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THE SECOND BRIDGE BETWEEN NEW YORK AND BROOKLYN.

Mention was made a fortnight ago of the beginning of work on the pier foundations of the long-promised bridge across East River at Blackwell's Island. To-day we are able to set before our readers an engraved illustration showing the bridge as it will appear when completed, three years hence, if no mishap delays the expected progress of the work. The entire structure will consist of two spans across the two channels of East River, one elevated viaduct across the Island, and two approaches, the whole having together a length of nearly 9,000 feet, or almost 1¾ miles.

The New York approach will begin at the east side of Third Avenue, and traverses block between 76th and 77th streets to the river, a distance of about 3,000 feet. Connection will be made with the east side elevated railways, and with the New York Central and Hudson River Railroad traversing Fourth Avenue. The viaduct will be of similar construction to the high structure of the Metropolitan Elevated Railroad in Eighth Avenue, between the Park and 125th street, both on the shore ends and on the Island. The bridge spans will be respectively 734 and 620 feet long, and will have a clear height above high water of 150 feet. The design of the spans is of the kind known as trussed chain suspension bridge.

The roadway will consist of two central railroad tracks each 14 feet wide; two carriageways each 9 feet, and two sidewalks each 5 feet wide, all on the same level. The bridge will be proportioned to carry two consolidation locomotives on each track followed by as many heavy freight cars as will cover the spans, and at the same time a general load on the highways and sidewalks of 40 lb. to the square foot. The floor will be designed to carry 100 pounds a square foot. The factors of safety will be three for dead load and eight for live load.

The eight towers which support the chains for the main spans will be made of Phœnix columns, well braced together in every direction. They will be 46 feet long on top, and 90 feet long on the base, and 260 feet high.

The long spans will be, as stated, "trussed chain suspension" bridges, somewhat similar in design to the "Point" bridge at Pittsburg, illustrated in SCIENTIFIC AMERICAN, vol. xliii., page 159.

Instead of there being one cable at a side, as at Pittsburg, there will be two, crossing each other in the center, on a pin joint, and flowing into each other in symmetrical curves, one above the other. The total load dead and live, is equally distributed between the two, and the resulting tension is always sufficient to more than counterbalance any compression resulting from unequal loading, the space between the two being thoroughly braced by diagonal bracing.

A somewhat similar arrangement has been suggested by an English engineer, Mr. Fidler, but in his designs he makes the upper chain straight. Besides the disagreeable appearance of this plan, it would be impracticable to draw the upper chain straight by any force that could be applied, and Fidler's bridge could only be erected by using false walls or staging, which are inadmissible across the East River.

By the plan proposed, however, the chains will be put in place by means of small temporary cables of wire, and will be allowed to take their own curves. The weight of the platform, being attached to the lower chains, half on each side, will draw the opposite upper chains nearly into position, and by temporarily loading the platforms, the chains can be made to take the curves designed for them. The intermediate bracing will then be put in, and the temporary loads removed.

This plan was designed by Messrs. T. C. Clarke and A. Bonzano, Members American Society of Civil Engineers, and, it is believed, overcomes all objection to trussed chain suspension bridges.

The principal contractor for the bridge is Thomas Rainey, Esq., of Ravenswood, L. I. The iron works will be constructed by Clarke, Reeves & Co., of Phœnixville, Pa., who have erected the West Broadway and Ninth and Eighth Avenue lines above the Park of the West Side Metropolitan Elevated system, and the Second Avenue line on the East side, besides many other bridges too numerous to specify.

The total cost of the bridge, including real estate, is estimated at five millions of dollars, and it is believed that it will be ready for traffic by December 31, 1883.

The Corwin's Cruise.

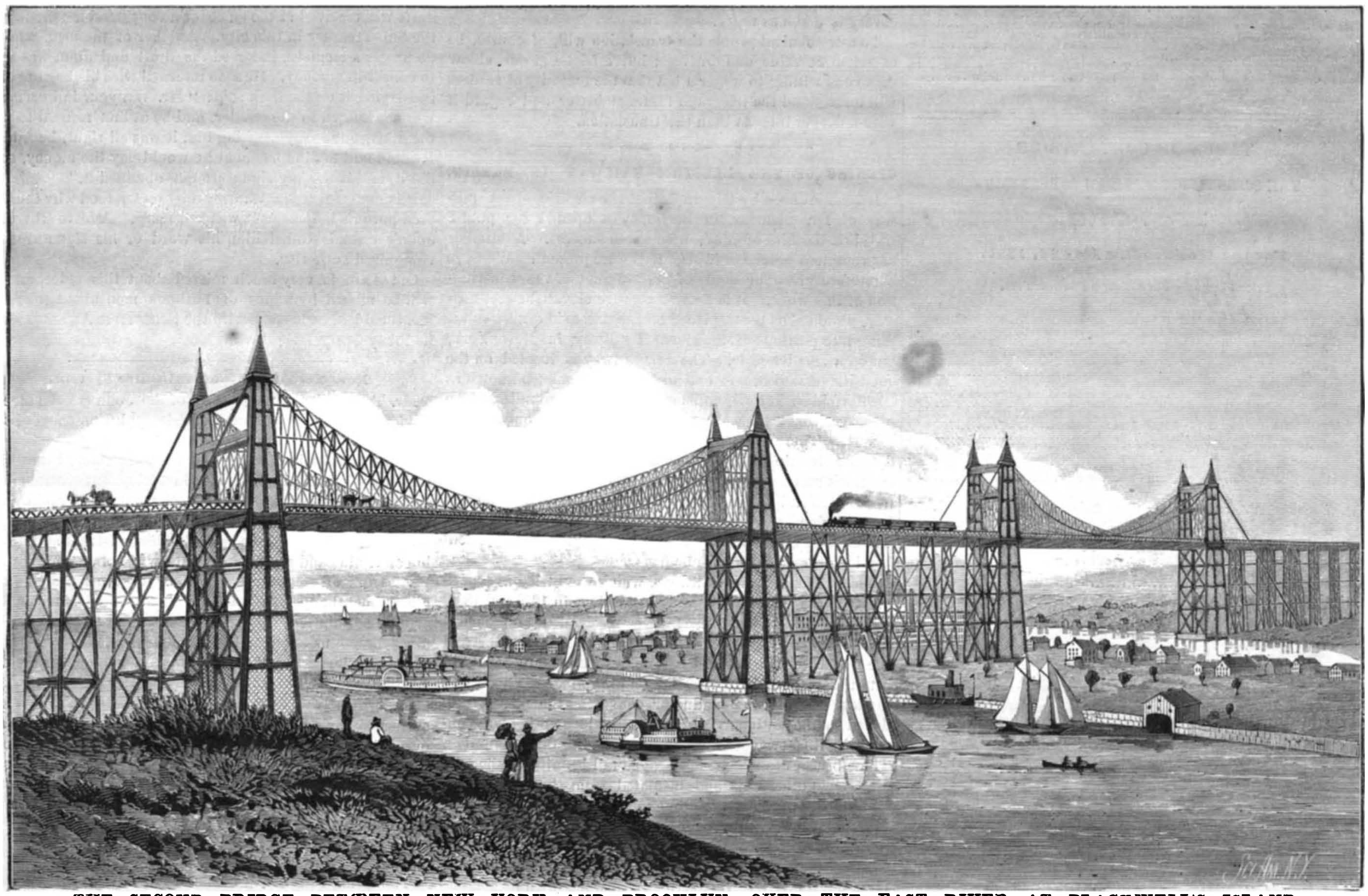
The U. S. revenue steamer Corwin sailed from San Francisco for a second cruise along the northern shore of Alaska, May 4, with the following assignment of officers: Captain, C. L. Hooper, Boston; First Lieutenant, W. J. Herring, New York; Second Lieutenant, E. Burke, Milwaukee; Third Lieutenant, O. B. Myrick, Boston; Third Lieutenant, George H. Doty, New York; Third Lieutenant, William E. Reynolds, Washington; Chief Engineer, James T. Wayson, Baltimore; First Assistant Engineer, Charles A. Laws, Philadelphia; Second Assistant Engineer, Frederick E. Owen, Owego, N. Y.; Surgeon, I. C. Rosse, Washington. There are thirty of a crew and a professional coal miner taken north with the view of working the crew in utilizing the coal ledge discovered during last year's cruise at Cape Thompson.

Captain Hooper's instructions give him great discretionary powers in his search for the Jeannette, and the expedition may winter in the Arctic regions.

A Filler for Porous Hard Woods.

Use boiled oil and corn starch stirred into a very thick paste. Add a little japan and reduce with turpentine. Add no color for light ash. For dark ash and chestnut, use a little raw sienna; for walnut, burnt umber and a slight amount of Venetian red; for bay wood, burnt sienna. In no case use more color than is required to overcome the white appearance of the starch unless you wish to stain the wood. This filler is worked with brush and rags in the usual manner.

Let it dry 48 hours, or until it is in condition to rub down with No. 0 sandpaper, without much gumming up, and if an extra fine finish is desired fill again with the same materials, using less oil, but more of japan and turpentine. The second coat will not shrink, it being supported by the first coat. When the second coat is hard, the wood is ready for finishing up in any desired style or to any degree of nicety by following up the usual methods. This formula is not intended for rosewood, and will not be satisfactory if used therefor.—*T. F. Page, in the Coach Painter.*



THE SECOND BRIDGE BETWEEN NEW YORK AND BROOKLYN.—OVER THE EAST RIVER AT BLACKWELL'S ISLAND.

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NEW YORK, SATURDAY, MAY 28, 1881.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 282,

For the Week ending May 28, 1881.

Price 10 cents. For sale by all newsdealers.

COMET TELEGRAPHY.

In a special circular issued by the *Science Observer* the announcement is made of the receipt by cable of the elements and ephemeris of Swift's comet (*a* 1881), as computed by Drs. Copeland and Lohse at the Observatory of Dun Echt, in Scotland. The experience with Swift's periodical comet of last year, which was not seen at all in Europe for nearly a month after its discovery, owing to the moonlight and a total inability to determine its position after the moon had gone, was useful. It was an experience which involved the loss of many observations before perihelion passage, and caused the Boston Scientific Society to adapt a code to the telegraphic transmission of astronomical intelligence, and the first test of this code has just been made. The *Science Observer*, published by the society, has for the past three years issued special circulars by mail to American astronomers and observers, containing the elements and ephemeris of each new comet, when the date could be obtained, and Lord Crawford has made a similar distribution of circulars by mail from his observatory at Dun Echt to the English astronomers. It was, therefore, agreed that, as a test of the code, the elements and ephemeris computed at each place should be cabled to the other; the Boston data to Dun Echt, and *vice versa.*

The elements from Boston were sent across a few days ago, and those computed at Dun Echt have just been received at Boston, and form the subject of a special circular of the *Science Observer*. As a proof of the adaptability and utility of this astronomical code, both the original message and its translation are given. By the same code the announcement of a comet, which now requires a message of sixteen words, with a liability to error, can be condensed into seven words, five of which are necessary and two of which serve as check words to correct any possible error that might occur in the other five.

The elements and ephemeris computed at Dun Echt, on Monday, May 9, were transmitted by cable to Boston in the following message: "Decimosexto erective contextual bewitchery anticly demonstrative courageously sputter arithmancy stomachical auriferous suety bayou synecdochically bissextile eminently." The translation of this message is herewith given.

ELEMENTS OF SWIFT'S COMET, 1881 (*a*).

Per. Passage. 1881, May 20.67, Greenwich Mean Time.

Long. Perihelion	300	2	Eq. 1881.0.
Long. Node	124	54	
$\omega = \pi - \Omega$	175	8	
Inclination	78	48	

Log. q = 9.7674 .... q = 5854.

Motion direct.

EPHEMERIS.

Greenwich, midnight.	A.R. h.	m.	s.	Decl. °	′	Brightness.
May 10,	0	38	32	+26	46	1·69
14,		56	48	21	35	
18,	1	17	32	15	54	
22,		40	48	9	55	2·32

Computed by Dr. R. Copeland and J. G. Lohse, from observations made at Dun Echt Observatory. The light at discovery is taken as unity.

To astronomical people the translation will, of course, be of scientific value and interest; but a friend at our elbow says he is willing to wager a hat that the majority of readers will understand the telegraph message better and regard it with a deeper interest than the translation.

OPENING OF THE ELECTRIC RAILWAY IN BERLIN.

It is announced by telegraph that the electric street railway of Dr. Siemens, in Berlin, was opened for public travel on the 12th of May, with much success. A number of prominent officials and scientists were present. We have heretofore given accounts of the progress of the construction of this work. It is a narrow gauge elevated street railway, mounted on posts, placed on the street sidewalks, something like portions of the elevated railway in New York, but on a smaller scale. The new railway is located on the outskirts of Berlin, and extends from the suburb known as Lichterfeld to Yeltow, a distance of about two miles. The passenger cars are narrow and short, carrying only 14 passengers. There are two tracks. The cars are propelled by a dynamo-electric machine, which receives electricity through the track and a suspended cable, from an electric generator, one at each end of the line, each generator driven by a sixty horse engine. An average speed of twenty miles an hour was expected to be realized. We shall give further particulars in future numbers of our paper.

The original electric railways, which were tried as experiments at Berlin and Dusseldorf exhibitions in 1879 and 1880, were worked by locomotives whose mechanism resembled a fixed dynamo-electrical machine. The rails of the line and the wheels of the locomotive engines were made of use to conduct the current of electricity and produce the necessary motion. The second conductor conveying the current produced by the stationary machine to the locomotive was connected with a system of brushes attached to the locomotive. These brushes touched a high-edged rail running in the middle of two other rails and insulated from the ground by a longitudinal sleeper. In practice, however, it has been found that this arrangement is exposed to serious interruptions. The wet, snow, and mud which (according to the season) collects in the ordinary course of traffic upon the middle rail interfere very seriously at times with its conductive capacity. It has accordingly been determined on the Berlin electric line to conduct the current by means of a copper wire properly insulated, and attached to pillars erected alongside the line, the current being conducted from the copper wire to the locomotive by means of contact rollers.

IRIDIUM.

Several weeks ago we described the new process of John Holland, of Cincinnati, by which he is enabled successfully to work this refractory metal, thereby effecting some very remarkable and promisingly useful results. A patent has lately been granted for the invention. The process consists in bringing the iridium to a high heat, then adding phosphorus, then casting the metal into the desired form, and then eliminating the phosphorus by heating the metal again in a chalk bath. In a recent lecture before the Ohio Mechanics Institute, Cincinnati, Professor Dudley enlarged upon the value and importance of the discovery, reiterating the particulars given in the SCIENTIFIC AMERICAN of February 26, about the aid of the metal as an electrode in the electric lamp, its astonishing hardness, anti-corrosive nature, etc. He stated that the metal has the appearance of steel, but is much harder, being next in hardness to the ruby. It does not rust and cannot be injured by acids. Professor Dudley stated that a bar of it had been used with gratifying success, in place of the negative carbon in the electric light. It burned for sixty hours without any loss in weight or any perceptible change in form. Iridium cannot be fashioned by hammering while hot, nor can it be filed. It is moulded into convenient forms, and then sawed or ground by rapidly revolving copper disks, treated with emery and water. Many uses for the metal have been suggested. Besides its applicability to the electric lamp it has been found to be superior to platinum in telegraph instruments. Heretofore owing to the exceeding difficulty of working the metal its use has been much restricted, its most extensive employment, probably, being for pen points.

Faithful John.

JOHN W. JACKSON, for more than thirty years a faithful employe in this office, died on the 6th of May, of consumption, and was buried from the Colored Methodist Episcopal Church in Sullivan street the following Sunday.

"Old John," as he was familiarly called, had grown up with the SCIENTIFIC AMERICAN, and was as well known among business men down town as the paper itself.

John was faithful to his trusts and exacting in others. If he had business to transact with a business house or an official department and he discovered in the clerk a disposition to give another attention to the exclusion of himself he would have no argument with the clerk as to his rights, but would seek out the head of the firm or department and lay before him his complaint, which, he used to say, prevented delay and facilitated business next time.

A number of years ago, before the present system of making collections through our banks was general, John had a great many collections to make throughout the city. One day, in the absence of the member of our firm who was accustomed to indorse the drafts and checks for collection, a draft was received at the office for a considerable amount on the Sub-Treasury in this city. Another of the firm, who is no longer a member, indorsed the draft and John was sent to collect the money. He soon returned with his bag of gold, and laying it on the desk said: "Mr. W., your indorsement was not known to the cashier, and he at first refused to pay the draft, but on my assuring him it was all right, he said if I would add my indorsement he would pay the money, so I did it, and it was my signature that obtained it."

It is doubtful if Mr. W. ever fully understood why the colored porter's indorsement was necessary. And so wherever John's errands called him, his word or his signature was recognized authority.

Old John is very much missed about this office, and he will be missed by scores of business men about town, so identified had he become with the SCIENTIFIC AMERICAN and its thirty-five years' growth.

New Telephone Central Office System.

Mr. T. G. Ellsworth, manager of the John street office of the Metropolitan Telephone and Telegraph Company, of this city, has patented an improved telephone central office system, the principal object of which is to facilitate connection between wires of telephone lines in a telephone central office, and to afford means for making such connections rapidly and accurately.

Ordinarily in telephone central offices mistakes and delays in connecting and disconnecting the wires of communicating parties are of frequent occurrence, for the reason, among others, that the operator at the telephone cannot conveniently, or does not himself, connect and disconnect the wires, but gives directions to others to do so; hence results much noise and confusion, and consequent misunderstanding and forgetfulness or neglect of orders.

To avoid these difficulties Mr. Ellsworth has devised a system involving the use of novel switch connections and of novel telephone stands, and their peculiar arrangement relative to each other, whereby each telephone operator is enabled easily and without delay to connect and disconnect several communicating wires that are connected with his instrument.

American Medical Association.

The spring convention of the American Medical Association in Richmond, Va., the first week in May, opened with every promise of a successful and profitable meeting. Five hundred physicians were in attendance.

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THE GAMGEE PERPETUAL MOTION.

One of our reporters called upon Mr. Edward N. Dickerson, the civil engineer and lawyer, to get his views with regard to the Gamgee "thermo-dynamic engine" and Chief Engineer Isherwood's report thereon. After reading the extract from Isherwood's report, as published in this paper last week, and after examining a copy of Gamgee's letters patent, Mr. Dickerson said that his attention had not been called to the matter before, and that he was somewhat astonished that Isherwood, who had published two or three books in years gone by, and expended millions of the public money in the attempt to prove that there was no power to be got out of expanding steam, should now be found advocating an engine whose entire merit is supposed to consist in the power that will result from the expanding of another liquid following the same laws as water in its operation; and that, in his opinion, the ignorance exhibited in the first publications is equaled by that exhibited in the last. In the first publications he denied the value of the dynamic effect due to expansion, and in the second one he converts that effect into the means of producing perpetual motion!

Mr. Dickerson then went on to say: The truth is, that any gas whatever which is produced by vaporizing a liquid will give out more or less of the value of the heat expended in the production of it, as it is expanded more or less. Isherwood, in the position of Chief Engineer of the Navy, prevented this simple truth from being made available for the United States for many years; and now he is going to the other extreme in assuming that if some other liquid beside water be used, not only an enormous amount of power can be obtained, sufficient to drive navy vessels without fuel, but that this enormous power, produced by means of expansion, has the faculty of restoring the liquid used to its normal condition by its own internal action, when it will be ready to perform the ceremony over again *ad infinitum*.

A simple way to illustrate this whole subject is to suppose a thoroughly exhausted vessel of any kind, into which some liquid ammonia or other low-boiling substance is introduced. If that liquid can derive from the environment heat enough to vaporize it, it will be thoroughly evaporated, and will fill that vessel under a tension corresponding to its volume and heat. When that is done the work of that amount of heat thus absorbed has been accomplished, and the gas will be very cold, if the volume into which it expands bears a large proportion to its normal liquid volume. Now if in that condition, and by reason of this low temperature, this gas could suddenly reconvert itself into a liquid form, it could be very readily replaced in the original vessel, or a similar one, and again derive its heat from the environment and reproduce the original effect. The difficulty about it is that it will not reconvert itself into a liquid, and this is the fallacy of the whole assumption; and in order to reconvert it into a liquid form it must be compressed into its liquid dimensions, when it will again be as warm as it was in the beginning, and when the power expended in reproducing it will be equivalent to that it gave out in the expansion. This general truth may be confused by pictures of cylinders, condensers, and by jargon; but it is altogether probable that this law will assert itself notwithstanding the confusion that will result from such an organization as Mr. Gamgee exhibits in his patent. If not, there is, practically, a perpetual motion machine made.

