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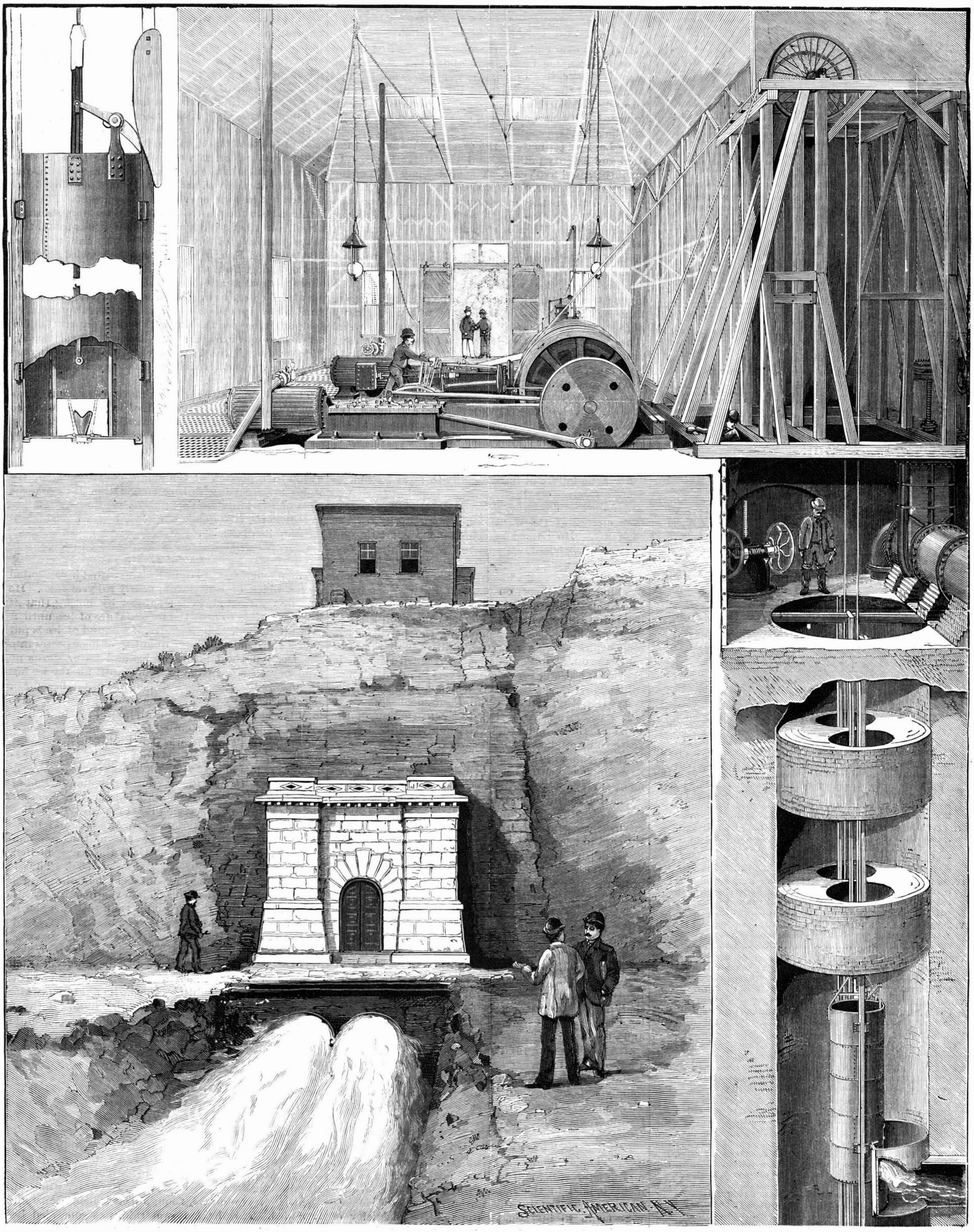

THE NEW CROTON AQUEDUCT—THE HARLEM RIVER SIPHON AND PUMPING APPARATUS.—[See pages 36, 40, 41.]

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Contents.

(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 759.

For the Week Ending July 19, 1890.

Price 10 cents. For sale by all newsdealers.

COST OF THE NEW AQUEDUCT.

The new Croton Water Works for New York City have so far cost a little over twenty-three and a half millions of dollars. It is expected the water will be let on within a few days. The total length of the new aqueduct is 33⅛ miles, of which 30¾ miles is in the form of a tunnel, mostly through solid rock, 18 feet diameter, lined with brick 16 to 18 inches thick, filling of concrete, interior diameter for the most part of 14 ft. The delivering capacity is three hundred and ten millions of gallons per day. The work of excavating the tunnel was begun March 7, 1885, and finished July 7, 1888. This may be regarded as excellent progress, and shows the practical advantages of using the best and most improved tools.

THE PANAMA CANAL BUBBLE.

It is now over eight years since work was first begun upon the Panama Canal, and about two years have elapsed since active operations were suspended. The total cost of the work up to the present time, including the indebtedness of the company, is estimated at seven hundred millions of dollars, and the canal is hardly half finished.

De Lesseps' estimate of the cost in 1881 was one hundred and twenty millions, and the time required to open the canal five years. The mismanagement of the enterprise has been conspicuous, and the swindling practiced upon the company fearful. Among the methods of deception the following system was at the time reported. When a ship arrived with a cargo of coal, a small portion would be landed and vouchers given for the whole cargo; the ship would then depart and return again in a short time, ostensibly with another cargo, for which new vouchers would be given; the same trick would then be performed again. Thus by the knavery of its agents, who were simply plunderers, the company paid for materials several times over. There were rumors of frauds in almost every department of the work. There seems to have been a woful lack of that rigid business organization, and close scrutiny of details, which should govern in such an undertaking, in order to secure economy and success. Much of this laxity was doubtless due to the deadly and enervating climate, which almost at the beginning of the work carried to the grave several of the ablest and most experienced chief officers and many of their valued assistants.

After the failure of the company to meet its obligations, a receiver, as we should term him, but in France he is called a liquidator, M. Brunet, was appointed to take charge of the work and the properties of the company. He named a commission, consisting of twelve independent, experienced, and prominent persons, among whom were engineers and professors, who were charged to visit Panama, examine the works and machinery, and report on the best way of completing the canal, the further costs, etc. Efforts were also to be made to obtain a renewal of the concession granted by the Colombian government, as the privilege will soon expire—having now only a little more than two years to run. The commissioners reached Panama in December last and investigated everything with much care. Their report has lately been made to the Chamber of Deputies, and is anything but encouraging.

The committee says that the construction of the canal at the calculated level would occupy twenty years and would cost 1,737,000,000 francs—$347,400,000. In the opinion of the committee the work could only be completed on the basis of an international agreement or a syndicate of the states interested.

The report further states that, taking into account the interest to be paid during so long a period without any receipts, and also the general financial charges, the capital necessary must be estimated at three milliards of francs, or say six hundred millions of dollars.

A further report deals with the defects and omissions of four plans proposed for the completion of the canal. According to the first of these plans, the canal is to be isolated, no use being made of the existing waterways. The second plan proposes to make use of such waterways. The third provides for a ship railway as a portion of the proposed interoceanic route, and the fourth for a ship tunnel through the high land at Culebra.

Meantime the unfortunate shareholders have petitioned the French Congress, asking that the liquidator shall prepare a statement showing precisely what has been done with the money received by M. De Lesseps and the directors. More than twice the sum they stated would be required has been subscribed, and the creditors now believe it was obtained upon false representations. They seek to have the directors made personally responsible for their losses, and hope in that way to recover back at least a portion of their vanished treasures.

The Plasticity of Ice.

Mr. Thomas Andrews, F.R.S., recently read a paper on this subject before the Royal Society. The experiments named in the paper form a continuation of a previous research by the author. The experiments were made to investigate the relative plasticity of pure ice at various temperatures, ranging down to —35 deg. Fah. The arrangements of apparatus used in determining the plasticity of pure ice, and also of pond ice, are illustrated in detail in the paper.

The ice for the pure ice experiments was frozen from distilled water; the coldest freezing mixture used, consisting of three parts by weight of crystallized calcium chloride and two parts by weight of snow, yielded a constant temperature of —35 deg. Fah. Other freezing mixtures were used for the temperatures above this. The cylinders of pure ice employed were 2 feet 1½ inches long and 2 feet 1½ inches diameter, and weighing 470 pounds. The plasticity was ascertained by measuring the relative penetration during equal periods of time of the polished steel rods into the ice, care being taken to avoid errors from conductivity. A large number of experiments were also made on the plasticity of natural, lake, or pond ice. The influence of the composition of water on the plasticity of the ice frozen therefrom was investigated, and a number of experiments were made to ascertain the proportion of the saline constituents of the lake water taken up into the ice during crystallization.

Roughly speaking, it was found that the proportion of inorganic matter in the melted ice was about 10 per cent of the total inorganic salts contained in the lake water from which it was frozen. The general summary of results of the experiments on the plasticity of pure ice at the various temperatures employed are plotted out in four curves, and the results of the experiments on the plasticity of pond ice were shown in detail. In the majority of instances it was found that if the plasticity of the ice at —35 deg. Fah. be called one, at 0 deg. Fah. it would be about twice as much, and at 28 deg. Fah. the plasticity would be about four times as great as at 0 deg. Fah., or eight times as much as at —35 deg. Fah. The comparatively great contractibility in ice observed at considerably reduced temperatures—see the author's former paper "On Observations on Pure Ice and Snow," Royal Society "Proceedings," No. 245, page 544—may probably account for the great reduction in its plastic properties at low temperatures.

This is in accord with the practical cessation of motion in glaciers during the cold of winter. It was also noticed in course of the research that the plasticity of the naturally frozen pond ice was manifestly greater than that of the prepared pure ice. The comparative difference in the behavior of the pond ice was doubtless owing to a portion of the saline constituents of the water interspersing during congelation between the faces of the individual crystals of ice, thereby tending to reduce the cohesion of the mass as a whole, and increasing its plasticity.

Latent Heat.

The phenomena of latent heat were first investigated by Dr. Black, of Edinburgh, nearly 130 years ago. He was first attracted to the subject by noting that it was impossible to raise the temperature of ice until it was all melted. For instance, if a pound of ice is put over a spirit lamp, a large quantity of heat passes into the ice, but the mixture of ice and water shows no tendency to rise in temperature until all the ice has disappeared. The question then was what became of the heat. It was proved that the heat was used to melt the ice, but where did it all go to? It had disappeared and was unaccounted for.

Another experiment was tried in which a pound weight of water at 100° C. and a pound of water of 0° C. were mixed, and the result was two pounds of water at 50° C. In the mixture the pound of boiling water gave up 50°, reducing its temperature one-half, and the cold water receiving it is raised to 50°. But if instead a pound of water at 100° C. and a pound of ice at 0° be mixed, we have two pounds at the same temperature, but the mixture, when the ice is melted, would show but about 10° C. instead of 50°. Thus it would appear that 80 units of heat had disappeared and were unaccounted for. The experiment was then tried, from which it was found that this 80 units of heat reappeared when water was converted back again to ice, and this heat was manifest and given to the surrounding bodies. The question was: Where does this heat go to and where does it come from when it reappears? Dr. Black answered that heat was a kind of matter, a subtile and elastic fluid, and water had a great capacity for holding this fluid. Between the molecules of the water, it was said, there are minute spaces into which the heat finds its way, and there lies hidden as long as the water remains in the liquid state. In this condition the heat produces no sensible effect on the thermometer. But no sooner does the water begin to pass back into the solid form of ice than this heat is forced to come out from its lurking place and to make itself sensible once again. This was the doctrine that prevailed down to the close of the last century. The same action is seen in making steam, for if heat be applied to water, the temperature will rise until the boiling point is reached, and if the steam formed is allowed to escape, the water will show no higher temperature, though heat is being constantly added. This heat, it was said, was concealed between the particles of the vapor, and was squeezed out again when the vapor was changed back to water. This is what is known to-day as latent heat, just as it was called by Dr. Black, and the point for the engineer to remember is that in making steam 966 of the units of heat required to make a pound of steam at atmospheric pressure disappear and have no effect on the thermometer; also that when the steam is condensed, this heat reappears and is sensibly felt, hence is not lost.

But although it has disappeared, the modern theory of heat as a kind of motion does not allow this idea that it is hidden somewhere and can be found by shaking. According to the modern theory of heat, when we add heat to a mass, we do not pour into it a certain quantity of matter, but we impart to it a certain amount of energy. This energy goes to pull asunder the molecules of the ice against the molecular action that tends to keep them locked together in solid form. In overcoming these forces the heat expends itself, and ceases to exist as heat. Hence the term latent heat is hardly applicable. To make this theory clear, assume two blocks of lead suspended by two strings from one point. Under the influence of gravity each tends to place itself vertically below the point of suspension, and thus they cling together with a certain small force. If we wish to pull them asunder, we must overcome the force that is pulling them together, and in doing so expend a certain amount of muscular energy. If we allow the blocks to go, they will fall together and acquire an energy of motion equal to that expended in separating them. In the transformation of ice to water, and water to steam, this same process is seen, for the particles cling together and resist separation. Heat is the agent by which we overcome this attraction, and in doing so it expends its energy until all the particles are separated and the block of ice becomes the liquid water or the liquid water the vapor steam. The heat has disappeared as heat and has become energy. Hence the term latent heat is not applicable in a strict sense. It is applicable to this extent, that as the particles of water and steam are held apart they possess a certain amount of energy of motion which will cease when the particles come again in collision, and be converted into the energy of heat. It was so with the two blocks of lead on a large scale, and exactly the same on an indefinitely smaller scale in the conversion of water to ice and steam to water. The energy of motion of the steam is changed into heat by condensation. Hence all the heat that disappears to separate the particles of the water to make steam is given up and becomes sensible when the steam is condensed and becomes water. This heat disappearing and appearing again is what is known as latent heat, yet our engineer friends will understand that when it has disappeared to make steam it is no longer heat that can be shaken up and driven out of its hiding place, but energy which can be converted into heat again by condensing the steam. It is this fact that makes steam such an efficient vehicle of heat, because in condensing it so much heat is produced in its change of form. It is put into the boiler and carried in the steam as energy, but all is given up again. Therefore there is no loss.—*Bos. Jour. of Commerce.*

Files.

BY JAMES D. FOOT.

Files is a word which to the average mind conveys various meanings. Persons looking at the word associate it with newspaper files, stationers' files for properly assorting invoices, letters, etc., but to the mechanical mind it represents a tool which for centuries has been the mechanic's best friend, and sometimes the convict's in his prison cell. It is the object of this article to dwell especially on files as applied to the various mechanical arts, and it may be of interest to know the various materials used as files from the earliest ages. The first application of any article as a file we find by research to have been the dried skin of certain fish. As arts progressed, copper was treated in such a way as to produce a file sufficiently hard to work the softer metals. At a later period, when iron was largely used for armor, house trimmings, and decoration, the people of that age succeeded in forming a metal harder than iron, and practically what is known by the present generation as steel. From that time on this material has been used exclusively for the manufacture of files.

Jumping from this early period several centuries forward we find in Switzerland, Germany, and France files being made of all grades of cut, both fine and coarse, large and small; most of the work being done by families in their houses, their work being afterward assembled by one large factory and in turn placed on the market with dealers and large consumers. It is not necessary to mention the various manufacturers of these files. Those which are perhaps best known in the market to-day are manufactured in Switzerland, and known by the maker's name as the "Grobet" files. The common shapes of these files are flat, hand, half-round, round, triangular, and square, and at the present time this special brand of file is principally used by jewelers, silversmiths, etc., on the finer class of work—files being cut with teeth so fine as to finish to a polish gold material without showing a scratch on the surface. Formerly these files were cut entirely by hand, but for the past twenty years part of them have been cut by machine and part by hand. To cut most of the shapes by hand a chisel and hammer are used. Where cut by machine the chisel is used in connection with a plunger or hammer worked by a machine. On the finer grades of round files and the backs of half-round, the cutting is done by what might be called a system of etching, that is rubbing in the teeth by the use of a large file. Persons sometimes ask how it is that a tooth can be raised on a file which is so hard as to file or cut other hard material. The answer to this is that the blank before being cut is annealed so as to be as soft as the softest iron. After it is cut and goes through the various processes it is then tempered, or in other words the carbon restored to it, and the needle-like points are thereby made extremely hard and tough. Space will not permit the writer to give an extended account of the manufacture of files at the present day. If brief, where twenty-five years ago all files made in this country were virtually cut by hand, to-day over 90 per cent of the files used are cut by machines; in fact, most of the work necessary to produce a file is to-day done by the operation of the machine.

The process of making the files of to-day, briefly, is as follows: The manufacturer of files first secures his steel rolled to proper shape and size from the steel manufacturer in bars about eight feet in length. After the steel is received it is cut into proper lengths to make the various size files, and then passed under power hammers, where the shape and tang of the file is produced. The file is then known as a black file blank, and this process is known as forging the blank. From the forging it goes to what is known as the annealing department, which consists of large ovens in which the files are stacked or placed in a mass surrounded by a hot fire. At the proper time, when files are at the right heat, the fire is allowed to burn out and the files cool gradually, being kept entirely from contact with the outside air, this cooling process taking perhaps two or three days. When the blanks emerge from this fire they are then known as annealed blanks, that is the carbon has been extracted from them without destroying the quality of the steel. After these blanks are straightened on an anvil and put in shape for grinding they are then taken to large machines, where several are inserted at a time and brought with great force against the surface of a revolving grindstone. This produces an abrasion on the surface of the blank, it being necessary to remove the scale or what is known as the "skin" of the steel. These stones are about 6 feet in height, 12 inches face, and weigh something over two tons, and it requires about 25 horse power to run one of these machines in which the stones are used, the stone revolving about 200 revolutions a minute. When the blanks are finished on these stones they have a bright, polished appearance, and are known as ground blanks.

