cates with the vacant space in the roof. The tube passes through the back wall of the house, and descends to within 4 feet of the ground. At the bottom of the tube is fitted a perfectly tight draw valve. When the tube is full, or at stated periods, an air-tight tank is brought round to the back of the house, a gutta-percha hose of sufficient length is fitted to the valve, which is then opened. The column of fecal matter, six sevenths of which is fluid, some 30 feet, 20 feet, or 10 feet in hight, then rushes into the tank. The valve is then shut down, the hose removed, and the joints of the valve are washed with diluted carbolic acid. The liquid manure is then conveyed beyond the limits of the city, and is distributed in properly constructed casks which are affixed to Liernur's subsoil plow, of which an illustration is given

These plows, being driven over some of the exhausted soils in the vicinity of the city, will at once restore to them the valuable manures of which they have been despoiled for years past. The offensive manure is then effectually hidden from sight, and from smell, and the "wilderness will be made to blossom as the rose."

We are informed that it is intended to form a company to supply the whole apparatus to houses and to remove the soil at a fixed rate per annum, and also to lease a large area of barren land which is to be reclaimed by the aid of the valuable manure now worse than wasted.

The invention has been patented by Mr. J. Dyer, of Melbourne, Australia.—*Mechanics' Magazine.*

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

A Final Zoic Catastrophe.

Messrs. Editors:—In your issue of Feb. 12 (page 110), is an extract from Prof. H. Wurtz, in which it is stated that through the agency of marine animals, that secrete carbonates from the ocean water, the carbonic acid of the atmosphere is passing "into solid forms, permanent and forever unavailable thereafter," and that soon, geologically speaking, the atmosphere will be exhausted of its carbonic acid, and all organic life come to an end; the burning of the fossil coal by man postponing the catastrophe but temporarily, etc.

Since the publication of Mr. Lyell's "Principles," many theories of igneous and cataclysmic catastrophe, formerly in vogue among geologists, have fallen into disrepute, as being founded on imperfect or fragmentary knowledge of the facts. In the progress of discovery one side of a cycle comes into view, and the "great machine seems to be running down." But further research discloses another side, where forces of equal potency are "re-winding it." Had the Professor looked a little deeper, he might have seen evidence that the crust of the earth, even, has two sides to it.

In some localities, carbonic acid derived from the atmosphere, is, by the agency of marine life, being deposited and locked up in the layers that are forming on the *outside* of the earth's shell. But similar beds of calcic and magnesic carbonates, which were deposited in past ages, are in other localities being acted upon by the heat from *within* the shell, and converted into igneous silicates; the carbonic acid being liberated and poured into the atmosphere through the fissures, vents, and craters of several hundred volcanoes.

This flow of carbonic acid, which is a constant accompaniment of volcanic agency, often takes place at great distances from the actual crater, and continues for ages after volcanoes have become extinct. In Auvergne the springs are charged with it. In California, I have seen the granites, and other igneous rocks, as soft as putty from the percolation of acidulated water through them. M. Fournet reports encountering emanations, while opening the mines of Pontgiband, that often burst into the galleries with explosive force, roaring like the steam from a boiler, filling the lower parts of the mines and pouring into the valley in sufficient quantity to suffocate horses, geese, etc.

From the Grotto del Cane, or from similar excavations, this gas has been flowing since the days of Pliny. "But the quantity evolved there is trifling," says Prof. Silliman, "compared to that which escapes constantly from Lake Solfatara, near Tivoli, whose surface is violently agitated with the gases boiling through it."

In the Island of Java there are some fifty volcanoes. Accordingly the flow of carbonic acid is so great, that in the celebrated "valley of poison," the ground is said to be covered with skeletons and carcasses of tigers, goats, birds, and even of human beings, that have ventured into the valley and been suffocated by the gas.

Very likely, at great depths, in these volcanic regions, stratified rocks are now being transformed to granite. It is believed that the granitic rocks of all the loftiest mountain chains, such as the Andes, Alps, Himalayas, etc., were once ocean mud, containing the usual proportion of carbonic acid; and that the carbonates have been changed to silicates, and the included carbonic acid returned to the atmosphere, since England was inhabited by pachyderms, bats, opossums, and monkeys. (Lyell's Manual, p. 231—Appleton & Co., 1864). In the central Alps nummulitic and even newer tertiary strata are found transformed to gneiss, a sort of half granite.

Thus the carbonates secreted from the Eocene sea by the little nummulites, have "rendered up again the treasure of carbonic acid in their marble grasp," by the action of just such a "fervent heat" as that which is now transforming the rocks, and slowly elevating the land in volcanic regions. (Dana's Manual, p. 721–725).

Belts of submarine volcanoes seem to be performing a similar operation upon marine deposits which contain the corals, crusts, and shells of existing species. Such beds are being buried deeper and deeper. Vast accumulations of "ashes," pumice, and cinders, are thrown up from below by eruptions, and then reduced to mud and spread out by the waves; alternating with floods of lava. Thus calcareous deposits are buried, and tend to become the inferior and underlying strata, where they will in time be transformed and decarbonized by the heat.

But this continual volcanic exhaust and depletion of the earth's liquid interior produces collapse; and, consequently, a lateral tension in the crust, which slowly bulges upward in a long wrinkle. This involves exposure to the denuding forces. First, by the dash of waves; afterwards by the action of rains, torrents, glaciers, etc.; the surface rock is scraped off again, and the gneiss, granite, etc., exposed.