In all engines operated by heat, whether atmosphere, steam, or the vapors of other liquids are used, a constant condition of disturbed equilibrium must be maintained between the opposite sides of the piston or diaphragm which is to exhibit the motion. One side of it may be made hotter than the ordinary temperature, while the other side need then only be of that temperature, or the ordinary temperature may exist on the one side and the opposite side may be made colder; and whenever that disturbance does occur a tendency of the gas to pass from the hotter to the colder space will exist, and power can be got. But, in order to make an engine operative, that tendency must be made chronic, or in other words, artificial heat must be added at one end, or the natural heat which has been expended at one end must be destroyed at the other by some refrigerating process. I have often said that if I were lecturing in a scientific school I would have a steam engine running in which the boiler should be filled with a mass of ice; and such an engine, which might easily be made, would illustrate the whole subject in a very striking way. Steam at the freezing point has a pressure of about one-tenth of a pound to a square inch; and, of course, if a pressure of about one hundredth of a pound to a square inch could be produced on the opposite side of a piston, ice steam would drive the engine; but it would require artificial refrigeration, and, of course, an expenditure of power at the lower side much more costly than to put an alcohol lamp under the little boiler at the upper side. It never occurred to me, however, that my ice machine would, by the expansion of this ice steam, destroy the heat and restore the ice to its normal condition in the boiler, so as to run in what Gamgee calls a closed circuit.

The best steam engine now existing (which consumes two pounds of coal an hour a horse power) yields about one tenth of the power which the combustion of the coal would theoretically produce, measured by thermal units. This result is more than twice as great as in Isherwood's engines built upon the theory that there was no benefit in expansion. They required about five pounds of coal an hour a horse power, or more. By carrying expansion further an engine can be easily built that will make a horse power with one pound of coal an hour, or half the fuel now used; and it is undoubtedly true that after steam has been used to its greatest capacity, the remaining heat, which now is discharged overboard in the warm water of condensation, can be utilized in vaporizing low-boiling liquids, such as ammonia, out of which a very considerable further amount of power can be obtained. But it is not worth while to make those attempts until the power to be got from steam has come somewhere near to the practical limits to which it may be carried. At present it is not half way there. When that has been done, and when all the heat possible has been used in vaporizing low-boiling liquids, there is no present prospect that more than a hundred per cent of the power of combustion will be utilized; or, in other words, it is not probable that more heat units will be exhibited in the dynamic effect than are due to the perfect oxidation of the carbon or hydrocarbon of the fuel. In all cases, practically, the limit of fall of temperature must be the temperature of the thermal ocean in which we operate, which is a variable one, affected by geographical position and seasons of the year. When the sea water is 70° hot, there never will be a time in which power can be obtained upon the assumption that a greater degree of refrigeration than 7° is possible without expense; and it will always be cheaper to raise the temperature at the other end by fuel than to lower it at the minus end by artificial means.

There is only one other set of experiments that I know of analogous to these, and they are to be found in Isherwood's "Experimental Researches in Steam Engineering," between pages 2 and 55, in which he was trying to find out a method by which steam, after leaving the boiler, could superheat itself, and in which he concluded that, although it did not do so in the particular set of trials he made, yet, if the machinery had been bigger, he thought it would! The converse of the proposition is now involved, in which the analogue of steam is *cooling itself*, and in which it would require probably a larger machine than they will be likely to make in the Navy Yard to establish a successful result!

INSECTIVOROUS PLANTS.

In your issue for May 14, 1881, reference is made to the later experiments of Sig. Vayreda with some of the different species of *Silene* (catch-fly), in which he arrives at the conclusion that the plants do not digest the insects, or if they do, they are not benefited thereby any more than if they did not eat them.

During the summer of 1878, assisted by Mr. Wm. I. Tait, of Jersey City Heights, N. J., we made most careful and exhaustive experiments with the Carolina fly-trap (*Dionea muscicipula*), and arrived at exactly the same conclusion as Sig. Vayreda has done, that the so-called "feeding" of the plants in no way conduced to their health or vigor, being identical in all respects with those that had not been given the insects. One hundred healthy plants were used in each of the two experiments. The whole details of the experiment were given in the *Gardeners' Monthly*, of Philadelphia, in December, 1878, and brought out a very interesting discussion from those believing in the Darwinian theory and those who did not.

But why because the exudations from a plant are such as to cause an insect to adhere to it, or its mechanical formation entrap the insect, we should jump to the conclusion that it should then feed on its prey, it is hard to imagine.

On the "cruel plant" (*Physianthus albens*) hundreds of moths, butterflies, and other insects may be seen any day in August when the plant is in bloom—dead and dying, firmly held by their antennæ. Professor Geo. Thurber thus describes the trap contrivance by which the insect is caught: "The anthers are so placed that their spreading cells form a series of notches in their ring around the pistil. The insect in putting its proboscis down for the honey must pass it into one of these notches, and in attempting to withdraw it the end is sure to get caught in a notch, boot-jack fashion, as it were, and the more the insect pulls the more its trunk is caught." Thus caught, the insect starves to death, hence the well deserved name of "cruel plant." Now, here is a trap nearly as wonderful as that of the Carolina fly-trap, and far more so than that of the viscid exudations of the *Silene;* yet even Mr. Darwin would hardly say that the "cruel plant" feeds on these insects, any more than that the gnats caught by millions by the resinous exudations of the hemlock tend to augment their growth, or that the thistle or burdock of the wayside owe any part of their health and vigor to the scores of butterflies, moths, or bumble bees that are in their headlong flight impaled on their spines.

PETER HENDERSON.

Jersey City Heights, N. J., May 9, 1881.

SILK ADULTERATIONS.

[A simple test, showing quality and value of all silks.—Cracking, greasy, and dull wearing silks easily detected.]

Having proved by numerous experiments that all pure silk burned in a gas flame yields in ashes two-fifths of the original weight, and that all weighted silks, when burned in a gas flame, weigh less than two-fifths in proportion as they are weighted, and where there is much iron, "the chief adulterant," the color of the ash is a red brown. From pure silk the ash is always black, and the silk while burning seems to melt and run together, while the weighted silk keeps its form, shrinking equally from all parts. It is not necessary to burn any pure silk "unless comparisons are desirable," if you take the fact as established that the resulting ash is two-fifths of the original weight, and all silk not coming up to that standard is proportionately weighted.

The theory is: pure silk leaves a residue of two-fifths when burned to ash, and the weighted leaving very little ash from anything but the silk it contains, the adulterants being principally converted into vapor and gas, pass off, leaving no perceptible weight of residue.

The best method of burning the silk for testing is to lay it on a piece of wire gauze and let the gas flame pass through.

SCALE.

20 parts silk yielding 8 in ashes is pure silk.
20 " " " 7 " " " ⅞ "
20 " " " 6 " " " ¾ "
20 " " " 5 " " " ⅝ "
20 " " " 4 " " " ½ "
20 " " " 3 " " " ⅜ "
20 " " " 2 " " " ¼ "
20 " " " 1 " " " ⅛ "

A very good idea of the purity of silk is shown by comparison: taking a piece of ribbon—any pure color, white, blue, pink, gold, or any bright color—"one inch or two is sufficient," weigh carefully; then weigh exactly the same weight of silk to be tested, and as much as it falls short in measurement with the pure silk it is weighted. Endeavor when testing as above to get a piece of ribbon the same substance as that to be tested.

When it is considered that the weighting is a very expensive process, and that the additional weight does not in proportion add to the bulk, and that the strength, durability, softness, and luster are greatly impaired, 'tis strange that the fraud is persisted in; but it being so, and the consumer must necessarily pay the expense of the adulteration, it is for them to understand how to protect themselves.

There are many black silks that are valued by weight, manufacturers and dealers agreeing as to the dyed weight; such is what is termed French twist, often returned by the dyer three pounds for one. This silk twist is made from waste, and as it is cut up and carded there is a great amount of fine fiber on the surface, causing a dull and woolly appearance. In the process of dyeing the silk is rotted by the many baths of nitrate of iron and other chemicals; the fiber on the surface becoming very tender is beaten off, leaving a smooth hard twisted thread; but the processes are so detrimental to the strength, its use is confined to cutting up into fringes, but it soon shows its components, in becoming dull and cottony.

This French twist costs in the gray about four dollars per pound, and the dyeing heavy weight two dollars and fifty cents, so when finished there is returned three pounds for six dollars and fifty cents, or two dollars and sixteen and three-quarter cents per pound. If dyed in the regular way, sixteen ounces would return twenty and cost fifty cents for dyeing. So in that way the good silk would cost four dollars and fifty cents for twenty ounces, or three dollars and sixty cents for one pound, against two dollars and sixteen and three quarter cents for the heavy weighted. Let it be understood that the same number of yards and the same amount of good silk is in twenty ounces, costing four dollars and fifty cents, as in the forty-eight ounces heavy weighted, costing six dollars and fifty cents, and that the four fifty silk is clean and strong, while the six fifty is dirty and rotten. So the advantage is hard to be understood, and perhaps is only in the fact there are yet very many who can only understand a pound is a pound and a yard is a yard and silk is silk.

It is, however, gratifying to know many of our manufacturers depend on excellence. This, when understood by the consumer, will be found to mean the best economy.

New Haven, Ct. LEWIS LEIGH.

City Area and Sewerage.

Cities, Dec. 31, 1880.	Area in acres.	Population by census of 1880.	Density of population per acre.	Linear feet of sewers per head of population.
New York	26,401	1,206,577	45·70	1·69
Philadelphia	82.803	846,980	10·23	1·25
Brooklyn	13.338	566,689	42·49	2·81
Chicago	22,797	503,501	22 00	3·54
Boston	4,416	362,535	82 00	2·91
St. Louis	40.000	350,522	8·76	3·04
Cincinnati	15,360	255,707	16·64	0·98
San Francisco	26,880	233,965	8·70	2·82

Prints on Linen.

Copies of drawings or designs in black and white may be produced upon paper and linen by giving the surface of the latter two coatings of:

Gum arabic	7 to 10 grammes.
Citric acid	2 to 3 "
Iron chloride	4 to 6 "
Water	85 cub. centimeters.

The prepared material is printed under the drawing, and then immersed in a bath of yellow prussiate of potash, or of nitrate of silver, the picture thus developed being afterward put in water slightly acidified with sulphuric or hydrochloric acid.

A LARGE CRANK SHAFT.—The crank and crank shaft of the City of Rome, the new Inman liner, are approaching completion at Messrs. Whitworth's. The crank has three throws, each piece weighing about 20 tons, and the whole about 61 tons, while the shaft of fluid compressed steel forged hollow will weigh 18½ tons when finished.

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Society of Mechanical Engineers.

The American Society of Mechanical Engineers met in Hartford, Ct., May 4. Though but a year old, the society has acquired an honorable standing and a large membership. About fifty new members were received at the first session. Professor R. H. Thurston occupied the chair Papers were read by the president and by A. R. Wolff, of this city, on "Ratios of Expansion at Maximum Efficiency." At the second session Mr. Alex. L. Holly called attention to the dependence of this country upon foreign manufacturers for large steel forgings, owing to our lack of heavy steam hammers. Mr. Holly anticipated the supplanting of forgings in a great measure by steel castings, which are already made of high tensile strength.

Professor Thurston remarked upon the empirical character of the practice of depending upon familiar rules and formulas in the construction of steam engines. While standard tables, so called, like those of Regnault or Rankine, on pressures of steam due to temperature, might be accurate and very nearly exact, they were not absolutely so under all conditions, and he urged that engineers should depend upon observations derived from the actual conditions of the special case in hand.

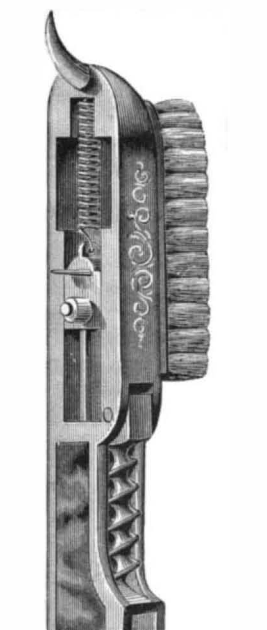
Chas. E. Emery, Esq., in a brief paper pointed out the value of non-conductors as a means of preventing radiation in steam pipes, and from a series of experiments presented the following substances in the order of their mention as valuable: Hair felt, mineral, wool, sawdust, charcoal dust, wood, loam, slack lime, asbestos, ashes, brick dust, sand, air, and space.

Cold Air for Domestic Use.

The *Chronique Industrielle* gives an abstract of a paper by a French engineer, M. Mougey, of Bray-sur-Seine, wherein the author shows the benefits to be derived from a system proposed by him for distributing cold air through a line of pipes to private consumers. Some such system has been suggested before, but the one under consideration differs from it in the fact that the projector proposes to compress the air to a greater degree (5 or 6 atmospheres), and to *cool* it before sending it through the pipes to the various points of distribution. At these points the opening of a cock, by allowing the air to escape and expand, will distribute throughout cellars, living apartments, or wherever else it may be needed, a pure cold air capable of preventing fermentation or putrefaction of organic matters, and of rendering the atmosphere of stores, manufactures, or dwelling houses refreshing during the most sultry days of summer. The air thus compressed may also be used, like steam, as a motive power. As for the proposed mode of distribution, that is essentially the same as now employed for supplying steam heat to consumers in Lockport, N. Y.

NEW CAN AND BOTTLE OPENER.

The engraving shows an improved opener for cans and bottles, recently patented by Mr. I. N. Arment, of Dayton, Washington Ter. On the top of the main bar forming the handle of the several parts, is fixed a brush for cleaning off the top of the can or bottle. On one side, and near the center of the handle, there is a groove in which is pivoted a corkscrew which is held in either of its positions by a spring in the bottom of the groove. In one end of the handle is pivoted a short, stub knife blade, to be used for cleaning off wax, cutting wires, etc., and at the opposite end there is a sharp curved spur which is designed to be thrust into the center of the top of a can. This end of the handle is slotted and contains a follower which carries a pointed double-edged knife and a small roller. The knife is to be forced into the top of the can, and the roller presses the side of the can at the top, to guide the knife.



Novel Can and Bottle Opener.

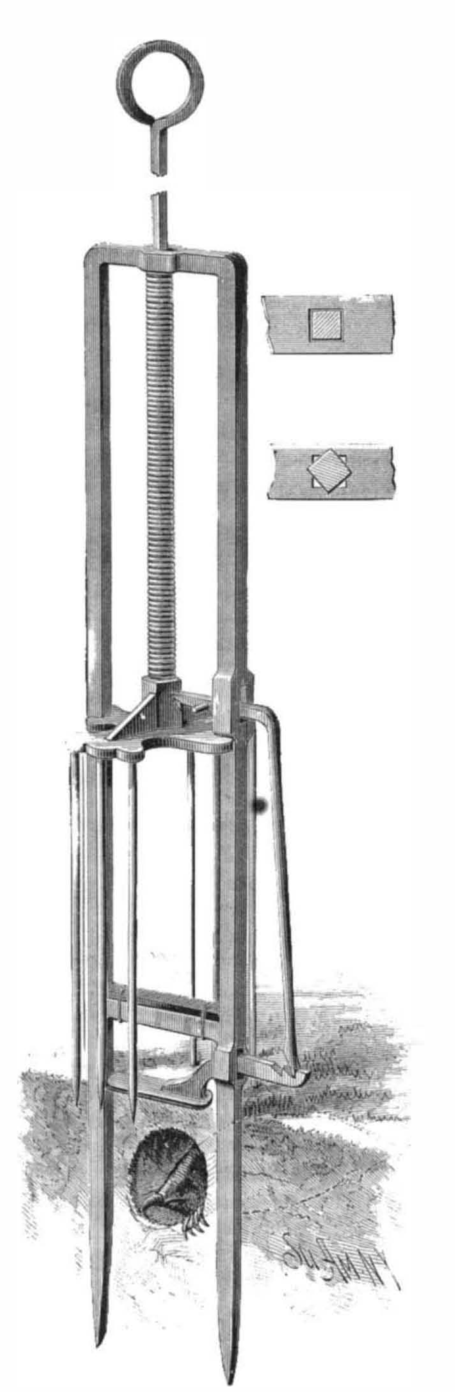
A spiral spring is attached to the end of the handle and to the follower, and tends to draw the latter toward the end of the handle. This device insures a contact of the roller with the side of the can. This tool, unlike many combination tools, is convenient and useful in all of its parts.

Conflicting Trade Marks.

The following decision indicates the way trade marks are sustained in England: A firm of brewers shipping to the colonies had put on their trade label the words "Bulldog Bottling." Another firm, also exporting to the colonies, had adopted, perhaps from want of originality, the words "Terrier Bottling." The users of the word "Bulldog" applied for an injunction against the use of the word "Terrier," and the Master of the Rolls, being of opinion that the labels could not be mistaken, declined to grant it. The Lords Justices, however, finding that the "Bulldog" beer had acquired the name of "Dog's head," reversed the decision of the Master of the Rolls, on the ground that the nature of the "Terrier" label would lead to its being described by the same name.

NEW MOLE TRAP.

We give an engraving of a simple and effective mole trap lately patented by Mr. Henry W. Hales, of Ridgewood, N. J. As will be seen from the engraving it may be set over the mole run without disturbing the ground in any way, or offering any obstruction to the free passage of the animal. The trap is so constructed that it may set very near to plants and flowers without injuring them, and it may be set close to a wall or fence without interfering with its working.



HALES' MOLE TRAP.

The trap consists of a vertical frame terminating in two pointed stakes at the bottom, which are wide enough apart to admit of pushing them into the ground on opposite sides of the run without disturbing the earth or changing the form of the run.

A follower fitted to slide in the vertical frame carries six long, pointed pins, three on each side of the frame. This follower is pushed downward by a strong spiral spring, and is retained in an elevated position by a lever extending through a mortise in the side of the frame and downward where it is engaged by a trigger. The trigger is furnished with a wide flat foot which rests upon the ridge of the mole run which is slightly depressed.

Now, when the animal attempts to go through the slightly contracted portion of the run the trigger is raised and the trap is sprung.

For convenience in setting and placing the trap, the square rod, extending upward from the follower through a square hole in the top of the frame, is rounded at a single point for a short distance, so that when the follower is raised until the round part of the rod is in the mortise in the frame and the rod turned as indicated in the detail view, the follower will be retained until the trigger and lever can be arranged, after which it may be again turned to bring it into position to operate. The trap is made entirely of metal, and is very simple and effective.

Statistics of Color Blindness.

The report of the committee appointed by the Ophthalmological Society of London, to collect statistics of cases of color blindness, presents many features of special interest. The secretary of the committee, Dr. Brailey, with the assistance of sixteen colleagues, has examined 18,088 persons of all classes, of whom 1,657 were females. It is at once curious and suggestive to find that while the average percentage of color defects among men is 4·76, and 3·5 for very pronounced defects, it falls in women to the low figure of 0·4. This, if true, remarks the London *Lancet*, would seem to suggest a new sphere of labor for women. If women are comparatively free from color blindness, they are so far specially indicated for many of the less laborious occupations in which good color perception is desirable or absolutely indispensable. It is satisfactory to find that these last statistics confirm, in the main, those collected by the late Dr. George Wilson, of Edinburgh, nearly thirty years ago. This is especially noticeable as regards the comparative frequency of color defects among members of the Society of Friends, particularly among the poorer section of them. Though the members of the Ophthalmological Society seem either not to have known the fact or to have forgotten it, Dr. Wilson found a considerable number of cases of color blindness among the members of the Society of Friends, and he was of opinion that this was not an accidental circumstance. He further believed that the largest proportion of cases of color blindness would, on extended examination, be found among the less accomplished male Friends in the larger cities.

A Japanese Bronze Worker.