Where, owing to the shape of the file, as in round and half-round, it is not possible to grind by use of the machine, what are known as hand-stones are employed, the work being accomplished by hand instead of by machine, the result being the same. These blanks are now supposed to have a true surface and be ready for cutting; that is they are soft and free from scale, or what is known as the "skin" of the steel. From this point they go to the department where cutting machines are used, and here, by the blow of chisels, very short in length but as to edge and shape very much like the ordinary chisel of carpenters' use, ridges of metal are raised on the blank, producing what are known as the teeth of the file. Where the lines of ridges intersect they form a diamond-pointed tooth and make files such as are used for general machinists' use.

For filing hand saws and mill saws they are cut with what is known as a single tooth, or only one long line or ridge extending across the face of the file. This ridge may be coarse or fine, according to the class of work the file is to accomplish (this also applies to the other form or diamond-pointed tooth previously mentioned), some of them being so fine as to necessitate the use of a magnifying glass to be seen, while others have from 10 to 14 to the inch.

Passing from the cutting shop, files then go through several processes, finally being ready to temper. When the tooth of the file is properly protected by what is known as pasting, the file is immersed into a bath of hot lead, commonly called "tempering pots," where it remains until it becomes what would ordinarily be called red hot, but what would be called by the practical man as "low cherry red." It is then taken from the bath and immersed in a tub of water more or less chemically prepared, and in this transformation takes back its carbon formerly given up in the annealing and becomes the hard-tempered file, ready for use to file anything from moderately hard steel to the softest metals or wood. After tempering there are several other processes, such as scouring, oiling, packing, etc., and the file is then ready for market, being placed in neat boxes, 10 inches and under a dozen in a box, 11 inches and upward one-half dozen in a box.

About two thousand tons of grindstones are used in the manufacture of files yearly, while probably from 4,000 to 5,000 tons of steel are annually cut up and made into files. The larger concerns of this country manufacture or have the capacity to manufacture from 800 to 1,500 dozen a day, and over 90 per cent of the files now used are cut and almost entirely made by the use of machinery. To a very small extent for making a few special files, or for recutting old files, the work is still done by hand, but this process of manufacture is fast becoming a thing of the past.

Artificial Emeralds from Gas Retort Refuse.

Owners of precious stones were surprised a short time since by the announcement that a method of producing artificial emeralds and other gems from the refuse of gas retorts had been discovered by Mr. Greville Williams, F.R.S., the chemist of the Gaslight and Coke Company, London. According to a contemporary, the gem which Mr. Williams has modeled is composed of about 67 to 68 per cent of silica, 15 to 18 per cent of alumina, 12 to 14 per cent of glucina, and minute proportions of magnesia, carbon, and carbonate of lime. The intensely green color for which the jewel is valued is believed to be due to a slight dash of sesquioxide of chromium, though this tint has by some chemists been attributed to vegetable matter—the analyst having to proceed warily when dealing with such costly stuffs as diamonds and emeralds. It may, therefore, be presumed that Mr. Williams has turned out his artificial emerald by skillful fusing and crystallization of these ingredients. It seems, however, that there is nothing very new in the artificial production of precious stones—these having been made upward of sixty years ago. In 1837 Gaudin produced rubies by heating ammonia, alum, and potash by means of the oxy-hydrogen blowpipe; the intense heat developed by this apparatus volatilizing the potash and the alumina, then crystallizing in rhombohedral forms identical with those of the natural stone, and having the same specific gravity and hardness. The artificial production of precious stones is interesting from the standpoint of the chemist and mineralogist, and in the present case the gas manufacturer may be included; but the cost entailed is too great to allow of the operation being a commercial success, and therefore the dealers in these adornments will probably not have to close their shops as the result of Mr. Williams' discovery.

Remarkable Electrical Invention.

"The woods are full" of wonderful electrical inventions, some good, some bad, and some so supremely foolish as to make one wonder that any man of average intelligence should waste a second thought on them. But turn the ordinary newspaper reporter loose on anything which has a suspicion of electricity or magnetism about it, and he will see, if not "sermons in stones," at least some wonderful manifestations destined to overturn all previous conceptions of force, power, and mechanical theory. "Heat as a mode of motion" is nowhere as compared with the deductions of these modern Tyndalls. The latest instance of reportorial credulity we find in a daily exchange. It is so good, and so far from being true, that it merits special mention. The invention described consists of two twenty horse power boilers to which is temporarily connected a ten horse power boiler, engine and dynamo. Steam is raised in the small boiler, the engine drives the dynamo, the wires from which are connected with the ends of the tubes in the larger boilers, the tubes being filled with asbestos. The current of electricity is turned on and, *presto!* the asbestos becomes red hot, the water in the large boilers is converted into steam and forty horse power is the result. This process can be multiplied without limit, and it is only a question of a string of boilers, engines and dynamos a mile or two long to put Niagara totally in the background. Shades of Carnot, Joule, and Watt, what will come next! exclaims the editor of *The Stationary Engineer*, from which paper the above is copied.

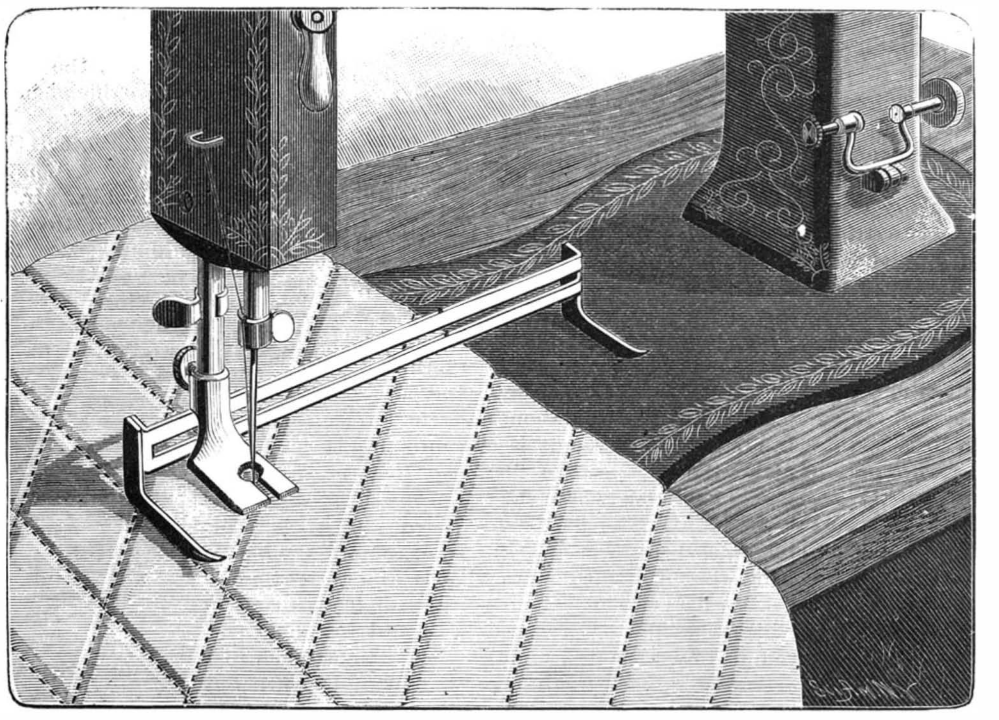
William L. Gilbert.

William L. Gilbert, aged 84, of West Winsted, Conn., died recently near Toronto, Can., whither he went several weeks since on business. He had been fifty years president of the Gilbert Clock Company, of Winsted, very prominently identified with many large factory interests in Winsted, and with railroad interests of Connecticut, as well as banking interests of the State. His fortune is estimated at $3,000,000. He built and endowed the Gilbert Home, of Winsted, a few years since, at the expense of $500,000. He was also the promoter of a project to tunnel the mountain so as to connect the waters of Crystal Lake with Mad River, with a view of giving increased power to about twenty Winsted factories. His promised donation to that project was $50,000, and it is thought some provision has been made in his will so that the project can be consummated. Mr. Gilbert was extensively known from Maine to California.

AN IMPROVED GUIDE FOR SEWING MACHINES.

The illustration represents a sewing machine gauge capable of use either as a right or left hand gauge, without being detached from the machine; it is also a device which may be expeditiously and conveniently adjusted, and is of simple, economical, and durable construction. The invention forms the subject of a patent issued to Mrs. A. La Guayra Mayo, of West Duluth, Minn.

The device has two main parts, the gauge bar and a perpendicular standard, to which is attached a sleeve adapted to receive the presser bar of a machine and be secured thereto by a set screw or equivalent device. The gauge bar is capable of sliding upon the standard, and has at each end a downwardly extending arm with right-angled extension having a curved outer end, forming feet for the gauge bar. Upon the inner face of the standard is a slideway, formed by a bracket secured to the standard, and the body bars of the gauge are introduced into the bracket, the adjustment being made by a set screw, whereby the gauge bar may be slid to the right or left and secured at any point in its length. When the gauge bar is placed in position the lower edge of the horizontal section of its feet-arms is practically in the same plane with the lower edge of the standard, or the arms may extend farther downward than the standards, as in practice may be found most desirable.



MAYO'S GUIDE FOR SEWING MACHINES.

A HEMMING ATTACHMENT FOR SEWING MACHINES.

The invention herewith illustrated relates to an improvement especially designed to facilitate the hemming of all articles that require a wider hem than the ordinary fell, providing a device that will turn a hem from a quarter of an inch in width to about seven and a half or eight inches in width, and also providing means whereby a draw-string, ribbon, or tape may be inserted in the hem. The hemmer also has a double gauge, and is made in a simple, durable, and practical manner. It has been patented by Mrs. A. La Guayra Mayo, of West Duluth, Minn.

The body bar of the device has a vertically apertured post integral with its upper face, in which the presser bar of the machine is secured by a set screw passing through to a contact with the presser bar. The frame consists of two side bars, one of which is provided with a scale of inches, the side bars being connected at their outer ends by a cross bar resting upon their upper surfaces, while a forward cross or guide bar is formed integral with one of the side bars, and extends at right angles therefrom. The latter guide bar is bent downward to form a vertical flange, so that the guide bar resembles an angle iron. The body bar, carrying the vertical post, is adjustably attached to the longer of the two side bars by a spring clamp or clasp, its other end resting upon or sliding along the side bar having a scale. The hemmer proper is secured to the edge of the body bar, and may be of any desired construction.

In operation the body bar is moved upon the side bar until the inner face of the body bar is made to register with the inch or fraction of an inch to which the hem is to be turned, when the material is passed under the entire frame and body bar, carried down in the direction of the guide bar, and beneath it and into the hemmer. A ribbon or tape may be inserted in the hem by placing it beneath the gauge, and in lace it can be used as a border, and in heavy material as a draw-string.

MAYO'S HEMMING ATTACHMENT FOR SEWING MACHINES.

WOOD brought to a mirror polish is coming into use for ornamental purposes in Germany, and has this advantage, that, unlike metal, it is not affected by moisture. The stuff is first treated with a bath of caustic alkali for two or three days, at a temperature between 164° and 197° F. Next comes a dip in hydrosulphate of calcium, for from twenty-four to thirty-six hours, after which a concentrated solution of sulphur is added. After another soak in an acetate of lead solution, at 95° to 120° F., it is thoroughly dried and polished with lead, tin, or zinc, as may be desired, when it resembles shining metal.

Thunder Storms.

Robert H. Scott, in *Longman's Magazine*, says a flash of lightning a mile in length is nothing very extraordinary, and it is therefore not to be wondered at that experiments to bring electricity down from the clouds are very dangerous, and have frequently had fatal results. Soon after Franklin, in the last century, had made his famous experiment with a kite, and proved that electricity existed in a thunder cloud, natural philosophers generally began to imitate him. One of them in St. Petersburg, a Professor Richmann, arranged an apparatus to collect this electricity. On the first occasion of a storm he went to his laboratory to observe the effects. A ball of fire was seen to leap from the apparatus to his head, and he fell lifeless. Having thus got some idea of the force exerted by lightning, it may be interesting to the reader to learn something as to the means we possess of guarding ourselves, or rather our houses, from injury. A flash of lightning really consists of a discharge between two objects, say two clouds, or a cloud and the earth, oppositely electrified, the charges on which suddenly combine, with the manifestation of light and heat. Lightning conductors are contrivances by which the electricity of the earth is allowed to escape quietly into the atmosphere, where it meets with electricity of the opposite character from the clouds, and the two neutralize each other quietly, without any explosive discharge, or, in other words, without lightning. I need not go back to the first principles of electrical science and explain why it is that electricity passes most easily through metals, and escapes with greater freedom from sharp points than from rounded knobs. Assuming these elementary facts, I may say that on any object, such as a house or other building, the electricity tends to accumulate itself on all projecting portions of the roof, etc., and especially on the highest points of it.

The ideal complete lightning rod system would call for a sharp-pointed copper rod erected at each of these projecting pinnacles, and rising above it, and would then connect all of these separate points by copper rods, and eventually carry down a stout copper rod to the earth. Care must be taken that due attention is paid to certain main precautions: (1) The point of the conductor must be kept sharp; (2) the section of the conducting rod must be sufficient to allow the electricity to pass along it; (3) the rod must be perfectly continuous; and, lastly (4), the rod must be efficiently connected with the ground.

1. The sharpness of the point is insured by gilding it or coating it with some metal which resists oxidation.

2. As to the section of the rod, a bar half an inch in diameter is sufficient for all ordinary buildings. Bars are not usually employed, as it is difficult to bend them over cornices, etc.; accordingly, either wire ropes or tapes are taken. The wire ropes are more liable to corrosion from wet getting in between the strands than are tapes, so that the latter are generally preferred. The metal used is always copper, being less oxidizable than iron, and being reasonably cheap and a very good conductor.

3. The continuity of the metallic connection from the highest point of the rod to the ground can only be secured by having as few joints as may be, and by making those joints as true and firm as possible by soldering. The joints should be examined from time to time, for it is often found, on examination of old conductors, that while the copper wire or tape is quite sound along its straight reaches, at the bends or joints corrosion has set in. As a chain is no stronger than its weakest link, a corroded conductor, such as has been described, is perfectly useless.

4. The earth connection. It is not easy in all cases to insure that this is satisfactory. Electricity will not pass at all so easily into dry earth as into wet earth, and merely plunging the end of the rope or tape into wet earth is not sufficient. The conductor from the building should be soldered at its end to a large sheet of copper, say at least two square yards in area, buried in damp soil, or else soldered to the water or gas mains, so as to insure that a large surface of metal is in contact with damp earth.

Supposing that the whole system of protection against damage from lightning has been properly planned, the work should be carefully tested after its completion, because injury to it often occurs at the very last, owing to accidental causes or to the carelessness of workmen. Conductors should also be examined from time to time, throughout their whole length, to make sure that all the joints are sound. Care should also be taken that the earth in which the terminating plate is buried is kept thoroughly moist. If any of these particulars be neglected, the conductor will be practically useless, and will afford no protection to the structure. The extreme practical importance of security against lightning must be my excuse for having been more diffuse over the subject of lightning conductors than over other details of the phenomena and effects of thunder storms.

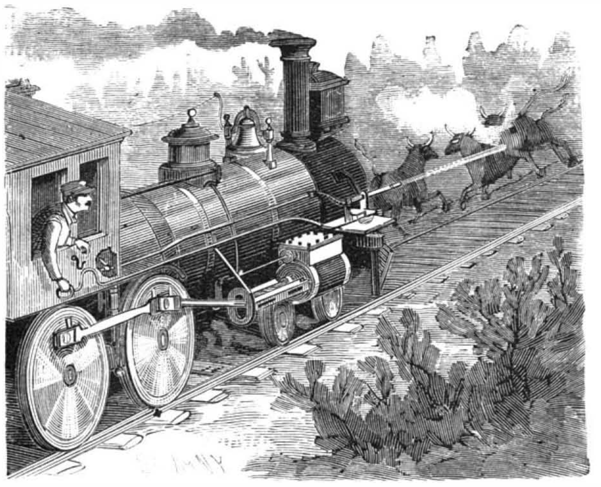
Tapping the Underflow.

What promises to be one of the most important features in water irrigation in California has been brought forward at Riverside, in the question as to the right to tap underground flow, or percolating water.

A company is at work upon a tunnel which will tap the underflow that makes a vast body of land around San Bernardino moist. Should this land be drained to such an extent that the moisture will be diminished near the surface, and thus compel irrigation where the character of the soil has heretofore not required it, a great hardship will fall upon property owners, and protracted litigation will follow. It is a wholly distinct feature in riparian law, and may result in riparian legislation. It would seem to be much on the same principle that one artesian well may be sunk on a lower level than another, and diminish or even dry up its flow, yet the owner of the upper well has no recourse at law. The question is fraugh with immense importance to Southern California, and the result will be watched with great interest.—*San Diego Union.*

HOT WATER TO DRIVE CATTLE FROM TRACKS.

The accompanying illustration represents a device, under the control of the engineer on a locomotive, designed to drive cattle off the track by means of a jet of hot water or steam from the engine. It has been patented by Mr. William J. Burke, of Seattle, Washington. Near the front of the boiler, on one side, is a bracket carrying a post mounted to turn, in the upper end of which is journaled one end of a horizontal bar, the other end of the bar being supported by a semicircular disk resting with its periphery on the base of the bracket, to turn or roll on the latter. From the bar extends an arm in which is secured a nozzle pointing in front of the locomotive, the rear end of the nozzle being connected by a flexible tube with a pipe leading into the boiler within the locomotive cab, where there is a valve by which the engineer may cause hot water or steam to be thrown forward by the boiler pressure through the pipe and nozzle. The outer end of the bar supporting the nozzle is connected to a rod extending rearwardly to the cab, the rod being so curved as to be readily hooked on the outside of the cab, and having a handle, whereby the engineer can so turn the nozzle as to direct the stream of water or steam to any part of the track in front of the locomotive, while also slightly varying its vertical direction, as may be necessary in thus driving cattle from the track. The pipe and valves are so arranged that the water will flow out of them by gravity after use, thus preventing the freezing of water therein.