In various places all these different operations are being slowly performed. Mountain chains are in the bed beneath the waves of the sea. Those who suppose that the earth is dead, and getting cold, are mistaken. So late as the middle of the Eocene tertiary period, nummulites and other marine animals luxuriated in the sea, on the very spots now occupied by the Alps and Himalayas. There was no more promise *then* that they would rise to their present altitude, than there is *now* that similar mountain chains will come up from the depths of the sea during the coming ages. "The Zoic Catastrophe," therefore, cannot be deduced from the facts of Science. J. W. Pike.

Windham, Ohio.

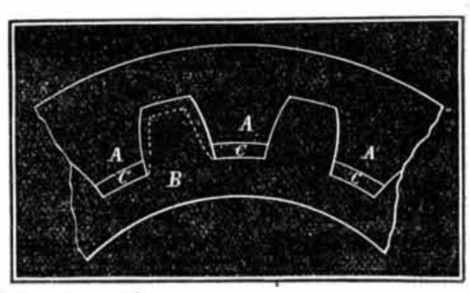
Chilling Cast Iron.

Messrs. Editors:—It is well known that the surface of iron castings is extremely hard, and that this hardness sometimes extends nearly, or quite through, when the casting is very thin, or when a certain quality of iron is used, termed "charcoal iron," such as is used for malleable articles.

On thick castings, made of good machine iron in a common sand mold, this crust is quite thin, hence when a thick, hard surface is needed on any portion of such castings, it is necessary to use a metallic mold at that point. These partial metallic molds, termed "chills," are fitted up with much care, and are so placed in the sand mold as not to mar the true symmetry of the casting.

In the casting of car wheels a "chill" constitutes the whole outer rim of the mold; it is simply a massive iron ring, the inner face of which is, of course, the exact mold or counterpart of the tread and flange of the wheel. If a little charcoal iron is mixed with the common iron, the surface will harden deeper in proportion to the amount used. This susceptibility of cast iron to harden when brought in contact, in a melted state, with cold iron, is a characteristic of great utility.

Some care is necessary in using "chills" on certain castings. In chilling the cogs of wheels, for instance, the cogs of the chill, A, should not extend quite to the base of the



cogs of the wheel, B, but the space, C, should be molded with sand, then the chilled surface will take somewhat the form indicated by the dotted lines; in this way the full value of the chill is obtained without impairing the strength of the rim of the wheel. Another advantage of chilled cogs is that they may be made nearly as perfect as cut ones, because the cogs of the chill may be formed in a gear engine as perfectly, of course, as the teeth of any gear wheel, and the chill is free from other imperfections of a sand mold.

F. G. Woodward.

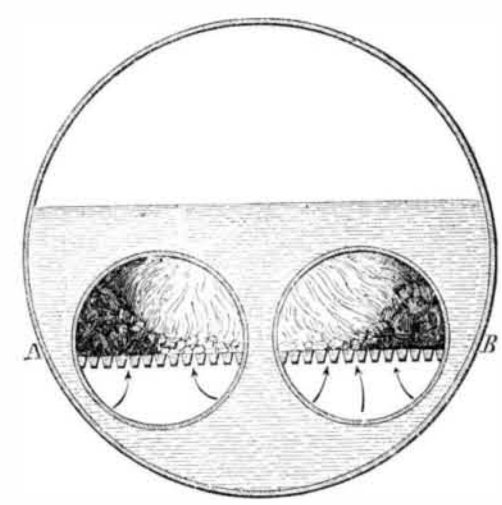
Firing under Steam Boilers.

Messrs. Editors:—Seeing an article in your journal, headed as above, I beg leave to offer you my experience both in this county and in Europe, on the above subject, and if engineers and firemen will give it a fair trial, I think they will find, as I have done, a saving of from 10 to 25 per cent in *fuel*, besides much less labor for the fireman and less danger to the boiler from expansion and contraction while under working pressure.

THE FURNACE.

After seeing that all fittings of the boiler are in the best possible order, turn your attention to the furnace. There is more required here than the simple process of feeding the fire with fuel. In the first place the nature of the coal should be ascertained, and if it be of a coking kind the grate bars will require it to be more open than for coal of a light and gaseous nature. Adjust the grate surface to the heating or absorbing surface of the boiler; this will greatly depend upon the quantity of the fuel and the draft, and the quantity of steam required. If the draft be good, work a thick fire, but do not break the coal excepting it cannot be got in at the furnace door, taking care to feed the furnace on one side, not covering more than one-half of the grate at a time. When that is sufficiently coked feed the other side, putting plenty on at a time, leaving the fuel at the middle of the furnace much lighter and thinner than at the sides, and keeping the grate bars well open. The placing of the coal on one side at a time will prevent the formation of a great portion of the smoke which would otherwise result, and produce a more steady heat. The coal so placed will partially damp the side of the furnace on which it is placed; therefore the necessity of stoking the furnace when the steam is up. By this method of firing, the gas generated will be given out slowly. The greatest quantity of air will pass through that portion of the grate where the fuel is most consumed and where the coal has not been made small by breaking, leaving the interstices wide; and as the oxygen of the air will be in sufficient quantity if this mode of firing is adopted to unite with the gas as it is extracted from the coal, a continuous flame of gas will be kept up and smoke prevented.

