SCIENTIFIC AMERICAN

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PROPULSION OF THE SECOR YACHT EUREKA BY THE EXPLOSION OF PETROLEUM VAPOR.

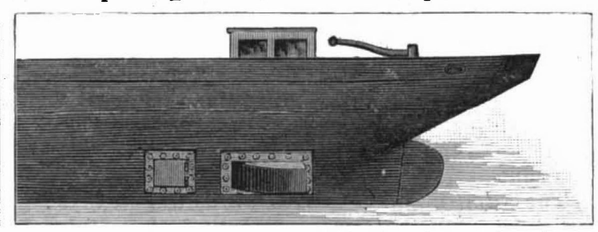
With the best marine boilers, and with the most approved forms of engine, shaft, and propeller, it is only possible in our present system of ship propulsion to utilize about five per cent of the energy developed by the combustion of the fuel. This fact has remained, for many years, a constant challenge to the inventive genius of the world. Yet it is a challenge which has seldom been taken up, for there are many difficulties in the path of the naval architect and engineer. We have to-day very little certain knowledge of the various elements which influence propulsion. We have attained, it is true, quite remarkable speeds, but they are the result rather of a lavish expenditure of energy than of skill in the adjustment of the several controlling factors. It is not, perhaps, too much to say that we have succeeded in spite of ever present difficulties, rather than by overcoming them.

There have been, however, a number of thoughtful efforts made from time to time to decrease this discrepancy between the energy stored in the fuel and effective work accomplished. As the loss sustained in the present system is generally regarded as inherent, these efforts have for the most part turned toward an attempt at direct propulsion. Many of our readers, doubtless, remember the Waterwitch and the Rival, which attracted considerable attention several years ago. Both of these vessels obtained some simplification of parts by the omission of shaft and propeller. They substituted a centrifugal pump, and effected propulsion by the large volumes of water discharged toward the rear.

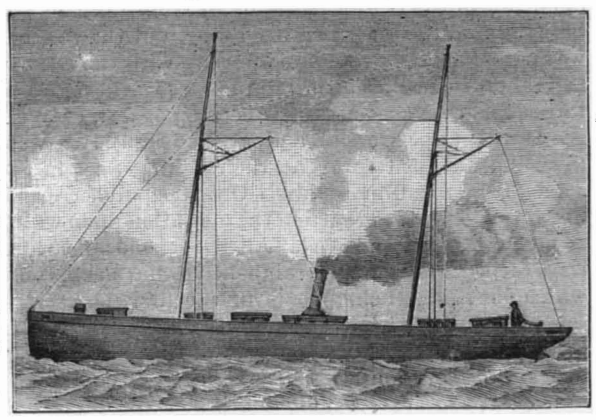
Somewhat later, Dr. Fleischer's hydromotor attempted the same thing in a modified form. In this the volume of water discharged was much smaller, but its velocity greater. The centrifugal pump in this case was replaced by the direct action of steam on the water in two cylindrical reservoirs. The little vessel supplied with the hydromotor met with a fair degree of success, attaining a speed of 9 knots an hour, and losing but 11 per cent in effecting the discharge of the water. It raised quite sanguine hopes that the new system would in time become so far perfected that it would pass into everyday use, and permit a marked economy in both fuel and first cost, as well as in the space occupied by the machinery. But for some reason all of these vessels remained mere experiments, and never became the types for any successors.

Working on the same general plan, but with a different agent, there have also been brought forward a number of propositions for pneumatic propulsion, in which jets of air are caused to impinge directly on the water, but as yet no practical success has been gained. The direct action of steam has been tried in the same manner, but so far has proved a failure.

Though the attempt to solve the problem of direct propulsion has thus rather discouraging precedents, it has, nevertheless, been recently renewed by Messrs. Samuel & John Secor, of Brooklyn, who have devised a new system, which they are now putting to the test of actual practice in their specially constructed yacht, the Eureka. Incited by the admitted loss of ninety odd per cent in the transformation of the energy stored in the fuel into motion of the vessel, both father and son, for a number of years, have given careful attention to the subject of propulsion. It was, perhaps, two or three years ago, that their joint meditations began to assume the shapes now materialized in their nearly completed experiment. Their motor is simply a modified form of gas engine, in which the gases, resulting from the explosion of a mixture of air and petroleum vapor, are made to impinge directly upon the water, through suitable portholes beneath the surface.



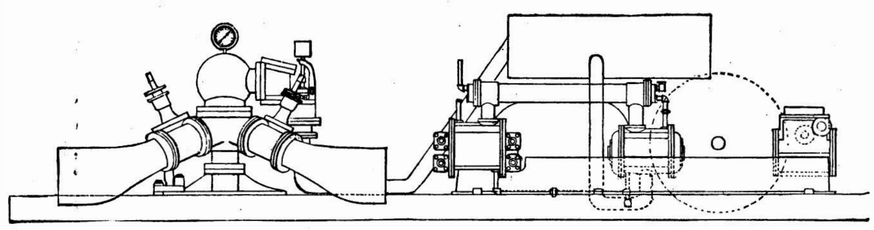
OUTSIDE VIEW OF THE EXPLODING PORTS.



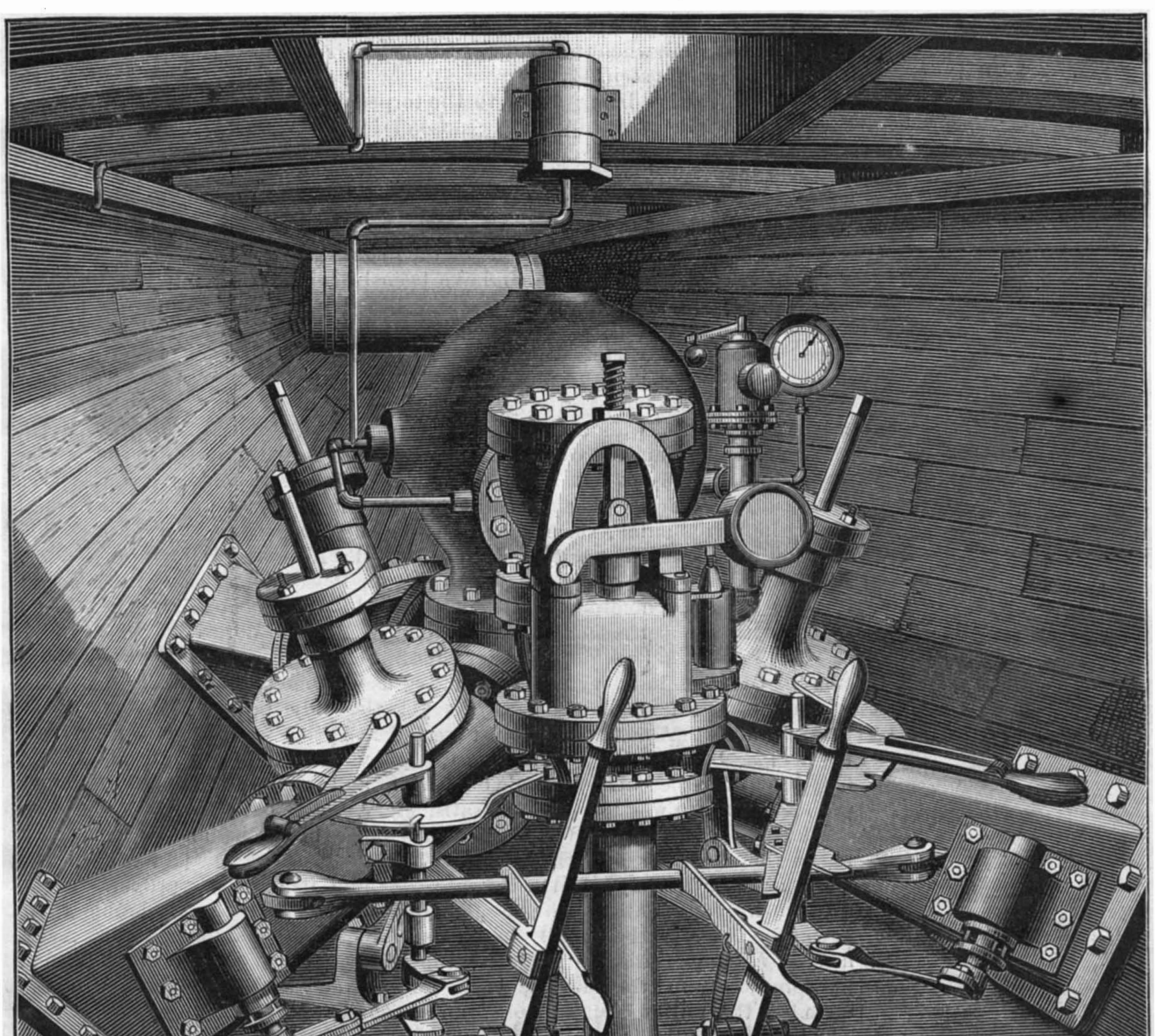
THE EUREKA.

The Eureka was launched last November from Poillon's shipyard, in Brooklyn. She is an odd-looking little racer, built very much after the model of a sharp wedge, and capable, to all appearances, of cleaving the water with but little expenditure of power. She has a total length on deck of 100 ft., an extreme width of 12 ft., and a depth of 6½ ft. Her draught is 4½ ft. aft and 2 ft. forward, but more ballast will probably be added, and the water line raised several inches all around. Her displacement is approximately 60 tons. Beyond the extremely narrow beam and pointed bow, the Eureka differs little in her external appearance from less revolutionary craft. An attenuated smokestack, leaning backward at a rakish angle, gives, however, the impression of meager motive power.

In the interior, the construction and machinery are decidedly more unique. A transverse bulkhead divides the vessel about amidships. An upright steel boiler of 25 horse power is located immediately back of the bulkhead. A Norwalk air compressor stands a short distance to the rear of the boiler, and furnishes the compressed air necessary for the exploding chamber. In this form of compressor the air is first condensed to a pressure of 20 pounds in a 14×16 inch cylinder, and then to any desired pressure up to 200 pounds in a second cylinder, 10×16 inches. The ordinary working pressure will be about 50 pounds. A steel reservoir, 6 ft. long by 2 ft. in diameter, is placed directly above the compressor, and has been tested up to a pressure of 200 pounds. The compressor also operates an Excelsior dynamo, having a capacity of twenty-five 16½ candle power lamps. From eighteen to twenty Edison incandescent lamps will be used to illuminate the vessel, but the main function of the electric current is to fire the mixture of air and petroleum in the exploding chamber.



SECTIONAL ELEVATION OF THE MACHINERY.



VIEW OF THE MOTIVE POWER OF THE EUREKA LOOKING TOWARD THE STERN.

The motor proper is placed in the rear of the compressor, at sufficient distance to allow room for the controlling levers and for the engineer in charge. The general arrangement and appearance of the machinery are shown in our illustration. It represents the motor as seen when looking toward the stern of the vessel. The motor is made entirely of cast steel, and consists, in the first place, of the spherical exploding chamber shown in the center of the engraving. This is (*Continued on page* 52.)

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NEW YORK, SATURDAY, JULY 24, 1886.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 551.

For the Week Ending July 24, 1886.

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TORPEDO BOATS IN THE GALE.

The report sent hither from Washington to the effect that the recent loss of torpedo boats sustained by the French is creating serious distrust in such vessels, and is likely to affect the torpedo movement here, can scarcely be founded upon anything more substantial than rumor. Surely no sailor or naval constructor would condemn the use of the torpedo boat for harbor and coast defense because it could not outride the gale. The torpedo boat, as designed for use here, is not a cruiser, and not likely, even in active service, to be called upon during storms. In harbors, which she is designed specially to protect, she can always find a lee to run under.

Nor should it be inferred, from the dispatches referred to, that the modern torpedo boat is unseaworthy. On the contrary, she has shown her capability to take to the high seas under the ordinary prevailing conditions of tide and wind. The recent storm in the Mediterranean was of unusual fierceness, and was greatly intensified in its destroying power off Cape Corsica, where the torpedo boats were lost, by the set of the tide, which was athwart the wind; that is to say, at right angles to the direction whence the wind was blowing.

The *Admiralty and Horse Guards Gazette* says:

"A force of eighteen torpedo boats left Bastia for the purpose of assisting in the attack on the squadron at anchor in the Bay of Ajaccio. A stiffish breeze was blowing and the sea was a bit loppy, but the weather was not sufficiently rough to interfere with the regular arrival of the packet boats at Corsica. Of the eighteen torpedoers that accompanied the men-of-war, only six got around Cape Corsica and of these only two were in such a state as to prevent their taking part in the attack before making repairs. One was patched up, so five torpedo boats engaged in the operation upon which so much interest centered. All the second and third class torpedoers had been compelled to put back, those which got round being boats of the first class. It is said that only two men among the crews of the six boats escaped seasickness."

Regardless of such instances of impotency on the part of the torpedo boat, it must continue to be at least a valuable auxiliary in the defense of harbors. Indeed, a torpedo boat which has cost but $100,000 or less may, under favorable conditions, destroy a modern steel monster which has cost three or four millions. Those interested in this matter will remember the brilliant affair in Chinese waters, during the recent Franco-Chinese war, when a well handled torpedo boat sunk the Chinese flagship Yung-Wo without losing a man.

Indeed, it is by no means certain that a fleet of great leviathans, like the English Devastation, the French Imperieuse, and the Italian Dandolo, could, with all their great guns in play, safely pass a fleet of a score of modern torpedo boats. A target moving as fast as the best torpedo boat, viz., 22 nautical miles an hour, is not easily hit, and, when the smoke of battle covers the waters, not readily seen.

More attention is being given to the torpedo boat to-day than to the war ship, and because of its effectiveness and cheapness, it is not strange that this should be the case.

THE BASIC STEEL PROCESS.

Among the several modifications of the pneumatic, or Bessemer, steel process which have been brought forward during the past few years, none has proved of such large commercial importance as that introduced by Messrs. Gilchrist and Thomas, and known generally as the "dephosphorization," or "basic," process. Though comparatively a recent invention, it has met with a wide application in Europe, both on the Continent and in Great Britain. In America, the plentiful supply of rich hematites and magnetites practically free from phosphorus has somewhat delayed its introduction, since provision for dephosphorization is less a necessity here than abroad. But the higher price of non-phosphoric pig iron, or Bessemer pig as it is denominated in the metal market, together with the perfection to which the basic process has now been brought, makes it a desirable addition to the steel industry of this country as well as to that of less favored districts. As yet the only basic "plant" in America is that just erected at Pottstown, Pa., by the Pottstown Iron Company. The first blow of basic steel was made on July 1, and the product obtained was in every way satisfactory.

Though there are a number of minor differences between the Bessemer and the Gilchrist-Thomas processes as regards the design of the converter and its subsequent manipulations, the essential difference between the two is in the lining. In the typical Bessemer vessel, no provision is made for the removal of phosphorus from the metallic bath, and therefore none but the purest brands of pig iron are available. The lining is entirely acid, being composed of ganister, a silicious rock in which the silica is held together by a small quantity of argillaceous material. The reactions occurring in such a converter are therefore limited to the oxidation of the silicon, carbon, and manganese, while the greater part of the phosphorus contained in the pig iron remains combined with the resulting steel. In the Gilchrist-Thomas process, on the contrary, the lining is composed of oxides of the alkaline earths, and is therefore strongly basic. The converter employed is very similar to that used in the acid process, and in some cases is identical, but in the best practice certain modifications are introduced, on account of the much more rapid destruction of the basic lining. The movable bottoms and interchangeable parts of the vessel are of even greater importance here than in the Bessemer; while the mouth of the converter, instead of being inclined to one side, is preferably wide and straight, in order that the charging and discharging may be on opposite sides, thus equalizing the excessive wear. The success of the basic process is largely dependent upon the proper preparation of the lining of the converter. Besides being strongly basic, it must be sufficiently refractory to resist extremely high temperatures. The material generally chosen for this purpose is dolomite, a magnesian limestone. This is either manufactured into bricks, which are then cemented together by anhydrous tar, or else it is burnt and ground, and then rammed into the vessel, with tar as a cementing material. The bottom of the converter is about two feet thick, and is formed of the same material as the rest of the lining. The blast holes, or tuyeres, are made by allowing rods, half an inch in diameter, and of sufficient length to reach entirely through the finished lining, to project upward from the bottom plate. When the plate and rods are withdrawn, the necessary openings are left for the entrance of the blast. The manipulations of the basic lined converter are quite different from the Bessemer, and the reactions distinctly characteristic. The charge, varying according to the size of the converter from 7 to 15 tons, is composed of highly phosphoric pig iron, low in silicon. At the celebrated iron works at Creusot, France, a pig iron is used containing from 2·5 to 3 per cent of phosphorus and 1·3 per cent of silicon. The most suitable irons for the basic process contain only 0·5 to 1·0 per cent of silicon, merely a trace of sulphur, and from 1 to 3 per cent of phosphorus, the higher proportion of the latter constituent being, however, preferred.

The converter, having been carefully heated, well burnt lime, free from silica, and in amount equal to about one-fifth of the subsequent charge of pig iron, is introduced, and by means of fine coke brought to a bright glow. The phosphoric pig iron is then added. Air under a pressure of 25 pounds is turned on, and the vessel brought to a vertical position. The blow lasts about thirteen minutes, in some localities longer, and is divided into two distinct periods, the Bessemer, or blow proper, and the after-blow. The ordinary blow terminates in a little over eleven minutes at the basic plant in Westphalia, Germany.

The silicon is first oxidized, and then the carbon. In the acid lined vessel it is seldom possible to effect a total elimination of the silicon, except in the Clapp-Griffiths converter, but it is characteristic of the basic process that the resulting steel contains no silicon, or only the merest trace. But very little phosphorus is removed during the blow proper. It is during the so-called after-blow that the reaction takes place upon which the invention of Messrs. Gilchrist and Thomas depends. The temperature rises at the close of this period to about 1,800° C. The phosphorus is rapidly oxidized to phosphoric anhydride, and combines with the lime added to the charge to form a phosphate of calcium, which is not subsequently reduced. In order to remove as much phosphorus as possible, it is necessary to keep the slag very basic; and consequently, when the silicon in the pig iron much exceeds 1 per cent, it is best to treat the metal by the "transfer method," in which the amount of silicon is first reduced in an acid lined converter, and the metal then transferred to one with basic lining for the after-blow. For otherwise the large amount of silicon would increase the slag, and not only more rapidly destroy the basic lining, but prolong the time required for a blow by hindering the basicity necessary for the removal of the phosphorus.

There is, however, a minimum percentage allowable as well, for in the absence of silicon the metal would become chilled, as it is the oxidation of this element which produces a large proportion of the heat of the reaction. The high temperature obtained in the after-blow is due to the combustion of the phosphorus. By oxidation to phosphoric anhydride it affords 5,747 heat units, and performs very much the same function during this part of the process that the silicon does during the blow proper. The slags produced in this process are almost double in quantity those produced in an acid lined vessel. Average specimens contain about 10 per cent of silica, 10 to 15 of phosphoric anhydride, 10 of oxide of iron, 40 to 50 of lime and magnesia, and varying amounts of manganese. It has recently been proposed to utilize these phosphatic slags in the manufacture of fertilizers, and the proposition is now carried out on a commercial scale in both Germany and England.

