SCIENTIFIC AMERICAN

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CITY WATER SUPPLY FROM DRIVEN WELLS.

The city of Brooklyn, N. Y., requires a daily water supply of from forty-five to fifty-five million gallons. There are no natural reservoirs or streams available for furnishing this great quantity and recourse has been had to wells, in a comparatively level stretch of country extending some fifteen or eighteen miles down by Jamaica Bay, toward the ocean, on the south shore of Long Island. From these wells the water is pumped into a brick conduit, by which it is conducted to a large reservoir on high ground on the outskirts of the city, into which it is lifted by pumping engines.

Previous to 1882 the supply of water was all obtained from large open wells, but in that year a contract was made with Messrs. William D. Andrews & Bro., of New York, for furnishing an additional supply of five millions of gallons of water daily, by their system of tube, driven and gang wells. One of the illustrations herewith shows a pumping station—there being four now in operation—whereby water is supplied from these driven wells, and in another view is a diagram illustrating the underground strata and watercourses through which the tubes are driven to reach sources most likely to be permanent, and furnishing water of a satisfactory character. This Forest Stream pumping station was established under a contract with the city of Brooklyn to furnish therefrom five millions of gallons of water daily, but it has furnished as high as nine million gallons in twenty-four hours, and regularly supplies six to seven million gallons daily. From the four driven well stations the agreed upon supply was eighteen and a half million gallons daily, but as high as twenty-seven million gallons have been furnished, the average being about twenty-two million gallons a day. At all of these stations Knowles pumps are used (a full description of the plant was published in the SCIENTIFIC AMERICAN of April 10, 1886); but at the open well stations from which the remainder of the Brooklyn water supply is furnished, both Worthington and Davidson pumps are employed.

The manner of driving tube wells is so well understood that a bare reference thereto is all that is necessary. They are simply two inch tubes (this size being generally found best in practice), with a galvanized steel point, above which comes a perforated brass strainer. These tubes are driven into the ground by means of a simple portable pile driver, worked by hand, a new section of tubing being tightly screwed on top as each successive length is thus forced into the ground, until the well has reached the desired depth. Of course it is important, in locating in one place a gang of wells from which so large a supply of water is to be steadily drawn, to have a thorough understanding of the stratigraphical features of a sufficiently large area of the surrounding ground, the natural rainfall on which must furnish the supplies which feed these underground streams by slow percolation. Yet these underground waterways are generally not difficult to find in any considerable extent of comparatively level country, and usually at a surprisingly slight distance below the surface. The manner in which these streams are frequently formed, one above another, at various depths, is clearly indicated in one of our illustrations, and the picture also shows one of the great advantages of the driven well over the ordinary open well, in that the tube may be driven entirely through one or more streams of water to take its supply from a source which may be deemed still more desirable yet lower down. In the pumping station we have illustrated, many of the driven wells are made to take water from two or more of the underground streams, by the interposition of lengths of tubing with openings and strainers at heights corresponding with the channels of the streams.

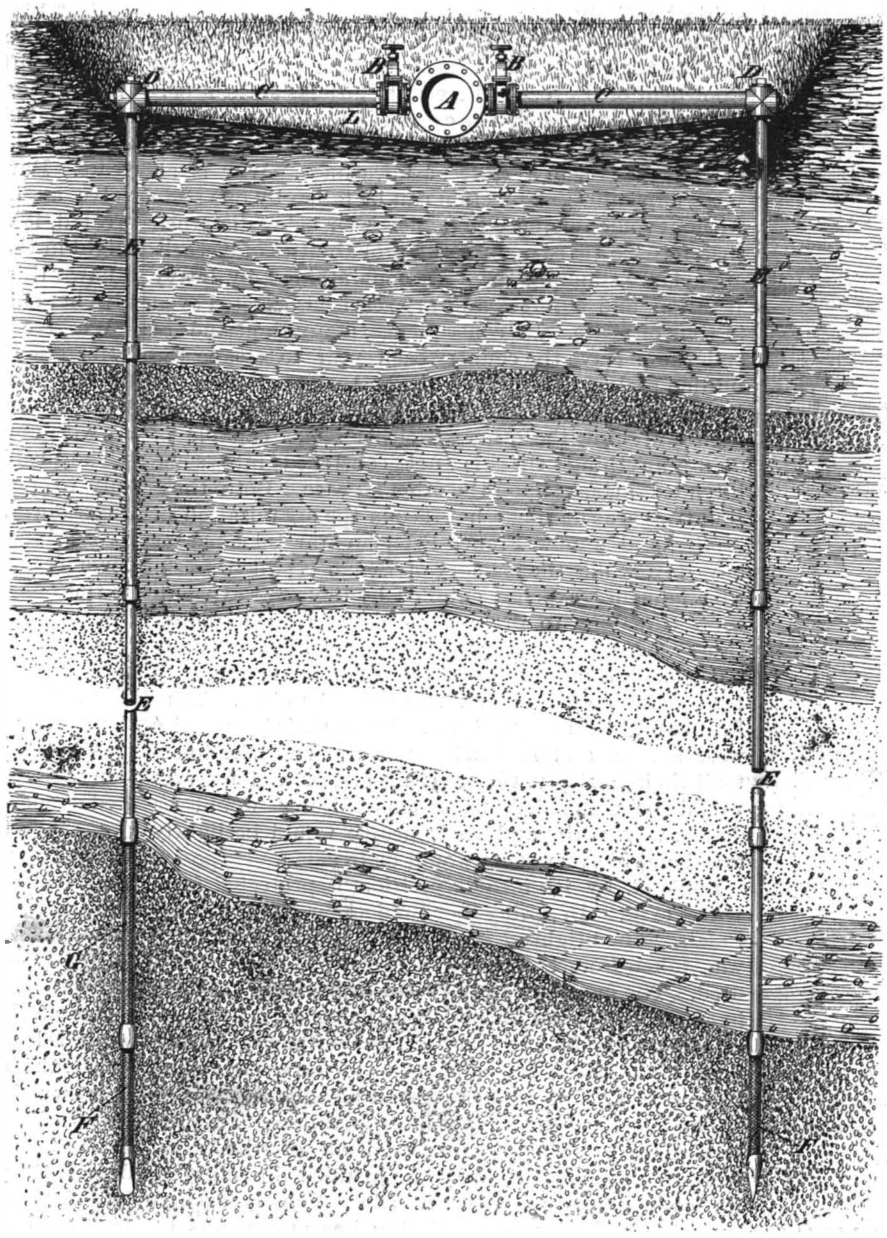
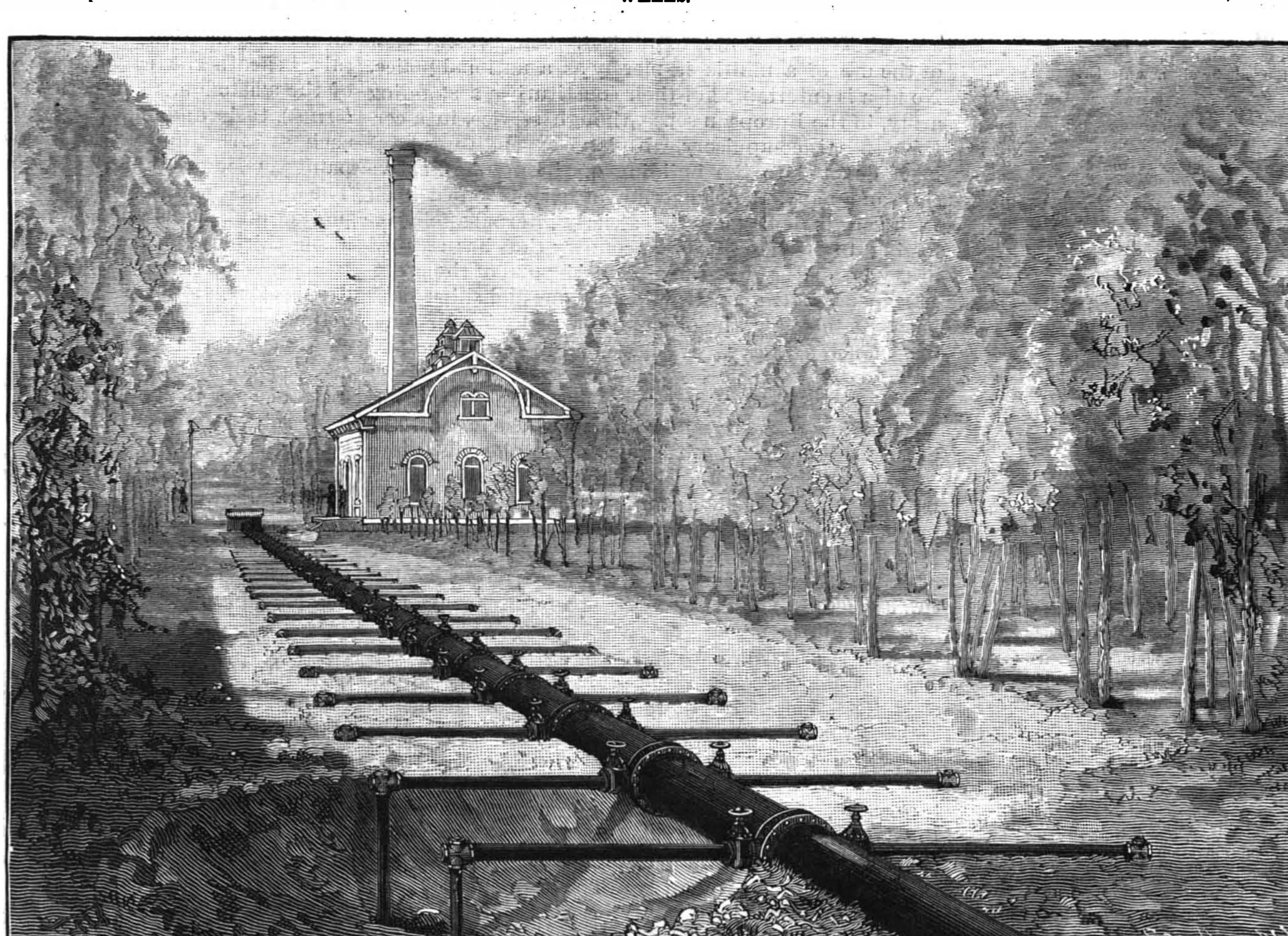


DIAGRAM SHOWING UNDERGROUND WATER COURSES PIERCED BY DRIVEN WELLS.

In the diagram showing how the underground strata are pierced by the well tubes, A represents a 16 inch collecting main, which is several hundred feet long, extending out both sides from the pumping station. A connecting pipe, C, three inches in diameter, leads from each well, E, to the collecting main, a valve, B, serving to cut out any single well from the system, and D representing a valve used at the top of the driven well, by which, also, connection may be made with still other driven wells.

There are, doubtless, a great many towns and cities in the country which may profit by the experience of the city of Brooklyn in this line. There is no other filter for water equal to the agents for such purpose that nature provides, and the localities are almost numberless where underground streams of such filtered water can, with proper skill and intelligent effort, be made to supply the wants of communities at a cost less than that often expended on obtaining supplies from other and less desirable sources.



FOREST STREAM DRIVEN WELL STATION, NEAR BROOKLYN, N. Y.

A CORRESPONDENT of the *Rural New-Yorker* found onion roots a foot long and still going down, though too fine to follow.

Scientific American.

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NEW YORK, SATURDAY, FEBRUARY 12, 1887.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 580.

For the Week Ending February 12, 1887.

Price 10 cents. For sale by all newsdealers.

THE COAST DEFENSES OF THE UNITED STATES.

In the House of Representatives on Tuesday, January 25, a letter from Admiral David D. Porter was read in reference to the above subject. It called attention to the defenseless condition of our ocean and lake coasts, and to the want of armed vessels and ordnance. While it is not advisable to admit the propriety of alarming the people of America, there are many facts and views presented in the Admiral's communication that are striking. His remedy, too, is good, if the necessity he insists on be admitted. It is to spend ten millions of dollars each year for ten years to come upon the creation of a navy. If a navy is needed here, this is the only way to acquire it. Unless large appropriations be devoted to it, the best plan is to dismiss the subject entirely.

The perfect ideal of a government is one that confines itself to the regulation of its own affairs only. On the Continent of Europe, where state adjoins state, a perpetual menace exists. The eagerness for the acquisition of new territory, the desire for satisfying old feuds, keep the powers ever in a state of uneasiness. War is always impending. No action can be taken by one state without some reference to its neighbor being discerned therein. To guard against the probabilities of disturbance, large standing armies are maintained, by heavy taxation, and enforced military service is exacted even in time of peace. In consequence, many thousands of emigrants leave the country each year to escape the burden of devoting some of the best years of their life to the camp and drill. Germany and France are each watching the other. Neither seems capable of doing anything that is not construed into some intended attack upon the other's peace. Both these countries are running a hot race in the organization of armies, and a new Franco-Prussian war is looked for any day, while the memory of Sedan is still so fresh. The immense expense entailed by their war expenditures threatens to drive these countries into bankruptcy. No better illustrations of the ill effects upon a nation of the policy or of the unfortunate necessity for holding itself ready for war could be cited. Were France and Germany able to feel that their boundaries were secure, and had neither of them a desire to extend their territory, the standing armies and reserves would be disbanded, navy expenditures would be done away with, and their people would be lightly taxed and in every sense would be freemen.

England, by its insular position, is protected from these evils. In losing her hold upon France, when Calais, "the brightest jewel in the crown of England," was taken from her, she was probably greatly benefited. The more her Hanoverian aspirations are held in check, the better for her. She has no such immense standing army and reserves as the Continental powers maintain. The twenty miles of water between her and the rest of Europe are her greatest blessing.

The United States are yet more fortunate. They are separated by the oceans from all of the great nations. If any country is justified in minding its own affairs only, it is she. She is exempt from the necessity of regulating her movements by those of other governments. This feeling of security has had most beneficial effects upon the happiness and freedom of her people. The old militia service has, to a great extent, fallen into neglect. The present view of the use of a militia is merely as a national police. No idea is entertained of their constituting a standing army, in the European sense, though service, in a certain sense, is compulsory. No large expenditures have been devoted to the building of the non-productive ships of a navy. The government has concerned itself with very little beyond the strictly internal affairs referring to itself only. The country thus has escaped heavy burdens of taxation. Experiments of the greatest expense in the construction of guns and ships have been conducted by the other powers really for our benefit as much as theirs. We have had to pay for no failures.

Within the last few years a sentiment has been growing in favor of the re-establishment of the navy. The present administration has met the popular views to a certain extent by taking steps in the direction of acquiring war ships. The sentiment has developed quite recently into a feeling of alarm. Meetings have been held and considerable agitation created, with the idea of calling the attention of Congress to the defenseless condition of our coast. Twenty-six prominent sea harbors and all the lake ports have been reported to Congress by the board on fortifications and defenses as utterly defenseless. The assumption made is that any of these harbors may be entered by one or more ironclads and the cities may be devastated or laid under tribute.

We do not believe that a feeling of insecurity should be created. War is not threatening us, and if it were, the danger would be provided for in some way. The efficacy of heavily armored ships is still to some extent an unknown quantity. The ordnance of the present day can pierce anything short of a Gruson turret or some fortification of that sort, too heavy for flotation. A fleet of small armored vessels of high speed, and provided with rams, could be rapidly constructed and put afloat. Much could be done by utilizing the fast river steamers now afloat. Light armor could be placed upon them, enough to resist smaller pieces, and they could be used as rams of satisfactory power. A number of vessels of the smaller class could, by the force of numbers, do effectual service in repelling attack.

Admiral Porter presents his views with much clearness and force. He advocates the immediate purchase of six hundred guns, and the building of ships to carry them. He gives the list of the "real navy" of this country as including eighteen ships, thirteen in embryo, and only one, the Dolphin, complete in all respects as regards armament and equipments in general. He states that we have but twenty-nine high-power guns, against 18,000 distributed between England, Russia, and France. His idea of a suitable American navy includes fifty heavy ironclads and seventy cruisers. Admiral Porter's one hundred million dollar appropriation could be supported, undoubtedly, by the people, distributed, as he proposes it to be, over a period of ten years. But the creation of such a navy would involve an immense sum for its maintenance. When created, it would act as a threat to foreign powers, and might in that way bring war upon us. Possessing such a navy, this country might be tempted into war, to give her ships something to do.

We give some quotations from Admiral Porter's letter elsewhere. Meanwhile, we propose a problem for our readers to solve. Assuming the port of New York to be threatened by ironclads, what could we do with our present means to defend it?

The problem is a good one, as being addressed not only to professional men and to representatives of the sciences, but also to all thinkers. Inventors here have a broad field for study. Those who have never devoted much thought to these special subjects may be the ones who will present the most striking plans. Originality unfettered by previous conceptions sometimes furnishes suggestions of value. The experience of soldiers and sailors, and of artillerists too, may be drawn upon for giving a practical cast to the solution. No limit of territory to be drawn upon for supplies need be included, as Pittsburg, and even the iron regions of the South and West, may be considered as close at hand, in view of the railroad facilities. Thirty days should be the period supposed to be allowed for completion of the defenses. We shall be glad to hear from every one having ideas to present, and trust we shall receive plans worthy of illustration and description in our columns.

A Remarkable Salt Bed.

One of the most remarkable salt formations in the world is located on the isle of Petit Anse, Southwestern Louisiana, 125 miles due west from New Orleans. It is owned by the Avery family. This singular salt deposit is sufficiently unknown to bear the light of a more thorough investigation than it has had. The deposit is pure crystal salt. So far as it has been traced, there are 150 acres of unknown depth, explored 140 feet down. The surface of the bed undulates from one foot above to six below tide level. The earth covering the salt ranges from ten to twenty-three feet in depth, but one hill rises 183 feet above, showing that an after-formation took place. On the top of the salt, beneath the earth, have been found the remains of the mastodon, mammoth sloth, horse (*Equus fraternus*), tusks and bones intermixed with Indian relics, such as arrow and spear points, tomahawk heads, paint pots, mortar and pestle, and pottery of all kinds. The dip of the salt is eight degrees. There is a deposit of pink sandstone quite decomposed, a coal formation thirteen to seventeen feet thick and seventy-two per cent carbon, the lignite cropping out a hundred feet above the sea. Over the salt come pink and yellow clay beds, then the sandstone and then the clay, each stratum trending toward the north. There are also sulphur springs. The salt is a conglomerate mass of crystallizations, which in the mine look like dark salt, but when exposed to the light are seen to be white. By analyses the salt is $99\frac{88}{100}$ per cent pure; the remaining three twenty-fifths is made up of sulphate and chloride of calcium. The position of the salt shows it to be older than the coal and sandstone which lie above it, and also the mastodon and contemporary prehistoric mammals. The deposit was discovered in 1862 while a well was being excavated. It was seized by Jefferson Davis and afterward by Admiral Farragut. It is now worked by a New York concern, which pays the Averys $5,000 per month royalty. To show the value of land here, it may be stated that a single acre, on which grow little peppers, yields a clear profit of $10,000 per year on the well known Tobasco table sauce.—*American Naturalist.*

BY the addition of automatic attachments to a press and pair of gang dies, the Ferracute Machine Company, of Bridgeton, N. J., have succeeded in producing 288,000 lamp collars per day in a single press. This is at the rate of 480 per minute, and affords an explanation of the low prices of some sheet metal manufactures.