When one side of the furnace so fired is sufficiently coked raise the burning fuel gently with the poker but do not break it into pieces; at the next firing, place the coal on the other side of the furnace, and similar results will follow. Replenish first one side and then the other, and continue to do so in the working of the furnace, keeping out the cold air as much as possible. Keep the furnace door open no longer than is absolutely necessary, and place your coal before firing near to the furnace, that there may be no loss of time in charging the fire; all cold air coming in contact with the boiler lets down the temperature and does harm. With a double fire-box boiler, fire each furnace alternately in the manner above described, and as illustrated by the engraving, where A and B



represent the sides of the fires last stoked, and the gas given out from the new fuel mixing with the air which passes in the greatest quantity through the thin portion of the fire, as indicated by the arrows. Being thus mixed with air at a high temperature, the gases ignite, and comparatively thorough combustion is secured, preventing smoke and saving fuel. This mode of firing is applicable to most furnaces, whether single or double fire-box, or wholly beneath the boiler.

By all means avoid having a dirty ash pit. A pit nearly full of ashes is a sure sign of bad management, it is necessary to keep the ash pit of a furnace clean and cool and the air as dense as possible, as it is to feed the fire with fuel. If the ash pit be hot the heat will expand the air and the furnace will require greater quantities to pass for the required amount of oxygen which would be supplied by less quantities of cold air. When convenient, use water for the bottom of the ash pit, allowing it to remain to quench the ashes as they fall from the furnace; the evaporation will tend to keep the grate cool.

A great body of fire will evaporate more water with less proportion of fuel than a small and thin fire. The greater the intensity of the fire the more steam will be generated with the same amount of fuel. Where there are a number of boilers it is important that the duty of stoking should be properly attended to; and as smoke is a great nuisance easily prevented, its prevention is a duty which each engineer ought to fulfill. Major Clegg.

La Crosse, Wis.

Liquid Fuel for Steam Engines.

Messrs. Editors:—I have read in the Scientific American many valuable articles on combustion, in which it has repeatedly been asserted that chemists prove by experiment that only 10 or 12 per cent of the total heat produced by the combustion of coal is utilized in the steam engine under ordinary circumstances. In connection with this subject, I would state that we have here in Washington, a couple of inventors that claim to do better in the production of heat than has yet been accomplished, as they have had published in every paper here that by their petroleum apparatus they can run a sixty-horse steam engine at the rate of 17 cents per hour; the combustion is so perfect they say that the flame extends the whole length of the boiler, say about 25 or 30 feet, and several feet into the smoke stack, and no smoke can be seen coming from the stack.

These are wonderful statements to any one who has been led to believe that, in all experiments in burning petroleum, the conclusions have always proved that petroleum is about eight times dearer than coal. As for the statement that no smoke can be seen escaping from the smoke stack, as a large black cloud of smoke extending far away in the distance can be seen, whenever the apparatus is at work, arising from said stack, it is rather ominous.

This apparatus consists in a tubular boiler, in which steam is passed through the tubes, and by its heat vaporizes the petroleum which is contained in the space between the tubes. The vapors are passed through a spongy mass and a metallic sieve, and are held in a receiver forming the outer jacket of the boiler. The gases or vapors are burnt at any convenient point, being conveyed through steam pipes. Another claim is that the steam is passed through the fire-place, and there decomposed and fed into the pipes jointly with the vaporized petroleum. This is in substance the whole apparatus, and how the inventors ever formed the estimate of 17 cents per hour is beyond my knowledge, as they have never run it for even a whole day. If their statement is true then the experiments made through the patronage of the Navy Department must have been made by persons incompetent to carry out a correct experiment; if, on the other hand, the Navy experiments have been properly made, this 17 cents per hour statement must be taken with strong faith.

In regard to decomposing steam to burn it, it is generally conceded that no heat is gained, therefore this part of the apparatus can not add to its efficiency. It would seem then that this more than wonderful result is simply obtained by burning vaporized petroleum. This is rather a late day to bring such claim forward with the present knowledge of the usefulness of petroleum. C. COLNÉ.

Washington, D. C.

Water as a Fulminate.

MESSRS. EDITORS:—The active investigations going on at present concerning steam-boiler explosions seem to demand all the scientific knowledge and facts as far as known of the characteristics of water. I have examined it, and witnessed it, as a fulminate in two different conditions. In the one case, in the spheroidal state on a hot, metallic plate; in the other in a similar condition from a mixture of warm and cold air in a storm-cloud. In both cases it plays the part of a fulminate. When I drop water on a hot plate, below a red heat, it rolls about without making noise or steam. When the spheroid is rolled over the edge of the hot plate on to one of lower temperature it explodes. If, however, it be struck with a hammer while rolling about on the hot plate it goes off like a fulminate, resembling the crepitating noise of thunder, as heard by an observer immediately above the cloud in which it occurs.