The elimination of the phosphorus seldom requires more than about two minutes. When it is judged to be complete, the converter is turned on its side, and a sample taken out in a ladle and cast in a small ingot. When cool, the metal is hammered out flat and broken in order to discover its fracture. Large and bright crystals are visible when the process is incomplete. These become smaller when the dephosphorization is ended. Usually, one test sample suffices. The necessary amount of ferro-manganese or spiegeleisen is then added for the recarburization of the molten iron. At some works, the slag is tapped before this addition, and at others afterward. A small amount of cold ferro-manganese is introduced into the ladle. The steel is then poured and cast into ingots in the usual manner.

The basic process has been developed on too extensive a scale in Europe to permit it longer to be called an experiment, except in the broad sense of the word, in which all industrial processes are experimental, since they are constantly subject to improvement; but the introduction of the process into American metallurgy is still very recent, and the newly erected plant at Pottstown will be watched with much interest. There is apparently a large field for the application of the basic process in this country, and particularly in the South, where so many of the limonite ores are highly phosphoric.

The tendency to substitute steel for iron wherever possible was never stronger than at present. Throughout Pennsylvania and the West, a number of Clapp-Griffiths plants have been established during the year, while in Tennessee extensive preparations are now in progress for converting the pure magnetic ores of the North Carolina mountains into Bessemer steel. But a large proportion of the iron deposits of the Appalachian system is not available for either of these processes, by reason of the phosphorus contained. In the great valley of Virginia alone there are almost inexhaustible stores of limonite of this character. It is in such localities, it seems to us, that the basic process will find an inviting field.

EFFICIENCY OF SMALL WATER MOTORS.

In our issue of July 10, we published an article from the *American Engineer*, on the use and efficiency of small water motors. We find, however, that while our contemporary has done no more than justice to the great convenience of these compact little motors, it has rated their efficiency very much too high.

The natural effect concentrated in a fall of water is equal to the weight of the quantity of water which passes in a second multiplied by the vertical distance through which it falls. Where the aperture and height only are given, the theoretical horse power developed may be calculated from the following formula.:

$$\text{H. P.} = 0{\cdot}573ah\sqrt{h}$$

in which a = the sectional area of the aperture or nozzle, and h = the vertical space through which the water falls.

In the motor under consideration, we have a vertical fall of 60 feet and a diameter of nozzle equal to three-sixteenths of an inch. Consequently

$$a = \pi r^2 = \pi\left(\tfrac{1}{2}\text{ of }\tfrac{3}{16}\text{ of }\tfrac{1}{12}\right)^2 = 0{\cdot}00019174+;$$

and substituting these values in the formula,

$$\text{H. P.} = 0{\cdot}573 \times 0{\cdot}00019174 \times 60 \times 7{\cdot}745,$$

or H. P. = 0·051.

A New System of Harbor Improvement.

Scattered along the southern shore of Connecticut there are a number of mills depending for their motive power upon the movements of the tide. The inflowing waters are permitted to pass through the open valves of a suitably constructed dam, while during the ebb the valves close automatically, and the waters have no escape except through the raceway of the mill. This principle of concentration of tidal force has been utilized by Prof. Lewis M. Haupt, of the University of Pennsylvania, in his new system for the automatic improvement of rivers and harbors in sand or alluvium. In place of the permanent dam of the mills, however, he employs a series of adjustable deflecting shields, suspended from buoys or floats in such a manner that they offer little obstruction to the inflow of the tide, but by properly deflecting the outflow they create a channel across the bar, of any required depth consistent with the head of water available.

His device is, in reality, a floating dam anchored by heavy guys to the bottom of the harbor. One or more rows of shields are employed, according to the local conditions, and are arranged in a direction either transverse or oblique to the line of the current. They are made in sections of convenient length, in order to be readily transportable. Being thus built up of separate parts or units, the dam can be extended over any desired distance. As it is simply anchored to the bottom, it can readily be put in place, and its position altered as experience or changing conditions may require.

The action of the floating dam is twofold:

By extending the structure from each shore to the edge of the desired channel, the outfloating waters are concentrated laterally, and pass through the opening left between the two with a largely increased velocity, which scours out a channel whose depth is inversely proportional to its width. But in addition to this lateral concentration of the waters, the inclination of the shields, and their arrangement so that they shall not reach entirely to the bottom of the harbor, cause also a vertical deflection. This lowers the limit of scour, and creates a greater depth of water over the entire bar. The importance of such an increase of velocity will be appreciated when it is remembered that the scouring force of the current is proportional to the square of the velocity, while the transporting capacity varies as the sixth power of the velocity.

By lessening the area of discharge in this manner, it is possible to largely increase the velocity of the current, and consequently both its force and carrying capacity. Such, naturally, is the ultimate result of any system of harbor improvement, but the one under consideration differs from those heretofore proposed in permitting the free inflow of the tide, and, though concentrating the outflowing waters, in interfering in no way with their circulation over the bottom of the entire tidal basin. There is a serious objection to those systems of improvement which depend upon the construction of permanent dikes and jetties, for, however admirable they may be in other respects, the fact remains that they do disturb the regimen of the river and harbor, and that by reason of their unstable foundation they are liable to constant deterioration.

Prof. Haupt has taken much interest in the subject of the improvement of New York harbor, and has advanced a proposition for applying his system in this locality. The need of deeper water over the bar in Gedney's Channel is indisputable, as will be seen by a reference to the illustrated article which appeared in the SCIENTIFIC AMERICAN of July 10. Any plan, therefore, which would secure such a result within reasonable time, and at not too great an expenditure, would certainly be most welcome. The system of floating dams has the advantages of being comparatively inexpensive and also capable of ready application. Its efficiency, we believe, has not yet been practically tested, but it apparently fulfills the conditions which are recognized as essential to success.

Photo-zincotypy and Other Photographic Printing Methods for the Printing Press.

In place of wood cuts, photo-zincotypes are very often used. The reproduction of line drawings is executed easily and securely by the well known methods of the photographic zinc etching, which offers no difficulties so long as half tones are not to be reproduced. For the production of photo-zincotypes, the transfer process with chrome gelatine or chrome albumen paper takes place, after the well-known method.

Some large houses use the asphaltum method, which gives greater sharpness of the fine lines. In the production of the asphaltum solutions, great improvements have been made lately. Husnik dissolves the asphaltum in rectified oil of turpentine to a thick liquid, requiring several days. With stirring, three to four times the volume of ether is added; a dough-like precipitate separates, which, after twenty-four hours, is washed with ether and then dried. The dry asphaltum is dissolved in pure benzole, free from any water, and mixed with 1·5 per cent of Venice turpentine to make the coating more flexible.

The zinc plates are coated with a thin asphaltum coating, and exposed in the sun under a drawing from 10 to 60 minutes. Oil of turpentine serves as the developer. As soon as the picture is developed, benzole is poured over the same without hesitation, and after draining it is washed with water. The dried zinc plate is etched as usual.

The production of photo-zincotypes in half tones, which can be printed in the printing press, is of the greatest importance for book illustrations. A short description might be appropriate, the many views about the manner of their production not being very clear. The idea of producing photographic reliefs by dividing the picture into lines and dots is an old one. It is the intention to have the dots compose surfaces in the deep shadows, while in the half tones the black dots are separated by white lines. The picture surface consists, so to speak, of a grain, which represents by its more or less close arrangement the half tones, without any actual half tones existing. Meisenbach, of Munich; Angerer and Goschl, of Vienna; and the Military Geographic Institution, deserve particular mention in this direction.

The heliogravure, or the production of copper printing plates by way of photography, is done by etching or the galvanoplastic process. Both processes are based upon the works of Poitevin and Woodbury of more than twenty years ago.

The helio-engraving by etching was brought to a high degree of completion by Klic, of Vienna, in 1883. The process was sold to some persons, and was kept strictly secret, so that it has only become known recently. In Volkmer's "Technik of the Reproduction of Military Maps" (1885), we find communications referring to it which have been obtained by practical observations in the Austrian Military Geographic Institution. The process is as follows: A copper plate is dusted over with asphaltum powder, to produce a grain when afterward etched. After this a glue (gelatin) picture is put on the copper plate by transfer (like the carbon process). This tender glue relief is etched into the copper with chloride of iron solution of 1·3 sp. gr. After this the gelatine film is hardened by the action of the chloride of iron, and is finally gradually penetrated, and etches by the small access of water in it. The picture obtained in the beginning is monotonous. By rolling in with heavy ink the finest tones are covered, the deeper ones remain open and can be etched afterward. Such plates print very delicate, and are durable when steeled, being capable of furnishing over 1,000 copies, as seen by the writer.

In the Imperial Military Geographic Institution of Vienna, the heliographic copper plates (for maps, etc.) are produced by way of the galvanoplastic method, by converting a gelatine relief into copper. The galvanic current is produced with a dynamo machine of Captain Von Huble. The plates to be treated are inserted one behind the other, giving more uniform copper deposits than when placed side by side.

Colored lichtdrucks are at present mostly made with the aid of retouchers and draughtsmen. The process executed by J. Lowy, of Vienna, approaches nearest to that of a genuine photographic picture. From the original or negative, stopped out by retouching, leaving open only those parts which are intended to print yellow for instance, a photo-lithographic plate is taken. In a similar manner a plate is made for blue, etc. The colored picture so obtained (chromo-lithography) lacks softness. This is obtained by final reprinting of the chromo-lithograph with a lichtdruck plate in half tone, which prints over the picture all those colors which give the picture its finish, the picture thereby gaining in fine half tones.

Troitzsch, of Berlin, prints the picture upon the stone by way of lichtdruck, and this serves as a base for the colorist. Hosch, of Berlin, produces color plates with the aid of photography and painting. He prints the several colored pictures, not from stone, but from lichtdruck plates.

These plates of course will wear off pretty soon, and give less uniformity than the stone; but a smaller number of color plates are sufficient, while in chromo-lithography seldom less than 20 are used.

Photo-zincotypes in Colors.—Angerer and Goschl, of Vienna, produce by a new process colored prints, so-called "photo-chromotypes," which are made in the printing press. The principle which is applied here is similar to the colored lichtdruck. At first, photo-lithographs are made from the picture to be multiplied, which serve to some extent as copies for the draughtsman. The latter works up only such parts which are to be yellow; upon a second sheet those only which are intended for blue, and so on. Negatives are produced which show only a picture of the blue parts, others for yellow, red, etc. From these negatives zinc printing plates are etched in half tone, and the rest of the manipulation is the same as the fitting of the several color stones in chromo-lithography.

Many newspapers, for instance the *Neue Illustrite Zeitung*, are furnished with these color prints.—*Anthony's Photo. Bulletin.*

Malignant Pustule.

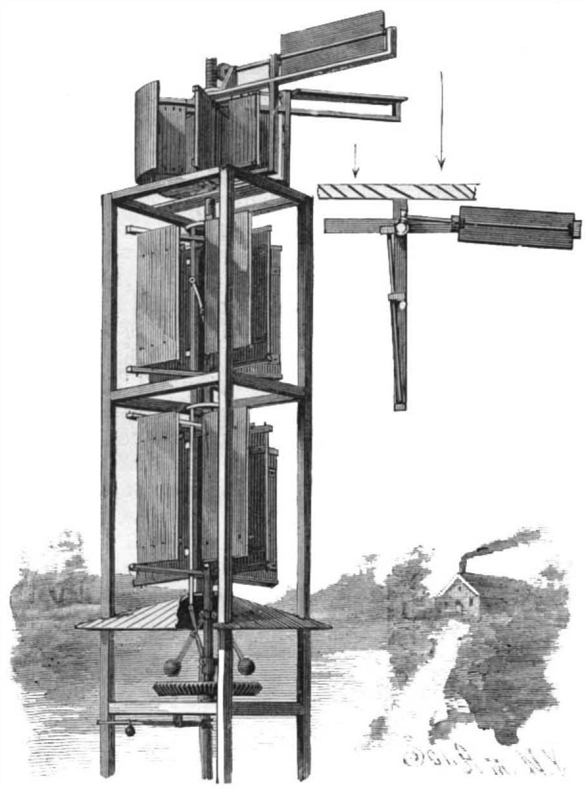
A patient suffering from this disease died recently in Guy's Hospital, London. He was employed on a wharf, in the handling of foreign hides, and undoubtedly contracted the disease from the hide of an animal which had been affected with the disease known by the French as charbon, by the Germans milzbrand, but by English speaking people as anthrax. The patient noticed a pimple on the back of his neck, which in twenty-four hours became greatly enlarged, and the glands of the neck were swollen. The surgeons removed the enlarged pimple at once, but without avail, the man dying in about four days from the time he first noticed the pimple. This disease may also be contracted by the bite of an insect, a fly for instance, which has been feeding upon the carcass of an infected animal. The microbe of the disease is a bacillus (Bacillus anthracis), and was observed in the blood of cattle as long ago as 1849 by Pollender, although its importance was first recognized by Davaine in 1850.

Value of the Electric Light.

The passage of the Suez Canal, which until recently occupied from thirty-six to forty-eight hours, can now be made in sixteen hours for vessels fitted with the electric light apparatus. This important advance is the result of a very interesting report by Commander Hector, of the steamer Carthage, belonging to the Peninsular and Oriental company, and addressed to the directors. This report was written after the Carthage made the first continuous passage, under the authorization of the Canal company, given the 1st of December, 1885. The Carthage arrived at Suez after a run from Port Said of eighteen hours. The actual running time was sixteen hours, there having been two delays caused by impediments in the channel; the mean speed made was 5·43 miles per hour.

IMPROVED WINDMILL.

The main tower consists of an open framework within which the floats of all wheels, except the upper one, revolve. In the center of the frame is a hollow shaft, to which the arms carrying the floats are rigidly secured; each float is formed with trunnions which are mounted in bearings in the ends of the arms, and each has two strips which project somewhat beyond the inner face of the float, and engage with stops carried by vertical rods arranged to move in apertures in the arms. The position of these rods is regulated by a governor. When the mill is revolving at too great speed, the governor arms are thrown out, thereby raising the vertical rods, so that their stops will be raised out of the paths of the projecting ends of the strips, and the floats will be free to swing upon their pivotal connection with the arms. The floats are then inoperative. As the speed decreases, the governor arms drop, the stops are lowered, and the floats become operative. The upper section of the mill is formed with a series of stationary floats carried by arms rigidly secured to the hollow shaft. These floats are partially surrounded by a curved shield carried upon a frame formed with two projecting arms, upon which are mounted vanes supported by shafts, having at their inner ends pinions that are engaged by a cylindrical rack formed upon the upper end of a central shaft. Upon the lower end of this shaft is a grooved collar engaged by the projecting end of a lever, whose position is controlled by a weight or by a pin inserted in one of a series of holes in the frame.



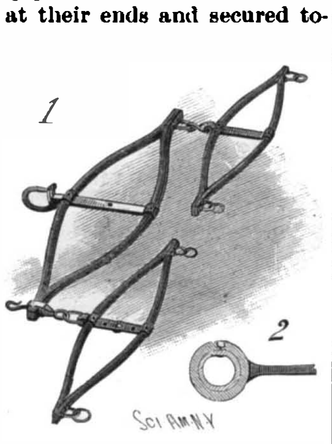
WOOD'S IMPROVED WINDMILL.

The vanes are so arranged that when one is horizontal the other will be vertical. When the first vane is in a vertical position, the shield will be so held that the floats upon one side will be shielded from the action of the wind, while those upon the other side will be exposed. Now, as the speed of the mill increases, the governor arms are thrown out, the shaft and its cylindrical rack will be raised, and each of the vanes partially rotated, thereby cutting off the wind from the exposed side of the wheel. To stop the mill, the lever is so moved as to cause the shield to be thrown in front of the floats, and raise the stops so that the lower floats will be free to swing. The hollow shaft carries a gear to transmit the motion of the shaft to the machinery to be operated. This arrangement of vanes may be easily applied to the ordinary wheel, as will be understood from the plan view.

This invention has been patented by Mr. David B. Wood, of Sibley, Iowa.

IMPROVED WHIFFLETREE.

This light, strong, and easily made whiffletree is the invention of Messrs. M. A. Gerber and E. J. Nicholas, of Lost Creek, Pa. The pipes of which the whiffletree is formed are flattened at their ends and secured together by rivets or eyebolts. The pipes are bent away from each other, and a cross bar having transverse holes, as shown in Fig. 2, is secured on them. The rear end of the cross bar is provided with a hook having a latch closing its open end, or is provided with an eye for receiving a ring. When it is desired to secure the traces directly to the whiffletree, the flattened ends of the pipes are turned upward and notched in opposite sides to receive the traces, or apertured to receive the whiffletree bolt. When the cross bar is made of a single piece of iron, the pipes are placed in the holes thereof before the ends are flattened; the bar may be made in halves and secured together by rivets when applied after the whiffletree has been formed. The whiffletree formed as described possesses great rigidity, with little weight of material.



GERBER & NICHOLAS' IMPROVED WHIFFLETREE.

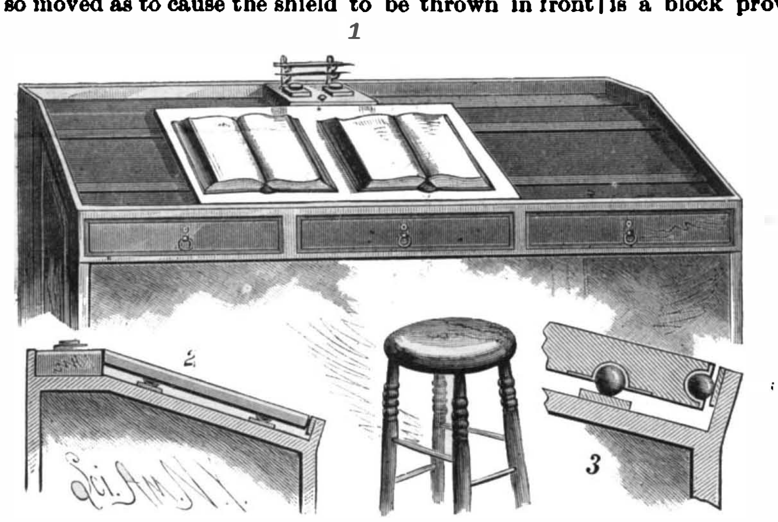
The New Bridge, London.

