, sheet music, or ornaments which may have been placed there either temporarily or permanently.


BESSEMER STEEL ACTION FRAME.

The graceful outline of the cylinder top, when closed, presents a far more pleasing appearance to the eye than the angular box-like ending of an ordinary upright piano. When open, there is disclosed to view the beautiful and delicate mechanism of the interior, and the bright gold of the bronzed iron frame contrasting with the rich, dark color of the wood surrounding it produces a charming effect. Thus the upper portion of the instrument, which usually appears to the least advantage, is made the most ornamental part of the piano.

The cases of these pianos are unique and extremely rich in ornamentation, but the firm have acquired a reputation for careful construction and conscientious workmanship in all the details of the instrument. The touch is elastic, the action uniform and even, and the tone rich, powerful, and mellow, with singing qualities of a high order. The principal warerooms of the firm are at No. 15 East Fourteenth Street, New York, with a large factory corner of Eleventh Avenue and West Twenty-ninth Street. This factory has been built only about two years, in place of a former one burned down, and is completely equipped with all the latest modern machinery and appliances. The facilities for kiln drying lumber are unsurpassed; the drying house containing four chambers, in which one hundred thousand feet of lumber may be kiln dried at one time by the best process known to science. In the adjacent boiler house there are two boilers, one of one hundred and twenty, the other of eighty horse power, which furnish the necessary amount of heat required for this purpose, as well as the requisite steam for the one hundred horse power engine which runs the machinery and elevator. The varnishing of the piano cases is carried on in a building adjoining the main factory. The spacious lumber yard is at the terminus of the New York Central and Hudson River Railroad, and consignments from the West are brought by the car load to the yard, where they are unloaded and stacked.

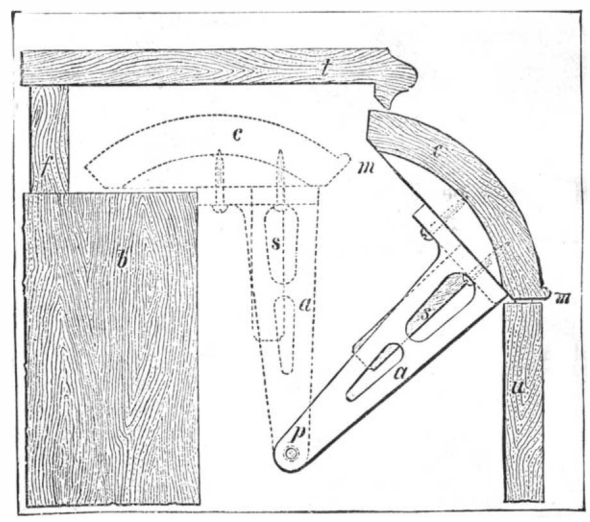


DIAGRAM OF CYLINDER TOP

The pianos of Messrs. Behr Bros. & Co. have received the warmest indorsements of eminent musicians as among the best instruments now made.

At the recent Exposition in New Orleans, the firm were awarded a medal of the first class for "piano (upright), harmonic scale (fourth string) with damper attached and pedal for same; the quality of tone, which is remarkably fine, by its power and brilliancy, the singing qualities of the instrument, the touch even throughout, the construction, excellence of design, and perfection of workmanship; the quality of tone is due to Mr. Gmehlin's new invention by adding a fourth string."

The Ammoniaphone.

A correspondent, referring to the description of the ammoniaphone published in a recent issue of the SUPPLEMENT, suggests that a valley whose atmosphere was *almost saturated* with peroxide of hydrogen and free ammonia gas would doubtless produce a heavenly voice, but that its melodies would only be heard in a place far more beautiful even than Italy. Such a peaceful spot might not produce a Guiglini, but it would very speedily produce something more ethereal.

Lemons for Malaria.

Dr. Crudelli, of Rome, gives the following directions for preparing a remedy for malaria which may be worth trying, as it is said to have proved efficacious when quinine has given no relief. Cut up a lemon, peel and pulp, in thin slices, and boil it in a pint and a half of water until it is reduced to half a pint. Strain through a linen cloth, squeezing the remains of the boiled lemon, and set it aside until cold. The entire liquid is taken fasting.

Practice and Theory.

In a lecture on the "Reflective Powers," James Freeman Clarke makes the following pertinent remarks: "There is an objection often urged against these higher reflective faculties in their exercise for common objects—that they give theoretical rules which are not practical. Thus, if one not actually engaged in teaching suggests any new view intended to improve the processes of education, he is apt to be told that this is not 'practical.' It is sometimes even assumed that theory and practice are opposed to each other. We often hear it asserted that a notion may be 'true in theory but false in practice'; that is, useless for practical purposes. I, for one, esteem practice. I trace all real knowledge to experience. I care for no theories, no systems, no generalizations, which do not spring from life and return to it again. I feel, perhaps, undue contempt for the vague abstractions we often listen to, idle figments of an idle brain, speculations with no basis of sharp observation beneath them. Yet we are in danger of going too far in this direction, and of undervaluing theory in its proper limits. People often eulogize *practice* when they only mean *routine;* boasting themselves as practical teachers, intending thereby that they only do what always has been done, and do not mean to do any better to-morrow than they did yesterday. Practice and theory must go together. Theory, without practice to test it, to verify it, to correct it, is idle speculation! but practice without theory to animate it is mere mechanism. In every art and business, theory is the soul and practice the body. The soul without the body in which to dwell is indeed only a ghost, but the body without a soul is only a corpse. I sometimes pass a sign on which the artisan has painted, "John Smith (or whatever the name may be), Practical Plumber." I should not wish to employ him. When the water-works in my house get out of order, I want a theoretical plumber as well as one who is practical. I want a man who understands the theory of hydrostatic pressure; who knows the laws giving resisting qualities to lead, iron, zinc, and copper; who can so arrange and plan beforehand the order of pipes that he shall accomplish the result aimed at with the smallest amount of piping, the least exposure to frost, the least danger of leakage or breakage; and this a merely practical man, a man of routine, cannot do. The merest artist needs to theorize, *i. e., to think*—to think beforehand, to foresee; and that must be done by the aid of general principles, by the knowledge of laws."

The St. Petersburg and Cronstadt Maritime Canal.

The Cronstadt Canal was opened on May 20 last, this being the second anniversary of the coronation of the Czar.

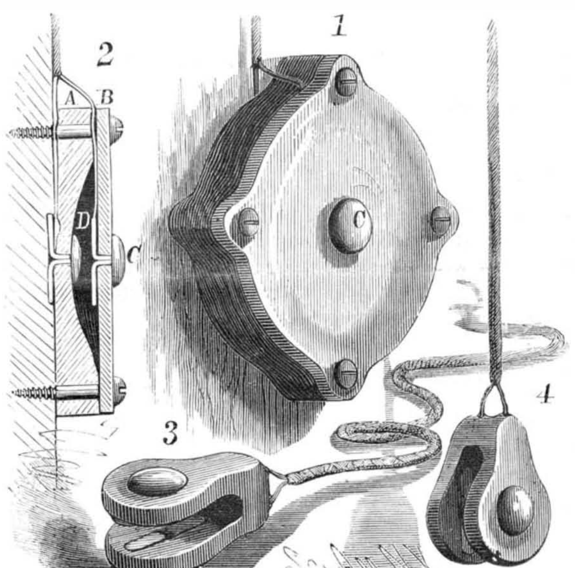
After a religious service, the Emperor and Empress went on board the magnificent yacht Dershava, anchored at the spot where the canal commences. At a quarter past twelve o'clock the Dershava proceeded to Cronstadt. Near Cronstadt the entire Baltic fleet was assembled, numbering 111 vessels and torpedo boats, when the forts of Cronstadt thundered forth a salute, and announced thus that the ceremony of opening the canal had been performed.

Although it was a leading idea in the mind of Peter the Great that St. Petersburg was to be a seaport, it has never been fully realized till the present day. Cronstadt has been the real port all this time. No vessel drawing over nine or ten feet of water could float over the bar of the mouth of the Neva and reach the capital; all vessels requiring a greater depth of water than this had to deliver their cargoes at Cronstadt. The goods were then put into barges, which were either poled or tugged up to St. Petersburg. All commercial operations were carried on at a great disadvantage under such a mode of operations. This will be best understood by stating that goods can at the present day be sent from London or Hull in about a week, but the transshipment of them at Cronstadt, with the short but slow passage to St. Petersburg, and the delivery there, usually occupied as much as three weeks, at times even more. This will now be all changed; sea going vessels of almost any size will now be able in the future to proceed direct to St. Petersburg by the new canal, at the end of which docks have also been constructed and connected with the railways. Cronstadt is to remain exclusively a port for the naval marine. It will henceforth be the Portsmouth of Russia.

In 1872 Count Bobrinski, then Minister of Ways and Communications, issued a report on the subject of the canal, and a commission was appointed under the presidency of the Engineer Kerbeds to study the question. This led to two projects being evolved. One was produced under the triple authorship of Cotard, Champoulion, and Janicky, and the other by a councillor named Poutiloff. This last was the one finally adopted in 1874, when it received the sanction of the Emperor. It was about three years later before the works were commenced. This was owing to the necessary machinery—such as dredgers, etc.—having to be made in Finland and England, and many of them were damaged and some were lost on their way to the Neva. The whole length of the canal is about seventeen miles. It starts from the island of Goutouieff, on the southern side of the Neva, where the river enters the Gulf of Finland, and it extends westward along the south side of the gulf, terminating at Cronstadt. The canal, after leaving the islands of Goutouieff and Wolnoy, and the low marshy ground known as the Isle des Cannoniers, passes all the rest of the way, which is nearly its whole length, through the waters of the gulf. On this account, instead of calling it a canal, the work might be described rather as the making of a channel through a shallow portion of the sea. At the eastern end a few miles of it had to be embanked, to prevent the deposit of sand and mud, which produces the bar at the mouth of the Neva. The longer portion on the west, which is not liable to this deposit, is simply a channel which has been dredged out, and its course will be indicated by means of buoys. A large dock has been formed on the island of Goutouieff, to which the railways have been connected. As the traffic increases, there is ample space on the islands for the construction of more docks. By the Neva, Schlusselburg on Lake Ladoga is reached, where the vast canal system of Russia begins. This system was another of Peter the Great's schemes in relation to his new capital, by which the city was to be connected with the great rivers of Russia, such as the Marinskaya, the Tichwinshaya, the Wishnevolodjskaya, and the Volga, the last being 2,500 miles in length; these form, with the canals, a communication between the Baltic and the Caspian. The steamers which are sailing at the present moment on the Caspian were built either in England, Sweden, or Finland, and were floated in pieces by the canal and river system from St. Petersburg to Astrakhan.