PHOTOGRAPHIC NOTES.

Washing Bromide Prints.—According to E. W. Foxlee, in an article in the *British Journal Photographic Almanac*, it is highly important that every trace of acid be eliminated from the print before it is transferred to the fixing bath, if permanency and pure whites are to be obtained.

It is suggested in a recent article on the subject in the *British Journal of Photography* that this is best accomplished by thoroughly washing the print under a rose with good pressure of water, and supporting the print upon a sheet of glass somewhat larger than the print, or, instead of glass, a sheet of ebonite or hard rubber. We formerly employed this process of washing with much success, until it was suggested that the prints could be safely washed in tanks of running water, which is the plan we now adopt. But when only one or two prints or enlargements are to be made, we recommend the plan of supporting the paper as specified, as being much the quickest and equally as efficacious.

The *British Journal* advises the use of the following appliances:

A dish or tray to contain the fixing solution, and another for washing the prints; a rose, like that of a garden watering pot, with very fine holes. This must be fixed in a piece of India rubber tubing eighteen inches or two feet long, attached to the water supply. A couple of glass plates, somewhat larger than the pictures to be treated, and a rather soft squeegee. Instead of glass, thin sheets of ebonite, mounted on boards to give rigidity, may be substituted with advantage, as they are less fragile than glass.

Continuing, it says:

Taking the picture in hand from the developing stage, the first thing to be done is to free it from the acid. This may be easily and quickly accomplished by washing if a good pressure of water be available; and we prefer simple washing to treating the print with an alkali.

The print is placed face upward on a glass or ebonite plate, and a stream of water from the rose is directed upon it with all the force that can be obtained. This will quickly wash out the acid, if the development has been conducted from one side only; but if the development has been effected by immersion, then the back as well as the front must be similarly washed. A slip of litmus paper pressed on the surface of the print, after slight draining, will always indicate if the acid has been removed. Experience will soon teach the operator when this has been accomplished without the necessity of testing chemically. The print is next freed from water as much as possible by draining, or, better still, by laying it on one of the glass plates and passing the squeegee lightly over the back. It is then ready for immersion in the fixing bath. This should consist of two pounds of hyposulphite of soda dissolved in a gallon of water and made slightly alkaline.

When the print is placed in the bath, it should be kept constantly in motion for the first five minutes, and occasionally for the remainder of the time—not less than twenty minutes. The picture is then removed and placed face downward on one of the plates, and the back squeegeed somewhat firmly to remove as much as possible of the "hypo" solution. It is then immersed in a dish of clean water and kept in motion for a few minutes. It is now removed and placed on one of the plates and the back squeegeed, and next it is removed to the other plate, face upward, and a stream of water from the rose with full pressure directed upon it. Then it is transferred to the first plate again, this time with the face downward and the back similarly treated. After this operation has been repeated on both sides, two or three times, the back is squeegeed and the print again put into clean water and allowed to soak for ten minutes. It is then removed and subjected to the syringing and squeegeeing operations as before.

By alternate soaking for ten minutes or so, and treating the picture as directed, the last trace of the hyposulphite can be more completely removed from the enlargement in an hour and a half, or two hours, than it may be with twelve hours or more of continuous soaking, even in running water, notwithstanding that the paper itself may be thick. The force of the fine jets of water from the rose dashes, as it were, the hypo out of the paper. It is needless to point out that the plates used for supporting the prints during the operations of squeegeeing and syringing should be thoroughly rinsed each time the picture is removed.

The directions here given for washing gelatino-bromide enlargements apply also to albumen prints. By treatment similar to the above, hyposulphite may be more thoroughly removed from a picture in an hour or so than it often is by simply allowing it to remain soaking in water for a whole day.

Two fixing baths are recommended to be employed. This is highly desirable when working on a commercial scale, or when a large number of prints are fixed in the same solution; but it is scarcely necessary when only one or two have to be dealt with, provided the solution be new and there is plenty of it, and, what is of equal importance, the prints are kept constantly moving about while they are in the solution.

Admiral Porter on the American Navy.

We give below some extracts from the letter from Admiral Porter to Congress, alluded to elsewhere. It is impossible to present the full reprint of the document by any number of extracts. We fail to agree with the Admiral in many of his conclusions.

"The board on fortifications and other defense represent the following harbors as entirely defenseless: 1, New York; 2, San Francisco; 3, Boston; 4, the lake ports; 5, Hampton Roads; 6, New Orleans; 7, Philadelphia; 8, Washington; 9, Baltimore; 10, Portland, Me.; 11, Rhode Island ports in Narragansett Bay; 12, Key West; 13, Charleston, S. C.; 14, Mobile; 15, New London; 16, Savannah; 17, Galveston; 18, Portland, Oreg.; 19, Pensacola, Fla.; 20, Wilmington, N. C.; 21, San Diego, Cal.; 22, Portsmouth, N. H.; 22, defenses of Cumberland Sound at Fort Clinch; 24, defenses of ports of the Kennebec River at Fort Popham; 25, New Bedford, Mass.; 26, defenses of ports on the Penobscot River, Maine, at Fort Knox; 27, New Haven, Conn.

"These harbors are to my knowledge entirely defenseless against a single first-rate armorclad, which could enter any of them at any time without any difficulty. Twenty heavy ironclads could in as many days lay every important town on our seaboard under contribution; so that by a well-concerted action by an enemy every harbor on our coast, on the same day, would fall into their hands."

"Note.—Defenses are most urgently required at the first eleven ports named."

We believe that a hostile ironclad in New York harbor would find herself in very hot water. The river boats and coasting steamers would be utilized to ram her or destroy her by torpedoes.

"Our lakeboard cities are entirely open to the attacks of the British navy. In twenty-four hours the English could overrun our lakes with gunboats and ironclads by means of the Welland Canal, and we have not a gun to prevent their doing so."

The Welland Canal could be put out of service in a few minutes. Our first move would be to capture it, and then no ironclad could make her way through it, or, if any danger of it appeared, the locks could be destroyed one by one.

"But we cannot expect to be always exempt from the difficulties that beset nations any more than other powers. Within the last year we have had a difficulty with Canada on the fishing question, which at one time promised to be serious, and nothing but the moderation and good sense of this Government prevented a crisis. Canada, with an improvised navy of two schooners, made actual war upon our fishing interests, captured our vessels on the most trifling pretexts, and scarcely gave them time to meet the requirements imposed upon them by the authorities. Does any one pretend to say that these aggressions would have taken place had the Government of the United States been provided with a force of fifty heavy ironclads and seventy fast cruisers? I unhesitatingly answer 'No.'"

The Admiral's immense navy would undoubtedly prove stronger than the improvised Canada navy of two schooners. But the fishing treaty aggressions can be dealt with on a lighter basis than one hundred and twenty ironclads. To re-enforce their navy, the Canadian authorities, within a few months, came to us and purchased an American vessel, the Yosemite. The game would hardly be worth the candle if an immense navy is to be created to enable our fishing vessels to violate treaties with Canada.

"We are building at the Washington navy yard new improved rifles equal in workmanship to any in the world, and the Bureau of Ordnance is hard at work on the batteries for the Chicago and Boston, which will make, when finished, eight 8 inch, nineteen 6 inch, and two 5 inch; in all, twenty-nine as the sum total of all the new high powered guns contained in the United States navy; and, to give you an idea of the paucity of resources of this favored land, most of the forgings for the tubes and jackets for these guns were furnished by manufacturers in England. Purchasing steel forgings abroad may be considered humiliating for Americans, but it is no more so than buying anything else there that can be furnished better than here or that we cannot furnish at all."

This has some of the right ring to it. We can finish guns in this country. The Canadians showed no feelings of humiliation in buying a ship here, in preference to the mother country. We should purchase steel forgings where we can get them cheapest.

The question of humiliation is a purely sentimental one, and does not apply to the present case.

"We, sitting here quietly, hardly realize that such a magnificent channel of trade as Puget Sound exists or that we have any rights there, while the Canadian Pacific Railway is now completed, and it is said that arrangements are perfected by which freight and passengers can be promptly transferred by rail and steamships from London, *via* Montreal, to Victoria, and thence by steamer to Yokohama and Hong Kong. There is enterprise for you, well calculated to throw the boasted enterprise of Americans into the shade. The nations of the earth are looking for the shortest route to and from China. The nation that can retain possession of the Eastern trade will be the richest on earth."

In the event of a war, the Canadian Pacific road would fall into our hands. As it is, we have led the way across the continent, and cannot stop Canada from building railroads. It is not our part to violently oppose the execution of peaceful enterprises, or to go to war for the purpose of hindering the development of Canada.

In fine, we believe that America is not yet forced to the wall. We doubt if she is in such imperative need of a navy as the Admiral thinks. We believe there are resources enough in the country for her ample protection at very short notice.

Useful Recipes.

The *Sanitary Plumber*, which should be good authority in such matters, gives the following recipes for plumbers and others:

Chloride of zinc, so much used in soldering iron, has besides its corrosive qualities, the drawback of being unwholesome when used for soldering the iron tins employed to can fruit, vegetables, and other foods. A soldering mixture has been found which is free from these defects. It is made by mixing 1 pound of lactic acid with 1 pound of glycerine and 8 pounds of water.

A wooden tank may be rendered capable of withstanding the effects of nitric or sulphuric acids by the following methods: Cover the inside with paraffine; go over the inside with a sadiron heated to the temperature used in ironing clothes. Melt the paraffine under the iron so as to drive it into the wood as much as possible, then with a cooler iron melt on a coat thick enough to completely cover the wood.

For brassing small articles: To one quart water add half an ounce each of sulphate copper and protochloride of tin. Stir the articles in the solution until the desired color is obtained. Use the sulphate of copper alone for a copper color.

To clean rust from polished steel, mix 10 parts of tin putty, 8 of prepared buck's horn, and 25 of spirits of wine to a paste. Cleanse the article by rubbing with this, and finally rub off with blotting paper.

A good cement for celluloid is made from 1 part shellac dissolved in 1 part of spirit of camphor and 3 to 4 parts of 90 per cent alcohol. The cement should be applied warm, and the broken parts securely held together until the solvent has entirely evaporated.

Tin and tin alloys, after careful cleansing from oxide and grease, are handsomely and permanently bronzed if brushed over with a solution of one part of sulphate of copper (bluestone) and one part of sulphate of iron (copperas) in twenty parts of water. When this has dried, the surface should be brushed with a solution of one part of acetate of copper (verdigris) in acetic acid. After several applications and dryings of the last named, the surface is polished with a soft brush and bloodstone powder. The raised portions are then rubbed off with soft leather moistened with wax in turpentine, followed by a rubbing with dry leather.

Curiosities of Alloys.

The way in which an alloy of gold and copper or other metal is affected by a small quantity of impurity presents one of the most serious difficulties with which our case makers and jewelers have to deal in working gold. It has long been known to workers in the precious metal that minute quantities of certain metals render it brittle and unworkable; and referring to this, in a lecture at Birmingham, Professor Roberts-Austen, of the Royal Mint, said:

"It may be well to demonstrate the fact. Here are 200 sovereigns. I will melt them, and will add, in the form of a tiny shot, a minute portion of lead amounting to only the 2,000th part of the mass; first, however, pouring a little of the gold into a small ingot, which we can bend and flatten, thus proving to you that it is perfectly soft, ductile, and workable. The rest of the mass we will pour into a bar; and now that it is sufficiently cold to handle, you see that I am able to break it with my fingers, or, at least, with a slight tap of a hammer. The color of the gold is quite altered, and has become orange brown; and experiments have shown that the tenacity of the metal—that is, the resistance of the gold to being pulled asunder—has been reduced from eighteen tons per square inch to only five tons. These essential changes in the property of the metal have been produced by the addition of a minute quantity of lead."

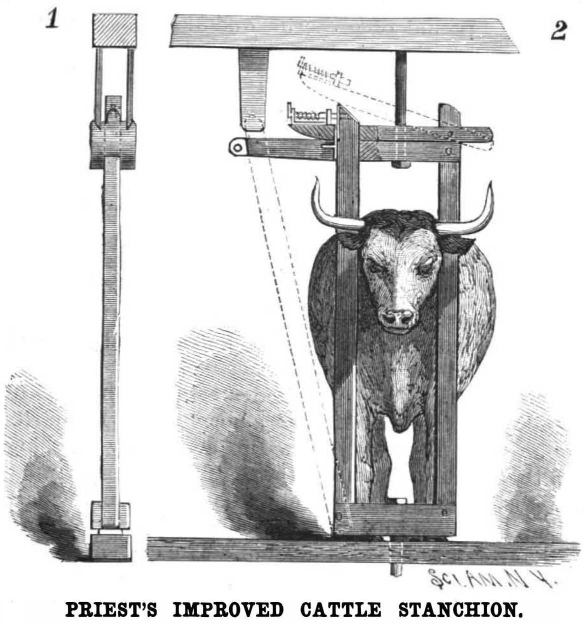
In the same lecture Professor Roberts-Austen said: "Here is a bar of tin, 2 ft. long and 1 in. thick, which it would be most difficult to break, though it would readily bend double. If only I rub a little quicksilver on its surface, a remarkable effect will be produced—the fluid metal will penetrate the solid one, and in a few seconds the bar will, as you see, break readily, the fractured surface being white, like silver."

New Russian Canal.

The Russian Government has contracted a loan of 25,000,000 rubles with the firm of Hersent & Co., Paris, for the construction of the Perekop Canal in Southern Russia. M. Louis Caisseau, a French engineer of Suez Canal fame, is to be the chief engineer. The canal will establish a direct communication between the River Don, the Black Sea, and the Sea of Azov, and will also be the medium of connecting several South Russian railway lines. It will be of considerable strategical importance, but its commercial significance will be still greater, as it will enable coal to be brought from the rich mines in the vicinity of the River Don to the Black Sea, where their selling price will be lower than that of English coals, which, at present, are the only kind used at Constantinople and the Black Sea ports.

IMPROVED CATTLE STANCHION.

The cattle stanchion which we herewith illustrate is the invention of Mr. John Priest, of Franconia, N. H. The stanchion is pivotally held between the floor of the stable and any stationary upper beam, by two bolts, arranged as clearly shown in the engraving. To one end of the base block is rigidly connected a vertical upright, to which is rigidly connected a cross bar formed with an elongated slot. To the other end of the block is pivoted a swinging bar, whose upper end slides in the slot in the cross bar. Above the cross bar is a catch bar, formed with a slot, through

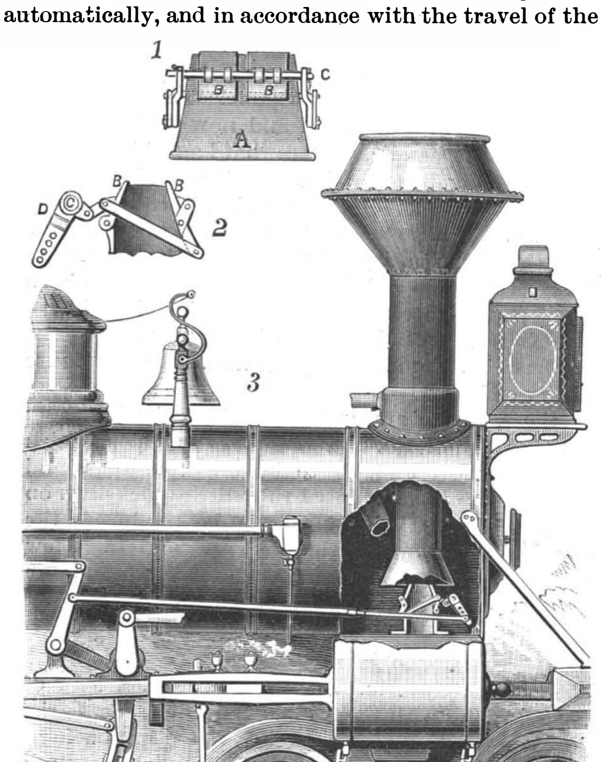


PRIEST'S IMPROVED CATTLE STANCHION.

which the end of the swinging bar projects. Upon one end of the catch bar is a bracket carrying a bolt pressed forward by a spring to enter a hole in the swinging bar, and thus hold the parts in the position shown by the full lines. When the bolt is withdrawn, the catch bar can be raised and the swinging bar moved to the position indicated by the dotted lines. A preferred method of preventing the cattle from raising the catch bar is by means of a plate secured to the outer face of the swinging bar, which prevents the animal from passing its horn up through the slot and raising the bar. When the plate is used—the locking bolt being, of course, then left off—the catch bar can be raised by pressing on the short handle end of the bar by hand, or by means of a pole from the rear of the stall; but when the bolt is used, the stall must be entered to release the bolt or raise the bar. The upper stationary beam carries two downwardly extending arms, so arranged that when the bar is swung back to the position shown in dotted lines, the stanchion will be held in a line parallel with the beam, that is, it will be prevented from turning on its pivotal supports.

EXHAUST MECHANISM FOR LOCOMOTIVES.

This exhaust mechanism for locomotives operates automatically, and in accordance with the travel of the



WALLACE'S EXHAUST MECHANISM FOR LOCOMOTIVES.

cylinder valves. Opening into the smoke stack is the exhaust nozzle, to the upper end of which are hinged doors operated by levers connected with the reversing shaft. Fig. 1 is an enlarged end view, and Fig. 2 is a side elevation of the improvement, which is shown attached to the locomotive in Fig. 3. The cylinders exhaust into the nozzle or pipe, A, which is provided on two opposite sides with the doors, B, which are formed with lugs, through which passes a rod connected by a link with arms secured to a shaft passing transversely through the boiler. On the outer end of this shaft is a crank arm, D, to which is attached an adjustable rod connected with an arm secured to the reversing shaft, as shown in the large view. In the arm are apertures, which permit of regulating the throw of the arm according to the travel of the cylinder valves. When the arm on the reversing shaft is in mid-position, the doors are nearest each other; when the arm is in either extreme position, the doors are furthest apart.

The doors are moved simultaneously toward or from each other, according to the oscillation of the reversing shaft, and thereby open or close the upper end of the exhaust nozzle, thus increasing or diminishing the opening for the free exit of the exhaust steam. The doors swing inward toward each other when the engine is using the least steam, and are swung apart and opened when the valves are opened to their greatest extent. This automatic opening and closing of the doors permits a free escape of the steam, thus preventing back pressure in the cylinders, increases the steaming qualities of the locomotive, and effects a saving of fuel. One lever arm, D, operates the doors upon both sides of the nozzle through the connections shown in Fig. 2.

The inventor of this mechanism, Mr. Ira F. Wallace, of Altoona, Wisconsin, a locomotive engineer running on the eastern division of the C., St. P., M. & O. Railway, has had his invention on an engine for the past year, the result being, as shown by the monthly official report, an increase of from 8 to 10 miles per ton of coal with this engine over other engines of the same class on the same division.

Liquid Fuel.

It appears, after an experiment of several months, that ferry boats plying between San Francisco and Oakland, which had been fitted up for burning petroleum, have now gone back to coal. The economy, as we understand, so far as the consumption of fuel is concerned, is said to be decidedly in favor of petroleum; but the trouble in its use came from the intense heat produced, by which, or by the peculiar nature of the combustion, the iron of both the furnaces and boilers began to indicate rapid deterioration—hence the return to coal.

