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THE MANUFACTURE OF FILES—THE NEW AMERICAN FILE COMPANY.

The engraving on our first page represents the outside and portions of the interior of one of the best equipped file manufactories in this country.

The New American File Company, of Pawtucket, R. I., was established only nine years ago, but they have already achieved a remarkable success, having a capital of $500,000, and employing two hundred hands. The works, originally of wood, are being rebuilt with brick. The machinery of the manufactory is driven by a 250-horse-power Harris-Corliss engine, a smaller engine being used for the machine shop.

Mr. Stephen A. Jenks is president and treasurer of the company, and Mr. C. M. Fairbanks is agent. The company is ably managed, and all the branches of its business are conducted with much success.

Some idea of the manipulations necessary to produce a file may be gained by the notes of a run through the manufactory of this company. The steel is made for the company in lengths that will cut without waste. The bars come from the steel makers at the proper widths and thicknesses for the blanks from which the files are made. Being cut to lengths, they are forged—the tangs and the taper, where taper is necessary to the shape of the file—and for this forging there are employed at this establishment twenty-one power hammers, comprising eleven Bradley hammers, six ordinary trip hammers, three Belden hammers, and one Grant hammer. These hammers have a capacity of 1,050 dozen per day.

But in addition to this power-hammer forging, there is a large amount of hand-hammering work. Most of the small files—especially the three-cornered files—are made by hand-work in dies fixed in ordinary anvils.

After the forging, the blanks must be ground for cutting. Now, this process of grinding is not merely intended to even the sides of the file or determine its edges; but it means a reduction of the surface in connection with the removal of the oxidation or scale. It is impossible to cut good file teeth through the scale of rolled or tilted steel. All of the exterior surface of the best forged or rolled steel must be removed before the chisel can raise the tooth of the file.

And yet in the grinding the exactness is not sufficient to satisfy the requirements of this company: for some purposes it is necessary to dress the file blanks in a filing machine that draw-files the blanks to the perfection of a surface plate. And although the grinding process is as near perfection as possible, leaving the surface with a variation of less than one one-thousandth of an inch, it simply cuts off the outside of the steel and does not make an absolutely perfect surface.

The principal attraction in the establishment of the New American File Company is their large cutting shop, where no less than eighty-five machines are busy in cutting the teeth in files. The room is shown in the central figure of the engraving. The process of file cutting by machinery is modern. For many years the possibility of machine-cut files was sneered at. It was asserted that no machine-work could supersede the hand-work of the skilled file cutter. Possibly this is a fact to a certain extent; for it is a fact that special sizes and forms of files must now be cut by hand, as also rasps and particular forms of sides, faces, or edges.

The Bernot patent, under which the machines of this establishment are worked, comprehends all that is possible in machine-cutting of files; and it is carried to its ultimate by this company. The machine is very simple; but its simplicity comprises its value. The file blank lies on a lead bed, and is fed by ratchet wheel and pawl, giving it intermittent forward movements, between which the chisel makes its cut. The chisel comes down with a springing stroke, very much like that of the human arm, the spring being given by a series of leaves of sheet steel, the number of the leaves and the thickness of the entire spring being adjusted to the style of the file to be cut. In the cutting of very fine files the spring for the blow of the cutter is quite light, being simply a coiled wire spring. These cutting machines give from 600 to 900 blows per minute, and cut over the surface of a file with such surprising rapidity that the eye wearies in watching the process.

The steel used in the chisels in the machines and by the hand workmen is made specially for the purpose, and costs, as imported, forty-eight cents per pound. The steel for the files is American; it having been found by actual tests that the American steel is preferable to any foreign product, as being more even and reliable.

By absolute and uninterested tests, it has been found that the machine-made file is really superior to the hand-made file, and large manufacturers acknowledge the fact by their patronage of this company, the production of which is about 1,000 dozen perday. Perfect order and good management pervade this establishment, which is a model in its line.

Irritating Effects of Stings in the Animal and Vegetable Kingdom.