SIMPLE PUSH BUTTON FOR ELECTRIC BELLS.

Mr. Gosonko, of Kozloff, Russia, sends us the following simple device for a key or push button for electric



GOSONKO'S PUSH BUTTON FOR ELECTRIC BELLS.

bells. A circular piece of wood, A, has formed in it a cavity, in which is placed an ordinary paper fastener, D, which is connected with one of the wires of a bell circuit. A diaphragm, B, of flexible rubber is placed across the face of the wooden disk, A, and has at its center a paper fastener, C, which is connected with the other circuit wire. By pressing the fastener, C, against the fastener, D, the electric circuit is established. In Figs. 3 and 4 is shown a modified form of the device to be attached to the end of the flexible conducting cord. This very simple and effective push button may be made by any one.

A Queer Superstition.

Abram Reed, a farmer living in Beaver township, Pa., cut down a large oak tree on his farm, and in cutting it up he found, embedded in the trunk, seven or eight feet from the ground, a small glass bottle and what had the appearance of a lock of hair. The bottle had been inserted in a hole in the tree made by an auger, then a pine plug was driven into the hole over the bottle, the hair also being held in the hole by the plug. The bottle was corked, and contained a colorless liquid. Over the plug had grown six solid rings of wood, besides a thick bark. There was a superstition among the early settlers, and it is held by many of their descendants, that asthma and other affections could be cured by the victim standing against the tree and having a lock of his hair plugged in it while the hair was still attached to his head. It must then be cut off close to his head, and the afflicted person walk away without looking at it or ever passing by the tree again. While the use of a bottle was not included in this treatment, it is believed that the one with the hair discovered in the heart of the oak tree was put there in the early days of the settlement by some believer in the superstition to cure an ailment of some kind.—*Lumber World.*

The Different Processes of Preserving Timber.

The American Society of Civil Engineers publishes a summary of its report of its committee on this subject, which is to be one of the topics discussed at the next annual convention of that body. The report classifies three principal methods of working, viz.: 1. Steeping. 2. Vital suction or hydraulic pressure. 3. Treatment in close vessels by steaming, vacuum, pressure, etc.

The experience in the United States is given in five tables, comprising the results, more or less conclusive, of 142 authenticated trials or experiments. In each case these are referred to to give the reasons for success or failure, and the lesson taught. The five heads corresponding to the tables are:

1. Kyanizing, or use of corrosive sublimate.
2. Burnettizing, or use of chloride of zinc.
3. Creosoting, or use of creosote oil.
4. Boucherie, or use of sulphate of copper.
5. Miscellaneous, or use of various substances.

Of the first, *Kyanizing*, it is stated that an absorption of four or five pounds of corrosive sublimate per thousand feet, b. m., is considered sufficient, and it would now cost about $6.00 per 1,000 feet, b. m. It is not recommended except in situations where the air can circulate freely about the wood, as in bridges and trestles, but in very damp locations (as for ties when in wet soil and pavement) its success is doubtful. Its cost when first used led to cheating, which for a time brought discredit upon it.

Burnettizing the committee do not consider the best adapted to use where the timber is exposed to the washing action of water (as this removes the preservative); but, on account of its cheapness, it is probably to be preferred at the present time to any other process for the preservation of railroad ties. The Wellhouse, Thilmany, and other modifications of the process aim at making the chloride insoluble, but are yet on trial. This process has been largely and successfully introduced in Germany. Experience shows the life of soft wood ties to be doubled and trebled by its use. Its cost in this country is about $5.00 per thousand feet, b. m., or 20 to 25 cents per tie, and for the latter purpose the committee particularly recommend it.

The work must be well done; but some of the failures were from doing it *too* well, that is, from using solutions of too great strength, thus making the timber brittle. A solution of 2 per cent by weight of chloride of zinc in water is recommended.

Creosoting, or the injection of timber with hot creosote oil in a cylinder under pressure, is considered to be the very best process which has been fully tested, where *expense* is not considered. It is as yet the only one known which is sure to prevent the destructive attacks of the teredo or other marine animals, and to give absolute protection against decay in very wet situations. It is a somewhat expensive process, requiring for protection against the teredo from 10 to 20 pounds per cubic foot of timber, and costing from $12 to $20 per 1,000 feet, b. m. For resisting decay alone a cost of $10 to $14 is sufficient.

The *Boucherie* process, in which green timber is impregnated with sulphate of copper either by *vital suction, hydraulic pressure*, or a *vacuum*, when well done, using a solution of 1 pound of sulphate to 100 of water, has proved fairly successful.

Under the head of "miscellaneous," are classed 41 experiments with almost as many substances, sulphate and pyrolignite of iron, lime, resin, oil, tar, etc., but with as yet no commercial success. The general principles laid down are, to select the process with reference to the subsequent exposure. Use *open-grained, porous* timber, for that reason *in general* the cheaper woods. Extract the sap and water to make room for the material to be injected, natural seasoning, except for the Boucherie process, being very desirable. Steaming takes the place of seasoning. Use enough of the antiseptic to insure a good result, and then let the timber dry before using, as its durability will thus be increased. Do not hasten the work if it is to be well done. Protect ties or timber in the track as far as may be from water by drainage. Contract only with reliable parties of established reputation, under a skilled inspector, who must be in constant attendance when the magnitude of the order warrants.

There is at the close a discussion of the question, Will any preserving process pay? This is answered in the affirmative. The chairman of the committee gives a careful estimate in one of the appendices in an actual case in this country; another general estimate is given based on European experience, and three other separate appendices give different methods of examining the question of economy and comparing values. Other appendices (to the number of twenty in all) treat of the general question of destruction and conservation of forests, and give reports of the personal experience of a number of engineers, with methods pursued, apparatus used, etc.

THE use of electric lights on athletic grounds has been tested for a few weeks at Williamsburg, L. I., where the grounds of the Williamsburg Athletic Club are now lighted by electric lamps. By their light games were carried out in the evening.

The Typhoid Epidemic at Plymouth, Pa.

In all the medical literature upon the subject of typhoid fever, the late epidemic will undoubtedly be considered unique. Seldom, if ever, in the history of any disease has the excreta of a single patient directly communicated its poison to so many people. Between 700 and 1,000 were inoculated almost simultaneously, during the time from March 26 to April 1, and this in a little mining town having less than 2,700 inhabitants. The population was in a ripe condition for the development of the typhoid genus, as they had been drinking river water contaminated with sewage. A new supply of water was received on March 26, from a presumably pure mountain stream. But, most unhappily, the excreta of a typhoid patient living near its banks had been thrown within a few feet of the water, and with the melting of the snow was carried into it. The stream, now released from ice, soon filled the nearly empty reservoir, but an eighth of a mile distant. The great outburst of fever occurred between April 12 and 18, the time of incubation of the typhoid germ being from 10 to 20 days, and during the weary weeks since then the town has been but one large hospital. As many as ten deaths have occurred in a day, and almost 300 families have been at one time dependent upon charity; $14,000 have already been distributed, but there is still destitution. The town, even now, is in a very unwholesome condition, but in spite of the terrible warning they have received, the local authorities are doing little or nothing for its improvement.

How Thought Presents Itself among the Phenomena of Nature.*

Every phenomenon which a human being can perceive may be traced by scientific investigation to motions going on in the world around him. This is obvious to every scientific man in regard to such phenomena as those of color and sound, and these simpler cases were first adduced by the lecturer. He then pointed out that the statement is also true of all other material phenomena, and he specially dwelt on the phenomena investigated in the science of mechanics, showing that all the quantities treated of in that science, such as force and mass, prove, when the investigation is pushed far enough, to be expressible in terms of mere motion. He also showed that the prevalent conviction that motion cannot exist unless there is some "thing" to move will not stand examination. It proves to be a fallacious conviction traceable to the limited character of the experience of motions which we and our ancestry from the first dawn of organized thought on the earth have had within reach of our senses. This conviction accordingly has no authority with respect to molecular motions and to some others that have been brought to light by scientific study. He also showed that the "thing" which in common experience moves, proves in every case to be nothing else than these underlying molecular motions, the transference of which from place to place is the only kind of motion which common experience can reach, when unassisted by science.

The intermediate steps between the world external to our bodies and the brain which take place in our organs of sense and nerves can also be ascertained to be motions. And finally, a change consisting of motions takes place in the brain itself, whereupon we become conscious of thought, *i. e.*, a change occurs within the brain which would be appreciated as motions by a bystander who could search into our brains while we are thinking, and could witness what is going on there while all the time the change that we experience is thought. It must be borne in mind that our brain is a part of the external world to the bystander whom we have supposed to be observing what is going on in it. It thus appears that every phenomenon of the external world is reducible to motions and their modifications, while all that is within the mind is thought.