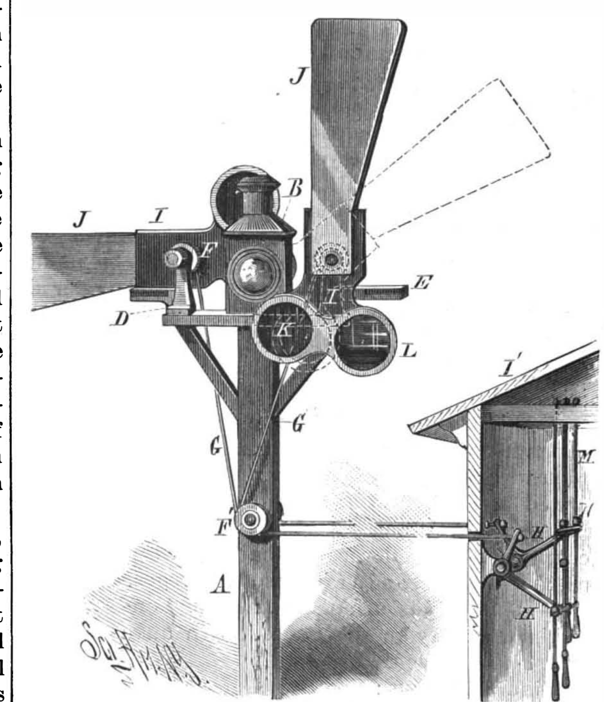
Instantaneous Process with Bitumen.

To obviate the drawback of the very feeble sensitiveness of bitumen of Judea, a process has been conceived, published quite recently by Geymet, which process consists in the application of a film or, better still, of a print in carbon, superimposed on the film of bitumen. This is how it is worked: The zinc is first covered with a film of bitumen in the ordinary way; then a carbon image is developed on paper for double transfer (flexible support), and transferred to the film of bitumen. This image forms a protection. The bitumen is then dissolved with spirit of turpentine, but the bitumen coating is not dissolved where it is covered by the lines of the carbon image. The plate may then be etched with acid in the ordinary manner. Again, the film of bitumen may be covered with one of bichromated albumen, exposed to the light, developed in cold water, and then the bitumen not covered with albumen dissolved.

IMPROVED RAILROAD SIGNAL.

The object of this signal, which may be used on either a single or double track road, is to enable the operator to communicate accurately with trains at a distance the condition of the block or track while the trains are under full speed or otherwise. The vertical post, A, is provided with a horizontal top bar and a stationary lamp, B. Upon each outer end of the top bar are secured standards, D, formed with horizontal arms, E, upon the upper surface of each of which is a hard rubber block. Pivoted to each standard is a light metal frame, formed at one end with two distinct circular openings, and having the sheave, F, rigidly attached to it. Secured to the rectangular portions of the frames are wooden arms, J, which constitute, by their position in relation to the standards, signals by day. Cables attached to the fixed sheaves, F, pass downward over sheaves, F', to the bell crank levers, H, in the station, I, where they are operated by means of the cords, M, which are attached to the ceiling at one end, the other ends entering apertures in the levers and terminating in suitable handles.

The different positions of the signal arms are controlled by the position of stops, N, upon the cords, which come in contact with the upper side of the lever when the handle is drawn back. When the signal arm is thrown to a vertical position, it indicates a safety signal by day and the unobstructed white light by night. When the arms are set in a horizontal position, a danger signal by day is indicated, and as the red disk, L, is then in front of the lamp, a danger signal is indicated at night. When the arms are at an angle, a cautionary signal is indicated by day and the same at night, as the green disk, K, is then in front of the lamp. When in a horizontal position, the arms rest upon the rubber blocks on the arms, E, of the standards, D. The signal will return to the red or danger position automatically the instant it is released by the operator, or in case of breakage. The failure to operate the signal, either on the part of the attendant or owing to



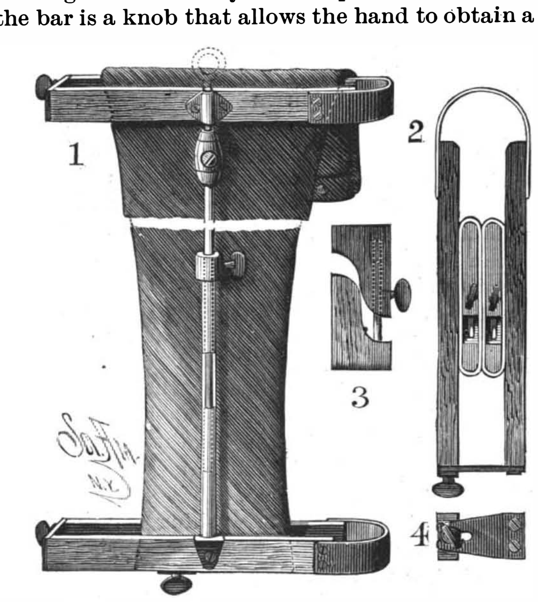
COX & BLACK'S IMPROVED RAILROAD SIGNAL.

breakage, is a notice to the approaching train that something is wrong, which in itself is a signal to stop and ascertain the cause.

This invention has been patented by Messrs. J. C. Cox and W. F. Black, of Louisville, Ky.

TROUSERS STRETCHER.

Trousers stretchers now in use, while stretching the trousers, give an objectionable shape to their bottoms, and form a crease front and back. Another objection is that they are not adapted to different sizes of trousers. It is claimed for the invention here illustrated that it is adjustable to any size of trousers; that it will not form creases in them; and by the use of adjustable forms inserted in their bottoms, it not only does not give any objectionable shape to them, but directly tends to restore their original shape; it is thoroughly effective in stretching the trousers, as well. Engaging with the upper and lower part of the pantaloons is a clamp, Fig. 2, consisting of two bars united at one end by a bent spring, and provided at the other end with a slotted strap and screw, Fig. 4, by means of which the bars are held against the trousers. Within the bottom of each leg is placed a tree, Fig. 3, the bars of which have rounded faces, and can be adjusted, by means of a rod and clamping screw, so as to properly occupy the bottom portion of the pantaloons. When the clamps are located in the position shown in Figs. 1 and 2, they grasp the top and bottom of the pantaloons. Connected with one of the clamps is a tube in which slides a bar entering a socket secured to the other clamp, the tube being provided with a screw for holding the bar in any desired position. Attached to the bar is a knob that allows the hand to obtain a firm



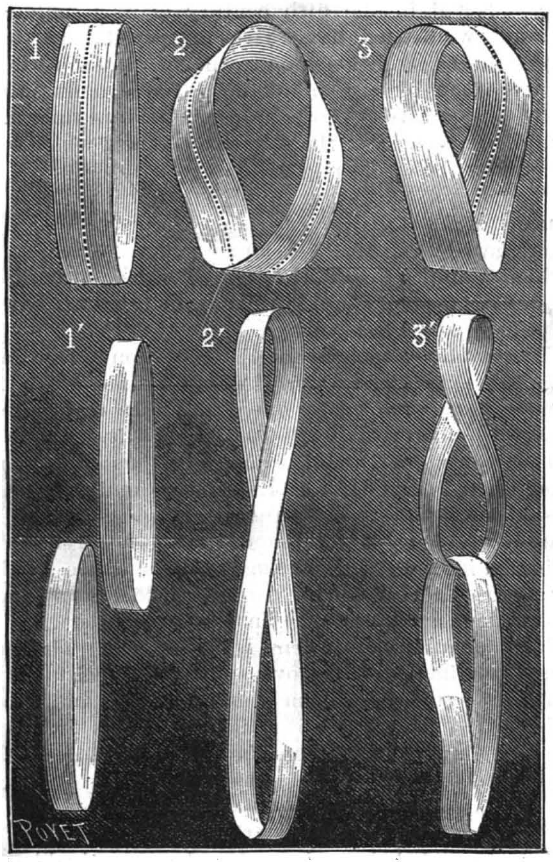
WESTON'S TROUSERS STRETCHER.

grasp. This telescopic connection of the tube and rod permits of the proper stretching of the trousers, and adapts the stretcher to trousers of different lengths. When the straps are released, the springs cause the bars to spring apart, thereby disengaging the clamps from the pantaloons.

This invention has been patented by Mr. E. C. Weston, of 17 South 40th Street, Philadelphia, Pa.

EXPERIMENT WITH PAPER RINGS.

The annexed engraving, from *La Nature*, shows the method of preparing paper rings for the performance of a curious experiment. Take three strips of paper, 2 inches in width by from 2 to 5 feet in length, and with one of them form a ring, as shown in Fig. 1, by pasting the two ends together. Before pasting the ends of the



EXPERIMENT WITH PAPER RINGS.

second ring, give the paper a single twist (Fig. 2), and before completing the third ring give the strip two twists. These twists in the completed rings (1 and 2) will be so much the less perceptible in proportion as their diameter is greater.

If we take a pair of scissors and cut through the circumference of ring No. 1 in the direction shown by the dotted lines, we shall obtain two rings, as shown in No. 1′. Proceeding in the same way with ring No. 2, we shall obtain a single elongated ring, as shown in No. 2′, and with No. 3, two rings which are connected like the links of a chain, as shown in No. 3′.

A NEW METHOD OF CONSTRUCTING PROPELLER SCREWS.

For several years past I have been engaged in studying the application of electricity to the propulsion of small boats, and I now desire to communicate to readers the conclusions to which I have been led by my experiments upon the operation of the screw, as well as a new method of constructing the latter.

My motor, which, with a minimum weight and size, develops very great power, gives its maximum of performance with a velocity of several thousand revolutions per minute. We have here, then, very different features from those presented by steam motors, which, on account of the inertia of their oscillating parts and the limited resistance of certain portions, are unable to practically exceed quite a low speed. Instead of reducing the velocity of the motor by the method of transmission, it has seemed to me more advantageous to allow the screw to have a very high rotary speed. It is well known that the resistance of water rapidly increases in measure as the speed of a body moving in it augments; and, in order to obtain a diminution of the screw's recoil, and reduce the loss of live power due to the whirling of the mass of water set in motion, we ought, therefore, to approximate the conditions offered by a screw that takes its bearing point upon a solid nut.

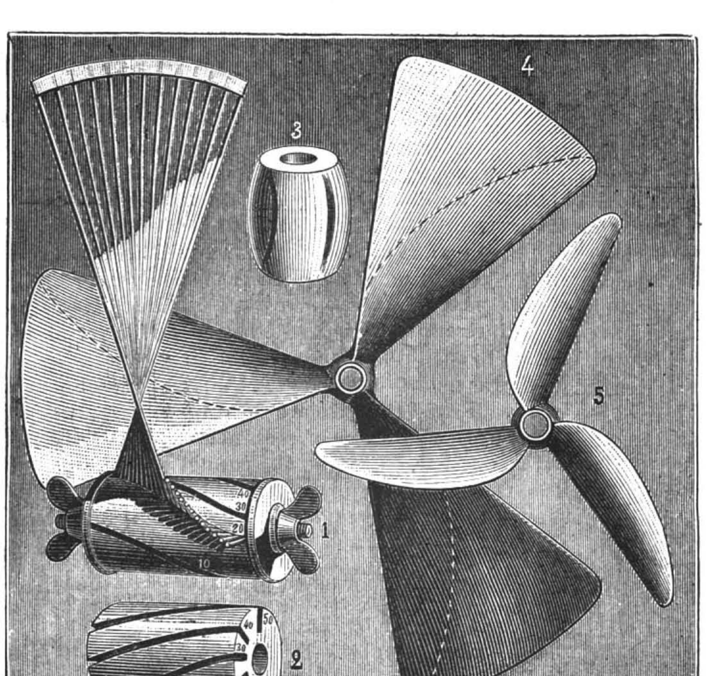
This high speed necessitates a large reduction in the pitch of the helix, which is likewise a favorable condition, since the resultant of the forces due to the inertia of the water, acting upon each element of the surface of the blades, advances toward the direction of the axis—the direction in which the useful effect must exert itself. There likewise results less of a tendency in the water to take on that rotary motion that gives rise to a centrifugal stress, which forces it to escape through the circumference of the helix, and is, as well known, the cause of jarring and loss of live power.

Experiment has confirmed this view of the subject, for, upon increasing the rotary speed up to 2,400 revolutions per minute, the performance of the screw very notably increased, while at the same time the boiling of the water astern was observed to diminish, the jarring to cease, and the motion to become perfectly regular and easy.

As these experiments necessitated the trial of a large number of screws of variable shape and pitch, I was led to devise a method of construction much simpler than those that are in use. The making of the mould for a helix is, in fact, an operation that requires quite a deep knowledge of geometry, since it includes the making of working drawings of the blades, of developing and laying down quite a large number of cylindrical sections concentric with the blades, and of cutting out templets, which, when afterward centered, permit of carving in a wooden mould the curves of the sections that are afterward connected by surfaces in which the sensation of continuity, and, consequently, the skill of the workman, plays a great role. The result is that such pieces can be made only by a small number of special workmen, and that the net cost of them is high.

On the contrary, the new mode of construction presents such simplicity that any workman can thereby make a model of a screw. It is as follows:

In a cylinder of a diameter equal to that of the boss of the screw, I make a helicoidal groove, an operation that the gear lathe performs with perfect regularity. I afterward take a series of metallic rods, of a diameter equal to the width of the groove, and insert one of their extremities in the latter at right angles with the axis of the cylinder, pressing, as I do so, one closely against the other, so as to secure a contact. We thus, with the greatest ease, form a helicoid of determinate pitch. It only remains to connect the outer extremities of the rods by means of a strip of thin metal, to which they are then soldered in order to fix their position, and to likewise solder together the lower extremities, and finally to fill in the spaces between the rods with an easily fusible metal. In this way I obtain two surfaces, with which the rods are flush, and which sensibly coalesce with the geometric helicoid, having exactly the pitch that was chosen.



CONSTRUCTION OF A HELIX.

1. Grooved Cylinder. 2. Details of Grooves. 3. Boss. 4 and 5. Three-bladed Screws.

Moreover, I can form the geometric helicoidal surface perfectly by making one of the angles of the tool coincide with the tracing of such surface on the cylinder. If it be desired, curved blades may be cut out on the surface thus formed, and the face that is not designed to act can be strengthened by means of some plastic material. In this way, there may be easily obtained, at slight expense, a mould, by means of which perfectly regular screws of definite pitch may be cast.

As the mould is of a non-distortable substance, deprived of core, it will remain as a standard for verifying either the products of casting or such screws as have got out of true by use.

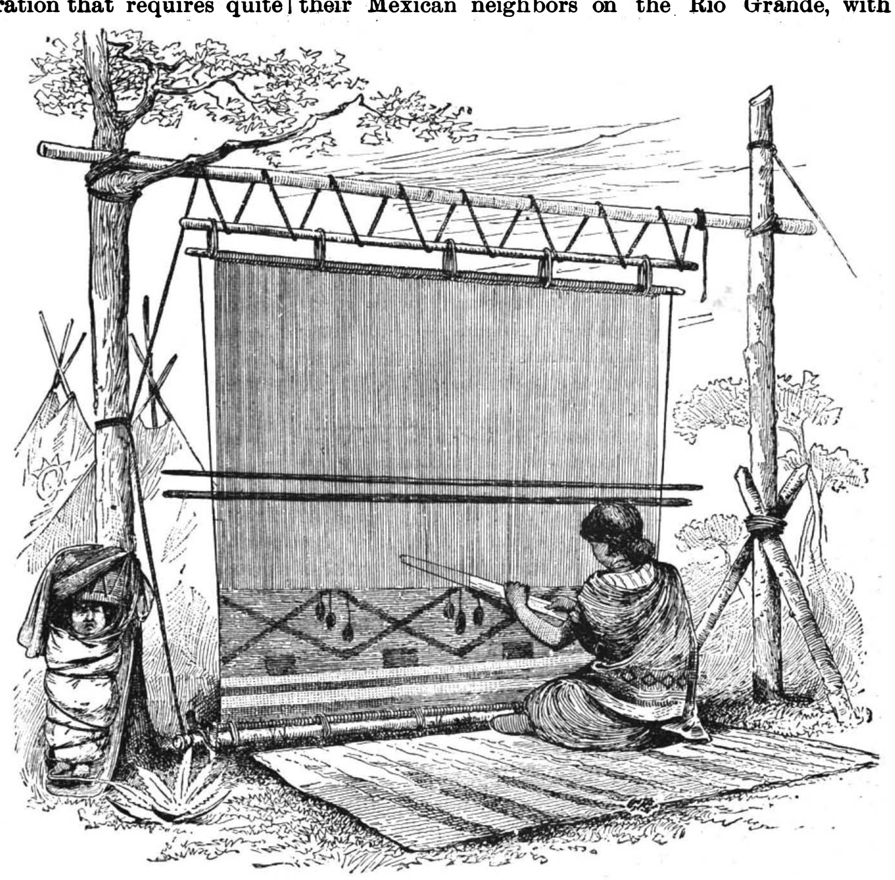
The screw with variable pitch, which is so complicated and so difficult to make, can be formed with the same ease. This method of manufacture may likewise render services in teaching, by permitting of rendering the generation of the helicoid tangible, this being a surface whose form and properties are understood with difficulty through diagrams and drawings.—*G. Trouve, in La Nature.*

HOW THE NAVAJO INDIANS MAKE BLANKETS.

BY W. MATTHEWS.

The art of weaving is undoubtedly of high antiquity among the American aborigines, and was brought to great perfection long before the advent of the white man. My reasons for thus believing cannot be discussed in the limited space here allotted to me. Probably in no tribe on our continent at the present time are higher results in weaving obtained, or ruder means employed, than among the Navajo Indians of New Mexico and Arizona, and among none, perhaps, has the craft of the weaver been less europeanzied. Hence a brief description of their processes and appliances cannot fail to interest the student of this art.

In preparing their wool, the Navajos now use the hand card, purchased from the Americans. Previous to the introduction of this tool, a tedious method of picking with the fingers and rolling between the palm was employed. They still spin their wool with the old distaff, consisting of a simple rod of wood thrust through a hole in the center of a round disk, although their Mexican neighbors on the Rio Grande, with whom they have had constant intercourse in peace and in war for the past three hundred years, use the spinning wheel. And although they probably possess sufficient ingenuity to make wheels, and undoubtedly have ample means to purchase them, they have never adopted them. They cling to the older and simpler implement.



METHOD OF WEAVING A NAVAJO BLANKET—INDIAN WOMAN AT WORK.

Their most important native dyes are the following:

A dull, brownish-red (approximating the tint of burnt sienna), a deep black, and a brilliant yellow. The red dye is a decoction of the bark of alder, mixed with the bark of the root of mountain mahogany (*Cerocarpus*). The yellow is a decoction of the flowers of a species of *Senecio*, with a crude native alum (*almogen*) for the mordant. The black dye is made by throwing into a strong decoction of the twigs of aromatic sumac (*Rhus diversiloba*) a calcined mixture of pinon gum with a mineral substance called by the Navajos *tse kon*.