The most skillful living bronze worker in Japan, and one of the most skillful of workers in metal that Japan has ever possessed, is said by the *Japan Mail* to be a Kiyoto artisan named Zoroku. His specialty is inlaying with silver and gold, an art which he carries to such perfection that his pieces are scarcely distinguishable from the *chefs-d'œuvre* of the Min period. What one sees on going into his *atelier* is a very old man—some 65 or 70—peering through a pair of huge horn spectacles at a tiny incense-burner or still tinier flower vase, from whose frets and diapers he is paring away, with marvelous patience, an almost imperceptible roughness or excrescence. Beside him, winter and summer alike, stands a brazier with a slow charcoal fire, over which an iron netting supports one or two bronze vessels similar to that he holds in his hand. Plainly these bronzes are being subjected to a slow process of baking, and if you watch for a moment, marveling at the purpose of a proceeding which seems only calculated to mar the fair surface of the metal, you shall presently see the old man dip a feather into a vessel filled with greenish liquor, and touch the heated bronze here and there with the most delicate and dexterous care. This liquid is acetate of copper, and this patient process, which you see repeated perhaps twenty or thirty times during a visit of twice as many minutes, will be continued in the same untiring fashion for half a year to come, after which a month's rubbing and polishing will turn out a bronze rich in green and russet tints that might, and indeed must, you would fancy, have been produced by centuries of slowly toiling time.

IMPROVED FRUIT JAR.

The engraving shows a fruit jar whose cover is retained by a wire bail carrying a roller, the wire being bent so as to retain the roller in its central position, and to form bows extending away from the pivots to increase the leverage in moving the bail. The cover has an arch across it, the surface of which is two arcs of circles of shorter radius than the bail, so that the movement of the bail across the arch causes the roller to press the arch and cover and bring the cover down tightly upon the packing of the bottle or fruit jar, and the roller remains in the slight depression formed in the surface of the arch.

Reilay's Fruit Jar.

This invention has been patented by Mr. Richard B. Reilay, of Wilkesbarre, Pa.

A New Cattle Car.

A "parlor" cattle car, with twenty head of cattle, arrived in this city the other day from Cincinnati, the cattle having come through without unloading. The cattle were fed and watered by a mechanical contrivance operated from the end of the car. With an ordinary car the cattle would have had to be unloaded for feeding three times, with considerable injury and delay. The superiority of the new car was shown not only in its increased capacity and the superior comfort of the animals, but also in the saving in weight by diminished loss, which is usually about ten per cent. With the "parlor" car the loss was under three per cent.

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ASSAYING.

THE ASSAYING OF GOLD AND SILVER ORES.

A ton of rocks containing one thirty thousandth its weight of gold, or one fifteen hundredth its weight of silver, can in many instances be worked profitably; this is something like one fiftieth of a grain of gold or four grains of silver per pound of rock or ore. A quantity so small, even if in the metallic or free state when diffused through the rock, is difficult to detect with any degree of certainty by any physical examination or blowpipe test. Chemical analysis by the wet way is in this connection too slow and expensive, and without the greatest care and most expert manipulation the quantitative results in the case of poor ores are apt to be uncertain. The fire assay is by far the most expeditious, certain, and inexpensive method of testing such ores, as well as of quantitatively determining their value.

The apparatus and materials requisite in assaying are as follows:

A balance for weighing ore and fluxes, sensitive to a grain, with a weight of three ounces on each pan, with box of weights.

A finer balance, sensitive to one-tenth milligramme, with a weight of one gramme on each pan, with box of weights.

A small crucible or melting furnace, with hood to carry off the fumes produced in roasting ore.

A cupel or muffle furnace.

Crucible, scorifier, and cupel tongs, muffle cleaner, poker, and shovel, and stone hammer.

Brass moulds for making cupels.

Large iron mortar and pestle for breaking and grinding ores. Fine work with very hard ores also requires an agate mortar and pestle.

Brass wire gauze sieves—80, 100, and 120 mesh. Small spatulas, camel's-hair brush, and glazed paper.

Iron pans for roasting.

Tin samplers.

Moulds for pouring scorified charges.

Crucibles, scorifiers, annealing cups, parting flasks, and test tubes.

Silver foil, lead foil, granulated lead, litharge, floured charcoal, argol, niter, borax glass, boracic acid, bicarbonate of soda, salt, carbonate of ammonia, fine bone ash, and white silicious sand (silica), nitric acid (pure).

The first requisite in any assay is that the whole of the ore or rock to be tested be reduced to a uniformly fine powder or flour and separated from metallic scales or particles, if there be any. This is usually accomplished by breaking with the hammer, and then completing the reduction in the mortar or beneath a muller. The sample in process of reduction is from time to time thrown on the sieve to separate the finer portions and avoid the inconvenience and loss by dust. If any of the metallic particles or scales remain on the sieve these must be weighed and assayed separately, the results first proportioned to the weight of sample of ore taken being added to the results from the powdered ore assay.

The powdered ore should be well mixed together and weighed, then sampled. A handy sampler is made of three or four semi-cylindrical tin troughs cast six or eight inches long, about three-fourths of an inch in width, and one inch deep, placed parallel at a distance equal to their width, and soldered at the ends to a tin or wire frame or support. When powdered ore is sifted over this half falls through the openings, the other half being retained in the troughs, and the portion caught may in like manner be further divided, so that a large sample is reduced to one of suitable size for assay, the small sample correctly representing the large.*

The method of assaying depends much upon the character of the ore and gangue. If the ore contains any considerable quantity of sulphides, arsenic, or antimony it should be roasted. This is usually performed by spreading the weighed sample of ore on an iron pan, previously coated with oxide of iron or chalk, and gradually heated under a hood to low redness until all fumes cease. Carbonate of ammonia and powdered glass or sand is sometimes added to hasten or complete the action and prevent fusing or agglutination.

The scorification method is preferable in most cases where it can be applied, but owing to the limited quantity of ore that can be conveniently operated upon in this way its use is restricted to comparatively rich ores. Poor or presumably poor ores are best treated in the crucible which permits the working large samples.

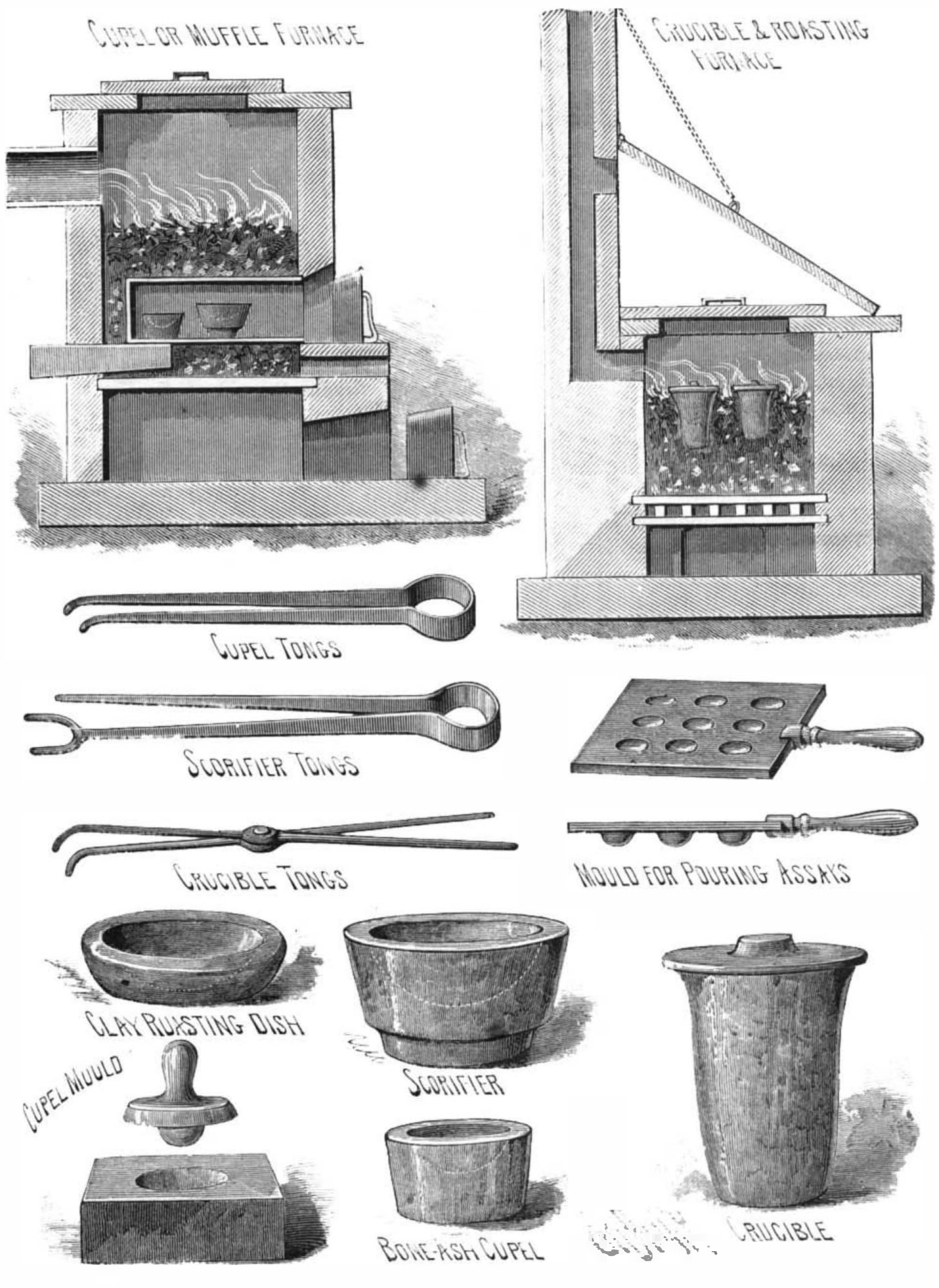
With regard to fluxes, litharge (the yellow oxide of lead), carbonate of soda, and borax are the most important. Charcoal and argol as reducing agents, and niter as an oxidizing agent, are used in connection with them. Salt is used as a cover or wash in the crucible. Lead or its oxide, which is a powerful flux, plays a very important part in the gold and silver cupellation assay. In the crucible assay the oxide (litharge) is always used. The ore or the reducing agents mixed with the fluxes react upon it in such a manner that a portion of it is reduced to metallic lead, which, as the contents of the crucible becomes liquefied by heat, falls by reason of its greater gravity to the bottom of the vessel, washing down and alloying with the liberated particles of precious metal, so that when the crucible has been cooled and broken a button of lead is found at the bottom, and this button, if the assay has been properly conducted, contains all the precious metals.

* All assays should be made in duplicate to check any error.

In the scorification the metallic lead exposed to a current of highly heated air is partially converted into litharge, which, acting as a flux, liquefies the ore, the liberated gold or silver alloying themselves with the unchanged portion of lead at the bottom of the scorifier.

In the crucible assay the following proportions of flux will be found to work well with most quartzose ores:

Ore	1 A. T.
Litharge	2 "
Bicarbonate of soda	1 "
Argol	2½ grammes.



APPARATUS FOR ASSAYING.

Too much argol will produce too large a button of lead, and too small a quantity the reverse, or none at all. The ore itself acts as an oxidizing or reducing agent in many cases. The use of oxidizers, such as niter, in the crucible are objectionable, and careful attention to the preparatory treatment or roasting will, in most cases, dispense with the necessity of their use Experience alone enables the assayer to judge of the oxidizing or reducing powers of the ores and the proper proportion of reducing material. Charcoal or flour or mixtures of these may be employed instead of the argol. These reducing agents should be in the finest state of division, and free from lumps and thoroughly dry. This applies equally to all the fluxes. Ores containing much limestone require a considerable addition of borax silica or borax acid (anhydrous); a similar addition to the charge is necessary if the ore be argillaceous—that is, slaty or earthy.

The ore and fluxes having been weighed out they are thoroughly mixed together and put into a dry and warm sand crucible, and covered with about one-quarter inch of dry salt loosely packed down. The crucible is then put into the melting furnace and covered with a good fire. Twenty minutes to half an hour is usually sufficient to accomplish the thorough decomposition and fusion of the ore, and the crucible is removed as soon as its contents are found to be in a state of complete fusion. It is allowed to cool thoroughly, then broken, and the button of lead at the bottom removed and cleaned by hammering it on an anvil. The appearance of the slag will indicate whether or not the decomposition and fusion were properly completed. The button of lead is put aside for cupellation (or scorification if necessary).

For the scorification assay the following charge will in most cases suffice:

Ore	1/10 A. T.
Granulated lead	3 "
Borax	q. s.

Two or three pieces the size of peas are usually sufficient. The ore is mixed with part of the lead in the bottom of the scorifier, the rest of the lead being poured over the top and the fragments of borax placed on top. The scorifier must be large enough to admit the charge without filling it. When placed in the muffle, properly heated, the lead and borax melt, the surface of the former by contact with the air becoming converted into liquid litharge, which with the aid of the borax fluxes the ore, forming a ring of liquid slag, which finally covers the whole surface of the lead. As soon as this takes place the vessel is removed from the muffle and its contents dexterously poured into the iron mould, where it quickly chills, and the lead button is removed and cleaned by hammering. If the buttons are too large to be admitted to the cupel (which should weigh at least as much as the button) they must be scorified down; that is, placed in a scorifying dish and exposed in the open muffle. The hot air oxidizes and slags off the lead, and on pouring and cooling this may be separated from the reduced button by pounding as before; in many cases it separates itself.

When the button is of proper size it is dropped into the bone ash cupel, thoroughly dried and heated to bright redness, where it melts, and as the hot air converts the lead by degrees into liquid litharge, and this latter is absorbed into the porous cupel, the button decreases in size until the last of the lead is slagged off and there remains in the bottom of the cupel only the fused bright button of gold or silver or any alloy of these. By too high a heat or overlong exposure in the crucible there is apt to be a loss of silver through volatilization. If too low a heat the litharge is imperfectly absorbed by the dish and the button solidifies ("freezes").*

Gold is nearly always found associated in ores with silver, and the button or bead obtained from an assay usually requires "parting;" that is, the separation of these metals. The button having been carefully weighed is treated with pure nitric acid diluted with half its volume of water, and heated to boiling in a test tube or small parting flask. If the proportion of silver is not less than three to one of gold all the silver dissolves in the hot acid, the gold remaining as a dark spongy mass. If less than this proportion of silver is present the gold protects it from the proper action of the acid, and the silver dissolves out slowly, or not at all. In this case—and a little experience enables the assayer to judge from the color of the button whether enough silver is present or not—silver must be added. Enough silver is cut from the silver foil, wrapped about the button, and this in turn placed in a small cornet of lead foil and placed in a clean hot cupel, where it melts and alloys; the lead soon slags out and the button is ready for the parting in acid as described.

The gold sponge or particles of gold powder obtained in parting is washed by decantation with hot water in a test tube. While the tube is filled with water a small annealing cup or porcelain crucible is placed with its mouth over the tube or flask, which is then quickly inverted, so that the fine gold falls to the bottom of the cup or crucible. By immersing this and the mouth of the flask the latter may be removed without disturbing the gold, which after decanting as much of the water as possible is dried at a gentle heat, then heated to redness to give it coherence, cooled, and weighed.

The greatest care is necessary in weighing assay beads of gold and silver, as, owing to the value of the substances weighed, a very small error may make a great difference in the results.

The decimal or French system of weights are commonly employed in assaying. The *assay ton* is intended to simplify and facilitate the final calculations; the ratio which an A. T. bears to a milligramme is the same as that between a ton (2,000 lb. avoir.) and a troy ounce, so that if one A. T. sample of ore is assayed and found to contain one milligramme of

* Large silver buttons must be removed with care from the muffle to avoid loss through spatting, occasioned by the escape of absorbed oxygen from the silver at the moment of solidification.

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gold or silver it is known at once that a ton of the ore contains just a troy ounce of the metal.

The weight of gold found as above deducted from the weight of the bead before parting (or adding silver) corresponds to the weight of silver.

One ounce of pure gold has a value of twenty dollars and sixty-seven cents. The ounce of silver is worth about one dollar and fifteen cents; it varies with the market.

As nearly all commercial samples of lead and litharge contain traces of silver, those intended for use in assay should be carefully sampled and assayed, due allowance being made for silver found in calculating results.

The Zeromotor.

Mr. Isherwood has recently been employed to report to the United States Government on the merits of a very remarkable proposal made by Professor Gamgee. It will be remembered that this gentleman has given much attention to the construction of ice-making machines; and a few years ago his real ice skating rink in Chelsea attracted a great deal of attention. Of late Professor Gamgee has resided in the United States, and continued to occupy himself with ice and its artificial production. During the early portion of the present year he submitted to the United States Government the proposal to which we have referred, which is that he shall construct a new motor which will, to a large extent, take the place of the steam engine and work without fire. If such a scheme had been brought forward a few years since its inventor would have been regarded as a lunatic. But so much knowledge has been disseminated concerning the behavior of gases, and the conditions under which work is performed, that Professor Gamgee need have no fear now that his ideas will be neglected or passed over without due examination. Apparently the "zeromotor" is "perpetual motion" over again. But the inventor of perpetual motion engines is always trying to produce a machine which will work itself without external aid of any kind. Professor Gamgee's scheme has nothing in common with this. He proposes to utilize natural forces; and his engine would be, if constructed, a heat engine in just the same sense that the steam engine is a heat engine, only he proposes to work at much lower temperatures than the steam engine requires, and to use ammonia instead of water.

In order to make the principle involved perfectly intelligible, let us consider for a moment what takes place in a steam engine. We take water and heat it, thereby enormously increasing its volume, and converting it, in a word, into what we may call, for convenience, a gas. This gas is used to propel a piston against a resistance. It is then suffered to escape into a cool chamber, condensed, or in other words reduced in volume as much as it was before augmented, and pumped back in the boiler. We have thus a complete cycle, and the engine works between two temperatures, that of the boiler, say 320°, and that of the condenser, say 120°, and the efficiency of the engine is determined solely by the difference between these two temperatures. Now let it be supposed that the normal heat of the atmosphere was 320°, then water could not exist, but it would be still quite possible for beings who could live in such a temperature to work a steam engine, if only they could isolate steam from the air, which might be done easily enough; and if, besides, they possessed any means of reducing the temperature of a condenser to 120°. Given these two conditions, and their steam engine would work without fire. Considerable difficulties would, however, be met with in producing the low temperature required, while without the steam engine would be impossible.

Now we have several liquids which behave at normal temperatures, such as 60°, just as water would behave at 320°, and these liquids might be used to develop power if only we could obtain the low temperature needed to condense them. So long as sufficient difference of temperature exists power can be had; and it is of no consequence whatever, whether the range of temperature is at one end of the scale or the other. Power can just as well be obtained from a fluid working between zero and —200°, as from a fluid working between 320° and 120°. In the one we must provide heat to raise the temperature above the normal. In the other we must provide a source of cold, to speak popularly, and it is far more convenient to do the former than the latter. We have no stores of ice and salt, for example, to draw upon for the production of zero temperature, but we have stores of coal which will give us high temperatures. So much being understood, the rest will be easily comprehended. Without going into details it will be enough to say that Professor Gamgee proposes to work an engine between 60° and 40°, that is to say, through a range of 100°; and this he purposes to do by taking a quantity of liquid ammonia and putting it into a vessel, which we may call a boiler. In this the ammonia will be heated by the atmosphere to its own temperature. It will boil, and the gas will be used in an engine. So far all is quite clear. We have one-half the cycle, but we have yet to see how the low temperature, —40°, is to be obtained. It is, of course, out of the question to get this by the use of refrigerating agents; and it is here that the really beautiful portion of the invention comes in. When a gas is expanded and does work, it is cooled down. Professor Gamgee proposes to use his ammonia so expansively that it will be cooled down sufficiently to liquefy. Then it will be pumped back into the boiler and the cycle will be complete. An engine would thus be obtained capable of developing very great power without the use of fuel. It need hardly be said that the man who can achieve this object may hope for riches and honors such as the world has never before bestowed on inventors. Before we can say whether Professor Gamgee is or is not likely to obtain success, we must clearly understand the properties of the fluid with which he proposes to work.