Now this motion to which all other material phenomena are reduced, this motion as it exists in nature, must be distinguished from man's conception of motion, which, after all, is one of his thoughts—a very complex one, no doubt, but not part of the external world. This particular conception in our minds is one remote effect of the motion as it exists outside us, and what we really know of that external cause is that it is a cause which does unfailingly produce this effect if the intermediate appliances of our senses and nerves are also present. Motion, the cause, must no doubt stand in absolutely rigorous relations to its effect, viz., our conception of motion; but it need not be like its effect, the presumption being quite the other way. The lecturer pointed out that, under these circumstances, the simplest, and so far the most probable, hypothesis that can be advanced is the monistic hypothesis that this unknown cause is itself thought; and he pointed out that it is no objection to this view that we are unconscious of all the thought here supposed, for this is only to say that it is external to that particular group of interlacing and organized thoughts which we call our own mind, just as the thoughts of the many millions of our fellow men and of all other animals are external to our little group.

The lecturer accordingly recommended the following hypothesis: (1) as consistent with everything we know, (2) as the simplest hypothesis, (3) as a hypothesis which dispels all the difficulties that encumber the dualistic supposition that there are two kinds of existence, viz., the hypothesis that if a bystander were armed with adequate appliances to ascertain what is going on in our brain while we are thinking, then what we should experience to be thought is itself the remote cause with several intermediate causes of that change within the observer's brain which determines his having that complex thought which he would call perceiving some of the motions in our brain—in short, that what he appreciates as motion we experience to be thought.

If this view be correct, it will follow that the thoughts of which we are conscious are but a small part of the thought going on even in our own brain, and which would be seen by a beholder as motions, the rest being unconscious cerebration, and as much outside our consciousness as are the thoughts of other people. We are led also to the conclusion that the thought, which is going on in the brains of all the animals that exist is but the "small dust of the balance" compared with what is going on throughout the rest of the mighty universe.

* Short Abstract of Royal Institution Friday evening discourse (February 6), by G. Johnstone Stoney, M.A., D.Sc., F.R.S.—*Nature.*

Sir Astley Cooper a Horse Dealer.

In the life of Sir Astley Cooper it is said that he required his coachman to attend every market morning at Smithfield, and purchase all the lame young horses exposed for sale which he thought might possibly be convertible into carriage or saddle horses, should they recover from their defects. He was never to give more than seven pounds for each, but five pounds was the average price. In this manner thirty or forty horses were sometimes collected at Gaelisbridge, his farm. On a stated morning every week the blacksmith came up from the village, and the horses were in successive order caught, haltered, and brought to him for inspection. Having discovered the cause of their lameness, he proceeded to perform whatever seemed to him necessary for the cure. The improvement produced in a short time by good feeding and medical attendance, such as few horses before or since have enjoyed, appeared truly wonderful. Horses which were at first with difficulty driven to pasture, because of their halt, were now with as much difficulty restrained from running away. Even one fortnight at Gaelisbridge would frequently produce such an alteration in some of them that it it required no unskillful eye in the former owner himself to recognize the animal which he had sold but a few weeks before. Fifty guineas were paid for one of these animals, which turned out a very good bargain, and Sir Astley's carriage was for years drawn by a pair of horses which together cost him only twelve pounds ten shillings.

We believe a similar business to that of Sir Astley Cooper is carried on by a class of horse dealers in New York and other large cities. Lame and otherwise worthless horses are bought for a few dollars and taken to the country, where the change to pasture diet, the needed rest, and the watchful and careful treatment of the owner frequently transform a worthless horse into a valuable animal.

Mechanical and Steam Engineering.

Of all created beings, we of the human family are the only "tool making animal"—the only living beings who have the faculty of observing the effect and looking for the cause, or *vice versa.*

In the department of mechanics there is a large field for the exercise of our powers. The steam engine alone is a study for a lifetime.

Water will store up more energy, or force, with the application of heat, than any known substance, except hydrogen. We find that combustion in a furnace produces a perfect magazine of power. The heated gases pass off in a spiral or rotary motion through flues and tubes; by conduction delivering up their caloric to the water. A unit of heat, which raises one pound of water one degree Centigrade, will raise nine pounds of iron or thirty-three pounds of bismuth to the same degree. It is essential that every engineer should understand the fundamental principles, and the responsibilities of his profession, and should recognize the vigilance required to handle as much force and energy as is stored up in a steam boiler.

But with the requisite skill and intelligence there is nothing mysterious in the physical laws that govern water, heat, and combustion.

One cubic inch of water, with the requisite amount of heat, and at normal pressure, flashes into sixteen hundred cubic inches of steam, as would be the case in the bursting of a steam boiler. (An expansion about the same as that of gunpowder. Nitro-glycerine expands about ten thousand times its original volume.) Many engineers entertain the idea that as long as the requisite amount of water is maintained in the boiler there is no danger of an explosion; that the pressure will merely relieve itself by causing a rent in the boiler; not realizing that the bursting is one thing and the explosion is what follows, from the stored up energy, or heat in the water.

The water heater that surrounded the uptake, or smokestack, of the steamship Great Eastern on her trial trip is an instance of the destructive and fearful results of the stored up energy in water, with the application of heat. These boilers were constructed with very little knowledge of the laws of combustion.

There is a vast field for the constructive engineer in the study of the laws of combustion, the proportions of grate bar surface, combustion chamber, and of flues and tubes, with the smokestack, to obtain the best results with the different classes of fuel.

One of the most essential things for the constructive engineer is to look after the free circulation of the water in the boiler. The lack of the free return of the water to the heating surface of the boiler is one of the principal causes of foaming and general derangement of the successful working of the boiler. (Probably the danger of bringing the hot sheets of the boiler in contact with the steam has been overestimated.) Take, for instance, the careening of a small class of steamers in a rough sea-way, or the upright type of boilers, where the tubes go through the steam; there are tens of thousands of these in use, and we scarcely ever hear of any disastrous effects. The tubes are not as durable in steam as the parts immersed in water.

We frequently hear engineers make the remark, in commenting upon an accident, that it was not possible for water and steam to make such an explosion, ignoring the fact that the boiler was not strong enough to sustain the pressure. The more one studies the chemical laws of water, the less will he believe in gas theories or similar delusions.

It is difficult to conceive how the two gases that compose water can be torn asunder as long as there is any water in the boiler. There might barely be a possibility of separating the two gases by the steam coming in contact with the white hot tubes and sheets of the boiler, by which the oxygen is absorbed and the hydrogen left free. But these conditions would not be possible as long as there was any water in the boiler.

The boiler of the future will probably be constructed with more regard to the free circulation of the water in all its parts, especially the lower part, as it is very difficult to drive heat downward below the fire or heating surface.

The "Galway," an English type of boiler, is probably one in the right direction.

Vertical flues or tubes through the main firebox insure a good circulation from the extreme bottom of the boiler. Some of the best forms of the water tube or sectional boiler carry out this principle. They are at present taking a prominent position as a steam generator, and will probably be the boiler of the future.

Success depends largely upon actual practice, and close observation upon the construction and wear and tear of the weak points, to draw correct conclusions in regard to the efficiency and durability of a boiler.

J. R. WILLIAMSON.

The Hebrew Technical Institute.

The Hebrew Technical Institute in New York city has now been established about ten months, and by its gratuitous instruction is doing an excellent work among the poorer Jewish children of the metropolis. The pupils vary in age from 12 to 15 years, and the training given them is intended to make them good, practical mechanics. As far as the capacity of the school will permit, all are taken who want to learn, and the results obtained from this rather indifferent material—boys often without any previous instruction whatever—are surprisingly favorable. Six hours daily are spent at the school, the time being equally divided between the English branches, including geometry and physics, free hand and mechanical drawing, and the workshop. The course is intended to cover three years, the third being devoted to the particular branches in which the pupil has shown the greatest aptitude. It is the aim of the Institute to impart the general underlying principles rather than the details of any particular trade. Mr. Leipziger, who is in charge, has done admirably during the short time he has been at work. A recent exhibition at the Institute made a very creditable display of drawings, modelings, and cabinet work accomplished by the pupils. It is intended to include metal work in the next year's course.

Electric Lights for Cars.

The Pennsylvania Railroad Company continues the experiments with lighting cars by electricity from Brush storage batteries, using the lights on a train running between Altoona and Pittsburg. The arrangement has worked satisfactorily. The storage batteries are charged in the company's shops by connection with a Brush dynamo-electric machine. It takes about nine hours' running to charge the batteries with sufficient electricity for the round trip. The intention is, should the plan be found advisable for general use on through trains, to establish electric plants at different stations for charging the batteries.—*Philadelphia Railway World.*

THE ENGINE AND BOILER OF THE STILETTO.

We herewith present engravings of the engine and boiler of the Herreshoff steam yacht Stiletto, which was illustrated in the SCIENTIFIC AMERICAN of last week. The boiler corresponds in general principle with those of the ordinary Herreshoff type, but differs most essentially in the arrangement of the tubes. By means of a pump the water is forced through the boiler, which consists of series of pipes so placed and connected as to form, practically, one continuous length of tube, into the upper and cooler portion of which water is admitted, and from the lower and hotter portion of which the steam is led away.

The fire box is 6 feet 3 inches square. The sides terminate in a cone-shaped top leading to the smoke stack. Just below the conical portion are seven sets of tubes placed alternately across and parallel with the length of the vessel, the lowest set being athwartships and only a short distance above the fire. These sets are made up of tubes graduated from 1½ inches in diameter to 3½, the smallest being at the top, the largest at the bottom. The alternate ends of the separate tubes in each set are united by U-shaped or return bends, and at one end one set is united to the set above it. The steam is thus compelled to pass successively through each tube in each set. The tubes are spaced far enough apart to permit the products of combustion to pass between them.

The boiler circulation is kept up by means of a pump feeding into the upper set of tubes and taking its supply from a surface condenser, and when necessary, as will be explained shortly, from the separator, which is located in front of the boiler between the feed doors, as shown in the view of the boiler room. Steam is led from the lowest set of tubes to the separator, which consists of a cylindrical shell ⅜ of an inch thick, 18 inches in diameter, 4 feet long, and formed with conical tops; this is jacketed. The separator allows the steam and water coming from the boiler to divide, the latter, of course, collecting in the bottom, which is provided with a glass gauge to indicate the amount. The bottom is connected with the pumps, so that when necessary the excess of water can be removed and returned to the boiler.