Besides these colors, they had, in old times as they have to-day, wool of three different natural tints, viz., the white of the ordinary sheep, the rusty brown of the so-called black sheep, and the gray wool of the gray sheep. So, before the introduction of new colors by the whites they had a fair range of tints wherewith to execute their artistic designs.

In time the Mexicans gave them indigo, and, as far as I have observed, this is the only dye which the Spanish Americans introduced. With this, by varying the strength of the solution, they color their wool of different shades of blue, and by adding their native yellow they make different shades of green.

But the Mexicans brought them another material, which has added even more than indigo to the beauty of their fabrics. This is the bright scarlet cloth known as *bayeta*. The face of this cloth has a long nap; the Indians ravel it and use the weft. Some of the Eastern correspondents of the *Textile Record* will be able to give more trustworty information concerning the sources of supply of this cloth than I can. Originally brought from the south by the traders from Old Mexico, it is now procured from the wholesale dealers of our Atlantic seaboard by the Anglo-American traders. It is much superior in finish to the scarlet strouding supplied to the Indian trade of the North, and although it comes labeled with an illuminated Spanish coat of arms and the legend in Spanish, "Bayeta de cien hilos grana," it is probable that it is now made in England, if not in the United States.

Of the materials and colors above enumerated, some of their most beautiful blankets are still made. But of late years the Yankee traders have brought much American yarn into the country, and the finer *serapes* are now largely made of Germantown wool. This is most likely to be the case in blankets made to order for Americans, since the party giving the order is usually required to supply the yarn.

Our traders have, strange to say, introduced no new dyes among them; but I believe that a good series of aniline dyes would be extensively purchased by the Navajos if they were once taught the use of them.

To make an ordinary blanket, the weaver usually proceeds in this way: She selects two slender straight trees, about 6 or 8 feet apart, or erects two posts about the same distance from one another. To these she lashes two horizontal parallel poles—one close to the ground, the other at a height of 6 or 8 feet, according to the size of the blanket to be made. This arrangement serves as the frame to which the loom is secured. Thus it is evident that the web must hang vertically before the weaver.

Two stout, round sticks, each about an inch and a half in diameter, form the beams of the loom. I will call the upper stick the yarn beam and the lower one the cloth beam, from their counterparts in the European loom; but they differ from the latter in that they do not revolve. The warp is never wound around the one, nor is the finished web ever wound around the other, hence the Navajo cannot weave a piece of indefinite length. The yarn beam is secured with cords to the upper transverse pole of the frame, so as to hang horizontally, and the cloth beam is tied to the lower pole; the distance between the beams being the length of the proposed blanket.

The application of the warp is the next thing in order. An extra stout woolen cord is laid along each beam parallel to its axis, on the upper side of the lower beam and on the lower side of the upper beam. These cords are secured in position by means of a spiral thread. The warp is then fastened to these stout cords, and when the blanket is finished they are found included in it, forming the borders at the ends.

When this is done, the healds are applied by looping one continuous string in figure 8 loops, twisted once in the middle, one of the circles of each figure 8 including the selected thread of the warp, and the other passing around the rod. In ordinary weaving, only one set of healds is used. The place of the other is supplied by putting a stout rod into the shed. When the weaver wishes to pull the healds forward, she pushes this stout rod up out of the way, and draws the rod which holds the healds toward her. For the next cast of the shuttle she draws the stout rod downward, and so throws the warp in the healds backward.

I say "shuttle" only for convenience of description. Properly speaking, the Navajo woman has no shuttle. If the pattern is a simple one, where a single thread of the weft is passed the whole way through the shed, the yarn is wound on a rough stick or slat; but if the pattern is intricate, where each thread of the weft is reversed every inch or two, the yarn is simply made into a small skein and shoved through the shed with the finger.

Their substitute for the reed is a small wooden fork, having about five or six tines. With this the weft is made to lie smoothly; but in beating it firmly into place another instrument is used, which I will call the batten. The batten is a broad, thin oaken stick; it is inserted lengthwise into the shed, and applied to the weft with firm blows. It is by the vigorous use of this tool that the Navajo blanket is rendered waterproof.

The weaver sits on the ground, and works from below upward. When the web has been completed to the height of about two or three feet, the cords which fasten the yarn beam are somewhat loosed or lengthened, the beam is lowered, the finished portion of the web is folded and sewed with coarse stitches down to the cloth beam, and the unfilled warp is thus brought within convenient reach of the artisan. This arrangement supplies the place of the revolution of the beams in our looms. You will rarely see a new Indian blanket, except one of the smallest size, in which the marks of these stitches are not visible.

Many blankets, particularly those used for saddle blankets and women's dresses, are made in the style of our tweeds and diagonals. In some specimens the diagonal ridges are seen to run continuously in one direction, while in others the direction is varied, so as to make diamond or zigzag figures. These effects are produced by using three sets of healds, which are applied to the warp and actuated on essentially the same mechanical principle as those employed by our own weavers in making similar fabrics. In goods of this description the Indians do not attempt such elaborate designs in color as they do with goods woven with a single set of healds. Uusually, diagonals are seen in one solid color or in plain stripes; but they are more extensively manufactured by the Pueblo Indians than by the Navajos.

The Navajo blankets, notwithstanding their weight and thickness, are all single-ply, and consequently the figures are the same on both sides, no matter how intricate they may be. The Indians do not understand our method of producing figures by completely hiding one set of threads with another set; but neither, it would seem, are our weavers capable of making single-ply patterns like those of the Indians; and this observation leads me to close with a few remarks to those American manufacturers who are endeavoring to imitate the Navajo fabrics.

Of all the imitations I have seen, only those of the plain striped patterns are even tolerably successful; where the more intricate patterns are attempted, it always results in failure. It must be remembered that the Navajo woman has a separate shuttle or skein for every element of her pattern—to see a dozen different little skeins hanging from the front of a growing web is a common sight—and that the shuttle is not thrown the whole width of the web in every case, but only the width of the particular figure to be represented. A similar result, it seems to me, could only be produced cheaply on our looms by using a single warp thread dyed of different colors, the length of each colored section being carefully computed, so that when woven it would make a definite pattern. But even if this arrangement were possible, many blankets of the same pattern would have to be woven in order to "make it pay." How, then, would such blankets compare with those of native make? Of the many hundreds of the finer Navajo blankets which I have examined since I have been in New Mexico, I have never seen two of exactly the same pattern. Every owner of a genuine blanket of this kind may feel reasonably certain that he possesses an article which has not a duplicate in the whole world.

Expensive as these blankets are, the weavers are but poorly paid for their trouble. From three to six weeks are commonly spent in making one of the best *serapes*. They do not weave them for sale; there is too little profit in making them, and the Navajos are too wealthy to seek income from such a source. The women weave them partly for artistic recreation—just as our ladies embroider—and partly for the sake of personal adornment. It is only when they get tired of a blanket and want a new one, or meet with heavy losses at *monte*, that they sell it. Hence new blankets of the best workmanship can rarely be obtained except at exorbitant prices.

Blankets are, however, not the only "fruit" of the Navajo looms. Handsome sashes, garters, bands for the hair, and saddle girths are also woven; the apparatus for making which necessarily differs in size from that used in weaving the blankets. They also knit stockings and slippers with four needles.—*Textile Record.*

Ancient Hygiene.

The Boston *Medical Journal* has recently published a lecture on the hygienic laws and sanitary conditions of ancient Rome, which formed one of a course of lectures delivered before the Lowell Institute by Professor Lanciani, the Government Director of Archæological Researches at Rome.

As might be expected from such a teacher, says the *Sanitary Engineer*, especially when speaking to such an audience, the address contains much that is interesting to the modern sanitarian. Professor Lanciani suggests that the existence of a thriving and healthy population in the Campagna about Rome, where a few centuries later (at the beginning of the historic period) the locality is described as pestilential, may have depended on the purifying influence exerted by volcanic fires and sulphurous emanations. At all events, malaria invaded these regions as soon as they ceased to be volcanic, and a proof of its prevalence is found in the large number of altars and shrines dedicated by the early inhabitants to the Goddess of Fever. One altar has been found which was consecrated to Verminus, who to-day would be reckoned as the God of Bacteria.

By the construction of drains and sewers, the providing a general water supply, and by regulating burials, etc., Rome was gradually made a healthy city. When these improvements fell into disuse, after the fall of the empire, the vicinity again became pestiferous, and again they resorted to worship to avert the evils, and built a chapel for the Madonna of the Fever.

The great sewer of Rome, the Cloaca Maxima, is well known as one of the oldest triumphs of sanitary engineering. Recently a still larger sewer has been discovered, of which Professor Lanciani remarks that "the enormous size of its blocks, the beauty and perfection of its masonry, and its wonderful preservation, make it compare most advantageously with the Cloaca Maxima, to which it is altogether superior as regards length and extent of district drained."

The introduction of pure drinking water to Rome was effected in the fifth century of its foundation. "Fancy what must have been in early Roman times the sanitary conditions of a town, the drains of which, not washed by any influx of water, communicated with the streets by large unprotected openings and emptied into a river, the polluted waters of which were drunk by the whole population."

The magnificent water supply brought into Rome by means of fourteen aqueducts was its salvation. The aggregate length of these aqueducts was 359 miles, of which 354 miles were in tunnels. The longest of these tnnnels is that of Monte Affliano, 4,950 meters long, 7 feet high, and 3 feet wide.

The public cemeteries for the reception of the dead of the poorer classes were huge pits, into which the bodies were tumbled promiscuously. In one place a mass of human remains 160 feet long, 100 feet wide, and 30 feet deep was found, which is estimated to have contained 24,000 bodies. In and around the great Esquiline Cemetery the refuse and garbage of a population of nearly a million of people were heaped. Finally, in the reign of Augustus, the whole of this was buried under a mound of earth 25 feet high and a third of a square mile in surface, on the top of which magnificent gardens were laid out. This produced an immense improvement in the health of the city. It would seem, from what one sees in and about Rome, that there were skilled engineers in those ancient days. The sewers in many instances have outlasted the temples and palaces.

Lime Cartridges.

The cartridges have been found most valuable for work in many kinds of stone, including granite, Portland stone, sandstone, etc., as well as masonry of stone or brickwork. A block of granite weighing about four tons, and embedded on two sides and at the bottom in strong cement, was recently moved easily by two shots. In experiments for the Admiralty at Portland, three shots of lime cartridges got thirty tons of stone in large merchantable pieces. The cartridges were used with great success for upward of twelve months in the formation of the Copenhagen Tunnel, North London, and they are now in use for removing the sandstone in the excavations of the Mersey Tunnel Railway Company, at Liverpool.

The Longest Tunnel in the World.

An engineering work that has taken over a century to construct can hardly fail to offer some points of interest in its history, and illustrate the march of events during the years of its progress. An instance of this kind is to be found in a tunnel not long since completed, but which was commenced over a hundred years ago. This tunnel, or adit, as it should be more strictly termed, is at Schemnitz, in Hungary. Its construction was agreed upon in 1782, the object being to carry off the water from the Schemnitz mines to the lowest part of the Gran Valley. The work is now complete, and according to the *Bauzeitung fur Ungarn* it forms the longest tunnel in the world, being 10·27 miles long, or about 1 mile longer than St. Gothard, and 2½ miles longer than Mont Cenis. The height is 9 ft. 10 in. and the breadth 5 ft. 3 in.

This tunnel, which has taken so long in making, has cost very nearly a million sterling, but the money appears to have been well spent; at least the present generation has no reason to grumble, for the saving from being able to do away with water-raising appliances amounts to £15,000 a year. There is one further point, however, worth notice, for if we have the advantage of our great-grandfathers in the matter of mechanical appliances, they certainly were better off in the price of labor. The original contract for the tunnel, made in 1782, was that it should be completed in thirty years, and should cost £7 per yard run. For eleven years the work was done at this price, but the French revolution enhanced the cost of labor and materials to such an extent that for thirty years little progress was made. For ten years following much progress was made, and then the work dropped for twenty years more, until the water threatened to drown the mines out altogether. Finally, the tunnel was completed in 1878, the remaining part costing £22 a yard, or more than three times as much as the original contract rate.

Phosphorescent Photography.

We publish in this week's Supplement, No. 580, an interesting paper by Dr. Jno. Vansant, on phosphorescent photography. It is of special interest in connection with the article on the same subject published by us in the Scientific American of October 16, 1886. Dr. Vansant, it will be seen, has followed the same path as that followed by M. Ch. Zengler. His practical dark room notes are of interest to all photographers.

Correspondence.

Fall of the Sheepshead Bay Water Tower.

To the Editor of the Scientific American:

As I see in your paper several theories advanced in regard to the fall of the stand pipe at Sheepshead Bay, I will advance my theory, and if you think it worthy of publication, you may publish the same, and I will need but few words to express it. The actual cause of the bursting of said pipe I believe to be the vibrations of the water inside of tube or pipe, caused by and from the motion of the pumps, by which motion, on the stroke or discharge of the pumps, the water in the tube would have to rise, and on the receding motion would drop back, which rising and falling motion would cause a greater strain on pipe than if it had been full of water, said vibrations being kept up until there was gained a regular rising and falling motion of water in pipe. Hence the rumbling noise and the irresistible force. WESBY KORMS.

Salina, Kan., January 28, 1887.

Chances for Trade with Madagascar.

To the Editor of the Scientific American:

Much has been written in reference to possible markets for manufactures, and it would seem that Madagascar, now that the war is over, offers something of a field. Recent investigation shows that there is a pressing demand for various manufactured goods, and extravagant prices are demanded and obtained for articles of every day use in countries more favored with the one great necessity for commerce, *i. e.*, transportation. A personal inquiry and research on the west coast of the island of Madagascar has convinced me that the trade of that section, at least, is capable of great expansion. The resources have never been touched, and an immense area of country still remains that neither the trade from the east nor west coast stations at present reaches at all. The goods exhibited on the west coast are of the cheapest and most flimsy description, with the exception of the American brown sheetings, and there are more imitations of that article than there is of the real. Also, the prices range from 66 to 100 per cent profit on the most common articles, while for anything outside of the usual trade it is by no means an uncommon thing to hear of 600 to 700 per cent profit.

Except to the people actually in the trade, the commerce of Madagascar is very little known, and the west coast is almost a *terra incognita*, even merchants long established in Mozambique—only two to three days' sail from one busy port (Maintyrano)—knowing nothing at all of it; and those who are in the trade will only forward letters, etc., when they are obliged to, and then grudgingly and with a great deal of grumbling, sometimes even passing the bounds of decency in their efforts to keep the trade hidden.

If the interest of American manufacturers in the export trade is a real one, why do they not place their productions before the people of Madagascar? Here are 225,000 square miles of tropical country, peopled by races that have the means of payment ready to hand, in the shape of natural products to be had for the gathering. A long list of valuable articles are indigenous, foremost of which at present are rubber, orchilla, hemp, etc., with immense possibilities in the future. B. E. M.

Moroundara, Madagascar, October, 1886.

An Indo-European Canal.

In a recent communication to the French Academy of Sciences, M. Emile Eude proposes a canal between India and Europe by way of the Euphrates Valley, the Persian Gulf, and Syria. This was in ancient times the great route of commerce, before the founding and and development of Alexandria diverted it on Suez and led to the Suez Canal. The new route is put forward as a parallel way to that of Suez. His project is a canal with a double aim—a canal of irrigation and of navigation. In this way he proposes to restore fertility to these wastes.

The plan is to create a river from Soueidieh to the Persian Gulf, by making the Euphrates flow to the Mediterranean by Aleppo and Antioch; from Beles, in deepening the river from Beles to Felondjah (near ancient Babylon); in passing from the Euphrates to the Tigris by the canal of Saklavijah; and lastly, in descending the Tigris from Bagdad to Kornab, Bassora, and Fao on the Gulf. The new canal would shorten the going and coming voyage to Bombay by six days. M. Eude does not consider the engineering difficulties of a serious kind, except the stony banks of Abou-Said and Kerbeleh, which, however, would not resist modern appliances. He estimates the total cost of the works at more than a milliard of francs, and the maximum capital required would be fifteen hundred million francs.

N. W. AYER & SON, advertising agents, Philadelphia, have issued a substantial, practical calendar, especially suitable for business offices, etc., with figures that can be read across a large room.

Recent Progress in the Manufacture of Explosives.

Several new processes have recently been patented in France and Germany for the manufacture of explosives. The improvements consist chiefly in the substitution of other detonating substances for nitro-glycerine, as most of the accidental explosions in mining operations in late years have been caused by explosives in which nitro-glycerine forms the chief ingredient.

The use of nitro-glycerine and explosives derived from it are now under the discussion of the legislature of this and several of the European countries, and it is hoped that the laws relating to the use and sale of explosives may be modified in a way which will exclude the storage and transportation of large quantities of materials which are now known to be spontaneously explosive.

Nitro-glycerine was discovered in the year 1847 by the Italian chemist Sobrero, who was a pupil of the celebrated French savant Pelouze, who had previously described in 1838 the preparation and principal properties of gun cotton. It is, however, chiefly due to the investigations of the Swedish engineer Nobel, whose death was recorded only a short time ago, that we are indebted for an exhaustive examination of the properties of nitro-glycerine, and for the present methods which are in use for rendering it a suitable explosive agent. The various explosives now manufactured and known under the names of dynamite, sebactine, extra dynamite, petrolite, nitrolite, and possibly many others, consist of nitro-glycerine mixed with different proportions of solid materials, such as charcoal, gun cotton, nitrate of potash, and different kinds of porous earth and clay. All these compounds have given rise to numerous accidents, by reason of their spontaneously explosive nature. Many other nitro compounds besides nitro-glycerine have been suggested as explosive agents. Among these may be mentioned nitro-benzol, nitro-toluol, nitro-naphthaline, nitro-phenol, nitro-mannite, and the compounds obtained from starch, cellulose, and sugar by the action of concentrated nitric acid.

A German patent (No. 36,872) of Alfred Nobel, in Paris, covers the use of a mixture of metallic salts of acids rich in oxygen, *e. g.*, nitrate, chlorate, or perchlorate, with one or other of the nitro compounds of glycerine, sugar, or cellulose. The barium, potassium, and sodium salts are mentioned in the patent, and for blasting operations a mixture of from 75 to 80 per cent of one of these salts with 20 to 25 per cent of nitroglycerine is recommended. For fire arms, 5 to 15 per cent of nitro-glycerine is added, or 10 to 30 per cent of either nitro-glycerine thickened with nitro-cellulose, or nitro-sugar, or nitro-cellulose alone, is substituted. These mixtures are said to be safe, and not liable to spontaneous combustion or explosion. A somewhat similar mixture has been patented by Jacob Engels, of Kalk, near Deutz (Nos. 36,705 and 10,232), in which the nitrate, sulphate, or chloride of ammonium is the salt added to the nitro compounds. The composition of these explosives is somewhat complicated; they contain 5 to 10 per cent pyroxyline, 70 to 60 nitro-glycerine, 15·5 to 18 pyro-papier, 0·5 nitro-starch, 5 to 1 nitro-mannite, 0·5 nitro-benzole, 10 to 30 ammonium salts, 0 5 waterglass, and 8 to 10 of saltpeter. An explosive based on the same principle, and recommended for shells, is made from gun cotton saturated with a solution of potassium chlorate (100 parts gun cotton to 12 parts potassium chlorate), and then slowly dried at a temperature of from 62° C. to 75° C.