BY PROF. AUGUST VOGEL, OF MUNICH.

It is well known that the effect of a stinging nettle on the skin agrees very closely with the sensation produced by the sting of a bee or wasp. But the great similarity is not limited to the feelings it causes, but, what may not be so well known, the cause of the irritation produced on the skin is essentially the same. It may be considered as definitely settled that formic acid is present in the poison sac of the bee sting, in the so-called bee poison. The same corrosive acid also occurs in the sting of the nettle. Some species of caterpillars have formic acid in some of their hairs, which they seem to be able to shake off at will, and when a person touches such a caterpillar the poison penetrates the skin wherever it is moist and causes burning, itching, and inflammation. These poisonous members preserve their irritating powers even after the death of the worm. This accounts for reliable statements that visitors to collections of caterpillars have suffered from exanthematous eruptions on the neck. "Many hairy caterpillars cause itching and burning of the skin when touched, and sometimes it gives rise to swelling and redness. This depends on the fine hairs, which produce the same effect when they float around in the air. Many ladies who visited the caterpillar room of the naturalist Reaumur had a breaking out on the neck."

In the sting of the bee, wasp, hornet, etc., a minute drop of a transparent liquid may be observed on the sting, and is called "bee poison" (formic acid). It penetrates into the wound produced by the sting, and causes the well known effects. It would, however, be a great mistake to assume that the only object of this is to increase the effect of the sting, that is, that it serves only to injure. It has a far more important purpose, namely, to prevent fermentation and decay. The celebrated bee cultivator, Holz, reports that in his long experience with honey, that which came from what are called "rancorous swarms" (boshaft) had peculiar properties. It always had a bitter, harsh taste, and its smell was sharp too. How can the character of the swarm affect the smell and taste of the honey they gather? We know that bees, when they are disturbed, run out their stings, on the end of which may be seen a tiny drop. This little drop, as we have already said, is bee poison, or formic acid. When the disturbance is at an end they draw in their stings again, but the little drop of liquid does not go back with it, but is wiped off on the comb, and sooner or later gets mixed up with the honey. This explains how honey from such excited bees must taste and smell sharper than from peaceable bees. Excitable bees will rub off this little drop of formic acid more frequently than other bees; perhaps a larger drop is formed by nervous bees than by those that are not nervous, and hence the honey is richer in formic acid. This acid is never absent in genuine honey, but the amount differs. This contamination is not only uninjurious but very useful, in fact necessary, for it keeps the honey from spoiling; we know, indeed, that purified honey, from which the formic acid has been removed, very soon ferments, while unpurified honey will keep unchanged for years. Nature furnishes the bees with this knowledge instinctively, and therefore they do not carry this drop of formic acid away out of the hive. Bee connoisseurs assure me that the bees add it to the nectar which they collect that is free from it so as to make it keep, and they do this in places where they are not disturbed too.

Bee stings are often spoken of in agricultural and popular papers as a remedy for rheumatic affections, and numerous cures are adduced to prove it. If the formic acid that accompanies the sting can be looked upon as the principal agent in the cure, it would be worth while to try the experiment of rubbing the spot with this acid or injecting it under the skin, so as to avoid the somewhat inconvenient method of applying live bees.

Two hundred years ago formic acid was made from the brown wood ants, by triturating them with water and distilling it. The acid liquid was used to irritate the skin. The reddening of the skin, by using baths of pine leaves, is also due to the action of the formic acid. The anti-fermentative action of formic acid has also long been recognized.

As regards the irritative action of stinging nettles and other similar vegetables, it depends, as already stated, on its formic acid. The point of the nettles is brittle as glass, and by the lightest touch penetrates the skin and breaks off, pouring out its acid and causing the burning sensation.

In this little notice frequent mention has been made of formic acid. In conclusion it may be stated that it gets its name from the ant (*formica*), because it was *first* found in them. If it had been found first in the bee or nettle it would have received another name. If an ant runs over a piece of blue litmus paper he will leave a red streak. Put a stick in an ant hill and they will squirt strong acid on it.—*Humboldt.*

Poisonous Maple Sirup.