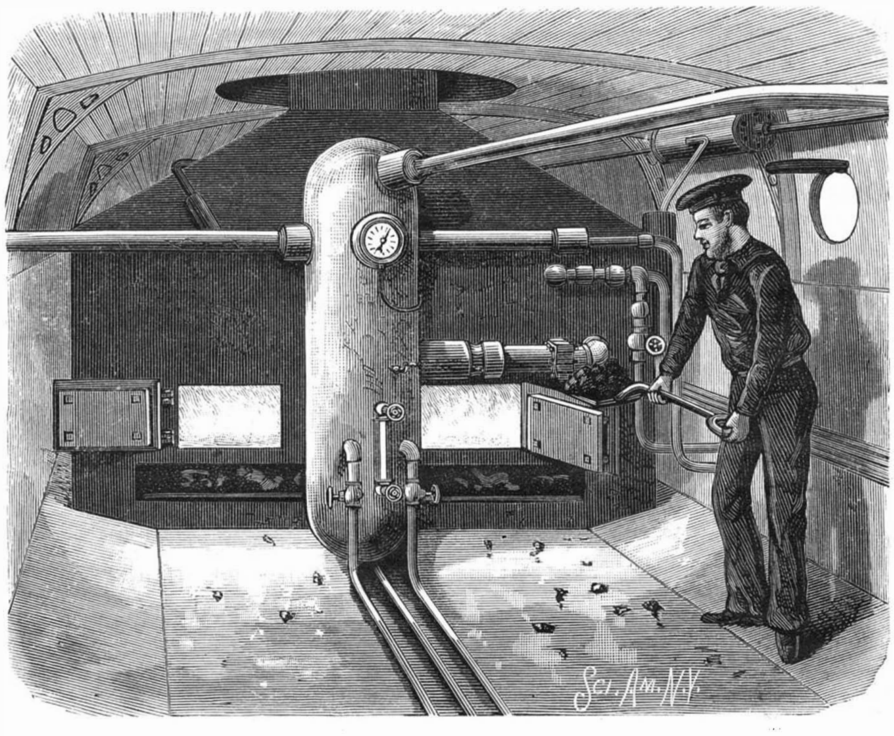
In the ordinary pattern of this boiler the steam from the separator is led to a set of tubes placed in the upper part of the furnace, the steam being thereby superheated; but in this case steam is led direct from the separator to the engine. Artificial draught is obtained from a blower.

The engine is a compound condensing, having a stroke of 12 inches, and cylinders 12 and 21 inches. The Herreshoff annular valve is used. This consists mainly of a cap sleeve on each end of the cylinder, which is surrounded by the steam chest, moving in a direction parallel with the axis of the cylinder; the inlet is through the side, and the exhaust through the end of the valve. Under ordinary conditions the cut off is ⅝. The cranks are placed quartering, and the shaft is of steel 4 inches in diameter. The engine exhausts into a surface condenser, from which the water is returned to the boiler by the pump. It will be seen that the pump operates in a continuous circuit, the water entering the upper tubes of the boiler, passing from the lower set in the shape of steam to the separator, thence to the high and low pressure cylinders to the condenser, and from the condenser and separator to the pump. The only water allowed to escape is by leaks and the use of the whistle; this loss, which is inconsiderable, is made good by the use of an injector.

The screw is four bladed, 4 feet in diameter, 6 feet 6 inches pitch, and may be run at 400 revolutions per minute.

The great power of this engine—calculated at 450 horse power—considering the small space it occupies and its remarkably light weight—4,275 pounds—is due to the design and to the material employed in its construction. Steel has been introduced wherever possible, both in the engine itself and its parts and in the bracing.

The boiler weighs 13,637 pounds, and has a heating surface of 615 square feet, and may safely be worked under 160 pounds pressure; but in the race with the Mary Powell it was only necessary to use from 120 to 125 pounds, so that the full power of the engine was not exerted at that time, and the speed attained cannot be considered as the fastest the Stiletto is capable of. The boiler generates steam only as it is needed and utilized by the engine, the only reserve or surplus steam being that contained in the separator, the lower sets of tubes, and in the connecting pipes. This form of boiler, it is almost needless to say, is a most rapid generator of steam, is absolutely reliable and free from all danger from explosion, and most economical in the use of coal, two pounds per hour per horse power being the average.

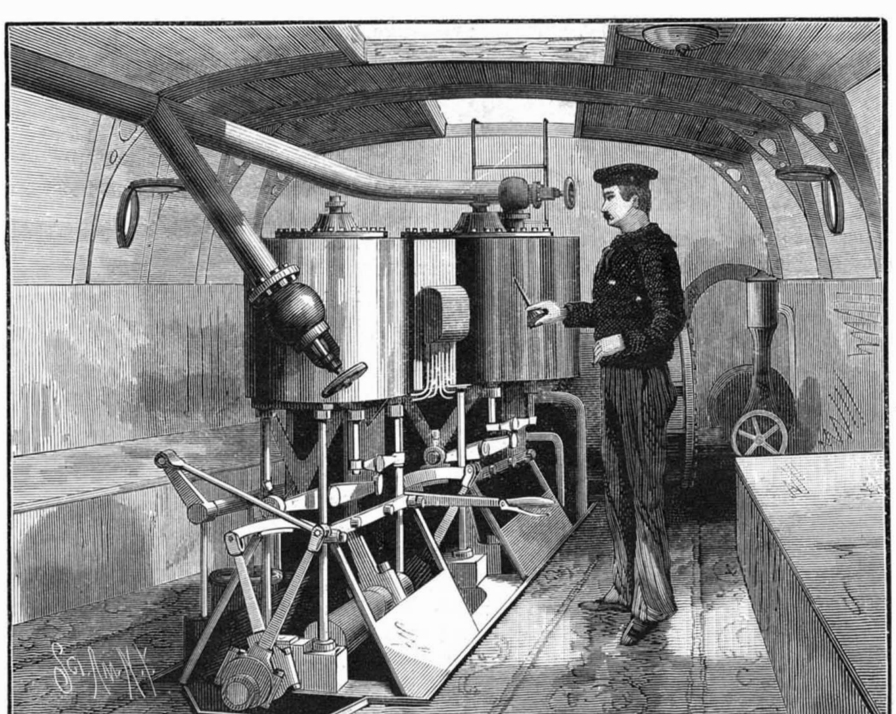


THE BOILER OF THE STEAM YACHT STILETTO.

The Aneroid Barometer.

The name of this barometer is derived from the Greek *a*, privative, and *neros*, moist; no liquid being used in its construction. The working part consists of a cylindrical metal box exhausted of air, the top of which is made of thin corrugated metal, so elastic that it yields to very slight alterations in the pressure of the atmosphere. As the pressure increases, the top of the box is pressed upward by the weight of the atmosphere, whereas when the pressure decreases the top of the box rises. These motions are multiplied by means of levers, and the index moves over a comparatively large arc on the circular scale marked on the dial of the instrument. Each instrument has been, or ought to be, graduated separately, by comparing it with a standard mercurial barometer. The aneroid has the advantage of being portable and very sensitive, aneroids having been made that will show the difference of height between one floor and another; hence its almost universal employment by mountain explorers.

Aneroid barometers, like properly constructed mercurial barometers, should have a thermometer attached to them, as their indications vary with the temperature.



THE ENGINE OF THE STEAM YACHT STILETTO.

The Electric Railway in Philadelphia.

The electric railway soon to be constructed along Belmont Avenue, Philadelphia, will present the novel sight of cars running without any apparent propelling force, free from annoyance of noise, smoke, and dust. The motive power for the cars, which are to be run according to the Bidwell system, will be furnished from a station located somewhere on Belmont Avenue, outside the park. It could, if necessary, be carried over an indefinite distance. This system differs from other systems of electric railways in not passing the current through the rails. Guards made of lumber run along the inner side of the rails, and a broad covering projects toward the center, leaving a narrow slot in the middle of the track. Beneath this cover and parallel with the rails, properly insulated copper conductors, of a semi-tubular shape, are placed. The current is conveyed from the dynamos supplying the power through wires to the terminus of the railway, where connection is made with the copper tubes, and a current is thus sent through the whole length of the road.

To propel the car a receiving dynamo or electromotor is placed in the center of the car. Connection with the current is made by means of an iron tube passing down through the slot, with branches in either direction in the form of an inverted T. On the end of each branch a small wheel, so placed as to run against the copper conductors, completes the connection, wires being run through the tube from the electromotor in the car to the wheels. The electricity being passed through the circuit of the track, the operator has but to turn a lever to receive the current in the motor, which immediately revolves, and by an attachment with the wheels of the car propels it in either direction, according as the current is reversed or not. Through the reversal of currents the need of brakes is dispensed with. If necessary, the car can be brought to a sudden standstill, but the change can be effected as gradually as may be desired. There will, therefore, be no danger of running over persons on the track.

The avenue will be lighted with the same current by running wires from the tubes to the lamps, as in ordinary street lighting, while the cars will be illuminated by running a wire from the motor to the incandescent lamps in the interior of the car, the whole power coming from the single current supplied by the stationary engines some distance away from the track. If it is desired to heat the cars, another draught is made on the current by passing the electricity through some poorly conducting substance, as German silver, the electrical energy being thereby dissipated in the form of heat. These connections are made by means of switches, so that no current may be made through the branch wires when the light or heat is not wanted.

An important feature of this railway for the park is the utter impossibility of trifling with the conductors and receiving injury from a shock. They are placed beneath the board flooring near the rails, and the only opening is the narrow slot, more than a foot distant, the whole being concealed from view. The road will be about a mile and a quarter long, and ten cars, carrying from fifty to sixty passengers, will be run. To furnish the power for these and to light both the avenue and the cars about 100 horse will be required.