The shells are filled with this compound by first making it into a paste with collodion (12 to 14 per cent) and then allowing the mass to harden within the shell. This mixture is also said to be capable of withstanding a sudden percussion without explosion. The double picrate of sodium and lead or barium obtained by mixing three equivalents of sodium picrate with one of lead or barium picrate is also the subject of another patent. The explosives in which these picrates are used have the composition: 15 to 30 per cent barium sodium picrate, 8 to 30 lead sodium picrate, 2 to 10 potassium picrate, 20 to 5 nitro-naphthaline, 40 to 20 potassium nitrate, 3 to 1½ sugar, 3 to 2 gum, and 4 to ½ of lamp black (English patent 14,140).

BELLITE, A NEW EXPLOSIVE.

M. Carl Lamm, the director of the manufactory of explosives at Stockholm, has come to the conclusion that one of the safest explosives consists of a mixture of nitrate of ammonium with a di- or tri-nitrobenzine. The dinitrobenzines are easily obtained from benzine by direct nitration with a mixture of nitric and sulphuric acids. All three compounds are thus formed, the meta compound being in the largest quantity. They are all soluble in alcohol, from which solution, on cooling, the meta compound crystallizes out first, while the ortho and para dinitrobenzoles remain in the solution. The meta compound melts at 90°, and, when free from nitric acid, can be kept unchanged for any length of time. The tri-nitro compound is easily obtained from the meta compound by heating it with more nitric acid and fuming sulphuric acid to 140° C. Numerous experiments have been conducted by M. Lamm, with a view of ascertaining the best proportions of these two substances to yield the maximum explosive effect. He has named this mixture "bellite," and recommends its use as a substitute for the coarser kinds of gunpowder used in the larger fire arms.

Bellite has the important quality of not being spontaneously explosive; it can, therefore, be manipulated and transported without any risk. To cause it to explode, it is necessary to bring it into contact with a light or with some substance which is strongly heated. Numerous experiments have been tried, in order to determine whether it is possible to explode it by a violent shock; but, in the two years during which these experiments have been carried on, it has never been made to explode by a shock alone, or by friction. Both dinitrobenzine and ammonium nitrate are stable compounds, if in their preparation care be taken that there remains no excess of free nitric acid. P. J. Cleve, the well-known professor of chemistry in the Swedish University at Upsala, has confirmed these statements of the discoverer, and has certified that bellite may be stored or transported by railway without any danger of spontaneous explosion.

Bellite appears to have a power which is greater than any of the explosives at present employed. In one experiment 15 grammes, exploded by means of an ordinary fulminating cap, projected a shell weighing 42·5 kilo. to a distance of 120 meters; and in experiments on blasting, bellite has been found to remove a greater quantity of rock than that obtained by employing the same weight of explosives derived from nitro-glycerine. The mean force of bellite is equal to thirty-five times that of ordinary cannon gunpowder.

The Swedish artillery have made a series of experiments with this new explosive, which go to prove that when it is used for grenades, these grenades are not liable to spontaneous explosion by any sudden shock, and that, when thrown and caused to explode by a convenient percussion fuse, the results are superior to those obtained from grenades charged in the ordinary way with powder. Mines constructed with bellite are not set on fire or exploded even when struck by a bullet.

The explosive force of bellite, compared with that of fulminating cotton, is as 115 is to 100. From these results, it would appear that bellite marks a new departure in the history of the manufacture of explosive materials; and it would appear that, from its valuable property of being incapable of explosion by shock or friction, we may not fear its application to the destruction of property in the same way as dynamite has unfortunately been used for. M. Henry M. D'Estrey has lately brought this compound under the notice of the scientific public of France, so that we may hope that, before long, it may come into general use as a substitute for dynamite and the allied nitro-glycerine compounds.

Recent experiments by the Minister of War at Berlin on new explosive materials have just been conducted at the island of Eiswerder, near Spandau, and if this compound has been included in their investigations, we may hope for further particulars of its properties in the report on the results.—*Industries.*

Dams in California.

Among the most important dams built in California are: The Bowman dam, height 100 feet, length 425 feet; three dams owned by the Milton Mining and Water Company, forming the English reservoir, the largest of these having a height of 131 feet; the Fordyce, of the South Yuba Canal Company, 567 feet long and 75 feet high; catchment basin, 40 square miles; the Eureka Lake dam of the Eureka Lake and Yuba Canal Company, length 250 feet and height 68 feet. All these dams are built of dry rubble stone and faced with a water-tight lining of planks. An engraving of this kind of dam we take from Mr. Bowie's work on hydraulic mining in California, together with these facts:

The Tuolumne County Water Company built several timber crib dams, the largest across the south fork of the Stanislaus River. This dam, which is 300 feet long and 60 feet high, rests for its entire base on solid granite bedrock. The cribs constructed of round tamarack logs, from two to three feet in diameter, and about eight feet square from log to log (10 feet center to center), and the timbers are pinned together with wooden treenails. The cribs have no rock filling.

The face is formed of flattened three inch timber pinned with wooden treenails to the crib and calked with cedar bark. The flood water passes over the crest of the dam for the entire length. The water is drawn off by several gates, one above the other, placed on the inclined water face. The dam was built in 1856. Its total cost did not exceed $40,000. Pine dams owned by this company, constructed on the same plan, have decayed, while cedar cribs are still in perfect order. The Spring Valley and Cherokee Company's Concow reservoir, in Butte County, is formed by two earthen dams, each about 55 feet in height. One of these, which is used as a waste, has its lower side built of heavy brush embedded in the earth. —*Min. and Sci. Press.*

The American Watch Industry.

John Fernie, M.I.C.E., writes from Philadelphia, in *Engineering*, December 3, as follows, on the American watch manufacture:

"I always read with great pleasure the words which fall from Mr. Head, the able president of the Institution of Mechanical Engineers, and I am sure he will pardon me when I call his attention to a great omission he made in his remarks about the American Watch Co. Mr. Head, like a good many more Englishmen who speak about American machinery, gets the facts all right, but does not get down to the philosophy of the facts; and this, I observe, has been the case in like discussions in England about American bridges. Now, in 1876 I visited the watch works at Waltham, and a long account from my pen was published in the *Times* of what I had seen there. This paragraph I copy from the letter:

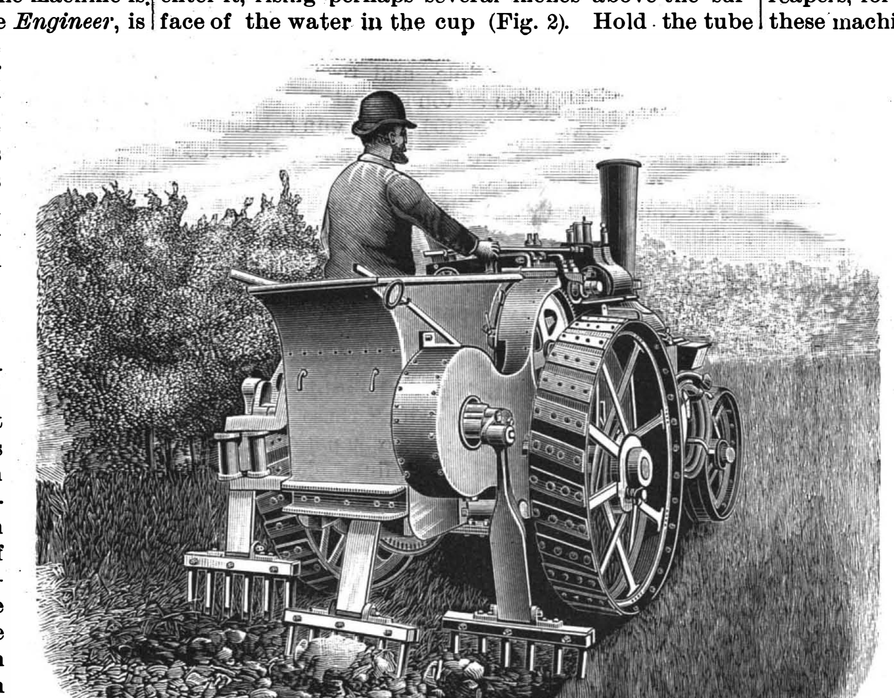
"'I was desirous of seeing how they obtained their scale, and Mr. Webster, the able engineer of the company, informed me he found the thousandth part of an inch too coarse a dimension and the ten-thousandth too fine, and he was led to divide the millimeter into a hundred parts, and found it a proper proportion for his work; and it is from a series of gauges founded on this system that the whole of the watches are built up and the constant accuracy of all their dimensions maintained.'

"Now in this scale, this series of gauges, lies the philosophy of the success of the American watch, because it is the foundation on which stands the accuracy, the repetition, the almost perfect duplication, of a perfect machine, which no one can make any finer. The ordinary fineness of work for the principal part of the watches is 1-2540 part of an inch, but for the very finest work they can subdivide this into 1-5080, or even 1-10160 part of an inch, and in the manufacture of standard gauges they can work to the 1-25400 part of an inch. Now what has grown out of this system since 1876? The old factory torn down and doubled; hand machinery replaced by automatic machinery; watches made for half the cost; quantity increased three or four times; quality immensely improved; in 1876 they were turning out 366 watches a day, in 1886 they were turning out 1,200 watches a day; and now I come to my moral, and apply the wise warning words of Mr. Head about watches to the manufacture of locomotives in England:

"'They began by studying the watch as a piece of mechanism. They selected the best points of any current type. They abandoned the pin (*sic*) and chain. They introduced improvements of their own. They settled on a standard type, determined to adhere to it; made certain sizes and no others. Result: Killed the watch trade in England, and would have killed it in Switzerland had the Swiss not adopted the American system and machinery.'"

IMPROVED STEAM DIGGER.

Our engraving shows an improved form of steam digger, recently made at Thetford, Eng., by Burrell & Sons, from the plans of F. Proctor. The machine is said to work well, and, according to the *Engineer*, is likely to prove valuable. The machine is provided at its rear end with a series of three digging forks, which alternately enter and break up the ground, and the vehicle advances as fast as the diggers perform their work. This device appears to be capable of operating on uneven ground. When not employed in breaking the soil, the machine may be used for various other agricultural purposes.



IMPROVED STEAM DIGGER.

To Re-ink a Type Writer Ribbon.

J. S. D. writes about type writer ribbons:

"Some time ago I tried the experiment of re-inking a ribbon, with such success that I never expect to buy one again. In two ounces or more of any ordinary writing fluid put a spoonful of thick gum arabic mucilage and a teaspoonful of brown sugar, warm the mixture, and immerse the ribbon long enough to become well saturated. When dry, spread the ribbon on a board and brush it well with glycerine. Should there be too much "color" in the ribbon, press it out, between papers, with a warm flatiron; or, if too dry, brush it again with glycerine. The secret of the ribbon giving out its color is in the glycerine, and if you have body enough in the color, there is no danger that it cannot be made to work well. Such a ribbon is not affected by the dryness or humidity of the atmosphere, and I esteem mine as much better than any obtained from the trade.

"It may be that I was fortunate in hitting upon just the right proportion of the different constituents, and possibly a second trial might not be so successful; but I think with a little care any one could do as well with the same or similar means. My object was to get body to the color, hence the mucilage and sugar. Then it was necessary that the ribbon should retain a certain degree of moisture, for the gum and sugar make it dry and harsh, so the glycerine coat was put on; but there was danger of smearing the paper with too much moisture, or a wrinkled surface, and the ironing obviated this."

HOW LARGE DOES IT APPEAR?

T. BERRY SMITH.

I give a method which I have found useful in giving to students of the microscope some adequate idea of the dimensions of animalcules found in stagnant water.

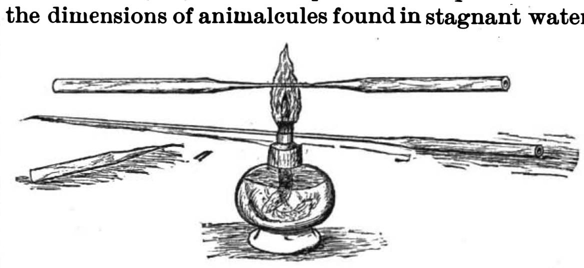


Fig. 1.—DRAWING THE GLASS TUBING IN ALCOHOL FLAME.

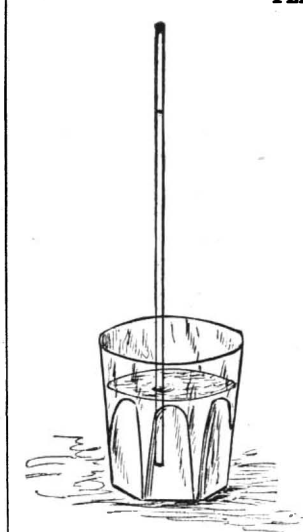


Fig. 2.—FILLING THE TUBE BY CAPILLARY ACTION.

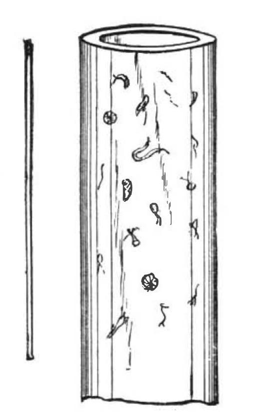


Fig. 3.—THE TUBE, AND THE TUBE ENLARGED SHOWING ANIMALCULES WITHIN.

A drop of apparently clear water may be placed on a glass slide, put under the objective, and cause wonder and astonishment when the multitudes of animalcular life are brought to view. There they are, swimming, twisting, standing, but how large are they? Don't know, because there is nothing to compare them with. Take a piece of soft glass tubing and soften it in the flame of a gas or alcohol lamp, and then draw it out into a very fine thread, which will be a capillary tube (see Fig. 1). That it is a tube may be proved by inserting one end in water, and blowing into the other end, when minute bubbles will rise. Now, insert this tube in a cup of stagnant water, and the water will readily enter it, rising perhaps several inches above the surface of the water in the cup (Fig. 2). Hold the tube before you. No larger than a hair of your head, and the bore much smaller. Is it possible there are living creatures in that small space?

Place the tube under the microscope, and lo! many a curious creature disporting itself in as much space as a man would have in a wide street of a city (Fig. 3). I have seen them where it would take at least a score of them placed end to end to make a chain long enough to reach across the space in the tube.

How large are they? Hold up the glass thread before your eyes and consider. It is small, the bore is smaller, and they are twenty, perhaps fifty, times smaller still. Yet each is a perfect creature, with organized structure, and organs adapted for various functions. How large is one's mouth, foot, heel? Where is the limit?

"'Tis said that all the larger fleas have lesser fleas to bite 'em,
And these in turn have smaller fleas, and so *ad infinitum*?"

Interchangeability of Machinery.

Mr. David Beddie, writing from Blayney, New South Wales, to the *Ironmonger*, raises certain questions which merit the attention of implement and machinery manufacturers. He complains of the multiplicity of patterns of various parts of harvesting and other machines, and instances fingers, intersections, braces, and connecting rods as parts which he thinks might with advantage be reduced to about half a dozen standard forms. In knife sections he complains that the rivet holes vary, while in the fingers the bolt holes are not alike. In consequence of these variations it is often difficult, and even impossible, to get extra parts; and, as these are not made in the colony, much trouble and loss are caused. As examples Mr. Beddie furnishes the following particulars:

"Last year I altered some old fashioned wrought iron fingers to the steel plated fingers of a popular American maker. This year I got some more to alter. I set to and drilled the bar, etc., for the alteration, and sent for the fingers, and was informed they were not to be had in Australia. I sent to the agent for some Hornsby fittings four months ago, and have not got them yet. I ordered some shares for Ransomes, Sims & Jefferies' Scotch grubber, and am informed they are not to be had. I ordered a Pulsometer No. 1 pump from the agents, and was informed they had none. I asked them to get one from their branches in the other colonies, or say how long until they would have one. To the first part I got the answer 'none,' and to the second that they could get it in, 'say, four months.' I have written six letters over it, and have not had one yet. In some of the replies I was informed that a Mr. Clarke could make one in Melbourne in two weeks from receipt of order. The address was not given. I was advised to address him, 'Maker Pulsometer Pumps, Melbourne,' which I did, and have not received a reply. Perhaps I will have it through the Dead Letter Office. Did all manufacturers catalogue and code their wares, as all number them, in cases such as I have mentioned, they could be telegraphed for and landed here in six weeks, independent of agents, who will not trouble to do so."

These complaints, it will be seen, appear to hint that there is something wanting on the part of the Australasian agents for the British firms named.

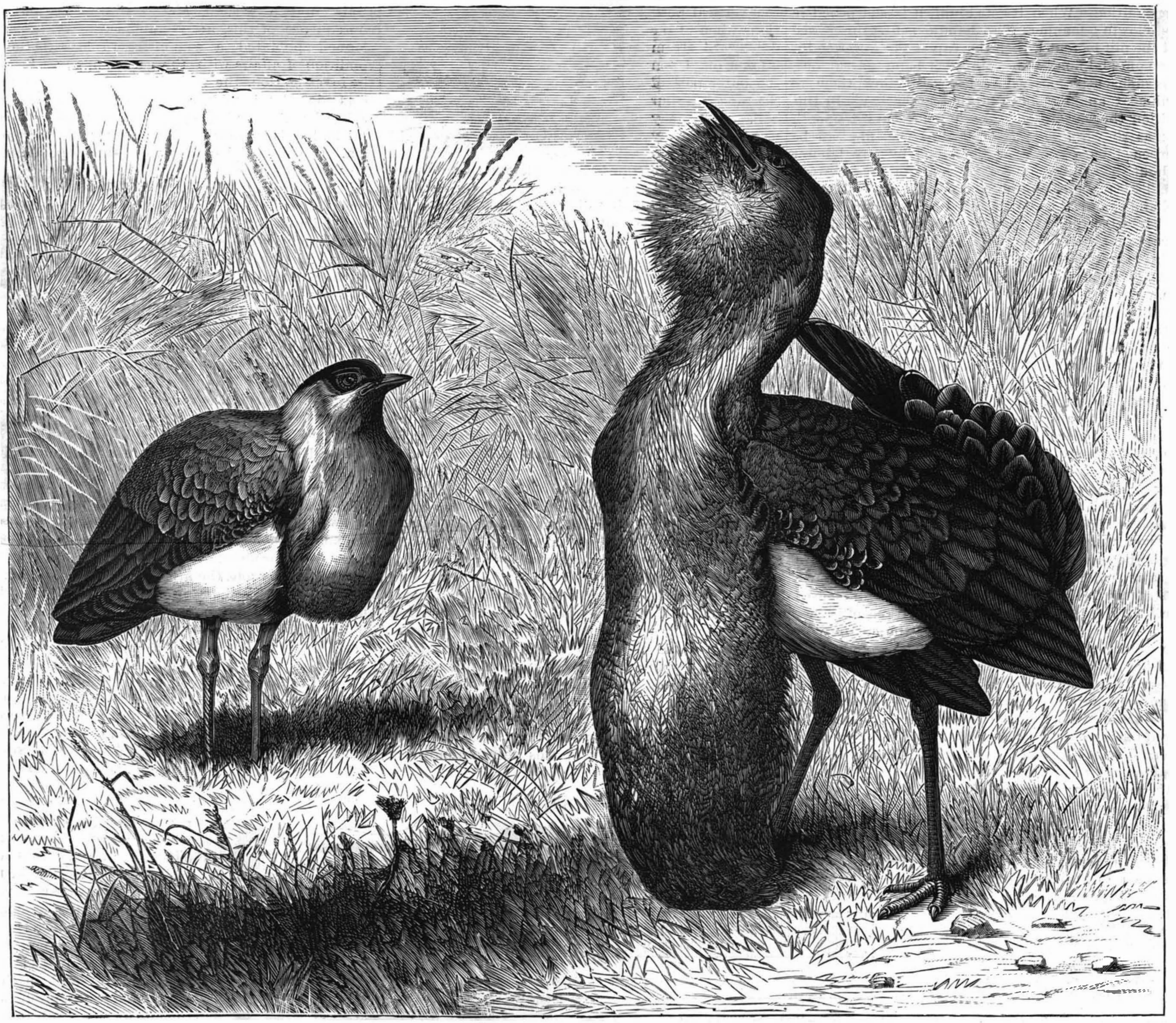
What is really worthy of being discussed is the question of the interchangeability of machine and implement parts, although we do not anticipate that that system is likely to be carried so far as to cover all the makers of any given article. Take mowers and reapers, for instance. There are numerous patterns of these machines, each having its peculiarity, and each being claimed to possess merits not owned by any of its rivals. It is not easy, consequently, to understand why or how A will derange or alter his machine in its vital points simply in order that the parts of B's machine may interchange with it. Nor, supposing the principle to be admitted, is it easy to settle who shall give way, and who be regarded as having the standard to which all the other makers are to work. At the same time, we are quite of opinion that there are several minor--and some leading—parts of the different kinds of machines and implements which might with advantage be made to standard sizes or dimensions.