The Prince of Wales, representing Her Majesty the Queen, recently laid a memorial stone as a commencement of the new bridge the Corporation of London are building across the Thames, immediately below the Tower. The total width of the river at the point of crossing is 880 feet, which will be divided into three spans, the two outer being each 270 feet, and the center one 200 feet. The central span of the bridge is on the bascule principle, that is, it consists of two arms or leaves, one pivoted to each of the piers, and capable of turning on a hinge. When a ship is about to pass the bridge, each leaf will be raised into a vertical position, after the manner of a medieval drawbridge, and then, after the vessel has passed, it will be lowered until it is approximately horizontal, and will be locked by strong bolts to its fellow leaf. But although the central span may be open, the foot traffic will not be suspended. The piers are to be carried to a great height, and about 135 feet above Trinity high water a light bridge will be thrown across them. Access will be provided to this elevated road by staircases in the piers, and also by hydraulic hoists capable of carrying a large number of passengers simultaneously. This is the first bridge, we believe, in which the central span has been crossed by two roads, a permanent one at a great elevation and a movable one at a lower level. In the SCIENTIFIC AMERICAN of October 24, 1885, we gave an engraving of the new bridge.

IMPROVED DESK ATTACHMENT.

This desk attachment is designed to aid an accountant or bookkeeper to post his books. Upon the inclined top of a desk of the ordinary form are arranged two metallic strips, a third strip being fixed upon the upper face of the ridge secured to the lower edge of the top. To the under side of an auxiliary top are secured casters that roll along the strips. Back of the top there is a block provided with an inkstand, which is on a level with the auxiliary top. The journal and ledger are placed upon the top, which may be rolled forward or back so as to bring either book before the accountant, who sits in front of the desk, and whose time is thus economized, and who is relieved of much unnecessary and tiresome work.

This invention has been patented by Mr. Wm. F. Fitz-Gerald, of 159 Boush Street, Norfolk, Va.



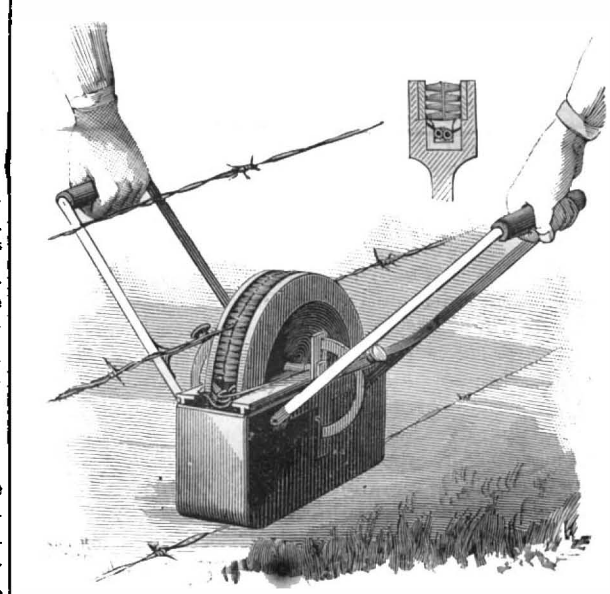
FITZ-GERALD'S IMPROVED DESK ATTACHMENT.

Pile Driving by Dynamite.

An engineer of Pesth, Mr. Pradanovic, has lately used dynamite for driving piles. A circular cast iron plate, 15 inches in diameter and 3¾ inches thick, is fixed on the pile to be driven in a perfectly horizontal position. A dynamite cartridge made in the form of a disk, 6 inches in diameter and three-fourths of an inch thick, and containing 17½ ounces of dynamite, is placed upon the cast iron plate and exploded by electricity. It is stated that the depth to which the pile is driven by each explosion is equal to five blows of an ordinary pile engine weighing 14¾ Vienna cwt. falling 9 feet 10 inches. A cast iron plate, on an average, resists 25 explosions.

WIRE PAINTING MACHINE.

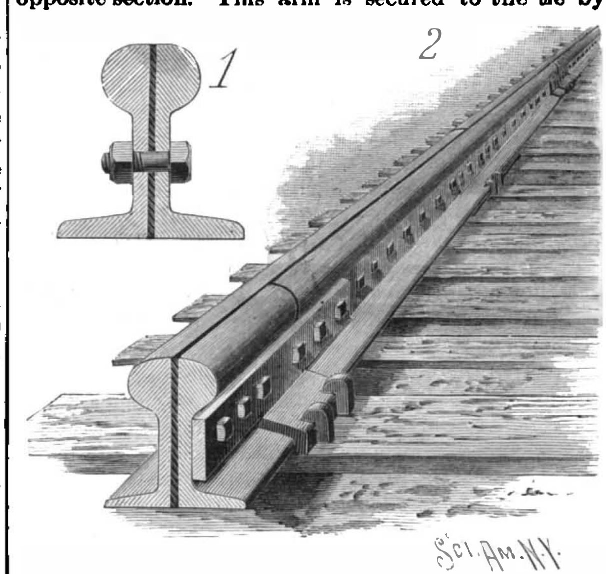
While the machine shown in the engraving is designed more especially for painting the wires of barbed wire fences, it is also applicable for painting wires or strands passing to or from a reel. The vessel in which the paint is placed is carried by two handles, which may be raised or lowered, and held in any desired position, according to the height of the wire to be painted. The wheel is journaled in bearings which may be set higher or lower, as the quantity of paint in the vessel may require. In a groove in the periphery of the main body of the wheel are teeth upon which the barbs of the wire catch, thereby rotating the wheel. Beyond these teeth are fixed annular brushes. The surplus paint is removed from the brushes by a properly arranged wire, and paint from the sides of the wheel is removed by wipers, which prevent the paint from being wasted by adhering to the sides, or by being thrown from the vessel by centrifugal force as the wheel revolves. The machine is carried along the wire, the operators simply walking along the fence, one at each side, when the wire is thoroughly painted by the revolving brushes. Should the bristles of the brushes become set or inclined to one side, the wheel may be reversed in its bearings, so as to operate the other way. It will be seen that, by means of this machine, which is the invention of Mr. R. Quatermass, of Moline, Kansas, fence wires may be painted thoroughly as rapidly as two persons can walk, and with no waste of paint. Should the fence wires be placed too closely together to admit of carrying the machine upright, it may be inclined to one side.



QUATERMASS' WIRE PAINTING MACHINE.

RAILWAY TRACK.

The rail is formed of two similar longitudinal sections, which are oppositely arranged with respect to each other and joined together to form a complete rail, the joints of one section alternating with those of the other, so that there is no break at any point in the length of the track. Between the sections is placed a strip of elastic material, such as rubber, leather, or wood. Each joint of the inner and outer sections is stiffened and strengthened by a plate which is applied to the web of the rail and extends each way from the joint, and is secured by bolts. The plate is provided with an arm, which extends beneath the joint and the opposite section. This arm is secured to the tie by spikes, as shown in Fig. 2. The elastic strip placed between the sections allows the rail to expand within certain limits without straining the bolts or connecting plates. It also prevents jarring of the track, and the breaking of the joints of the inner and outer sections produces a continuous rail.



MEISENHEIMER'S RAILWAY TRACK.

This invention has been patented by Mr. W. S. Meisenheimer, of Dongola, Ill.

MAKING FINE GUNS FOR SPORTING PURPOSES.

The production of smooth-bored shotguns and grooved rifles for sporting purposes, now always after the breech-loading pattern, and very commonly double-barreled, has shown a steady improvement in the manufacture during several years past that is highly creditable to American ingenuity and mechanical skill. With the exception of the Prussian needle-gun, nearly every arm on the breech-loading system that was used for ten years after the commencement of our civil war, in 1860, was of American origin, something like five hundred patents having been issued during that period relative to this one department of gun making. The most of these were principally designed to meet the call for arms for military purposes, but they also contributed materially to the advancement of the art of making guns for the use of sportsmen, a branch of the manufacture in which the "Parker" gun has for many years stood in the first class. The "Parker" double-barreled shotgun has, indeed, become so well known, that not to be acquainted with its excellences is to argue that one has but little familiarity with firearms especially designed for sporting purposes.

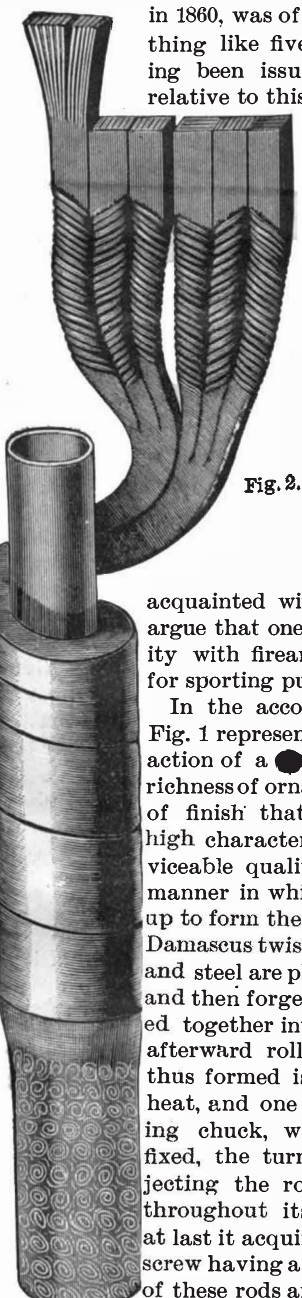


Fig. 2.

In the accompanying illustrations, Fig. 1 represents the stock and breech action of a Parker gun, and shows a richness of ornamentation and fineness of finish that well accord with the high character of the gun in its serviceable qualities. Fig. 2 shows the manner in which the metal is worked up to form the gun barrel, to make the Damascus twist. Alternate rods of iron and steel are placed upon one another, and then forged and thoroughly welded together into a solid bar, which is afterward rolled into rods. The rod thus formed is raised to a bright red heat, and one end placed in a revolving chuck, while the other remains fixed, the turning of the chuck subjecting the rod to a severe twisting throughout its whole length, so that at last it acquires the appearance of a screw having a very fine thread. Three of these rods are then placed together, the twist of one being in a contrary direction to that of the other two, and they are welded together and rolled, making the strip which is wound around the mandrel, as shown in our illustration, the coil being welded till the spirals unite to form a hollow cylinder. The fine figures that appear in the finished barrel are the result of the skillfulness with which these several operations are performed, after which follows a process of hammering while the barrel is nearly cold, to further condense the metal, and the barrel is then ready to be bored, turned, and finished. About three-fourths of the material is cut away in the making, 16 pounds of iron being used in the first instance to make a pair of barrels which would weigh only 8 pounds when the welding is finished, and from three to four pounds after boring and grinding.

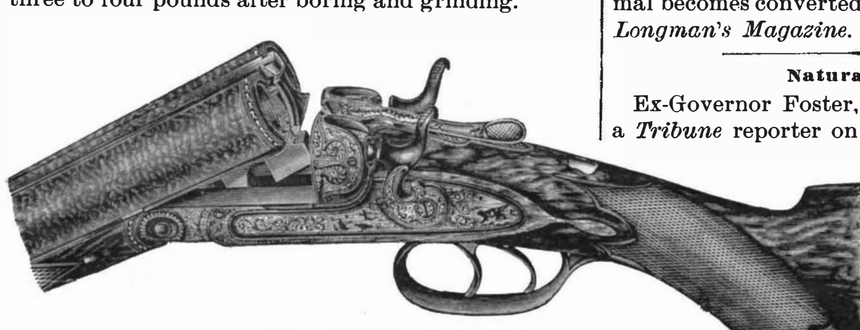


Fig. 1.—THE PARKER GUN.—BREECH ACTION.

In the manufacture of laminated steel barrels, the best quality of steel scrap is mixed with a small proportion of charcoal iron, heated in a furnace, puddled into a ball, well worked up under a forge hammer, drawn out under a tilt hammer into strips of the required length and thickness, and then treated as above described. Such barrels are much esteemed for hardness and closeness of grain, and show a different marking and appearance from those made by the Damascus twist.

It is only by such elaborate treatment of the metal that gun makers have succeeded in making guns so very light, and yet of such great strength and beauty. The most thorough testing is, of course, an important detail of the manufacture, and tests are made at various stages of the work, in order that imperfections may not pass into any part of the gun where they might afterward be covered up.

The factory of the Parker Brothers is at Meriden, Conn., but their principal salesroom is in New York city.

Cuttlefish.

Any one who has seen an octopus resting in its tank in an aquarium must have been struck by the puffing and blowing movements of the sack-like body, the nature of which excited Victor Hugo's imaginative powers in the "Toilers of the Sea." The octopus is seen to inspire and expire with great regularity. The soft body expands and contracts rhythmically enough to excite a natural comparison between its respiratory acts and our own. If we could dye the water so that our eye could follow the currents which the octopus inhales and exhales, we should perceive that at each inspiration the soft body expands, and water is drawn in two currents into the neck openings. These openings lead directly each into a gill chamber of the animal.

Here, inclosed in its own cavity, we find a plume-like gill. In its nature, this structure is simply a mesh-work of blood vessels, and thus comes to resemble a lung in its essential features. Impure blood—that is, blood laden with the waste materials of the octopus-body, with the products of the vital wear and tear—is driven into the gill on one side. Subjected to the action of the oxygen gas contained in the water breathed in, the blood is purified. Its waste materials are given forth to the water, and it is passed onward out of the gill on its way to the heart for recirculation throughout the cuttlefish frame. Breathing in oxygen entangled in the water is, therefore, in the case of the cuttlefish an analogous act to that seen in higher animals, which inhale oxygen directly from the air.

The octopus, however, performs an expiratory act likewise. Placed below the head is a short tube, named in zoological parlance the "funnel." When cuttlefish inspiration has come to an end, expiration begins. The body contracts, and the water, which a moment before was drawn into the gill chambers by the neck openings, is expelled from the "funnel." The openings of entrance are guarded by valves. These close when expiration begins, and the water has no choice save to find a forcible exit by the tube just named. So far in octopus existence, it would seem as though there were no economy of power exhibited in the act of breathing. Muscular action expands the soft body, and muscular force contracts it.

There is exhibited here a plain difference between the octopus and the higher vertebrates. But the story of cuttlefish economy is not yet completed. A moment more, and your octopus, which sat crouched in the bottom of the tank, is seen to wing its way through the water. It skims like a living rocket through the clear medium in which it lives, as if impelled by some marvelous and invisible agency. The secret of this flight is the solution of cuttlefish economy and reserve force. So long as the resting mood prevails, the water used in breathing is ejected slowly, or at least without any marked display of force.

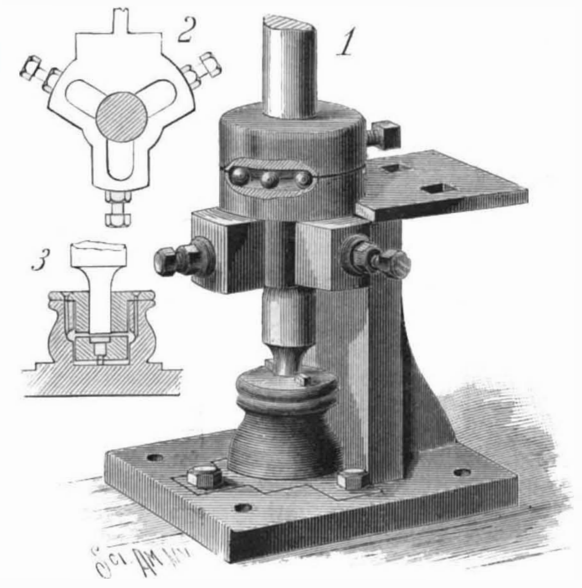
But when locomotion has to be subserved, and when the cuttlefish desires to swim, it propels itself through the water by aid of a veritable hydraulic engine. The effete water from the gills is ejected with force from the funnel, and by the reaction of this *jet d'eau* upon the surrounding medium the animal is enabled to execute its aquatic flights. Economy of a very rigid order is illustrated clearly enough in octopod existence. The otherwise useless "breath" of the animal becomes converted into a means of locomotion.—*Longman's Magazine.*

Natural Gas in Ohio.

Ex-Governor Foster, of Ohio, in an interview with a *Tribune* reporter on this subject, says that "natural gas fields have been discovered through the northern part of Ohio, and gas wells are in operation within nine miles of my town. I am pretty confident that I have found a field covering at least 200 square miles which is underlaid with natural gas reservoirs, which can be tapped at a depth of 1,100 to 1,300 feet. I have been engaged for some time in corralling this field. It would furnish a supply for Chicago by pipe lines, and not only that, but would make the country where it exists a great iron field. It is a curious fact that iron cannot be made except by a mixture of ores. Thus the ore of Lake Superior is united with ores of Pennsylvania and Ohio to make valuable iron. All are brought together where the fuel is cheapest. That has hitherto been in the coal fields. Natural gas has superseded coal at Pittsburg. It is a cheaper fuel and a better fuel than the world has ever known. If these fields are developed in Northern Ohio the iron business would become prominent in that locality."

ANTI-FRICTION BEARING.

The engraving represents a bearing designed for vertical shafts that revolve at a high rate of speed and are required to support considerable weight. Below a collar secured by set screws, the shaft passes through a pillow block and box, and terminates in a step (Fig. 3), which consists essentially of a hollow casting within which the shaft-guiding socket fits. The casting is so formed that there is an annular oil chamber about the socket, fed by proper oil ducts; about in line with the bottom of the shaft are two oil ducts, leading from the chamber to the interior of the socket. The step merely acts as a guide for the



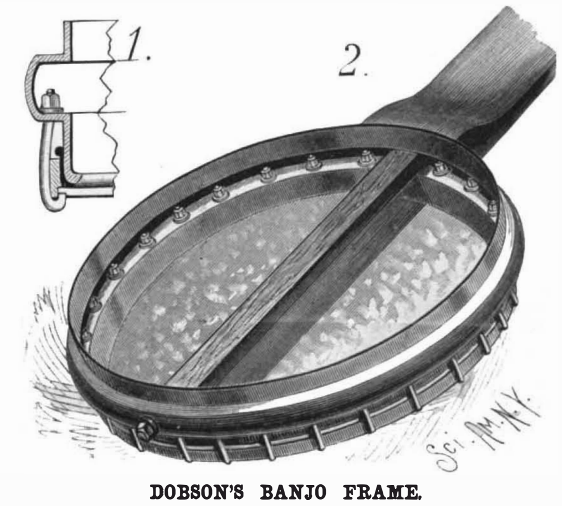
GALE'S ANTI-FRICTION BEARING.

lower end of the shaft, and not as a weight-supporting device, as the weight of the shaft and its load is taken up by a series of anti-friction balls that rest within a groove formed on the upper side of the pillow block, a corresponding groove being formed on the under side of the collar. The box to which the pillow block is bolted is provided with three or more converging slots (Fig. 2), in which are fitted adjustable blocks made of any of the well known anti-friction bearing metals. The adjusting devices of the box make it almost immaterial whether the weight carried by the shaft is equally distributed on all sides or not. The construction above described permits the shaft being revolved at high speed and of carrying quite a weight.

This invention has been patented by Mr. Morgan Gale, whose address is care of the San Sebastian Gold Mining Company, La Union, San Salvador, C. A.