BERTHOUD and BOREL are preparing a new insulating substance in the following manner: Linseed oil is maintained at a temperature of 300 deg. until it acquires a brown color and a sirupy consistence. A quantity of colophane is then added, and the mixture is then stirred for a time. To cover a body with an insulating coat, it is plunged into the mixture at a temperature of 200 deg.

THE engineering firm of Napier Brothers has long been an eminent one in Great Britain, and their success in shipbuilding has made the name well known throughout the world. The senior partner of the house, Mr. Robert D. Napier, died a few weeks since, in Glasgow, at the age of 64. Besides his regular business, he was a frequent contributor to scientific journals, and was the author of an investigation of the laws attending the flow of steam, which has received considerable attention.

THE NEEDLE AND THREAD PLANT.

The *Agave Americana*, or maguey of the Mexicans, is known as the century plant among our collections, the latter name being given to it from the erroneous idea that it bloomed once in a hundred years, and "with such rapidity as to resemble the explosion of a cannon." The period at which the plant really flowers is owing to the climate and the cultivation to which it is subjected. In warm countries twenty-five years is sufficient to bring the flower to perfection. Mr. Hawkins, in his "Transactions of the Horticultural Society," gives an account of the most remarkable instance on record of the flowering of the American aloe. Without manure or protection this plant bloomed in eighteen years, having attained a height of twenty-seven feet, and having on it forty flowering bunches, each with four hundred blossoms, making sixteen thousand flowers in all; the scape, with its panicle of rich yellow blossoms, in appearance like a candelabrum.

The vast plains in the interior of Mexico is the home of the maguey, and the plant with its thorny leaves imparts a peculiar character to the Mexican landscape.

The strange form of the plant and the rarity of its blossoms are not the only circumstances which recommend it to our attention. From the leaves, roots, and sap are obtained a variety of products. "The natives," says Obers in his "Travels in Mexico," "make as many uses of this plant as the South Sea Islanders of the cocoa palm, namely, one hundred." The juice of the sap, which is obtained by making incisions in the trunk, being highly caustic, is used by physicians in cleansing wounds. Its more extended use is that of producing a bitter-sweetish juice known as aquamiel (honey water), which furnishes to the natives a drink called pulque, and when taken in moderation is innocuous and wholesome. The foliage of the maguey yields an extract which lathers water like soap.

The agave holds the place of Asiatic hemp and Egyptian papyrus. Ancient hieroglyphics were inscribed on the leaves, macerated in water and glued together as the bark of paper mulberry. Much attention has been recently paid to the manufacture of paper from the leaves. "The fabrication of this material is destined to be a great industry, says the "Catalogue of Mexican Products," owing to the quality and cheapness of the material.

The fibers of the leaves with the thorns at the end are applied to manifold uses. The edges of the leaves are indented; at each indenture is a spine. These spines are frequently so strong as to serve the Indians for nails. A needle and thread is also furnished the natives by the simple process of pounding the leaf so as to soften the pulp, then scraping the latter away, allowing the fibers with thorns attached to remain. These are dried by hanging in the sun a few days, and the Indian woman has her needle, which is smooth, and not liable to rust; her thread to sew her coarse dress made from "petal flax" (a textile fabric of this plant), prepared in the crudest manner, yet stronger than cotton which has gone through many processes of manufacture.

A rope is made from the fiber of the maguey which is used in the mines and for the cordage of ships on the western coast. The poorer classes of Mexico thatch the roofs with the leaves, and these being concave serve as gutters to conduct the water away from the eaves. The Greek meaning of agave is "noble," and it is well named, as it is one of the most valuable gifts which nature has bestowed on these tropical regions of America. The wealth of a Mexican often consists in his maguey plantation.

New Gutta Percha Tree.

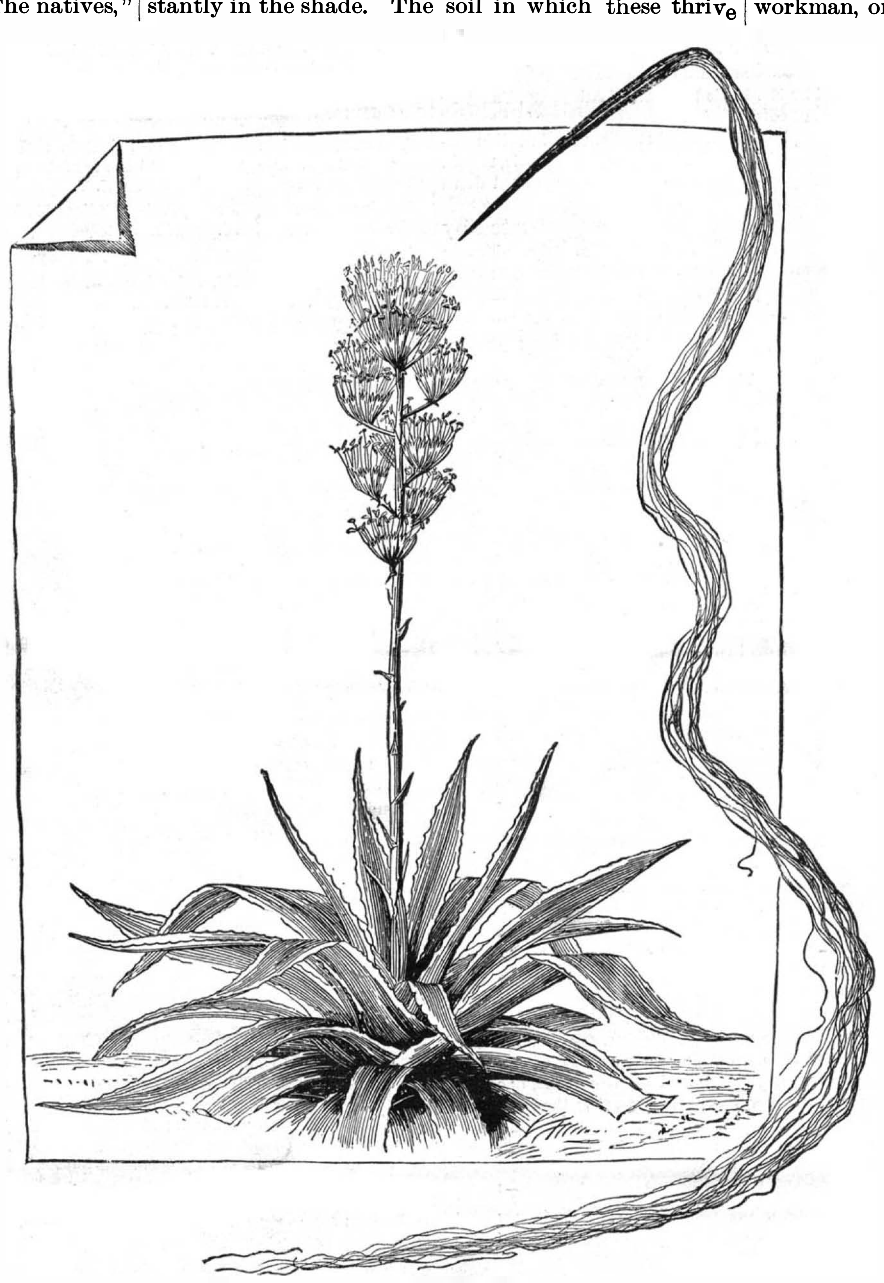
Instigated by the threatened dearth of the gutta percha tree (*Isonandra Gutta*), M. Heckel has sought a substitute, and claims to have found it in the *Birtyrospermum Parkii* (Kotschy) of equatorial Africa, and abundant in latitudes between Upper Senegal and the Nile, especially in the forests of the Niger and Nile regions. It affects the argillaceous and ferruginous soils of Bambarras Boure and Fonta-Djalon, where the Africans gather its fruit, which yields a grease called *karite*. The juice or milk is obtained by incision from the bark, and on evaporation resembles gutta percha. M. Heckel states that he has sent seeds to various French colonies, and also to England, in the hope that latter country will try the experiment of introducing the tree into her vast tropical possessions. M. Heckel also calls the attention of English botanists and chemists to the divers Indian *Bassias*, as he is led by analogy to infer that they might furnish milky products similar to the Bassia Parkii.

Specific Gravity of American Woods.

Of the four hundred and thirteen species of trees found in the United States, there are sixteen species whose perfectly dry wood will sink in water. The heaviest of these is the black ironwood (*Condalia ferrea*) of Southern Florida, which is more than thirty per cent heavier than water. Of the others, the best known are the lignum vitæ (*Guaiacum sanctum*) and mangrove (*Rhiziphora mangle*). Another is a small oak (*Quercus grisea*), found in the mountains of Western Texas, Southern New Mexico, and Arizona, and westward to the Colorado desert, at an elevation of five thousand to ten thousand feet. All the species in which the wood is heavier than water belong to semi-tropical Florida or the arid interior Pacific region.

Plants under Trees.

We have been asked recently to name a section of plants that could be planted under trees. We could name several, such as hollies, privet, euonymus, box, berberis, etc., with something like a preference for the latter. In berberis we get a genus of shrub possessing the highest qualifications for purposes of ornament; and all the grander evergreen species do better under trees than in the open; in fact, they require to be constantly in the shade. The soil in which these thrive



THE NEEDLE AND THREAD PLANT.

best is a deep, rich, moist, sandy loam, with abundance of water overhead and at the roots. Among the species the noblest of all is *Berberis* (*Mahonia*) *japonica*, which for magnificence of foliage has no equal among hardy shrubs. It naturally grows in the form of a dense bush, with large pinnated leaves of hard texture and of a lively green hue. Specimens of it are now covered with spikes of flower buds, which will open at the first break of spring weather, and soon be succeeded by bunches of grape-like berries, covered with a lovely bloom.