Wanted—An Inventor.

The pita plant of Honduras invites the enterprise of American capital and Yankee invention. Only one thing is needed and the lucky man's fortune is made. Mr. Burchard, our consul, reports that this pita plant, which has never been cultivated, grows spontaneously and in apparently inexhaustible quantities by the margin of every river and lagoon, and, indeed, anywhere below the altitude of two thousand feet. It can be had for the cost of cutting. The fiber is susceptible of a thousand uses. The people of Honduras convert it into thread for sewing boots and shoes, and into nets, fish lines, and cordage. The finest hammocks and most costly are also made of it. The small quantities which have been sent to this market have been manufactured into handkerchiefs, laces, ribbons, false hair, and wigs. The difficulty is to decorticate the plant without rotting or otherwise injuring the fiber. The man who can do that will be able to take fortune at the flood.—*N. Y. Herald.*

THE AUSTRALIAN BUSTARD.

This remarkable bird, which is known as the *Chariotis Australis*, or wild turkey, is found in many parts of the colony, more especially on dry, sandy plains, where they feed promiscuously on insects, herbs, or grain. They deposit their eggs in small hollows on the open plains, and directly the young birds leave their shell they are allowed to follow their instincts, and forage for themselves. In their habits they are particularly shy and timid, and very sensitive to the approach of danger. The plumage of the male, as is usual among the feathered tribes, is more variegated and beautiful than that of the female, and he is decorated with a singular pouch-like appendage suspended from his neck. This pouch was once thought to be a receptacle to hold water, but naturalists have proved it to be merely a temporary air chamber, and closely connected with the reproductive function. Our illustration represents the male bird as he appears at a time when he is termed "throwing off," but a display of this kind can only be seen early in the morning or at sunset in the month of June. With the advance of civilization the bustard has been driven back to the interior, and is now rarely to be met with. One specimen is, nevertheless, to be seen among the collection of birds at the Botanic Gardens.—*Pictorial Australian.*



THE AUSTRALIAN BUSTARD.

Exhibition Rats.

We have referred on several occasions, says *Nature*, to the extraordinary number of rats which emerge from various parts of the building when the late exhibitions at South Kensington have closed and the supply of food is cut off. This year their number has been larger than ever, and shortly after the termination of the late Colonial and Indian Exhibition, the rats, desperate with hunger, invaded every part. During the summer nothing would induce them to enter traps, whereas now they rush in as fast as they are set, and not until they have devoured the bait do they seem to realize the fact that they are prisoners, when they seek deliverance in their usual wild fashion. Recently their cravings for food culminated in a fierce onslaught upon one another, which was evidenced by the piteous cries of those being devoured. Their method of seizing their victim is to suddenly make a raid upon one weaker or smaller than themselves, and after overpowering it by numbers, they tear it in pieces. At the present time there cannot be found a single young rat in the building. So far this is satisfactory, as the large numbers bred during the summer will thus become exterminated.

Oxide of Iron as a Polishing Material.

Rouge, crocus, and colcothar are terms which designate the various forms of peroxide of iron used as polishing agents in the fine arts. Rouge is oxide of iron which has been prepared by a delicate and tedious process, and is in a state of minute subdivision. It varies in color from bright red to purple red, and exists in several degrees of fineness, which are of corresponding pecuniary value.

Rouge is used to "color" metal work and to polish glass; for the "coloring" of gold, it must be excessively fine, and is then worth 4s. per lb. and upward. For ordinary silver and German silver work, a rouge worth from 1s. 6d. to 3s. per lb. is employed, according to the perfection of "color" required. By this term is meant the final polish or luster given to the articles after the preliminary processes, which, in the case of German silver, are sand buffing and lime buffing. The latter is effected by means of freshly burnt and powdered magnesian limestone obtained from the neighborhood of Sheffield.

After the articles are covered with silver, this lime is applied to obtain the first polish, and then rouge is made use of to impart the black luster or color. Steel is, of course, known to possess the highest luster of all metals, by which is meant that it reflects light more regularly from its polished surfaces than the others do. In other words, more light is reflected according to the angular law of reflection, and less is scattered indiscriminately. The better the range, the nearer the surface approaches these conditions, and the blacker the article appears when not directly reflecting a beam of light. Silver, the whitest of all metals, owes its distinction to the great amount of light irregularly reflected, and, of course, also to the high ratio of total reflected to incident light.

Buffing lime has not cut enough to remove the dead or frosted surface from articles just out of the nickeling bath, and burnt rotten stone was formerly in much request. This has now, however, given place to crocus, by which used to be meant on oxide of iron of coarser character than rouge, but now almost universally applied in Birmingham and Sheffield to the material when made up into bars by admixture with about 15 per cent of solid fat.

Crocus is of a tint approaching purple, and the oxide in this state possesses great hardness and cutting power. Cutting power, or cut, does not, however, depend altogether upon hardness; many hard substances, as, for example, glass, scratch with great readiness when in comparatively large particles, but abrade a metallic surface to an extent quite inferior to oxide of iron when in a state of fineness similar to rouge or crocus. Colcothar is oxide of iron, harder than crocus, and of still darker appearance; it is found very suitable for the polishing of iron and steel, but has a severe competitor in emery for this purpose. Crocus and colcothar are, to some extent, convertible terms, and no very well defined limitation of meaning exists between them.—*Industries.*

Successful Hatching of Salmon in Australia.

According to the *Colonies and India*, the last experiment in sending salmon ova to the antipodes appears to have been a great success. In January, 1885, a shipment of eggs was made by Mr. James Youl, by desire of the Tasmanian Government, and the bulk of the eggs reached the colony in good condition, development of the embryo having been suspended by means of Haslam's refrigerating machinery. The eggs have developed into "fry," and the "fry" into "smolts," for several young salmon about 8 inches long have been captured accidentally in the Tasmanian Mersey.

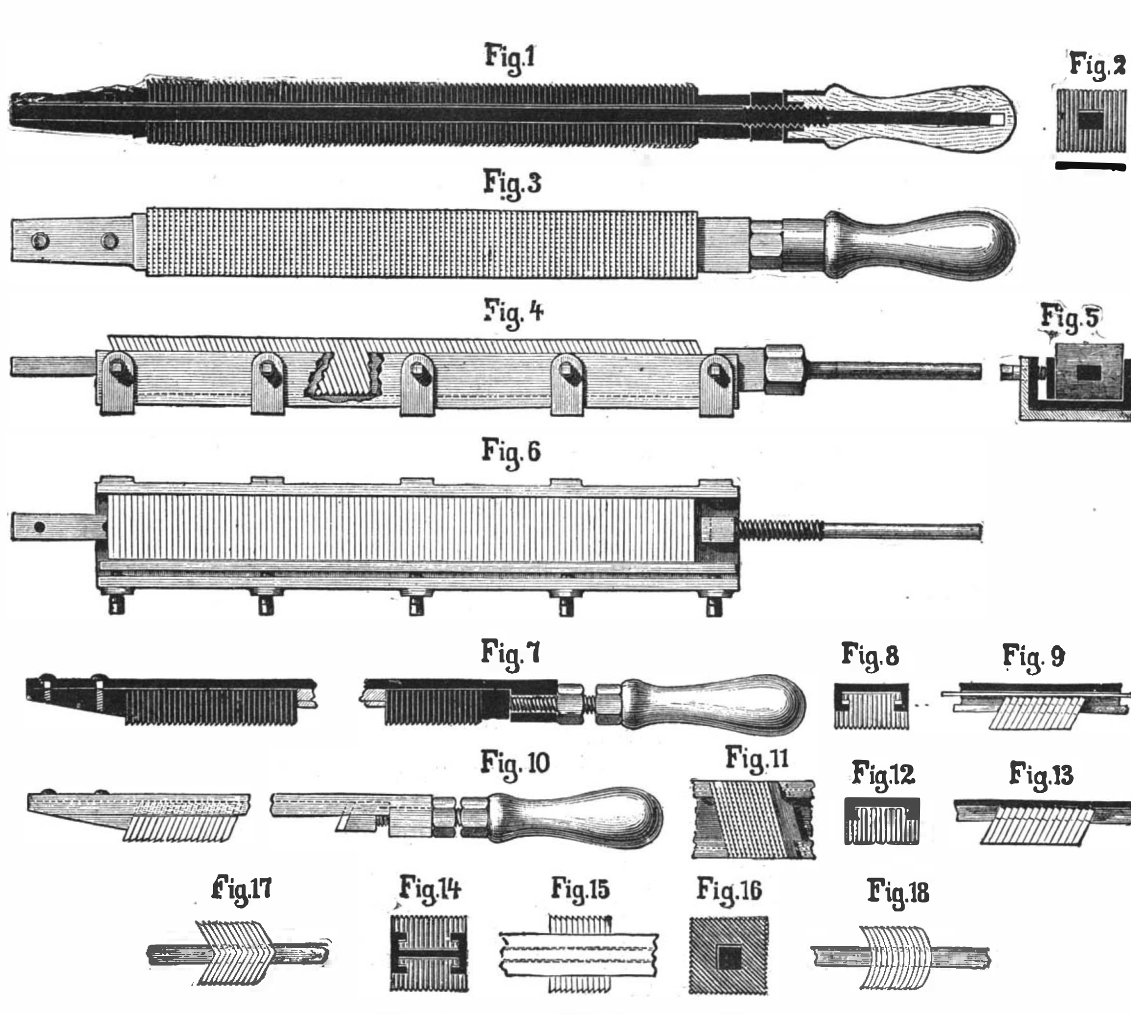
THE BUILT UP FILE.

This file is composed of a series of serrated plates, held together by a nut and screw, and which plates can be sharpened on a grindstone, recutting in the ordinary way being obviated. Fig. 1 of our engravings shows a longitudinal and Fig. 2 a transverse section of this file, with two sectional views of a plate. Fig. 3 shows the cutting surface of the file. The body of the file consists of a number of plates or leaves, which are grooved or serrated on one side, as in Fig. 2. These leaves have a square hole in the center, and are threaded on a square steel bar, alongside of which is inserted a thin band of steel for tightening purposes. At one end of the bar is a cap fixed by rivets, which prevents the leaves slipping off.

At the opposite or handle end is a steel ferrule, kept in place by a screw nut, beyond which is a handle working on an internal screw, the whole being screwed up tightly on the cap at the lower end. It will thus be seen that Figs. 1 to 3 represent the file in its working condition. When it gets blunt, it i sharpened in the following manner. The handle is first unscrewed and the nut loosened, then the cap at the lower end is taken off, and finally the thin steel band drawn out. This sufficiently loosens the leaves to allow them to decline at an angle of 22° to the center bar. In this position the surface to be ground presents a smooth face, as shown in Fig. 4, and thus the file can be sharpened on a common grindstone by any laborer without the trouble and cost of sending to a file cutter. The file is put into an iron box or form, as seen in Figs. 4, 5, and 6, and this box is fitted with an inside sliding bar, which can be screwed up tight to keep the leaves in position for grinding, as in Figs. 5 and 6.

Fig. 7 shows in longitudinal section a file having one cutting side only, and Fig. 8 the same file in cross section. Here the leaves are not placed on a bar, but inserted in a frame. The tightening up is effected by the same means as in Figs. 4, 5, and 6. To grind this file the handle and nut must be removed, the cap taken off, the leaves brought into an inclined position and fixed by a steel band, which is inserted between the frame and the upper edges of the leaves, as in Fig. 9. Figs 10 and 11 also represent a one-sided file, where the leaves are placed at an angle with the bottom and side of the frame. Figs. 12 and 13 show respectively a transverse and longitudinal section of this file. For grinding purposes, the leaves need only be turned so that the grooved sides are toward the handle, thus forming a smooth surface. Fig. 14 is a cross section of a file with a cutting face on both sides. The system of handling is the same as in Fig. 7. Fig. 15 is a side view of the same. Fig. 16 is a cross section of a file similarly constructed to Figs. 1, 2, and 3, but which can be used on all four sides by the diagonal serrations of leaves. There is, however, this disadvantage—the cutting surface decreases in width when the file is ground on all four sides, whereas the cutting surfaces of the two-faced files are not diminished in breadth. Figs. 17 and 18 are also similar in construction to Fig. 1, except that the leaves are made angular or circular. The straight leaved file is, however, preferable not only for working effect, but also for greater facility and exactness in grinding. These files are used in the same way as an ordinary file, but they are said to require much less pressure.

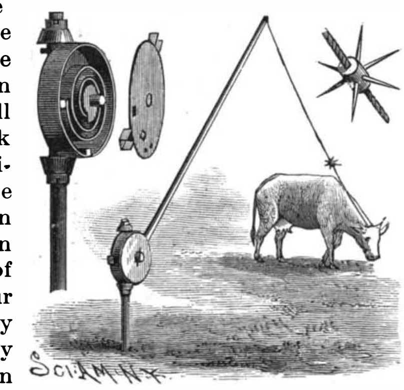
The advantages claimed are an increase of working power, durability, and the facility of resharpening by grinding, thus avoiding the necessary heating for recutting and rehardening. It is stated that it never gets clotted, and is more easily cleaned than the ordinary file. A manufacturer of this file at Vienna calculates, says *Iron*, that whereas the ordinary file has to be recut after ten days' use, the Muller file will stand 20 days' use without requiring resharpening, and that it can be resharpened twenty-one times, while the ordinary file can only be recut six times. Its working power would therefore be 420 days, against 60 days of the ordinary file, until its complete absorption. Thus the Muller file should perform the work of seven ordinary files, at the cost of only twenty-one grindings, as against forty-two recuttings of the ordinary file. Therefore the latter, although at first cheaper than the former, would in the end appear to be four times as expensive.



IMPROVED BUILT UP FILE.

IMPROVED TETHER.

Driven into the ground a sufficient distance to hold it firmly in a vertical position is an iron stake, upon the upper part of which a casing is held. The casing is free to turn upon the stake, and in its edge are formed suitable sockets for the reception of one end of a light wooden pole, which is pressed toward a vertical position by a spiral spring arranged within the casing as shown in the left of the engraving. To the outer end of the pole is secured the tethering rope, provided at its outer end with a snap hook. It will be seen that as the animal grazes around the stake, it will turn the spring casing and the pole to which the rope is fastened, thus preventing the rope from being wound around the pole



The pole can be drawn over to one side to a certain extent, and will be brought back to a vertical position when the downward strain is taken off. Upon the outer part of the rope is a spur ball, which may be adjusted in any desired position on the rope. This spur ball, by pricking the animal in the side or shoulder, prevents it from pulling straight out on the rope. This tether is simple, strong, and efficient, and can be readily taken apart when moving from place to place, and can be as readily set up in working portion.

This invention has been patented by Mr W. B. Farrar. Further particulars can be had by addressing Mr. C. D. Benbow, of Greensborough, N. C.

Accidents with Odorless Fuel Gas.

From the time that coal gas was introduced, its disagreeable odor has been the subject of criticism. This comment was met by its advocates with the assertion that its odor, as disclosing any escape or leakage, was a good feature. Their claim has received, during the last few weeks, a most melancholy confirmation.

Fuel gas, essentially a nearly odorless mixture of carbon monoxide, hydrogen, and one or two other gases, has recently been introduced into the city of Troy, N. Y. It is distributed through pipes purchased of a steam heating company, whose works as well were purchased and utilized by the fuel gas company. Toward the end of the past year, several operatives in a laundry were overcome by some unknown cause. They suffered from headaches and other symptoms, and soon fainted away. It was found that fuel gas had been escaping into the room, and this at once gave the cause of their sickness. More recently another similar case occurred. In both these instances, the blame was attachable to the consumers, who had left faucets partly open

On the fifth of January of this year, a number of people were similarly affected, twelve in all succumbing to its influence in different buildings, but situated on the same block, about 300 yards from the gas works. A leak in the gas main had permitted the gas to escape, and it found its way, possibly by the sewers, and thence through the sewer pipes, to the houses affected. The victims, after suffering considerably, gradually recovered. The doctor, on reaching the scene, was informed that no fuel gas was used in any of the buildings, but notwithstanding this, suspecting the cause of the trouble, opened the windows and used th remedy of plenty of ventilation. Owing to this timely action, due to the belief of the attending physician that gas was at the bottom of the trouble, the result was far less disastrous than it would otherwise have been.

But a further escape of the gas occurred on Sunday, January 16, within a hundred feet of the works, which, in addition to producing injurious effects upon people, killed outright two victims—a man, Charles Pratt, and a woman, Mrs. Caroline Bennett. In consequence of this, a special meeting of the Troy Council appointed a committee to investigate the condition of affairs with the gas company. Pending the investigation, the franchise of the company was suspended by a unanimous vote. The company is said to have expended over $100,000 on their plant, and had a large new holder nearly ready for operation. It is doubtful if they will resume operations on the old plan.

The point proved is that an odorless gas is unfit for general distribution. The company had hoped to succeed in imparting an odor to their product, so as to make it safe in the sense that ordinary illuminating gas is. Absolutely no odor could be detected in the buildings charged with the fuel gas, although those prostrated by it in some instances spoke of tasting it. It was emphatically a hidden foe. The writer, as a gas engineer, has had considerable experience with coal gas, having been overcome with it a number of times. This can never happen without forewarning by its characteristic odor. Coal gas, moreover, contains so little carbon monoxide that its effects are not nearly so serious as those of water gas such as that made by the Troy Company On resuscitation from the swoon produced by coal gas, large quantities of milk can be imbibed with benefit, the system seeming to crave this nutriment.