Ammonia is a compound of one atom of nitrogen with three of hydrogen (NH_3). At ordinary temperatures and pressures it is a gas. Concerning certain of its physical properties a diversity of statement unfortunately exists. Thus, according to one authority, liquid ammonia—which must not be confounded with the water saturated with ammonia used by Lamm in a totally different way to propel tram-cars, as described in the *Engineer* for January 12, 1872, and popularly known when diluted as sal volatile and hartshorn—boils at —36° Fah.; while according to another it does not liquefy until a temperature of —40° is reached. The difference is apparently small, but it is very important at the lower end of the scale of temperatures. The higher the temperature at which liquefaction takes place the better in one way for Professor Gamgee. The specific gravity of the gas is 0·59, air being unity; and that of the liquid is 0·76, water being unity. The specific heat of the gas is 0·508. At a temperature of —22° the gas—to carry out the analogy we might term it ammonia steam—has a pressure of 17 pounds on the square inch absolute. At 32° its pressure is 60 pounds. At 68°, which is about the highest air temperature it is wise to reckon on, its pressure is 126 pounds on the square inch. The volume of the gas as compared with the fluid which produces it has not been tabulated. At atmospheric pressure and 62°, 1 pound of the gas would occupy about 23 cubic feet, and 1 pound of liquid ammonia would occupy about 36·5 cubic inches. The latent heat, or the heat absorbed by the liquid in becoming a gas, does not appear to have been ascertained. All the figures we have given must be considered as approximate only.

Hitherto comparatively little interest has attached to what we may term the mechanical properties of the gas, and this may account for the differences in the figures given by various authors, and the silence of all on such a question as the latent heat of gas. It will be seen that the maximum pressure which Mr. Gamgee can reckon on without the aid of artificial heat is 126 pounds absolute. But there is some doubt as to whether the gas will remain wholly unliquefied at this pressure and temperature. Kemshead states that it will liquefy at 60° and 105 pounds on the square inch; and it is more than probable that the pressures and temperatures we have given above are all critical; that is to say, those at which the gas is on the point of liquefaction. We do not think it would be safe under the circumstances to assume that a higher working pressure is attainable without the aid of heat than 100 pounds on the square inch.

So many points have to be considered that it is by no means easy to say precisely to what extent the gas must be expanded to produce the cold necessary for liquefaction. If we deal with it as a perfect gas we find that, if the initial temperature is 68° or 529° absolute, and the gas be expanded adiabatically three times, the final temperature would be —81°, or very much more than low enough. As, however, it will be impossible to prevent the gas from picking up some heat, it will not be safe to reckon on less than this amount of expansion; possibly much more will be required. A threefold expansion would give a terminal pressure of 33 pounds on the square inch absolute, but before this liquefaction would have begun, the average effective pressure in the cylinder would be 66 pounds less the atmosphere, 15 = 51 pounds, which is a good working pressure. So far it will be seen that much is in Professor Gamgee's favor, but it must not, therefore, be assumed hastily that its success is assured. Something remains to be learned concerning the behavior of the ammonia.

The zeromotor is in this dilemma, that if the expansion be not sufficiently extended no liquefaction will take place; while on the other hand, if it is sufficiently great, the engine may waste all its energy in overcoming the back pressure of the atmosphere. The intense cold of the cylinder will tend powerfully to reduce the pressure of the gas at the beginning of a stroke, while toward the end it will give out heat and prevent liquefaction. A very complex action has to be provided for, and nothing but direct experiment can settle the question at issue. Theoretically, the zeromotor is, so far as can be ascertained from the somewhat limited data available, sound in principle. It remains to be seen whether it can be reduced to practice. We agree with Mr. Isherwood, however, that the invention is one having sufficient promise to make its further investigation very desirable. "What is now mainly desired," writes Mr. Isherwood, "is that Professor Gamgee may be permitted to prosecute his experiment at the Washington Navy Yard to a conclusion, and there bring his engine to a practical test with as little delay as possible. Should the department be able to grant this, the favor will be well and properly bestowed in the interest of the navy and of the world."—*Engineer.*

Large Centrifugal Pump.

W. H. Allen & Co., Lambeth, have lately made a large centrifugal pump for the irrigation of extensive cotton fields in Egypt. The pump has a 60 inch disk and 36 inch pipes, and is capable of discharging 70 tons of water per minute. The lift against which it is to work is 15 feet. The pump will be driven by a horizontal engine of 125 indicated horse power, the power being transmitted by a belt 21 inches wide, and five-eighths inch thick.

Microscopic Structure of Metals.

Some observations on the minute structure of metals, recently communicated to *Nature* by Mr. J. V. Elsden, are both interesting and instructive. Notwithstanding the great opacity of metals, it is quite possible to procure, by chemical means, metallic leaves sufficiently thin to examine beneath the microscope by transmitted light. Silver leaf, for example, when mounted upon a glass slip and immersed for a short time in a solution of cyanide of potassium, perchloride of iron, or iron alum, becomes reduced in thickness to any required extent. The structure of silver leaf may also be conveniently examined by converting it into a transparent salt by the action upon it of chlorine, iodine, or bromine. Similar suitable means may also be found for rendering more or less transparent most of the other metals which can be obtained in leaf form. An examination of such metallic sections, says Mr. Elsden, will show two principal types of structure, one being essentially granular and the other fibrous. The granular metals (of which tin may be taken as an example) present the appearance of exceedingly minute grains, each one being perfectly isolated from its neighbor by still smaller interspaces. The cohesion of such leaves is very small. The fibrous metals, on the other hand, such as silver and gold, have a very marked structure. Silver, especially, has the appearance of a mass of fine elongated fibers, which are matted and interlaced in a manner which much resembles hair. In gold, this fibrous structure, though present, is far less marked. The influence of extreme pressure upon gold and silver seems to be, therefore, to develop a definite internal structure. Gold and silver, in fact, appear to behave in some respects like plastic bodies. When forced to spread out in the direction of least resistance their molecules do not move uniformly, but neighboring molecules, having different velocities, glide over one another, causing a pronounced arrangement of particles in straight lines. This development of a fibrous structure, by means of pressure, in a homogeneous substance like silver, is an interesting lesson in experimental geology, which may serve to illustrate the probable origin of the fibrous structure of comparatively homogeneous limestones like those of the Pyrenees, Scotland, and the Tyrol.

The Insulation of Electric Light Wires.

At a recent meeting of the New York Board of Fire Insurance Underwriters, the danger arising from the use of electric lights with uninsulated conductors came up for discussion. The matter had been investigated on account of an accident a short time ago in a jewelry store in Maiden Lane, when a man was on the roof running an electric light wire across. It came in contact with the telephone wire, and a flash passed down to the telephone box, destroying it. The shock loosened a considerable extent of plaster.

City Electrician Smith said that the shock must, he thought, have been very powerful, and had any one been at the telephone, he might have been killed; or if the flame had passed near light goods, there might have been a conflagration. The wires of the electric light ought to be thoroughly insulated.

Superintendent Harrison, of the New York Board of Fire Insurance Underwriters, said that the Board would ask the proper authorities to see that the electric wires were properly insulated. Owing to the rapid introduction of the electric light, and the many new wires that were being run over the city houses, the danger, he said, was constantly increasing. In the meantime buildings using the electric light would be rated as "specially hazardous," unless the insulation of the wires was approved.

A. A. Hayes, Jr., of the Brush Electric Lighting Company, has informed the board that the wires of that company were already insulated while the matter was under discussion; and since the action of the Board, the other companies have been experimenting in regard to the best method of insulation.

Actinic Zinc.

Dr. Phipson describes a zinc white of a dazzling purity obtained by precipitating a solution of zinc sulphate by means of barium sulphide, submitting the precipitate to strong pressure, and igniting it with limited access of air. If any barium sulphide escapes oxidation, the white compound, on exposure to the sun, begins to darken, and in about twenty minutes becomes of a deep slate color. If removed into a dark place it gradually loses color, and in about five or six hours it becomes again snow-white. This experiment may be repeated with the same specimen as often as desired. Further, this change of color does not take place under a slip of common glass, whether thick or thin; at most the compound takes a slight yellowish brown color on exposure to the sun for two hours. The sample on analysis was not found to contain silver or any other substance known as actinic.

The Fourth State of Matter.

The first public exhibition in this country of the experiments and apparatus employed by Professor William Crookes in his investigation of the ultra gaseous state of matter was made in this city, May 5, by Professor H. S. Carhart, of the Northwestern University, under the auspices of the New York Electrical Society. The experiments were admirably reproduced and explained by Professor Carhart, whose skillful manipulation of the delicate apparatus was only excelled by his terse and lucid presentation of the character and import of these novel explorations along the extreme verge of material existence.

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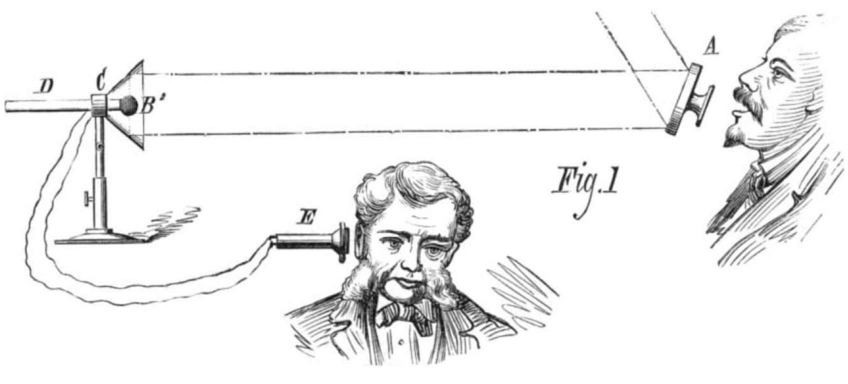
THERMOPHONES.

BY G. R. CAREY.

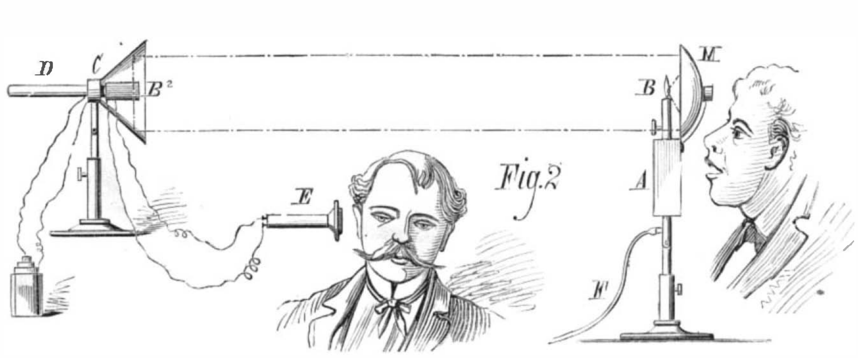
Figs. 1 and 2 represent magneto-thermophones. In Fig. 1, A is the transmitter, which consists of a highly polished thin mirror, similar to Prof. Bell's photophone transmitter; B^2 is a hollow iron ball which forms the pole of the magnet, D This ball should be made very thin and covered with lampblack in order that it may absorb and radiate its acquired heat rapidly. C is an insulated helix of copper wire placed around the pole of magnet, D, and having in its circuit the receiving telephone, E. Sound waves of any kind generated before transmitter, A, will cause the reflected heat and light waves to undulate in unison with the sound waves; these undulatory heat and light rays will strike the pole, B^2, of magnet, D, producing corresponding variations in its strength, thereby generating magneto-electric currents in coil, C. These magneto-electric currents will correspond in time and strength with the sound waves made before transmitter, A, and will reproduce by means of telephone, E, any sound made before transmitter, A.



MAGNETIC THERMOPHONE WITH REFLECTING DIAPHRAGM TRANSMITTER.

The operation of instruments shown in Fig. 2 is similar to that just described; the difference is mainly in the transmitter, which consists of a manometric flame apparatus, A, of the usual construction, the light and heat of the flame, B, being projected by the mirror, M, to the magnet of the receiver.

In Fig. 3 the receiver is a thermopile connected with a receiving telephone. The heat and light thrown by the reflecting transmitter, A, generate an undulating electric current in the thermopile, C, which produces audible effects in the telephone, E.



MAGNETIC THERMOPHONE WITH MANOMETRIC FLAME TRANSMITTER.

In Fig. 4, the chamber, A, of transmitter is supplied with gas by the tube, F. Speaking against the chamber, A, will produce undulations in the inclosed gas corresponding in time and strength with the sound waves generated before it, thereby vibrating the flame, B, and its emitted heat and light rays. These modified heat and light rays will generate electric currents in the thermo-electric pile, C, against which they strike, and these thermo-electric currents corresponding in time and strength with the sound waves at the transmitter, the magneto-telephone, E, being in the circuit of the thermopile, C, will reproduce any sound made before chamber, A, of the transmitter.

The Atlanta Exhibition.

The plan of the proposed Cotton Exhibition at Atlanta, Ga., next October expands rapidly with the popular demands made upon the management. The indications now are that the Exhibition will be not merely a successful cotton show, but one which will include, also, all the great industries of the South, and so much of those of the North as are tributary thereto. The Exhibition buildings have been multiplied and enlarged accordingly. The main building, which is now in process of erection, will be 750 feet long by 90 feet wide, with a transept 500 feet by 90 feet.

The Exhibition will be held in Oglethorpe Park, chiefly a flat meadow surrounded by an oblong race-course half a mile in length. Outside the race-course the ground rises and will be terraced for the accommodation of the subordinate buildings of the Exhibition.

The main building will be devoted to exhibits of textile fabrics and the machinery for producing them. Another building, 250 feet long by 100 feet wide, will be filled with machinery for preparing sugar, rice, and similar products. A still larger one will contain exhibits of all varieties of tobacco, its products, machinery, and everything connected with it. A building on the plan of that which contained the Kansas and Colorado exhibits at the Centennial Exhibition will be given up to a comprehensive display of the agricultural, the mineral, and the woods of the South. This display is to be made chiefly by the Southern railroads, which are cooperating to make it the fullest and most comprehensive ever seen. All the territory south of the Ohio River will be ransacked for suitable objects to show here, and the result is expected to be a most important display of the surface and underground wealth of the South.

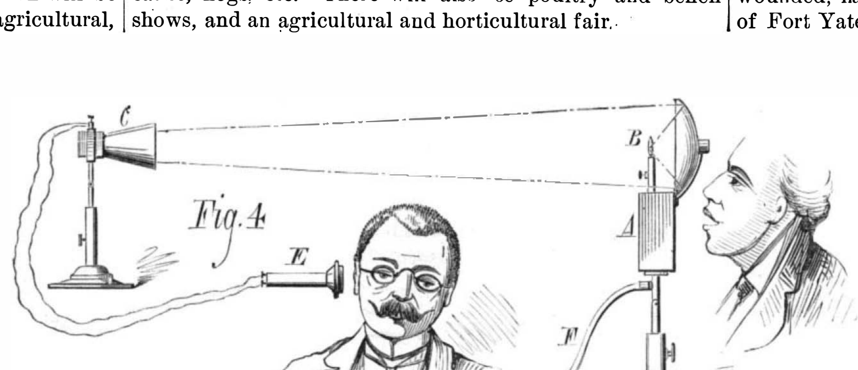
An annex to the main building will be known as the Foreign Department, and will be a bonded warehouse, under charge of a Treasury special agent, for the display of such foreign exhibits as the proprietors do not wish to pay duty on. This important concession has been made by Secretary Windom, and will secure a large amount of foreign exhibits. Letters have been received from a large number of manufacturers in various European countries, who express a desire to enter machinery for exhibition, but object to paying duties on it unless it is sold in this country, which, of course, could not be promised. In addition to the buildings mentioned there will be a large restaurant for the accommodation of visitors, and Director-General Kimball is particularly interested in "a press pavilion," which he intends putting up for the use of visiting journalists.

An exhibit which will probably attract the attention of more visitors than any other will be a cotton field, showing the plant in all stages of growth. Thirty acres of the park have been laid out in half-acre lots, and given to as many different planters for a competitive trial of skill in cultivation.

Pains have been taken to make this a complete display of every variety of cotton in the world. Seed has been imported from Africa, India, and other parts of the world, sometimes at great expense, a single half pound of a certain rare variety having cost $200 in gold. This plantation has been already seeded, and is now being cultivated under the general direction of Mark Hardin, a well-known representative Southern planter. Material for another interesting display is being gathered by Mr. Edward Atkinson, who has charge of the foreign exhibit of fabrics and fibers, and is collecting specimens of every variety of cotton goods, fibers, and primitive machinery for treating them. He is ransacking every portion of the world to make his gathering complete. A full display of agricultural implements will also be made.

THERMOPHONE WITH THERMO-ELECTRIC RECEIVER AND REFLECTING DIAPHRAGM TRANSMITTER.

There will also be a number of special exhibits of horses, cattle, hogs, etc. There will also be poultry and bench shows, and an agricultural and horticultural fair.



THERMOPHONE WITH THERMO-ELECTRIC RECEIVER AND MANOMETRIC FLAME TRANSMITTER.

The management of the Exhibition has been committed to H. I. Kimball, Director-General, with twelve chiefs of departments, several of whom have already been appointed.

MISCELLANEOUS INVENTIONS.

An improved axle box, patented by Mr. Willis Jones, of Brooklyn, N. Y., is designed to secure perfect lubrication of the journals and boxes of the axles of vehicles, securing as collateral advantages the exclusion of dirt, sand, or other abrading material from the bearing surfaces of axles and boxes.

Messrs. Robert Dodsworth and John W. Holdsworth, of St. Louis, Mo., have patented an improved mouth-piece for speaking tubes and telephones, which consists in combining an electric circuit closing device with the cover of the mouth-piece of the tube or telephone in such a manner that when the cover is opened the circuit shall be momentarily closed to give the signal.

An improved vertically swinging gate has been patented by Messrs. John Flinner and Jacob Hollinger, of Millersburg, Ohio. This invention consists in a peculiar arrangement of a locking mechanism for holding the gate down and preventing it from being raised, except when it is to be raised by the working levers.

Messrs. Frank Baldwin, of New York, and Howard Selvage, of Brooklyn, N. Y., have invented a scarf, so constructed that it can be folded in different ways, and will present a fresh wearing surface each time.

Messrs. John B. Grégoire and Hubert Hebert, of Lake Linden, Mich., have patented an improved bedstead. This bedstead has a horizontal frame supported by suitable legs, and provided with a series of transverse or longitudinal spring slats, upon which blocks supporting a like spring slat frame rest, this latter frame being provided with springs on both sides and with a hinged adjustable head rest.

An improved heat reflector for fireplaces has been patented by Mr. John Southward, of Mount Sterling, Ohio. This invention relates to certain improvements on the invention for which letters patent No. 197,205 were granted to William J. Cox and to the present inventor, under date of November 20, 1877.

An improved fabric for the manufacture of packages in which to put up ground coffee, spices, baking powder, and other substances which deteriorate by exposure to the air or to moisture, and which will serve to preserve their aroma or other desirable qualities for a long time, has been patented by Mr. Henry C. Crocker, of Milwaukee, Wis. The improvement consists in a paper fabric formed of one layer of waxed paper inclosed within two layers of common paper, whose edges project over that of the waxed paper and are pasted together.

Mr. Edward Birmingham, of Brooklyn, N. Y., has patented a shirt ironing board having a projection and rounded shoulders upon its forward end to fit the neck and shoulders of a shirt, and having slotted arms upon its rear corners, a pair of rollers for holding the shirt, and a handle for turning the rollers.

Mr. Friedr. Adolf Reihlen, of Stuttgart, Würtemberg, Germany, has patented a process of making wine from grapes, which consists in exposing for a few minutes to a water bath kept at a temperature of 212° Fahr. the mass of seed, flesh, and skins remaining after expression of the must; also macerating them in water or grape juice, and in mixing them with the must.

A spring cushion support for carriage seat backs has been patented by Mr. Charles C. Bailey, of Wellsburg, N. Y. This support is for the cushions of carriage seat backs between the seat backs and the lazy backs, to hold the cushion out against the backs of persons riding in the seats and prevent the cushions from sagging.

An improved travois or horse litter, especially designed for military purposes for the transportation of the sick and wounded, has been patented by Mr. Thomas M. McDougall, of Fort Yates, Dakota Ter. The novelty consists in pivoting the forward ends of the bed frame to the long shafts between which the draught animal is attached, and in providing hinged and adjustable legs or supports for the rear end of said frame, whereby it may be supported at different elevations; also, in providing an elastic or yielding socket for such supports.

An improved engineer's level rod has been patented by Mr. Michael L. Lynch, of Cameron, Texas. This invention relates to the class known as "self-reading level rods," and is distinguished from others by the peculiar manner of marking the scale upon the face of the rod, whereby the readings of fractions of a foot may be readily made without the use of a sliding target.