R. B. Warder, in a paper at the February meeting of the section of Chemistry and Physics of the Ohio Mechanics Institute, stated that information was received from Mr. Stanley Hatch, of Riverside, that some maple sirup, which had been made in a pan of galvanized iron, had an unpleasant taste. This led to a suspicion of contamination with zinc. A committee was appointed to examine the matter, and from their report we take the following:

The so-called "galvanized iron" consists essentially of sheet iron coated on both sides with zinc. A film of tin is sometimes deposited upon the iron first, in order to secure a more perfect adhesion of the zinc; but no danger was apprehended, except from the zinc itself. The pans are usually soldered so that no edges of iron are exposed; but the solder itself renders the surface non-homogeneous, and may thus promote galvanic action and corrosion. Manufacturers and dealers in sugar-making apparatus inform us that galvanized iron evaporating pans were introduced about the year 1859, and that they are now in general use, no complaints of corrosion or zinc poisoning having come to their notice. This material is much preferred to sheet iron, which rusts (if not painted) during the long interval from one season of use to another. Mr. C. G. Hampton, of Detroit, Michigan, informs us that galvanized iron is nearly always used for the evaporation of maple sap, except when the same pan is also to serve for the concentration of apple juice; in this case copper pans are used. It is stated that galvanized iron will do service for ten seasons, and that the zinc coating is not worn through, unless by excessive scouring.

Our own analyses of the samples received from Mr. Hatch led to the following results. The sap when examined had distinct acid reaction. By titration with caustic soda and phenol phthalein (with prolonged boiling to expel CO_2) we found that a liter of the sap would neutralize 28 milligrammes NaOH, corresponding to 42 milligrammes acetic acid. The sirup was rich and viscous, of dark color, having a specific gravity of 1·732 at 22° C., having the characteristic maple taste, but leaving an unpleasant astringent after taste, similar to that of zinc salts, yet not so pronounced as to render the sirup wholly unpalatable. This also had acid reaction; and titration indicated 300 milligrammes (calculated as acetic acid) to 1 K. It gave 1·38 per cent of white ash. We may readily see from the experiments of Wagner and Snyders that such acid liquids, especially at high temperatures, could not fail to have an appreciable action upon the zinc. The presence of this metal in the sirup was clearly shown by qualitative tests, both wet and dry. Unfortunately, the material at our disposal was not sufficient for the accurate estimation of zinc; but a single determination gave us about 0·1 per cent of ZnO. This amount, calculated as sulphate, would correspond to 6·14 grammes (95 grains) of the crystallized salt per liter. Such an amount must certainly be regarded as unwholesome, though perhaps not dangerous, if the sirup is used in moderation.

CONCLUSIONS.

1. Galvanized iron evaporating pans have been used in sugar-making (including maple sugar) for more than twenty years. This material seems to be generally preferred to any other.

2. Even pure water, in presence of air, is known to have a distinct solvent action upon zinc, at the ordinary temperature. This action would doubtless be much increased, in the evaporation of sap, in consequence of the high temperature and the salts found in the sap.

3. In ordinary cases, this action is practically so slight that the zinc dissolved can not be considered a source of danger. If the sap is allowed to become sour, however, the sirup may take up so much zinc as to become unsalable and unwholesome, even if not absolutely dangerous.

4. The danger of contamination may be diminished by promptly evaporating the sap, before fermentation or souring begins to take place. Addition of a little lime, or other alkali, may sometimes be helpful even for maple sap.

5. When the pan is new, it may also be desirable to form an insoluble film over this surface by first boiling a solution of sodic phosphate, or even hard spring water, to diminish the action of the sap or cane juice.

[It would appear from the foregoing that all maple sirups and sugars now put on the market are more or less poisoned with zinc salts, and it is therefore evident that some other material than galvanized iron should be used for the evaporating pans. There is here a pressing need for a new improvement.—ED.]