The gas companies who wish to sell fuel gas have before them the task of discovering some available compound that can be used to impart a characteristic odor to their product. If it were not for its high cost, a little nitro-benzole, the artificial oil of bitter almonds, might answer a good purpose. A gas at once odorless and poisonous is a dangerous subject to handle. In all the history of science, it is hard to find a more heroic devotion than that displayed by Sir Humphry Davy, who, in his studies of gases, inhaled a number of them, to determine their effects upon the system. It was thus that he discovered the peculiar properties of laughing gas. The world is to be congratulated that he did not inhale carbon monoxide in fatal quantity. The Troy fuel gas was made by the Lowe process. Its want of odor having come to be recognized as an evil attribute, experiments had been conducted with a view to curing this defect. Carbolic acid was tried and found too expensive, and the addition of a sufficient quantity of hydrocarbons would remove it from the category of a non-luminous fuel gas. It had been sold for fifty cents a thousand; and while public sentiment was strongly roused against it by the fatal occurrence of January 16th, the laundry proprietors feel that the probable definite deprivation of it is a serious loss and inconvenience to them.

Cornell in Luck.

It is rumored that Mr. Hiram Sibley, the founder of Sibley College of Mechanic Arts, Cornell University, is about to add to his previous liberal donations to that institution $250,000 Since Professor R. H. Thurston has become the director, and had charge of this college, its success and influence has been greatly augmented.

EIGHT thousand miles of new railroad were built in the United States during 1886.

SCIENCE IN TOYS.

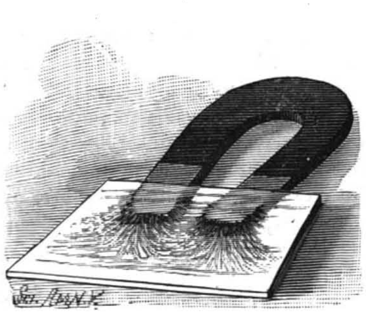
VI.

In view of the comparatively recent advance in electrical science, it is remarkable that so little attention has been paid to electrical and magnetic toys. Enough, however, has been done in this direction to furnish material for a great deal of study and experiment.

A common, simple, and, at the same time, wonderful toy is the permanent magnet. Faraday made it the subject of investigation and study, and it is to his skill as an investigator that we owe the great discovery of induction, which has made all modern electrical enterprises possible. Faraday reasoned, that since the circulation of an electric current in a wire coil surrounding a bar of steel rendered the bar magnetic, the introduction of a magnetic bar of steel into a coil of wire should produce an electric current in the coil. Experiment proved the reasoning correct, and the world is richer for the discovery of induction.

A magnetic bar of steel will attract and repel. Its influence reaches out to a distance, rendering other objects within its field magnetic. The very fact of holding its armature with such tenacity always excites wonder, even in those who know most about it.

The direction taken by the lines of force emanating from the poles of the magnet may be exhibited by the old and well known experiment, consisting in sprinkling iron filings over a glass plate laid over the poles of the magnet, as shown in the engraving.

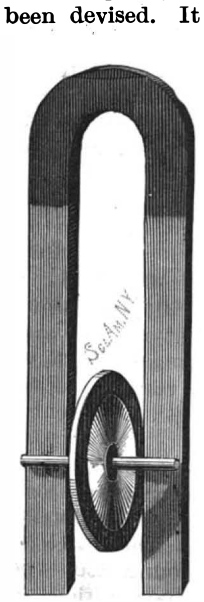


MAGNETIC CURVES.

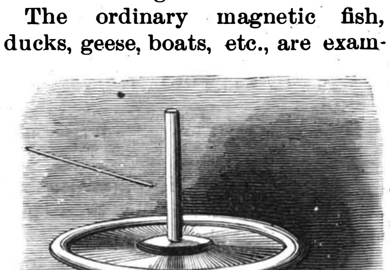
These curves show where the field is strongest.

The rolling armature applied to a long U-magnet exhibits the persistency with which an armature adheres to a magnet. The wheel on the cylindric armature acquires momentum in rolling down the arms of the magnet, which carries it across the polar extremities and up the other side.

A very pretty modification of this toy has recently been devised. It consists of a top with a magnetic spindle, and straight and curved iron wires. The top is spun by the thumb and fingers, in the usual way, and one of the wires is placed against the side of the point of the spindle. The friction of the spindle causes the wire to shoot back and forth with a very curious shuttle motion. The point of the top rolls first along one side of the wire and then along the other side.



MAGNET AND ROLLING ARMATURE.



MAGNETIC TOP.

The ordinary magnetic fish, ducks, geese, boats, etc., are examples of floating magnets, which show in a very pleasing way the attraction and repulsion of the magnet. The little bar magnet accompanying the magnetic figures serves as a wand for assembling or dispersing the floating figures; or it may serve, in the hands of the juvenile experimenter, as a baited fish hook.

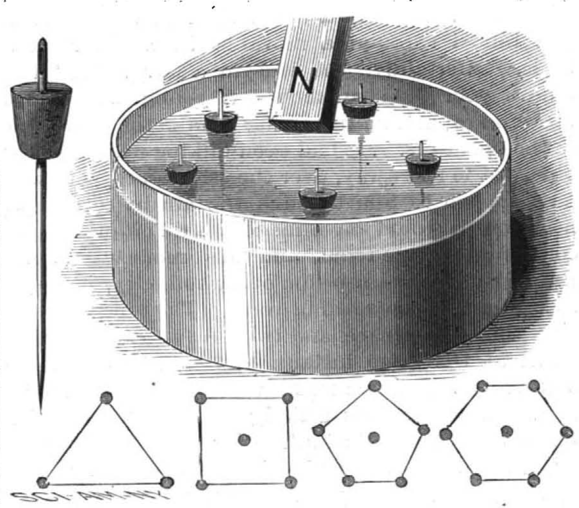
Prof. A. M. Mayer has devised an arrangement of floating magnetic needles which beautifully exhibits the mutual repulsion of similarly magnetized bodies. A number of strongly magnetized carpet needles are inserted in small corks, as shown in the perspective view of the engraving.

FLOATING MAGNETIC FIGURES.

When floated, these needles arrange themselves in symmetrical groups, the forms of the groups varying with the number of needles.

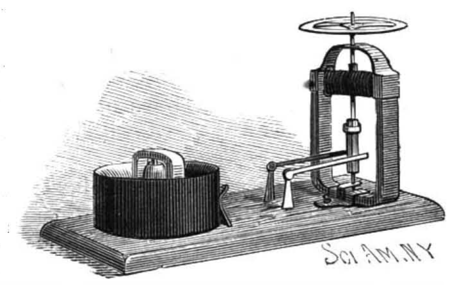
One pole of a bar magnet held over the center of a vessel containing the floating needles will disperse the needles, while the other pole will draw them together.

A fifty-cent electric motor is perhaps quite as remarkable as a steam engine of the same price. Such a



MAYER'S FLOATING NEEDLES.

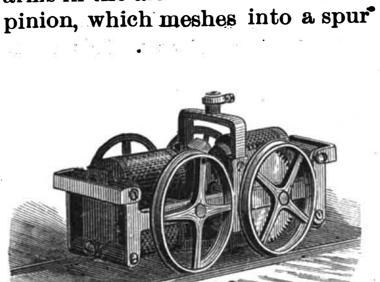
motor is shown in the annexed engraving. It embodies all the essential features of the larger motors and electric generators.



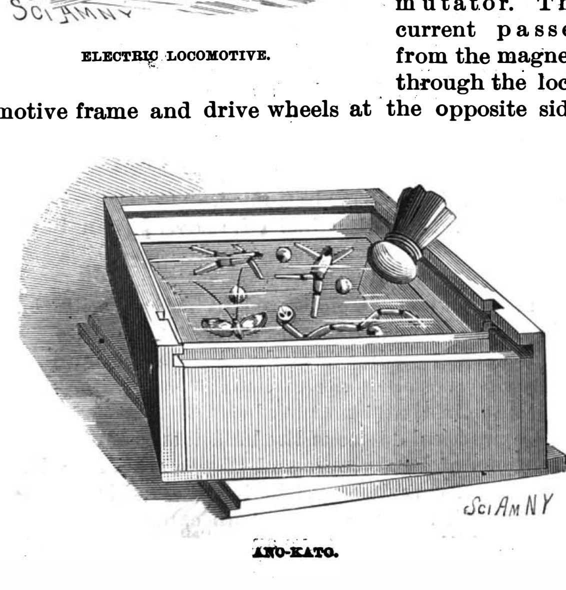
FIFTY CENT ELECTRIC MOTOR.

The vertical spindle which carries the armature is journaled at the lower end in the middle of a U-magnet and at the upper end in a brass cross piece attached to the poles of the magnet. The armature consists of a cross arm of soft iron wound with four or five layers of fine wire. The terminals of the winding of the armature are connected with a two-part commutator carried by the spindle, and touched by two commutator springs supported by wires driven into the base. A metal stud, rising from the base, is connected with one of the commutator springs, and is provided with an insulating covering on its sides, while its upper end is bare. Upon the stud is placed an annular cell of carbon, which is touched on its outer surface by a spring connected with the remaining commutator spring. The cell forms one of the elements of the battery. The other element consists of a bar of zinc provided with a central aperture for receiving the upper end of the stud, and having its ends bent downward. The cell is filled with a solution of bisulphate of mercury in water. As the salt is reduced by chemical action, a current is produced which will run the motor at a high rate of speed. The motor is fitted with a wheel or plate for carrying color disks, similar to those accompanying the well known chameleon top.

The toy electric locomotive is a far more expensive affair. It is provided with two electro-magnets with their poles facing each other. Between the poles of the magnets is placed a shaft carrying an armature having a number of arms. Upon the armature shaft is placed a star-shaped commutator, which interrupts the circuit for every revolution as many times as there are arms in the armature. The armature shaft carries a pinion, which meshes into a spur wheel on the drive wheel shaft. The wheels on one side of the locomotive are insulated, and provided with sleeves touched by springs, which convey the current to the commutator. The current passes from the magnets through the locomotive frame and drive wheels at the opposite side.



ELECTRIC LOCOMOTIVE.



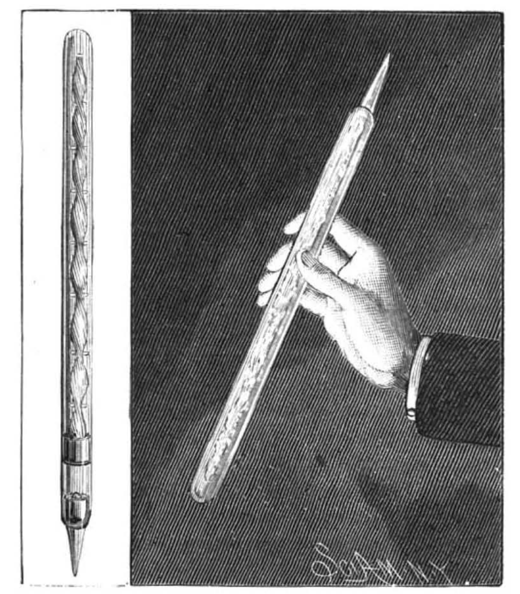
ANO-KATO.

The poles of the battery are connected with the track rails. The machine will run in either direction.

A toy exhibiting some of the phenomena of statical electricity is shown in the annexed cut. It has received the name of ano-kato, but it is only a simple electrophorus formed of a flaring box lined with tin foil, covered with a piece of ordinary window glass, and containing figures made of pith.

By rubbing the glass with a leather pad charged with a little bisulphide of tin, the electrical equilibrium is disturbed, and the figures are made to go through all sorts of gymnastics.

The self-exciting Geissler tube is a beautiful object in a dark room. The electrical effect is produced by the friction of mercury on the inner surfaces of the vacuous glass tube, as the tube is inverted or shaken. The



SELF-EXCITING GEISSLER TUBE.

tube is ingeniously contrived to prevent breakage by the falling of the mercury against the end of the tube, and at the same time to increase the effectiveness of the device by arranging two tubes concentrically, the inner tube being beaded, and provided with little knobs for breaking the fall of the mercury. The inner tube is sealed to the outer tube near one end, and in the inner tube, a short distance above this sealing, is formed an aperture which determines the amount of mercury to be retained between the inner and outer tubes when the tube is inverted preparatory to use, as all of the mercury between the two tubes and above the aperture will run through the aperture into the lower end of the tube. In this manner the mercury is equally divided, so that when the tube is reversed, one half of the mercury flows through the inner tube, and the other half flows downward between the inner and outer tubes.

The full effect is realized only when the mercury is allowed to flow quickly from one end of the tube to the other, but any agitation of the mercury in the tube produces some phosphorescent light. G. M. H.

English Railway Couplings.

On the 2d of December last a number of tests were made at Derby with the prize car couplings shown at Nine Elms in March of last year, through the offer of a prize, the object of which is to prevent the present loss of life among car couplers. The contrivance which at the last demonstration elicited the most unanimous approval is a light pole, about 5 ft. 6 in. in length, with a skillfully devised hook at the end, by which the chains can be attached or set free in wonderfully short time. One man ran along twenty cars and uncoupled them in seventy seconds; another coupled them again in seventy-six seconds. This plan has been in use on the Midland Company's system for some time, and has led to a decided diminution of accidents. It is to be hoped, says the *Lancet*, that other railway companies will speedily take steps to terminate or materially diminish the slaughter which annually results from the goods guards and shunters having to pass between the cars to couple and uncouple them.

To Americans this mode of coupling cars is so clumsy as to be laughable; but it suits John Bull to a dot.

The Medical Possibilities of Photography.

The *Evening Post* says: "In the *Camera* magazine a very curious phenomenon, in connection with photography, is recorded by the person who observed it. He took a portrait of a child apparently in full health and with a clear skin. The negative picture showed the face to be thickly covered with an eruption. Three days afterward the child was covered with spots due to prickly heat. 'The camera had seen and photographed the eruption three days before it was visible to the eye.' Another case of a somewhat similar kind is also recorded, where a child showed spots on his portrait which were invisible on his face a fortnight previous to an attack of smallpox. It is suggested that these cases might point to a new method of medical diagnosis."

A Reporter's Visit to the Boston Telephone Exchange.

Any one who has often used the telephone must have had occasion to be impressed with the mysteriousness, the sense of material non-existence, of that part of the machine and its belongings that lies beyond one's own instrument and that of the person at the other end, whom one is talking to, says a writer in the Boston *Post.* My own material existence I am reasonably assured of. I can imagine my friend at the other end of the line. But between us two there is an airy nowhere, inhabited by voices and nothing else—Helloland, I should call it. The vocal inhabitants of this strange region have an amazing vanishing quality. Even while you are talking casually with one or another of them, you may become aware that you have been unaccountably "cut off;" and if you become impatient, and raise your voice in earnest demand or protest, the more you bellow, the more you become aware that you are idiotically shouting yourself black in the face against a mere inanimate box stuck against the wall. Nothing else than the supremest invention of the nineteenth century could make man so supremely ridiculous as he is when he is shouting objurgations into a telephone transmitter that isn't "connected." The consciousness of such an experience produces in sensitive men, I am sure, a sensation of nervous shock, somewhat akin to seasickness. And sometimes, when you are talking blithely enough through your central office intermediary, you hear the confused murmur of a hundred voices. You catch more expressions from private conversations than your nerves can transmit to the central office of your brain; and if you are imaginative you may undergo, as I have, a feeling as if you had a hundred astral bodies that were guiltily listening at as many keyholes. The central office is not like any other business establishment whatsoever. The telephone seems to you to have no visible agency. If you have business with the company, you telephone it. Your applications and complaints go over the wire to that one impersonal, impalpable voice.

In the first place, there is something besides a voice at the central office. I beheld, as the door was opened, twenty comely young women sitting in a long row, in easy arm chairs, before tables with endless apparatus before them. That was the first fact that I grasped. The next one was that those girls were not shouting at all. There was a low, indistinct murmur, and that was all. As I approached nearer I could hear, in tones not much above a whisper, the ever monotonous "Hello! hello!" "Ye-es!" "Good-by!" but one clear voice in a good speaking tone might have been heard plainly across that whole room above all the business of making the connections for 2,000 people. Every girl had strapped upon her head, or rather held there by its own grip, an apparatus composed of crossed steel bands, which held a small telephone receiver to her ear. Before her, dangling by a long wire in just such position as to hang exactly in front of her mouth, was the transmitter. Each girl leaned back in a comfortable attitude, and seemed entirely cool and totally unconcerned, while both of her hands were occupied in inserting wires with metal plugs at their ends into certain holes before her, and pulling them out again. There were rows upon rows of these little apertures, and every one of them represented somebody's telephone number. Each girl takes care of a limited number of calls, which are signaled to her by the dropping of a little metallic tablet with the number of the caller's instrument upon it; but she has within her reach, in those little apertures that I have mentioned, every one of the telephone numbers within the radius of the exchange.

"These seem to be young women of excellent physique," I said to the superintendent.

"We insist upon that," said he. "We have found that girls of good physique, healthy young women, are much less liable to irritation and impatience, much less likely to 'get rattled,' than those who are a little weak or ill. It is not that the work wears upon them, so that only women of unusual physique can stand it, but that we must have operators who are likely to keep their tempers and maintain coolness of demeanor. Does it deafen them? I have never known but one case of an operative's hearing being affected, and that might easily have been from some other cause. They do not seem to suffer much nervously, though there was one case of hysteria here last week. One of the girls—that one with the slender figure and dark hair near the end of the line—got confused and 'rattled,' as we call it, over a series of vexations, and asked to have a substitute placed in her chair. You see that we keep five substitutes in the room to relieve those who desire to be relieved at any time. Well, this young woman went into the girl's waiting room and had an attack of hysteria there. Not infrequently something occurs on the line—somebody gets impatient and loses his temper—which troubles the girls. They generally go out into their room and have a good cry, and come back feeling better. They certainly seem to like the work, though the pay is only $7 a week. The hours are not long; they sit all day; they are relieved when it is needful, and the actual work seems to be agreeable to them."

There was a strumming sound under the superintendent's table. He held a telephone receiver to his ear, and talked through a movable transmitter on the table. "Certainly," he said in a low voice, "I will relieve you." He summoned a young woman from the window, and motioned her to take the chair of one of the operators. He had been talking with one of the girls, not 15 feet away, over the telephone! She could have spoken to him through the air by turning her head, but it would have made a little bit of noise and confusion in the room, and this modern tower of Babel, this vocal sensorium of a whole city, is as quiet as a public library reading room. The substitute girl took the other's place, and two "calls" came tumbling down at the same instant, and somebody was undoubtedly vexed because he was not answered for an instant while she was making the other connections. But it takes but an instant.

"We like to have people who have telephones come up here," said the superintendent. "It gives them an idea how the thing is done, and we notice that they seldom get impatient in the use of their telephones afterward."

Certainly these girls were not trifling with their work. The superintendent, by merely putting an instrument to his ear, can hear every word that passes between an operator and the people with whom she talks; and that seems almost an unnecessary restraint. Vexation makes the work harder for the operator, and she avoids it. Women are found to be better operators than boys, though boys must be employed at night; and that is why the day service is better than that of the night.