Mr. Charles A. Schneider, of New York city, has patented a lamp wick impregnated with a compound consisting of phosphate of ammonia, siborate of soda, sulphate of ammonia, and chloride of lithium.

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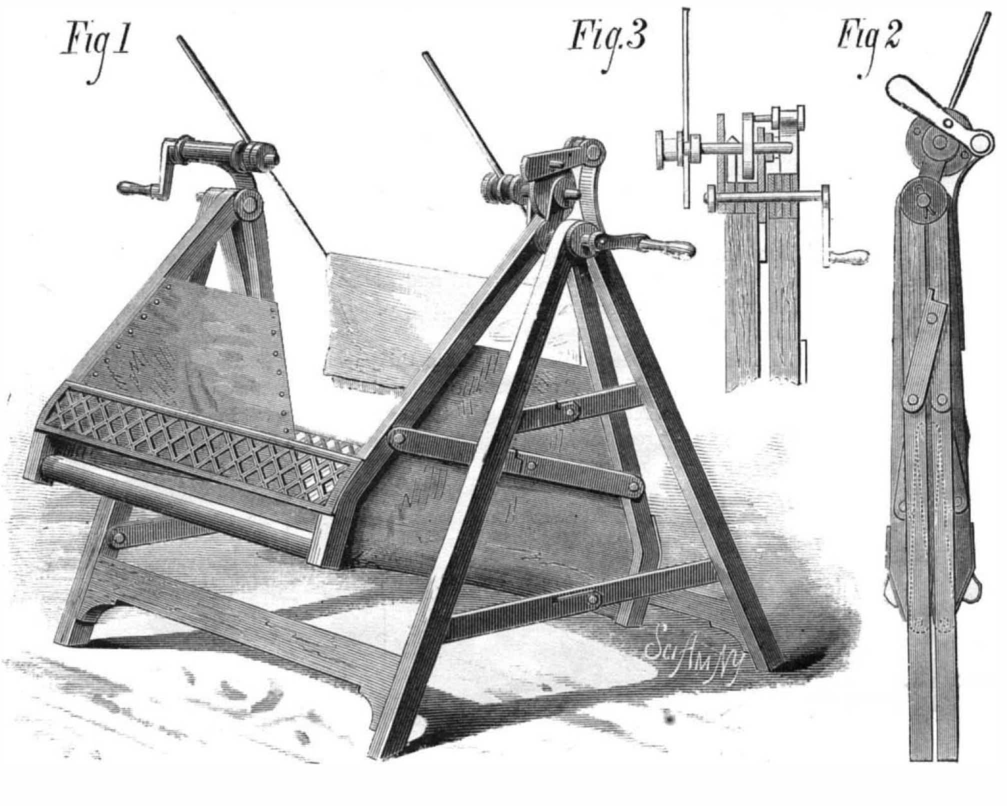
NOVEL FOLDING CRADLE.

The cradle represented in the annexed engraving is capable of being folded into very compact form for storage or shipment, and, when extended, it possesses all of the conveniences of the best cradles in use. The cradle is formed of two triangular folding end frames provided with folding braces and connected by longitudinal rods, from which the canvas bottom is supported. These frames are pivoted at their apex on the top of two connected triangular folding standards, and are provided with a crank for swinging the cradle.

A bent rod, from which a fan is suspended, is attached to the bearings of the cradle in such a way that it moves in a direction opposite to that of the cradle when it is swinging, or the fan may be operated independently of the movements of the cradle. The two triangular frames forming the cradle are provided with pivoted folding braces and are suspended at their apex from shafts mounted at the apex of triangular folding standards which are also provided with the pivoted folding braces. The cradle ends are connected with each other by rigid longitudinal rails. The cradle frames are connected by the longitudinal bars from which the canvas forming the bottom of the cradle is suspended. Wicker work or a railing extends along the sides of the cradle.

The shaft, from which the cradle is suspended, is provided with a crank for swinging the cradle, and with connections for operating the fan. These connections are made adjustable, so that the fan may be moved more or less, and provision is made for swinging either cradle or fan separately. The cradle may be operated by means of a treadle, or by a string or belt, from an adjoining room.



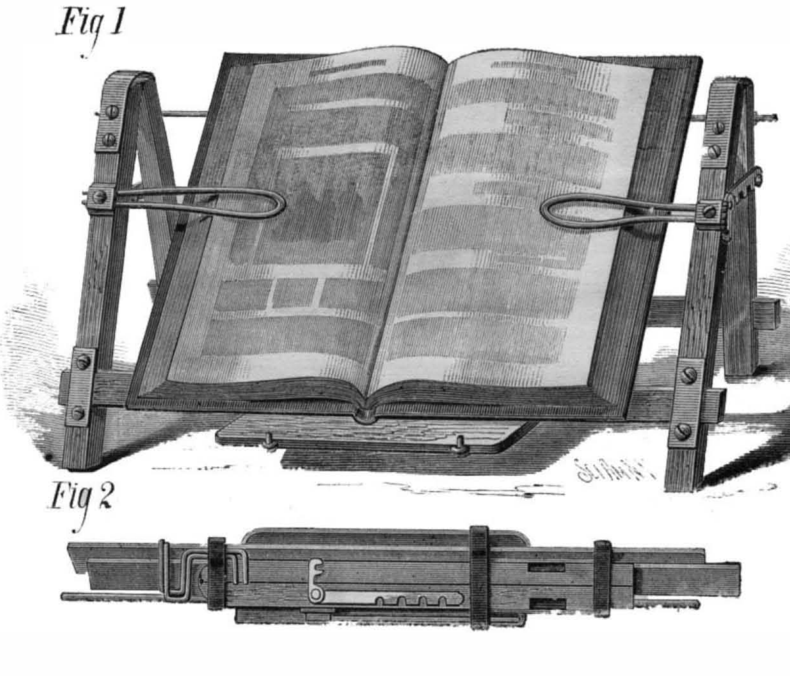
CLARK'S FOLDING CRADLE.

Fig. 1 is a perspective view showing the cradle in condition for use, Fig. 2 is a sectional view, showing the operating mechanism, and Fig. 3 shows the cradle folded up.

This invention was lately patented by Mr. C. C. Clark, of Brownwood, Texas.

NOVEL BOOK HOLDER.

The engraving shows a new adjustable and folding-book holder recently patented by Mr. Philip Lohges, of Pittston, Pa. The frame has two upright ends, each formed of two strips connected at the upper end by a hinge and by a band spring. These end pieces are provided with spring fingers for holding the book open, and are connected together by removable upper and lower longitudinal rails, one of the lower ones being provided with a shelf for supporting the book. The end pieces are provided with an adjusting device by means of which the inclination of the book may be changed at pleasure. The device may be taken apart readily and packed in very small compass. It will be found very useful by students, copyists, and readers generally. It is neatly and substantially made of wood and nickel-plated brass.



LOHGES' BOOK HOLDER.

Cooking by Electricity.

Of the many curious things certain to be seen at the forthcoming exhibition of electricity at Paris, not the least remarkable will be the electrical cooking range of M. Salignac. That ingenious gentleman is going to fit up his apparatus in the grill room of the restaurant, and intends to furnish a great variety of meats which have been cooked by heat generated from the electric current.

At the last Paris Exhibition, M. Mouchot roasted mutton in condensed sunshine, and literally turned his spit on the hearth of the sun; but an enthusiastic admirer might say that M. Salignac had far surpassed this in broiling steaks by lightning and warming coffee with the aurora borealis. As a matter of fact, the electric current is as well fitted to produce heat as it is to produce light, and just as electricity will, in all probability, be made to yield the principal artificial light of the future, so will doubtless it be applied to household heating. The same machines which light the house by night will heat and cook by day, besides performing other duties, such as driving a coffee mill or a sewing machine.

The Philadelphia Elevated Railway.

The elevated extension of the Pennsylvania Railroad on Filbert street, Philadelphia, is open for freight traffic. The line of the extension leaves the present passenger tracks at Powelton avenue, and passes over Thirtieth street on a wrought iron deck bridge 33 feet above the street. The Schuylkill River is crossed 42½ feet above ordinary high tide on a wrought iron double intersection triangular truss of three spans. About 190 buildings were removed along Filbert street in preparing for the construction of the work. The roadbed from Shock to Sixteenth street, a distance of 2,042 feet, is 106 feet wide, and contains nine tracks. Near Seventeenth street is a turn-table, east of which is a hydraulic elevator for mail express and baggage.

The building on the square bounded by Fifteenth and Sixteenth and Market and Filbert streets, formerly used for the freight station, has been entirely removed and rebuilt of iron and brick, two stories high. All the freight will be received from and delivered to wagons on the ground floor, being moved between the first and second floors by sixteen hydraulic elevators capable of lifting five tons each. All that portion of the second story from Market street is laid with four tracks for freight, with standing room for thirty-five cars. That portion of the second floor parallel with Filbert street, extending from Fifteenth to Sixteenth street, is intended for a shed for the incoming and outgoing passenger trains. Fifteenth street is crossed by the eight passenger tracks, 19 feet above the surface of the street. The space between Fifteenth street and Merrick street, a distance of 122½ feet, and extending from Filbert street southward 190 feet, is occupied by the passenger station, which is not yet completed.

RECENT INVENTIONS.

Mr. Charles Barlow, of Cookshire, Quebec, Canada, has patented an improved fire escape which consists of a cylinder provided with a piston filled with compressed gas, water, or other liquid, and having a wire coiled around its screw-threaded surface, inclosed, sliding, and revolving in another cylinder that is to be attached to the belt of the operator; and it consists also of an arrangement of valves and their connections, so that the operator may control the movement of the inner cylinder, and thereby the speed of the unwinding of the coiled wire and the rapidity of his descent.

Mr. John F. Rakes, of Greenup County, Ky., has patented an improved apple cutter and corer, so constructed as to cut the apples into pieces, separate the pieces from the cores, and discharge the cores from the machine.

A cigar-lighting device or lamp, which will not only be adapted for the purpose of cigar lighting, but at the same time embody an attractive and effective means of advertising, has been patented by Mr. William E. Parsons, Jr., of New York city.

Mr. George G. Niedomanski, of Washington, D. C., has patented an improved spring catch or lock to be applied to cigar boxes, by means of which nails are dispensed with, and a fastening is provided that may be instantly operated to lock or unlock the lid to the box.

Heretofore paper moulds have, in practice, generally been made up of alternate layers of unsized paper and sheets of tissue paper pasted together, which, while damp and more or less plastic, receive the impression of the type, and after being set by baking, form a matrix into which the melted stereotype metal is poured. The object of the tissue paper in the composition of the mould is to give a body to the same and to prevent ragged edges from sticking up. In making this kind of mould the paper of which the mould is composed has set once by drying, and is dampened when the mould is made. It has been found that it is not possible to reduce the paper, having once been set, to the proper condition of a plastic, no matter how damp it may be made, and when an impression is taken in such a composition the proper depth of impression is not obtained, and the tenacity of the tissue paper on the face of the mould causes it to draw, so that the cups of the letters and the spaces between the same are not of sufficient depth and sharpness. To remedy these objections Mr. Willard S. Whitmore, of Washington, D. C., has constructed a new composite mould, which is formed of a sheet of unsized paper covered with a layer of paper pulp which has never been set by drying.

An improved speaking-tube mouthpiece has been patented by Mr. George F. Richter, of New York city. The invention consists of an indicator that opens and closes horizontally, in combination with a vertically adjustable mouthpiece, that when adjusted for use closes the indicator, so that it can fall at the slightest puff of the operatar.

Mr. William F. Mann, of Mount Pleasant, Mich., has patented an improved form of buckle designed to be used, in connection with a strap, for fastening the mouth of a bag or other purpose.

An improved rack and spool for holding rope coils has been patented by Mr. Charles J. Le Roy, of Palestine, Texas. This invention relates particularly to certain new and useful improvements upon the rack and spool for holding rope coils, patented September 28, 1880, No. 232,733; and it consists in a peculiar construction of frame adapted for supporting spools of different lengths, as well as an improved construction of spool for expanding and holding the coil of rope in the center of the reel while being used.

A simple, inexpensive, and efficient device for propelling vessels, and for other purposes, has been patented by Mr. John C. Smith, of Troy, N. Y. It consists of a swiveled loop, and a propeller having a twisted plate at the opposite end of its shaft and a crank, whereby the twisted plate is worked in the swiveled loop so as to feather the paddle.

An improved moth trap, to be placed in front of the openings or apertures of beehives for the purpose of trapping the moths as they attempt to enter the hive, has been patented by Mr. Robert F. Ivey, of Williamsburg, Ga., The invention consists in a box or receptacle provided with two tubes, one inside of the other, the inner one passing through the box into the hive, and the outer one leads into the box, so that the moths that are not able to get at the inner tube must pass into the box, whereas the bees pass through the inner tube directly into the hive.

Mr. John F. Smith, of Erie, Pa., has patented an improved bit in which cheek plates are provided with suitable means for attaching them to the check rein and cheek of a bridle, the cheek plates being connected by elastic metallic bars, secured to each of the plates at one of their ends, and pass loosely through the other plate, and are provided with loops or other suitable means at their other ends for attaching them to the ends of the reins, whereby the cheek plates may be drawn together to clamp and compress the jaws of the animal without cutting, pinching, or otherwise injuring the mouth.

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Messrs. C. and M. C. Jackson, of Denver, Col., have patented a stovepipe that may be adjusted to fit pipes of various sizes, so that one may be telescoped within the other any desired distance to lengthen or shorten the line of pipe and to make a closely fitting joint.

An improved chair brace has been patented by Mr. Floyd Heavener, of Denver, Col. This invention consists in combining with the chair two wires running from the crossbar of the back of the chair down through the seat, and thence to the front corners of the seat, and upward over these wires two other wires are strained, which pass from the two hind legs to the two fore legs.

Cement Floors.

A correspondent of the *Country Gentleman* states how he mixed cement and gravel for cellar bottoms and roads, which stand use and the weather.

In October, 1878, I put down a cement drive-way. The first coat was three and a half inches thick, seven parts of sharp, coarse sand or fine gravel, to one part of cement, thoroughly mixed in a box dry, then dampened with water. I spread it on the ground in sections or squares. As soon as it was set, I put on another coat, one inch thick, of one part of cement to three parts of sharp sand. When that was set, for a finishing coat I put half an inch thick of one part of cement and one part of sand. It will in a week or ten days do to drive over. For my cellar bottom I used five parts of clean, coarse, sharp sand (plasterers call it fine gravel) to one part of cement. This was mixed in the same manner as for the drive-way. It only requires to be damp enough to work well. It was mixed in a box, wheeled into the cellar, dumped, and spread smooth with a shovel, hoe, or trowel, about two inches thick. Take a spade or shovel, flat side, and beat it down hard and smooth. For finishing, use one part of cement to one part of sand; this is thoroughly mixed, and then watered so it is like plastering mortar. Dump it on the first coat, about half an inch thick, spread and smooth with a trowel. It will soon become as hard as stone. The cement I used is known as Portland cement, though I think the common hydraulic cement will answer if fresh.

Cruising for Icebergs.

The early appearance of icebergs in the track of Atlantic steamers, and the imminent risk which these wanderers from the north occasion to navigators and passengers, again call forth the query whether something cannot be done to diminish the hazard of them, if not to destroy them outright. Commander McKay, of the steamship Parthia, suggests that it would be a good plan to detail a government gunboat or two to follow one or more of these icy monsters to study their natural history after they have entered upon their voyage. A record of such observations, he says, would be of priceless value to the navigator, as it would help him to estimate the probable position of an iceberg, so as to avoid it after being told of its position at some previous date. This would give value to the now practically useless ships' reports, signaling, etc. He suggests, also, as has been recommended before in this paper, that gunboats might profitably be detailed to test the effects of shot, shell, dynamite, or torpedoes on these ice masses, and is disposed to think that such treatment might very much hasten the dissolution of the bergs.

For the benefit of readers who are not navigators Commander McKay adds that neither the air nor the water temperature gives the slightest help to the navigator in indicating the neighborhood of an iceberg, except perhaps when there is a fresh breeze blowing directly over it and in a line with the ship, or when there is a change of water temperature crossing its wake. But in the passages to and from America it is usual to cross their track on nearly a right angle. Consequently this last small factor as a guide to its whereabouts is lost. In the early part of last July he passed within three miles of an iceberg with temperature—air, 63°; water, 61°. In the latter part of the same month, 120 miles north and 100 miles east of the former position, he passed quite close to an iceberg with a steady temperature of air 64°, water, 60°.

Ammonia Vapor Engines.

A correspondent of *Engineering* says that one may find the theory of the subject discussed in a paper read in 1867 by M. Frot before the Société des Ingenieurs Civils (Paris), and reported in the *Mémoires* (1867, pp. 671, 688; 1868, p. 170). He might also consult with advantage the references under the entry "Moteurs," in the index to the *Comptes Rendus* of the Paris Academy of Sciences for 1865. See further, *Génie Industriel,* August, 1865 (vol. 30), p. 63, for an account of Delaporte's machine, with historical notices of other inventions; *Génie Industriel,* April, 1867, (vol 33), p. 198; Fromont's ammonia vapor pump; *Annales du Génie Civil* 1865, p. 826; A. van Waeyenberch's engine. Tellier's machine is described in *L'Invention* 1865 (vol. 21), p. 87; and in *Le Technologiste,* December, 1865, p. 149. The use of such engines for driving tram cars is mentioned in SCIENTIFIC AMERICAN, November, 1871, p. 290; *Engineer,* January, 1872, p. 23; Dingler's *Polytechnisches Journal* (vol. 203), p. 234. Joy's engine is described in *Bayerisches' Industrie und Gewerbeblatt,* 1872, p. 153. For an account of Laughland's engine, see *Engineer,* August, 1871, p. 131; *Mechanics' Magazine,* August, 1871, p. 152; SCIENTIFIC AMERICAN, July, 1871, p. 70; September, 1871, pp. 131, 199. See also the "Abridgments of Specifications Relating to Air, Gas, and other Motive Power Engines" parts, 1 and 2, in which he will find a description of all the ammonia vapor engines patented in Great Britain from the earliest period to the end of 1876.

INDIAN FAIENCE.

FAIENCE OF INDIA.

The engraving shows several examples of the curious faience of India, which is remarkable for the simplicity of its design and ornamentation, yet is truly artistic and pleasing. The ornamentation is of the character usually found in Eastern textile fabrics.

ELEGANT CHAIRS.

We give an engraving of two fine chairs from the manufactory of B. Ludwig, of Vienna. The frames are of solid mahogany or of ebonized wood, and the cushions and back are of richly embossed morocco leather.

CHAIRS UPHOLSTERED IN STAMPED LEATHER.

MECHANICAL INVENTIONS.

An improved spring brace for vehicles has been patented by Mr. George W. Cooper, of Pulaski, Iowa. The object of this invention is to brace the springs of buggies and other vehicles against the forward and rearward pitching of the vehicle bodies. It consists in constructing the braces with ball-and-socket joints to give the braces freedom of movement in every direction without employing loose joints.

A steam cock with a self-adjustable check valve has been patented by Mr. William Bronk, of Albany, N. Y. The cock has its rear end threaded to screw into the boiler, and is provided with the valve seat, to which is fitted a valve, which may be closed by the boiler steam and opened by a push pin.

An improved hose coupling has been patented by Mr. John B. Newman, of Milford, Pa. By this device hose or pipe can be coupled or uncoupled more quickly than by any of the devices in general use, and without the use of wrench, spanner, or any other special tool. The construction of the coupling is such that it cannot be described without engravings.

Petroleum and Plant Life.

At the last meeting of the California Academy of Sciences a discussion took place on the subject of the use of petroleum for destroying scale insects on rose bushes. Dr. Henry Gibbons said that two months ago he put petroleum on the trees in his garden. Since then the trees have grown better than ever before, they have grown faster than ever before, and given better roses than ever before. The petroleum seems to kill the scale insect. The handsomest rose he exhibited was from a bush which looked nearly dead a short time since. The petroleum was mixed with castor oil. It is not applied profusely and allowed to run down the roots. Perhaps in a crude state the petroleum would be bad, even on the stalks; but mixed with the castor oil it appears to be advantageous to the plant. The compound does not evaporate nor give out the insoluble portion. Therefore you have a permanent coating, acting on the entire surface of the plant.