Testing Drains.

One very notable instance of the value of the smoke test in discovering imperfect joints is given by Mr. G. H. Stanger, C.E., in his treatise on "House Sanitation." He there says: "When making a first inspection at the Wolverhampton General Hospital, and testing with the smoke test, by forcing smoke up the drains with a small fan blast, and thus finding out the untrapped inlets and leaky joints within the building, we discovered, among many other defects, smoke issuing from a pipe casing in the corner of one room. On examination it was found that an inch overflow pipe from a disused cistern had been cut off by some plumber, anxious, perhaps, not to contaminate the water supply, and the end communicating with the sewer left perfectly open into the room. On retesting to prove the work where the alterations were completed, one part of the basement was filled with smoke, and it was thus discovered that a temporary connection put in during the alterations had not been removed." Testing, as Mr. Stanger points out, is absolutely necessary. The work should be tested both during the work and after it is done; but, unfortunately, no one ever thinks of testing drains, unless, indeed, the plumber himself. Very few architects ever trouble themselves about the matter, and, in the absence of inspectors, our plumbing details are left entirely to the honesty and mercy of the workmen employed. It is full time tests of the capabilities of our journeyman plumbers were instituted.—*Building News.*

Drainage Operations in Florida.

The Florida Land Improvement Company's canal was completed August 23, to Lake Kickpochee, a large lake within three miles of Lake Okechobee. When the lake was tapped an immense body of water poured down the Caloosahatchee River. The drainage of this region is expected to bring into cultivation some millions of acres of fine sugar land.

Pneumatic Drainage.

A new system for the protection of houses from the infiltration of sewer gas and the disposal of town sewage has been introduced at Paris and Lyons by M. J. B. Berliez, civil engineer, and former director of the Compagnie des Vidanges, of Lyons. An illustration of this new system can now be seen in working order at the barracks of the Pépinière, Boulevard Malesherbes, where a thousand soldiers are quartered, and with the permission of M. Berliez we were able to examine every detail of the process. Underneath the closets the old cesspool has been emptied, thoroughly cleaned, and converted into a cellar. Here we found M. Berliez's apparatus. From each closet above a pipe communicates with an iron cylinder or drum. Within this first receptacle there is an iron basket which will retain a hard substance, such as a brush, or even an infant if thrown down the drain. The detection of crime is thus facilitated, and the obstruction of pipes rendered impossible. A portable handle, affixed from the outside, is used about once a week to impart a strong rotary motion to this basket; the presence of any hard substance is then detected by the sound, and any accumulation of softer substances macerated and driven out

From this first receptacle, and by natural gravitation, the liquefied sewage flows into a second iron receptacle placed close at hand, within a yard or so. A large ovoid floater occupies the greater part of the space within, the pointed end fitting hermetically an opening at the bottom, where the pneumatic suction keeps the floater in its place. It is not till the receptacle is almost full of water that the floater is able to disengage itself from this suction, and, rising, enables the sewage to escape by passing under the floater into the pipes, where the pneumatic suction carries it away. This suction is produced by a steam engine situated in the suburb of Levallois-Perret, and the iron pipes, placed within the main sewers, communicate not only with the Pépinière barracks, but with several private houses, and with a depot at the Place de la Concorde, where the contents of many cesspools are brought and emptied. The total distance is 4,600 meters. It is, therefore, on an extensive scale that the experiment has been tried, and so far has worked well, giving rise to no sort of nuisance, and instead of allowing sewer gas to ascend house drains, drawing it, on the contrary, away.