BANJO FRAME.

The banjo frame herewith illustrated is so constructed that the head-holding hooks are prevented from tearing the clothes of the person playing the instrument. The frame is made of metal, and is provided with a hollow head forming an internal annular groove. In the annular shoulder thus formed by the top of the head are holes, through which are passed the lower screw-threaded ends of the clamps, the hooks of which engage the upper edge of the usual ring sur-



DOBSON'S BANJO FRAME.

rounding the frame. This construction is clearly shown in the sectional view, Fig. 1. The nuts are screwed on the ends of the clamps within the groove, and are turned by means of a key introduced through the open bottom of the frame. The head serves as a guard to prevent the clothes of the performer from coming in contact with the nuts or ends of the hooks.

This invention has been patented by Mrs. Minnie Dobson; further particulars can be had by addressing Dobson & Co., 234 West 37th Street, New York city.

SEVERAL kinds of quadrupeds in the London Zoo suffer from corns on their feet, due to the hard floors; and these produce boring ulcers which may extend clear through the foot. Hernia also occasionally afflicts the monkeys.

PROPULSION OF THE SECOR YACHT EUREKA BY THE EXPLOSION OF PETROLEUM VAPOR.

(*Continued from first page.*)

of 20 in. internal diameter, and is 2 in. thick. It is guaranteed by the makers, the Pittsburg Cast Steel Company, to withstand a pressure of 5,000 pounds. It has been tested up to 1,000 pounds. The exploding chamber communicates beneath with four radial portholes or chutes, protruding through the hull and open to the outside water. Two of the ports extend toward the stern, and two toward the bow. These are each 2 ft. high at their open end and 1 ft. wide, giving an area of impact of 2 square feet.

The rear ports terminate in line with the keel, as shown in our outside view, thus giving the escaping gases direct action upon the wall of water at the rear of the vessel, when it is desired to drive her ahead. In our view of the motor, only one of these ports is shown, the other one being hidden by the rest of the machinery. The forward ports, used in backing or in stopping the vessel suddenly, terminate obliquely. The escaping gas is, however, made to impinge upon the water in line with the keel by means of the doors located at the open ends of the ports.

Four levers, placed within easy reach of the engineer, and shown in the foreground of our engraving, operate as many valves controlling the communication between the exploding chamber and the several portholes. The vertical levers control the valves in the stern ports, and, as shown, may be operated quite independently of each other. The horizontal levers, similarly independent, operate the valves of the forward ports, and at the same time the doors at the outer ends of the ports. The pipe shown in the foreground leads from the compressed air reservoir to an auxiliary chamber in front of the main exploding chamber.

The petroleum used in producing the explosion is stored in the copper reservoir shown in the very stern of the vessel. It has a capacity of three-fourths of a barrel, and will probably suffice for a twenty-four hours' run. The reservoir is surrounded by a water jacket in communication with the outside. By this precaution, risks of accident from fire, leakage, or explosion are avoided. The reservoir connects by means of a pipe with the small can placed immediately above the motor.

From this can the petroleum, as shown, passes through a tube in the exploding chamber, by which it becomes heated about to the boiling point, when the motor has once started up. The oil tube is then brought into the passageway in front of the exploding chamber, and terminates in an injector. This passageway communicates with the auxiliary chamber containing compressed air. The mixture of petroleum and air introduced into the exploding chamber by the injector impinges upon a small coil of platinum wire heated to a white heat by the electric current, and is at once exploded. Suitable valves cut off the communication with the air compressor and oil can during the explosion, so as to prevent the resulting gases from rushing back into either of the reservoirs. The motor is also so arranged that no explosion can take place, unless at least one of the valves leading to the portholes be open. The best proportions of air and petroleum to form the explosive mixture have not been determined.

It will thus be seen that the motor is simply a gas engine, in which the piston is replaced by a wall of water. This being the case, no lubricants are necessary on the interior of the chamber, and the temperature need not be reduced by the customary water jacket. No thermometric observations have yet been made, but Mr. John Secor states that the probable temperature during an explosion is 2,000° Fah. The absence of moving parts makes this high temperature possible, and permits a greater efficiency than in the usual form of gas engine, where a large amount of energy is dissipated by the water jacket. The safety valve attached to the motor is set at 500 pounds. The ordinary working pressure will be about 100, though this can be increased at pleasure. There will probably be about eighty explosions per minute.

Such being the construction of the motive power of the Eureka, the question of her speed and economy remains to be proved. That she will move with comparatively little agitation of the water, when once under headway, has been demonstrated by a preliminary trial at the dock. When the motor was first started, the only results of the explosion were seen in the bubbling of the water at her stern; but as the machinery became heated, and the explosions more numerous and violent, the vessel moved forward with fairly smooth motion, and the gas came to the surface of the water in fine bubbles some distance from the stern. Considerable difficulty has been experienced in the vibrations produced when the first explosions take place and before the boat is under headway. But these have been greatly reduced, and it is not too much to hope that they can be entirely avoided when the mechanism is perfected.

Everything about the boat has been built in a most substantial manner, and in the design of all her machinery the safety factor has been made unusually large. The Messrs. Secor hope to make a more extended trial trip down the bay about the 1st of July. It is hardly to be expected that they will attain a speed comparable with that of ordinary steam yachts, as it is the first trip of the Eureka, but they have already much to encourage them in believing that they will make the vessel eventually a success.

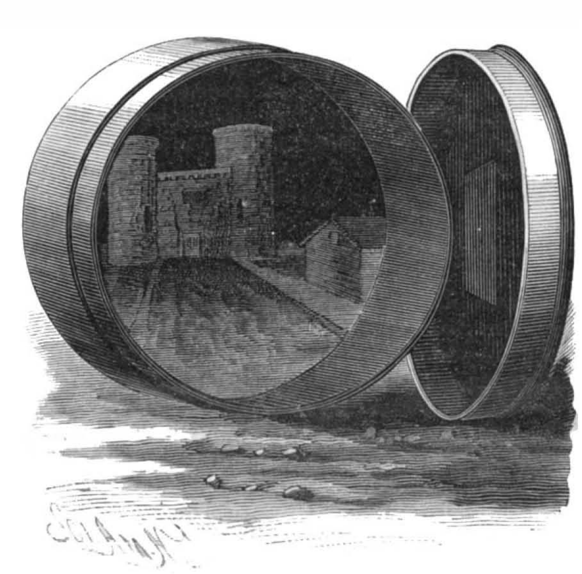
Each piece of mechanism has been thoroughly tested separately, and all designs have been first submitted to competent mechanical experts before they were executed. Although one professional gentleman expressed his confident opinion that the only result of the experiment would be a hydraulic display in the shape of a fountain, and that the boat would not move an inch, the large majority of persons qualified to pronounce upon the merits of the system have assured the inventors that their plan is entirely feasible, and can be made a commercial success when the details have been worked out more perfectly. There is at present very little ground upon which to calculate the probable economy of the vessel.

The junior inventor states that he believes it will be possible to run from New York to Newport and back on a dollar's worth of oil. The experience of the next few months will probably decide these questions, and will prove, it is much to be hoped, an important epoch in the history of direct propulsion.

PHOTOGRAPHIC NOTES.

PINHOLE CAMERA.

We illustrate in the cut a camera for photography in which the *ne plus ultra* of simplicity may fairly be said to be attained. It is a little tin box two inches in diameter and three-quarters deep from cover to bottom.



PINHOLE CAMERA.

A hole was punched in the center of the cover, and over this a piece of foil was secured by varnish. The foil was taken from a button card. Small mother-of-pearl buttons are generally mounted on pieces of pasteboard with this foil under them. Through the foil, where it extended across the hole in the box cover, a hole was made with a No. 10 needle. The needle was pressed through until its point could just be felt by the finger held against the opposite side of the foil. This made an aperture one-sixtieth inch in diameter. The interior of the box was blackened. A piece of Eastman's "A" bromide paper, cut circular, so as to fit in the box, was placed in it against the bottom, and the cover put on. This, of course, was done in the absence of actinic light. Then, with an exposure of four minutes, at a distance of about ten feet from the object, the negative shown in the sketch was taken. It was developed with oxalate developer. Castor oil or vaseline was used to make it transparent, so as to adapt it for printing from. The subject of the negative was the old armory at Summit Hill, Mt. Jefferson, Pa.

As nothing special, neither paper, glass negative, nor developer, was used, this process of pinhole photography deserves special mention. It might often be of considerable use in emergencies that sometimes will present themselves to the photographer.

The special novelty that presents itself is the use of paper instead of glass for the negative, as paper can be cut to fit any size or shape of box. The brand of paper employed is slow paper; it would be interesting to try a quicker paper, that would reduce the necessary time of exposure.

Theater Fires.

In the twenty-one principal theater fires of modern times, from the destruction of the Schouwburg Theater in Amsterdam, in 1772, to the burning of the Ring Theater in Vienna, in 1881, a total of 6,548 victims are chronicled. Among the more appalling disasters may be given the Capo d'Istria Theater, with a loss of 1,000, in 1794; the Canton Theater, with a loss of 1,670, on May 25, 1845; and the Ring Theater in Vienna, with a loss of 1,100, on December 8, 1881. The Brooklyn fire on December 5, 1876, caused a loss of nearly 400.

A New Way of Making Ready for Printing.

The making ready of cuts and electrotypes for printing very frequently presents considerable difficulties, which are still increased where the block has been obtained through one of the photo-mechanical and photo-chemical processes. The ordinary way of underlaying with paper, cutting away, and scraping off does not answer as well as might be desired. Hence there have been strong endeavors to find a different and more satisfactory manner of securing the desired results.

An article in the French trade journal *L'Imprimerie* speaks of a novel and certainly noteworthy way of proceeding.

After mentioning the difficulty of making ready the electros, the article goes on to describe the innovation, asking the workmen not to shrug their shoulders, but rather to give the directions a fair trial.

First a few remarks as to the packing upon the cylinder. A stout cardboard, but perfectly smooth, answers best; over this is drawn a layer of white muslin, which has been run through the calendering machine, and over which is placed a sheet of calendered paper. A hard and dry packing is absolutely necessary for the printing from photo-engravings with half tints.

In the making ready proper, the following steps are taken: The first impression is made upon the sheet of paper stretched over the muslin, pasting a few bits of tissue paper in the deep parts of the photo-engraving. After that a second thinner sheet is pasted over the first impression, run through, and proceed with the making ready upon this.

During the time, a quantity of English red has been ground together with an equal quantity of glue.

To be serviceable, the substance must not give off color when used, nor dry with a luster. It must have a dull appearance; and where one layer is placed over the other, the lower layers must neither soften nor absorb the upper ones.

Should there not be taken a sufficiency of glue, or too much of it, the covered parts will get too stiff or not flexible enough. The mixture should always remain fluid enough to run easily from the brush.

For the work there should always be on hand a set of paint brushes of various sizes.

Next, let a commencement be made with a laying on in large spaces, which have not shown up upon the second impression sheet, proceeding to those less prominent and continuing until the requisite strength is reached. Care should be taken to have every layer of the paint dry before the succeeding one is added. Before turning to printing, let a thin sheet be pasted over the entire make-up.

It is self-evident that a few strokes of the brush will not take nearly as much time as the cutting out and pasting formerly resorted to.

Should there have been placed too much paint in some part, the defect can be easily remedied by rubbing, done with a piece of *ossa sepia* or cuttlefish bone. Delicate graduations are obtained even more easily by such a manipulation than by resorting merely to the painting.

The making ready which we have described deserves to find favor. When the first difficulties arising in the handling of the brush are surmounted, the proceeding spoken of will be preferred to all others. There is certainly no better one for the making ready of photo-engravings.—*Lith. and Printer.*

Hot Water Artesian Well at Pesth.

The deepest artesian well in the world is that now being bored at Pesth, for the purpose of supplying the public baths and other establishments with hot water. A depth of 951 meters (3,120 feet) has already been reached, and it furnishes 176,000 gallons daily, at a temperature of 158° Fah. The municipality have recently voted a large subvention in order that the boring may be continued to a greater depth, not only to obtain a larger volume of water, but at a temperature of 176° Fah.

Earthquake Waves.

The chief effect of an earthquake on the ocean is the raising of a great sea wave, sometimes very large, *e. g.*, 60 feet high at Lisbon (1761), 80 feet at Callao (1724), 210 feet at Lupatka (1737). These waves are often more destructive on land than the actual shocks; the influx is usually preceded by an outflow, which, in fact, acts as a warning. One of the most remarkable effects is the distance to which these waves are propagated as "great waves," *e. g.*, right across the Pacific. Thus most large earthquakes on the east or west coast of the Pacific produce waves which are recorded on the opposite coast about twenty-four hours after.

As to prediction of earthquakes, nothing certain is yet known. In many cases there are noticeable changes in springs and wells preceding earthquakes. One useful warning is, however, obviously possible, viz., the report of an actual earthquake on one side of the Pacific could be at once telegraphed to the other side, thus giving twenty-four hours' warning of the probable advent of a great sea wave.

Correspondence.

Compressed Air for Driving Lifeboats.

To the Editor of the Scientific American:

On page 3 of your issue of July 3, I find a valuable suggestion in regard to compressed air for increasing the speed of lifeboats. I see no reason to doubt that the ejection of highly compressed air would attain the object, not only in lifeboats, but in larger craft.

The point of ejection is not given. I suggest that in a small craft liable to violent motion, the outlet must be well under water, and pretty well aft. I also suggest that the boat be provided with a fixed air pump to be worked by hand, so that the supply may at convenient times be kept up. If the device be good for a boat, why may not an ocean steamer be supplied with an ejector on each quarter well aft, and so arranged that one could be operated at a time to help the steering? A sailing craft may also be assisted by the process indicated. R. B. FORBES.

Milton, Mass., July 2, 1886.

Photography of the Solar Spectrum.

To the Editor of the Scientific American:

In a communication to the Franklin Institute, which you reprinted a short time ago (in Phot graphic Notes), I stated that some allowance should be made for the fact that the relative intensity of different portions of the lime light spectrum is not the same as that of the solar spectrum, but at the same time expressed a belief that the difference was small. Further investigation of the subject proved that there is more difference than I supposed. This difference does not affect the value of my original experiment as a demonstration of the positive action of chlorophyl and eosine, and the advantage of their combination, but it does affect my estimate of relative sensitiveness to different portions of the solar spectrum. I have, therefore, now made a photograph of the prismatic solar spectrum on one of my chlorophyl-stained plates, with the following result. There appears a strong action throughout the entire visible spectrum, strongest in the red below C, almost as strong throughout the violet, blue, and green, and weakest in the green-yellow. The appearance of this photograph is therefore similar to that of the illustration published in the *Journal of the Franklin Institute* (July), where I stated that the chlorophyl negative of lime light spectrum was of such extraordinary intensity in the red that the contrasts in that part could not be brought out in a process plate. The same comparison will probably hold good for a chlorophyl-eosine plate, which should give a photograph of the prismatic solar spectrum of nearly uniform intensity from about A to beyond H, with the weakest action near D. FRED. E. IVES.

Philadelphia, Pa., July 10, 1886.

Aerial Navigation.

To the Editor of the Scientific American:

I see in your issue of June 12th that Herr Gaswindt is constructing a balloon, which I infer to be cigar-shaped. He seems to consider the grand difficulty to be the wind. Is such the case? I have always considered that a cigar-shaped balloon will cleave the wind to a great extent. I have been working for some years past on this principle, and am now constructing a cigar shaped balloon, 200 feet long and 60 feet in diameter, which displaces about 20 tons of air. I intend to run it with a gas engine which weighs two hundred and fifty pounds. This actuates a transverse shaft, which rotates four fans on each side, giving a forward, downward, or upward motion, and, by a simple apparatus, a rotary motion to the machine. These four motions are achieved by shifting one piece of mechanism. The machinery weighs, exclusive of frame and engine, about twenty-five pounds. I expect to get a progression of 100 feet at each revolution. I am not very favorably impressed with the wind theory, unless Mr. Gaswindt includes the aerial currents in that category, as the wind is nothing but the rushing in of the lower currents to take the place of the warm air heated by terrestrial refraction or other caloric, and which rises to join the aerial currents where it is cooled.

The field of usefulness of the balloon will take it out of the reach of these disturbing influences, and it will have to contend with the aerial currents which have a general direction westward, although, as they do not travel as fast as the earth, a balloon would have therefore considerable forward movement as regards the earth, though it practically went with that current. To illustrate: If the earth moves at the rate of 1,000 miles an hour, and the current 3 miles high at 750 miles in the same direction, then a balloon in that current will travel 1,500 miles westward in six hours. These upper currents are constant, the winds being but factors in the terrestrial economy. The earth may be regarded as a ball revolving rapidly in a gaseous fluid which the earth parts with but slowly, or as a wheel running at a high rate of speed carrying with it a stratum of air which forms first an acute and then a right angle, and finally merges in the general circulation. This current has its greatest velocity when the earth's attraction for it is greatest, that is, at the point of contact. This velocity is so great, in fact, that a balloon, if but slightly elevated, will have but a slight westward tendency, and is readily affected by local causes; but at the limit of the main current there is but little attraction between the gaseous medium and the earth, though it still travels with the earth to the limits of space, at which point, could a balloon be adjusted to remain stationary, the earth in its revolution would recede from it, and would present the same surface opposite the balloon twenty-four hours thereafter.

Now, the earth traveling at the rate of 1,000 miles an hour, and the retrograde movement of the current being 30 miles an hour near the surface of the earth, then the velocity of the terrestrial current will be 970 miles an hour. It is therefore the latter velocity which has to be overcome, and not the so-called wind, which is but the difference between the terrestrial velocity and that of the terrestrial current.

This will readily explain why the later experiment at the French aerial school did not succeed. I refer to the cigar-shaped balloon constructed with a propelling wheel in front. It can be understood that such a wheel, even with a velocity of 30 miles an hour, could not make any headway against a current running 900 miles an hour. If, therefore, Herr Gaswindt attains a velocity of 40, 50, or even 100 miles an hour, he can scarcely solve the difficulty that way.

F. FIELDING MACCAFFREY.

A New Motor for Torpedoes and Lifeboats.

To the Editor of the Scientific American:

In experimenting with motors of great velocity applied to dynamos, I have discovered that steam or compressed air at a pressure of 150 pounds, conducted directly from the generator to a reaction wheel without any engine whatever, gives tremendous power and velocity. I have obtained up to 60,000 revolutions per minute with the above pressure, but the consumption of energy was so large in a short time that I consider the reaction principle impracticable for ordinary industrial purposes.

Recently, however, I have made new experiments under water. By conducting the compressed air or steam through the hollow shaft of a screw propeller, directly inside of the blades and without any engine whatever, I have obtained such a remarkable result that on the 7th of this month I made a communication to the Secretary of the Navy, with plans and specifications, tending to the suppression of the air engine of the Whitehead torpedo and the adoption of my system of propulsion in its place. I received the following reply: "It is thought that your plans might be effective if suitably applied to the Whitehead torpedo; but as, so far, the navy has not been furnished with that weapon, it cannot make use of your device."