In the case of spheroidal water, as noted in "Silliman's Principles of Chemistry," the author says "Water passes into this condition at 340°, and may attain it even at 288°. A grain and a half of water in this state at 392° requires 3·30 minutes to evaporate." If you drop the water on a plate of low red-heat it oxidizes the plate, and necessarily deoxidizes the water, freeing its hydrogen. Now it is well known that water in a spheroidal condition is ensconced in an atmosphere of its own vapor, and this vapor being a non-conductor, chemists say its formation abstracts the sensible heat from water, and leaves the temperature of the fluid at 205°; and this would seem to be a correct statement, as I find my spheroid to leave no watery track as it floats on its vapory cushion over the hot plate undisturbed, but as soon as it is struck with a hammer the watery trace becomes visible on the plate and on the hammer. This envelope of the spheroid must be of considerable tenacity, as indicated by its bursting and fulmination when struck with the hammer.

The book referred to says, "If a thick and heavy silver capsule is heated to full whiteness over the eolipile, it may by an adroit movement be filled entirely with water, and set upon a stand, some seconds before the heat declines to the point when contact can occur between the liquid and the metal. When this happens, the water, before quiet, bursts into steam with almost explosive violence, and is projected in all directions."

Now let us apply these known characteristics of water to its action in steam boilers, and see whether it can account for *some* of those terrific explosions too frequent of late.

As soon then as a heat of 340° accumulates in the boiler plate it produces the spheroidal state in the water in contact with it, and as long as that temperature is maintained, the spheroidal condition continues, and if all that boiler surface covered with water attains that temperature, its inclosed water immediately becomes a spheroid inclosed in its fulminate shell, ready to burst explosively as the drop in the eolipile, as soon as the temperature falls to the maximum steam-generating heat. In a tubular boiler of comparative great water surface to a given capacity of water room, such high temperature of boiler shell is soon acquired upon a cessation of motion in the engine; and *vice versa*, when the furnace doors are suddenly thrown open allowing a rush of cold air to the boiler shell, causing this tenaciously bonded fulminate to give out suddenly its pent up power, as do the insidious granules of gunpowder in the bomb-shell, when they are touched by that mysterious agent, fire.

The work referred to says "The quiescence of the spheroid of water, as it rolls to and fro over the heated plate, is due to the elastic force of its own vaporous atmosphere, as well also as to the repulsive action of hot surfaces." This is not a lucid explanation to my comprehension. I suggested to a high authority of science that electricity played a conspicuous part in the phenomenon, but was told it did not. I hold that heat, oxygen, fire, and galvanism, are only different forms or modes of that one mysterious element we denominate electricity, and that in the spheroid of heated water its positively-electrified repulsive power is balanced by the equally positively-electrified heated boiler shell; and that a change, or reduction of the electrical tension in the heated plate, rendering it negative to the spheroidal water, or, *vice versa*, by a reduction of the electrical tension in the spheroidal atmosphere of the water, will necessarily cause an explosion.

But lay the electrical theory aside, and take the simple fact of water "in a spheroidal state," as explained by M. Boutigny—the water in the capsule—the experiment of Perkins, and the water on the hot plate, and we have the evidence that water in a boiler may, and does, become spheroidal at a temperature of 340°, and must then float about upon its self-created atmosphere, exerting just as much repulsive pressure against the shell of the boiler, as does the heated boiler shell against the water, bringing the two forces into equilibrium; and that as soon as this balance of power is broken, by any of the causes always incident to such conditions, an explosion must follow. The atmosphere surrounding the spheroid suddenly expanding into a large volume of steam, while at the same instant its liberated heat converts the inclosed liquid into an additional volume of steam, and, unless such boiler is made with the same comparative power of resistance as a gun-barrel is made, it will burst; that is to say, if it has not a vent or opening like the gun-barrel, to let off the expanding force, and a sufficient resisting strength for the initial shock, an explosion must result.

Boiler explosions have always on examination appeared to me more like the explosion of a bomb-shell than one caused by the gradual augmentation of steam pressure over and above the resisting strength of the boiler. That steam boilers may explode from this simple cause of over-pressure, is not to be denied, but in all *such* cases they must at best be but poor magazines of power.

My article being already long, I will omit for the present the analogous fulminating characteristics of water spheroids as formed by the commixture of cold and warm air in the formation of a thunder cloud, and the electrical explosions they give rise to as they fall from the upper to the lower cloud.

Lancaster, Pa. JOHN WISE.

Running Locomotives a Mile per Minute.

MESSRS. EDITORS:—I observe in your issue, of February 26, C. P. L, of Minnesota, asks, "Are railroad locomotives with 6½ feet drivers capable of exhausting fast enough to allow them to run at the rate of one mile a minute?"

I answer this question—with conditions, "Yes." Those conditions being several in number, I will not enumerate all, but the principal ones.

1st. The size and weight of train, etc.

2d. Gradients, and state of rail, wind, and weather.

3d. Capacity of boiler for generating desired amount of steam.

4th. A proper proportion of area of passages or parts of cylinder and nozzles to exhaust, for free ingress and egress of steam before and after using.

5th. A good valve motion to use steam expansively and to the best advantage previous to link motion.

Various devices were used to work steam expansively, and among those first were the variable cut-off, etc. I once ran an engine (the Samson) on the Great Western Railway, of Canada, from Lynden station to London, 61 miles in one hour and twenty-five minutes.