It is proposed to place these apparatus under all the houses of Paris instead of cesspools; to draw by pneumatic action all the sewage to depots situated in the open country outside Paris, and there pump it forward distances varying from ten to fifty miles, where it may be used either to irrigate farms or be precipitated and converted into solid manure. It is calculated that the sale of this manure and an annual tax of £2 8s. for every house where the system is applied will cover working expenses and yield a large profit. This tax would be an economy on the present cost of emptying cesspools, and the sanitary advantages secured would be an inestimable benefit. The principal objection to the system, so far as its application to towns such as Paris is concerned, rests in the fact that the iron used for the pipes must corrode under the action of sewage matter, and the slightest leakage would cause a total collapse of the whole system. Careful, constant supervision and prompt repairs would be indispensable. Then, the avoidance of nuisance depends on the frequent usage of the closets, as fermentation would set in if the receptacles were left half full for a few days. Families leaving home would have to carefully flush their closets the last thing before their departure; for though each house would be thoroughly protected from sewer gas, it would not be protected from any noxious gas arising within the receptacles. Fortunately these receptacles are very small, and must, in ordinary households, be frequently and automatically emptied during the day; so that, generally speaking, there would be no time for mischief to arise.—*Lancet.*

Detection of Lead in Tinfoil.

A drop of concentrated acetic acid is let fall upon the suspected leaf, and a drop of a solution of potassium iodide is added. If there is lead present there is formed in two or three minutes a yellowish spot of lead iodide. Kopp moistens the leaf to be examined with sulphuric acid. If the tin is pure the spot remains white, but if lead is present there is formed a black spot.

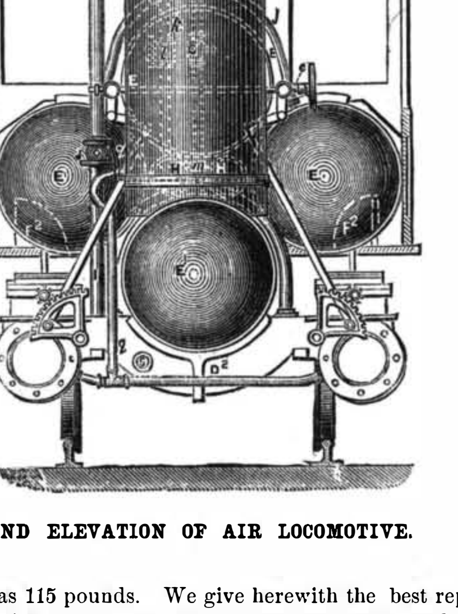
Tannin Soap.

Cocoa-nut oil, 18 lb.; Solution of soda (38° B.), 9 lb.; Tannic acid, ½ lb.; Alcohol, q.s.; Balsam of Peru, 1 oz.; Oil of cinnamon, ⅓ oz.; Oil of cloves, ⅓ oz. Saponify the cocoa-nut oil with the solution of soda, then add the tannic acid previously dissolved in alcohol, and add the other ingredients.—*Seifenfab.*

EXPERIMENT WITH AN AIR LOCOMOTIVE ON THE ELEVATED RAILROAD.

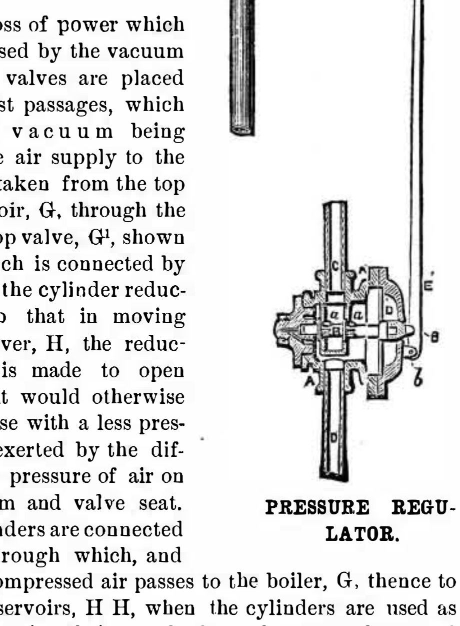
In October last an interesting experiment with the Hardie air locomotive was tried on the Third Avenue Elevated Railroad, a run being made from the 128th street station to 42d street and return. The air pressure at the start was 580 pounds per square inch, and the pressure on the return, after a nine mile trip, carrying three cars, and stopping at every station, was 115 pounds. We give herewith the best representation of the engine that has come to our notice, and furnish detail views that will afford a good idea of the working parts of the machine.