Dr. Gibbons exhibited a large bunch of beautiful roses of exceeding fragrance and in full bloom, which he gathered from a bush in his garden which two months ago was overrun with scale bugs and nearly dead.

Now, since using the petroleum and the castor oil, no sign of any scale insect can be seen in the whole garden. He thought castor oil was the only oil that will mix with alcohol, turpentine, and the benzines. It is soluble in alcohol, and when mixed with crude petroleum forms a sort of varnish or cement, which remains on the bushes, and does not fall to the ground. Petroleum, uncombined with castor oil, evaporates swiftly, but when combined forms a useful coating to preserve the plant. Many things have been thus tried. Trees have been whitewashed with caustic potash and lime. One of his rose bushes, nearly ruined by scale insects, thus treated, has borne an unusual number of roses, and a single cactus has borne 200 flowers this season. He thought these were practical facts, and quite as valuable as theoretical ones, although he valued both, and was glad to learn of any experience having a bearing of such importance to the agricultural industries of the human family. He cautioned persons against saturating the earth with petroleum, as such a course prevents future vegetation. Like all things else, its moderate use, wisely directed, is good, and its excessive use is destructive. A grain of opium relieves pain, but its habitual use persisted in brings death.

Dr. Behr said that as the mixture was not soluble in water, if it reaches the earth, it cakes the ground and thus shuts out the air, which must permeate the surface and is necessary to plant growth. A few applications will make rose bushes grow better if sparingly applied, and kill the scale bugs, but if allowed to reach the soil it renders vegetation thereafter impossible in that spot until it is eradicated.

Dr. A. Kellogg thought a simple wash of common lye would at first be sufficient in many cases. Petroleum deteriorates ground for crops. One scale bug has sixty offspring.

Mr. Verder received a large lot of lemon trees from Australia, covered with scale bugs. He applied refined petroleum to the leaves carefully, and they all fell off, but every bug died, and fresh leaves came out, and the plants continued healthy for many years. He afterward applied it successfully to orange trees. He thinks there is a misapprehension among those who condemn its use. It should not be allowed to reach the ground.—*Mining and Scientific Press.*

PURE olive oil will saponify by combination with spirits of hartshorn.

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The Largest Anvil Block in the Country.

Mr. C. T. Thompson describes as follows the casting of the large anvil block for the 17-ton hammer, built by William B. Bement & Sons, of Philadelphia, for Park Bros., Black Diamond Steel Works, Pittsburg. Its general dimensions are:

Diameter of cylinder, 40 inches; stroke, 9 feet; diameter of piston rod, 11 inches. The ram is of Krupp steel, 6 feet 6 inches long, 46 inches wide, and 2 feet 6 inches thick. Dies, 32 inches long by 16 inches wide. Weight of falling parts, 17 tons. Frame and legs are of wrought iron. The plates, which are from ⅞ inch to 1⅛ inches in thickness, are riveted together with angle iron, which is, generally, 6x6x⅞ inches. The legs are bolted to frame and bed plate; all the rest of the work is riveted together. Total weight, excluding anvil block, 190,000 lb.

In casting the anvil block there were in use five cupolas, four plain cylinders, 54 inches in diameter, and one Mackenzie. The spouts were joined together by a trough of fire bricks, in cast iron frame; these ran into a large receiver, capable of holding 30 tons. There was another reservoir, capable of holding 20 tons, to be used in case of accident to the first. These reservoirs were built of fire brick lined with fire clay. In the largest reservoir there were two openings, so that a large flow of metal could run out without any danger of not being able to plug them up. The anvil block is 12 feet 8 inches x 10 feet across the bottom; 10 feet high, 3 feet 6 inches x 6 feet across the top, with a recess for the anvil die, the size of which I am sorry to be unable to give. The mould was made so that the top of the anvil block was at the bottom of the mould, so that any dirt or slag could rise to the top, or rather the bottom of the anvil block, so giving a clean face for the die to rest on. The mould was sunk into the ground, so that the top was slightly below the level of the floor. A large plate of iron had been cast to build the mould upon. The outside of the mould was the same as in an ordinary loam casting; then, on account of the intense heat, came two layers of fire brick, and this was covered by half an inch of fire clay, and then blackleaded. The gates were six in number, at different heights, and were about 6 x 4 inches. They were connected by one slightly smaller, so that the iron would not back up and come out of a higher opening. These gates did not chill up, as it was supposed they would, from the fact of such a quantity of iron being poured each time. There were sixteen vents, about two inches square, for taking the gas from the bottom of the mould, but there was very little escape, or rather formation of gas. Around the outside of the brick mould, about a foot from each side, was a sheet iron case, riveted together, and between this and the mould sand was rammed, and then on the outside it was rammed up again, so as to make it a firm and secure backing for the mould. To dry the mould, fires were lighted around the brickwork before it was rammed up, and kept burning for about two weeks, and baskets were suspended, filled with coal. While the drying was going in, the mould was covered by sheet iron plates to keep the heat in.

The fires were started in the cupolas at 5:20 A.M.; the blast was turned on at 6 A.M.; at 6:40 the first iron was run into reservoir; reservoir was tapped about 7:20 A.M., and last run from reservoir made about 1:30 P.M.; the iron, through all the tappings, running very fluid. The mould, or rather, the casting, after having chilled sufficiently to form a skin, was covered with fine charcoal, and then sand, to a depth of about two feet, to be left for four or five months before being uncovered.

Coating of Metals.

To protect metals against the oxidizing influence of a damp atmosphere has long been an object of research of great practical importance. It is well known that a bright sheet of zinc, such as is used in covering roofs, very rapidly gets covered by a thin layer of oxide, and that this thin film becomes so thoroughly united to the metal below that it forms a firm coating and protects the metal against further oxidation. A precisely similar object has been followed by several inventors with regard to iron when they endeavored to provide it with an adhering coating of black magnetic oxide of iron. This, says *Engineering*, was done successfully in 1860 by Thirault, who employed a solution of chloride of iron, which was well rubbed upon the metal and gave it a black luster, when the artificial rust was converted in the black oxide after having been dipped in boiling water. In 1862 a similar result was obtained by Sauerwein, who used, besides chloride of iron, chloride of antimony and gallic acid, while another method was to cover the surface of iron with linseed oil and to expose it then to a dull red heat. By the process of Barff, in 1877, such a coating is obtained by subjecting iron at a dull red heat for six to seven hours to dry steam, when a black fast-adhering coating will be formed. More recently another method, of Mr. Bower, came in use, and it is now carried out on a large scale by a French company, the Société Française d'Inoxidation, which has its works at Val d'Osne. The coating of the iron articles is produced by first cleansing their surfaces and then by heating them in a furnace to a light red heat, when successively currents of carbonic oxide and carbonic acid are passed through it. In this way a bluish-black oxide of iron is formed upon either cast iron, wrought iron, or steel. This oxidized surface, on being polished with oil, takes a beautiful luster, and it is further ornamented by scraping some parts of it free from the coating, which are then either covered with a thin layer of bronze, gold, or platinum by galvanic action, after the invention of M. Dodé. Many articles made by the Société d'Inoxidation, such as statues, vases, fountains, basso rilievos, fire grates, stoves, balconies, candelabra, railings of staircases, and others, are really of a very beautiful appearance.

Teasels.

The teasels which are used in woolen mills for the purpose of raising the fiber out of the yarn when the cloth has left the loom, are a natural product, and not an artificial one, as those unacquainted with woolen manufacture might be led to suppose, and though wire cards have repeatedly been tried for this purpose, says the *Textile* (Eng.) *Manufacturer*, these teasels are still holding their place as the only suitable material for effectually raising the nap without any undue damage to the fiber.

A large amount of teasels are grown in Belgium. They are sown in spring, in August or September they are transplanted, and twelve months after this the first crop is gathered. The heads must be gathered before all flowers have bloomed, else the points are dried too much and lose their elasticity. The older and drier ones are always preferred to the fresh ones.

This plant is found growing wild in Middle Europe, but is then useless for manufacturers because in that state the points are not bent. In England the cultivated plant is grown chiefly in Yorkshire. Russia also raises a good crop in Poland and the Crimea.

The heads, after having been cut off the plant, generally pass at once into the hands of the dealers. The latter, in France, travel in July about the districts mentioned above, and buy the crops in the field, the price averaging from 25*s.* to 60*s.* per cwt. The dealer then sorts the teasels, taking out those which are crooked, too thick, or wormeaten; he removes the husks, cuts the stems to one uniform length, ranges them into first and second qualities, divides these again into eight or ten sorts, according to their length, and packs them into large casks, and sells them at so much per 1,000; a cask of the smallest size holding as many as 150,000, while one of the larger sizes only containing 10,000, but all weigh four cwt. In Russia they are sold by the cask, in other parts of Europe by weight.

As the teasel is a cultivated production of the thistle plant, it follows that its value for manufacturing purposes is enhanced by careful cultivation. The hooks, which are small bent leaflets of the flower, are generally set vertically in transposed rows, though in the French in the form of a spiral round the central cone, and closer at the bottom than the top. This leaflet has a strong rib at its back which is both stiff and elastic; the sides form, so to speak, wings, which are attached to the softer central core, and thus form an elastic spring which enables the hook to spring back in work, each hook also leans against its predecessor, so that when the force which pulls it is too strong, it turns a little sideways, and thus lets the resistance slip off. This is one of the principal qualities of the natural teasel, and has never been reproduced in artificial imitations. In the well-grown teasels the hooks are situated horizontally, and vertically to the spindle, while in the inferior ones they incline as much as 40 degrees.

The French teasels are pretty regular, the hook is horizontal, stronger, and longer than others, and dries better without losing its elasticity; the German kind is less regular or strong, but on that account is often preferred for fine qualities of cloth, which require more careful treatment. Dampness is injurious to all teasels, which soon mould and then lose much of their elasticity.

Glass Making.

A preliminary report issued from the Census Office presents the following statistics relative to the manufacture of glass in the United States for the year ending May 31, 1880, compared with the results obtained by the census of 1870:

	1880.	1870.
Number of establishments	194	154
Employes	23,822	15,367
Capital	$19,415,599	$13,826,142
Wages paid	9,112,301	7,589,110
Materials used	7,991,303	5,904,365
Value of product	21,603,464	18,470,507

The investigation into the growth and extent of this industry included only those works which manufactured glass from the crude material, and not those in which manufactured glass is a raw material, such as manufactories of painted or stained glass, mirrors, chemists' ware, etc.

A Whale Attacks a Ship.

The bark Anna lately arrived here in ballast from London to Read, Lauder & Co., after a most eventful voyage. One of the principal incidents is entered upon the captain's log-book as follows: "February 28, 3 P.M., latitude 42° 31' north, longitude 35° west, hard gale blowing and ship running under lower foretopsail and mainsail, sighted a large whale over bows. The fish bore down on us, and struck ship on the port side of the stern, and knocked the forefoot into matches and kindling wood; sounded pumps, but no leak; whale went off, leaving a track of blood behind." Captain McPhail states that he was surprised at the whale dashing right into a large vessel in mid ocean. He says that when he first saw the big fish it was rolling and spouting water 15 feet high. He had not then any idea it would charge his vessel, but soon discovered that the whale meant business. As the whale came on he luffed a little to prevent it from striking the side of the vessel and ripping a plank off. It dashed by and just gave one slap with its tail that fairly knocked the cut water of the boat off from the 11 inch mark to the keel. He thinks it was stunned and hurt.

Manufacture of Nitro-Glycerine.

E. M. Eissler, in the *Mining and Scientific Press*, gives the following information concerning the manufacture of this remarkable explosive:

The practical production of nitro-glycerine, therefore, is accomplished by the treatment of glycerine with a mixture of concentrated nitric and sulphuric acid, in which treatment the sulphuric acid plays a secondary role, and by the absorption of the eliminated water it maintains the surplus of the nitric acid in a concentrated condition.

Different chemists employ different proportions in their mixtures of nitric and sulphuric acids, and also in adding the glycerine.

In the production of nitro-glycerine there is a very strong elevation of temperature, which must be avoided, as it may lead to explosions. There are also different methods employed to avoid this elevation of temperature.

According to Sobrero, 2 volumes of sulphuric acid of 1·831 specific gravity, and 1 volume of nitric acid of 1·525 specific gravity, are mixed, permitted to cool, and into this mixture half a volume of glycerine, of a very sirupy consistency, is introduced with constant stirring. The mixture is again cooled, and after having become turbid and been separated into two layers, poured into 15 or 20 times its bulk of cold water. The oily nitro compound sinks quickly to the bottom, is freed from unchanged acid and glycerine through repeated washing with water, and hastily dried in vacuo.

Praeger & Bertram add 1 part by weight of glycerine to 8 parts of a mixture of 1 part of concentrated nitric acid and 2 parts of fuming sulphuric acid.

Liebe recommends to pour 1 part by weight of glycerine into a mixture of 2 parts of nitric acid of 1·525 specific gravity, and 4 parts of concentrated sulphuric acid, to keep the mixture below 75° F., and to dry the washed nitro-glycerine in the steam bath. There are various methods proposed, but on working on a large scale, the process is carried on as follows:

The manufacture of nitro-glycerine usually takes place in three wooden sheds of light structure, separated from one another by strong earth banks of 25 to 30 feet in thickness at their base. The walls and roof are lined with straw, and the temperature, by means of hot water pipes, is kept day and night at about 60° Fahr.

In the one shed the glycerine is brought together with the mixture of acids; in the second shed the nitro-glycerine is poured into the water, and otherwise washed; in the third shed the complete elimination of acid from the oily compound is effected, and eventually the nitro-glycerine is worked up into dynamite.

These sheds are sunk into the ground, so that their flat roofs are barely above the level of the ground; they are lit up by reflecting lamps placed outside on the roofs; the floor is covered with fine sand. At some distance from these sheds are the huts in which the cartridges are made. They, too, are separated from one another through earth banks, and so is another shed, in which the packing takes place. Quite away from all these buildings are the storehouses, sunk into the ground. There are usually also cellars for keeping the ice, which latter serves for cooling the wash water. The storing of the raw glycerine and the sulphuric acid requires no special precaution.

Nobel's arrangement for making nitro-glycerine is very perfect, as large quantities can be produced by it at a time, as much as 3,500 lb. in one operation, and to accomplish it, only a few hours are required, and under the supervision of an able man the operation can be considered comparatively safe, as he keeps his mixture cool, and avoids in this way the great danger of the nitro-glycerine igniting and causing explosions. I shall enumerate the way the nitro-glycerine is manufactured in some large establishments on the Continent.

In one of the largest dynamite factories in Europe, where the daily production is over two tons, the nitro-glycerine is prepared in the following manner: 1,300 lb. of nitric acid of the specific gravity 1·48 are mixed in four cast iron pans with 2,600 lb. of sulphuric acid; this mixture, which is left to cool for a day, serves for the treatment of 630 lb. of glycerine. The acid is drawn from the pans into a wooden cylindrical vat, of about 6 feet high and 3½ feet in diameter, lined inside with thick lead, and containing along its lining two spiral lead pipes of about 1 inch diameter, which reach from the bottom to the top. Each of these spirals, or worms, forms a system by itself through which cold water circulates, and one may serve as substitute for the other in case one gets out of order. The mixture of acids is stirred first by itself in this vat; the stirring is effected by two iron disks covered with lead, disk and covering being perforated, which glide up and down on a vertical iron shaft, the gliding motion being effected by pulling the rope attached to the disks over a pulley. The two or three workmen who perform this task stand at a distance of 30 or 40 feet from the vat, behind a strong earth bank. When the acids have been introduced into the vessel, and the agitation has commenced, water of the temperature of about 25° Fahr. is let into the worms. The temperature of the acid can in this

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way be maintained at about 50° Fah., as may be ascertained from a thermometer which reaches through the lead cover of the vessel into the acid. The glycerine, which is kept in a zinc tank on the roof of the shed in which the mixing vat is, is now allowed to run into the latter vessel. The flow is regulated by means of a tap, and also by letting the glycerine first run into perforated zinc boxes, placed on the lid of the mixing vat, and corking up, if occasion requires, some of the perforations. As soon as the glycerine falls into the acid the temperature rises at once, but by carefully regulating the supply of glycerine it may be kept at about 60° Fahr.

It is advisable not to allow the temperature to rise above that degree, though experience shows that a higher temperature yields a larger quantity of nitro-glycerine. It requires, according to the season and the temperature of the cooling water, two to three hours for 630 lb. of glycerine to pass into the mixing vat; the stirring must not be stopped for a moment during the process. When all the glycerine has been added to the acids, the mixture is at once drawn off through a leaden pipe to the so-called wash shed, where it passes into a tank about 8 feet high and 12 feet in diameter, which is half filled with cold water. The inlet tube carries a sieve to retain lead sulphate that may have been brought from the mixing vat. While the nitro glycerine flows in, stirring with wooden poles is begun, and continued until the nitro-compound has settled below the dilute acid. The bottom of the wash tank is slightly inclined, so as to allow a complete drawing off of the nitro-glycerine. The outlet taps are of stoneware. The nitro-glycerine is now twice washed with water, freed from acid and lead sulphate, and finally washed with water, to which some sodium carbonate has been added.

But even after this purifying process there remain traces of acid. To eliminate these the nitro-glycerine is transferred to a third shed, where it is agitated for about an hour in a rotating vessel called a butter machine, with about 50 lb. of a concentrated solution of sodium carbonate; after this time it will no more redden litmus paper. It is now separated from the alkaline solution, filtered through felt, and collected for further use in leaden reservoirs.

The yield differs greatly according to the condition of the raw glycerine, the concentration of the acids, and the temperature. The yield of nitro-glycerine falls generally below the theoretically calculated quantity. This short-coming is due to the formation of glycerides, which dissolve in the wash water. As a rule, the yielding in winter is greater than that in summer.

The above is a system employed by some continental manufactures, and, notwithstanding the precautions taken against the accidental rise of temperature during the production and washing of the nitro-glycerine, some very serious explosions during its manufacture have not been unfrequent; but Nobel has adopted a method of operation which, so far as experience goes, appears not to involve any special elements of danger if properly applied, and also presents advantages from an economical point of view, besides promoting the attainment of uniform results; and to his credit it must be said that when he made his first trial with his new apparatus he certainly exhibited a great deal of boldness and pluck, as it was a question of converting several hundred-weight of glycerine into the explosive compound in a single operation. His mode of operation is successfully carried out by the Giant Powder Company of San Francisco. The plan pursued by some of the other companies established near this city differs somewhat in its arrangement.

A series of small iron kettles, or pots, are arranged in a trough, each provided with a stirrer, which receive their movement from a common shaft, which is revolved by a man stationed outside of the building. The pots are charged with the acids, and the glycerine is supplied either from a common reservoir by small outlet pipes, or above each pot is a small vessel containing glycerine, from which the same runs in a small stream into the acid mixture.

The iron pots are surrounded by a running stream of cold water while the reaction is going on, and stirring has to be constantly kept up. After the reaction is complete the pots are taken up and their contents dumped into large tanks filled with water, where the nitro-glycerine separates and is afterwards washed.

As simple as this operation may appear, the writer earnestly warns anybody who is not experienced in the matter to undertake any trials, as there are points connected with the manufacture of nitro-glycerine which can only be acquired by practical experience, and even then it is fraught with danger.

At G. M. Mowbrey's factory, near North Adams, in Massachusetts, the nitrification of the glycerine takes place in stoneware jars. 116 of these are distributed over 9 wooden troughs, which latter are filled to within a few inches from the top of the jars with ice-cold water, or a mixture of ice and salt. Each jar receives 17 lb. of acid mixture, and into this 1 lb. of glycerine is introduced, drop by drop, from glass vessels, which are placed on a shelf just above the acid jars. Below this shelf runs an iron tube, about 1½ inch diameter, through which cold, dry air is conducted. From this tube glass pipes branch off, joined by means of India-rubber tubes, into each jar, which thus receives, during the dropping of the glycerine, a constant current of cold air, acting both as cooler and as stirrer. Very beneficial influence is ascribed to this air current, which oxidizes also nitrous acid vapors.

