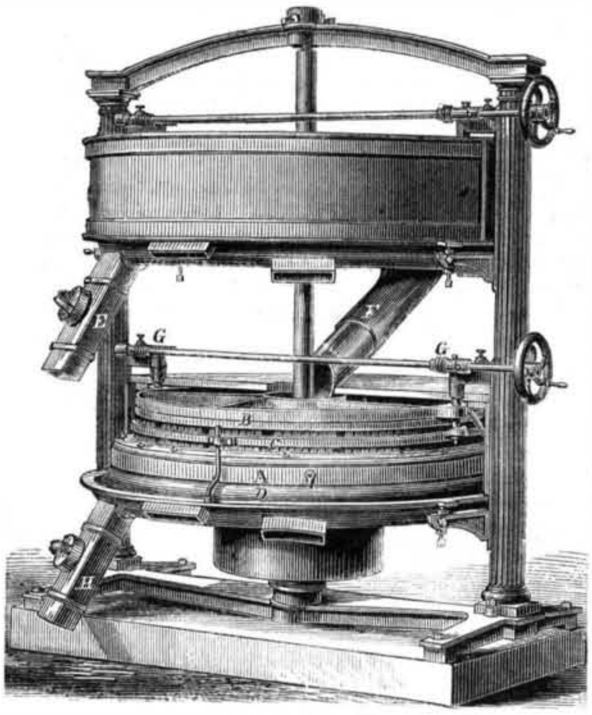
CLARK & ELTING'S "EXCELSIOR" BOLT AND DUSTER.

This machine, of which the engraving is a representation, is designed by the inventors to supply a want long felt by the milling fraternity, viz., a machine which will extract the flour from middlings as well as bran, and at the same time allow the flour so extracted, or at least a large portion of it, to pass into the best grade of flour; in other words, a machine, which will increase the yield without injuring in the least the quality.

That the Clark & Elting machine accomplishes this result, the testimony of such mills as the celebrated "Passaic," of Newark, N. J., the "Pearl," of Pittsburgh, the "Star and Crescent," of Chicago, the "Plants," of St. Louis, the "Boston City," of Boston, and many others of equal reputation, bear ample witness. In the accompanying engraving half of the lower casing or curb is removed, in order that the working of the machine may be more fully shown.

The machine is constructed with revolving horizontal disks, A, covered with wire cloth, varying from 36 to 44 inches in diameter, and having two or three disks as may be deemed advisable, with a view to the work to be done. Above these revolving disks are stationary ones, B, filled with long bristles of the very best description. Surrounding these bristles, and among the openings or furrows of the stationary disks, is what is termed a tempering wheel, C, the object of which is to virtually shorten or lengthen the bristles, as the work to be performed may require. Attached to the under side of the revolving disk are fans, which run in an air chamber, D. These fans form a suction, whereby the flour is drawn through the revolving disk, and conducted into the air chamber, where it passes off through the spout, E, and is carried to its proper place to be rebolted.



The brace and middlings pass off between the disks, by centrifugal force at the periphery, and so are reconducted by the spout, F, to the eye of the lower disk, that the same operation may be repeated. The disks are arranged in such a manner that by means of worms and screws, G, they may be adjusted at will while the machine is in motion. Thus the machine is under the control of the miller to just the same extent as the millstone.

The meal is taken from the return reel at the point where it begins to show specks (the main object being not to return any specks to the superfine reel), and is carried into the eye of the first disk, which is so set as to clean the stuff all it will bear, to run into the best flour.

The tailings of this disk are then returned to the next disk, by the spout, F, and the same operation repeated, and so on to the third disk, if a three-disk machine is used, and the tailings from the last disk are carried to a separating reel, by the spout, H, where the division of middlings, shorts, and bran, is made. By this operation, it will be discovered, that not only the quantity of the best flour will be increased, the color improved, greater clearness obtained, but that the amount of middlings to be reground will be materially lessened.

The middlings to be reground will be sharper, rounder, and cleaner, than it is possible to make them with bolting cloth. And it will be discovered that the same number of bolting reels will do more work than by the previous method; since the removal at once of the middlings frees the cloth, and prevents the particles which before were being worked over and over, from being returned to accumulate.

The machine was patented through the Scientific American Patent Agency, February 12, 1861, and is now in successful operation in over three hundred of the principal flour mills of the country. It was brought to its present perfected condition by the Elting Bolt & Duster Company, of Cincinnati, the sole manufacturers of the machines and owners of the patent, to whom all communications should be addressed.

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A CORRESPONDENT recently returned from the East says:—"In Turkey, in Asia, the only mode of measuring distances is by the walking gait of a horse, and the traveler is told, when he inquires the distance to a given village or city, that it is so many caravan *days* or *hours*, which of course is not uniformly the same. This to a stranger is a great annoyance."

Science Familiarly Illustrated.

HEAT AND COLD.

BY JOHN TYNDALL, ESQ., LL. D., F.R.S.

Lecture IV.

In our last lecture I intended, if time permitted, to explain the action of the geyser of Iceland, but at the end of the lecture I found that the time was insufficient for the purpose; and I promised then to explain this wonderful spring in the lecture of to-day; but when I came to look at the other matter before me, I found that it was so abundant that I really could not get the subject of the geyser into it.