The train of circumstances occurred thus: The accommodation west, Patterson Hall engineer, with engine "Firefly," ran off track at Lynden, when the engine "Samson," cylinders 16 by 22, 6 ft. 2 in. wheels, when new was ordered to relief, and at 12:15 P. M. left with two passenger cars and one box car for London, made nine actual stops, and slacked up once at Smith Creek Bridge, at Harrisburgh, and Paris, changed baggage, etc., on the branch of cross roads, and arrived in London at 1:40 P.M. being one hour and twenty-five minutes on the journey.

Mr. Brodie, late (if not the present) station master of London, was conductor, D. McCarthy, fireman, and the train was run at the solicitation of assistant Superintendent E. S. G. Colpoys, late of the Great Indian Railway, Calcutta. At one station (Beachville) the train was run by, a distance equal the length of it, and backed up for passengers, and the delays at stations occupied about fifteen minutes; besides, nine miles of the distance was up a heavy grade, and consumed 13½ minutes. WALTER S. PHELPS.

Muncie, Ind.

Absorption of Oxygen by Charcoal.

MESSRS. EDITORS:—In an article entitled "Spontaneous Combustion," in No. 16, of Vol. XXI, Dr. Jackson says that he has found that charcoal when freed from dampness absorbs oxygen very rapidly. Is there not in this peculiarity of charcoal a source of cheap extraction of oxygen from the air? Charcoal might be heated to a certain degree when it would absorb oxygen, it would then be made to yield it up; the gas could then be passed through water and received in tanks ready for consumption.

In these days of search for cheap fuel and light, may we not have an unlimited supply of oxygen in the air waiting to be extracted? May not this substance be as suitable as manganate of soda used in the *Tessié du Motay* system of extracting oxygen? Charcoal is cheap, and any chemist having a suitable apparatus can easily make the experiment.

This idea is thrown out for what it is worth, and I hope any one making the experiment will report the result in the SCIENTIFIC AMERICAN. C. C. S.

Washington, D. C.

Waste of Labor in Building.

MESSRS. EDITORS:—Apropos to your article under this heading, the writer noticed a device in use in Paris, Lyons, and Marseilles, which might be copied to advantage in cities with a good water supply.

The basement being constructed and sewerage and water connected, two wrought-iron tanks come on the scene, about six feet square, and say two feet deep, covered with a stout wooden platform. Six upright timbers are fixed to serve as guides, as in an ordinary hoist. The tanks are attached by a chain passing over a pulley at the top of the uprights, the length of which is regulated from time to time, so that while one tank is on the ground the other is at the hight where materials are to be delivered. Each tank has a funnel opening at the top and a plug valve at the bottom. The water is led up in flexible hose to the place where the work goes on, and one tank being down and loaded, water is let into the upper one until the weight to be raised is counterpoised, when down goes the water and up comes the material, which, on arriving at the landing stage, is secured and unloaded. Meantime the plug valve has emptied the bottom tank it is loaded, and water being put into its elevated companion they change places as before. In this way blocks of stone, bricks, timber, tiles, and the workmen themselves go up and down rapidly, and without fatigue. The apparatus does not cost more than a derrick and tackle, and is easily taken down and moved from place to place.

There is a brake to prevent too rapid descent, the rounds placed at the sides to form a ladder, and other points which I have probably overlooked. VOYAGEUR

Toronto, Canada.

The Hartford Steam Boiler Inspection and Insurance Company.

The Hartford Steam Boiler Inspection and Insurance Company makes the following report of its inspections for the month of January, 1870:

During the month, 372 visits of inspection have been made; 766 boilers examined, 714 externally and 207 internally; while 54 have been tested by hydraulic pressure. Number of defects in all discovered, 270; of which 23 were regarded as dangerous. These defects in detail are as follows:

Furnaces out of shape, 9; fractures in all, 21—1 dangerous; burned plates, 23—2 dangerous; blistered plates, 30—2 dangerous; cases of incrustation and scale, 42—1 dangerous; cases of external corrosion, 41—3 dangerous; cases of internal grooving, 3; water gages out of order, 8—1 dangerous; blow-out apparatus out of order, 2; safety valves overloaded and inoperative, 9—1 dangerous; steam gages out of order, 46—4 dangerous. These gages varied from— 25 to + 12. Cases of deficiency of water, 6—2 dangerous; boilers without check valve in feed pipe, 6—6 dangerous.

It will be noticed in the foregoing report that there have been found 30 blistered plates, on two of these in one boiler were found six large blisters, which so reduced the strength of the material that it became necessary to renew the plates. All parts of the furnace and fire sheets of boilers should be examined at stated intervals with a view to detect these defects—they are not especially dangerous if attended to in season. Two boilers examined during the month were so badly weakened by corrosion and fractures that they have been condemned as unsafe and beyond repair. New ones are being supplied. We not unfrequently find boilers without hand holes. This is a great oversight on the part of boiler makers, and we especially call their attention to this matter. Several cases have come under our notice this month when the fire-box sheets were badly burned by collection of sediment in the water legs, no hand holes being provided by which this could be removed. Again, we not infrequently find boilers set in angles of the building, where if they are furnished with hand holes, they are inaccessible from the boilers being set so near, or in direct contact with the wall. In the construction and setting of boilers every facility should be given to make the matter of removing sediment free from unnecessary trouble.