FIG 2



END ELEVATION OF AIR LOCOMOTIVE.

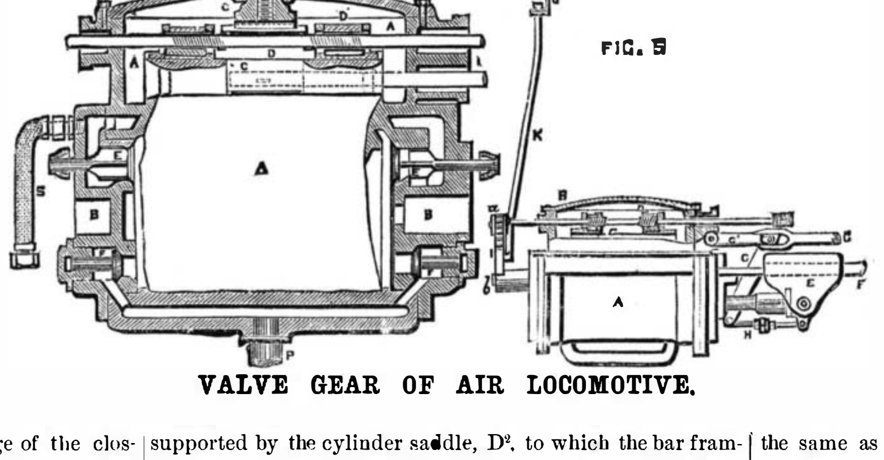
Fig. 1 is a perspective view, and Fig. 2 shows the position of the four air reservoirs, E E E E¹, the lowest one, E¹, running the entire length of the engine, its dished end being seen projecting beyond the cab frame. This reservoir is supported by the cylinder saddle, D², to which the bar framing is secured, while the other reservoirs are supported by brackets, bolted or riveted to the lower reservoir and frame. The reservoirs are all connected by pipes, *j k*, and the air passes from them through a reducing valve, *l*, into the bottom of a small boiler in the cab, the water of which is kept at boiling point, the design being not to mix steam with the air, but to heat and moisten it by contact with hot water. The reservoirs, E, have a capacity of 460 cubic feet, to which air is originally supplied at 600 pounds per square inch. The working pressure in the cylinders is 100 pounds to 130 pounds, and it has been found that when using the air expansively while running, *i. e.*, with a quick cut off, the expansion is sometimes so rapid that toward the end of the stroke the pressure in the cylinders is less than the external atmosphere; to obviate the loss of power which would be caused by the vacuum thus created, valves are placed in the exhaust passages, which prevent any vacuum being formed. The air supply to the cylinders is taken from the top of the reservoir, G, through the throttle or stop valve, G¹, shown in Fig. 3, which is connected by a lever, E, to the cylinder reducing valve, so that in moving the throttle lever, H, the reducing valve is made to open earlier than it would otherwise do, and to close with a less pressure than is exerted by the difference in the pressure of air on the diaphragm and valve seat. The two cylinders are connected by a pipe, through which, and the pipe, *q*, compressed air passes to the boiler, G, thence to two small reservoirs, H H, when the cylinders are used as air pumps, drawing their supply from the atmosphere, and making use in this way of part of the energy needed to retard the train going down hill or coming to a standstill. This arrangement proved to be so successful that no other brakes are required on the engine. The valve gear is shown in Fig. 5 and in the perspective view; the wheel, *e*, by levers, J K, moving the geared segments, I—which rotates the small toothed wheels, *a*, when the cut-off valves, D¹, on the spindle are either drawn together or apart, they deriving their motion from a lever, G, coupled to a crosshead by link, H. The cylinder saddle, D², Fig. 2, is made hollow and forms an exhaust chest, from which extends the exhaust pipe, I, with check valve, J, and it is also used as a vacuum chamber, when the cylinders are used as air pumps and draw their air supply from it. A hose connected with the coupling, S, Fig. 4, communicates with the vacuum brakes upon the train.