"The surface of Iceland slopes gradually from the coast toward the center, where the general level is about 2,000 feet above the surface of the sea. On this, as a pedestal, are planted the Jökull, or icy mountains of the region, which extend both ways in a northeasterly direction. Along this chain the active volcanoes of the island are encountered, and in the same general direction the thermal springs occur, thus suggesting a common origin for them and the volcanoes. From the ridges and chasms which diverge from the mountains, mighty masses of steam are observed to issue at intervals, and where the escape takes place at the mouth of a cavern, and the resonance of the cave lends its aid, the sound of the steam is like that of thunder. Lower down in the more porous strata, we have smoking mud pools, where a repulsive, blue-black, aluminous paste is boiled, rising at times into huge bladders, which on bursting scatter their slimy spray to a hight of fifteen or twenty feet. From the base of the hills upward extend the glaciers, and on their shoulders are placed the immense snow fields which crown the summits. From the arches and fissures of the glaciers, vast masses of water issue, falling at times in cascades over walls of ice, and spreading for miles and miles over the country before they find definite outlet. Extensive morasses are thus formed, which add to the monotony of the dismal landscape. Intercepted by the cracks and fissures of the land, a portion of these waters is conducted to the hot rocks underneath; here meeting with the volcanic gases which traverse these underground regions, both travel together, to issue at the first convenient opportunity, either as an eruption of steam or as a boiling spring.

"In the Great Geyser, we have a tube ten feet wide and seventy feet deep; it expands at its summit into a basin, which from north to south measures fifty-two feet across, and in the perpendicular direction sixty feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the Geyser water will, perhaps, furnish the first surmise. In 1,000 parts of the water the following constituents are found:

Silica	0·5097
Carbonate of Soda	0·1939
Carbonate of Ammonia	0·0083
Sulphate of Soda	0·1070
Sulphate of Potash	0·0475
Sulphate of Magnesia	0·0042
Chloride of Sodium	0·2521
Sulphide of Sodium	0·0088
Carbonic Acid	0·0557

"The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment, even when cooled down to the freezing point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analyzed in this institution, was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency, and that the spring merely lined it. A painting of the Geyser, the property of Sir Henry Holland, himself an eye witness of these wonderful phenomena, was exhibited. The painting, from a sketch taken on the spot, might be relied on. We find here that the basin rests upon the summit of a mound; this mound is about forty feet in hight, and a glance at it is sufficient to show that it has been deposited by the Geyser. But in building the mound, *the spring must also have formed the tube which perforates the mound;* and thus we learn that the Geyser is the architect of its own tube. If we place a quantity of the Geyser water in an evaporating basin, the following takes place: in the center the fluid deposits nothing, but at the edges where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edge we find a ring of silica thus laid on, and not until the evaporation has continued for a considerable time, do we find the slightest turpidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of nature's operations in Iceland. Imagine the case of a simple thermal spring, whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over which the water passes, until finally the stream has to choose another course; here the ground becomes elevated by the deposit, as before, and the stream has to move forward; thus it is compelled to move round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astonished both the traveler and philosopher.

"Before an eruption, the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming an eminence in the center of the basin, causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depth, which, rising into the cooler water of the tube, becomes suddenly condensed and produces explosions. Between the interval of two eruptions, the temperature of the water in the tube gradually increases, but even immediately before an eruption, at no part of the tube is the water at its boiling temperature. How then is an eruption possible? Bunsen succeeded in determining the temperature of the water a few minutes before a great eruption, and his observations furnish the key of the entire enigma. A little below the center he found the water within two degrees of its boiling point, that is, within two degrees of the point at which water boils under the pressure of the atmosphere, *plus the pressure of the superincumbent column of water.* The actual temperature at thirty feet above the bottom of the Geyser, was 122° Centigrade, its boiling point 124°. We have just alluded to the detonations and the lifting of the Geyser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observed at various intervals before an eruption. Imagine, then, the section of water at thirty feet above the bottom to be raised six feet by the entrance of a mass of vapor below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling point under this diminished pressure is 121°; hence, in its new position, its actual temperature (122°) is a degree above the boiling point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressure further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the upper part of the column of water, through the sudden boiling up from the middle downward, is ejected with immense velocity, and we have the Geyser eruption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube through which it gradually rises again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more *nearly* attained its boiling point is the lifting of the column able to produce an eruption.

"In the regularly formed tube the water no where quite attains the boiling point. In the canals which feed the tube, the steam which causes the detonation and lifting of the column must therefore be formed. These canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and sufficient cause of the eruptions. Its sufficiency was experimentally shown during the lecture. A tube of galvanized iron six feet long was surrounded by a basin; a fire was placed underneath and one near its center to imitate the lateral heating of the Geyser tube. At intervals of five or six minutes throughout the lecture eruptions took place; the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

"Sir George Mackenzie, it is well know, was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geyser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompanied Bunsen to Iceland. It is unnecessary to introduce the solid objections which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity which gave it birth.