Two other noble, large-leaved species which thrive under trees are *M. Bealli* and *M. intermedia*. For warm, sheltered gardens, *M. Nepœnus* is most beautiful, and *B. Fortunei* is well worth having, but both these are rather tender. One of the loveliest of flowering shrubs is *B. Darwinii*, which blooms abundantly, and of which we have had spikes of bloom sent us on Christmas day from Devonshire. One of the cheapest for common purposes, and really a beautiful species, though not equal to those already named, is *M. aquifolium*, well adapted to plant in quantity in town gardens, and to form game covers or belts for screening off the compost or rubbish yard from the kitchen garden. These are certainly the best for planting under trees.—*Land and Water.*

The Cutlery Manufacture.

American cutlery is now finding its way all over the world, and knives, shears, scythes, and planes of our manufacture are to be found in the warehouses of most large English cities. In 1872 the importation of cutlery into the United States amounted $10,500,000, which was cut down in 1880 to about $900,000 a year, besides which $700,000 worth of domestic goods were exported in that year. In the manufacture of axes, the United States have made most marvelous advances, surpassing all other countries, except Canada, which bears an equally good reputation for making these useful implements.

Good table knives are made of steel and iron welded together; the part which goes into the handle (called technically the tang in England) and the shoulder are of iron, and the blade of steel. The tang and shoulder are forged from bar iron, and the blade from shear or cast steel. Knife blades, razor blades, and other small articles are usually forged into their required shape while still attached to the bar, which serves for the workman to hold them by. When the bar becomes too short, it is grasped in a pair of tongs held close by a ring which clamps them by sliding up their conical handles. Two men are employed in forging such work. The principal workman, or fireman, as he is sometimes called, uses a small hammer of two to four pounds weight, while the hammerman wields the sledge hammer, weighing from ten to fifteen pounds. The fireman, who attends the heating as well as the anvil work, directs the hammerman, whose blows merely follow those of the small directing hammer of the fireman. In drawing down or reducing a bar both in length and width, the flat face of the hammer is used; but when the length or breadth alone is to be extended, only the narrow edge of the hammer is used. The concavity of razor blades is made by hammering the blade on a small round-faced anvil; the notch, or nail hole, of a penknife is struck by means of a chisel of the required form. Superior work, such as razor blades, are "smithed" after forging, that is, beaten upon an anvil, to condense the metal as much as possible, and slightly ground or scorched upon a rough stone, to finish the shaping and remove the scale, or black oxidized surface, which would interfere with the color of the tempering.

Common knives are made entirely of iron, and the difference of price arises not merely from the difference in cost of the material, but from the greater facility of working. It should also be understood that, in many articles composed of steel welded to iron, the saving of steel is not the only advantage, for steel being more brittle than wrought iron, it is very desirable, in all articles subject to a transverse breaking strain or to concussion, that every part except the cutting or working edge should be of iron. Thus a hatchet made entirely of steel would be less durable than one of iron with a welded steel cutting edge, and so of other articles.

Table forks are forged rudely into the shape required, first as though but a single thick prong were required. The part for the prongs is then beaten out, and a stamping die is brought down upon it, which forms the prongs, with a thin film of steel between them; this is cut out by a cutting die. Then they are softened and filed up, again hardened and tempered and ground to smooth and finish. The dry grinding of forks, needles, etc., is a very deleterious trade, on account of the particles of steel which enter the nostrils of the workmen, and produce most painful irritation, followed by a peculiar disease called "grinder's asthma," which is said to shorten life so seriously that few dry grinders, exposed to the steel dust, reach forty years of age. Many remedies have beeen proposed for this. A magnetic mouthpiece was invented; but the workmen would not wear it, on account of its novelty, its grotesque appearance, the trouble of cleaning it, and the belief that if their trade were more healthy, greater numbers would enter it, and wages be reduced. A revolving fan, which sets in motion a current of air, that is carried by a pipe to the outside of the building, has been used with greater success, and is now in general use when it can be applied, though its introduction was much opposed by the workmen.

Progress of Natural Gas.

Natural gas will soon be used as an illuminant in Kansas City, Mo., Wyandotte, Kan., and several other cities and towns near these places. The gas has been struck at several points during the last two years, and parties from the Pennsylvania oil regions have undertaken to develop its use.

ENGINEERING INVENTIONS.

A governor for steam engines has been patented by Mr. Aaron J. Allen, of Hope, R. I. Combined with a governor of the ordinary type is a rotating sleeve, gearing, and sliding clutch, by which the spindle operating the cut-off or throttle is shortened and lengthened to give more or less steam as required by the load, without making any great change of speed.

An electric engine has been patented by Mr. William A. J. Kohrn, of San Francisco, Cal. Combined with field magnets, swinging armatures with coils, and a battery connected with the field magnets, another battery is connected with the coils of the armature, and there are devices for automatically closing and opening the circuits of the field magnets and of the armatures, with other novel features.

A boiler feeder has been patented by Mr. Samuel Haigh, of Coquitlam, New Westminster, British Columbia, Canada. This invention relates to the use of water cylinders which are alternately filled and their contents run into the boiler in succession, there being a novel arrangement of floats, rods, and stops for actuating the valve of a steam cylinder in combination with the water cylinders.

MECHANICAL INVENTIONS.

A lathe for turning spirals has been patented by Mr. Silas Moore, of Cleveland, O. It feeds the work regularly against a revolving cutter, which may be quickly withdrawn and returned, so spirals may be cut either right or left handed, cylindrical, tapering, or wave pattern, and the pitch may be regulated at the beginning of each job by arranging the gear wheels in proper relation to the screw.

AGRICULTURAL INVENTIONS.

A cultivator has been patented by Mr. Jabez C. Nelson, of Marion, Ala. The tongue has a rounded forward end, a forked rear end, two arched bars attached to it, plow beams secured adjustably to the arms of the arched bars, with other novel features, making a cultivator which can be readily adjusted to a variety of different kinds of work.

MISCELLANEOUS INVENTIONS.

A table corner has been patented by Mr. Harvey N. Hall, of Evansville, Ind. It consists of a curved clamping iron and a curved stud or block, combined with a table frame and leg, the object being to thus provide firm and durable fastenings for securing table legs to the frames.

A trace carrier has been patented by Mr. Frank O. Derr, of Moulton, Iowa. It is made with side loops for the side straps of a harness, with a cross bar for the back strap, and a rear loop and keeper for the crupper strap, the device being cheap and durable and easily applied to any harness.

A salt boiler or pan has been patented by Mr. John Seely, of Warsaw, N. Y. Steam is used for heating, and wood is the principal material composing the boiler or pan, the construction being such that the different parts may be keyed up at any time to keep it from leaking in case of shrinkage.

A step ladder has been patented by Mr. William H. Kline, of Watsontown, Pa. Combined with the ladder is a folding table and a drawer for holding small articles; the ladder is automatic in opening and closing, and is strengthened and made more firm than step ladders ordinarily are.

Window and other glass forms the subject of a patent issued to Mr. Michael Magrath, of New York city. The glass has a novel configuration on one of its faces, especially adapting it for fan lights, doors, etc., giving multiplied prismatic effects by the refrangibility of the rays of light upon a wall or other surface upon which the light is made to fall.

A rope clamp has been patented by Mr. Samuel H. Magee, of Galveston, Texas. It consists of a pair of clamping segments, combined with a wedge-shaped plate, for use in place of selvage straps, and purchases in setting up rigging, instead of catspaws, and also for joining two ends of a rope in place of splicing.

A velocipede has been patented by Mr. Lindsey Dickey, of Vibbard, Mo. The velocipede wheel is made with a wheel having an internal gear formed on its rim, spokes projecting from the rim of the said wheel, and a rim on the spokes, making a novel machine which can be driven at a high or low speed and easily steered.

An advertiser and card holder has been patented by Mr. John M. Hubbard, of Lake Village, N. H. A board is divided into spaces by transverse ridges, and on the side edges of the board are two pins for each space, on which are held cords which pass over the spaces and hold cords in place between the ridges, the holder being provided with means for hanging.

A pump has been patented by Mr. Charles H. Bennett, of Blossburg, Pa. This invention relates to improvements in that class of pumps where the piston is reciprocated vertically by the stand pipe through which the water rises, the construction being simple, the pump easily operated, and not liable to get out of order.

A thill coupling has been patented by Mr. George D. Umland, of Osceola Mills, Wis. The invention covers a specially formed block on a carriage axle clip, with other novel features, affording means whereby either a tongue or a pair of thills may be quickly attached to or detached from the axle of a carriage.

A fastening for bag, pocketbook, and purse frames has been patented by Mr. Charles S. Shepard, of Brooklyn, N. Y. A pair of studs is attached to one part of the frame, and studs with knobs to the other part of the frame, and a rod with a knob is hinged to the one pair of studs, shutting down between the knobs of the other pair.

A gas cautery has been patented by Mr. Charles Graefe, of Sandusky, Ohio. This invention relates to cauteries heated by gas, for which the instrument is made with separate tubes, one for the gas and the other for the air, the ends being so bent that the current of air is discharged at right angles, or nearly so, to the flame.

A combined hammer and nail feeding device has been patented by Mr. Emmet Horton, of Dundee, N. Y. It is for use by carpenters, and for shingling, lathing, etc., having a nail receptacle which, by the swinging movement of the handle, is made to feed the nails by gravity, one at a time, to an attachment that places them in position for being driven.

A plaque or panel has been patented by Mr. Edward de Planque, of Hoboken, N. J. It is formed of two layers of canvas or duck united by a mixture of glue, whiting, and finely pulverized wood, the face or panel having a covering of whiting and glue on which the painting or drawing is produced, the plaque being readily pressed into any desired shape.

An ice creeper has been patented by Mr. Peter B. Laird, of Brooklyn, N. Y. It is made of two elastic wires, connected at their middle parts by a collar or band, and bent at their ends to form lugs to clasp the edges of the sole and heel, and points to engage the ice, the device being one readily applied to and detached from the soles of boots and shoes.