The girls glanced at me as I walked by their desks with the passing curiosity of all women and all men, but their hellos went on just the same. I saw more than one genuinely pretty face. Helloland is not so ghostly after all!

Submarine Boats.

Submarine boats are a much older invention than is generally conceived; but they are now coming prominently forward, because there is a useful field for their employment, and also because modern devices have rendered it possible to construct vessels which can be propelled safely beneath the surface of the water. Who first suggested the idea is not known; but it seems well authenticated that in the reign of James I., a Dutchman named Drebbel designed a boat which was actually propelled by twelve oars under the surface of the Thames, the air being revivified by some liquor, the composition of which Drebbel kept a secret.

The Marquis of Worcester, in his "Century of Inventions" (1663), refers to a similar invention, and there is a record that a man named Day sank with his submarine boat in Plymouth Sound in 1774. It is, however, to Robert Fulton that we are indebted for the first definite ideas on the subject, for so long ago as 1801 he descended to a depth of 25 feet in the harbor of Brest, and demonstrated the fact that his "plunging boat" could be trusted to take himself and three companions under the water and return to the surface in safety. This boat was named the Nautilus, and when beneath the surface was moved 500 yards in about seven minutes, by two men turning the "engine," while Fulton regulated the position of the boat. On one occasion the boat remained beneath the surface for nearly six hours; but nothing in the shape of effective warfare was accomplished when Fulton was persuaded to lend his services to this country, though he did by way of experiment blow up some old vessels with torpedoes. Fulton published his work on the subject, "Torpedo War and Submarine Explosions," in 1810, at New York, in which he shows that a system of harbor defense based on stationary and movable torpedoes is the surest, quickest, and cheapest plan for protecting maritime cities against the naval forces of an enemy.

In 1860 a submarine boat was made in France, in which compressed air was utilized for working the propelling device, and also for expelling the water taken in to produce submergence; but this vessel, too, does not seem to have been a success. A submarine boat has, however, been used for some time by the Pacific Pearl Company in carrying out their fishing operations; but it is not intended to serve as a torpedo boat, being flat bottomed, with "doors" in the bottom, through which the oysters can be collected. Toselli's submarine exploring vessel is a fairly perfect device for diving, but has no means of propulsion; it is, in fact, an elongated diving bell, with reservoirs of compressed air and two or three stories.

Much attention has been devoted to the subject of submarine vessels in Russia, and many experiments were made in that country about twenty years ago; but no practical device of the kind was produced. The inventions of Denayrouse and Fleuss, which disclosed a method of carrying sufficient air to enable a man to breathe either in the ways of an exploded coal mine or beneath the water, gave an impetus to the search for a submarine boat, and modern inventions in connection with electricity have helped to place the scheme on the road to ultimate success. A few years ago two submarine boats were built at Liverpool from designs by Mr. Garrett, who employed chemicals to revivify the air and render it respirable over and over again; but the most successful of these boats was lost off the Welsh coast. Since then Mr. Nordenfelt has turned his attention to the subject, and has lately demonstrated that boats can be propelled for a few hours under water, although not with sufficient accuracy for torpedo work. A large and powerful vessel is being built from his designs, and will probably be ready for trial in the spring. Meantime Professor Tuck is progressing with the Peacemaker, which we briefly described, and which has since been astonishing those who have witnessed her performances in the Hudson River.

Both Nordenfelt and Tuck employ steam for driving the propeller, the former carrying the heated water in reservoirs, the latter using the Honigmann caustic soda (or potash) boiler. Recently, further trials were made with the modern Nautilus in the Tilbury Docks. That is a cigar-shaped vessel, 60 feet long by 8 feet in diameter, with a short raised deck in the center, through which a conning tower projects, and provides access to the interior.

The vessel is built of steel plates five-sixteenths inch thick, with 3 by 3 by ½ inch frames 1 foot 9 inches apart, and is estimated to be strong enough to withstand the pressure of 50 feet of water. The boat is fitted with two screws, each driven by an Edison-Hopkinson motor at about 750 revolutions, the current being supplied by 104 secondary cells; but owing to the comparatively confined space of the dock, no trials of speed were made. The method of sinking and raising the vessel was designed by Mr. A. Campbell, and consists in a simple method of decreasing or increasing the displacement without affecting the weight of the vessel. This is accomplished by means of four horizontal cylinders on each side of the hull, which can be thrust outward into the water or drawn into the hull.

The cylinders work through water-tight sleeves, and can be moved either by hand or by screws worked by gearing from a shaft so arranged that corresponding cylinders on each side are pushed out or withdrawn simultaneously. It will be readily understood that if the vessel with water ballast tanks full and the cylinders within the shell sinks to the bottom, the extra displacement which can be obtained by thrusting out the cylinders will bring her to the surface, while the tanks will enable her weight and trim to be regulated. Besides a rudder of ordinary pattern, the Nautilus has a horizontal fin or rudder for guiding the vessel or preventing a tendency to rise or dive, thus keeping a uniform depth below the surface.

It is said that the air contained within the vessel is sufficient for a two hours' submarine trip with a crew of six; but no doubt if other vessels of the kind are constructed, either compressed air will be carried, or some means will be adopted for revivifying the air, as men engaged in such work as submarine torpedo warfare will need clear heads, and must run no risk from air heavily charged with carbonic acid. A patent has recently been secured in this country by Mr. C. D. Goubet, of Paris, for a submarine torpedo boat in which equilibrium is maintained by a pendulum acting through a horizontal bar on a clutch that actuates one portion of a double action pump, which displaces water from one or the other of two reservoirs at the ends of the vessel. Water ballast tanks assist in the submergence of the boat, and the motor is driven by electricity supplied from storage batteries.

The screw propeller is movable, so as to be capable of giving the vessel an oblique direction in any sense in relation to the vessel's axis while having a regular continuous rotary motion. The vessel can thus be guided without a rudder, and can perform various evolutions. The torpedo is placed at the after part of the vessel, and is connected to an insulated wire wound on a drum. The crew enter an opening at the top closed by a dome, and sit on a compressed air reservoir from which air is taken and moistened by being caused to pass into the water compartments, whence it is discharged by a pipe into the dome. The vitiated air is constantly expelled by an air pump.

The torpedo vessel is fitted in front with a cutter or spike which can be projected forward several feet; it is worked by a lever, and serves to cut torpedo wires or nets. An obturator tube serves to discharge signal cartridges, which on reaching the surface explode, and thereby give an indication to the ship with which the torpedo vessel is connected. A special arrangement enables this vessel to be propelled also by means of oars. We are not aware that any trials have been made with this vessel, or whether one has been constructed; but we may rest assured that it is only one of many patents which will be taken out for vessels and machines adapted to submarine navigation for the purposes of warfare.—*English Mechanic.*

M. HIGNETTE makes a white artificial stone from sand which has been used for polishing plate glass.

ENGINEERING INVENTIONS.

A car starter has been patented by Mr. Phillip Listeman, of Collinsville, Ill. An arm is pivoted approximately concentric with the car wheel, and on its axle, this arm having a pawl or clutch arranged to engage the periphery of the wheel, with other novel features, making a device by which the weight of the car may be utilized in starting it.

A car coupling has been patented by Mr. J. Baptist Butts, of Philadelphia, Pa. The draw head has a full bell-shaped mouth, with aperture near the mouth to receive a coupling pin operated in a special manner, the coupling being adapted to couple with any other kind of coupling, whether higher or lower, being also readily operated from the top or sides of the cars, and calculated to couple the mautomatically.

A wedge for mining coal has been patented by Messrs. James O. Watson and Conrad A. Sipe, of Fairmont, West Va. It consists of a cylinder formed of two independent sections, each with a tapering groove, forming a central rectangular recess, in connection with a rectangular shaped wedge having a longitudinal threaded aperture, with other novel features, whereby the use of powder and other explosives may be done away with in breaking down coal.

MECHANICAL INVENTIONS.

A sawing and grinding machine has been patented by Mr. Thomas E. Goodwin, of Nashville, Tenn. It is a combination machine, consisting of a rectangular frame, with ways, standards, main shaft, fly wheel, treadle, grindstone, and saw, with other novel features, designed to be run either by hand or foot for use as a cross cut or rip saw or as a grinding machine.

A motor has been patented by Mr. Bartholomew McCabe, of Buffalo, N. Y. The object of this invention is to provide simple and efficient mechanism for converting reciprocating into rotary motion, in machines driven by treadles, as well as steam engines, a shaft with ratchet wheel and loose pulleys carrying pawls to engage the ratchet wheel, and cords or cables connected with reciprocating mechanism extending around the loose pulleys, with other novel features.

AGRICULTURAL INVENTIONS.

A hay loader has been patented by Mr. Adolf Lasack, of Oxford Junction, Iowa. It has shifting devices suspended within side rakes, in combination with crank shafts, connections, and gear wheels, whereby the hay is moved steadily and continuously up the elevator as rapidly as it is gathered by the rakes.

A mowing machine cutter has been patented by Mr. William T. Decker, of Lehigh Tannery, Pa. The cutter bar has a series of revoluble studs with eccentric edges, eccentric washers on the studs, the studs being secured in holes in the cutter bar at suitable distances for receiving the cutter sections, the latter having apertures and shoulders for engagement by the fasteners, making an effective device for securing the cutter sections.

MISCELLANEOUS INVENTIONS.

A child's tray has been patented by Mr. Thomas Cousins, of Norwalk, Conn. It is a combination of an upper with an under or subsidiary tray, wherein is a plate in a fixed and protected position, and provision is made to receive a drinking vessel, the under tray receiving anything that happens to be spilled.

A land scraper and leveler has been patented by Mr. Ernst Sell, of Canon City, Col. It is designed to be used in working ordinary roads, in grading roadbeds of railways, and in leveling lands for farming, the invention covering various novel features of construction and combination of parts, and the machine being simple, strong, and durable.

A strike sander for brick machines has been patented by Mr. Henry C. Hill, of Haverstraw, N. Y. Combined with the receiving table and the strike table is a sand trough, enabling the attendant to sand the strike without moving from his place or turning around, it also serving as a convenient receptacle for the strike when the attendant wishes to lay it down.

A combined door plate and letter slip alarm has been patented by Mr. Frederick Sanderson, of Chicago, Ill. It is a device applicable to any door, sounding an alarm at once on the deposit of the mail, and is also adapted to serve as a door plate, the invention covering certain peculiarities of the construction and arrangement.

A fireplace has been patented by Mr. Josiah T. Reaves, of Bently, Miss. This invention covers a protector of back plate and side plates hinged thereto, to protect the brick or stone work from injury from heat or by contact with the fuel or poker, and to improve the heating qualities by facing the fireplace with iron.

A can-filling machine has been patented by Mr. John B. Hodapp, of Mankato, Minn. It is for filling fruit, vegetable, and meat cans, automatically and evenly, pressing down the charge compactly, and delivering the filled cans to their reception table, the invention providing a novel construction and combination of parts in a machine for this purpose.

Shears form the subject of a patent issued to Mr. William E. Lant, of Lancaster, Pa. By this invention shears are made especially adapted for cutting button holes, there being a stop pin for limiting the motion of the shear blades and a gauge for regulating the distance of the button hole from the edge of the garment.

A washing machine has been patented by Mr. James C. McCandliss, of Barnard, Mo. It has suspended semicircular rubbers, and when the machine is operated by means of its handle, these rubbers, though moving in opposite directions, have at the same time a rotary reciprocating motion, whereby the washing is speedily and effectively performed.

A hoisting and lowering apparatus has been patented by Mr. Augustus Ilse, of Evanston, Wyoming Ter. It has a pulley block, a top pulley to run upon a horizontal line or rail, a central pulley, and two guide pulleys, with other novel features, being designed more especially for elevating and lowering goods, but also adapted for use as a fire escape or for transferring goods and persons from one place to another in a building.

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References to former articles or answers should give date of paper and page or number of question.
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Minerals sent for examination should be distinctly marked or labeled.

(1) F. F. writes: I still fail in lacquering polished brass. It has a dull appearance after lacquering, not clear and bright, like the new gas fixtures we have from New York, etc. What is the cause? A. The dullness arises from the want of heat to melt the lacquer after the brush has gone over the piece. The heat should be raised by putting the piece back into the oven for a few minutes, and allow the heat to increase to above 212° or until the surface looks clear. The lacquer should not be too thick; it should be thinned down with 95 per cent alcohol to a semi-transparent or amber color as you look through it in the bottle. A steam coil is probably the best means of heating the work. A stove oven is good if it is large enough to hold the work. A few trials with thin lacquer and continuing the heat after lacquering will give you entire success. Muddy lacquer should not be used for metal.

(2) G. F. C.—You may polish brass pipe readily by hand. Use the finest flour of emery paper, with a little oil, until the surface comes to an even finish. Then rub with rotten stone and oil on a piece of soft leather, and finish with dry whiting and a rag. All parts must be clean and free from oil when ready for lacquering. Use thin shellac varnish; thin with 95 per cent alcohol, and let it stand a few hours to settle, when the pure lacquer may be poured off. Warm the brass work to the temperature of boiling water, and apply the lacquer with a camel's hair brush.

(3) W. F. H. writes: I am thinking of becoming an electrical engineer, but want some information and advice as to the opportunities in that line for a young man. A. The opportunities for a young man to acquire electrical engineering experience are as good as in most professional business. If you are not posted in electrical work, you will have to begin at the bottom and work up. Wishes do not make a profession. You will have to study hard and work harder to gain a paying position. There are many electricians and electrical supply establishments in the great city near which you live, where you may readily? with a little intelligent and persistent inquiry, acquire a knowledge of what is required and how to go to work, but first get books from your library or the Philadelphia libraries, and glean some information as to the general principles of electrical work. You will find much that is interesting in back numbers of SCIENTIFIC AMERICAN SUPPLEMENT.

(4) J. M. E. writes: Say 1 pound weight will turn a sewing machine after it has been started, how heavy must a weight be, attached to necessary gearing, to run the sewing machine one hour and 6,000 revolutions, the weight having 30 inches fall? A. The descent in feet per minute of the weight required to move the machine at the required velocity should be multiplied by the whole time in minutes, and this product divided by the distance in feet of the required fall of the weight, for the answer as to the whole weight in pounds; to this must be added enough to overcome the friction of the necessary gearing. So that if it takes 1 pound descending $2\frac{1}{2}$ feet to maintain 100 revolutions per minute, then $2\frac{1}{2}$ feet$\times 60 = \frac{150}{2\frac{1}{2}\text{ ft. fall}} = 60$ pounds$\times 1 =$ weight to run the machine 1 hour, to which must be added the weight to overcome friction of gear. In case the initial weight is more than 1 or a unit, the quotient should be multiplied by the initial weight.

(5) A. W. W. asks how flowers can be preserved in their natural colors. A. Dip the flowers in melted paraffine, withdrawing them quickly. The liquid should be only just hot enough to maintain its fluidity, and the flowers should be dipped one at a time, held by the stalks and moved about for an instant to get rid of air bubbles. Fresh cut flowers, free from moisture, make excellent specimens in this way.

(6) E. E. T. asks what size should an air pump be for a marine engine 5 x 5, with surface condenser. A. One-eighth the capacity of the steam cylinder, or 12 cubic inches.

(7) W. E. L. asks: Why is it that a steam whistle, when steam is first turned on, strikes the pitch an octave above its natural or fundamental note? A. This is not a general phenomenon of whistles. The eccentric pitch is due to the position of the valve and amount of water or air preceding the steam, or the wetting of the bell by the water first ejected.

(8) J. P. McL.—For drying hickory for mallets: Heat in a steam box until the sap is boiled out, then transfer to a dry room or box heated to nearly 200°, and allow to cool slowly.

(9) J. F. H. asks if old daguerreotypes that have faded can be restored. A. They cannot be fully restored, but they may be improved by flowing over them a weak solution of hyposulphite of soda or cyanide of potassium to clean them, afterward gilding them as described in the article on the subject on page 47, current volume of SCIENTIFIC AMERICAN.

(10) D. A. D. and S. H. ask for the recipe for a blackboard preparation. A. Take ½ gallon shellac varnish, 5 ounces lampblack, 3 ounces powdered iron ore or emery; if too thick, thin with alcohol. Give three coats of the composition, allowing each to dry before putting on the next; the first may be of shellac and lampblack alone.

(11) J. B. B. asks: 1. Is there any radical difference between an electric dynamo and a motor? A. There is generally no radical difference. A good dynamo generally is a good motor. 2. Would not any dynamo be converted into a motor by exciting the field magnets with an independent current? A. The terminal binding screws should receive the battery connection. Simply exciting the field magnets will not effect the result.

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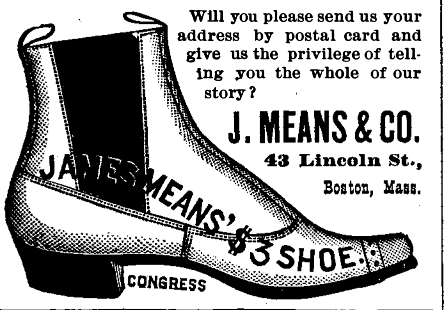

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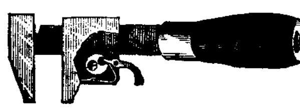

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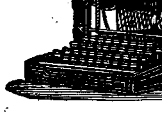

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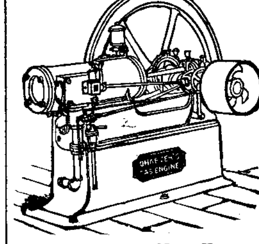

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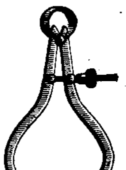

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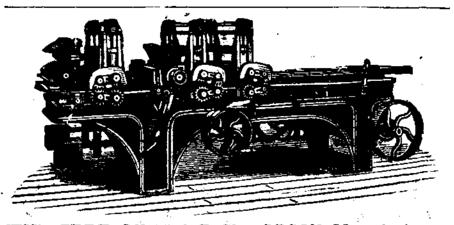

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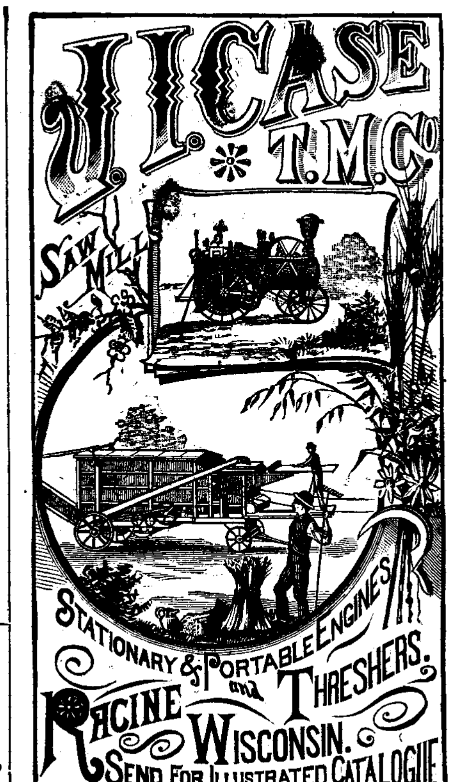

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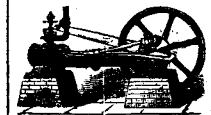

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