"A moment's reflection will suggest to us that there must be a limit to the operations of the Geyser. When the tube has reached such an altitude that the water in the depths below, owing to the increased pressure, cannot attain its boiling point, the eruptions of necessity cease. The spring, however, continues to deposit its silica, and forms a *laug* or cistern. Some of these in Iceland are of a depth of thirty or forty feet. Their beauty is indescribable; over the surface a light vapor curls, in the depths the water is of the purest azure, and tints with its own hue the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geyser. There are in Iceland traces of vast but now extinct Geyser operations. Mounds are observed whose shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have, in fact, the Geyser in its youth, manhood, and old age, and death, here presented to us: in its youth, as a simple thermal spring; in its manhood, as the eruptive spring; in its old age, as the tranquil *laug;* while its death is recorded by the ruined shaft and mound, which testify the fact of its once active existence.

"Next to the Great Geyser, the Strokkur is the most famous eruptive spring of Iceland. The depth of its tube is forty-four feet. It is not, however, cylindrical, like that of the Geyser, but funnel-shaped. At the mouth it is eight feet in diameter, but it diminishes gradually, until near the center the diameter is only ten inches. By casting stones and peat into the tube, and thus stopping it, eruptions can be forced, which in point of hight often exceed those of the Great Geyser. Its action was illustrated experimentally in the lecture, by stopping the galvanized iron tube before alluded to loosely with a cork. After some time the cork was forced up, and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable hight; thus demonstrating that in this case the tube alone is the sufficient cause of the phenomenon."

Thoughout the lectures that have been hitherto given I have had occasion to admire the attention and patience of my younger hearers. My hearers are of different ages, but although I have been obliged to mention certain things that could not possibly be understood by the very young boys, and to mention some elementary facts which were, perhaps, very well understood by the older boys yet the young boys have been patient when I spoke to the elder ones, and the elder ones have been patient when I spoke to the younger boys; and for this I feel very thankful. With reference to the present lecture I have to address all the boys, especially the elder ones, for I have to explain a term or two very much used at the present time in connection with the subject of heat.

If you carry a pound of any substance whatever to a hight of 772 feet above the earth's surface, and allow it to drop down upon the earth from that hight, you always get the same amount of heat generated, and that amount of heat would be just sufficient—I mean neither more nor less than sufficient—to raise the temperature of one pound of water one degree Fahrenheit. Thus, if you conceive a pound weight falling from this great hight, 772 feet, and conceive all the heat generated by its collision with the earth collected together and put into a pound of water, that pound of water would have its temperature elevated one degree. Now, by proper means we can reverse this process, and by means of heat we can lift the pound weight. If we lift the pound weight to a hight of 772 feet, of course we should then be pulling it, as it were, away from the earth which attracts it; and in order to lift this pound weight to that hight we should consume—in fact, annihilate, destroy—an amount of heat equal to that which would raise a pound of water one degree in temperature; so that the amount of heat consumed in lifting the weight 772 feet is exactly equal to what is generated when the weight falls from a hight of 772 feet. Now, if we lift one pound of matter one foot from the ground, a certain term is employed. It is called "*the foot-pound*;" and if you lift a pound weight to 772 feet it is 772 foot-pounds; or if you lift 772 pounds to the hight of a foot you have 772 foot-pounds. Now, this quantity of 772 foot-pounds, which would raise the temperature of a pound of water one degree, is termed "*the mechanical equivalent of heat.*"

In lifting a weight from the earth we are overcoming attraction of the earth, and in doing this we consume heat, if heat be the agent which lifts the weight. Now, I have asked you over and over again to figure the atoms of solid bodies such as this I hold in my hand. As a general rule, when heat is communicated to a body the atoms are forced asunder. You know the enormous power and force with which these atoms may attract each other, for I showed you that when an iron bar was cooled the contractible force pulling together its atoms—the mutual attraction of its atoms on cooling—was sufficient to smash the steel bar which you saw broken in front of the table. Now, we have among the atoms of bodies pulling each other together an action substantially the same as that which occurs when we separate the weight from the earth. To this action we may give a name. Let us call this work which occurs in a body "atomic work" if you like—work done on the atoms. This work necessitates a consumption of heat. Heat is consumed in this way; and what I want you now to bear in mind is that the amount of heat consumed is very different indeed in different bodies; and consequently some bodies, in order to raise them one degree in temperature, require more heat than others. In order to raise one pound of the liquid metal mercury one degree in temperature a certain amount of heat must be imparted to it. It would require *thirty times* that amount of heat to raise a pound of water one degree in temperature. Water requires thirty times the quantity of heat required by mercury, simply because the work to be done is a great deal more than that necessitated in the case of mercury. Now, I want to show you what follows from this action. It would appear, in consequence of this atomic work which I have been speaking of, as if the water had a power of storing up heat thirty times greater than the power possessed by mercury; and, indeed, formally people thought that heat *was* something stored up, and they called the amount of heat which it was needful to impart as a body to raise its temperature one degree its "capacity for heat." They looked at a body as a kind of vessel for heat, and hence they used this term "capacity for heat." It was found by experiment that the capacity for heat (as the term went) was very different in different bodies; and the amount of heat which a body had stored up was determined by what the body could do—by the amount of ice or wax which it could melt.