The compressed air motor of the Whitehead torpedo is certainly one of the most ingenious pieces of machinery ever contrived; but it is both heavy and very costly, and raises the price of the torpedo up to $2,000, a large expenditure for a single shot. In my system I do entirely away with the engine, and secure, in addition, a velocity equaled only by the flying arrow.

With compressed air at two to three thousand pounds in coiled steel pipes, a lifeboat could be propelled for several hours between the shore and a wrecked vessel, and could cross the line of breakers with great rapidity, provided the crew and rescued passengers were suitably protected from the force of the waves.

Numerous other useful applications of the reaction wheel will suggest themselves at once to any practical mechanic.

As all of the maritime powers are now experimenting with the Whitehead torpedo, it is probable that in the near future the United States will also adopt a form of torpedo propelled by some improved system. In that expectation, I would like to record my newly devised system of propulsion, in order that the priority of invention may not hereafter be disputed.

H. J. LEIGNEURET, M.D.,
Late Surgeon, U. S. A.

Henderson, Minn., June 27, 1886.

The Management of Petroleum Lamps.

In view of the numerous fatal and other accidents caused by petroleum lamps, the Metropolitan Board of Works, London, England, have issued the following suggestions as to the construction and management of such lamps, which are founded on recommendations made by Sir Frederick Abel and Mr. Boverton Redwood, Chemist of the Petroleum Association, after investigating the causes of lamp accidents:

1. That portion of the wick which is in the oil reservoir should be inclosed in a tube of thin sheet metal, open at the bottom, or in a cylinder of fine wire gauze, such as is used in miners' safety lamps (28 meshes to 1 inch).
2. The oil reservoir should be of metal, rather than of china or glass.
3. The oil reservoir should have no feeding place nor opening other than the opening into which the upper part of the lamp is screwed.
4. Every lamp should have a proper extinguishing apparatus.
5. Every lamp should have a broad and heavy base.
6. Wicks should be soft and not tightly plaited.
7. Wicks should be dried at the fire before being put into lamps.
8. Wicks should be only just long enough to reach the bottom of the oil reservoir.
9. Wicks should be so wide that they quite fill the wick holder without having to be squeezed into it.
10. Wicks should be soaked with oil before being lit.
11. The reservoir should be quite filled with oil every time before using the lamp.
12. The lamp should be kept thoroughly clean, all oil should be carefully wiped off, and all charred wick and dirt removed before lighting.
13. When the lamp is lit, the wick should be at first turned down, and then slowly raised.
14. Lamps which have no extinguishing apparatus should be put out as follows: The wick should be turned down until there is only a small flickering flame, and a sharp puff of breath should then be sent across the top of the chimney, but not down it.
15. Cans or bottles used for oil should be free from water and dirt, and should be kept thoroughly closed.

These suggestions apply to ordinary mineral oil lamps, such as are generally used, and not to benzoline or spirit lamps.

Value of Sanitary Precautions.

According to the *Annals of Hygiene*, they have not had a case of smallpox for one year past in Philadelphia. If the Health Officer of the city receives in his morning mail notice of a case of smallpox (suspected), he at once sends word to the vaccine physician of the district to visit the suspected house and neighborhood, and vaccinate all who are not evidently well protected, by this operation, against the disease. The agents of the Board are at once dispatched to thoroughly disinfect the suspected premises, and to inquire into and insist upon the premises being placed in proper sanitary conditions. Later in the day the proper officer, when he reports, is sent to investigate the nature of the case reported. The result is that, whether the case be smallpox or not, vaccination and disinfection are secured. The neighbors of the doubtful case are sufficiently frightened to cheerfully submit to the necessary precautions; and as a grand and glorious result, this great city has passed one whole year without a case of smallpox. This can be said of very few large cities, if of any, in the world. There never has been a time in the history of this city when her preparations to battle with this disease were so good, and we see that we have accomplished that which sanitarians always tell us can be accomplished. We have dirty water at least; we have badly paved streets; we want sewers; but we have not had smallpox. We emphasize this fact, because it is encouraging to those who labor for the public good, and it is the presentation of such facts that will enable us to convince the people of the beneficence of sanitation.

Scarlet Fever in the Cow.

Dr. James Cameron has reported the results of observations tending to show that cows may suffer from a peculiar, hitherto undescribed, infectious disease, and that consumers of milk of these cows may get scarlet fever. His attention was attracted to the subject by an outbreak of scarlet fever which occurred in a certain district in and near London. It was found that the families in which the fever appeared used the milk from a certain dairy, the cows of which were affected by the peculiar disease in question. The disease is not exactly a new one, being known to farmers as "sore teats," "blistered teats," etc., but its nature has not been recognized. In veterinary text-books it is spoken of as "erythema mammillarum." Dr. Cameron believes it to be a specific contagious affection occurring usually in the first instance among newly calved cows, and capable of being communicated to healthy cows by direct inoculation of the teats with virus conveyed by the hands of the cowman. The disease may continue from four to six weeks, and is characterized by general constitutional disturbance, a short initiatory fever, a dry, hacking cough, sometimes quickened breathing, sore throat in severe cases, discharges from the nostrils and eyes, an eruption on the skin round the eyes and hind quarters, vesicles on the teats and udder, alteration in the quality of the milk secretion, and well-marked visceral lesions.

As it is admitted, we believe, that scarlet fever may be disseminated by milk, the importance and interest of Dr. Cameron's observations are at once apparent.

Scarlatina has been described by Professor Barlow as affecting the cow, but the clinical description given is more like that of purpura hæmorrhagica.—*Medical Record.*

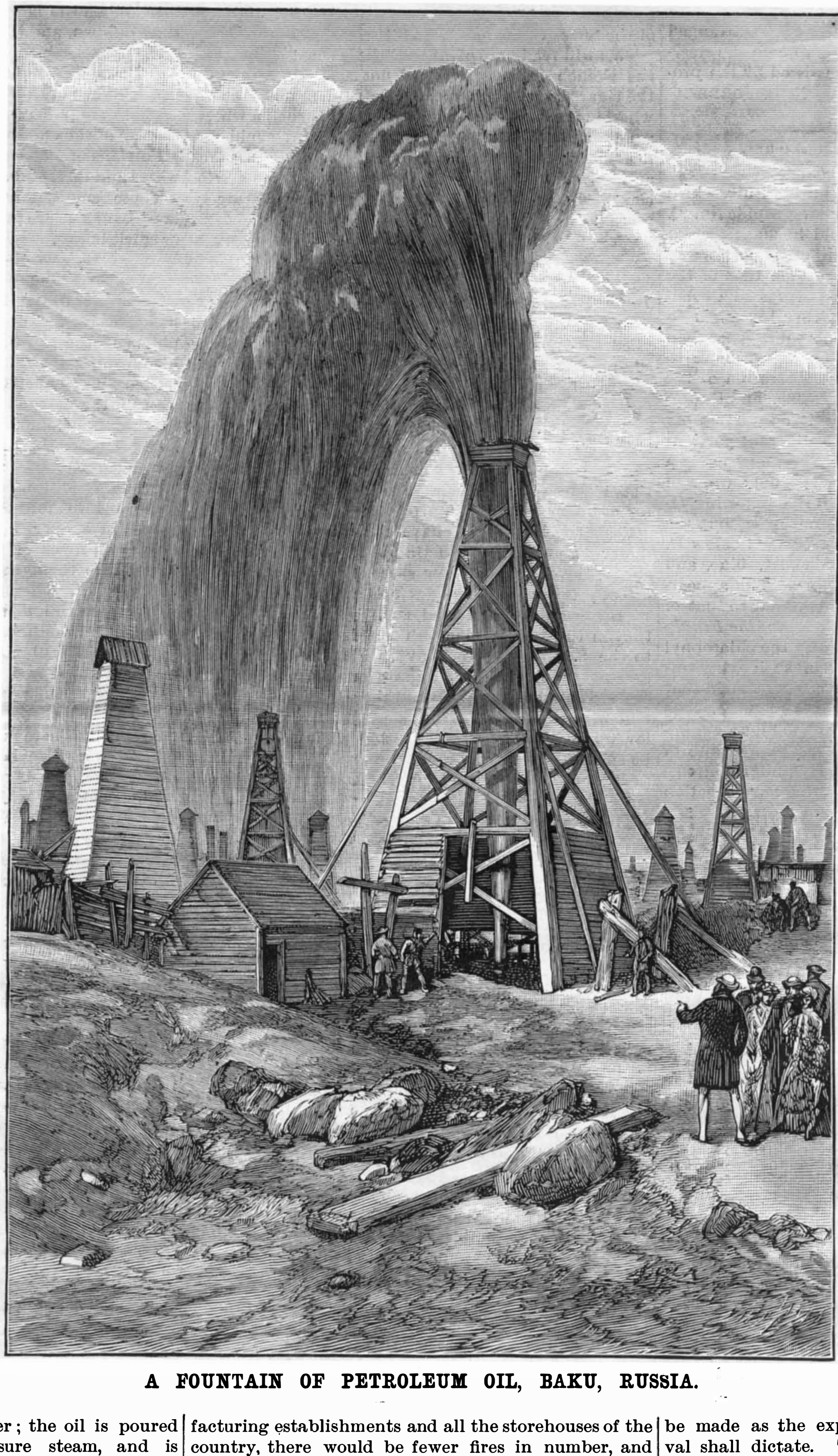
To make bay rum from the bay oil, take 10 fluid drachms oil of bay, 1 fluid drachm oil of pimento, 2 fluid ounces acetic ether, 3 gallons alcohol, and 2½ gallons water. Mix, and after two weeks' repose, filter.

THE PETROLEUM OIL WELLS OF BAKU.

We have at different times described the great establishment of Messrs. Nobel Brothers, at Balakhani, adjacent to Baku, and the operations conducted there. The boring of oil wells, the pumping, refining, and other processes, are not the only task which the petroleum industry of Baku has to carry out. The transport of the article to the consumer has also to be accomplished. It is known that for many centuries past there has been more or less trade in naphtha with Persia and other neighboring regions. The great problem was to get the oil into Russia, and send it into all the principal towns of that widely extended country. The distant position of Baku made this a most difficult undertaking. The oil has first to be sent in steamers to Astrakan; but at the mouth of the Volga, owing to its shallow water, a transshipment into barges has to take place. Some of the oil is sent on by the river, but the greater part is transported by railway. Trucks of a peculiar form have been made for this purpose, and they are now to be seen at all the principal railway stations of Russia.

Messrs. Nobel Brothers, who have brought all the science of Europe, as well as the experience of the Americans, to bear on the manufacture of the oil, have also carried their ability and energy into the organization of transport. They have a splendid fleet of iron screw steamers, fitted up with tanks, which carry the oil to the Volga, with barges carrying it on to Tzaritsin. At this town they have a large depot, from which they send the oil by rail to depots in all the principal towns. By these means they now supply the whole of Russia, says the *Illustrated London News*, to which we are indebted for cut and description, and the American oil has been entirely driven from that country. They have begun to extend the supply into Germany; and it may be looked upon as only a question of time when a great part of Europe will receive its petroleum from Baku. Among many projects connected with this new industry is the proposal to lay a pipe, to act like a siphon, from Baku to the Black Sea, and thus to deliver the oil at Poti or Batoum, and by steamers thence to carry it not only over the Black Sea, but over the Mediterranean. The cost of such a pipe line would be great, for the distance is over 500 miles; so, at present, it is only talked about; but, if the supply of petroleum at Baku continues in undiminished quantities, this is likely to become an accomplished fact at no distant date.

Petroleum oil is now largely used as a fuel to heat the steam boilers in the Caspian steamers. The oil is brought to the furnace by one pipe, from a tank, while another pipe brings steam from the boiler; the oil is poured into the blast of high pressure steam, and is thereby pulverized or blown into minute particles, which become a sheet of flame underneath the boiler. If a sufficient supply of this fuel could be procured for our ocean-going steamers, many advantages could be derived from it. Among these may be noticed that it occupies less bulk than coal; a ton of *astatki*—the Russian name, which means "dregs"—is equal to about two tons of coal; but on the Caspian a ton of *astatki* is about thirty or forty times cheaper than the ton of coal. The furnaces burning this material require no stoking, thus saving hands; to vessels going through the Suez Canal and the Red Sea, and in all tropical seas, this would end the well known horrors of the stokehole. The disagreeable process, more particularly to passenger ships, of "coaling" would be done away with; and, of course, there are no ashes to raise and throw overboard. In proper tanks it is perfectly safe—even safer than coal, the danger of which we have had experience of not long since. It would thus be cheaper than coal, safer, and its use would be conducive to the comfort of passengers and all on board ship.



A FOUNTAIN OF PETROLEUM OIL, BAKU, RUSSIA.

A Good Idea.

In various parts of one of the largest Philadelphia printing establishments, the following fire rules are conspicuously posted: "No smoking allowed. Fire buckets must always be kept filled. All rags in use on the presses must be hung up. Rags not in use must be removed from the building daily. All waste paper must be collected and removed before closing." If such rules were posted and enforced in all the manufacturing establishments and all the storehouses of the country, there would be fewer fires in number, and the destructiveness of the few would be materially reduced.

New Steel Works.

It is an encouraging sign that Carnegie, Phillips & Co., of Pittsburg, Pa., have commenced work on the new steel plant which they will erect adjacent to their present works in Homestead, the Pittsburg Bessemer Steel Works. The plant will consist of four 30 ton open-hearth furnaces, a plate mill, and a shearing department. The furnaces will have a total weekly capacity of 900 tons of ingots, and will occupy a building 350 feet long by 150 feet wide. One train of rolls will be erected, and will be capable of rolling plates 115 to 120 inches wide and 1½ inches thick. The rolling department will occupy a building 250 feet long by 90 feet wide.

Cosmopolitan Geology.

The great desirability of having the systems of nomenclature and cartography employed by the geologists of the different countries of Europe not only comparable with each other, but also with those in use in America, led, some years ago, to the formation of the International Congress of Geologists, whose third session was held at Berlin during the past fall. From the reports of the work of the Congress recently published by the American Committee, under the direction of its secretary, Dr. Persifor Frazer, it appears that while the results of these conferences are as yet only provisional, there is every reason to believe that some system will eventually be decided upon which will be sufficiently comprehensive to satisfy the conditions imposed by the geology of the several continents. The essential differences between the local subdivisions of the rock formations of Europe and America are too great to permit the adoption of any system covering them all, and it is not the intention of the scheme now proposed to include more than the grand geologic divisions which are recognizable the world over. It is, however, highly important that these shall be generally comparable, and that the terms employed for their designation shall have equivalent meanings in all countries. A very difficult part of the work of the Congress, and one that has required much discussion to reach even the present tentative results, has been in deciding upon the line of demarkation which shall separate the several groups, systems, and series. Two formations, which in one land are separated by decided unconformity, may, in another, pass into each other by insensible gradations, and it then becomes a difficult question to decide what conditions shall constitute the true line of division.

The tendency of modern geologists to depend upon paleontological rather than structural grounds for the final classfication of our rock systems has scarcely lessened the difficulty, since the distribution of fossils is by no means regular. The ultimate decision of the Congress was that, in spite of some local discrepancies, a distinct division of the formations with sharp lines of demarkation would be productive of less confusion than a more flexible system. Throughout the entire proceedings, the voice of the minority received as much consideration as possible; and though the results now published do not represent the unanimous judgment of the Congress, they are probably as near an approximation as the nature of the case permits.

At the next session, to be held in London, the final determination upon a system of nomenclature will probably be reached, and such changes in the color scheme be made as the experience gained during the interval shall dictate. The publication of an elaborate geologic map of Europe according to the international system makes it highly desirable that the forthcoming map of the United States shall, if possible, be published in conformity with the same system. Dr. Frazer has issued a small map of Chester Co., Pa., colored in this manner, and the efficiency of the color scheme will be further tested on a selected area, with a view of its adoption in the work of the United States Geological Survey.

PROF. LONG, of the Illinois State Microscopical Society, after repeated experiments, says: "Taking all things into consideration, I am forced to believe that we have no absolutely certain method of distinguishing between butter and some of its substitutes; and that, of all methods proposed, the microscopic are, perhaps, the least reliable."

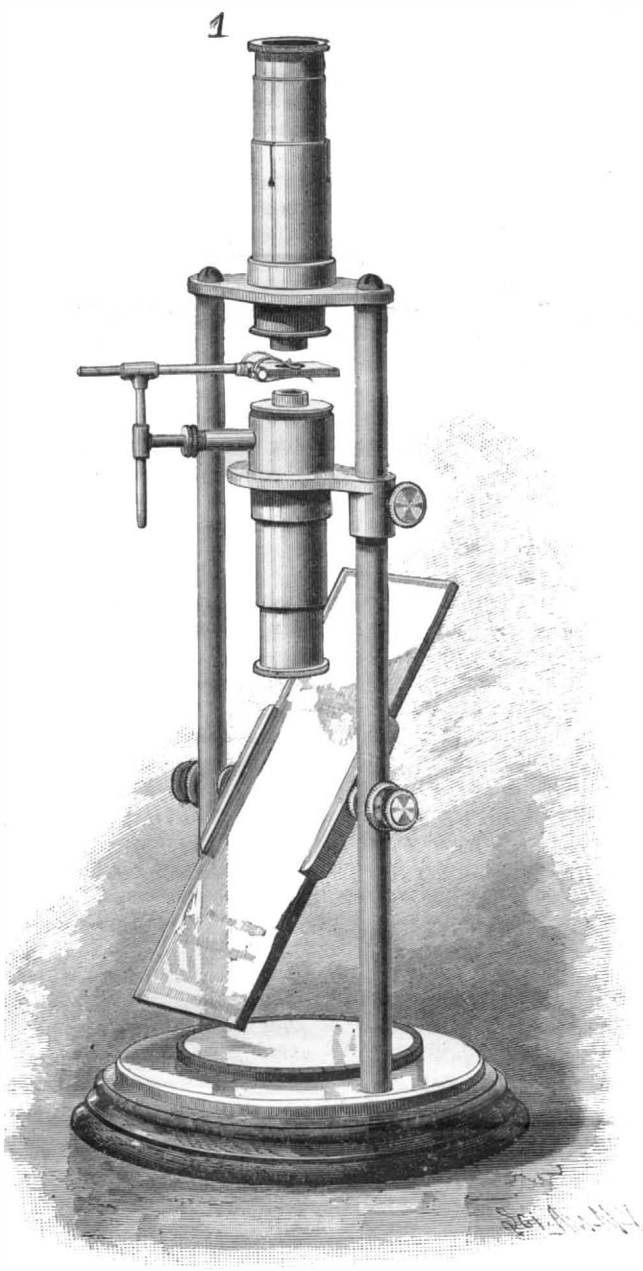
POLARIZED LIGHT.