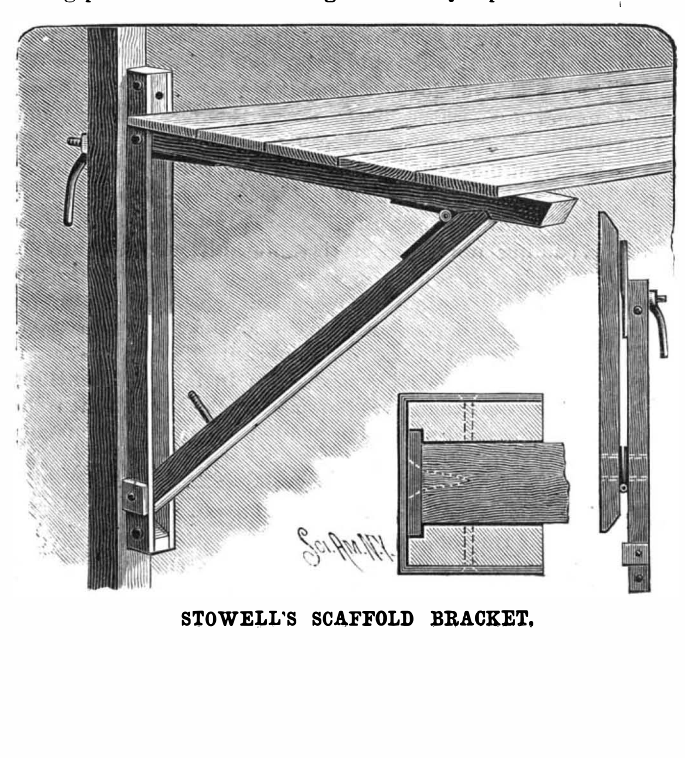


BURKE'S DEVICE TO DRIVE CATTLE FROM TRACKS.

AN IMPROVED FOLDING SCAFFOLD BRACKET.

A strong, light, and inexpensive scaffold bracket, for carpenters, painters, etc., and one which may be quickly applied to an upright or detached therefrom and folded compactly for convenience in carrying it, is shown in the accompanying illustration, and has been patented by Mr. Charles A. Stowell. The upright body bar of the bracket has a vertical opening or slot, the base wall of which is downwardly beveled, and at the base wall of the slot a bearing plate or strap is attached, the strap passing across the rear face, with its ends attached to the sides of the body, there being at the rear of the body and at each side of the slot a rabbet adapted to receive a plate to rest upon the bevel, whereby a slideway is produced, as shown in the sectional view.

The supporting beam of the bracket is pivoted at one end in the upright, and has on its under face, near the outer end, a recess, adapted to receive one end of the brace bar, which is attached to the supporting section by a hinge. The brace section is adapted to enter and slide in the slot or opening of the upright, when the bracket is folded up, as shown in one of the views, and its lower end is beveled to bear upon the inclined base wall of the slot in the upright, the brace being prevented from leaving the slot by a plate on its lower end resting in the rabbeted surface of the body. To the inner end of the supporting section is fastened a rearwardly projecting screw bolt, passing through an aperture in the body, and the bracket is held in position by a lock nut with a handle screwed upon the threaded end of the bolt. When the bracket is to be folded, the base plate of the brace is lifted, and the brace portion is swung through the slot in the body section, a threaded bolt near the lower end of the base, projecting from its inner side, being then made to pass through an aperture in the upper end of the upright, and the handle nut is screwed on this bolt, making a firm and substantial fastening for the bracket when closed, as shown in one of the views.

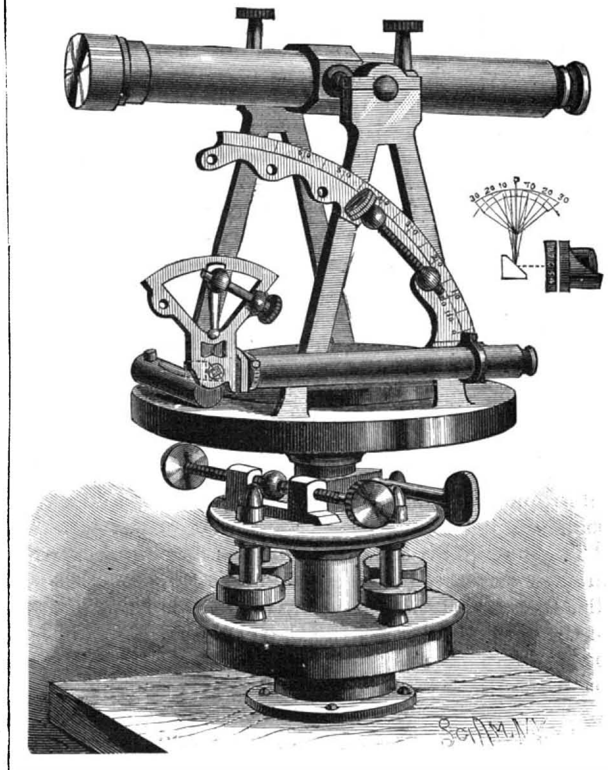


STOWELL'S SCAFFOLD BRACKET.

For further information relative to this invention address the Stowell Manufacturing Company, Putney, Vt.

A SOLAR ATTACHMENT FOR TRANSIT INSTRUMENTS.

The accompanying illustration represents an attachment for an engineer's transit, to furnish means to obtain the true meridian, solar time, and latitude and longitude of the locality, where observations are taken by the usual methods, from the data furnished by the instrument. It is a patented invention of Mr. Walter Scott, of Hot Springs, South Dakota. A latitude arc is secured on the vertical side of the inclined standards of a transit frame on their bed plate, with a vernier scale therefor adapted to move vertically, while a carriage for a solar attachment is pivoted to the side of a frame standard by one end, and a horizontal sight tube bearing an hour circle on one end, the sight tube being clamped to the carriage so as to be revolubly adjusted thereon. The small figure represents a rear elevation of the time-indicating device, a solar reflector and a diagram in elevation indicating the different angles of incidence and reflection produced by the concentrated rays of the sun when directed on the reflector through the lens of a vernier attachment to the declination arc. The sight tube has an eye lens at one end and a web cross at the other end, and a ray lens is set in an aperture in the vernier scale plate at its zero center, an inclined mirror-supporting block with mirror being pivoted below the vernier limb in the same vertical plane, the mirror being set at an angle of forty-five degrees. An upwardly projecting arm affixed to the mirror block loosely engages the depending limb of the vernier plate, and the sight tube is supported to receive a light beam from the mirror. When the parts are correctly adjusted, the degrees and minutes of the sun's declination may be read on the arc plate and vernier scale plate, from which data, with the time shown on the solar circle and its vernier, the true meridian may be calculated by the usual methods, as well as the longitude of the locality.



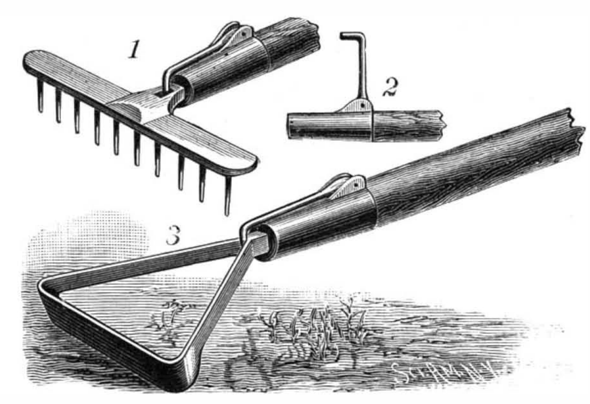
SCOTT'S SOLAR ATTACHMENT FOR TRANSIT INSTRUMENTS.

Sir George Airy.

Sir George Airy, the oldest of the English men of science, has just entered upon his ninetieth year. Sixty-five years ago he was elected to the Lucasian professorship at the University of Cambridge, having been Senior Wrangler two years before. The remuneration was *nil*, or consisted merely of a house, and this circumstance gave the late Mr. Todhunter an opportunity for his mot, "They gave to Airy nothing—a local habitation and a name." Airy has been for forty-five years Astronomer Royal (he resigned in 1881), and has received every honor and distinction open to men of science, including the presidency of the Royal Society.

AN IMPROVED GARDEN IMPLEMENT.

A simple and efficient tool for cutting up weeds, loosening the soil and gathering up weeds, stones, etc., is shown in the accompanying illustration, and has been patented by Messrs. James H. and G. L. Baxter, of Lexington, Ky. Figure 1 shows the implement arranged as a rake, and Figure 3 illustrates it in the form of a hoe made as a triangular loop. The handle has a metallic socket, shown in Figure 2, with a square hole for receiving the shank of the hoe or rake, the hoe being arranged at a slight angle to its shank. The handle socket has ears, in which is pivoted one end of a hook adapted to enter the angle of the loop of the hoe, to hold it in the socket, or an aperture in the rake head, whereby the latter is held in place in the handle socket.



BAXTER'S GARDEN IMPLEMENT.

American Bell Telephone Company.

The American Bell telephone statement of instruments for the month to June 20 records a net increase of 1,414, or more than 50 per cent of the increase for the half year, as see the following:

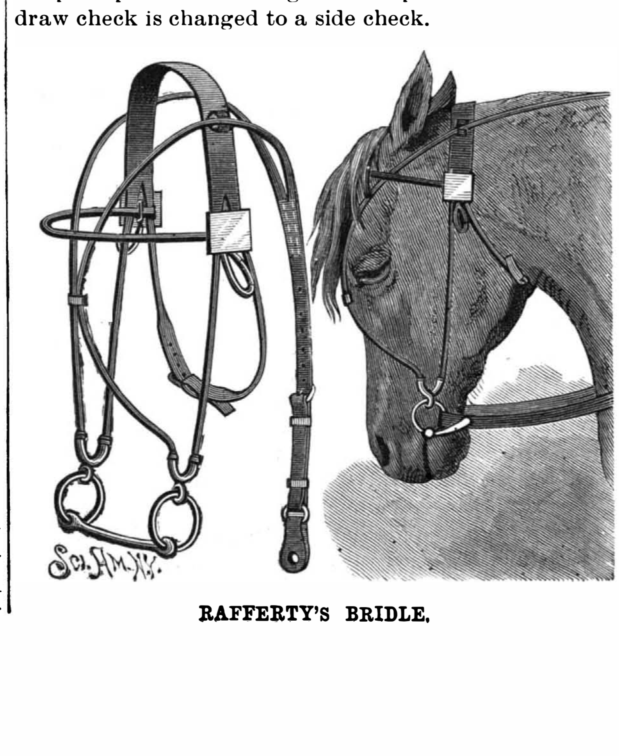
Month June 20.	1890.	1889.	Increase.
Gross output	7,758	6,511	1,247
Returned	1,927	2,094	*169
Net output	5,831	4,417	1,414
Since Dec. 20.	1889-90.	1888-89.	
Gross output	33,577	30,216	3,361
Returned	12,104	11,281	823
Net output	21,473	18,935	2,538
Instruments in use June 20	466,334	430,476	35,858

* Decrease.

AN IMPROVED BRIDLE FOR HORSES.

The illustration represents a combined bridle and check device, designed to be readily convertible for service with an overdraw check rein or a side check rein, and adjustable also to fit animals' heads of different sizes, while being light and inexpensive. It has been patented by Mr. John H. Rafferty, of 12 Green St., Worcester, Mass. Except its metal trimmings and bit, and the brow band, this bridle may be made practically of one continuous leather strap, the check rein strap being made partly of the leather straps forming the bridle, and stitched fast to the bridle straps. The cheek and face pieces of each side are formed as continuous straps connected at one end to the crown strap, and extending rearward at the other ends to form a check rein.

Bent or U-shaped divided clasps hold the straps at their lower bends or bights, the straps here being bent around or doubled upon themselves within the cavities or openings of the clasps, the two parts of which are also made to form a round eye to receive the bit ring, while overdraw check loops and side loops are held to the crown strap, with a detachable clip device for the face straps. By this means the bridle may be adjusted with an overdraw check or a side check, and the strap bights may be readjusted in the divided clasps to prevent twisting the straps when the overdraw check is changed to a side check.



RAFFERTY'S BRIDLE.

THE NEW CROTON AQUEDUCT—THE HARLEM RIVER SIPHON AND PUMPING APPARATUS.

As our readers know, the new Croton aqueduct will soon be in use. It is now practically completed. One of the most interesting features of its construction is the siphon by which it passes under the Harlem River. The old aqueduct was carried above the river on the High Bridge, and up to the present time all of the Croton water supplied to the city of New York has passed over this structure. In constructing the new aqueduct, it was determined to carry the conduit under the bed of the Harlem River, forming an inverted siphon. The conduit, coming from Croton Lake in a practically straight line, reaches the banks of the Harlem River at a point north of High Bridge at shaft 24. The general course of the aqueduct up to this point may be summarized in a few lines. Its grade for the majority of the distance is seven-tenths of a foot to the mile. This average it maintains for a distance of about 23 miles from the Croton Dam to South Yonkers. In the neighborhood of Van Courtland a ten per cent grade exists for about a quarter of a mile. For the next four miles it resumes the original rate of descent of seven-tenths of a foot to the mile until within two miles of the Harlem River. Here the descent is very steep, being 15 per cent, and it ends at shaft 24.

Shaft 24 marks the eastern extremity of the siphon with which we are now particularly concerned. The shaft is 341 feet deep. In its center there is a break indicating the level originally contemplated for the tunnel under the river. At its bottom it forms a sump 6 feet deep. On attempting to prosecute the work on this level, it was found that a large fissure in the bed near the western bank interfered with the progress of the work. It was accordingly abandoned and a further descent of about 150 feet was made, and a new tunnel started. This is the reason why this shaft is so deep. Starting six feet above the bottom of this shaft, the tunnel runs across the river with a uniform grade of 1 per cent, descending toward the western extremity. The tunnel runs 1,500 feet under the river, falling in that distance 15 feet, to shaft 25, on the western extremity. The shafts and tunnels are all circular and 12 feet 3 inches in diameter. They are constructed of brick, and the tunnel in places is lined with cast iron plates bolted together by flange joints. The tunnel ends at shaft 25, on the west bank of the Harlem River.

Shaft 25 is a double shaft, 413 feet 6 inches deep from the original level of the ground. From the floor of the engine house above it, its depth is 424 feet 6 inches. The original excavation was in general terms a rectangular one, but is now divided into two circular shafts of identical size, one the aqueduct shaft, which is brick lined, the other one the pump shaft, also brick lined, but lined in addition with cast iron plates. The rest of the rectangle is filled in solid with rubble masonry. At its bottom the pump shaft has a sump, which descends 21 feet 6 inches below the floor of the conduit.

On both sides of the Harlem blow-offs are constructed, connecting respectively with shafts 24 and 25. Shaft 24 has a single line of pipe connected with it for the blow-off, partly of 30 and partly of 36 inches diameter. The blow-off on the western bank connecting with the pump shaft of shaft 25 is naturally larger, and includes two lines of 48 inch pipe. Both lines of blow-offs are provided with gates, in order to keep them closed during the working of the aqueduct.

Owing to its great depth, there is no means of draining the siphon. The establishment of pumps for pumping it was not approved of, not only on account of its great depth, but also because it will have to be emptied very seldom, and an installation of pumps would be exposed to deterioration for want of use. Accordingly a system of buckets have been applied to its emptying, and for some days they have been in use discharging water. For many months the siphon has been full of water that has drained into it from the long line of aqueduct. Before pronouncing it acceptable, it has to be emptied and examined by the authorities.

The pump and aqueduct shafts, it will be remembered, are side by side. Near their bottoms they are connected by a rectangular conduit, two feet six inches by one foot eight inches. This conduit is provided with a gate. In the normal working of the aqueduct this gate is kept open. To empty the siphon, the valve or gate is opened, admitting water to the pump shaft. In the latter two buckets are suspended by steel wire cables. The buckets are made of sheet iron, and are of 1,390 gallons capacity each. The cables by which they are suspended are carried over pulleys to the drums of a pair of hoisting engines. The whole is so connected that as one bucket rises, the other descends. At the bottom of each bucket is a butterfly valve, opening upward. When such a bucket is lowered into the water, the butterfly valve opens upward and water enters. In addition to the valve in its bottom, each bucket has a valve or gate in its side. This is normally closed. As a bucket rises filled with water it comes in front of a discharge spout near the top of the shaft which connects with the blow-off. The rear of this discharge piece is curved to correspond in shape with the contour of the bucket. A handle is connected to the side gate of the bucket, which, as the bucket rises opposite the discharge spout, strikes a cam so as to open the gate. The water from the bucket then enters the discharge spout and escapes through the blow-off into the Harlem River.

The buckets are worked by a pair of engines built by the Franklin Iron Works, of Fort Carbon, Pennsylvania. They are provided with a steam reversing gear, so that the links are thrown one way or the other by reversing a lever controlling the admission of steam into a cylinder which actuates the reversing mechanism. An attendant at the entrance does the reversing. Turning the engines one way, one bucket descends and the other rises. As the proper height is reached a bell rings and an indicator also shows the fact to the attendant. The engines are stopped until the bucket has emptied itself. By motion of the lever they are next reversed; the empty bucket descends and the full one rises, until the alarm is again given, notifying the attendant to stop the engine. In this way the water is rapidly withdrawn. It will be seen that several peculiar features are involved in the process. While the buckets always rise to a standard height, they have continually to be given a little more descent. This is effected by having one of the drums fixed upon the shaft, while the other is loose and attached to the first by eight bolts. By releasing these bolts, while holding the loose drum with the brake, the engine is driven in one or the other direction until the proper amount of rope has been fed out. The bolts are refastened again. The operation takes about three minutes. The contract requires each bucket to be hoisted in an average of 40 seconds. So far this time has been exceeded. While it would seem that at greater depths the operation would be slower, it is found that the reversing and emptying takes most time, and that the actual hoisting operation will be of short duration for the maximum depth.

Both aqueduct and pump shaft are provided with heavy brick diaphragms, each embodying an inverted arch. These, when the aqueduct is in use, have the manholes closed, and resist the pressure of the water. As some water will percolate through the pores of the brick, a small overflow of 12 inch pipe is provided to discharge this leakage into the Harlem River.

Carbon.

BY GEORGE L. BURDITT.