I have here a vessel of hot oil, and in it I have spheres of metal of different kinds. They are all equally hot at thep resent time; but you will find that these spheres of metal have very different powers in melting bodies. They will be placed on a flat piece of wax, D (Fig. 1), and their heat will act upon that piece of wax. Some will force their way through, and others will not. This ball of copper will go through the wax first. The tin will go partly through. The bismuth certainly will not go through, although it is just as hot as the copper. Here, too, we have a ball of lead which is not competent to melt its way through the wax. The ball of iron will go through. Here is a ball of zinc; I think that will go through; but I am sure that the lead and tin and bismuth will not do so. [The balls of copper, iron, and zinc melted their passage through the slab of wax, and fell to the ground one after the other. The three other balls did not perforate the wax.] This illustrates the different amounts of heat possessed by these bodies, although they are all at the same temperature.

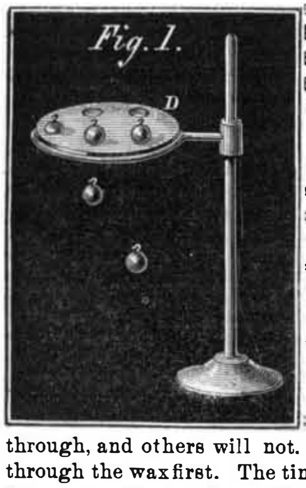
Fig. 1.

We must now go on considering the heat consumed; and I must rapidly make a few experiments illustrative of the consumption of heat in this work of forcing the particles of bodies asunder or changing their position. One of the most remarkable cases of the consumption of heat occurs when a body is caused to pass from the solid state to the liquid. Here, A B (Fig. 2), I have a beautiful instrument [the thermo-electric pile], which has been introduced to your attention before. It is a kind of thermometer, and I want to show you how we can make use of this instrument for the purpose of ascertaining whether we have cold or heat. I cannot go into the full explanation of the thing; but if you observe the needle, *m n*, of the galvano-meter, G, to which it is connected by the wires, *w w*, you will see how wonderfully delicate the instrument is. It is more delicate than any thermometer whatever. I will turn the face of that instrument towards me, or I will breathe against it, or I might allow any young philosopher present to breathe against it. The warmth of his breath would at once make itself evident by causing that magnetic needle to move. Now, as I breathe against this pile, you observe that the red end of the needle comes towards me. When the needle returns to its former position and comes to rest, I will try the effect of cold upon the instrument, which, you will remember, is called a thermo-electric pile. (You see I can stop the needle by this other one.) I will now put a piece of this ice in a spoon, and on the cold spoon coming in contact with the face of the pile you will see that the red end of the needle will move towards you, and away from me. Thus, in this instrument we have the means of telling whether heat or cold has been imparted. We now again bring the needle to rest. And now we have made the acquaintance of this beautiful instrument, I will proceed to experiment with it. Here is a little flat basin, B, which I place upon the face of the pile, thus; and you observe that although that dish has been up to the present time resting upon the table it has become a little warm, and causes the red end of the needle to move towards me. But when I pour a little cold water into this dish you see the suddenness of the movement of the red end of the needle towards you. I will now warm this water by dipping my finger into it, and after a time you will see that the needle will come down in consequence of the warmth imparted to it by my hand, and come back on the other side of the middle line. [After a pause.] You see that the needle now comes to my side, showing that the water is warmed by my finger. And now I might take sugar, or salt, or saltpeter, which would be still better, and put a little of the powder of that saltpeter into the water. That powder would become liquefied; and on its melting the warmth of the water is consumed—is used up, and the water is thereby chilled. Now, in making this experiment I will confine myself to a particular substance called sulphate of soda. You see that there is now a very great deal of heat imparted to the water by my finger and that the needle comes very much on my side of the middle line. I will now pour into the water some powdered sulphate of soda, and you find that the water immediately becomes chilled by melting that sulphate of soda. This, then, is a consumption of heat by the act of liquefying or melting the sulphate of soda. I want now to make another experiment. It is a very instructive one. I want to show you the reverse of the last experiment. When dissolved sulphate of soda is permitted to solidify—become solid—you get out of it the heat that was expended in rendering it liquid. I have in this flask, B Fig. 4, some dissolved sulphate of soda. It was carefully melted last night, and has been carefully kept apart from any thing which could disturb it. We will allow the face of the pile to rest against the bottle; and now I want to cause that body to solidify before your eyes. I can cause it to become crystallized sulphate of soda, like that which was dissolved in that dish a moment ago. You will see the liquid in the flask become more and more opaque, and when it begins to solidify opposite the face of the pile it will give out heat—the heat that was expended in melting it, and you will then see the red end of the needle come towards me. I will now open the neck of the flask, and throw a crystal of sulphate of soda into the solution. [This was done, and the contents of the flask began to solidify from the top downwards.] You now see the compound crystallizing; and the moment that portion opposite the face of the pile becomes solid, heat will be communicated to the face of the pile, and we shall get a deflection (as it is called) of the red end of the needle in the direction in which I stand. [After a pause]—What I predicted was quite right. There we get out of the sulphate of soda the heat that was expended in melting it. There is the movement of the needle caused by the heat.