An adjusting device for rolling mills has been patented by Mr. John Wood, of Conshohocken, Pa. The invention consists in a wedge operated by a screw, and fitted between the breaker and bolster at one end of the top roll, whereby the adjustment of the roll to the lower one can be be accomplished accurately and without loss of time.

A spectacle and eyeglass frame has been patented by Mr. Louis Lazarus, of Allegheny, Pa. The bows are divided to allow of the convenient insertion of new lenses, but have a novel attachment of flexible metal tape or springs, which is scarcely perceivable, to hold the abutting ends of the divided bows pressed down upon the lenses.

A millstone dress has been patented by Mr. Robert Wilson, of Greenup, Ky. The millstone has furrows and lands, the latter with their tops rounded from the inner ends to a circle surrounding the eye, and with their remaining portions made flat, so the bran will not be cut or torn, and the stones are kept comparatively cool.

A combined reclining and rocking chair has been patented by Mr. Henry G. C. Lauer, of Iowa City, Iowa. The rockers are upon the rear legs only, and the arms are adapted to slide upon upwardly extended parts of the rear legs, and when used for reclining the chair will remain in any position to which it may be adjusted.

A truss frame for roofs of buildings has been patented by Mr. William P. Buckley, of Oxford, Chenango County, N. Y. This invention covers a special combination of rods with the framework and braces to support the weight of the roof in such manner as to give the greatest amount of strength and security from the building spreading or roof settling.

An ore and salt drier has been patented by Mr. Robert A. Nevin, of San Francisco, Cal. Combined with a rotating drier, ore roaster, and stack, are specially arranged flues and dampers, making an apparatus peculiarly adapted for drying ores preparatory to pulverizing and chloridizing, and also for drying the salt to be used in the chloridizing process.

A press for moulding ornamental tiles or other articles of cement has been patented by Mr. Jean Larmanjat, of Paris, France. By this invention a slight vertical movement is imparted to the mould table by means of counterweighted levers, springs, etc., to prevent the accumulation of dust and grit between the mould carrying table and the press frame, so the table will not become clogged.

A temporary binder for books, magazines, etc., has been patented by Mr. George E. Alvord, of St. Louis, Mo. A hollow body or back carries book covers of the usual form, and has two hooks, one movable and the other fixed, for engaging the leaves, the movable hook being drawn toward the fixed hook by means of a spring, the device being cheap and easily operated.

A staple has been patented by Mr. Abram Nelson, of New York city. This invention covers a new form of hook staple intended especially for binding the strands of wire fences to the post or framing, the body and point being such that it may be driven independently of the grain of the wood, and arranged vertically or horizontally or at any intermediate angle.

A furnace for annealing metals has been patented by Messrs. Edwin M. Herr, of Denver, Col., and George W. Cummins, of Vienna, N. J. This invention covers a novel construction and arrangement of parts for an annealing furnace in which is an air tight chamber with furnace surrounding it, a piston carrier, swinging gates, and other special features, whereby it can be automatically operated.

A brick machine has been patented by Mr. Charles A. Tarragon, of Portland, Ore. It is made with a sliding frame having cross bars and carrying moulds open at the corners and provided with lugs and pins, with which engage double hooks attached to shafts carrying cam plates, with other novel features, to facilitate the removal of bricks from the moulds of brick machines.

A cartridge loading board has been patented by Mr. Henry W. Howe, of Lawrence, Kan. It has any desired number of holes for receiving shells, and at the bottom side the holes are countersunk to receive the flanges, a hinge being on that side to close against the head of the shells, which are held by holding springs made wedge-shaped and flat, preventing the shells from turning during crimping without injuring the rim. A cartridge shell creaser has also been patented by the same inventor, more particularly intended for loading apparatus of the foregoing kind, but the creaser, either with or without an attached trimmer, may be used separately or in connection with a hand brace or other means for turning it, so that shells may be creased, trimmed, and crimped without removing from the loading board

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.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter,** should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) C. F. G.—Coke, or mixed coke and anthracite, or mixed coke and bituminous, are only injurious to boilers by the amount of sulphur contained. The heat is always supposed to be controllable. For locomotives we should not hesitate in using coke mixed with good bituminous coal.

(2) R. W. C.—There has been no vessel yet built or afloat that can withstand the destructive effect of the best guns now made. You will find most interesting accounts of the direction that active warfare may take in the future by reading the articles on the American cruisers in SCIENTIFIC AMERICAN SUPPLEMENT, No. 432. Also on Rifled Ordnance, SCIENTIFIC AMERICAN SUPPLEMENT, No. 437. On French Iron Clads, No. 442. Also a most interesting account, illustrated and tabulated, of the heavy guns of 1884, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 450.

(3) L. E. I. asks: What size propeller wheel should a boat 25 feet keel 6 feet beam and carrying a 4 horse power engine, use? A. 24 inch 3 blade wheel.

(4) D. B. G. writes: Butterine is made from the best creamery butter and from the finest leaf lard deodorized and thoroughly mixed, a slight amount of butter color being added. It gets its flavor entirely from the butter used. Is there anything that will give this butter flavor, except butter? If so, is it safe to use it? A. Nothing but butter will give the desired flavor. It is safe enough to use oleomargarine, but the trouble is it is generally sold for what it is not—at a high price for deodorized lard, but a lower figure than good butter can be sold at.

(5) A. W. A.—The weights of the largest guns now being made are about 119 tons, 15¾ inches bore and 46 feet long, made by Krupp in Germany. The largest castiron guns made in the United States are the 20 inch 100 ton guns cast at Pittsburg. In May, 1884, the heaviest gun yet made was cast at the South Boston Iron Works—12 inch rifled, 30 feet long, weighing 212,000 pounds finished.

(6) J. W. R. asks the proper way to test gum fire hose. A. Use any pump capable of making the pressure with a pressure gauge attached, fasten a ½ hose coupling to the pump, and to the other half fix a valve for letting out the air; attach the hose to the coupling in the usual way, pump in the water, and let out the air at the opposite end. Pump up by gauge to the required test.

(7) J. W. H.—The compound engine consists of two cylinders, or a combination of a high pressure and low pressure engine in one—the second and larger cylinder taking the exhaust from the first cylinder at about 5 pounds pressure working, as a low pressure engine with condenser and air pump. A triple expansion engine is a new experiment, consisting of three cylinders—a very high pressure in the first, exhausting at a medium pressure to a second, and from the second exhausting at a low pressure to the third cylinder which works under the same conditions as the large cylinder, in the compound type. Extraordinary claims have been made for economy in this class of engines, but possibly without due consideration to weight, complication, and friction. They are yet to be proved a success.

(8) A. H. L. asks: 1. What is the chemical constitution of carbide of iron, or spongy iron, used for filtering? A. Metallic iron. 2. How is it made commercially, and where can it be bought in large or small quantities? A. The carbide of iron is said to be prepared by heating hematite with sawdust. You will find in SCIENTIFIC AMERICAN SUPPLEMENT, No. 124, a description of just how "spongy iron" is made in England, but ordinary fragments of metallic iron are all that is necessary. 3. What literature is there on the subject? A. See the articles on "Filtration" in Cooley's Cyclopædia of Practical Receipts;" also 'Spongy Iron and Putrescent Organic Material," SCIENTIFIC AMERICAN SUPPLEMENT, No. 87; "Experiments with the Silicated Carbon and Spongy Iron Filters," SCIENTIFIC AMERICAN SUPPLEMENT, No. 165; "Filtering and Purifying of Waters, " SCIENTIFIC AMERICAN SUPPLEMENT. No. 195; "The Utility of Water Filters," SCIENTIFIC AMERICAN SUPPLEMENT, No. 209, etc.

(9) A. R. R. asks what is the best material to stick cloth to metallic plate. A. Cloth can be cemented to polished iron shafts by first giving them a coat of best white lead paint; this being dried hard, coat with best Russian glue dissolved in water containing a little vinegar or acetic acid. See also SCIENTIFIC AMERICAN SUPPLEMENT, No. 158.

(10) B. D. A. writes: We have in our city 12 inch water mains and 6 inch mains. Our fire plugs have an outlet of 2½ inches diameter; where connections are made to plugs, water pressure is about 45 pounds per square inch. Will a greater amount of water be discharged from the 12 inch main than from the 6 inch main through the connections? A. The discharge will be nearly the same for all parts of the system for a single hydrant. The largest by a small percentage will be found in the hydrants nearest the source of supply. The 12 inch main probably being nearest the source of supply, has the least friction, and will give the strongest stream.

(11) W. D. C. asks whether the figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, can be placed so as to make 100, that is, using every one and only once? A. 50+37+6+4+1=98+2=100. Several other arrangements are possible of the figures before the equality mark, or the same answer comes by variously using the minus and plus signs in a great number of ways.

(12) P. E. C. says: I have a large collection of French stereoscopic views on glass; they are beautiful, and I would like very much to use them as slides for my "sciopticons," but they are all damaged with spots, I think from dampness. I took the binding paper off of some of them to see if they could be cleaned, but have failed in cleaning them. Will you explain the cause, also the way after cleaning to make them fit for use in the magic lantern? A. The slides referred to are made on an albumen film, and are sulphur toned. There is no possibility of restoring them so as to get rid of the spots. To render such slides of use in the magic lantern, apply a coating of any good transparent varnish, and then touch out the defects by a scraper and the aid of transparent pigments.