In looking over Mendelejeff's table, we find at the head of the fourth series the element carbon. It is one of the most abundant elements, and one of the most important in nature. It is the characteristic element of organic chemistry, where it forms a sort of framework upon which the organic compounds are grouped. Indeed, inorganic chemistry is called by some the study of the carbon compounds. Carbon occurs in all vegetables and in some minerals. It also exists in three allotropic forms, as the diamond, graphite, and charcoal.

The diamond is the purest form of carbon, occurring in nature usually in the conglomerate formations. India, Brazil, and the Cape of Good Hope furnish most of the diamonds in use, the Cape of Good Hope mines being more recently discovered. The diamond has probably never been made artificially, although many attempts have been made. In order to make one, the carbon would have to be liquefied and crystallized. But carbon is only soluble in melted cast iron, and is infusible; and so diamonds could not be got in this way. Making diamonds from benzole was at one time tried by a Scotch chemist, but with questionable success. In nature they are probably made from some liquid form of carbon, but little or nothing is known of the process. Although they may be of almost any color, they are usually white, and when entirely free from all color are said to be of the first water, and these are the most valued. However, owing to impurities, they may be gray, yellow, brown, green, red, blue, or black. The rose diamonds are valued highly, and next to them the green.

To heighten the effect of a diamond it must be cut. This is a very slow and tiresome job, sometimes taking many weeks or months to finish. The stone is first clipped off, piece by piece, until it is nearly the required size. It is then fixed upon a steel spring, by means of melted lead, and the lead allowed to soldify. This spring is then pressed down until the stone reaches a swiftly revolving steel wheel, upon which there is a quantity of diamond dust, called "bort." By the constant grinding of the stone against the bort, a smooth plane or face is formed. And this is what is meant by diamond cutting. The operation must be repeated for each face. The commonest forms after cutting are the rose and brilliant. The diamond is the hardest substance known, but is quite brittle. Besides its extensive use as a gem, it is used for cutting glass and in making diamond drills for boring rock. Quartz is hard enough to scratch glass, but the diamond point is more curved than that of quartz, by virtue of which it gives a cleaner scratch, and so is always used. Diamonds do not occur to any extent in the United States, although small ones have been found in North Carolina.

The second allotropic form of carbon is graphite, sometimes—but wrongly—called blacklead. It is found principally in Siberia, Cumberland, and at Ticonderoga, where it occurs as lumps between layers of slate. It is of a grayish-black color; soft, greasy, and has a metallic luster. It can be made artificially by dissolving carbon in melted cast iron, and treating the product with dilute hydrochloric or nitric acid to remove the iron. Owing to its high fusibility, it is used in making crucibles for melting substances which require great heat. It is also used with oil as a lubricator; also in electrotyping. Its most important use is in making pencils. The graphite is crushed fine under water, on top of which it floats off through a series of tubs, each a little lower than the one before; and in this way the fine powder is separated from the coarser. Pipe clay is then added to it, and enough water to make a paste about as thick as cream, and this is ground until the substances are perfectly mixed. For hard pencils, more clay is added; for soft ones, less; medium hard pencils contain about seven parts of clay to ten of graphite. After grinding, the paste is put into canvas bags and pressed until all the water runs out, leaving a thick dough. This dough is then put into an iron cylinder with a tight-fitting piston. In the bottom of the cylinder are holes the size and shape of the lead desired, and through these the dough is slowly forced by the descending piston, coming out in long strips. These strips are then cut into the proper lengths, baked, and put into their wooden cases.

The third or amorphous form is represented by charcoal. Charcoal is made by burning wood in a limited supply of air. Sticks of wood are piled up into a round heap, with a small hole in the center for a chimney. Another hole runs from the chimney to the outside of the pile, so as to give a draught. The whole pile is then covered with sod and earth. The wood is lighted through the chimney, and chars slowly until it is all converted to charcoal. The time required varies from one to three weeks, according to the size of the pile. The best quality of charcoal is made by heating wood in iron cylinders. When made in this way, some other valuable substances—such as wood alcohol, etc.—are also formed, which run off as liquids and are collected. This kind of charcoal is used for gunpowder. Charcoal is black, lusterless, soft and smutty. It has no crystalline form, but retains the internal and external forms of the tree from which it is made. While the wood in the pits is charring, the walls of the wood cells become charcoal, but the matter within the cells is driven off. This makes the charcoal very porous, and it absorbs air to such an extent as to float on water. Charcoal has a strong tendency to condense gases on its surface. It acts on different gases to different degrees, but most readily on ammonia and sulphureted hydrogen. It is also used to absorb coloring matter in bleaching colored solutions; but boneblack—a sort of charcoal made by burning animal bones—is better for this purpose. Brown sugar is turned into white sugar by running it through a layer of boneblack from twenty to thirty feet high.

Lampblack is made in much the same way as charcoal, only no wood is used. Heavy oil of tar or natural gas is burned in a close chamber, at the top of which is a tight-fitting iron dome. The oil is lighted and burns with a smoky flame, giving off small particles of carbon, which are condensed on the sides of the chamber into lampblack. When the process is finished, the dome descends and scrapes the lampblack off. It is tolerably pure, is very black and permanent, and can be advantageously used in making paint, blacking, etc.

The question may sometimes arise: How do we know that these allotropic forms are really carbon? The proof is, if we burn twelve parts of carbon, it will give forty-four parts of carbonic acid gas—and this is the case with each of the three forms.—*Pop. Sci. News.*

The Infrequency of Deaths by Lightning.

It is probably idle to tell people that there is a thousand times the danger in the sewer pipes that there is in the thunder clouds, but it is true all the same. The deaths by lightning are few indeed. Who of the readers of this paragraph, says the Hartford *Courant*, ever lost a friend that way? Who of them hasn't lost a score of friends by the less brilliant and less noisy destruction that comes up out of the drains? The trouble with the lightning, or the trouble that it gives the people, is in its indescribable suddenness and its absolute uncertainty. You know neither when it is coming nor where it is going, all you feel certain about is that some storms leave a number of catastrophes to mark their course. The caprice of the lightning defies the explanations of science, and there is no predicting beyond a few generalities. This much it does seem safe to repeat, even in a lively lightning season, that the increased use of electricity, with the multiplicity of wires, has tended to fewer fatal strokes of lightning in cities.

To Remove Thirst.

Paint the tongues of your fever patients with glycerine, says a physician; it will remove the sensation of thirst and discomfort felt when the organ is dry and foul.

HOME MADE GRILLS AND GRATINGS.

A dwelling house without ornamentation of the class mentioned above indicates one of two things, either the owner or occupant does not appeciate the value of this kind of home decoration or he does not possess the skill to make or the ability to purchase it. It is true, the beautiful metal and wood work now manufactured for this purpose is very expensive; but it is also true that something equally as beautiful may be had without much trouble or expense.

The grills shown in Figs. 1, 2, and 3 are made of rope, sized, bent into shape, dried, glued in a wooden frame and finally painted an appropriate color or gilded or bronzed. These ornaments when placed in a doorway or window or across a hall from the stairway to the wall, or in some corner in the library, add wonderfully to the appearance of the room.

The materials required are some $\frac{5}{16}$ in. sash cord, glue, round sticks or doweling $\frac{5}{16}$ in. in diameter, paraffine, (a paraffine candle will do), some strips of wood, and paint or varnish.

There are in the present case only two fundamental forms for the spindles or bars, but these are combined in several different ways, as shown in Fig. 6. The spindle most used is shown in Fig. 4. It is formed by winding the sash cord—which has been previously steeped in the glue size—upon the wooden rod. The rod is coated with melted paraffine before use, to prevent the size from adhering, and equidistant marks are made upon the rod as guides for the winding. These marks are 1½ inches apart. The winding can be easily done by placing one end of the wooden rod in a vise, driving a tack through the end of the rope into the rod. If every turn of the rope around the rod is made to coincide with one of the marks, the spindle will be true enough for all purposes. A tack should be driven through the end of the finished spiral into the rod to prevent the rope from unwinding. A number of rods will be required. Part of the spindles should be wound in a right-handed direction and the remainder in a left-handed direction. The rope should be allowed to stand for a day or so dry. It is well, especially in warm weather, to add to the size some oil of cloves or carbolic acid to prevent it from souring while drying.

The other form of spindle is shown in Fig. 5. This is made by bending the sized rope around pins driven

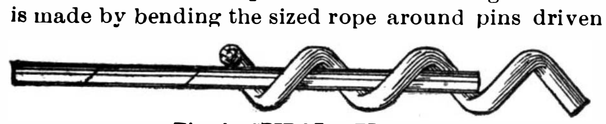


Fig. 4.—SPIRAL SPINDLE.

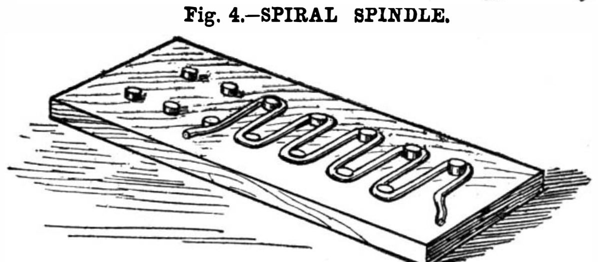


Fig. 5.—ZIGZAG BAR.

into a board in two rows, the pins of one row alternating in position with those of the other row. The board and pins are covered with paraffine, as in the other case.

The spiral spindles may be combined with each other, as shown at *a*, *b*, *c*, *d*, and *e* in Fig. 6, and with a straight rod, as shown at *f*. At *g* they are shown in combination with the zigzag rope. At *h* the zigzag rope is shown in combination with straight rods.

The circles and segments of circles shown in Figs. 2 and 3 are made by winding the sized rope around a tin pail, a can, or some other cylindrical body and allowing it to dry. To form a complete ring, one turn of the rope is cut off, its ends are cut off diagonally and fastened together with strong glue.

The spindles are cut by means of a sharp knife. The various parts of the work are fastened together and attached to a light wooden frame, and, as a rule, no fastening other than glue will be required. If, however, a stronger fastening is necessary at some points, small brads or wire nails, or even screws, may be used.

In Fig. 3, the rosette, *d*, is formed of a circular ring filled with segments of a similar ring in the manner shown. Each pair of spirals, *a*, consists of one right-handed one and one left-handed. The spindles, *b*, *c*, are spirals.

Grills made in this way may be finished in the same manner as wood. They may be stained or painted to match the work into which they are fitted, or they may be painted white and relieved by a little gilt on the projecting part.

It is obvious that a large number of patterns may be worked out by the aid of these suggestions. Different kinds and sizes of rope may be used alone or in combination.

These grills may be placed in windows, doorways, across halls, above mantels, across niches, between windows, and in many other places which will suggest themselves. Like many other household ornaments, if well and carefully made, they will repay the labor and trouble of making.

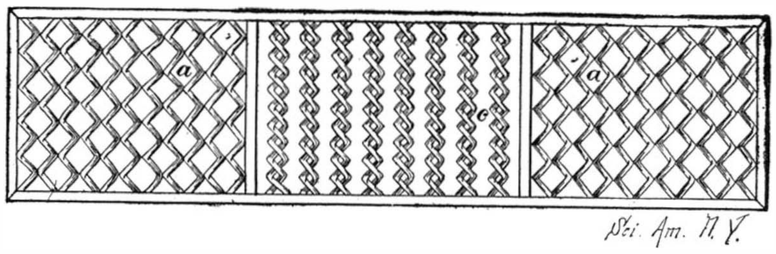


Fig. 1.—GRILL FOR DOUBLE DOORS.

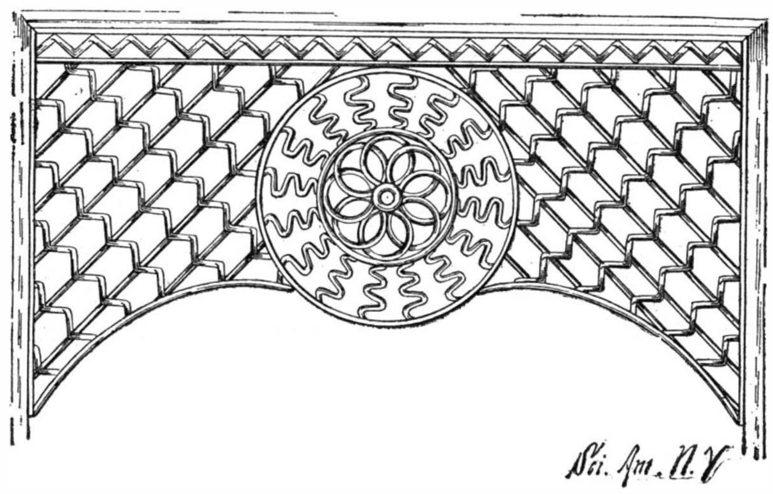


Fig. 2.—ROPE GRILL FOR WINDOW, DOOR, OR HALL.

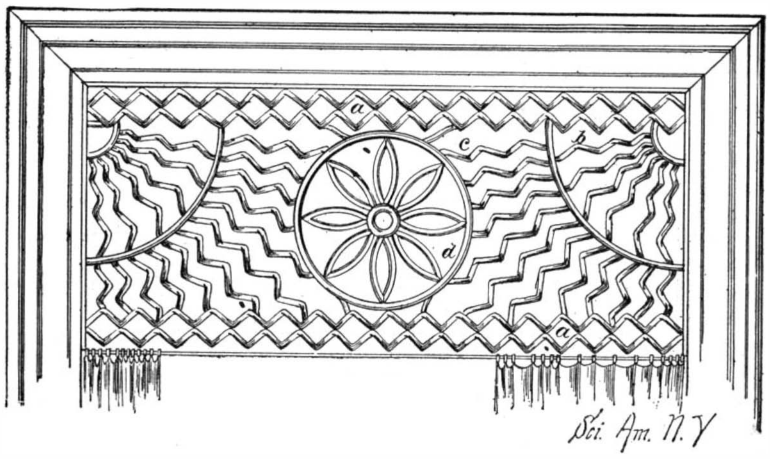


Fig. 3.—GRILL FOR WINDOW.

Electrical Workers will Please Report.

We are constantly in receipt of letters from interested readers of our articles on electrical machines and apparatus for amateurs, which indicate that a very large number—we might almost say an army—of amateurs, as well as many electricians, are in some manner following our instructions in these matters. We are pleased to know that many of them have done some very creditable work.

We have in mind a plan of mutual exchange of ideas on these subjects, and therefore request any reader of the SCIENTIFIC AMERICAN, or of the SUPPLEMENT, who has made electrical machines or apparatus of any sort after instructions given in either of our papers, to send us a brief description of the same, giving size and amount of wire, size, weight, and material of various parts, the amount and kind of current; if a battery is used, the kind and quantity; and finally, an account of the performance of the machine or apparatus. State exactly what it will do.

We refer to dynamos, motors, electro-magnets, galvanometers, batteries, induction coils, static machines; in fact, anything in the electrical line made after the instructions given in either of our papers.

A CANAL which will afford a cheap and more direct means of communication between the west of France and the north is that which was formally opened on June 1, by M. Yves Guyot. It connects the Oise with the Aisne. Its length is 48 kiloms., or 30 miles, and it saves a detour of 58 kiloms., about 36 miles. Many serious difficulties have been encountered in carrying out the work, notably in the construction of the subterranean portion of the canal. This tunnel is 2365 m., 1½ miles, in length, and the cost of boring was about 10,000,000 f.. or $2,000,000. In this work both fire and water had to be contended with, and six years ago eighteen men were suffocated in the workings. The canal, which was made under the direction of M. Bœswilwald, has occupied ten years in construction.

The Pool of Bethesda.

Consul Henry Gilman, writing to the state department from Jerusalem, gives the following account of the discovery of the pool of Bethesda: Of the more remarkable discoveries in the ancient city during the year, that of the Bethesda is of paramount interest and importance. As is well known, the Birket Israel has in the past been considered as the site of the Bethesda; but the excavations of the Algerine monks under the ruins in the rear of the Crusader Church of St. Anne have gradually transferred opinion in favor of the latter locality. This was strengthened by the discovery of a rock-hewn pool containing water beneath three successive structures. Subsequent excavations revealed the remains of two tiers of five arched porches, the lower tier being in the pool. The intelligent labors of the monks who are in charge of the property have been further rewarded by the recent discovery of another pool containing a good supply of water to the westward of that first discovered, the entire agreeing with the descriptions of the Bethesda as given by the fathers of the church and Christian pilgrims and writers as early as the fourth century. The correspondence in number of the five porches to those mentioned in the gospel of St. John (v: 2) will not escape notice. Steps cut in the rock lead down into the water. An ancient Christian church in ruins surmounts the whole. The remains of the upper tier of porches extend above the pool at right angles from the north wall of the crypt beneath the church, in which the apse, at the east end, though dilapidated, is still distinctly defined. On clearing away the debris that choked the fifth porch westward of the apse all these discoveries culminated in revealing the remains of a painting or a fresco upon the plaster of the wall in the rear. This discovery was made just before Easter, or about April 18, last. The fresco represents an angel as if descending into and troubling the water, which latter is depicted by conventional zigzag and wavy lines of an olive green, shaded with black, more suggestive of Egyptian hieroglyphics than of modern art, and surrounding the figure on every side. The right hand of the angel was shown as uplifted; but this has been carefully destroyed, probably by the Moslems, after their habits, in the early days of their power. So, also, the face of the angel, which has been battered so as to be completely obliterated. The glory or nimbus

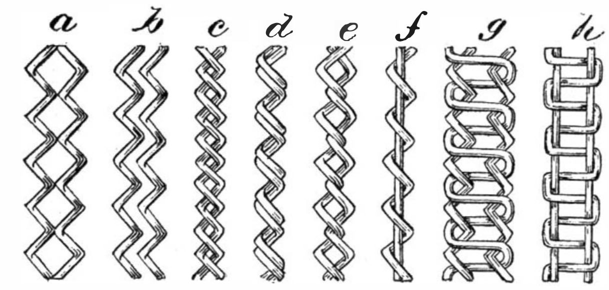


Fig. 6.—FORMS OF SPINDLES AND BARS.

above the head, painted an orange yellow, still remains, but little injured. The edge of the pool appears to be indicated by a broad red line inclosing the painting, and having an occasional rectangular projection into the water, perhaps representing steps or the piers for the porches. On the east of this fifth barreled arch (the wall extending at right angles) are remains of another figure, also in fresco, much defaced, and supposed to represent the Saviour. Above the head, evidently intentionally mutilated, is a portion of the nimbus, and in the lower outer corner of the painting, part of a blue robe. It is to be regretted that these frescos, the colors of which were quite bright when first uncovered, have since greatly faded, so that the blue is now a dull, ashy gray. The reds and yellows, however, though lowered in tone, preserve their hues somewhat better. To summarize, these discoveries are as follows: First comes the rubbish covering the ruins, and built upon by the more or less modern Turkish houses; next beneath is the small church, with apse; under this the crypt, with five porches, containing the frescoes; and fourth and last, underneath all is the pool itself, cut in the solid rock, and with five arches of well preserved masonry. This last, from the historical and other evidence, I have not the slightest doubt is the veritable pool of Bethesda.—*Boston Herald.*

TO fill up cracks in a boat, melt equal parts of pitch and gutta percha in an iron pot; thoroughly mix by stirring. Make up in sticks and melt into the cracks with a warm iron.