APPARATUS FOR EXHIBITING WIDE-ANGLED CRYSTALS.

BY GEO. M. HOPKINS.

IV.

The only simple device for exhibiting the rings and brushes of wide-angled crystals is the tourmaline tongs of the kind commonly employed by opticians for testing spectacle lenses; but the dark color of ordinary tourmaline renders a polariscope of this kind objectionable.



POLARISCOPE FOR EXHIBITING WIDE-ANGLED CRYSTALS.

A system of lenses devised by Norremberg, and improved by Hoffman, is at present employed for observing the phenomena of wide-angled crystals; but it is a matter of some difficulty to secure exactly such lenses as are required for the apparatus as constructed by Hoffman. Very good results, however, may be obtained by the employment of lenses designed for other purposes. Reference is made to the hemispherical condensing lenses used by microscopists, and ordinary meniscus (periscopic) spectacle lenses. Six lenses in all are required. The converging and collecting systems are exactly alike, but they are oppositely arranged with respect to each other. In the present case the two systems are adapted to a Norremberg doubler substantially like that described in the last article of this series, the main difference being that the instrument now illustrated is made principally of metal.

The tube of the upper system of lenses is prolonged upward beyond the upper lens to receive a Nicol prism, E, or other analyzer, which is mounted in a short inner tube arranged to revolve in the outer tube.

The lower system of lenses is contained by a tube fitted to the stage of the doubler. The arrangement of the lenses and analyzer is shown in Fig. 2. The two systems of lenses being alike, a description of one will answer for both. The object, A, to be observed is held between the adjacent ends of the two tubes in the universal holder shown in Fig. 1.

The lens, B, next the object is nearly a hemisphere, about eleven-sixteenths in. in diameter and three-eighths in. focus. The second lens, C, a meniscus (periscopic) spectacle lens of 3 in. focus, is arranged with the concave face one-sixteenth in. from the convex side of the hemisphere. Beyond the 3 in. meniscus, 3½ in. distant, is placed a bi-convex spectacle lens D, of 4 in. focus. The inner surfaces of the tubes are made dead black by the application of a varnish formed of lampblack, and alcohol in which only a trace of shellac has been dissolved.

The tubes may have any suitable diameter, and the proportions of the doubler may be about the same as indicated by Fig. 1, which is one-quarter actual size. The tubes and lenses shown in Fig. 2 are one-half size. The exact proportions, except as to the focal lengths and distances apart of the lenses, are immaterial. The lower system of lenses must produce a very convergent beam of light, while the upper system is arranged to collect the rays after they pass through the crystal, and bring them within the range of vision.

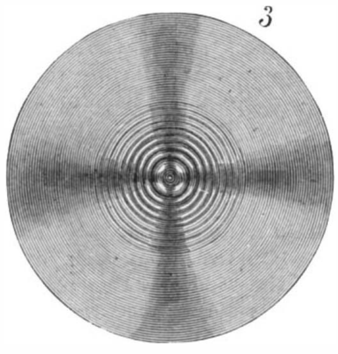
The angle between the optic axes in some crystals is so small as to permit of seeing them readily. Niter and carbonate of lead are examples of such crystals, but there are other crystals whose angle is so great as to render it exceedingly difficult to exhibit them, and in some crystals the angle is so wide as to render it impossible to see both axes at once. The only method of exhibiting them is by tilting the crystal first in one direction and then in the other, and viewing them separately.

Figs. 3 to 8 inclusive represent the figures shown by several crystals in the instrument illustrated. The drawings, having been made directly from the objects by the aid of the instrument, are correct in form and proportion, but the beautiful coloring is necessarily absent.

Fig. 3 shows the rings and brushes exhibited by calcite in a convergent beam of polarized light, with the polarizer and analyzer crossed. With the polarizer and analyzer parallel, the dark cross is replaced by a white one.

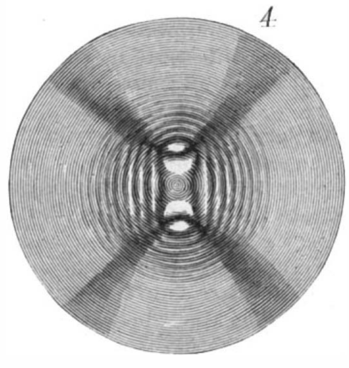
Niter is shown in Fig. 3 as it appears when the analyzer is crossed. With the analyzer parallel with the polarizing plate, the dark brushes are replaced by light ones. Turning the crystal in its own plane produces different effects.

In Fig. 5 is shown a figure produced by a slice of quartz cut at right angles to the axis of the crystal, and examined in the instrument with the analyzer arranged at an angle of 45° with the polarizer. Crystals of quartz vary in their effects on the polarized beam, some requiring the turning of the analyzer to the right, and others to the left to produce like results. For this reason the plates are called right or left handed, according to the direction in which the analyzer is required to be turned.



3

CALCITE.



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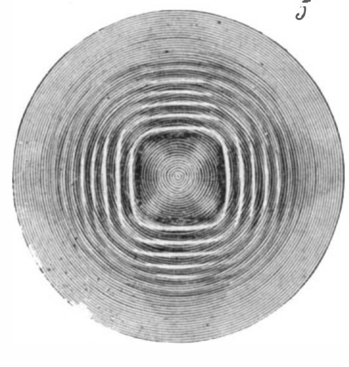
NITER.



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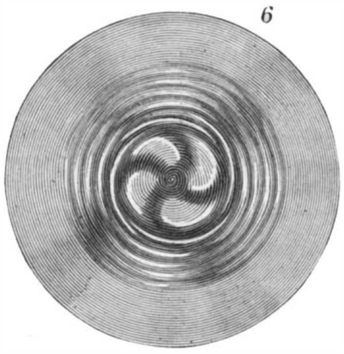
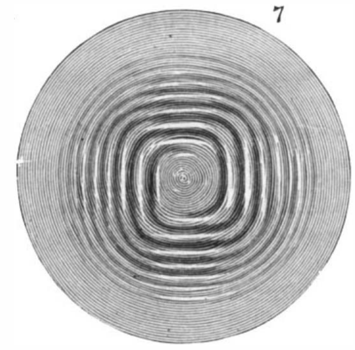
QUARTZ.



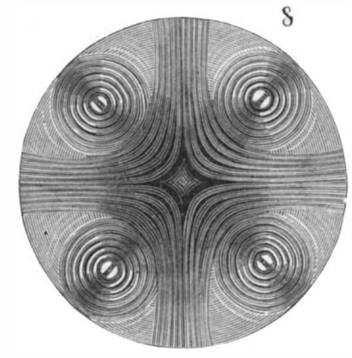
6

AIRY'S SPIRALS.



7

QUARTZ POLARIZED CIRCULARLY.

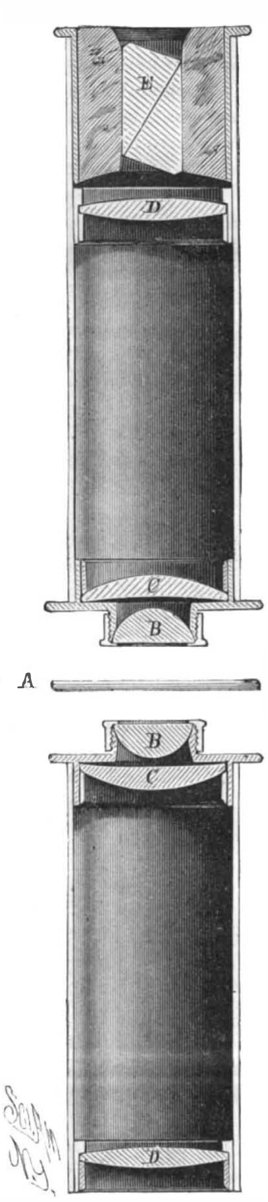


8

CALCITE HEMITROPE.

By superposing a right hand quartz on a left hand quartz, the beautiful spirals discovered by Airy, and named after their discoverer, may be exhibited. These spirals are shown in Fig. 6.

In Fig. 7 is shown the figure produced by the interposition of a quarter wave mica film between the polarizer and a plate of quartz viewed in the instrument. This altered appearance is due to circular polarization, a phenomenon readily understood on reading the literature of the subject, but requiring an explanation too elaborate for the space at command.



LONGITUDINAL SECTION OF TUBES OF POLARISCOPE.

Calcite polarized circularly shows singularly broken up and disjointed rings, the brush-like cross being absent; and when analyzed circularly, or viewed through a quarter wave plate, as well as through the analyzer, the rings appear perfect, and there are no transverse markings.

Fig. 8 shows the intricate figure produced by a calcite hemitrope, or pair of crystals arranged at right angles with each other. Somewhat similar figures are produced by crossed plates of mica.

The following is a list of some additional objects which may be viewed in the instrument: Sulphate of nickel, sugar, aragonite, bichromate of potash, chrysoberyl, chrysolite, topaz, anhydrite.

Instead of employing the Norremberg doubler for polarization, the lower tube may be prolonged, and a large Nicol prism inserted and arranged like the analyzer.

Boy Inventors.

There are a good many useful inventions which are the outcome of some boy genius, and the records of the Patent Office show that quite a number of patents have been issued to minors through their guardians. The invention of the valve to a steam engine is said to have been made by a mere boy. The story runs that Newcomen's engine was in a very incomplete condition, from the fact that there was no way to open and close the valve except by means of levers operated by hand. He set up a large engine at one of the mines, and a boy (Humphrey Potter) was hired to work these levers. Although this is not hard work, yet it required his constant attention. As he was working the levers he saw that parts of the engine moved in the right direction and at the same time he had to open and close the valves. He procured a strong cord, and made one end fast to the proper part of the engine, and the other end to the valve lever, and the boy had the satisfaction of seeing the engine move with perfect regularity of motion. A short time after the foreman came around, and saw the boy playing marbles at the door. Looking at the engine he saw the ingenuity of the boy, and also the advantage of his invention. The idea suggested by the boy's inventive genius was put in a practical form and made the steam engine an automatically working machine.

HYDRAULIC mortar.—1 of Portland cement, 2 of sand.

DECISIONS RELATING TO PATENTS.

U. S. Circuit Court.—Northern District of New York.

THE ALABASTINE COMPANY *vs.* PAYNE.

Motion to dissolve injunction.

Coxe, J.:

The complainant is the owner of Letters Patent No. 161,591, granted to Melvin B. Church, April 6, 1875, for an improvement in calcimine.

The inventor in the specification says:

I take of pulverized calcined gypsum nine pounds and of white glue one pound, the glue having been previously dissolved in hot water. When this glue, thus dissolved, is cold, I stir it into the gypsum in any suitable vessel, adding thereto from time to time sufficient cold water, until the mixture has the consistency of mixed paint for priming coats, when it may be laid on the wall with a brush, where it sets slowly, affording a hard, dead smooth surface that will not rub off, and is much cheaper than the calcimine which has whiting or zinc for the body.

The claim is for—

A calcimining compound adapted to be used with brushes, composed of pulverized calcined gypsum, dissolved glue, and cold water, substantially as described.

It is conceded by the defendant that this patent is valid, or, to be more accurate, that he is not in a position to deny its validity. The question of infringement therefore is alone involved.

The defendant has sold to consumers in this district a compound known as "anti-kalsomine," composed of pulverized calcined gypsum and white glue, manufactured and sold to him by a company located at Grand Rapids, Michigan, of which Melvin B. Church, the patentee, is president, general manager, and prime mover. Church was for years, as superintendent of the complainant corporation, engaged in manufacturing and selling a compound known as "alabastine," which he then insisted and publicly proclaimed was protected by the patent in controversy. Having disposed of his patent to the complainant and severed all connection with his former associates, Church is now, through the medium of the new corporation, engaged, to the great injury of the complainant's business, in selling anti-kalsomine, a compound almost exactly identical with alabastine.

The question to be determined is whether, keeping in view the past relations of these parties, the plea of non-infringement should now be accepted by the court.

It is contended that one who sells a dry mixture of pulverized calcined gypsum and glue, even though he subsequently reduces it to a liquid condition by the addition of hot water first and cold water afterward, does not practice the invention.

The defendant sells the gypsum and glue put up in packages, upon which are printed directions, to which it is unnecessary to refer in detail, further than to to say that, *mutatis mutandis*, they follow quite closely the formula of the patent. The liquid thus produced ready for use upon the wall is almost the exact counterpart of that described and claimed in the patent. With this product alone before him it would be a difficult task, even for an expert, to say how it was produced—whether the former or the latter directions were followed.

In selling a compound which he knows cannot be practically applied without making the user a trespasser, the defendant, within the doctrine of the following authorities, renders himself an accessory to the infringement: The Rumford Chemical Works *vs.* Hecker, 2 B. & A., 351, 363; Cotton Tie Co. *vs.* Simmons, 106 U. S., 89, 94, 95; Tilghman *vs.* Proctor, 102 U. S., 707, 728; Goodyear *vs.* Railroad, 2 Wall., Jr., 356, 359; Wallace *vs.* Holmes, 9 Blatchf., 65; Woodward *vs.* Morrison, 1 Holmes, 125; Bowker *vs.* Dows, 3 B. & A., 518; Travers *vs.* Beyer, 26 Fed. Rep., 450.

Parties should not be permitted to evade the law by such proceedings as these papers disclosed. It is the clear duty of the court to arrest the wrong in its inception.

The motion to dissolve the injunction is denied.

Railway Brakes.

The following is from the recent report of the Committee on Driving Wheel Brakes, read at the recent convention of the Railway Master Mechanics' Association, Boston, Mass. A thorough and satisfactory discussion of the value and suitability of any of the mechanical appliances for securing brake power is possible only after a clear conception is obtained of the nature of frictional resistances as shown by experiment; and the most important point to be borne in mind is the difference in the character of sliding and rolling friction.

Sliding friction (that of all shafting and axles in their journal boxes, and cross heads on slide bars) is a varying but always large and measurable quantity, comparatively low in amount as velocity diminishes.

In the rolling of a cylinder on a plane, even if the surfaces are not as perfect as those usually provided for sliding, the frictional resistance resulting is very small, and the relative motion is not that of one surface rubbing past another, so that it is quite proper to say that at the actual point of contact between circle and line these extremely limited surfaces are for the moment at rest with reference to each other, or to say they are moving at equal and similar speeds.

Hence, the positive resistance of motion, due to the contact of wheel with rail, may for our purpose at least be considered *nil*, as long as ordinary conditions prevail. But the primary object in the application of brake resistance is to disturb these ordinary conditions, so that the touch of wheel on rail, instead of being a rolling and therefore almost frictionless contact, shall become that of sliding or rubbing at very low velocity, thus securing the highest coefficient of frictional resistance possible between two given metallic surfaces moving on each other, and achieving the final result of bringing the train to rest in the shortest time and distance.

For with engine and train in motion, all that we can do to bring it to rest is to create additional friction; and that of the brake block on the tire is only a means to an intermediate, most necessary, but (as our Patent Office shows) not self-evident end, viz., the creation of friction between rail and wheel, the two surfaces that are in rolling (or equal speed) contact, but that must be put into slow sliding contact; for, although the sliding friction of block on tire will soon destroy the centrifugal motion of wheel and axle, centrifugal force forms but a small fraction of the momentum tending to keep the mass in rapid horizontal movement.

We need not go to the mathematical labor of getting the square of the center of gyration of a hollow spoke cast wheel (which would be necessary for any close comparison), but it can safely be said that in the worst case the centrifugal power in the wheels (tending by their rotative contact with rail to keep the train in motion) is, at any speed, but from 5 to 7 per cent of the total momentum or power requiring to be neutralized by the opposing brake; the remainder of the brake force, if properly employed, is used in producing sliding at low velocity, or destroying rolling contact between tire and rail, this being its main and legitimate duty. Therefore, any force or mechanical combination, other than the application of brake blocks, may be used if it will result in producing this difference in touch between tire and rail; as our object is to change the contact from rolling to sliding, yet at the same time keep the sliding velocity exceedingly low, because the lower the sliding speed the greater the frictional resistance. It is now self-evident why we endeavor to avoid skidding the wheels; as, when that is done, although tire is certainly sliding upon rail, the velocity of this sliding is high and the coefficient of friction correspondingly low, and the resistance to neutralize the momentum of the train is low.

Thus the locking of the wheels, although it looks so effective in the eyes of a green employe, and has often been the object aimed at by quite as verdant a patentee, is a gross mistake; in effect not only injuring rail and tire, but absolutely lessening the frictional resistance between them, which is all we have to depend upon. The maximum is attained when the wheel is revolving with a peripheral speed almost but not quite equal to that of the train, and no further resistance to motion with the modern train equipment is possible. Our object, then, in the application of brakes is to attain just this slight difference in the nature of the touch between tire and rail; more we cannot get, and less is a defect.

The answer to the committee's query, "Should brakes be applied to the wheels of all engines?" show an overwhelming majority in favor of the application of brakes on all engines. Mr. Lockwood lent us the official Board of Trade returns for 1884, showing in Great Britain a total of 4,177 locomotives so equipped.

On the general question as to the coupling up of the brake gear throughout the whole train, its automatic action on drivers, or whether it is advisable to allow a conductor to apply brakes on drivers, opinions vary much; but there is a general feeling in favor of enginemen having the opportunity to apply the whole brake power, restricting the application by conductors to cars or a car and tender only; that is, no one in rear should have the opportunity of applying brakes on driver while the engine is under steam.

"Is there any danger in using a powerful brake at front end only?"

It is satisfactory to find not a single case of trouble due to the application of drive brake only is recorded in the answers received, while 18 state definitely that in their opinion there is no danger.

What percentage of the total weight of the engine can effectively and safely be utilized for brake resistance? If there is no risk or danger in locating a powerful resistance forward of the moving body, no attention to this question is necessary, unless the brake is automatic in application when the train separates. In considering this latter case, it should be remembered that it is not judicious in arranging the lever proportions for any cars to count upon utilizing more than the tare or empty weight; otherwise, if arranged to take advantage of the increased weight when more or less loaded, then, if brake blocks be applied to wheels when car is actually empty, the effect would be to promptly skid them. Hence, if the engine brake is designed to utilize the whole of the weight of engine and tender, and the detached cars in rear be heavily loaded, the latter will, after the brakes have gone on automatically, move with a higher speed than the front end, and eventually collide. Such a rear pitch-in could only take place when the brakes on engine and front cars utilized for resistance to motion a greater percentage of the total dead weight resting on the braked wheels than was utilized on the rear portion. Some engines have blocks on all wheels, and tank engines lend themselves readily to such arrangement; but care should be taken to arrange the leverage so as not to utilize the whole insistent weight, if the application is to be automatic.