The introduction of the glycerine into the acid must be finished within one and a half hours. There should be no rise of temperature, and certainly no appearance of red vapors. After the transformation of the glycerine, the jars are emptied into troughs containing water of 70° Fahr.; the nitro-glycerine sinks to the bottom and remains covered with about six feet of water, for a quarter of an hour, when first the water is drawn off from above, then the nitro-glycerine from below. The latter is transferred to oscillating casks, in which it is washed three times with water, and twice with soda solution, a current of air passing through the liquid all the time. The wash waters pass into a tub, from thence into two casks, sunk into the ground, where such nitro-glycerine as had been carried away by the water is retained. (The writer considers Mowbrey's plan very good, and strongly recommends some of its features to the consideration of nitro-glycerine manufacturers.)

The nitro-glycerine is carried in copper vessels to a shed, about 100 yards distant, and poured into stoneware jars (the writer objects to the employment of stone, porcelain, or such like ware for handling made nitro-glycerine; he would recommend vessels of India-rubber or paper, or something which does not break or leak) of 60 lb. contents, and the jars placed in reservoirs filled with water of 70° Fahr., and left here three days. Impurities rise to the surface, and are skimmed off.

The nitro-glycerine is now ready for commerce. It is filled in canisters of galvanized sheet iron, coated inside with paraffine, and capable of holding 56 lb. The floor of the shed where the filling takes place is covered with a thick layer of calcined plaster of Paris, in order that any spilled nitro-glycerine be absorbed at once. The canisters are then exposed to the cold of ice and salt for the sake of freezing their contents. In this state they are stored, 30 to 40 to a batch, in magazines at least 100 yards from all the other buildings of the factory. The transport of this nitro-glycerine takes place also while it is frozen.

Nitro-glycerine is an organic poison. It produces serious consequences when taken into the system—vertigo, weakening of sight, stupor, pains in the cardiac regions; in larger doses it acts like strychnine, being fatal when more than 10 grammes are swallowed. Even mere contact with the skin produces serious symptoms, though workmen get used to it after a time. In external contact, the nitro-glycerine may be of serious consequences if it is taken into the blood; so workmen, if they have sores or wounds on their hands, must be extremely cautious in handling it.

At ordinary temperatures it is an oily liquid, clear, colorless, or yellowish, refracting light, of sweetish and burning taste, without odor, of 1·6 specific gravity. It solidifies at a comparatively high temperature—40° Fahr. In water it is insoluble, but dissolves easily in ether, wood spirit, benzole, chloroform, and hot alcohol.

Pure nitro-glycerine does not decompose spontaneously at ordinary temperatures. Up to 120° Fahr. its loss is hardly perceptible by evaporation. By gradual heating in inclosed vessels up to 212° Fahr., it can be kept in that state for several days without explosion. If the heating is continued gradually and slowly up to 400° Fahr., it commences to decompose and loses its explosive properties. A sudden and quick heating to 380° Fahr. will explode it. The gases resulting from the explosion are: carbonic acid, water vapors, nitrogen, and oxygen, and combinations of the latter two elements.

Theoretically the explosive force of nitro-glycerine as compared with gunpowder is stated to be as 1 to 10, but in practice this figure is much lower, and different experimenters give different opinions. Putting a light directly to nitro-glycerine does not lead to detonation, but it is very dangerous to set fire to it, as in bulk the fire may heat the mass to its exploding temperature and lead to disastrous results. Some writers assert there is no danger if any amount of nitro-glycerine is set on fire. They say it will burn away quietly long before it is heated to the degree at which it explodes.

If heated in a closed space it explodes violently.

If it is exposed for some time to a strong heat, like in a tropical climate, it becomes very sensitive, owing to a partial decomposition; then any concussion, increase of temperature, or strong vibration in the air, will explode it.

Electricity will explode it. By putting the two poles of an electric battery into the fluid, and passing the sparks between them for some seconds, the surface of the nitro-glycerine becomes agitated, turns black, and then it explodes.

Mr. Abel says that nitro glycerine explodes by electricity or any other influence which produces heat; only then, when the intensity of the same or the time during which the same acts, is sufficient to produce a decomposition of a portion of the liquid, and if this decomposition has once commenced, the temperature rises by accumulation of heat to such a point as to cause its explosion.

Nitro-glycerine explodes by a blow or concussion, but gradually increasing pressure is unable to explode the liquid, but if a blow is given to it with sufficient vehemence and quickness, so that the force of the stroke will produce a sufficient heating point, then the particles struck will explode.

At about 32° Fahr., nitro-glycerine becomes solid, and when exposed to that temperature for some time it becomes a hard substance. In this condition it is hard to explode, even with the fulminates (caps). Although in a frozen condition this substance is considered much safer than in its liquid state, it has still to be treated with due precaution.

Several accidents are on record where, in Europe, the frozen stuff was broken with a pick, and these accidents have proven that, although frozen nitro-glycerine is hard to explode with a cap, it will nevertheless explode easily when struck heavily with a sharp-pointed instrument. For instance, take a pick with a sharp point, of 10 lb. weight, and strike it against a hard rock with a velocity of 20 feet per second, and if there is any nitro-glycerine at the point of contact, this blow will exceed by far in intensity the concussion produced by an exploding triple-force cap, and consequently detonate the nitro-glycerine.

An Electric Railway in London.

One of the novelties at the Crystal Palace on Easter Monday was the opening of an electrical railway, constructed by the Société Anonyme d'Electricité, of Brussels, on the Siemens system. On the upper terrace of the Palace grounds, overlooking the charming scenery of Sydenham, a miniature circular line of railway, consisting of three lines of metals, has been laid down, surrounding one of the ornamental ponds, and a small wooden hut erected beside it as a passenger station. On this railway, which is about 300 meters in length, and has a gauge of about 50 centimeters, or 19 inches, between the outer rails, stands the electrical locomotive. Its length is about four feet, its breadth about a meter, its height about as much, and its weight some three-quarters of a ton. It is, in fact, a Siemens dynamo-electric machine, neatly boxed in, and mounted on a truck with four metal wheels, and provided with a brake and alarm bell for its control by the man in charge. A stationary engine of about eight horse power nominal, in a shed about thirty yards from the railway line, drives a stationary dynamo-electric machine, from which the electro-motive current is primarily obtained. Two wires are connected with this fixed dynamo machine. By one of them the current flowing out is conveyed to the mid-rail of the railway, to which it is attached by an iron plate bolted on. The second or return wire is attached to the exterior rail of the railway. The mid-rail is supported upon wood blocks, and is thus in a certain degree insulated.

Beneath the electrical locomotive a brush of iron wires sweeps the mid-rail, and the electrical current is thus taken up into the locomotive, where it passes through the mounted Siemens machine within it, the large bobbin of which is thereby caused to revolve, and the current passing away by the wheels of the truck to the exterior rails of the road, is conveyed back to the stationary dynamo-machine. As the current thus circulates, and the bobbin of the mounted machine revolves, it drives the four wheels of the truck as the locomotive moves on, hauling after it a load of nearly three tons with ease at the speed we have named. The electrical locomotive is easily managed; by applying the brake the electro-motive current is cut off as a driving power, while the wheels are at the same time mechanically skidded. By reversing the current the locomotive can be driven in either direction, as desired. The circulation of the electro-motive current from the stationary dynamo-machine to the mid-rail, and from the mid-rail to the locomotive, from it again to the outside rail, and from it back to the fixed machine, depends entirely upon the superior conductivity of the metallic wires and rails over the conductivity of the earth; and this mode of driving the electrical locomotive seems to make such a system open to difficulties upon railroad lines of any considerable length.

Cod Liver Oil.

Under the heading of "Practical Notes," Mr. R. B. Fairthorne suggests, in the *American Journal of Pharmacy*, a new method of taking cod liver oil. As the use of this remedy is at the present time more extensive than ever before, any means employed whereby it can be more readily taken without causing disgust will prove of service to sufferers who have to use it daily. Mr. Fairthorne's method consists in adding two drachms of tomato or walnut catsup to each ounce of the oil, the mixture being well shaken whenever required for use. He has found this mixture to agree with many persons much better than any other form in which cod liver oil has been taken, and this he attributes to the association of substances generally employed as additions to food, bringing into operation those digestive faculties of the stomach which might otherwise remain dormant when such incongruous substances as sugar and one of the principal ingredients of fish are introduced together into the stomach. Mr. Fairthorne also states that the following forms a not unpalatable mixture, which is readily taken by the patient: Liebig's extract, ½ ounce; extract of celery seeds, ½ fluid drachm; vinegar, 1 fluid ounce; water, 2 fluid ounces; cod liver oil, 5 fluid ounces. The extract of beef is to be dissolved in water, and the oil and vinegar to be added and shaken well together with the extract of celery.

The Horse Power of the World.

It has been estimated that, in 1878, on the 270,000 miles of railroad, there were at work 105,000 locomotives, of an aggregate 30,000,000 horse power, while the total number of engines amounted to 46,000,000 horse power. Taking the nominal horse power at an effective force equal to that of three horses, and the work of a horse as equal to that of seven men, it will be seen that the steam engines represent the force of nearly 1,000,000,000 men, which is more than double the amount of workers on the face of the globe. The steam engine, which is fed by coal, has, therefore, tripled the productive power of man.

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NEW INVENTIONS.

Mr. Frank W. Mix, of Terryville, Conn., has patented a novel lock case, designed to meet the requirement of that type of indicator padlock in which the bolt mechanism and indicator mechanism are arranged in different planes, with a supporting plate between the same. The object sought is to combine economy in the manufacture of the case with intrinsic merit in its structure, the principal points aimed at being the largest amount of room for the indicator mechanism in the smallest compass of case, and such a structure of a three-part case as will avoid strain on the rivets.

A simple, inexpensive, and efficient means for holding the sashes of a window at any desired adjustment, and locking them when closed, has been patented by Mr. Edwin L. Barber, of Larwill, Ind. The invention covers certain peculiar features of improvement upon that form of sash holder in which a bar is attached to the horizontal upper portion of the stationary window frame and depends to the upper edge of the bottom sash, and passes through a notch in the meeting rail of the same, each sash being provided with an attachment to the rod, which permit the sashes to be adjusted up or down upon the rod to open or close the window.

An improvement in the class of table frame whose rails and legs are connected by metal clamps having flanges that enter a groove in the legs, has been patented by Mr. James Pleukharp, of Columbus, Ohio. The improvement consists in providing the legs with vertical grooves which are inclined transversely toward each other, and the rails with grooves that incline toward the legs, and in locking the legs and rails together by means of metal clamps having flanges that enter the grooves.

An improved tire setter has been patented by Mr. Fredric P. Beucler, of Charleston, Iowa. The object of this invention is to facilitate the setting of wagon and other tires, and the adjustment of felly and spokes. It consists of a revolving swinging head carrying a central ring, which is provided with pivoted radial arms that can be retracted or extended to suit wheels of varying diameters, and is vertically pivoted in a block rocked on a vertically adjustable standard by levers from a horizontal to a vertical plane, and *vice versa*, whereby a wheel on the machine may be plunged into and withdrawn from a water tank.

An improved oiler has been patented by Mr. Alexander McMullen, of Ottumwa, Iowa. The object of this invention is to facilitate the oiling of pulley bearings, journal bearings, and other wearing surfaces, regulate the amount of oil applied, and prevent the escape of oil when not required.

Mr. William S. Bright, of Letart, West Va., has patented a stalled stock car, whose stalls can readily be enlarged or reduced in size to accommodate the largest number of animals, and the car is fitted so that the animals can be conveniently supplied with water.

An improved furnace for ventilating mines has been patented by Mr. John R. McBroome, of Woodville, Pa. This invention consists in a furnace of novel construction, placed in an arched passage within the mine, so that the furnace arch is surrounded at top and sides by an air space. The furnace arch and air space enter a vertical ventilating shaft at one point.

Mr. James Smith, of Philadelphia, Pa., has patented an improved apparatus for elevating bricks and mortar in hods It consists in features of construction for rendering the operation more perfect, and in a safety stop for preventing the hods from being carried over the upper wheels

Lead Poisoning by Cosmetics.

The death of a young lady in this city from lead poisoning by the excessive use of cosmetics has called out from Dr. Hammond the statement that the case was not an uncommon one.

"Lead poisoning," he said, "occurs more frequently than is generally thought. The public rarely hears of such cases. It is only once in a while that cases like that of Miss Blanchard attract the attention of the public outside of the medical profession. The use of any kind of cosmetics, even if not habitually indulged in, is attended with danger. There are very few, if any, that do not contain white lead. This poison is used in the manufacture of face powders, face washes, and hair dyes. Minute particles enter the skin and are taken up by the blood and communicated to the system. It produces various effects. Paralysis, colic, prostration of the nervous system, and insanity are among the most frequent results of its introduction into the system. A very distressing case came under my notice a few years ago, in the wife of the Governor of one of the Western States. She had been in the habit of using a certain hair dye—I forget the name at the present moment—which contained white lead in a large proportion. She became hopelessly insane, and death ensued finally. Another case was that of a young lady who used a so-called 'bloom of youth.' In this case paralysis preceded death."

In answer to the question touching the amount of lead necessary to be absorbed to produce symptoms of poisoning, Dr. Hammond said:

In some cases the quantity is infinitesimal, but it varies. The most common kind of poisoning is occasioned by the use of water conveyed in lead pipes. The family of Louis Philippe suffered from lead poisoning while living at Claremont. The water upon examination was found to contain but one grain of lead to the gallon. A lead colic was almost unknown in Amsterdam till the inhabitants began to substitute lead roofs for tiles, when a violent epidemic of the disease occurred and caused great ravages. In experiments which I instituted with reference to the action of water upon lead I found that one pint of water remaining in a bright leaden jar for six consecutive hours contained, upon being tested by passing a current of sulphureted hydrogen through it, one-seventh of a grain of lead—a proportion amply sufficient to have produced the most serious results if the water in which it was found had been used as a drink for a few weeks."

Winter Cholera in Chicago.

During the first three months of the present year a remarkable outbreak of what is called "winter cholera" occurred in Chicago and many parts of the Northwest. Fortunately the disease was not fatal, though it no doubt increased indirectly the fatality of other diseases. The characteristics of the outbreak were described as follows in a report to the National Board of Health, by Dr. H. A. Johnson:

"The epidemic of so-called winter cholera the present winter in Chicago is noteworthy as decidedly modifying the usual health condition of the city, and also for its own peculiarities. From all that can be learned from conversation with physicians it appears that it became suddenly prevalent about the holidays, though there are records of a rather unusual amount of diarrheal trouble earlier in December. From that time to the present the epidemic has continued with more or less violence, but now seems to be somewhat abating. It is not possible to even approximately estimate the degree of its prevalence with any certainty. The disorder has made no marked figure in the mortality reports, and there are no returns of non-fatal diseases. Judging from the number of cases mentioned to me by physicians as having come under their own observation and treatment, and allowing for the whole number in the city, as well as the very large probable number of cases where no physician was consulted, I should say that at least 15,000 or 20,000 cases have occurred; and perhaps 30,000 or 40,000, of all degrees of mildness or severity, would be more nearly correct. In one of the principal suburbs, where it was easier to make an estimate, and where it was to all appearances much less prevalent than in the city, nearly 2 per cent of the population were more or less affected. Here, too, according to the experience of some physicians, a majority of the cases were adult males, whose business carried them to the city every day. Popular opinion was at first inclined to attribute it to the excessive cold of the winter, and many physicians were inclined to share the opinion. Bad sewerage and ventilation could not be generally credited with its production, as it occurred equally where nothing was wrong in these respects. It is probable, however, that it was aggravated in some instances by bad sanitary conditions. The fact that the disorder occurred simultaneously in many widely separated localities over the country is against the idea of any local conditions producing it—such as the drinking water, which was constantly and carefully watched by Dr. DeWolf and the health officers without finding any marked impurities, notwithstanding that the Fullerton avenue conduit was discharging from the North branch into the lake all winter. A number of physicians of extensive observation strongly suspected a malarial element in the disorder. In this connection I may state that a well known physician from the interior of the State, Dr. Howard, of Champaign, has said that in his town he had seen a large number of cases of severe bowel complaint this winter in children, and very few in adults. In all, or nearly all, cases he found that the sufferers had been eating snow, and that the disease was apparently directly traceable to that. He also favored the idea of its malarial character, at least in part. The facts known are very suggestive, but it will require much more extensive inquiry at a later period to justify any positive deductions."

The prevalence of diarrheal complaints in Chicago has continued into May, and the general sanitary condition is described as extremely bad. The death rate was higher than it has been before in many years, particularly among children.

Distemper.

Ceilings and walls are often finished in distemper, but very often turn out unsatisfactory from the want of knowledge in the mixing and laying on. Absorption in the wall should be checked or stopped, or one part will absorb more color than another, and an uneven or spotty appearance results. Various preparations are used for preparing walls and to stop absorption. One of these is to mix about a dozen pounds of the best whiting with water, adding thereto enough parchment or other size to bind the color, about two ounces of alum, and the same weight of soft-soap dissolved in water; mix well and strain through a screen or coarse cloth. In mixing the distemper, one writer says, "two things are essentially necessary, clean and well washed whiting and pure jellied size." The whiting should be put to soak with sufficient soft water to cover it well and penetrate its bulk. When soaked sufficiently the water should be poured off, which will remove dust from the whiting. It may then be beaten up to a stiff paste by the hand or spatula. Size is next added and mixed together. Care should be taken not to break the jelly of the size any more than can be avoided. Another caution is that distemper should be mixed with jellied size to lay on well; the color then works cool and floats nicely, but when the size is used hot it drags and gathers and works dry, producing a rough wall. A little alum added to the distemper hardens it and helps to dry out solid and even. The best size is made from parchment clippings, which are put into an iron kettle filled with water and allowed to stand twenty-four hours till the pieces are thoroughly soaked, then they are boiled for five hours, and the scum removed. The liquid is then strained through a cloth.

For mixing colors the whiting and the color required, finely ground, are dissolved separately and then mixed to the required tint. For example, lampblack mixed with whiting makes gray, and the most delicate to the darkest shades may be obtained. For French gray the whiting required is taken and soaked in water, and Prussian blue and lake finely ground in water are added to produce the necessary shade or tint. Buff may be made by dissolving in like manner, separately, whiting and yellow ocher. A little Venetian red gives a warm tone. A good salmon tint is produced by adding to the dissolved whiting a little of the same red, just sufficient to tinge. Drabs of various tints can be easily made by grinding up finely a little burnt umber and mixing it with the dissolved whiting. The sooner the distemper color dries after being laid on the better, and the best plan is to close windows and doors during laying and throw them open afterward.—*Building News, London.*

Qualitative Analysis of Alkaloids.

As well known, reagents for certain alkaloids and their salts have hitherto been wanting. Mr. Maurice Robin proposes, in a new French scientific journal, *Revue Scientifique*, a new method of qualitative analysis of these substances based on the use of sulphuric acid and cane sugar.

A small portion of the alkaloid to be examined is mixed with double its weight of common powdered sugar in a small porcelain capsule, one or two drops of sulphuric acid are added, and the mixture is stirred with a glass rod.

Hydrochlorate of morphine treated in this manner give a very beautiful *rose* color, which passes very rapidly to *violet.*

The latter color is persistent, and resembles that which is obtained on dissolving permanganate of potash. Sulphate of quinine gives a color which is at first *greenish*, then *bright yellow*, and finally *coffee brown*, surrounded by a yellow circle.

Sulphate of atropine gives a *violet* color, which increases in depth till it becomes at length *brown.* With narcotine there is developed a persistent and very characteristic *mahogany* color which cannot be mistaken. With salicine, a *bright red;* with veratrine, a *dark green.* With codeine the reaction is especially manifest, and this is the more interesting from the fact that up to the present time we have had no precise reagent for this alkaloid. The color obtained is a magnificent and very intense *cherry red*, which soon changes and becomes *violet.* This violet tint, which is very beautiful, differs somewhat from that which morphine assumes; and, moreover, these two alkaloids are distinguished very readily by the first reaction, which, in the case of morphine, is accompanied by a *rose* color. This reaction may also serve to show whether, as sometimes happens, codeine has been adulterated with sugar. If adulteration *is* present the *cherry red* and *violet* will make their appearance, while pure codeine acted upon by sulphuric acid shows no change of color whatever.

Suspension by Subdivision.