THE McLEOD PNEUMATIC SYSTEM OF HEATING, VENTILATING AND COOLING, AND IMPROVED SUBWAY CONSTRUCTION.

The accompanying illustrations represent a few of the most important features of a new and improved system of heating and ventilating buildings, etc., the invention of Mr. J. S. McLeod, of Boston, to be owned and controlled by the McLeod American Pneumatic Company, of New York and Boston, and sub-companies, embracing the field of pneumatic heating both automatically and inexpensively, together with the construction of improved subways, etc.

The inventor designs to use for this purpose a furnace to be specially constructed at a central point, whereby a current of fresh air will be heated and circulated through a series of pipe coils and heating tanks, so arranged in a zigzag flue as to absorb all the heat from the burning fuel and its gases usually escaping to waste through the chimney, and extending through one or more pipes to as many buidings, offices, and apartments as may be desired.

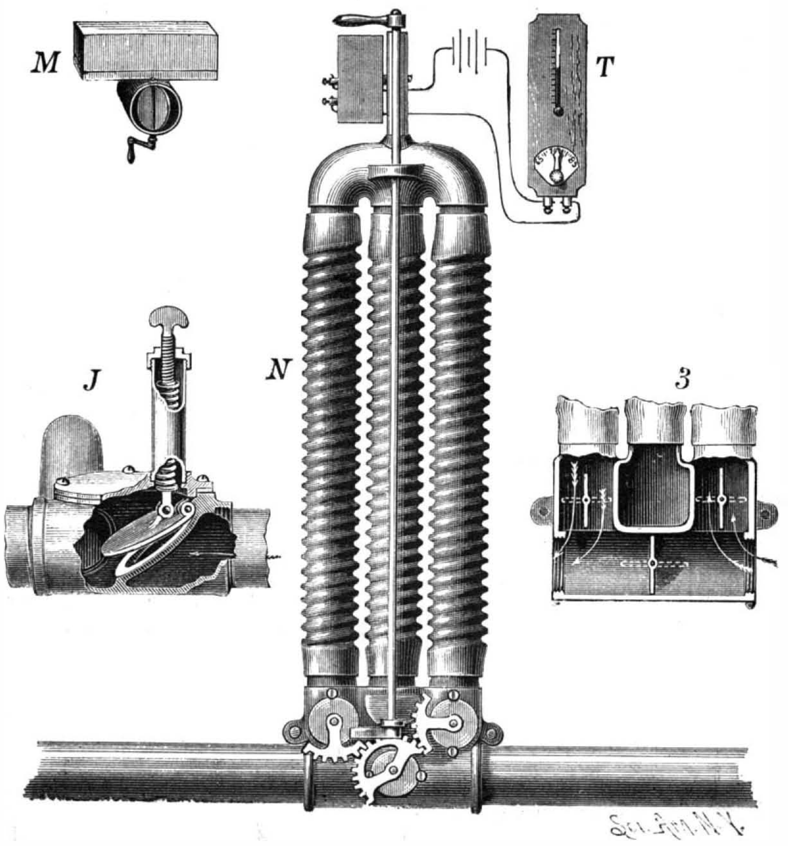
The hot air in these pipes, which are connected with a series of adjustable radiators, registers, and open air vents, controlled either by hand or automatically by thermostatic connection, continues around back in a circuit to the flue end of the heater to be reheated and circulated, except that which is emitted from the registers for heating and ventilation, and is controlled by a blower and an adjustable valve to admit fresh air and regulate the pressure to about two pounds to force circulation through the heater and buildings.

This system provides for the utilizing of hot air in the same manner as hot water and steam when used for similar purposes, while also providing an additional means of heating and ventilating by allowing the escape of the hot air itself into the rooms through vents and registers during cold weather, and for cooling and ventilating by forcing cold air through the same or similar pipes in hot weather.

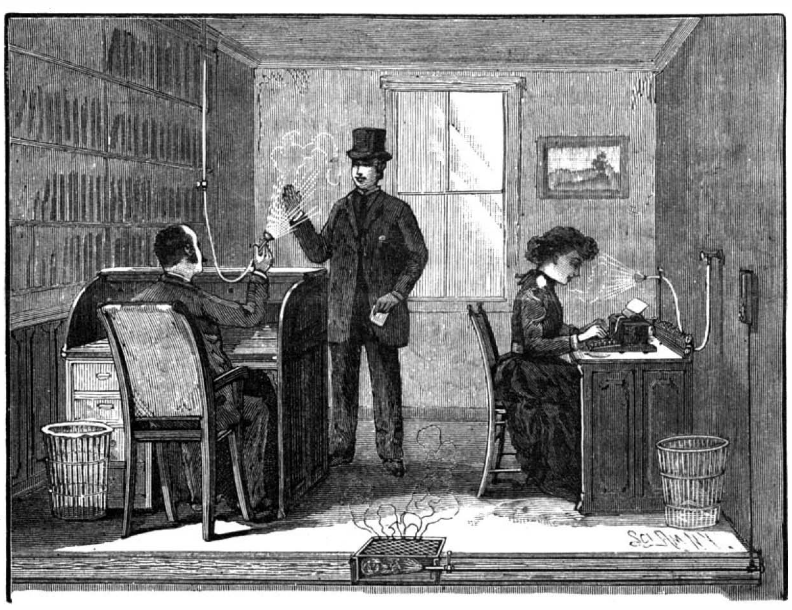
The construction of the zigzag furnace with the heating pipes and hot air tanks provides for the utilizing of all the heat of combustion, and, in connection with the blower, to insure continuous circulation, is designed to heat many buildings and apartments from a central point, thereby insuring not only a great saving of fuel, but furnishing in addition, in an admirable manner, the great desideratum of pure, fresh heated air for ventilation. It is designed to secure as well the warmth and comfort of the occupants of the buildings during the cold term, and a most healthful, salubrious, and invigorating supply of fresh cold air to heated interiors during the hot spell, together with an entire immunity of the destruction of walls, ceilings, and ornaments, caused by leakage of steam, or explosions with loss of life and property, and the well known deleterious influences injurious to health, as well as the dust and dirt, and the great expense of supervision and attendance incident to all other methods of heating.

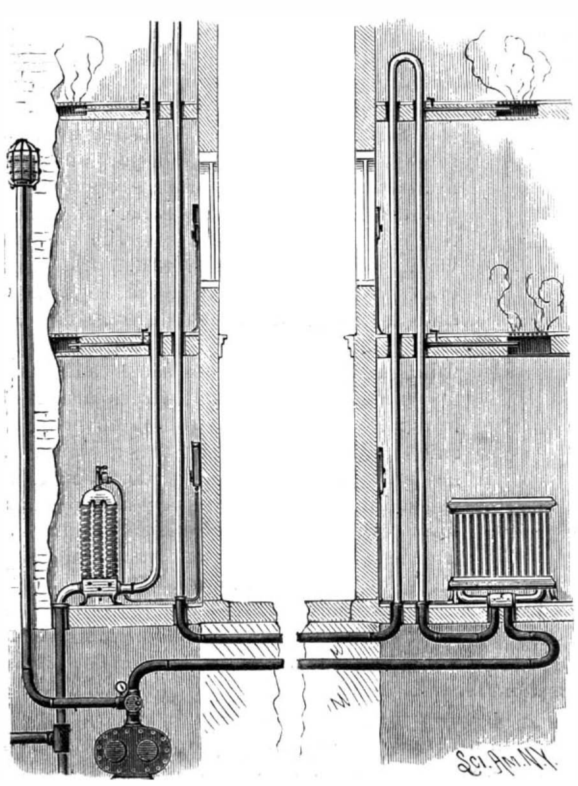
The circulating pipes will be connected with different buildings and apartments by branch circuit pipes, provided at their junctions with special damper valves. to divert the current from one apartment to another, as may be desired, and designed to work automatically by thermostat or be controlled by hand.

The circulating pipes may be disconnected from the furnace in warm weather, or special pipes may be provided to supply a current of fresh air for cooling and ventilating purposes, which may be drawn directly from the outside, to be supplied through the registers or by means of elastic tubing and spray jets to the desks or tables of occupants of the different apartments, whereby the temperature may be kept at the most salubrious and agreeable point during either hot or cold weather.



THE McLEOD THERMOSTATICALLY REGULATED RADIATOR.


APPLICATION OF THE McLEOD SYSTEM.


THE McLEOD HEATER AND RADIATOR PIPE CONNECTIONS.

In our view of the radiator, T represents the thermostat; M the thermostatic operating valve which controls the admission of hot air, N the radiator, Fig. 3 the interior of the supply valves of the radiator, operated by cog wheels by means of connecting rod with handle, as shown at the top of radiator, while J shows the automatic air pressure regulating valve governing the supply of fresh air and regulating the force of the current.

The thermostatic control, whereby the temperature is regulated as desired to any degree of heat, is effected by setting the dial of the thermostat as shown, this regulator being electrically connected with a switch operating practically as a valve, whereby the amount of hot air admitted to the pipes is regulated as readily as the admission of steam to an engine is controlled by its governor. By means of a handle on a connecting rod extending above the top of the radiator, as shown in Fig. N, the flow of hot air in the system may be confined entirely to the large supply pipe near the floor when desired, as may frequently be the case in mild days, in colder weather the circulation being caused to flow through the radiator itself, while, when the weather is cold enough to call for still more heat, the radiator, in connection with the thermostat, will admit hot air to the room in sufficient quantity to keep the temperature at the desired point, the valve connected with the thermostat opening and closing automatically, as may be required to effect this object.

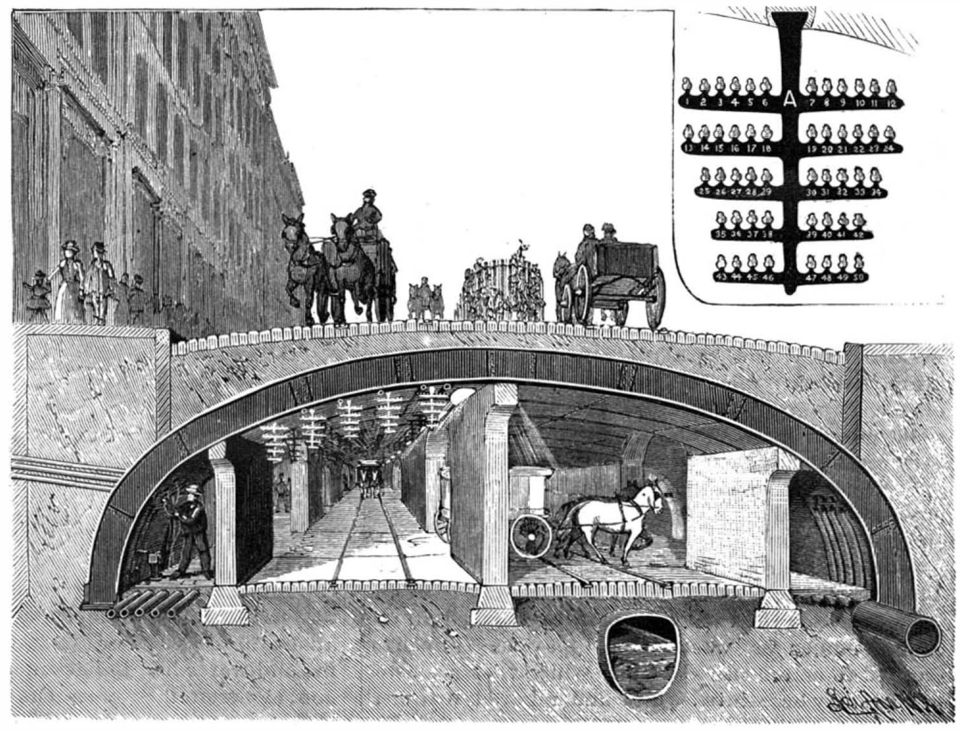
The subway construction shown is designed to be of such good, strong and substantial character as to last for ages, affording convenient facilities for the placing of electric wires, and their connection with the buildings at either side, as well as for the arrangement of sewer, water, pneumatic and gas pipes, etc., and their connections, in such a way as to avoid the enormous expense and annoyance of constantly disturbing the streets and tearing up pavements, while the various pipes and wires can always be readily reached.

This subway may be divided by partitions into separate channels or ways, under one of which may be laid a general sewer. In one of the ways may be laid pipes for heating or other high temperature purpose, and another may be assigned for gas pipes, telephone or other special electric wire pipes, with free access through the open tunnel to any of them at any time.

The wire hangers shown are provided with indexed cams, each designated by figure or letter, and numbering from 1 to 50, or as may be desired, whereby all wires are so designated by numbers and letters that any one of them may be easily traced and got at without the necessity of sounding or tracing instruments, and may be altered, branched off or removed at any desired point along the line, at any time, without trouble, delay, or interference with other wires or pipes.

The tunnel is preferably provided with openings in its roof for light and ventilation, and free access is had to it through side passageways at such junctions or intervals as may be desired, as from cross streets, etc. The different branches of the subway are connected with each other by openings in the partition walls, provided with well-fitting doors, and it is designed that the subway shall be shut off into sections every few hundred feet, the pipes also having such shut-off valves, unions, etc., that any portion may be disconnected or shifted at any time.

For further information relative to these inventions apply to McLeod & Hartley, promoters, P. O. Box 2492, Boston, Mass., or in care of Robertson & James, bankers, No. 7 Nassau Street, New York City. Also H. Hartley, No. 6 St. Paul St., Back Bay, Boston, Mass.


THE McLEOD SUBWAY CONDUIT SYSTEM

THE GRAMOPHONE.

Among instruments for recording and reproducing speech and other sounds, the invention of Mr. Emil Berliner, of Washington, D. C., known as the gramophone, is remarkable as being distinct from the others in both form and principle. The gramophone was one of the early modern talking machines. It was nearly perfected when the latest form of phonograph appeared. Since that time it has been improved, and we understand that recent trials of the instrument in Europe have proved very successful.

Fig. 1 shows the recording apparatus; Fig. 2 the reproducer; Fig. 3 a print from an electrode taken directly from a gramophone record plate; and Fig. 4 shows the record of the vowels greatly magnified.

In this machine a central apertured disk of zinc is used for receiving the record. The disk, which is covered with an extremely thin film of wax, is mounted on a vertical spindle within an etching trough which revolves with the spindle. The recording stylus, the diaphragm, and the mouth tube are mounted on a carriage, which is moved toward the center of the zinc disk by a screw, taking its motion from the spindle carrying the disk. Motion is imparted to the record disk by a friction wheel on the horizontal shaft at the right of the engraving. This shaft is provided in the present case with a hand crank by which the plate is revolved. The same shaft is also provided with a pulley for receiving a belt from a suitable motor, when it is desired to operate the machine by power.

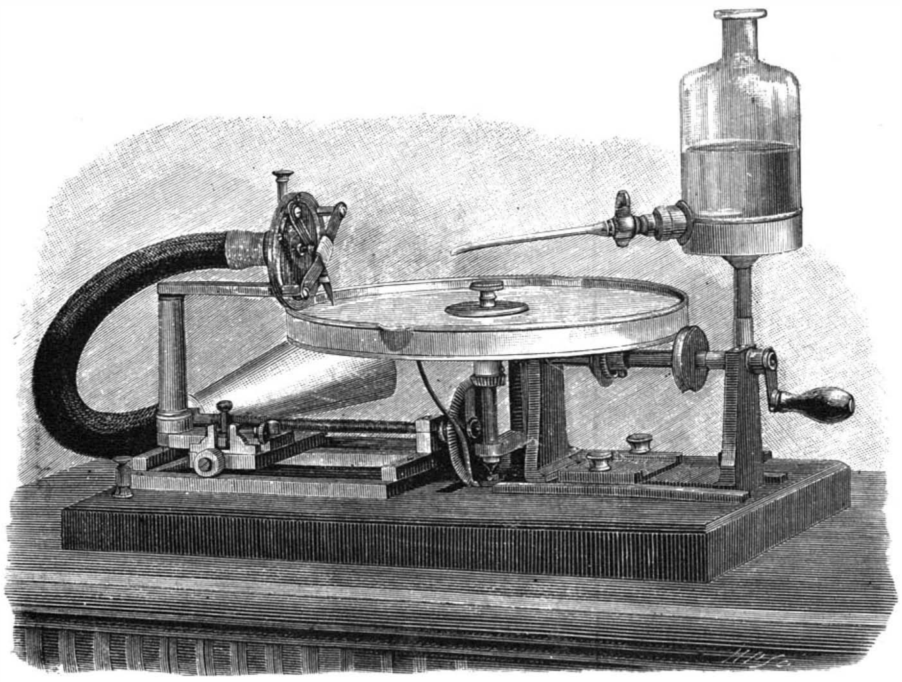


Fig. 1.—BERLINER'S GRAMOPHONE—THE RECORDER.