Steam gages, it will be noticed are frequently found incorrect. This can only be detected by making frequent examinations and comparing them with a test gage. To show how liable boiler appliances are to be neglected, the attention of an inspector was recently called to a steam gage that had not varied in its indications for a month; on examination it was found that a stop cock in the pipe leading to the gage was turned so as to shut the steam entirely off from the gage. This cock being opened the gage was all right.

In another instance, where the steam gage was not working, examination ascertained the fact that the steam-gage pipe entered the boiler through the head, and then turned a right angle, descending perpendicularly below the water line; the pipe was filled with sediment at the lower end, hence the gage was useless.

We mention these cases to show how a little carelessness in fitting or working a boiler may be a source of danger. We have frequently urged the importance of providing boilers with all necessary fittings, also that engineers give them daily attention. Attachments are not placed on boilers to make the engineer less vigilant, but to keep him constantly on his guard.

We repeat what we have frequently said. Raise the safety valve slightly and carefully, allowing it to return to its seat easily and without concussion, this should be done daily at least. See that the steam gage is in working order, and if for any reason it is thought to be incorrect in its indications, have it attended to at once. Keep the gage cocks clean and bright, not allowing them to become foul and incrustated, and if provided with a water gage, see that it is in working order.

With vigilance in these particulars the dangers of *low water* and *high steam* will be entirely avoided.

Tunnel Photographs.

We are indebted to Messrs. Rockwood & Co., 839 Broadway, mechanical photographers, for a series of stereoscopic and other photographs illustrating the pneumatic railway under Broadway. As the works are entirely below the surface of the street, artificial light was employed, in the use of which the photographers have been very successful. The illumination was obtained by means of two large and powerful oxy-hydrogen calcium light. Photography has been brought to such perfection that even the bowels of the earth yield to it their mysteries, and Broadway has proved no exception. The pictures were taken with the entire travel of the street, omnibus, carts, carriages, and steam fire engines, all trotting directly over the head of the artist.

Step Support for Mill Spindles.

The main object sought to be obtained in the improved step support for mill spindles, of which we give engravings herewith, is to secure perfect truth in the perpendicularity of the mill spindle to the face of the bed-stone. The collateral advantages thus secured will be apparent to practical millers and millwrights.

The improvement consists in the arrangement of the step in the top of a vertically-adjustable tube or other sliding support, provided with vertical guides, and working through guide plates, to insure the vertical position and to prevent rattling; the said support being mounted on a rod rising up from the bridge-tree and jointed to it, so that the joint may compensate for the curve described by it, due to the one end of the bridge-tree being fixed and the other swinging around the fixed point, and the step may be raised in a right line.

Figs. 1 and 2 are, respectively, a side elevation and a section, by reference to which all the parts of this simple and excellent device may be readily understood.

A represents the husk-frame to which the bridge-tree, B, is pivoted in the usual manner; the end, opposite the pivoted end, being raised or lowered by the adjusting screw, C, as hitherto; but instead of placing the step on these bridge-trees, as has hitherto been practiced, the bridge-tree, B, is placed lower down than in the old method, and the step support, D, itself supported from the bridge-tree by the rod, F, is provided, as shown in the engravings.

The rod, F, is pivoted to the bridge-tree, as shown in the engravings, and engages with the broad lateral arms, I, on the interior of the support, D, the top of the rod, F, being formed into a crutch, as shown in Fig. 2.

The lateral arms, I, Figs. 1 and 2, extend across to vertical guide-plates, K, which being pressed against the arms by means of the screws, L, adjust the step support so that it shall move in a line exactly perpendicular to the face of the bed-stone, and also prevent rattling or clattering against the edges of the plates, G, through which the step support passes.

The step support is preferably made tubular, as represented in the engravings, and the step, E, of any approved construction, is placed at the top and held by screws, as shown in Fig. 2, or in any other suitable manner.

It will be seen that perfect truth in the perpendicular action of the spindle is thus secured.

Patented, through the Scientific American Patent Agency, February 1, 1870, by John Russell, of Round Prairie, Missouri. See advertisement in another column.

Fig. 1

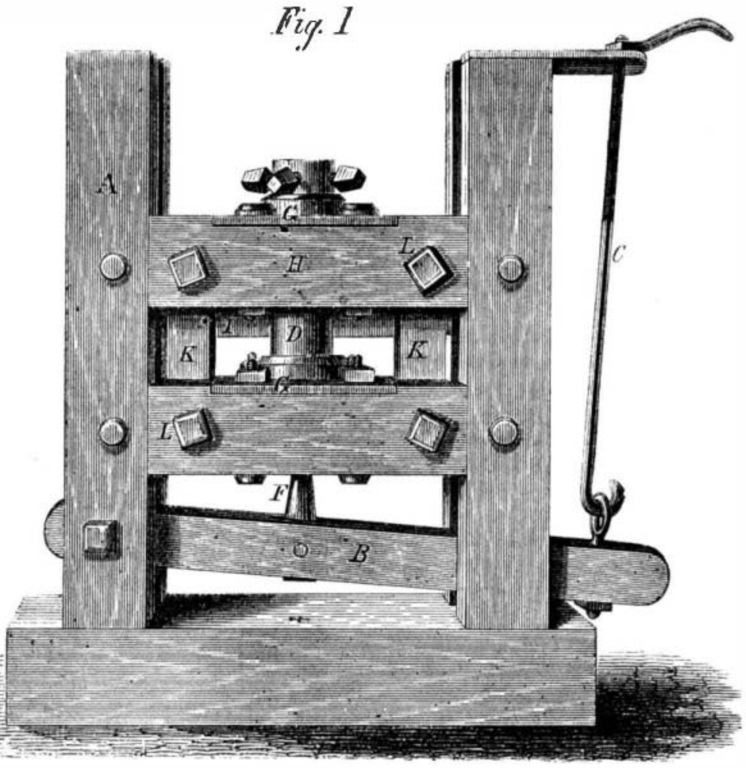
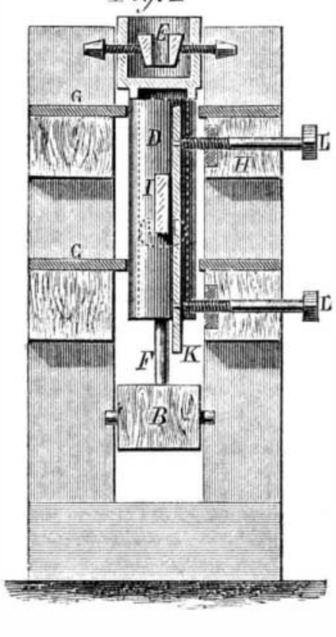