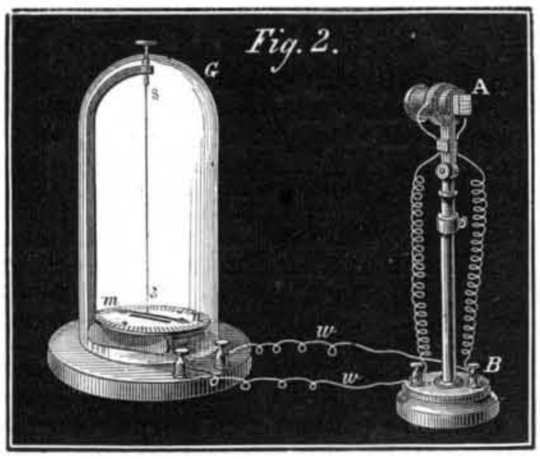
Fig. 2.

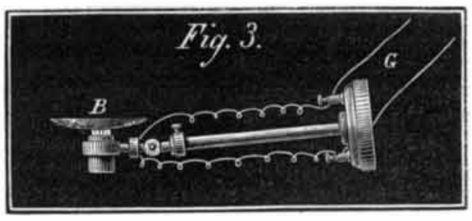
Fig. 3.


Fig. 4.

I might go on in this way, and show you that when a body is evaporated you also get a very large amount of heat consumed—used up—in order to evaporate it. In order to convert a pound of water at 212° Fahrenheit into steam at 212° Fahrenheit, an enormous amount of heat is required. It requires as much heat as would raise 967 pounds of water 1° Fahrenheit; and this heat is insensible to the thermometer, although it is so great. The reason that I employed a mixture of ice and salt as a freezing mixture in a former experiment, was that the action of the salt produces a liquefaction of the ice, and on that liquefaction taking place a large quantity of heat is consumed—so much that the temperature of the liquid is reduced far below the temperature of the ice itself. I am going to illustrate this point by the development of cold by vaporization; and if things go fairly I should not wonder if I could freeze water before your eyes by means of its own evaporation. An experiment has been arranged there for the purpose. Here are two bulbs, A and B, in this apparatus (Fig. 5), and the water which was in one of them has been frozen in this room since the lecture began. One end of this has been placed in a freezing mixture far away from the bulb where the water is frozen. This instrument is called a "cryophorus," or ice carrier. Water was placed in one bulb, and the air was taken from the interior of the instrument. The other bulb was placed in a freezing mixture, and as the vapor came over from the water it was condensed by the freezing mixture, and the vaporization which took place has been sufficient to freeze the water.

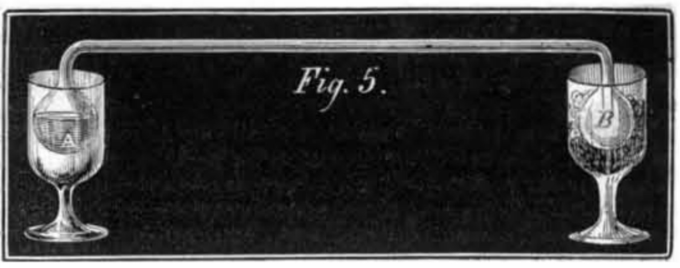
Fig. 5.

So much, then, for the heat consumed in causing a body to pass from the liquid state to the state of vapor. I have on the table various substances which would enable me to illustrate this in a very satisfactory manner. For instance I will take a little alcohol, and warm it by placing my finger in it, thus. I see there is a great amount of heat in the face of the pile. I have no doubt that the evaporization will very soon cause the end of the needle to come down; or if I take a substance that can vaporize more rapidly than alcohol—this substance, ether—it would not take an instant in order to overcome the heat which is the cause of that deflection. I will cause evaporation to go on a little more quickly, and if the needle be not held fast by some accident we shall soon find the heat which causes the present large amount of deflection entirely abolished, and the needle will move down, now you see the needle comes back. We get an enormous amount of cold by the evaporation of ether, so much that we can easily freeze water by it.

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Improved Electrical Process of Generating Gases.

John T. Rich, of Philadelphia, Pa., has lately patented the following:—

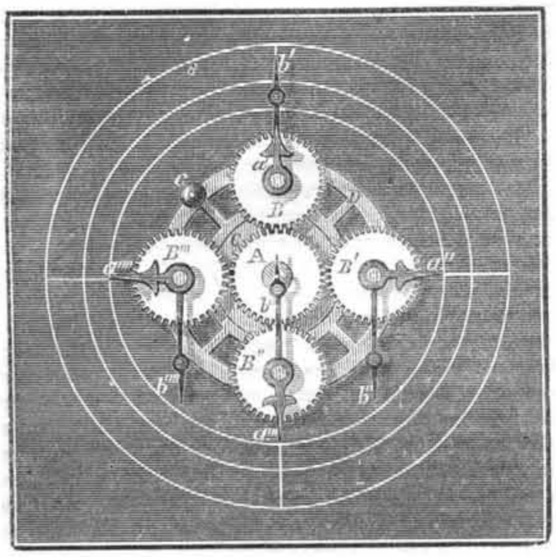
A gas retort heated by a furnace is employed. This retort is intended to be filled with fluid hydrocarbon. The fluids are caused to flow toward the center of the retort through the spaces formed by a volute partition, and being thus exposed to the action of the heat, they are evaporated. The vapor rises through a pipe, which terminates in a cone. A steampipe terminates in said cone, as does also an atmospheric air pipe.