As the record disk is revolved, sounds uttered in the mouth tube cause the diaphragm to vibrate, and the stylus is moved in a direction parallel with the face of the record surface, forming in the wax film a sinuous line representing the sounds uttered in the mouth tube. As the plate revolves, the stylus and parts connected with it are carried forward toward the center of the disk, thus forming a spiral sinuous line in the wax film. When the record is complete, the stylus is removed and acid is admitted to the etching trough, from the bottle supported at the right of the machine. As soon as the plate is sufficiently etched, the trough is removed, the acid is returned to the bottle, the wax film is dissolved off, and the plate is transferred to the reproducing apparatus shown in Fig. 2.

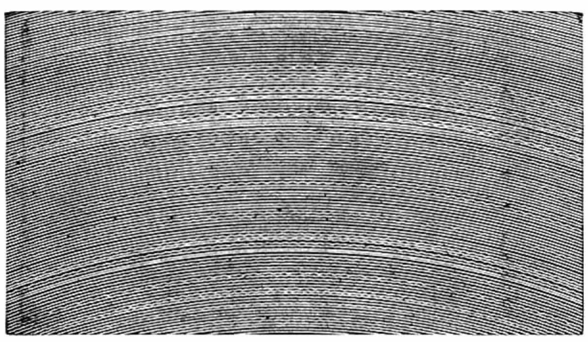


Fig. 3.—PRINT FROM SECTION OF GRAMOPHONE PLATE.

In this apparatus the record plate is mounted on a vertical spindle and revolved as in the other case. The diaphragm of the reproducing instrument carries a stylus which follows the spiral groove in the plate, thus causing vibrations in the diaphragm similar to those produced by the sounds uttered in the mouth tube of the recording instrument. The diaphragm cell and reproducing stylus are carried upon the smaller end of the trumpet, which is delicately pivoted on a standard and counterbalanced so that the reproducing stylus exerts only a slight pressure upon the record plate. The volume of sound issuing from the trumpet is great. Instrumental and vocal music are faithfully reproduced. It is obvious that the records formed by this instrument are permanent, and the plates capable of being stored in a very small space.

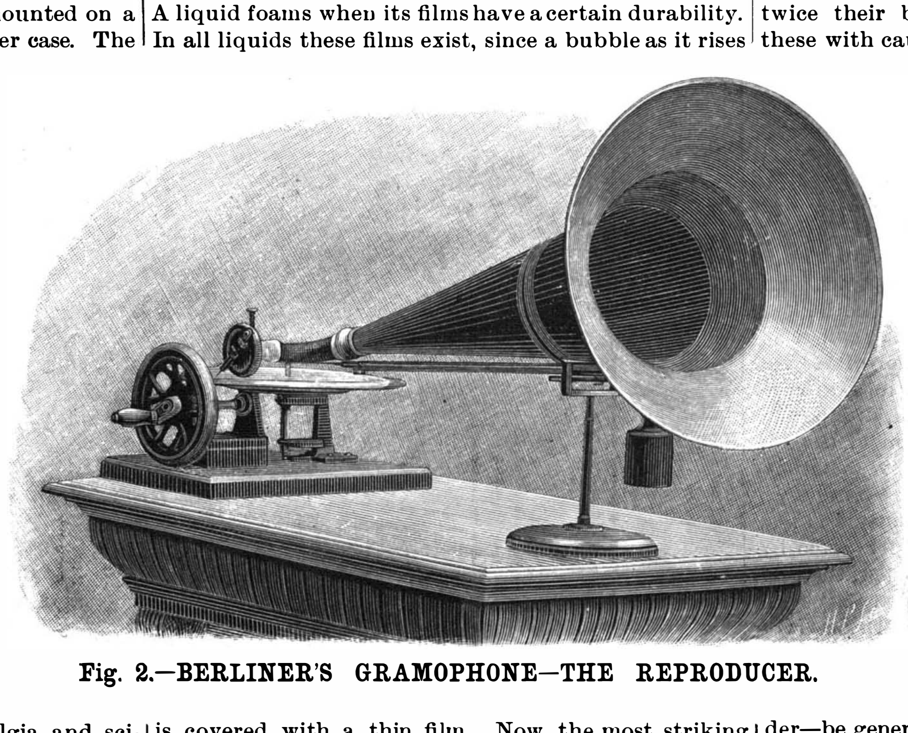


Fig. 2.—BERLINER'S GRAMOPHONE—THE REPRODUCER.

Danger in Wet Cellars.

Scarcely anything is more prejudicial to good health than wet cellars. Rheumatism, bronchitis, pneumonia, and malarial affections, including neuralgia and sciatica, are some of the dangers to be apprehended. Damp cellars mean foul and noxious air, and should be sedulously avoided. Now, before the rains come, while the water or moist line is considerably below the surface, is the proper time to prevent these evil influences. Drain tiling, laid outside and a foot below the base of the foundation, and running diagonally across the cellar, and connecting with the outside drains, and thence leading to the street drain or some low ground, is the best and perhaps only safe way to drain, not only the cellar for a foot below its surface, but the outlying ground for several feet in all directions from the house. This drain, while having a free outlet, should furnish no opportunity to put into it anything but what is extracted from the soil. It should never, on any conditions, have any connection with sewage, nor receive any kitchen slops or surface water, and should be well below the frost line. If possible, the cellar floor and the sides of the wall, as high as the surface of the ground outside, should be well cemented. It is well, owing to the great porosity of brick, if used for foundation walls, to have intervening layers of cement, so as to prevent, as far as possible, the upward passage of the water by absorption. This drain should be laid as far as possible from the well, lest in some way its contents should be emptied in the well and contaminate the drinking water. The expense of such drainage and wise precaution would be but a trifle—especially if, by its neglect, a protracted sickness, with its doctor, and drug and nurse bills, and eventually a funeral, should be prevented.

The soundest wisdom and strictest economy favor the adoption of all measures that lessen, or reduce to a minimum, the dangers from preventive diseases.—*Monthly Bulletin Iowa State Board of Health.*

Foam.

In a lecture on "Foam," Lord Rayleigh insisted that foaming liquids were essentially impure, for pure liquids will not foam. For instance: neither water nor alcohol can be raised into a froth, although a mixture of the two may be to a certain extent. The addition of gelatine to water in the proportion of 1 in 100,000 develops the foaming quality quite noticeably. Of course, the best-known foaming liquid is a solution of soap, such as the children use for blowing bubbles. A liquid foams when its films have a certain durability. In all liquids these films exist, since a bubble as it rises is covered with a thin film. Now, the most striking property of films is their tendency to contract, and they may be regarded as being in the condition of a stretched membrane, as of India-rubber, with the difference that the tendency to contract never ceases. An air bubble will force the air back through the pipe, and a loop of silk floating on a film will be forced into a circle the moment the film inside it is ruptured. Oil forms a film on the surface of water, and covers it entirely, even if the mass of the oil be collected into drops. This is well shown by dropping a particle of oil on to a vessel of water lightly covered with sulphur flour. The sulphur will be immediately driven to the edge by the spreading film. The reason of this is that the tension of the water-air film is greater than the combined tensions of the water-oil and oil-air films, and consequently pulls out the oil film. It is possible to reduce the surface tension of water by mixing it with various substances, such as ether and camphor. Camphor scrapings placed on the surface of pure water enter into vigorous movements, because the dissolved camphor diminishes the surface tension of the water; but, if the water be contaminated by the least quantity of oil or grease, the motion ceases. Lord Rayleigh made several experiments to find what thickness of oil film would accomplish this: he found it to be about 1½-millionth of a millimeter. This thickness bears to an inch the same ratio that a second of time bears to half a year. Lord Rayleigh explains the calming action of oil on the sea as follows: As the waves advance, the surface has to submit to periodic extensions and contractions. At the crest of a wave the surface is compressed, while at the trough it is extended. So long as the water is pure, there is no force to oppose this; but, if the surface be contaminated, the contamination strongly resists the alternate stretching and contraction. It tends always, on the contrary, to spread itself uniformly, and the result is that the water refuses to lend itself to the motion which is required of it. The film of oil may be compared to an inextensible membrane floating on the surface of the water, and hampering its motion.

Mixtures for Cleaning the Hands.

In chemical works, it is not an uncommon occurrence for one's hands to become so soiled with the various

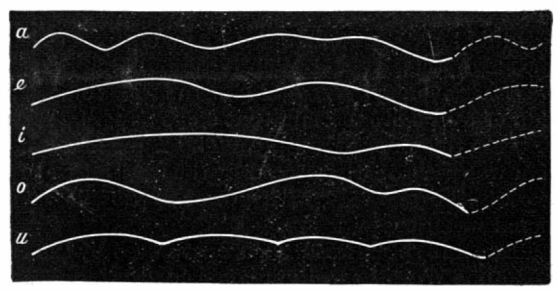


Fig. 4.—MAGNIFIED RECORD OF THE VOWELS.

well defined and separate nastinesses to be found there as to be quite insusceptible of cleansing by ordinary soaps or soap powders. One or two chemists of our acquaintance, the *Chemical Trade Journal* says, use a mixture under these circumstances, which we publish for the benefit of those of our readers who care to try it. Take about two or three grammes of bleaching powder, the same quantity of soda ash, and about twice their bulk of sawdust. Completely saturate these with caustic soda liquor, say 10 or 15 Twaddell, and quickly rub over the hands. As soon as the desired effect is produced, rinse the hands with water. It is occasionally necessary to repeat the process, but, as a rule, one application suffices to make the hands perfectly clean. There is an odor of bleaching powder perceptible from hands thus treated, to which some may object, but this may be destroyed, and the appearance of the hands still further improved, by rubbing them over with a little sulphurous acid solution, or by rubbing first with a solution of sulphite or hyposulphite of soda, or sulphite of ammonia, and, while still wet from this, rubbing over with very dilute hydrochloric or sulphuric acid. The hands should be well washed with water, and a little ten per cent glycerine rubbed in to keep them soft.

Nitric acid stains on the hands still appear to defy all comers, except pumice stone, but inks and organic stains may—in the absence of bleaching powder—be generally removed by a mixture of chlorate of potash and hydrochloric acid.

GLUE FOR TABLETS.—For 50 lb. of the best glue (dry) take 9 lb. glycerine. Soak the glue for ten minutes and heat to solution and add the glycerine. If too thick, add water. Color with aniline.

NEW YORK CITY AQUEDUCT—ITS ENGINEERING FEATURES AND DESIGN.*

ALEX. CRAWFORD CHENOWETH, ENGINEER IN CHARGE, CROTON AQUEDUCT.

The capacity of the Croton watershed to furnish a minimum supply of 250,000,000 gallons per day was determined from its meteorological history. The whole question was narrowed down to the selection of plans and means to secure sufficient storage and to conduct the water to the city. The plans for the utilization of the waters of the Croton basin were, therefore, to combine a simplicity of construction, embracing economy in their design, large storage capacity, and a conduit from the Croton River to New York City.

The erection of numerous small reservoirs for storage purposes had been under consideration by the Board of Public Works prior to and during the years 1857 and 1858. Departing from the original plan, it was proposed in place of numerous small dams to build a large one on the Croton River at Quaker Bridge, about four and one-half miles above the mouth of the river, forming a reservoir of 3,635 acres in area, with a storage capacity of about 32,000,000,000 gallons, above the level of the proposed new aqueduct. This dam will receive the entire drainage of the 361 square miles of watershed, including about 23 square miles below the present Croton Lake, not included in any previous plans or calculations. The most economical means for conducting the waters garnered by a system of reservoirs, or a single dam, was by means of a conduit to New York City, constructed of masonry, circular in form, with a capacity to deliver 250,000,000 gallons of water per day, the conduit to be in tunnel wherever possible.

This plan has the advantage of being almost wholly in rock tunnel, securing the greatest possible strength and stability of structure, with the least cost for supervision and maintenance after completion. The prominent features of the entire plan therefore are a large reservoir to receive the entire drainage of the Croton watershed, and capable of holding 32,000,000,000 gallons of water above the level of the aqueduct.

The Croton watershed is located some thirty miles north of New York City, in the jurisdiction of the State of New York, having a catchment equal to an area of 361·8 square miles, with an average yearly rainfall equal to 45·97 inches, an average yearly flow of 135,400,000,000 gallons, or a daily flow of 371,600,000 gallons. This was determined from a meteorological history covering 17 years.

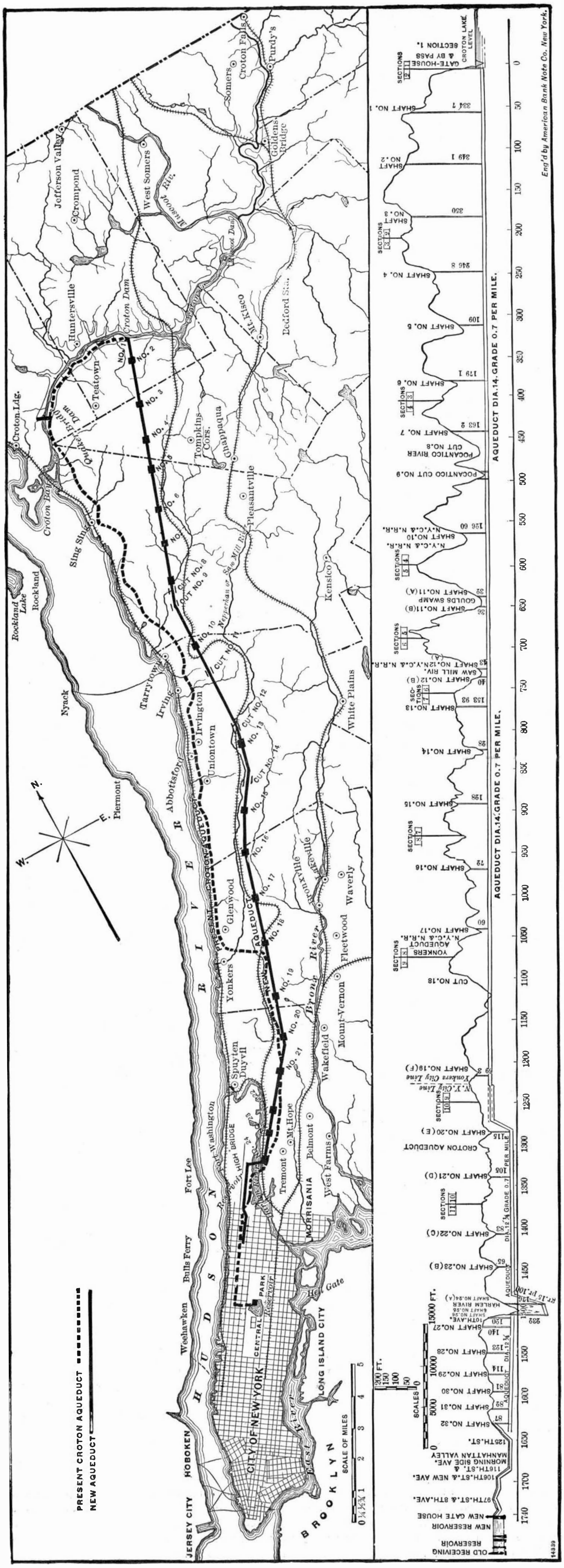
It had long been felt that the capacity and supply of the old system, erected when the population of the city was 350,000, were inadequate for the needs of a population of over 1,500,000, and that steps must be taken to increase the present supply. The Aqueduct Commission was accordingly created by the Legislature of New York in the year 1883, with power to provide an additional water supply.

Plans and specifications were presented by the Board of Public Works, specifying dams and reservoirs to be located at Quaker Bridge, in the Croton River basin, with a dam at Muscoot Mountain, in the upper Croton basin, together with a dam at Sodom, known as the West Branch Reservoir. After many public hearings and discussions the commission decided that the new aqueduct should be constructed with a conduit having an inside clear area equal to that of a circle of the internal diameter of fourteen feet, locating its northern terminus at Croton Lake, and afterward its southern terminus at Manhattan Valley.

The 9th of April, 1884, the plans relating to a conduit or tunnel thirty and three-fourths miles in length were adopted from gate house at One Hundred and Thirty-fifth Street to Croton Lake. The water was to be conducted to the reservoir in Central Park from the One Hundred and Thirty-fifth Street gate house, by means of pipes, a distance of two and three-eighths miles, making the total length of aqueduct thirty-three and one-eighth miles. The entire aqueduct is practically finished and ready for the introduction of water, its use being debarred only by some minor details. The water will enter the tunnel through a gate house located near the present Croton dam, this being constructed so as to receive water at an elevation of 140 feet above tide at the invert. Two other entrances are provided, one at elevation 166 and one at 184, discharging in Central Park Reservoir. The elevation of the flow line of Quaker Bridge Reservoir will be 200 feet above tide. The maximum elevation of the receiving reservoir in Central Park is 113 feet, the bottom 79 feet. The elevation of point of discharge is 104 feet; the hydraulic grade line at Central Park 113 feet, the total fall from water level of greatest flow in the aqueduct at Croton dam to high water in Central Park Reservoir being 33·8 feet, the distance being thirty-three and one-eighth miles.

The cross section of the tunnel is in the shape of a horseshoe, this modification from a circular cross section having been made with a view to economy in blasting out the rock, the natural inclination of which was to assume a square shape rather than a circular one; the hydraulic area of cross section remains the same as that

* Abstract of a paper read before the Franklin Institute, Philadelphia, Pa.



adopted by the commission, and extends without change twenty-five miles south of Croton Lake, with a hydraulic slope of 0·7 of a foot per mile, giving a velocity of four feet per second, and not being under flow pressure.

The remaining five miles being under flow pressure, by reason of a change in elevation, the diameter was reduced to twelve feet three inches. The hydraulic grade being raised increased the static head, and the capacity to deliver the amount of water required permitted a decreased diameter. The tunnel approached the surface four times in the total distance, enabling the work to be prosecuted by means of open cuts. Headings were driven in the rock north and south of thirty-eight shafts together with the portals in open cuts.

	Feet.
The greatest depth of shaft from surface....................	350
The least depth of shaft from surface..........................	28
Aggregate depth of shafts excavated..........................	4,491
Average depth of tunnel underground..........................	170

The work of excavating the tunnel proper was begun March 7, 1885, and finished July 7, 1888, the time being three years and four months. The remarkably short time occupied in excavating the tunnel was due to the advance in mechanical appliances for drilling and excavating rock.