PRESSURE REGULATOR.

The main valve is held to its seat when the cylinders are used as compressors by the bridge-piece, D (Fig. 4), connected by an adjusting screw, K, to a diaphragm, L, which just keeps it off the valve when in ordinary work.

When compressing, the supply is drawn through valves, E, and delivered through valves, F, and pipe, *p*, into the small reservoirs previously mentioned. The admission of air to or production of a vacuum in the exhaust cavity of the saddle is controlled by a stop-cock within reach of the engineer. The engine weighs about the same as the ordinary elevated railroad locomotive.



VALVE GEAR OF AIR LOCOMOTIVE.

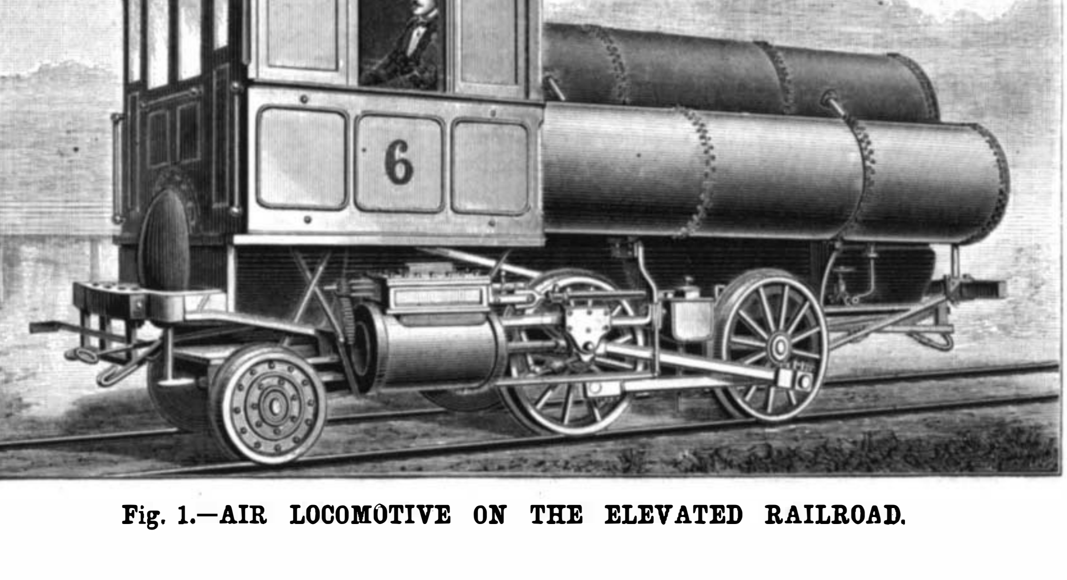


Fig. 1.—AIR LOCOMOTIVE ON THE ELEVATED RAILROAD.

Eruptions of Sulphureted Hydrogen.

A very peculiar phenomenon was observed last December in Missolonghi. On the night of the 15th of December the inhabitants were terrified by the sudden odor of sulphydric acid gas, which was so intense as to interfere with respiration. The next morning the sea was found to be covered with dead and dying fish, and it was seen that an eruption of sulphureted hydrogen gas must have taken place in the small creek of Aitolicon, which is almost completely cut off from the large bay. A similar eruption, accompanied with a light earthquake tremor, followed on the 13th of January, and other shocks were noticed in February. The phenomenon is exceedingly interesting, as explaining the occurrence of enormous quantities of fossil impressions of fish in many formations. At all events, such eruptions must have been of frequent occurrence in former times. It is also noticeable that the impressions of fossil fishes are sometimes filled with scales of pyrites, more particularly in the coal measures, proving that sulphur was present as well as iron.

THE best deep sea sounding apparatus is supposed to be that used by the U. S. Coast Survey.