The operation of the apparatus is as follows: By the action of particles of steam mingled with globules of water, commonly called wet steam, upon the sides of the cone, electricity is generated, the amount of which may be increased, according to well known principles, by making the cone of hard wood, and also by causing the jet of steam to impinge upon a brush of points or by using a cone of ground glass. This jet of steam, passing through the apex of the cone, carries with it the gas or vapors from the retort, and the electricity generated by the jet of steam acts upon the atmospheric air admitted through the pipe, setting free a portion of the oxygen, the nitrogen, uniting with part of the oxygen, forming nitric acid. After the gases or vapors passing from the retort are thus mingled with the oxygen, they are carried through water, which takes up the steam which has not been decomposed, and the nitric acid, thus forming a permanent gas not subject to condensation.

The use of a retort may be dispensed with, and oxygen gas be generated alone, which may be employed for chemical distillation, for the desulphurization of ores, and other suitable purposes.

THE WHEEL QUESTION.

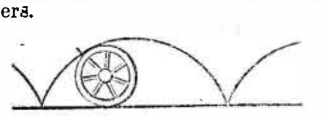
W. E. H was one of the earliest to send us a model illustrative of the views of the two revolution philosophers; but when the engraving of the model was ready we found that we had mislaid his letter. We have therefore been obliged to delay the publication of the engraving until we could communicate with him.



Above is the view of his model. A is the fixed wheel, set on a fixed disk, C; B the movable wheel, carried on a movable disk, D, which is turned by button, *c*. A long pointer, *b'* is attached to the center of the movable wheel, B. The axial line of the movable wheel we have for the convenience of the eye, enlarged into the form of the short pointer, *a'*: instead of a pointer, a dot or other figure might be used. This short pointer our correspondent wishes us to say, is not on the model. B' B'' B''' are the several positions of the movable wheel in passing around the fixed wheel. The following is the letter of W. E. H:

Messrs. Editors:—A wheel may properly be said to revolve on its axis, when each point in the circumference of the wheel is successively in every direction from that axis; *i.e.*, if the wheel is vertical each point of the circumference in succession is above, on one side, below the axis, on the other side, and again above: if the wheel is horizontal each point is successively east, south, west, north of the axis or in reverse order. In the case before us, the spokes of the wheel or an index placed upon it would point in order to all the figures on a large clock dial surrounding it. That this is the true and only idea of a revolution, seems to me evident from a simple illustration.

A wagon wheel is said by every one to revolve on its axis (or axle if you choose) when the wagon is drawn forward. This was your illustration on page 67 of the last volume. Why "revolve?" Because each point of the tire in succession is above the axis on one side of it, below it, etc. The actual path described by such point is a cycloid never returning into itself. I give a diagram which will make this clear to unscientific readers.



I refer, also, to Watt's sun-and-planet wheels, designed by him to take the place of a crank and in the use of which he mentions as an advantage, the fact "that one stroke of the engine produces two strokes of the wheel, while with a crank, one stroke of the engine gives but one revolution to the wheel." I regard this device of Watt's as the converse, so to speak, of the question under consideration.

Referring to the engraving I take this ground: 1st. That the long index shows clearly that the movable wheel makes two revolutions while rolling round the fixed wheel. 2d. That the short index, if it shows anything, shows that the bearing (not axis) of the movable wheel makes one revolution. 3d. That the two revolutions of the movable wheel are made on the bearing, the central line of which is the axis. I add also the suggestion prompted by the addition of the second index that the question is not how many more revolutions the wheel makes than its axis, but how many it makes on the axis.

W. E. H.

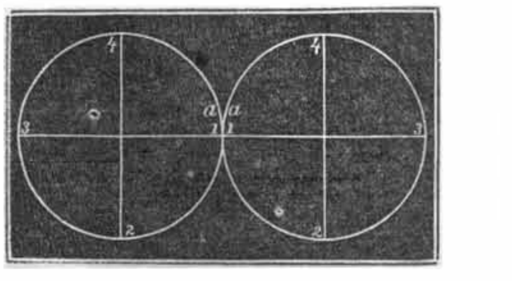
We have understood W. E. H. to be among those who maintain that a movable wheel makes two revolutions on its own axis in rolling once around a fixed wheel of the same diameter. But he does not positively state so in the above explanation. He says, 1st. that the movable wheel makes two revolutions. Does he mean on its own axis, or around the axis of the fixed wheel, or what? 2d. He says that the *bearing* (not axis) of the movable wheel makes one revolution. 3d. He says that two revolutions of the movable wheel are made on the *bearing*, (not axis.) Our correspondent has not clearly answered the question which he correctly propounds in the concluding sentence of his letter.

Whether the axis of B rotates or not, its position is changed by the passage of B around A. One position of the axis is indicated at *a'*, another at *a''*, another at *a'''*, and another at *a''''*. By observing these positions, and the movement of the wheel, B, in respect to them, as indicated by the long pointer, it will be seen that the wheel, B in passing once around A, makes one revolution on its own axis. The other movements made by B—*i. e.*, those not made on its own axis—need not be here noticed.