To the somewhat crude question of What percentage of weight on drivers should be utilized? one reply says from 7 to 10 per cent; another, 45 per cent on engine and tender, with 100 per cent on cars; a third, 50 to 60 per cent; a fourth, 80 per cent; a fifth, 75 to 90 per cent; a sixth, 95 per cent; and a seventh, say twice the weight on drivers, or 200 per cent. Captain Galton's experiments—which are now classic—prove that speed is the most important factor in this equation, 200 per cent being safely used at high speed of 50 or 60 miles per hour without skidding the wheels, but the pressure must be lessened as the speed lessens if skidding is to be avoided.

BRAKE SHOES.

In the matter of brake-block shoes, their substance, size, and shape, six are in favor of cast iron, seven of wrought iron, and the American Company say 95 per cent are of wrought iron. Mr. Webb says: "The best results we obtain from wood blocks when they can be conveniently applied. Those we have in ordinary use are of English poplar, about 18 by 3½ in.; the face is perforated with fine 1¼ in. holes, which are afterward filled with a mixture of resin and sand;" and Mr. Johann, while preferring wrought iron, has obtained excellent results from a head filled with hard wood blocks. The Eames Company say that material is to be preferred which yields the quickest stop, with due regard to economy, durability, and effect upon the wheels. Cast iron presents a greater frictional resistance than wrought iron, much as it granulates and retains a certain degree of roughness throughout all life of the shoe, instead of becoming smooth and polished, as the case with wrought iron.

The wear upon the tires is undoubtedly greater with the cast iron than with wrought iron, but this is the necessary result of its greater braking efficiency. The more effective the brake, the greater the wear of both shoe and tire. The same principle of efficiency applies to the comparative cost of the two materials. The wrought iron shoe has a longer life, and, independent of the work performed; is cheaper, but when the actual braking power furnished by each is taken into account, cast iron is the most economical.

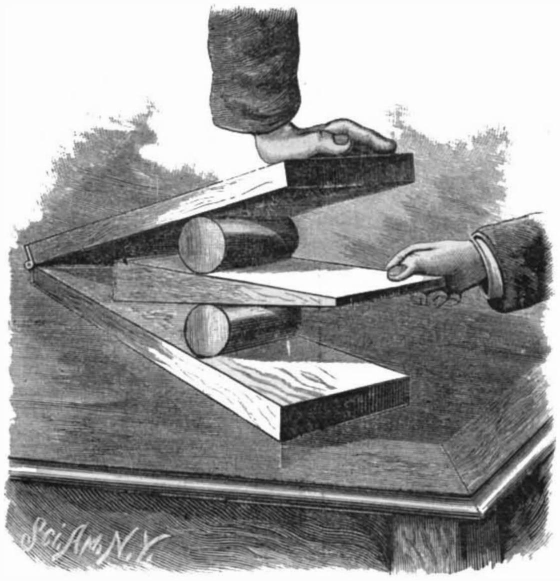
As to amount of surface, the American Company averages 60 sup. in.; two replies give a maximum of 88 in. and one a minimum of 36 in., or a difference in length varying from 22 in. to 9 in. The Eames Company say they favor the greatest length of shoe that can be conveniently applied. The longer the shoe, the less frequent the replacement; the frictional resistance being the same whatever the length of the shoe, the greater the surface of the shoe, the greater the distribution of the wear and consequent life of the shoe. The same principle applies also to the thickness of the shoe, the thicker the greater the durability. As a matter of practice, having regard to all these points, we make our shoes of a length equal to three-fourths of the radius of the wheel. Our experience is opposed to the use of channeled shoes, because of their liability to cut into the tire. But it is an advantage to have shoes fixed well over the flanges, and five replies indorse this latter statement.

New Fire Damp Indicator.

At a recent meeting of the Physical Society, London, the following, by Messrs. Walter Emmott and William Ackroyd, was read: The Royal Commission on Accidents in Mines point out in their recently issued report, as a serious objection to the use of the electric light in mines, notwithstanding its many great advantages, that the light of an incandescent lamp, being produced within a vacuum, cannot admit of any device for the indication of firedamp, such as is given by the Davy, for example. The present apparatus is the outcome of an attempt to overcome this difficulty. It consists of two incandescent lamps, one with colorless and the other with red glass, and the circuit is so arranged that in an ordinary atmosphere the colorless lamp alone shines, but in firedamp this goes out and the red one is illuminated. This is effected in a simple manner by the motion of a mercury contact occupying the lower part of a curved tube, one end of which is open and the other connected with a porous pot of unglazed porcelain, the motion of the mercury being due to the increased pressure in the porous pot occasioned by diffusion.

VOLCANIC ERUPTIONS IN NEW ZEALAND.

The details of the terrible eruption in New Zealand during the month of June, which have just been received, show it to have been one of the most disastrous on record. The volcanic disturbances were confined to North Island or New Ulster. This has an area of about 44,000 square miles, or almost equal to that of the State of New York. It is the second largest of the group. About one-tenth of the surface is covered by mountains, the highest peaks of which are either active or extinct volcanoes. The northern part of the island is noted for the extreme beauty of its scenery, the Auckland lake district being a favorite resort for tourists. The greatest volcanic activity seems to have



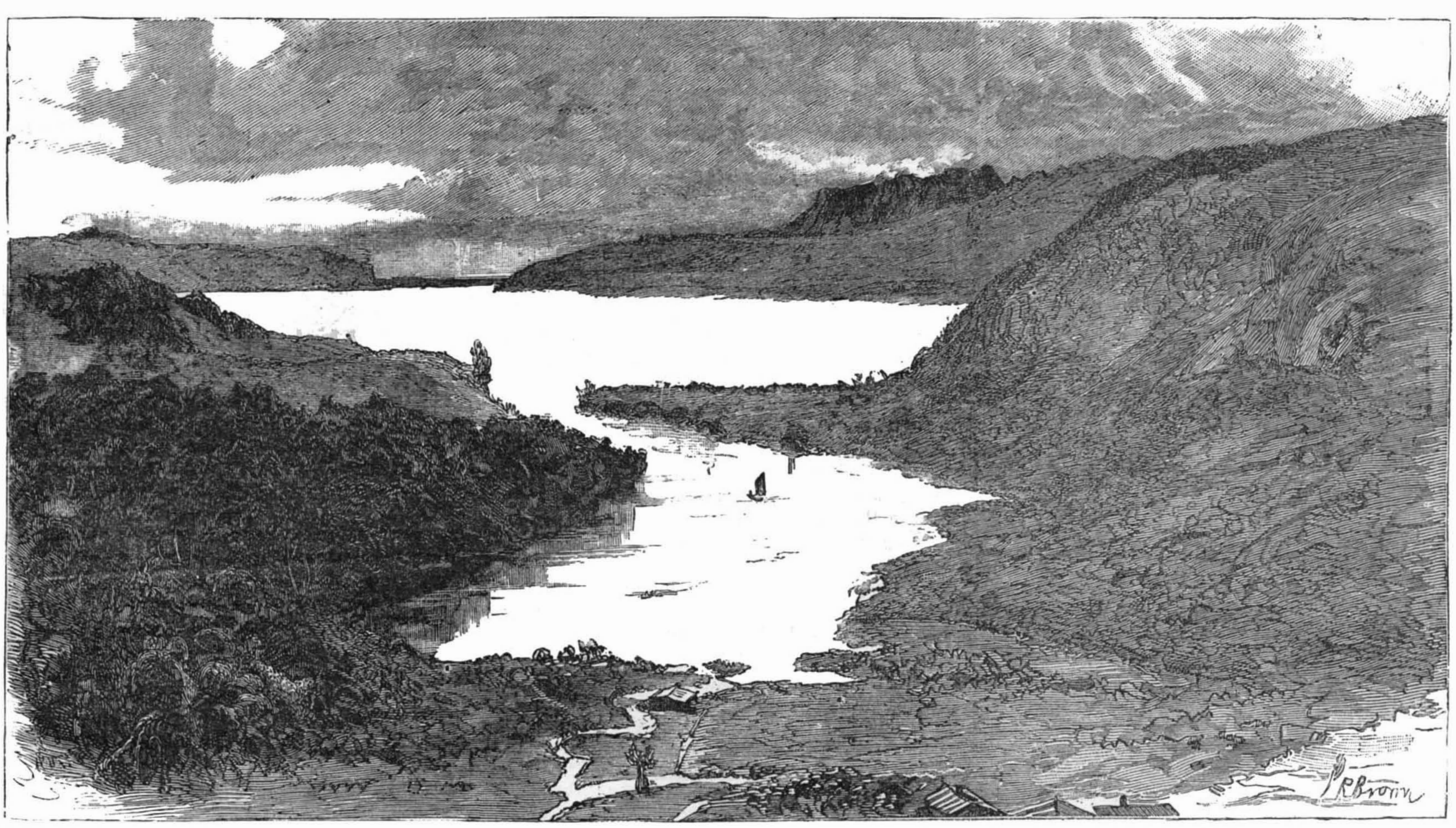
WEDGE PARADOX.

been felt in this part of the island. At Tauranga, on the Bay of Plenty, violent earthquakes followed each other in rapid succession on the morning of the 9th of June, and were accompanied by showers of fine dust. In the neighborhood of Rotona, the severity of the shocks was such that many believed the island would sink into the sea.

The sensation experienced is said to have been fearful beyond description. After the first shock, the inhabitants rushed frantically about in all directions. With the second shock the entire country was illuminated by the volcanic fires. Mount Terrawerra, on the shore of the beautiful lake of that name, was the first crater to break forth, but in a short time the entire Paersa range was in a state of active eruption, hurling lava and stones over the surrounding country. The extinct volcano of Ruapehn, which rises to a height of 9,100 feet near the center of the island, resumed its activity for the first time in tradition. The scene was one of awful grandeur. The land for an extent of 120 miles in length by 20 in breadth was one mass of flame and hot crumbling soil. Dense volumes of smoke made luminous by the reflection from the fiery craters hung heavily in the air. Showers of dust, having a strong sulphurous odor, continued to fall for nearly two days, turning day into night and totally destroying a large number of native villages. Wairoa was covered to a depth of ten feet with dust and ashes.

The loss of life was considerable, and included a number of English residents. Those of the natives who escaped were driven frantic with terror. Many were burned alive by the volcanic dust and scoriæ. An old Maori chief had a remarkable escape. He is stated to have been dug out alive after an imprisonment of 104 hours. The destruction of the pasture by the dust and mud was so extensive that many cattle have been starved, and great distress exists throughout the entire lake district. Nearly all vegetation has been blasted by the poisonous vapors, dust, and the mud of blue clay ejected from the volcanoes. The aspect of the country has been changed, and several of the lakes been transformed into mud baths. Many of the buildings which escaped being buried have been crushed by the weight of the falling mud.

The effects of the eruption were felt for some distance at sea. The steamship Southern Cross, bound for Auckland, experienced an almost fatal downfall of dust on the morning of June 10, the day following the earthquakes. From 5 to 10 o'clock there was complete darkness, and balls of fire constantly played around the mastheads. The men being unable to stand the blinding showers of dust, the vessel was put about and stood away to the north, but it was not until 11 o'clock on the following morning that the dust was left behind.



TERRAWERRA LAKE AND MOUNTAIN, THE SCENE OF THE RECENT VOLCANIC ERUPTION IN NEW ZEALAND.

WEDGE PARADOX AND FALLING AND PROJECTED BALL.

T. O'CONOR SLOANE, PH.D.

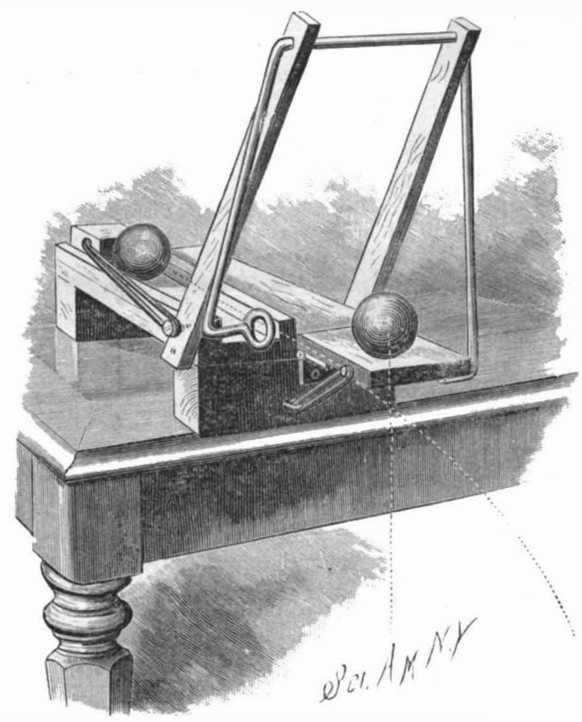
The general action of a wedge is well known. It forces apart surfaces between which it is driven. If, on the other hand, it has smooth sides, the reciprocal action may take place. When placed between two opposing faces that are pressed together by a constant force, and left to itself, it may, by their action, be violently expelled. The schoolboy's trick of shooting an orange seed from between his finger and thumb by compressing it violently, so that it flies out, is a good, though not very refined, illustration of this principle. The slippery sides of the seed help the action. Holmes also alludes to it in describing the toughness of the "settler's elm:"

> "The wedges flew from between its lips,
> Their blunt ends frizzled like celery tips."

The reciprocal has come to be as well recognized as its original.

If, however, a wedge is placed between two surfaces that constantly tend to approach each other, and the conditions are so arranged that when the wedge moves apparently the wrong way the surfaces will come closer together, then the wedge will act in this paradoxical manner.

The conditions may be obtained by the arrangement shown in the cut. Two pieces of wood are hinged together, so as to open and shut like a book. A strip of leather answers as well as a hinge. These are to represent the surfaces that tend to approach each other. A wedge of about the proportions of the one in the drawing must be provided, and also two cylinders or rollers. Cotton spools, or even two pencils, may be used as rollers. The apparatus is now put together as shown in the illustration. The wedge is introduced between the hinged boards, a roller being placed above and below it. It is placed so far within their opening that the angle that the boards make with each other is greater, or of more degrees, than is the angle of the



FALLING AND PROJECTED BALL.

wedge. The thin end of the wedge, supported in one hand, projects outward from the opened boards, and pressure is applied to the uppermost one. In accordance with general rules, this, it would seem, should draw the wedge inward. But, on the contrary, it will be found that it drives it outward, in opposition to the normal movement. The latter is forced outward, so that its thicker parts are brought between the rollers.

The ordinary action of the wedge is complicated by the inclination of the boards to each other, and by the rollers. If the angle included between the boards is greater than that between the sides of the wedge, then the boards will approach more by the rollers moving outward, than the wedge in corresponding movement can drive them apart. The consequence is that the rollers move outward, carrying with them the wedge, and, until the angles become equal, the motion continues, the algebraic sum of the wedge and roller action indicating an approach of the opposing faces. When the angles become equal, the conditions of repose are reached.

This action of the wedge when seen appears most curious. It is a good illustration of the short road to truth that is often afforded by experiments.

The other cut shows a simple apparatus for exhibiting one of the laws of projected bodies. If a body is projected or thrown in a horizontal direction, it will take no longer to reach the ground than one that is dropped at the same moment. Thus, if two marbles are simultaneously released over a level floor, and if to one of them a strong horizontal impulse is given, so as to throw it a considerable distance, both will reach the ground at the same instant, although one travels a much greater distance than does the other, and they will make but one sound as they strike, provided all the adjustments are correct.

A board about ten inches long and five inches wide is mounted on two pieces, one at each end. On its forward end, at one side, a little platform or trap door, two inches square, is hinged. An India rubber band extends diagonally from the outer corner of this trap door downward to the main piece. Thus the door is drawn strongly downward. With a center bit a hole is made partly through the platform. The end of the board at its other side is free. On its upper surface, running back from this plate, two strips are secured, making a groove about an inch wide. Within this a block of wood, two inches long, slides, fitting closely, but moving with little friction. A band of India rubber is fastened to and extends forward from its front end, and is secured to the board near its front.

These two parts are intended to receive two marbles. One rests on the trap door. The hole gives it a good resting place. The other runs in the groove in front of the movable block, and can be discharged by it a distance of ten feet or more. A wire catch is arranged so as to hold up the trap door, but is released when a ball is thrown from the groove. Its arrangement is clear from the cut.

The catch is set so as to hold up the trap door, and a marble is placed thereon. Another marble is placed in the groove, the block being previously drawn back. The marble rests in front of and in contact with the sliding block. It is well to have a trigger arrangement for holding the block in place, and for releasing it when all is ready. Such can easily be devised by any one. The apparatus being firmly secured and perfectly horizontal, the block is released. It shoots the marble in front of it across the room. As the marble leaves the groove it touches the catch and releases the trap door. The elastic band jerks this down, so that the other ball falls vertically and perfectly freely from the platform. If no elastic were used to pull the trap down, the ball would be retarded in its pulling. If the adjustments are correct, both balls will strike the floor together, making only one report.

This is more than an illustration of a law of projection. It also illustrates the fact that different forces act on a body irrespective of each other. Thus the action of gravity is exerted to an equal extent on both balls, though one is perfectly free and the other is acted on by a strong horizontal force. It may be used as an example of a broad principle of nature which is enunciated in one of Newton's laws of forces.

In the last issue of this paper, collision balls of easy construction were described. No attempt was made to give all the phenomena that they could be made to present. One very pretty experiment may be noted here. Three balls are hung about half an inch apart. The center one is then started into oscillation. This must be done carefully. As soon as it begins to strike the side balls, it is left to itself, when a most curious sound, almost musical in its time, is produced by the click of the balls. Many other variations will suggest themselves to any one experimenting with them. As an improvement in the method of suspension, the substitution of circular pieces of leather for the straps has been suggested. Before pasting the disks on the balls, they may be pierced with a needle in and out near the center, and the thread so carried through. Then they may be put in place, and a better attachment than the one described will be the result.

Andrew Carnegie.

David Brooks was manager of a Pittsburg railroad office when a boy named Andrew Carnegie was a messenger in it at a salary of $3 a week. The boy had just arrived with his father and mother from Scotland, the land of his birth. That was a very little more than 36 years ago, yet to-day he is the famous millionaire ironmonger of Pittsburg. Andrew Carnegie has said: "I owe my rise in life to a game of checkers." I will explain to you what that remark means.

The elder Carnegie was a moulder in a pottery. Like many Scotchmen, he was exceedingly fond of playing checkers. In Pittsburg, at that time, was a well known ale house, in one room of which those who loved to play checkers were wont to assemble. Among them were Carnegie and Brooks, and in this way the two men became acquainted. Carnegie's son also came there at times with his father, and he, too, tested David Brooks' powers at draughts. One day the elder Carnegie remarked that he did not know what to do with his son. "Send him down to my office, and I will make a messenger boy of him," said Mr. Brooks. The next day he began his new employment. The lad was intelligent and industrious. Manager Brooks had an old telegraph instrument fitted up in the office, and when the messenger boys were not engaged he showed them on this how to tick out the Morse alphabet. With this instruction young Carnegie soon became a skillful operator. Thomas A. Scott was at that time Superintendent of the Pennsylvania Railroad in Pittsburg. He had a telegraph instrument rigged up in his office and wanted some one to manipulate the key. Manager Brooks recommended young Carnegie, and he was employed. He showed such aptitude in managing the movement of trains by telegraph that he was transferred to the superintendent's office in Altoona. There he continued to attract the attention of Thomas A. Scott, and was rapidly pushed along. He was given opportunities to engage in some coal and oil speculations that were successful, and afterward made money from the first sleeping cars that were built.—*Philadelphia News.*

A Sacrificial Stone near St. Paul.