Fig. 2



RUSSELL'S SUPPORT FOR MILL SPINDLES.

Improved Form of Ax Blank.

This invention consists in rolling a bar of iron into the shape of a continuous series of blanks for ax heads, the fiber of the iron running lengthwise of the bar and ax head.

The blanks are formed by a pair of rolls provided with a groove or grooves, the contour of which corresponds to the desired form of the ax heads.

Fig. 2 represents a longitudinal section and plan view of the blank of a single-bitted ax as it comes from the rolls, and also a section of the blank ready for the insertion of the bit.

Fig. 1 is a section of a blank of a double-bitted ax as it comes from the rolls, and also a section of the blank prepared for the insertion of the bit.

A, Fig. 2, represents the poll of the ax and B the portions destined to form the eye, and C the eye.

Instead of the thick portion at A, Fig. 2, which forms the poll of the finished ax, the blank for a double-bitted ax is formed as at A, Fig. 1, so that when the two halves are bent together for the insertion of the steel, the junction at A holds them in position until the first steel is inserted and welded. The junction at A being then severed, the second steel is inserted, the first weld holding the parts in place during the latter operation.

The advantages of this method will be readily seen and appreciated by manufacturers of axes. Blanks thus formed can be readily bent into the form desired, will draw out more readily under the hammer, and are not liable to crack in the eye of the ax.

A common way of forming the blanks, is to take the ordinary sized bar, say 3 × ⅝, or other suitable size, for the kind of ax required, and cut it into lengths of say 7 inches, so that the pieces to start with are 3 inches wide, 7 inches long, and ⅝ of an inch thick.

These pieces are placed in a furnace and heated to nearly a welding heat. This heating is very irregular, causing the loss of many pieces in pressing and bending. The pieces are then taken from the furnace and one end placed between dies formed on rolls that revolve only half way round.

After pressing one end under the dies the piece is turned, and the other end pressed under, thus forming the ax blank. In this operation, the blanks are never made exact; they may run heavy or light on the edge which forms the eye, one side being thick and the other side thin. One end may be hotter than the other and therefore spread more when the pressure comes on it, so that when bent it necessitates more labor with the hammer.

Another method is to forge the blanks. There is also another way—"rolling them"—which has been patented. In this method the bars are welded into such a shape that when two pieces are cut or sawed off they form the ax blank. In this method two welds are required, and the fiber runs crosswise of the ax; while in the method of Mr. Jope there is a *solid poll, only one weld*, and the fiber runs *lengthwise*, as it should in all axes, so that in chopping wood or using the ax, the blow comes on the end of the fiber and not on the sides, thus weakening the ax. Moreover the iron can be rolled at a uniform heat, and every blank will be exactly like its fellow with each blank cut nearly, or altogether, off to the length required. Thus much time and labor will be saved in subsequent operations, and the blanks can be rolled out nearly at the same cost as ordinary bar iron, the saving in running machinery and in waste of material would seem to render this a valuable improvement.

Patented October 12, 1869, by G. W. Jope and Wm. Bunton, Pittsburgh, Pa.

Fig. 1

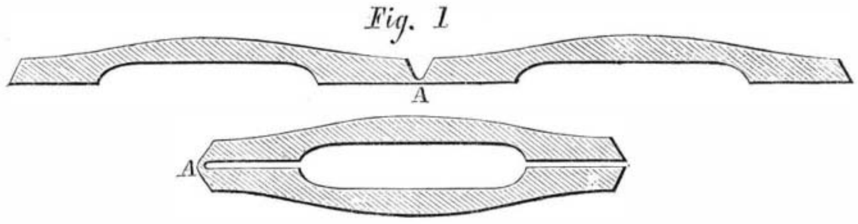
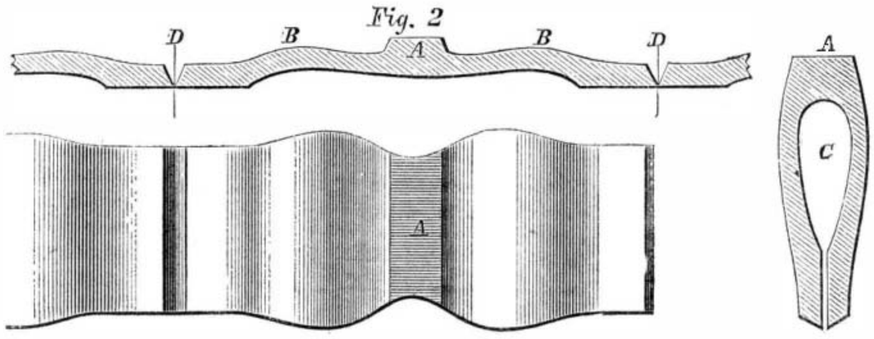