Messrs. Editors:—I submit another style of proof from any yet advanced in support of the "dual theory." It has been effective among the "*one*ists" of my acquaintance, and I hope it will answer as well with you.

A wheel, say three feet in circumference, rolled three feet on a plain surface, will make exactly one revolution; but if (as in the problem) it is ALSO required *to make the circuit of another wheel*, it must necessarily make another revolution to do it, otherwise there is no difference between a plane and a circle.

Again, I have two movable wheels of the same size hung side by side, thus—



I find, in turning them toward each other at equal speed, that it takes just *one* revolution of *each wheel* to bring the points, 1, 1, again together; *consequently* if one was stationary, it would take just *two* revolutions of the other around it to bring about the same result. Be kind enough to show the fallacy of these two propositions, or surrender at once to the victorious "dualists."

F. L. B.

Boston, Mass.

We think there may be a difference between a plane and a curve, whether the wheel makes a second revolution or not. Because two wheels of the same size each revolve once in returning to a given point, it does not consequently follow that if one wheel were fixed, the other wheel would have to revolve twice around the fixed wheel in order to reach the starting point.

We have received a model which shows two revolutions of a shaft produced by one revolution of the movable wheel. Also a model which shows one revolution of a shaft by one revolution of the movable wheel. Also a model which the senders think shows two revolutions of the movable wheel when a rod is set in a particular way, and one revolution when set in another way. We have also received a variety of novel diagrams upon the subject, one of which shows how four revolutions of a shaft attached to the axis of a movable wheel may be produced by one revolution of the wheel upon its axis. We shall shortly present diagrams of some of these devices.

Composition Fuel.

The mixture of tar, coal dust, sawdust, tan bark, peat, and other inflammable refuse stuff, and the pressing of the same into blocks, for the purposes of fuel, is very common, and several patents have been issued for variations of such mixtures. Washington Stickney, and Nathan B. Chase, of Lockport, N. Y, have lately obtained one of these patents, and they say:

"The coal consists of screenings and other fine portions, which accumulate in great abundance in coal yards, and hitherto have been considered comparatively valueless. The tan bark used (commonly called spent tan bark) is also comparatively useless and very abundant. These, with other ingredients, hitherto considered of little or no value, are so combined as to form a cheap and convenient fuel, and may be compressed, by mechanical power into blocks convenient for use. The coal tar cements the whole, making a solid mass, which may be readily ignited, and is well adapted for common fuel, especially for summer use.

"The above ingredients are combined in the following proportions, to wit: Coal, 3 parts; tan bark, 2 parts; sawdust, 2 parts; peat, or other fine woody or vegetable matter, 1 part, coal tar or pitch, 1 part, or sufficient to cement the whole; or they may be combined in a greater or less proportion of either, securing substantially the same result. The whole mass may be easily ignited with shavings or paper, or more readily by the application of a small quantity of benzine and a match."

Richardson's Process for Making Steel.

Many of the puddling furnaces of Great Britain have lately been improved by the addition of an apparatus for blowing air into them, resembling that used by Bessemer in making steel directly from the ore. The application of the improvement requires no alteration in the form of the common puddling furnace, for it does not essentially change the old method of puddling; but by introducing air through the iron rake or rabble used to stir the metal it reduces in quality or duration one particular stage of the process. Instead of numerous small holes in the blast pipe or tubular rabble, to subdivide the current of air, there is one broad slit or rectangular opening about half an inch wide, and three or four inches long, which is more easily kept free from slag. Two or three tubular rabbles are fitted to each furnace, to be used alternately, in order to prevent over-heating. Each one is connected to the air receiver by long flexible tubes of india-rubber. The air is turned on before the rabble is introduced, and remains on until it is withdrawn, in order to prevent the narrow aperture from being choked by cinders. By means of the blast rabble the time occupied in bringing the molten iron to a "boil" has been reduced from 30 or 40 minutes to 10. At the beginning of the operation the sparks thrown off indicate that silica is being separated from the mass, and as soon as the flame is clear the tubular rabble is withdrawn and the common rabble is substituted. A number of experiments have demonstrated that the whole process from the time an ordinary furnace is first charged until the mass is finished does not consume more than one hour and a quarter. The quality of the material produced is said to be superior, and in no case thus far has there been any failure to produce the desired results.

MANUFACTURING, MINING, AND RAILROAD ITEMS.

From a recent report of the Commissioner of the General Land Office, it appears that the construction of railroads in this country, since their first introduction, has been at the rate of a thousand miles a year; that there are now completed no less than 37,000 miles, and in course of construction 17,860 miles additional, or more than one third the length of all the railroads in the world. To assist this wonderful development, Government has contributed over $184,000,000, and 800,000 acres of land.

South Pass City, the headquarters of the last mining sensation, the Sweetwater gold field, was first laid out in October, 1867. It has now eighty houses and eight places of business. Its population at present is but 700, but it is confidently expected that next summer will witness the advent of from twenty to thirty thousand eager searchers for wealth, and that South Pass City will experience a much more rapid and substantial growth than even Cheyenne City.