BY H. C. HOVEY.

The ancient altar about to be described has not been hitherto mentioned in any published account, so far as I know, although it can hardly have altogether escaped notice in the local papers. Yet it gives its name, "Red Rock," to one of the landing places where the Mississippi steamboats have touched ever since they began to run on the upper portion of that longest of rivers. Formerly there was a flourishing mission here, sustained by the Methodists; and with that fact in mind I made inquiry for the veteran who had it in charge, Rev. Chauncey Hobart, from whom the facts now given were principally obtained.

This pioneer came on the field before the settlement of either St. Paul or Minneapolis, and retains a vivid recollection of many interesting events, which it is to be hoped he may yet publish in some permanent form before his useful career is ended. According to him, it was the custom among the Sioux to worship the bowlders that lie scattered among the hills and valleys and here and there on the prairies of this region. When a Dakota was in perplexity or distress, and desired deliverance from some impending danger, it was his custom to clear a spot from grass and brush, roll a bowlder upon it, streak it with red paint, deck it with feathers and flowers, and then pray to it for needed help.

Usually, when a stone had thus served its purpose, it was no longer regarded as a sacred object, but might be disposed of in any way that suited the savage whim. But the peculiarity of the sacrificial stone now described is that from generation to generation it was a shrine to which pilgrimages were made and where offerings were laid. Its Indian name was "Eyah Shah," which simply means Red Rock, and is the same term by which they designate catlinite, or the red pipe clay. The stone itself is not naturally red, as I found on examination, being merely an extremely hard specimen of hornblende-biotite-granite, quite symmetrical in shape, about five feet long and three feet in its greatest width.

The Indians also called it "Waukan," or a mystery, and had strange speculations as to its origin. It lies on a weathered ledge of limestone, and evidently has not been moved since left there by the ancient forces that brought it as a trophy from some granite range. But the Dakotas looked no farther than to an adjacent hill, about two miles distant, down whose sides, as they said, they could trace the path along which, self-impelled, it had rolled to the river bank. The particular clan of the Dakotas that claimed this rude altar was known as the Mendewacantons, although, being but two miles below the village of the Kaposia band, it was to some extent resorted to by them likewise.

The hunting ground of the clan was up the St. Croix River, and invariably before starting on an expedition they would visit Eyah Shah and leave an offering of gayly painted feathers, or a duck, or goose, or a slice of venison, and after a few simple ceremonies they would go on their way. But twice a year the clan would meet more formally, in order to paint the stone, which they did with vermilion, or, as some say, occasionally with the blood of their enemies, which had been saved up for that purpose. When the painting was done, they would trim the bowlder with flowers and feathers and other ornaments, and dance around it before sunrise, with chants and prayers for success from the spirit of the mysterious rock.

The last occasion on which they were known to have thus visited Eyah Shah was in 1862, prior to the terrible massacre that occurred in August of that year, and which is a matter of history. Since that date, however, the stripes of red paint have been renewed, the last coat having been applied as recently as three years ago—although my suspicions are that the work was done by white men desirous of perpetuating the interesting features of this ancient object of worship. Others with a different spirit have drilled a hole in one side, for the purpose of putting in a blast, by which it should be destroyed. I counted the painted stripes encircling the rugged rock, and found them twelve in number; each being about two inches wide, and the spaces between being from two to six inches wide. By the compass Eyah Shah lies exactly north and south. It is located just twelve paces from the present river bank. The north end is ornamented by a design representing the sun, and a rudely drawn face surrounded by fifteen rays. While mentioning these latter particulars, I do not attach much importance to them, because there is no proof that these existing markings were made by the Indians. Eyah Shah is about six miles below St. Paul, and is easily reached by boat or by rail.

Greek Quarrying.

You well know, writes W. L. Granville in the *Architect*, London, of the predilection of the Greeks for constructing with large sized blocks of marble or stone. They were extracted from the *λατομια*, or quarries, in the following manner:

In order to procure the square stones—after the top and front faces of a given mass of the rock in the quarry had been brought to a plain surface—incisions, usually from 4 to 5 inches wide, were made on the top surface, marking out the boundaries of the intended size of the block. These incisions being continued down to the required depth of the block, there remained nothing more to be done than to separate it from its lower bed, which operation was performed, as there is every reason to think, by the expansion of wooden wedges saturated with water. The cylindrical courses for the shafts of the columns were extracted (as may be observed at the quarries of Selinus, in Sicily) by means of a circular passageway, 2 ft. 8 in. in width, being hewn out of the rock, and taking the entasis of the intended column, thus leaving an insulated mass of stone in the center the exact shape and size of the required shaft. I should here add that the stone columns of every temple occupy almost invariably the same relative position in the building which they occupied in the quarry.

This circular mass of stone has now, like the square blocks, only to be lifted from its lower bed; and the method employed, which, from the examination of the quarries at Selinus, can be no longer doubted, bears me out in a conjecture I had previously made on the square blocks. A hole or deep incision, wedge-shaped, was made in the lowest part of the insulated cylinder, in the direction of its center, but considerably to one side, for reasons which will be obvious to you. Into this hole, I presume, a wooden wedge was inserted, which was saturated with water, and which being suffered to expand while in that position would, at no great distance of time, heave up the mass, on the same principle applied to the splitting of slate and millstones in France, and so separate it in the direction of its bed. Nothing, I think, appears more likely, from the consideration of the facts observed at Selinus, than that such was the method employed; and since I see from my memoranda that I observed the branch of a shrub, not one inch in diameter, which by its growth in a crevice of the rock had split a mass of stone weighing about fifty tons, I can readily conceive that the small orifice with its wooden wedge would have been sufficient to loosen the required mass.

Lightning Stroke in the Rocky Mountains.

The curious case of G. S. Edwards, who was struck by lightning while crossing Iron Hill, at Leadville, Colorado, on July 4, is attracting considerable interest among scientific men. After the flash, Mr. Edwards remained unconscious for fifteen minutes before receiving assistance. The lightning struck him on the left cheek, and after knocking out a number of his teeth passed diagonally across the breast to the right side. It then descended the body to the foot, emerging from the right boot. It passed entirely through the foot, leaving a hole similar to that made by a bullet. The clothing was torn into fragments, particles being found a distance of two hundred feet. Both of the boots were entirely destroyed, and one of them carried sixty feet away. The ground where the man was standing was torn up for a considerable distance. The course of the electric current along the body was marked by a black and red streak one and a half inches wide. The worst effect of the streak seems to have been on the lungs. A severe hemorrhage was produced, by which a quart of blood was lost. In addition to these injuries, the surface of the body was almost covered with blisters, the result of ugly burns. This, we believe, is the first authentic record of a person being injured by lightning at an elevation of 10,500 feet. It is remarkable such severe internal injuries were not followed by death.

A Magnesium Torch.

At a recent meeting of the Pharmaceutical Society, a cylinder of magnesium 10 in. long was shown by Messrs. Hopkins & Williams. When produced in a dense and massive form, such as this, there is less tendency to rapid combustion when burning. Magnesium torches are now used in Germany for the illumination of mines. The cost of the metal in London is now about $7.50 per pound.

ENGINEERING INVENTIONS.

A guard for railway cars has been patented by Mr. Robert J. Gillham, of Orlando, Fla. This invention covers a novel form of light metal guard, to be attached to the tops of railway cars at each end, to prevent smoke, dust, and cinders from passing down between the cars when they are in motion, and also to shield and protect the platform from rain and snow.

A balanced slide valve has been patented by Mr. William Jackson, of Allegheny City, Pa. It has a seat with apertures on opposite sides communicating with the live steam passages, and spring valves for closing said apertures, with slide valve in said seat, so balanced as to work easily and fit snugly even when it wears down, without being disturbed by back pressure, the invention being an improvement on a slide valve formerly patented by the same inventor.

AGRICULTURAL INVENTIONS.

A planter and manure distributer has been patented by Mr. David C. Bullard, of Elberton, Ga. It is a device designed to be drawn over the field by teams to sow seeds and to distribute fertilizers, such as guano, at the same time, or to plant the seeds and drop the fertilizer at different times, the single machine being adapted for both purposes.

A potato digger has been patented by Mr. William J. Davis, of Pittston, Pa. Its construction is such that the digging mechanism can be readily adjusted to work at a greater or less depth in the ground, and can be readily thrown into and out of gear, the teeth entering the ground easily and carrying the potatoes over the shaft to drop them upon the ground at the rear of the machine.

A sulky plow has been patented by Mr. Frederick T. Miller, of Fredericksburg, Va. The tongue is readily adjustable at such angle as desired, and there are right and left hand plows, either of which may be lowered into operative position, and at the end of the furrow, when the plow is turned to return across the field, the other plow may be lowered, so that the earth from each furrow is always turned by the mouldboard in one direction.

MISCELLANEOUS INVENTIONS.

A shaft tug has been patented by Mr. John Fischer, of Louisville, Ky. The invention consists of a peculiarly constructed metal frame, and the combination of the same with other parts, to make a simple, strong, and durable shaft tug.

A hand truck has been patented by Mr. Charles Walter, of Brooklyn, N. Y. It has a swinging frame carrying a third wheel, whereby it can be readily transformed from a two wheel to a three wheel truck, and the tongue can be used in a vertical or horizontal position.

A compound for cleaning boilers has been patented by Mr. William S. Baskin, of Corning, N. Y. The compound consists of saltpeter and white vitriol mixed together in certain proportions, for loosening old and hard scale and preventing the formation of new scale in the boiler.

A barrel roller has been patented by Mr. Thomas B. Dittrick, of East Tawas, Mich. It consists of two pairs of rollers mounted on curved arms and connected with a suitable handle, the rollers being adapted to bear against the sides of the barrel, and move it forward, when they are pushed by the handle, by continuous forward pressure.

An animal bit has been patented by Mr. Willard D. Harmon, of Beloit, Wis. It has opposite parallel side bars, connected by cross bars concaved from the lower side of the bit, and resting on the animal's tongue, which is held between the side bars, the object being to correct the habit of the animal of holding the tongue out of the mouth.

A sash holder has been patented by Mr. Moses C. Hargrave, of Wilmington, N. C. This invention relates to sash holders in which spring-actuated pulleys are employed to bear against the edge of the sash as a substitute for cords and weights, and combines with the pressure pulleys a lock which presents no obstruction when the sash is unlocked.

An oil can has been patented by Mr. Henry E. Wolcott, of Syracuse, N. Y. Its construction is such that the top and cover may be conveniently removed for cleaning the can, while the top serves as a support for cups and measures, and through it projects the pump, the construction being simple and such as can be furnished at light cost.

A middlings purifier has been patented by Mr. Richard A. Rew, of Pomeroy, Wash. Ter. This invention relates to middlings purifiers having vibrating sieves through which the middlings are passed, and covers various details for improving the efficiency of the machine, and by which it is made to occupy less floor space than the machines at present in use.

A process of treating tobacco has been patented by Mr. Goldsborough Robinson, of Louisville, Ky. It consists in first flooding the leaf tobacco with hot and then with cold alcohol, applying pressure to exclude the surplus spirits, and then flooding the leaf momentarily with cold water and drying, to improve the quality and color of the tobacco.

A fence post has been patented by Mr. Jay L. Quackenbush, of Portland, Oregon. It is made of plate metal, rolled, pressed, or cast, with a notched flange on one side to receive fence wires, and its bottom part is formed like a gimlet, to enter the ground easily, the screw being sharpened so as to compress, rather than lift, the earth around the threads.

A clutch coupling has been patented by Mr. Benjamin F. Applegate, of New Albany, Ind. It is made of two half sections which are counterparts of each other, adapted to interlock, each formed at its acting face with two annular series of driving faces, with other novel features, it being intended to drive both ways without backlash, automatically take up the wear of the driving shoulders, and to couple or uncouple readily.

A method of casting car wheels is the subject of letters patent reissued to Mr. William Wilmington, of Toledo, O. The distinctive feature of the invention consists in imparting rich ferro-manganese or its equivalent to molten chill hardening cast iron at or about the time it is first entering the mould of a car wheel, and at a later period imparting greater quantities of ferro-manganese to the flowing metal, the ferro-manganese being finely powdered or granulated, and melted and disseminated by the inherent heat of the iron pouring from the ladle, and thus vary the quality of the iron in different parts of the wheel.

Business and Personal.

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

Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(1) F. E. S. asks how to make amber varnish to varnish violins. A. Take of amber 3 ounces, benzol 50 ounces; heat the amber in a closed vessel to a temperature of 570° Fah. When it begins to soften and swell, giving off white fumes, then dissolve in benzol; amber is also soluble in chloroform. The gum may be purchased from any dealer in gums in New York or other large cities.

(2) E. W. T. asks if what is known as silkworm gut, used as leader on trout line, is made of the same. A. Yes; and is imported principally from Spain.

(3) J. E. W.—We know of nothing that can be added to shellac to increase its adhesiveness. It does not have any odor by itself. In the manufacture of shellac varnish, the gum should be dissolved in ethyl alcohol, but frequently methyl alcohol is substituted on account of its cheapness, although it has an exceedingly disagreeable odor.

(4) A. C. R. writes: 1. Can you recommend me a good rubber cement? I wish to cement leather together, the cement to be waterproof, to resist oil, and the leather to retain its elasticity after pressing. A. Dissolve gutta percha in bisulphide of carbon; shave off the edges of the leather, and pour on the cement; allow to evaporate to dryness. Then put the two faces together, previously heating thoroughly, and press until cool.

(5) G. F. asks the best kind of a vessel to make liquid gold in, for potter's use. A. Either a glass or a porcelain vessel will answer.

(6) W. J. M. asks how papier mache is made to stand the action of water. A. Coat with a mixture made by fusing together equal parts of pitch and gutta percha, to which is added two parts of linseed oil containing five parts of litharge. Continue the heat until the ingredients are uniformly commingled, and apply warm.

(7) J. D. H. desires a recipe for the manufacture of a white ink that can be used in a ruling pen as India ink is used. A. Mix Chinese white with water containing enough gum arabic to prevent the immediate settling of the substance. Magnesium carbonate may be used in a similar way. They must be reduced to impalpable powder.

(8) R. L. H. asks what will polish nickel plated goods after becoming black and not worn. A. Use rouge on a rag with a little oil; also see the scouring paste given in answer to query No. 20, in SCIENTIFIC AMERICAN of May 2, 1885.

(9) J. W. O. writes: 1. I have some gold coin dissolved in aqua regia; how can I recover it so I can sell it? A. The gold may be precipitated by means of iron sulphate. 2. Will you give a recipe for making phosphorescent paint? A. See "How to Make Luminous Paint," in SCIENTIFIC AMERICAN SUPPLEMENT, No. 249. 3. Also one for making inks that will fade out in four, six, or eight weeks. A. See the article on "Inks," in SCIENTIFIC AMERICAN SUPPLEMENT, No. 157. 4. What is the specific gravity of gold and silver coin? A. The specific gravity of gold is 19·50, that of silver 10·50, and that of copper, which is an alloy of silver coin, 8·788.

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July 6, 1886,

AND EACH BEARING THAT DATE.

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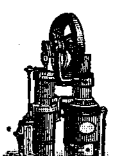

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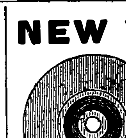

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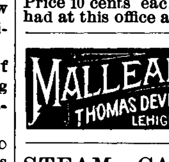

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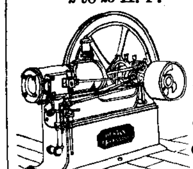

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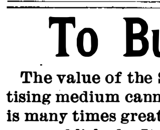

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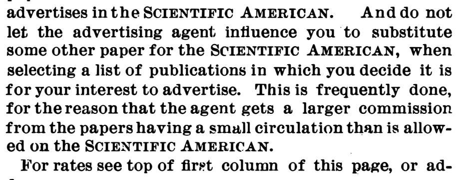

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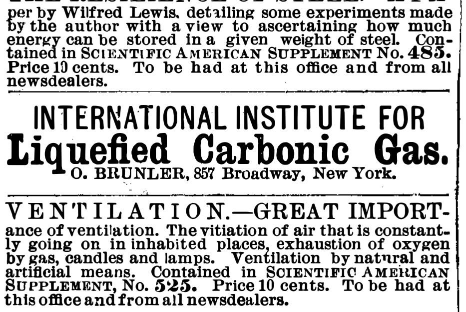

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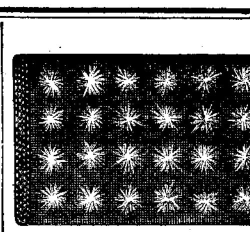

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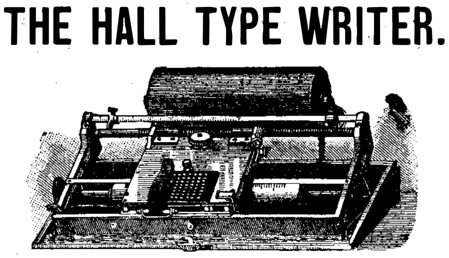

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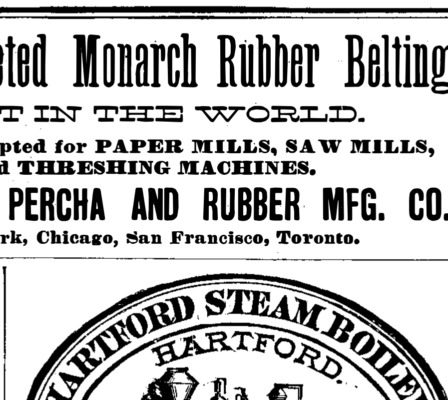

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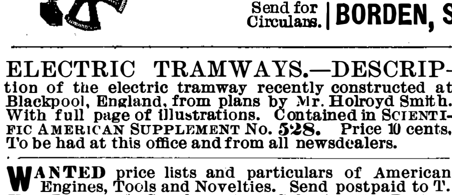

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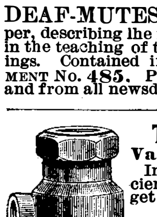

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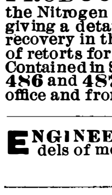

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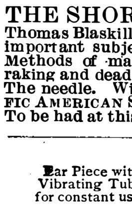

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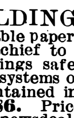

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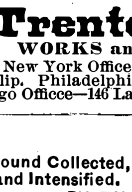

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