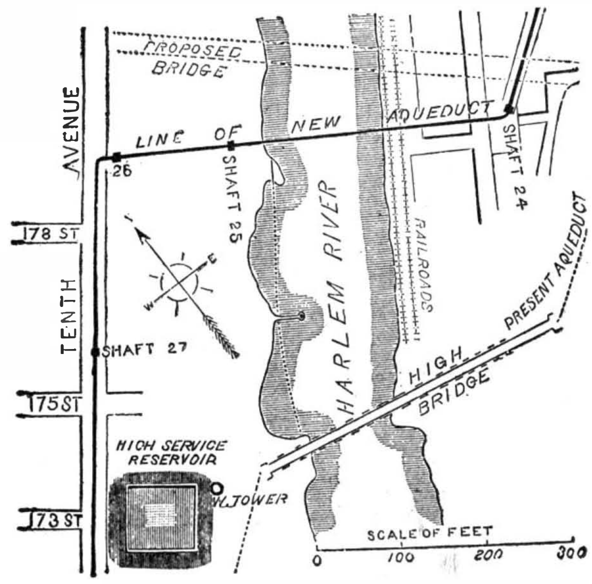
In passing under Gould Swamp the tunnel was driven on an incline with a hydraulic slope of fifteen per cent to a depth of sixty feet below the main tunnel, then carried for a distance of 716 feet under and beneath the swamp, rising again by a vertical shaft to the level of main tunnel. A pumping house was erected at this shaft, No. 11 "B," for the purpose of clearing the siphon of water when the tunnel is to be emptied for examination. The diameter of this siphon is the same as that of the tunnel, the change of elevation in main tunnel, which occurs about twenty-five miles from Croton Lake, descending by an incline with a hydraulic slope of ten per cent to a depth of sixty feet be ow the main tunnel. From this point the flow line is under pressure the remaining distance and the diameter is reduced to twelve feet three inches, the flow due to the increased velocity being about the same. Shaft No. 21, which is located near Jerome Race Course, twenty-five and one-fourth miles from Croton Lake, was designed with a view to the location of a reservoir at this point, discharging the water through this shaft.

The total capacity of the tunnel not under flow pressure being 310,000,000 gallons per day, will admit of storage of the surplus water at this point, the elevation of the surface at shaft 21 being at hydraulic grade line.

The hydraulic slope of the tunnel from the point at which the diameter changes to twelve feet three inches, as far as the north bank of the Harlem River, is 0·7 of a foot per mile. At this point a vertical descent of 169 feet is made in order to pass beneath the Harlem River. [See illustrations on first page.] The tunnel under the Harlem for a distance of 965 feet, being under flow pressure, was reduced to a diameter of ten feet six inches, which was found to be all that was required. In this part the hydraulic slope is 1 foot in 100 feet. The water is delivered to the tunnel through shaft No. 25, rising 321 feet, to an elevation 9 feet above high water mark, the tunnel being designed from this point to deliver the water at a gate house located at One Hundred and Thirty-fifth Street, with a rising slope of 0·065 per 100 feet, in order to drain that portion of the tunnel south of the Harlem into the Harlem River by an adit emptying into the river at shaft 25, situated on the south bank of the Harlem. Shafts 24 and 25 were constructed for the purpose of draining the tunnel under flow pressure north and south of the Harlem River, shaft 25 also serving as a pumping station to free the siphon under the river. The tunnel ends at the gate house located at One Hundred and Thirty-fifth Street, and the water is then conducted to the reservoir in Central Park by twelve lines of iron pipe, three feet in diameter. Four waste weir gate houses are located on the line, one at Pocantico River, near Tarrytown, nine and one half miles south of Croton Lake; the second at Saw Mill River, six and one-fourth miles further south, near Ardsley; the third at Tibbets Brook, five and one-half miles further; and the fourth at the Harlem River, seven miles below. Three gate houses serve to control and regulate the water supply through the aqueduct; the largest at Croton dam, the entrance; the second at the south end of the tunnel, One Hundred and Thirty-fifth Street, where the pipe line begins; and the third at the final terminus, in Central Park. The character of the rock varied considerably; hard, granitic, and syenitic gneiss rock was encountered, also lime rock, a soft laminated, micaceous gneiss and mica schist appeared in stretches. Disintegrated talcose rock occurred at shaft 18 south, and crushed in the strongest timbering. At shaft 30 south, some 300 feet of the tunnel were lined with iron in the form of rings bolted together, surrounded with brick and backed with rubble masonry. This was found necessary in such bad ground. Nearly every variety of tunnel experience was met with in this work.

The entire tunnel is lined with brick from end to end, forming a wall sixteen to twenty-four inches thick, and filled in from brick lining to rock face with rubble masonry. In order to obtain room for this lining, the tunnel had to be excavated to a clear diameter equal to eighteen feet along the section, with an internal diameter of fourteen feet, and to fifteen feet in that part twelve feet three inches in diameter.

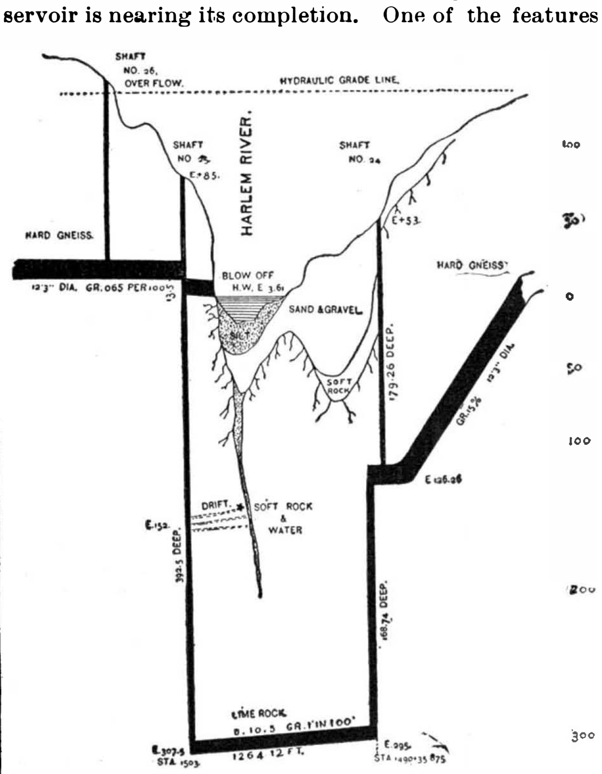
By far the greatest feature of the system designed for an additional water supply is the erection of Quaker Bridge dam and reservoir. Its utility and necessity are conceded, though its construction has not been finished. Its successful and permanent construction will undoubt-



THE HARLEM RIVER TUNNEL.

edly become an established fact, in view of the real design and intention for which the new aqueduct has been constructed. The total height at center will be 265 feet; the width or thickness at base will be 216 feet; width at top, 20 feet; its length at top, 1,500 feet; elevation of base, —52 feet; elevation of flow line, + 200 feet; elevation of flood line, + 206 feet; elevation of top of rail, + 213 feet. This dam has been designed as a straight dam, and has met with difference of opinion in regard to this feature from numerous engineers.

In connection with Quaker Bridge reservoir, the erection of a dam and reservoir at Muscoot Mountain, six miles above Croton Dam, is contemplated as a necessary auxiliary to Quaker Bridge reservoir. The dam would cover this territory with its back water, and would serve a sanitary purpose. In case the reservoir were drawn down at any time, the surrounding country would not be laid bare to the sun's rays, the consequences of which would be the serious contamination of the water. In order to acquire an increased storage of water above the present supply, pending the final determination and erection of the Quaker Bridge reservoir, a selection of a site on the west branch of the Croton River, near Sodom, was resolved upon. The reservoir is nearing its completion. One of the features



THE HARLEM RIVER TUNNEL.

of the Sodom dams and reservoirs is a double dam, two distinct drainage areas having two dams connected by a tunnel, so that the water can pass freely from one to the other.

The capacity of the Sodom or east branch reservoirs is about 10,000,000,000 gallons. The erection of this dam about doubles the existing storage in reservoirs and lakes located in the Croton watershed.

The Sodom or west branch reservoirs are impounded by small dams, one of them being of masonry 500 feet long, and the other an earth dam with masonry core. The Department of Public Works is erecting a reservoir on the Amawalk River, a small tributary, near the site selected for the Muscoot dam, with a capacity of 7,000,000,000 gallons. This, together with existing reservoirs and lakes, and the west branch reservoirs now building, will give a total storage of 26,000,000,000.

All the water in the Croton watershed will, in a few years, be stored up for use.

ESTIMATE OF FUTURE CONSUMPTION OF WATER IN NEW YORK CITY BY PROLONGING THE MEAN CURVE OF PAST CONSUMPTION.

Year.	Million Gallons.	Increase Million Gallons.	Year.	Million Gallons.	Increase Million Gallons.
1876.......	98·0	....	1889.......	168·0	7·0
1877.......	102·0	4·0	1890.......	176·0	8·0
1878.......	106·0	4·0	1891.......	184·0	8·0
1879.......	110·5	4·5	1892.......	193·0	9·0
1880.......	115·0	4·5	1893.......	202·0	9·0
1881.......	120·0	5·0	1894.......	212·0	10·0
1882.......	125·0	5·0	1895.......	222 0	10·0
1883.......	130·5	5·5	1896.......	234·0	12·0
1884.......	136·0	5·5	1897.......	246·0	12·0
1885.......	142·0	6·0	1898.......	258·0	12·0
1886.......	148·0	6 0	1899.......	272·5	14·5
1887.......	154·0	6·0	1900.......	290·0	17 5
1888.......	161 0	7·0			

The evidence of this record is that the Croton must be supplemented from some other source within a few years. The total capacity of the two aqueducts—the old and the new one—together being 350,000,000 gallons of water per day, their supply will answer all purposes for some time to come.

THE OLD CROTON AQUEDUCT.

Although the aqueduct which has for many years served New York City so well will undoubtedly be thus styled hereafter, it should not be forgotten that it still stands as one of the finest engineering works of its kind in the world, and will still be able to supply the city fairly well for some time yet in case of any failure in the newer and larger work. The Croton aqueduct was completed in 1842, having been five years in building, under the superintendence of John B. Jervis, chief engineer. The whole expense of the aqueduct, including $1,800,000 for distributing pipes, and amounts paid for right of way and other incidental charges, was $10,375,000, but commission and interest brought the total up to $12,500,000. The capacity of the old aqueduct is about 120,000,000 gallons daily, but of this amount only about 90,000,000 gallons daily reaches the great reservoir in Central Park for general use. This reservoir has for a long time been only a quarter to a third full. Its capacity is 1,030,000,000 gallons and it is the intention of the commissioners at first to use the new aqueduct only to fill up this great reservoir, flushing out the aqueduct for its whole length before letting the water into the reservoir. After the reservoir is full the water will be shut off for sufficient time to make a thorough inspection and repairs, wherever they may be needed. Readers should also in this connection refer to the article in last week's SCIENTIFIC AMERICAN on the Sodom and Bog Brook reservoirs.

Front Door Letter Box Wanted.

It is reported the Postmaster-General, in order to increase the efficiency of the free delivery service, desires to secure a device for a letter box for the doors of dwellings that will be simple in construction, low priced, and capable of adjustment to the interior or exterior of doors without injuring or defacing them. A letter box that will fill these requirements will save much of the carriers' time, while increasing the security of the mail to the householder. The Postmaster-General has appointed a committee, of which Postmaster Van Cott and the postmasters of St. Louis, Washington, New Orleans, and Boston are members, to invite the public to send to either of the members designs, samples, models, or suggestions for such a box. Designs will be received until October 1 next, and the committee, after examining them, will tell the Postmaster-General which box, in their judgment, is best adapted to the purpose. The Postmaster-General will probably officially adopt the box or recommend it to the public for general use.

PASTEUR might have been the richest man in the world if he had cared for the commercial value of his discoveries and protected them by patents. In addition to his discoveries in the prevention of hydrophobia he discovered the cause of a mysterious disease among silkworms, which threatened to destroy the silkworm industry in France, and applied a remedy. The wine growers of France and Italy complained of their vines being slow to mature and the grapes to turn sour. Pasteur's investigations of the yeast germs taught the grower how these evils could be cured. He discovered the microbe which propagates disease in sheep, and suggested a remedy. These discoveries represent a gain to the community of many millions of dollars, but the great scientist has made no effort to profit personally from any of them. —*N. Y. World.*

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — William P. Clark, Elberton, Ga. This is an improvement in automatic couplers in which a latching drawbar is employed. the drawhead being preferably cast from metal with an interior recess to receive the working parts, and the object being to provide a simple, practical device whereby the coupling may be effected without danger to the operator.

EXTENSIBLE CAR STEP. — James F. and John F. Wood, Wilmington, Del. This step has a piston rod angular in cross section, with a piston and a cylinder in which the piston works, provided with a head having an opening corresponding to the shape of the piston rod, whereby the step will be prevented from tilting, the invention being an improvement on a former patented invention of the same inventor.

SIGNAL. — Albert C. White, Afton, Iowa. This invention provides a signal capable of being manipulated to positively display any desired colored side of the signal to the train when employed as a semaphore, and any desired colored light at night, providing means also whereby the signal may hang very high, and the lantern may be conveniently lowered for lighting and cleaning.

AUTOMATIC AIR BRAKE. — George B. Williams, Portland, Oregon. This improvement provides for the recharging of the auxiliary reservoir with a single line of train pipe, either with or without the release of the brakes, as desired, and means whereby the pressure in the brake cylinder can be reduced to any desired extent, and the brakes only partially released coincident with a partial recharging of the auxiliary reservoir, with other novel features.

RELEASING ATTACHMENT FOR AIR BRAKES.—This is another patent of the same inventor for an improved construction and arrangement of parts connected with the triple valve and train pipe and governing the discharge passage from the auxiliary reservoir to the pipe, to effect a rapid and immediate equalization of the air pressure when that is increased by the engineer to release the brake.

RAILWAY SPIKE. — Samuel Emrich, Reno, Nevada. This spike has a longitudinal cavity with lateral mortises in which fit plates, a bar with wedge-shaped end being fitted to the cavity for forcing the plates outwardly in the mortises and causing them to project into the wood at the sides of the spike, whereby the spike is held in place in the wood into which it is driven.

FREIGHT HANDLING MACHINE.—Isaac Henderson, Vancouver, Canada. This invention consists of an endless double track arranged vertically, with cages traveling on the track, and conveyers connected with the track to move articles to and from the track, forming a portable machine specially designed for elevating and lowering and transporting freight from and to cars, ships, docks, etc.

Mechanical.

LUBRICANT. — John J. Stock, Watertown, N. Y. This is a compound consisting of pulverized talc, beef tallow, paraffine oil, potash lye, vermilion rod, and other ingredients, mixed and boiled together to form a reddish paste, and designed to be mixed with other lubricating oil to bring it to the desired gravity.

DIE FOR LEAD PRESSES.—Christopher C. Tracy, Brooklyn, N. Y. This die is designed more particularly for covering wire with lead and for making traps, and is so constructed as to enable the attendant to prevent "buckling" of the lead as it issues from the die if a straight and uniform product is to be produced, or to augment the flow if a curved pipe or trap is to be made.

AMALGAMATOR. — Samuel L. Townsend, Ohio, Col. This is of the so-called "pan" type of amalgamators, and is constructed to form closed helical channels in which mercury is held, and through which channel the pulp flows, being admitted at the center and discharged at the periphery of the apparatus.

PNEUMATIC ORE CONCENTRATOR. — Charles Ballard, Pueblo, Col. This invention provides a machine designed, by means of an exhaust blast, to concentrate pulverized ores such as are usually passed through water jigs, the ore to be treated being previously sized by suitable means, and only sufficient blast being used to carry off the light particles.

BELT FASTENER. — George W. Southwick, Stamford, Conn. This fastening consists of a plate having at each end arms of unequal length, with downwardly projecting spurs on their ends, the long arms at each end being opposite the short arms at the other end, and *vice versa*, and short spurs at each end between the arms.

SEPARATOR.—Edward Leslie, Orangeville, Ontario, Canada. This invention relates to machines for separating grain, gravel, etc., and consists mainly of a screen mounted to swing and having an intermittent fast and slow motion, the invention also covering various novel details and combinations of parts, and being simple, effective and durable.

Agricultural.

CULTIVATOR. — John D. Burkhart, Dayton, Washington. The plows of this machine are each made with lateral wings having a wide open space, the plows being secured to the lower ends of curved beams, to the upper ends of which are bolted the rear converging ends of connecting rods, and there being a lever by which the driver can readily raise all the plows clear of the ground.

FARM GATE.—John C. and Luther Merrill, Westphalia, Kan. This is a balanced sliding and swinging gate, designed to be simple in construction, inexpensive and easy to manipulate, the invention covering various novel features and peculiar combinations of parts.

PLANTER. — Frank F. Shanks, La Cygne, Kansas. This invention consists essentially of a planter wheel provided with hill openers arranged to be thrown beyond the peripheral face of the wheel, and deposit a certain required number of grains at stated intervals in ground that has not been prepared by plowing.

HAY RACK. — John L. Wilkerson, San Marcos, Texas. This is a rack adapted for application to a wagon body, standards or uprights being connected with the base bars, the standards having stop shoulders or hooks, while side arms have their inner sections pivoted to the uprights at a point in from the stop shoulders and arranged to rest on the shoulders when turned outward.

Miscellaneous.

ORDNANCE. — James A. Longridge, Greve d'Azette, Isle of Jersey, Great Britain. This invention covers a wire gun, the breech portion having an inner tube on which are wound coils of wire, a jacket inclosing the coils and receiving the breech-closing plug, with various other novel features designed to obviate prejudicial strains, first, affecting principally the jacket, and second those affecting principally the inner tube.

PERCUSSION FUSE.—Abraham Martin, Birmingham, Warwick County, England. This fuse is of that class in which the plunger acts by its inertia and momentum to bring into position and give force to a part not integral with it, but so connected as to admit of a change of the position of the parts to bring them from the safety to the firing position, such change being effected by the impact of the plunger and the sudden motion of the projectile.