(13) H. G. W. asks: 1. Have you ever published a description of an electrical annunciator? A. You will find descriptions of annunciators in the back numbers of our papers. You will find them also in all electrical books. 2. Can you give me directions for making an inexpensive electric battery for open circuit work, such as electric bells, etc.? A. Probably the easiest made and the most satisfactory battery for open circuit work is that known as the Fuller battery, which consists of a porous cell filled to a depth of about a quarter of an inch with mercury and containing a conical or cylindrical piece of zinc for one pole of the battery, the porous cell being placed in a glass jar along with a plate of carbon. The porous cell is filled with water, and the glass jar outside of the porous cell is filled with the ordinary bichromate solution, formed by dissolving bichromate of potash to saturation in hot water, and adding to the solution when cold one-fifth its bulk of sulphuric acid. This solution for the Fuller battery will bear reducing from one-third to one-half with water. 3. Where can I get a good small foot power lathe, for working wood and metal, with and without slide rest and chucks? A. You can obtain good small foot power lathes from any of the dealers in machinery who advertise in our columns. 4. How strong a current will the dynamo-electricity machine described in SUPPLEMENT, No. 161 (I think that is the number), give in volts? A. About six volts. 5. What is the cost of one of them? A. From 40 to 50 dollars. 6. Will a current passed through a No. 16 wire induce a current in a No. 32 insulated wire wound around the large wire at right angles to its axis? A. It will induce a slight current in a fine wire. 7. Can the carbon from gas retorts be sawed into slabs for Grenet battery? A. Yes, but it is an expensive operation. 8. Is this a good solution for Grenet battery. If not, which is the best—sulphuric acid 3 pounds, bichromate potash 1 pound, water 1 pound? A. The solution given above will suit you.

(14) H. H. F. writes: Yesterday, after a warm rain, thousands of fish worms were on the sidewalks. Many were crushed by pedestrians. In an hour not one was to be seen, nor even the remains of a crushed one. Neither were any holes visible where they could have burrowed, though the mud was streaked where they had crawled. From whence do they come, and where do they go? A. This is not at all an uncommon occurrence with the common angle worm. They often, in the earlier part of the year, leave the ground during or after a rain, in myriads. They enter it again just as quickly, *i. e.*, those that are not captured and devoured by birds and numerous enemies. Hence they come from the soil and go back to it.

(15) F. A. B.—For luminous paint see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 229, 249. Use 12 inch fly wheel, about 20 pounds. We recommend you to make a little more study of lathes, and try the operation of those in use before you make one.

(16) P. F. H.—The power of a jet depends entirely upon the pressure of steam and the form of the nozzle and jacket. In a plain pipe, as in your Fig. 1, a half pound pressure might be obtained under high pressure and best arrangement. Your Fig. 2 will have more power than Fig. 1. The pressure will vary with the size of the annular space between the jet and the outer pipe.

(17) F. F. C.—Tide mills seem to have gone out of use. We have no knowledge of makers. Any intelligent millwright should be able to construct an undershot tide wheel to work both ways by making a movable breast, or by setting the wheel in a movable frame to rise or fall with the tide. There are many ways of arranging such machines.

(18) P. M.—Devices for returning the tail race water to the flume are very old, the principle of which was by condensing steam in a large chamber, producing a vacuum, which would lift the water about 20 feet, when by operating large valves the water was discharged into the flume. It has no economy except under some peculiar circumstances.

(19) L. W. asks: 1. Is there a waste of fuel in using two boiler flues 8 inches by 8 inches instead of one 8 inches by 12 inches? A. There should be no loss of heat from the use of the two flues. The friction on the increased wall surface will compensate for the larger size. If the boiler and the connecting flue to the chimneys are properly proportioned, there should be no waste of heat with any size chimney. 2. The party who put in the boiler advised me to fill it with water to prevent rusting, and a machinist advises me to drain it and build a kindling fire in it to dry out. Which is right? A. Lay up the boiler full of water that has been boiled, and close all air valves and vents while steam is on, to keep out air. Moist air rusts a boiler. Water that is free from air does not rust the boiler.

(20) J. W. asks: 1. How high are the highest buildings in New York? A. 125 to 175 feet. 2. What size rope is used for a life line? A. ⅜ to ½ inch diameter. 3. Is it necessary to have an invention patented before it is tested? A. You should at least have a caveat. 4. How can it be introduced? A. We think only by personal trial and business application.

(21) J. C. writes: If a chamber 2 feet long by 1 foot diameter is charged with the solution used in a fire extinguisher, how long would the pressure last and in what manner would the cylinder have to be charged in case you wished for a continuous exhaust through a ½ inch pipe? A. You may charge the cylinder to any desired pressure by varying the quantity of acid and carbonate. You cannot maintain a constant stream. The charge soon blows out, when a cleaning out and renewal is necessary. The cylinder should be charged nearly full with water, and with only enough chemicals to obtain the desired effect. The pressure may be anything from one to a hundred pounds.

(22) A. S.—We think you have selected a poor form of motor for your boat; better make a Trouve or a Deprez motor. You will find descriptions of Trouve's motor in SUPPLEMENT, No. 259, and Deprez motor in No. 212. You will also find a description of Griscom's motor in SUPPLEMENT, No. 267. There is also a description of an electric motor as applied to small boats in SUPPLEMENT, No. 158. We would be unable say what the resistance of your wheel would be without knowing something of its form.

(23) W. A. H.—There are scientific theories in regard to celestial space set forth in the various later works on astronomy. Read Proctor's Myths and Marvels of Astronomy, which we can furnish for $3. Meerschaum is said to absorb nicotine and oil from tobacco smoke.

(24) J. P. McN.—You can make the wire solder by first making a small float pan out of sheet iron, and punch some holes along one of its angles at bottom. Then pour the melted solder into the pan, and drag it along the surface of a piece of flat iron, so that the perforations will be close to the plate. The solder will flow through the holes and chill on the plate. A little practice will show you how fast to draw the pan. You cannot mix any acid with the solder. If the parts to be soldered are perfectly clean, good solder (2 parts tin 1 part lead) will take on the tin dry, but requires acid or resin to make it take on the iron.

(25) F. K.—Tarred roofing paper, or heavy building paper, if well fitted, so as to close all cracks and crannies, and folded against the framing, will make a great improvement in warmth over the naked siding, and may answer your purpose. It will not interfere with a further improvement hereafter by plastering or ceiling with wood, if found deficient on a winter's trial.

(26) A. E. C. writes: In a vessel that weighs 50 pounds, a fish weighing 5 pounds has been put. Will the vessel then weigh 55 pounds, or less? A. The water supports the fish, and both weigh 55 pounds.

(27) J. A.—The objective of a stereopticon would answer very well for a camera obscura. There should be placed above the objective a fine plate glass mirror at an angle of 45 degrees, to throw the image down through the objective. If you desire to show with a single lantern diagrams composed of white lines on blue ground, you should flow the glass with blue lacquer or with fine shellac or French spirit varnish colored with aniline blue. The common method of showing diagrams with a colored ground with two lanterns is to trace the diagram on a smoked glass for one lantern, and to project the blue by means of a blue glass placed in the other lantern.

(28) J. A. D. asks: 1. What causes a lobster to turn from green to red when boiled? A. From the action of the heat on its pigmentary matter; acids and also oil produce a similar effect, but in a manner not perfectly understood, except it is by the further oxidation of the coloring matter. 2. What the terms open and closed circuit infer; whether they are used synonymously with constant and not constant? A. An open circuit is one in which the current does not flow except when work is done. A closed circuit is one through which the current always flows, except when interrupted in doing work. The terms are not synonymous with "constant and not constant" currents. The current flowing from a battery like the gravity is said to be constant. The current from a battery like the Grenet is not constant, because it gradually and continually diminishes.

(29) W. E. McK. asks: 1. Where can I find a description of the compound microscope so clear that I could build one by it? I have all the tools and skill necessary for fine and accurate work, and would like to build a microscope such as would cost in the stores about one hundred dollars, and which would magnify from 50 to 600 diameters. A. We know of no description that would enable you to build such a microscope as you describe. Better borrow a stand and copy it. We would not advise you to try to make the objectives. 2. I am building an induction coil from the instruction given in SUPPLEMENT, No. 160, and would like to arrange it so that I could regulate the current so as to give shocks. Can I do so by fixing a brass tube to the plug (marked J in the drawing), and which would slide in between the tube, A, and the bundle of iron wires, I? A. Induction coil referred to is too large for giving shocks. You can regulate the current by making the magnetic core movable. Sliding it into the coil strengthens the current, and withdrawing it weakens the current. 3. What is the object in having the secondary coil in two parts, and what is tea paper? A. To prevent short circuiting in the coil. Tea paper is a common white paper used in wrapping up tea. Any other paper of medium thickness will answer as well. 4. What is the melting point of the metal aluminum, and what solder can I use on it? It will not stand the heat to flow silver solder, and soft solder will not stick to it. A. About 700° C. We believe there is no good solder, at least not one that is generally known. 5. Please describe the manner in which pliers are made. What I want to find out is how they pass one jaw through the other and make such a nice fit. A. They pass one piece through a large enough opening in the other, then swage and finish them to shape, the one with the opening being cold, having already been shaped. 6. Jewelers use a metal disk for polishing flat surfaces; they call them laps; they are made of some alloy which looks as though lead, tin, or zinc was the principal metal, and are charged with emery. Can you tell me what the alloy is, and the proportions in which it is mixed? A. Laps are made of lead, an alloy of lead and tin, of copper, brass, or cast iron. 7. Would a small electric lamp made after the Brush model and with carbons ⅛ inch in diameter work well with 12 Bunsen cells, or what is called a carbon Smee battery, with bichromate solution? A. If well made, yes.

(30) T. J. writes: 1. I would like to know what nation has the largest man of war ship, name of, and the dimensions of it? A. We believe the British war ship Devastation is the most powerful afloat. Do not know its dimensions. 2. Also, I should like to know what is the best book I could procure to explain the difference of the different navies of the world, and where I could procure it? A. See SCIENTIFIC AMERICAN SUPPLEMENT, No 5, for comparison of German and American navy. Also No. 212 for Peruvian and Chilian iron clads in battle. Also No. 422 for an account of the largest ships of the British navy.

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

A. W. E.—The specimens are called fulgurites, and are vitrified sand tubes supposed to have been produced by the striking of lightning on sand.—D. S. H.—The specimen is sphalerite, or zinc blende, a valuable ore of zinc.

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