There is now in course of manufacture at a leather belting factory in this city, what is said to be the largest leather belt ever made. The width is 47 inches; length, 100 feet; weight, 18,000 pounds; and cost, $2,000. It is composed of triplicate layers of leather, making a thickness of three quarters of an inch, and cemented and pressed so firmly together that it has the appearance of one solid piece.

A bed of hematite iron ore has been discovered at Sinking Spring, some four miles from Reading, Pa. Parties have already sunk a shaft which passes through a solid bed of ore twenty-six feet in diameter.

From this city, via Philadelphia and Pittsburg, to Cheyenne City, at the base of the Rocky Mountains, a distance of 1,917 miles, but three changes of cars are made, and five companies control the whole distance. Between New York and New Orleans, 1,500 miles, there are ten different roads, while between New York and Charleston, only 788 miles, there are also ten.

A railroad project to unite the capital of Mexico with the United States, by a line along the Gulf coast, has been referred to a committee of the Mexican Congress.

About four miles from the newly opened Japanese port of Hiogo, is quite an extensive deposit of coal. The methods of working the mines are of the most primitive description. Wherever the coal or shale has been seen cropping out from the hillside, a horizontal passage, never more than twenty-five feet long, has been run in. The miners, crouched to the ground in these burrows, with pointed hammers pick away at the sides, and very carefully assort with their hands each little piece of coal obtained, according to its quality. The Japanese Government is not insensible to the advantages of an improved mode of working the coal of Hiogo, and it is not impossible that before long some more systematic plan will be introduced.

Scarcely inferior in interest to Krupp's mammoth establishment, are the great iron and steel works of Hoerde, employing 4,500 people. Here the iron is produced from the ore, and converted into castings of various kinds, into iron and steel rails, and into puddled steel sheets suited for a variety of purposes, ship-building among others. Most of the vessels built by one of the largest firms in Liverpool are constructed entirely from steel plates made at Horde.

The *Memphis Bulletin* says that the gold discoveries in the counties of Polk and Sevier, Arkansas, are still proceeding, while the indications have proved so encouraging, and so exciting has been the degree of success already achieved, that the winter's snow and cold has not been able to suspend operations now in progress.

There are now about 12,000 miles of railway open to travel in France. Every line is remunerative, some paying original stockholders from 20 to 25 per cent, and it is claimed that passengers are conveyed by them with more regularity, safety, and comfort than elsewhere in Europe. Within eighty years, at the farthest, all these lines will have reverted to the Government and become practically public property.

M. Goudin, some years ago, made exceedingly hard iron by combining it with a small quantity of boron. It is now said that he has produced an equally hard material by combining fused cast iron with phosphate of iron and peroxyde of manganese. The mixture cannot be forged, but is easily cast.

The Boston and Providence railroad are constructing a bridge from India Point, over the Seekonk river, on a plan which embraces some new features. The whole length of the bridge is 876 feet, and the supports in the river are iron cylinders filled with wooden piles and concrete. Six of these cylinders are six feet in diameter, and contain twelve piles, which were driven into the mud forty feet, the cylinders being sunk ten feet. Iron cylinders filled with concrete have been used before, but driving piles within them, and the combining of wood and concrete is a new experiment.

Recent American and Foreign Patents.

Under this heading we shall publish weekly notes of some of the more prominent home and foreign patents.

Cotton and Hay Press.—William Russell, Atlanta, Ga.—This invention relates to that class of presses in which the power is applied to the follow block by revolving the press box. The improvement consists in working the follow block upon two screw rods, in a device for causing the follow block to adjust itself, and in a device which enables the apparatus to be used as a stationary or portable press, and to be worked either by rotating the press box, upon a fixed wheel, or rotating the wheel while the box is stationary.

Extension Coal Shute.—Jacob Heatherington, Bellaire, Ohio.—This invention relates to coal shutes which are used on the banks of rivers and at wharves, for discharging coal from cars into steamboats and other vessels, and consists in making them extensible in order that they may be adjusted to vessels in different positions, and at different distances from the shore.

Combined Steam Engine and Cane Mill.—John Moore, Madison, Ind.—This invention relates to a cane mill, the frame of which is so constructed as to be susceptible of receiving such parts of a steam engine, as would be necessary to drive the rollers of the mill; and also in so constructing the said frame that the rollers of the mill can be readily removed therefrom, and placed therein, to enable the steam engine, which is arranged in connection with such cane mill, to be used for threshing wheat, driving a circular or a drag saw, a shingle or a lath machine, a straw or hay cutter, a grinding-mill for corn, and for many other purposes.

Combined Screw Wrench and Claw Hammer.—Ellis R. Meeker, Elizabeth, N. J.—This invention consists in combining a screw wrench with a claw hammer in such a manner that the device may be used either in the capacity of a claw hammer or a wrench with as great facility as if it were made for either purpose alone.

Beehive.—W. Y. Singleton, Springfield, Ill.—This invention relates to an improvement in the construction of beehives, and has for its object the wintering of the bees in a perfect manner, keeping them warm and dry, to which end a thorough ventilation of the hive is obtained, and due provision made for the absorption of all moisture.

Pump.—Jas. Vaughn, and John Magee, Galena, Ill.—This invention consists in a novel construction and arrangement of the various parts composing the pump, whereby great effectivness and many advantages are secured.