WALL FOR SHIPS. — Carl W. M. F. Busing, Oldenburg, Germany. By this invention the walls forming the hull of the ship, and its partitions, are provided with a lining of compressed sponge, forming a water absorbent material, to prevent water from entering the hull through a defective part or a hole made by a projectile or other means.

PADLOCK. — David M. Thomas, Au denried, Pa. This lock is designed to be so constructed as to form a safe and durable fastening, not liable to be picked, and which can only be unlocked by those familiar with its workings, the invention covering various novel features of construction and arrangement of parts to form a simple and effective lock, readily understood and operated.

METALLIC CEILING. — George H. Burt, Philadelphia, Pa. This ceiling consists of metallic plates adapted to be secured to the under sides of the joists and projecting on each side of them, arched bars being supported at suitable intervals on the projecting sides of the plates, and a sheet metal covering supported on the arched bars between the joists, making a fire proof and ornamental construction adapted for all kinds of buildings.

VEHICLE WHEEL. — Gabriel J. De Cordova and Percy A. Isaacs, Kingston, Jamaica, W. I. In this wheel the nave has an annular recess holding a projecting elastic band upon which rest spokes, there being flanges to hold the spokes from lateral displacement, making a wheel designed to prevent jar and noise when traveling, and decrease wear and tear on the vehicle, and also one that can be readily repaired.

ANTI-RATTLER FOR THILL COUPLINGS. —Robert J. Mitchell, Girard, Ill. This anti-rattler is formed from a single piece of spring wire, bent into a described shape, the wire being sufficiently stiff to hold the thill iron and bolt in position, but not so stiff but that it may be easily applied, and designed to be durable and cheap, while little affected by wear.

ANTI-RATTLER FOR THILL COUPLING. Clarence A. Carman, Wyandance, N. Y. This invention relates to anti-rattlers in which provision is made for adjusting the spring to increase its pressure on the thill when desired, or to remove the pressure in taking out and replacing the thill, the hanger being adjustably supported from a plate, and a spring pivotally connected with the hanger.

METALLIC POST. — Foster Milliken, New York City. This invention is for a post adapted for use when the post or strut is subjected to a pull or strain at a point above the base, and has an additional diameter at the base from the partial spreading of its segments, the post being designed to be readily climbed, to be of neat and ornamental design, and to be open for convenient inspection, painting, and ventilation.

WASHING MACHINE. — William J. Brackney, Coyleville, Pa. This machine has a rectangular suds box, with two oppositely pivoted rocking levers connected by a cross bar, and an upper rubber frame with slotted standards engaged by studs on the rocking levers combined with a lower rubber frame having open slots engaged by pivot studs on the lower end of rocking levers, with other novel features designed to make a durable and efficient device.

SHUTTER FASTENER. — Willie O. Whitney, Glens Falls, N. Y. This is a blind fastener designed to automatically latch fast to and secure a closed window blind when the lower window sash is raised, and also afford additional security by engagement of a portion of the blind fastener with the lowered and locked window sash.

SWING. — John Hannen, Chicago, Ill. This invention relates to swings in which suspension rods instead of ropes are used, a movable pyramidal frame being employed in which are two swinging suspension rods carrying a slightly tilting spring seat, the device occupying but little space and being one that can be easily operated by the person swinging.

LEAF TURNER. — Cyril P. Brown, Spring Lake, Mich. This is an instrument adapted for attachment to either a vertical or horizontal surface, without marring the latter, and to be folded into small space when not in use, while designed to positively turn the leaves of music, books, manuscripts, etc., either way, by means of a conveniently located lever actuated by a careless stroke of the hand.

ALMANAC OR CALENDAR.—Zeboim C. Patten, Chattanooga, Tenn. This invention relates to almanacs and weekly, monthly or yearly calendars, to be used in either book form or on independent pieces of cardboard, etc., combining therewith a code of signals indicating the phases of the weather or changes in temperature.

CUFF FASTENER.—Charles E. Candee, New York City. This fastener consists of a U-shaped bar forming two members, carrying at its inner end a spring clip and having at the outer end of one of the members an apertured post, the opposite member carrying a pointed slide adapted to move laterally and engage the aperture of the post.

BUTTON HOLDER. — Eugene T. Elliott and William O. Lyles, Danville, Va. This is an attachment for the drawers of a button cabinet to hold the sample button, whatever its size or shape, the button to be adjusted instantaneously, and the arrangement being such that it cannot be separated, while the price mark will always appear on a slate provided therefor, enabling dealers to display stock to advantage.

WICK MATERIAL.—Myron H. Chapin, Chicago, Ill. This is a new article of manufacture made of raw fibrous material, having its interior stiffened and held with adhesive substance and its exterior surfaces formed with a protective skin of compressed fibers and adhesive substance, the wick being designed to be less expensive, more lasting, and more efficient than the ordinary woven cotton wick.

EXTRACTING BAD ODORS FROM VEGETABLES, ETC.—Gysbert D. Nellensteyn, Amsterdam, Netherlands. This invention covers a method whereby the substances are first treated with a volatile solvent, as ether, petroleum, etc., then exposing the substances in a vacuum, to evaporate the volatile elements and those of the solvent, and subsequently condensing the extracted parts to recover and utilize them when required.

NEW BOOKS AND PUBLICATIONS.

PRACTICAL ELECTRICS: A UNIVERSAL HANDY-BOOK ON EVERY-DAY ELECTRICAL MATTERS. New York: E. & F. N. Spon. London. 1889. Pp. 135. Price, 75 cents.

This work is a reprint of a chapter on electrics given in the third series of "Workshop Receipts," a work with which many of our readers are already familiar. It forms a convenient compendium of practical electricity, and as such may be recommended to experimenters and those who are not very deeply versed in electrical lore.

THE CHRONICLE FIRE TABLES FOR 1890. An invaluable compilation of fire statistics. New York: The Chronicle Company, limited. 1890. Pp. 297.

A most complete resume of location, causes, and other facts in regard to fires in the United States during the year 1889 fills the body of this work. The classes of risks, numbers of fires, property lost, insurances and causes of fires are given. The tabular statement of these facts fills a large number of pages. This is supplemented by other tables and by diagrams showing the proportions between fires of exterior and interior origins, comparison by areas being used for the purpose. A very striking diagram gives the property lost by fires from electric lights and wires for the last successive four years, the amount rising from $460,259 in 1886 to more than 5½ millions of dollars in 1889.

THE FAIRYLAND OF FLOWERS. A popular illustrated botany. By Mara L. Pratt. Boston: Educational Publishing Company. 1890. Pp. 154.

A botany for children, admirably arranged and diversified in the most pleasing manner with numerous illustrations, is presented in the "Fairyland of Flowers." The book does not well lend itself to a review, and the most that can be said is that it is very complete and that it is surprising how interesting it has been made by the insertion throughout the family grouping of legends and poetry referring to the different flowers. It is calculated in every way to make botany seem a living thing, instead of a dry and abstract science.

REPORT OF THE ROYAL COMMISSION ON THE MINERAL RESOURCES OF ONTARIO, AND MEASURES FOR THEIR DEVELOPMENT. Toronto. 1890. Pp. xxiv, 566.

The titular subject of this report, which is due to the investigations of the Royal Commission, is treated in a very general manner. The geology of Ontario, notes on mines, locations and works visited by the commission, influence of commercial conditions upon the mining industry, mining laws and regulations, the smelting of ores, legislation for encouragement of mineral development, are the principal headings of the work. It will be of interest to all students of mining and metallurgy, and is of economic interest as showing what our colonial neighbor is doing in the production of metals.

"THE ELECTRICIAN" ELECTRICAL TRADES DIRECTORY AND HAND BOOK FOR 1890. London. 1890. Pp. xcix, 704.

The vast impulse which industrial electricity has received is well exemplified in this directory, which includes a calendar of electrical news arranged in months, obituary notices and biographical notices, in many cases accompanied by portraits. As its scope is not confined to Great Britain and its dependencies, but extends also to America and the colonies, it is of interest and value to all electricians, and not merely to those connected with the industries of the British Isles.

A SHORT COURSE OF BUSINESS SHORTHAND. By David Philip Lindsley, author of Tachygraphy. Chicago: D. Kimball. Boston: Otis Clapp & Son. New York: Fowler, Wells Co. 1888. Pp. 95. Price $1.25.

A simple style of shorthand adapted to many professional writers purports to be given in this book. It is not claimed to give a style rapid enough for the court reporter, but is supposed to give a simple method which will suit very many. Numerous examples and exercises are embodied in the work.

THE ELEMENTS OF TACHYGRAPHY. Re-written and re-engraved. By David Philip Lindsley. Boston: Otis Clapp & Son. New York: Fowler, Wells Co. 1889. Pp. 115.

This is a work similar to the one just reviewed, the aim of the author being to supply a simple shorthand for the use of non-professional people.

SLIDE VALVE GEARS. An explanation of the action and construction of plain and cut-off slide valves. By Frederic A. Halsey. New York: D. Van Nostrand Company. 1890. Pp. viii, 135. Price $1.50.

The drawing board practice in designing a valve gear, the graphical treatment of a complex problem, is given here by the author, rejecting formulæ and higher mathematics. The subject of lap and lead is also treated graphically. Numerous diagrams and a full index are included.

THOMAS JEFFERSON'S VIEWS ON PUBLIC EDUCATION. By John C. Henderson. New York and London: G. P. Putnam's Sons. 1890.

The views of the great statesman on university education are here brought forward, partly as an original work and partly as made up from Jefferson's letters and other writings. It is a work which is very timely, at the present day, in view of the great interest manifested in the higher education as well as in the development of the youthful mind in the kindergarten and by grammar school training.

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Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

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

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(2325) L. G. B. asks for a good way to remove warts. A. Use a strong solution of chromic acid, applied three or four times. It is said that repeated applications of whale oil will cause warts to disappear.

(2326) F. O. asks what the advantage is in making the ordinary mouth blowpipe conical. Is it simply a convenience in manufacture, and would a straight tube of same opening as the small end of the blowpipe answer as well? A. The conical shape of the tube is useful, as it gives more capacity for the transmission of air, and the operator does not need to blow so hard.

(2327) D. & S. ask: Is not much of the Vichy dispensed from fountains in drug stores, etc., artificial, and does it approximately represent the water of that name? What is the formula for the artificial manufacture? A. Yes; nearly all is artificial, made by formulæ approximating more or less to the true composition. For 10 gallons (80 lb.) of water use:

Sodium carbonate	4249	grs.
Sodium chloride	112	"
Potassium chloride	141	"
Sodium bromide	10	"
Sodium silicate	15½	"
Lithium carbonate	11	"
Calcium chloride	736	"
Magnesium chloride	308	"
Barium chloride	6¾	"
Aluminum chloride	12½	"
Iron chloride	$\frac{1}{16}$	"

(2328) F. M. N. asks: 1. Will shellac varnish do for coating, developing, and toning trays? A. No; use asphaltum varnish, or coat the bottom or sides of the wooden tray with:

Resin	1 part by weight.	
Beeswax	2 "	" "
Paraffine	3 "	" "

Melt the above first, warm the tray, and while hot apply composition with a brush. 2. How can I burnish photographic prints without going to expense of purchasing burnisher? A. Apply the prints face down while wet to the smooth varnished side of a ferrotype plate, squeezing it by rolling a rubber roller over the back, having blotting paper between the print and paper. When dry it will have a high polish and drop off the sheet. The polish is called *glacé* finish. To mount such prints without losing the glass, make the following mounting solution: Soak an ounce of refined gelatine in cold water for an hour, then drain off and squeeze out the water as much as possible; put the gelatine in a jelly pot and place the latter in a pan of hot water on the fire; when the gelatine has melted stir in slowly 2½ ounces of pure alcohol, and bottle for use. This glue will keep indefinitely, and can be melted for use in a few minutes by standing the bottle in basin of hot water. As it contains a very small percentage of water, it hardly affects the gloss of the prints and dries almost immediately. 3. How can I make nitrate of silver for photographic purposes? A. By dissolving metallic silver in nitric acid; the solution is then boiled down and set aside to crystallize. It should then be redissolved and again boiled down and allowed to crystallize. The recrystallized is the best. 4. Would like to know the difference between a *glacé* polish and lubricator used for polishing prints? A. The *glacé* finish is obtained as described above or by coating a plate with collodion and squeegeeing the print on to it, then stripping the whole from the glass plate. The lubricator is material rubbed on surface of photograph before it is run through the burnisher, and consists of white soap cut up in small bits dissolved in alcohol. One method consists in breathing on white curd soap and rubbing a cloth over it, then rubbing the soap (which adheres to the cloth) over the surface of the photo. Another plan is to dissolve 20 grains of paraffine wax in one pint of benzole and rub that over the surface of the photo.

(2329) I. S. D. asks: 1. What is put into fluid drawing ink to make it waterproof or to prevent it spreading when applying colors? A. It depends on the quality of the ink. Shellac dissolved in borax water may be used to rub the ink up in to increase its permanency. 2. What is used for moist water colors to keep them soft? A. Covered vessels are used to hold them. Glycerine will retard their drying, but will do the same after they are on the paper.

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the numbers therein given:

F. A. M., in query No. 2266, asks for method for polishing vulcanized rubber. I use powdered pumice stone and water for smoothing, and half polish, and finish with rotten stone and sweet oil on cotton flannel disk. This gives a very high polish.

In query 2261 W. P. S. asks what will take away the bad smell from cistern water without making it unfit for use. If he will take a pole with a dasher head on it and agitate the water once or twice a day for a few days, thereby aerating it, the smell will entirely disappear. I presume W. P. S. uses a pump, and this allows the water to become stagnant, supply being drawn from the bottom.

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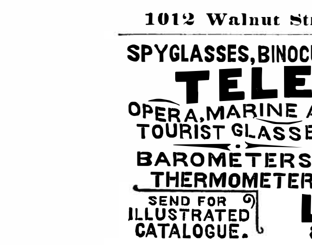

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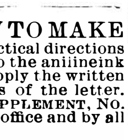

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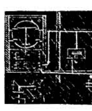

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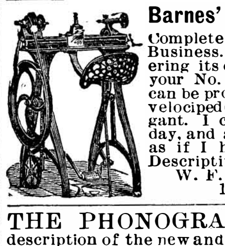

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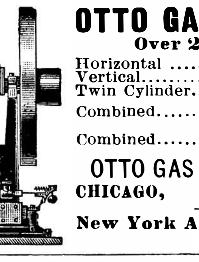

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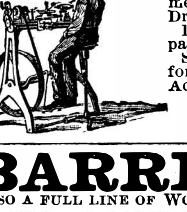

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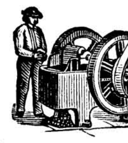

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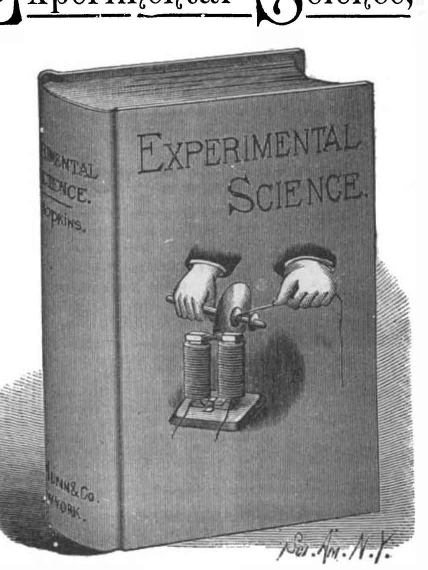

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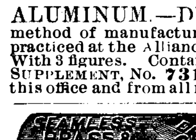

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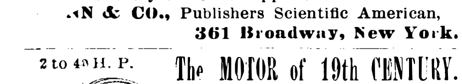

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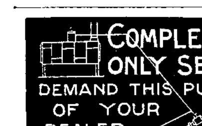

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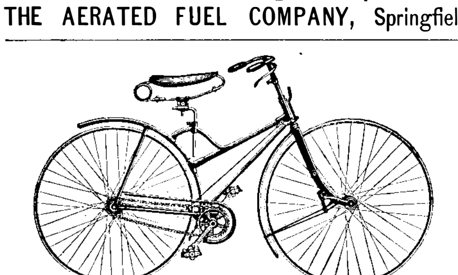

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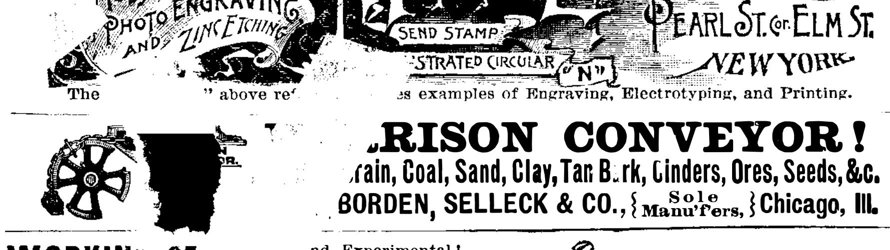

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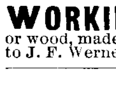

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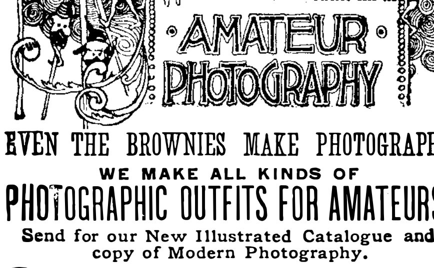

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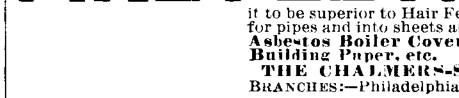

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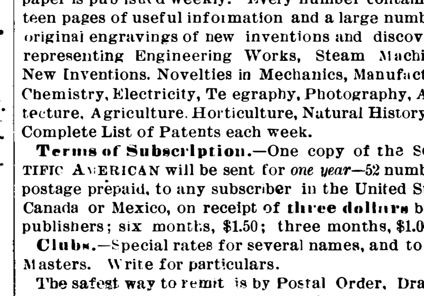

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