Fig. 2



JOPE'S NEW METHOD OF ROLLING AX BLANKS

Natural and Artificial Mechanism.

In every department of mechanics, working models have deceived the inventors. The laws that regulate motion differ widely from those that regulate chemical action. That which is true of an atom in its properties of combination, is true of any number of atoms—from the smallest experiment to one managed on the most extensive scale. The chemist in his laboratory, from his test tube and crucible, can give you the formula for any imaginable quantity. Not so with the machinist. His disturbing influences are not the atomic relations of the elements of his material. For construction, he has to use substances such as nature and art furnish, and subject these to the action of external forces which increase rapidly with their size and velocity. It is exceedingly difficult to estimate the amount of these forces; and as nature arranges the fibers of each plant, and machinery of each animal, after a different plan, to meet the forces that are opposed to it; so must the mechanic plan all his arrangements, from the smallest machine to the most stupendous engine, to harmonize with the laws of matter.

In whatever movement that is attempted in the animal construction, there is a concentration of forces directed through appropriate apparatus sufficient for the intended result. The nature of the force, its amount, and the magnitude of the result have such a relation to each other, and vary so much in different animals, that the instruments, by which the force is made effective, are necessarily varied in form and complexity. In all their relations to the end, however, they are perfect.

When man attempts to construct a boat—which we will introduce as an example of adapting means to the end—and this boat is to be driven by forces developed within itself; and if along with capacity for freight he wishes to insure great speed, he experiments on various forms of hulls and kinds of propellers. Every line from cutwater to sternpost is duly considered. The parting of the water at the bow, and the closing at the stern, with all the varieties of displacement at different speeds, enter into the investigation. Calculations, running from the tub-shaped argosies of olden time down to the sharp models of the present day, are made with the greatest seeming accuracy. Paddle wheels and submerged propellers are next considered; and all the science of the scholar, and experience of the practical boatman, are brought to aid in the choice, and to determine the form. Tables of experiments are examined. With certain models results have been obtained, varying with the propeller used. Every particular of power, number of revolutions, weight carried, conditions of temperature, wind, and water, are noticed, and data obtained, it is supposed, that will warrant the construction of another boat of greater magnitude, with the same relative proportions from which results may be expected, corresponding with the increase of size. The boat is constructed, and falls far short of the anticipation. The proportions between the inertia of the water and model boat are not the same as between the water and the larger vessel; yet the latter is but the magnified counterpart of the former, with the disadvantage of available power not being equal to in crease of weight. A small boat may be driven with great velocity, without its propellers scarcely making any wake in the water, after the manner of insects skipping over the surface of pools; for the resistance of the water is great, compared with the extent of surface of the moving body applied to it, and the weight to be overcome. A large vessel cannot carry such a proportionate extent of propelling surface, and here the calculations founded on the results of a model fail. If the amount called for by the enlarged plan were practicable, that is, if material were light enough, and sufficiently strong to carry it out, still there would be a disproportion in results. With the increased resistance of the water that must be rapidly displaced by an immense body urged with great velocity through it, and the water, to which the propeller is applied, being no more resisting for the larger boat than for the model, a velocity must be given to the propeller, to make the inertia of the water, on which it strikes, sufficient to overcome the resistance of the advance of the boat; and this to a degree proportionate to the speed to be attained. It will be seen at this view, that difficulties are to be encountered that make experiments on boat-models of less importance than is generally supposed. Although large steamers have made greater speed than small, the rate is far from being in direct proportion to size and power of engine. A very small boat, one that can be carried on a two-horse wagon—engine, boilers, and all—will easily make eight miles an hour. The *Great Eastern* cannot make three times that speed. Until the whole moving apparatus of one of these large vessels bears the same relation to its weight, and submerged size and power, that the tail and muscles do to the swiftest fish, rapid movements through the water by boats must be an imperfect attempt to rival the machinery of nature.—*Beecher's Magazine.*

A LONDON chemist—Dr. Andrews—has announced a discovery which, if confirmed, is of the first importance, namely, that the gaseous and liquid state of matter are continuous. His experiments have chiefly been made upon carbonic acid, confined in fine glass tubes, and subjected to various pressures up to that of 110 atmospheres; they show that from carbonic acid as a perfect gas, to carbonic acid as a perfect liquid, the transition may be accomplished as a continuous process, and that the gas and liquid are only distinct stages of a long series of continuous physical changes.

RAZOR PASTE.—Take putty powder 1 oz., oxalic acid ½ oz., and honey enough to mix with these so as to make a stiff paste. Apply it to the strop, and wrap the remainder in tin foil.