To the Editor of the Scientific American:

The fact that substances which are quick to obey the universal law of gravitation when in a mass are apparently lighter when in a state of fine division, will doubtless strike most persons as singular when they consider that the relative amount of air displaced by each part of a substance must be the same whether the part be large or small; while to make a body really alter its weight compared to air, it is necessary that the relation between its weight and bulk should be changed. Its specific weight has clearly not altered. How then is the suspension of finely divided substances to be accounted for when, if the same subdivisions be collected into a mass, they will rapidly fall; and also in view of the fact that the force of gravitation acts upon each particle without regard to its neighbors, and will exert its powers whether the particles are separate or aggregate ?

It is easy to understand, for example, why a sphere of wood will fall more slowly than a sphere of lead of the same size, the wooden one presenting such a relatively greater resisting surface to the air compared with its weight than the one of lead.

Let us see, therefore, whether the mere act of dividing a substance can alter the relations of weight and resisting surface so as to permit an explanation of this phenomenon.

If two spheres of lead or other homogeneous substance, having the respective diameters of one and ten, be weighed, it will be found that their weights are related to each other as the *cubes* of their diameters, or as one to one thousand, while the relation between the areas of their great circles or surfaces of resistance are as one to one hundred, or as the *squares* of their diameters, thus making the resistance of the air relatively greater in the case of the smaller body.

Now, although only liquids resolve themselves into spheres when divided, yet this reasoning may be regarded as approximately true of the irregular subdivisions of solid bodies, while the levity of fog and clouds will be made more comprehensible. This principle is, of course, applicable to solids immersed in liquids, and also to the ascension of bodies of less specific weight than the fluids in which they are immersed. As the text books do not explain this common phenomenon, I thought that the above might prove interesting. WM. B. COOPER.

Philadelphia, May, 1881.

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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.

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For 25 cents, complete cure of hard or soft corns by use of German Corn Remover. Sold by druggists.

For Sequeira Water Meter, see adv. on page 316.

Books on Practical Science. Catalogues free. Pocket Book of Alphabets, 20 cts. Workshop Receipts; a reliable handbook for manufacturers, $2, mail free. E. & F. N. Spon, 446 Broome St., N. Y.

Essay on Inventions.—What qualities will make them profitable, and how to incorporate these qualities in inventions. 25 cts. postpaid. Address N. Davenport, Valparaiso, Ind.

Improved Skinner Portable Engines. Erie, Pa.

"Rival" Steam Pumps for Hot or Cold Water; $32 and upward. The John H. McGowan Co., Cincinnati, O.

The Eureka Mower cuts a six foot swath easier than a side cut mower cuts four feet, and leaves the cut grass standing light and loose, curing in half the time. Send for circular. Eureka Mower Company, Towanda, Pa.

The Newell Universal Mill Co., Office 34 Cortlandt St., New York, are manufacturers of the Newell Universal Grinder for crushing ores and grinding phosphates, bone, plaster, dyewoods, and all gummy and sticky substances. Circulars and prices forwarded upon request.

Pure Oak Leather Belting. C. W. Arny & Son, Manufacturers, Philadelphia. Correspondence solicited.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

The "1880" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 262 Dover St., Boston, Mass.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Long & Allstatter Co.'s Power Punch. See adv., p. 285.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 10 Cortlandt St., N.Y.

Peck's Patent Drop Press. See adv., page 300.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Wren's Patent Grate Bar. See adv. page 300.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 300.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 301.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

For Light Machinists' Tools, etc., see Reed's adv., p. 301.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Saw Mill Machinery. Stearns Mfg. Co. See p. 300.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

Saunders' Pipe Cutting Threading Mach. See p. 301.

For Machinists' Tools, see Whitcomb's adv., p. 301.

Clark Rubber Wheels adv. See page 316.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 316.

Safety Boilers. See Harrison Boiler Works adv., p. 316.

The Medart Pat. Wrought Rim Pulley. See adv., p. 317.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 318.

For Thrashing Machines, Engines, and Horse Powers, see illus. adv. of G. Westinghouse & Co., page 317.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'f'rs, 23d St., above Race, Phila. Pa.

Turbine Wheels; Mill Mach'y. O. J. Bollinger, York, Pa.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Brass & Copper in sheets, wire & blanks. See on p. 332.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels now in use, the superiority of their Castings over all others. Circular and price list free.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Co., Buffalo, N. Y.

Cope & Maxwell M'f'g Co.'s Pump adv., page 332.

The Twin Rotary Pump. See adv., p. 350.

Millstone Dressing Diamonds. Simple, effective, and durable. J. Dickinson, 64 Nassau street, New York.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Eagle Anvils, 10 cents per pound. Fully warranted.

The I. B. Davis Patent Feed Pump. See adv., p. 332.

Geiser's Patent Grain Thrasher, Peerless, Portable, and Traction Engine. Geiser M'f'g Co., Waynesboro, Pa.

Pat. Steam Hoisting Mach'y. See illus. adv., p. 333.

Houston's Sash Dovetailing Machine. See ad., p. 334.

Moulding Machines for Foundry Use. 33 per cent saved in labor. See adv. of Reynolds & Co., page 334.

New Economizer Portable Engine. See illus. adv. p. 333.

Rue's New "Little Giant" Injector is much praised for its capacity, reliability, and long use without repairs. Rue Manufacturing Co., Philadelphia, Pa.

Skinner & Wood, Erie, Pa., Portable and Stationary Engines, are full of orders, and withdraw their illustrated advertisement. Send for their new circulars.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new Injector, worked by a single motion of a lever.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Solomon's Parallel Vise, Taylor, Stiles & Co., Riegelsville, N.J.

Toope's Pat. Felt and Asbestos Non-conducting Removable Covering for Hot or Cold Surfaces; Toope's Pat. Grate Bar. C. Toope & Co., M'f'g Agt., 353 E. 78th St., N.Y.

Use Vacuum Oil Co.'s Cylinder Oil, Rochester, N. Y.

Don't buy a Steam Pump until you have written Valley Machine Co., Easthampton, Mass.

Lightning Screw Plates and Labor-saving Tools, p. 333.

Use the Vacuum Oils. The best car, lubricating, engine, and cylinder oils made. Address Vacuum Oil Co., No. 3 Rochester Savings Bank, Rochester, N. Y.

Skinner's Chuck. Universal, and Eccentric. See p. 333.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) W. R. S. asks: 1. How can I successfully weld cast and spring steel? Please give fluxes best adapted for each. A. You will find directions in 'Spons' Workshop Receipts," page 361. 2. What is the best flux for welding iron? A. Silex is most commonly used, also borax, and sometimes a mixture of the two. 3. Can cast iron be welded? A. No, but they can be united by burning. 4. What is the best method of tempering taps and dies? Is there any brand of American steel as well adapted for these as the English steel? A. Each maker has his own especial process. Sometimes the heating is regulated by heating in a composition having a determined temperature and then cooled in water. Others heat in a clear fire and cool in a special fluid.

(2) F. G. writes: To settle a dispute among foundry men please state the height which the tuyere should be from the base in a cupola 22 inches diameter in the clear? A. From 14 to 16 inches.

(3) H. C. asks: Has a boiler, 44 inches diameter and 26 feet long, showing 100 lb. steam, more power than a boiler 36 inches diameter and 26 feet long, with the same pressure? A. The pressure of steam determines the power. The form of boiler does not influence the question.

(4) J. A. G. asks: Can you tell me of any good method of bleaching woolen blankets, etc., without the use of sulphur? We have always used sulphur, but it gives a very unpleasant smell to the goods. A. We know of no way of bleaching such goods that will compare favorably with the sulphur method. If properly washed after bleaching no unpleasant smell will remain.

(5) J. L. L. asks (1) for the best way to frost machine work. A. Use fine emery cloth or paper on a small revolving disk. 2. Is there a better way of finishing up work than by the use of emery cloth? A. For plain surfaces use French emery paper, for irregular surfaces use emery cloth.

(6) W. B. P. asks how to ascertain the height of a steeple, using as the surveying instrument a pocket rule bent so as to form a right angle. A. Open your rule so as to form a right angle, place one arm of the rule on a level surface in the same plane with the base of the steeple, allowing the other arm to stand vertically; place a straight edge against the side of the rule so as to touch both arms and look along the straight edge, moving it until it is exactly in range with the top of the steeple. Now by noting on the rule the perpendicular height and base of the triangle, of which the straight edge is the hypothenuse, you have the proportions of a triangle of which the distance between your point of observation and the center of the base of the steeple forms the base; *a*, being the base of your triangle; *b*, its perpendicular height; *c*, the distance from observer to center of base of steeple; and *d*, the height of the steeple, your formula would be, $a : b :: c : d$.

(7) M. L. asks: 1. How many cells on each end of the Watson battery will it require for a telegraph line three miles in length? A. Use about eight cells at one end only. We cannot give definite information in regard to this without knowing the resistance of the line. 2. Does it need more battery for a ground connection than a continuous wire? If so, how much? A. No, providing the ground connections are good. 3. Which is the best way to make ground connections? A. Connect with gas or water pipes if you have them; otherwise, bury a sheet of copper 2 feet by 6 or eight feet in ground that is always moist, and fasten your ground wire to it by soldering. 4. Will sounders, with relays of twenty ohms, work successfully on the above line? A. Yes. 5. What distance is considered one ohm resistance? A. 330 feet of No 9 B. wire gauge iron wire has a resistance of one ohm—a trifle over sixteen ohms to the mile; No. 10, about nineteen and a half ohms to the mile; No. 12 about thirty ohms to the mile.

(8) H. B. C. asks why an injector or inspirator will not do its work so perfectly when fed direct from water mains as from a tank. I have found that such is the case, and a number of theories have been advanced; but I apply to you for information. A. Probably because the current or agitation of the water in the main affects the regularity of the jet through the injector. This has been found to be the effect in other cases.

(9) J. L. asks: 1. If to an engine, 7 inches by 10 inches, running with 100 lb. pressure, cutting off at ⅝ stroke, another cylinder 12 inches by 10 inches be added, into which the first is to exhaust, and thence into the atmosphere: what will be the gain? A. From 30 to 35 per cent. 2. Will the area of ports in large cylinder have to be proportionate to its piston area, or will the area of ports of small cylinder do? A. Ports should be in proportion to area of piston. 3. Will the arrangement be of practical value? A. Yes, but it is very old.

(10) A. J. T. asks: Are the bulbs of spirit levels made curved for any particular purpose? If so, for what purpose? A. The glass is curved so that the bubble of air will rise readily to the central point of the glass.

(11) J. R. G. asks (1) how to make a paste to put fancy cards in an album, something that will not draw the paper and hold the cards perfectly tight. Have tried a prepared paper, but it does not answer my purpose. A. Thick starch paste mixed with a few drops of clove oil answers very well. It is better to strain the paste while hot through a coarse linen cloth to remove lumps. Use a rather stiff brush. 2. Will not an ordinary red paper do for making a lantern? A. No. 3. Tell me how to make a cheap drying box for drying the plates? A. Make a frame of three-eighths inch smooth pine, of a width and depth to suit the plates and long enough to hold two dozen plates one-eighth of an inch apart. Nail across this lengthwise at the top, close to the sides, two half inch pine strips notched at the face so as to loosely grip and hold the plates one-eighth of an inch apart. Similar notched strips are tacked inside at the bottom so as to support the plates and hold them apart. 4. Tell me how to make a sensitive paper to use on these plates? A. Nitrate of silver, 5 drachms; distilled water, 5 oz.; nitric acid, 2 drops; purified kaolin, 1 oz. Add the latter after the silver is dissolved, shake, and let settle. Pour off the clear solution into a clean shallow porcelain dish. Having cut good albumenized paper to the proper size, place it gently, albumen side down, upon the surface of the bath, lifting each corner in turn and letting it down slowly to exclude air bubbles. Remove from the bath in about two minutes, and hang it up by the corner to dry in the dark. When required for use expose it for about ten minutes to the fumes of aqua-ammonia in a tight box. 5. Will gelatine that you buy in grocery stores answer as well as Nelson's No. 1 gelatine? A. No, not very well.

(12) P. M. asks how to reclaim silver accidentally dropped in some diluted nitric acid. A. Dilute the acid solution with an equal volume of water and add muriatic acid until no further precipitate forms. Let settle, pour off the liquid, cover with clear water slightly acidified with muriatic acid, add a few fragments of clean zinc, and let the action proceed until the white chloride is reduced to spongy metallic silver. What remains of the zinc may then be picked out, the liquid poured off, and the silver washed with boiling water to remove all zinc chloride and cause the fine metal to dry quickly when placed to drain on filter paper. Mixed with a little borax and heated to bright redness in a small clay or blacklead crucible, the dry, spongy metal will melt and afford, on cooling, a button of compact and pure silver.

(13) F. W. writes: I am building a steam buggy, two engines, cylinders 2x4, with 50 lb. of steam what power will I get? Will boiler 15x30, with 30 one-inch tubes, 18 inches long, be enough to run them? A. With your boiler about 1½ horse power, your boiler is but about half large enough for your engines.

(14) J. M. J. writes: We have sunk a wood curb well, 12 feet square, 25 feet deep, near the bank of the Missouri river, from which we can take clear water, it soaking through the earth from the river; friction on the sides of the curbs prevented us from sinking further; also, in drawing water therefrom and taking out the sand when sinking, the quicksand would flow in about as fast as we could take it out, thereby causing the earth surrounding the curb to cave in and endanger the foundations of the buildings near the well. Now, in driving 2½ inch well points, from which we are satisfied we can get the same clear water, would they have a tendency to cause the quicksand to run in the same proportion as it did with the large well, and which make of well points in your opinion would be most suitable for the purpose? A. If there is underlying quicksand, the 2½ inch wells will draw it off and in time produce the same evil result as the large well. There are two modes you can pursue: either drive your 2½ inch well through the quicksand, so as to draw the water from lower strata, or select a location where you will avoid the quicksand, which you can do by boring.

(15) W. B. asks: 1. What could I put on an iron cider screw to keep the cider from eating it? It makes our vinegar dark colored. A. Clean the screw occasionally and keep every part of it well oiled. 2. Which would have the most force at the bottom: a tube one inch in diameter and ten feet high, filled with water, or a funnel-shaped vessel with an opening at the bottom the same as the tube, ten feet high, five feet in diameter at top, filled with water? Both vessels are to be kept full of water. A. The pressure per square inch at the bottom would be the same in both.

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Telegraphy, O. Lugo, New York city.
Wheels for railway vehicles, R. N. Allen, Chicago, Ill.

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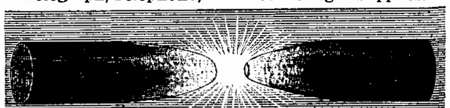

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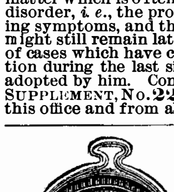

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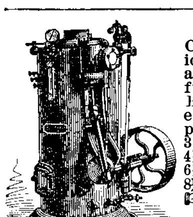

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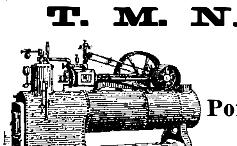

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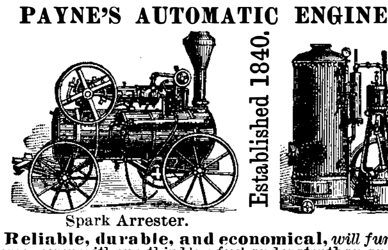

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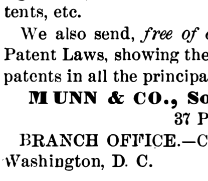

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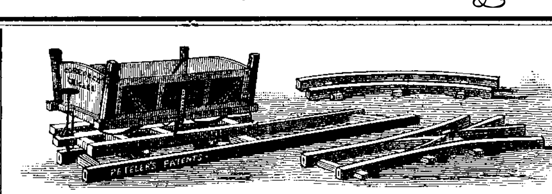

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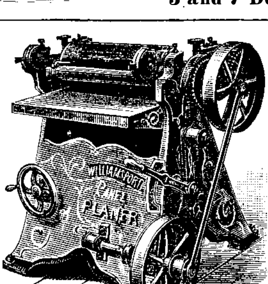

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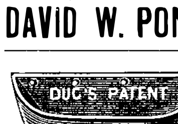

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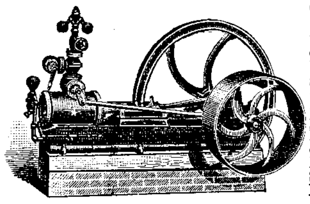

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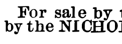

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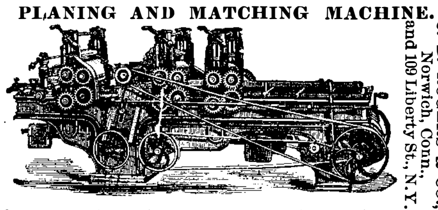

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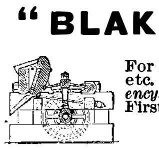

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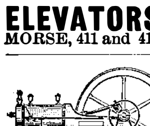

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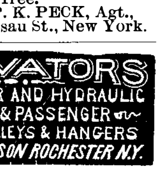

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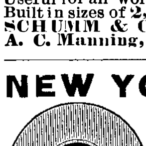

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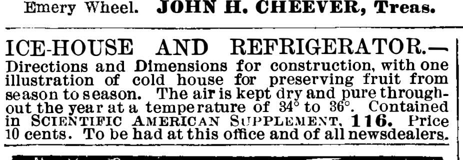

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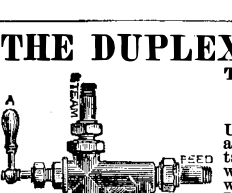

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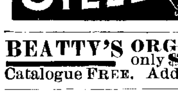

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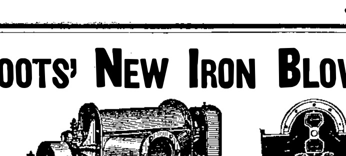

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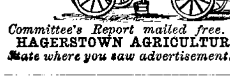

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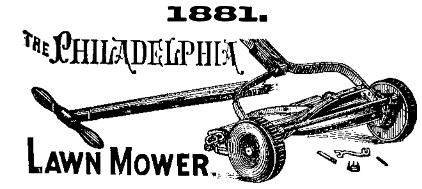

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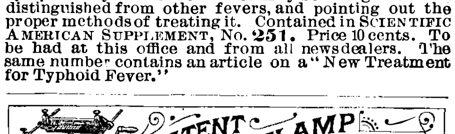

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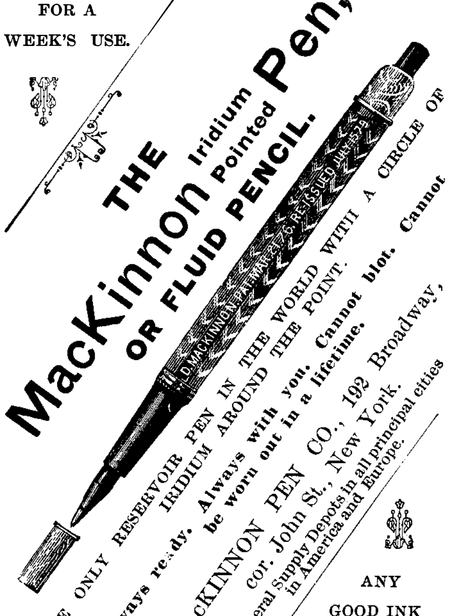

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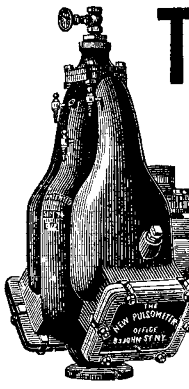

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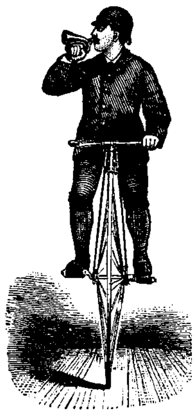

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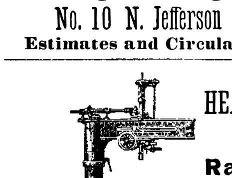

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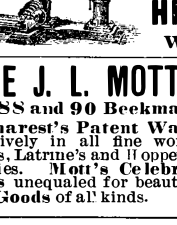

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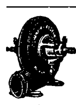

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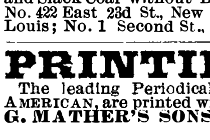

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