MOLECULAR VIBRATIONS.

No scientific doctrine is more generally believed than that of the conservation of force. The great students of nature almost universally accept it. So many old and credited theories have been overturned that advanced thinkers are prepared to see this one share such a fate. This is a possibility only; the theory is considered eminently a proved and true one.

Briefly stated, it amounts to this: In the universe there is no natural power known to us that can create or destroy force. All that man can do is to transform it and change the form of its manifestations. Whenever force becomes manifest to us, we can trace it back to anterior forms. It never appears spontaneously generated, and from no origin. Heat, one form of force, can be changed into useful effort. It is assumed to represent an intense vibration of the molecules. The minute heat vibrations of the molecules, which create impulses infinite in number, and, considering the size of the molecules, of almost infinite force, can be lengthened, and made to coalesce into a single prolonged effort. A cubic inch of water may be heated, by the combustion of carbon, until the repulsive force among its vibrating molecules has developed, and the paths of vibration have been increased to twelve times their former length. Thus steam is produced. The steam may be admitted into a cylinder, under a close-fitting piston, which it will raise until the space under the piston is of one cubic foot volume. If the steam is allowed to condense the piston will return. The minute vibrations of the molecules, too small to be measured, or fully conceived of, have been joined together so as to produce a single wave of a foot front, it may be, and of a foot altitude. The first phase of an oscillation is represented in the rise of the piston; its descent represents the second. The motion of the piston only renders the expansion of the water into steam visible in its effects. The true transformation of power was anterior to all this. The proximate origin of the force was the combustion of the fuel.

The chemical affinity of carbon for oxygen was called upon. These two elements were made to unite. They rushed together with very great yet measured velocity. As molecule of carbon came against molecule of oxygen it was split up into atoms, and immediately combined with the oxygen. Under the effects of the atomic concussion the newly-formed molecule of carbon dioxide started into vibration. The vibration was one of that character which affects our nerves with the sensation called heat. The myriad of vibrations was imparted to the cubic inch of water, and a measure of their amount arrived at. It came to some two thousand foot pounds.

This, it must be remembered, is theory, and unproved except by analogy. The resemblance between the phenomena of sound and heat is very great. Both can be reflected and refracted; both can start from a center and be radiated through space, in accordance with identical laws. Sound is unquestionably due to vibrations. They can be seen by the unassisted eye. Such are the vibrations of a long string or turning fork. From the analogies between the phenomena of sound and heat, the conclusion is drawn that heat is also due to vibrations.

We reach thus a true conception of the theory. Heat vibrations are invisible. They have been invented by scientists to explain existing phenomena. The proof of their existence is an analogical one only; and analogy has so often failed that the whole theory is provisional. The probability of the existence of the vibrations is founded on their capability to explain known facts. As soon as a discordance is shown they must be abandoned by the theorizer. As soon as such discordance between their existence and the phenomena of nature is shown, the proof and probability of their existence vanishes.

The weakness of any attempt to seek among molecular vibrations for a new source of force is thus very evident. They serve only to illustrate the possibility of the mutual transformation of different kinds of force. They are not absolutely known to exist, and may at any time be discredited and a new theory be adopted. To take such an unproved and unknown quantity as a reservoir of new and hitherto undiscovered power is going beyond the bounds of analogy or probability. S. T.

Electricity as a Motive Power.

Professor George Forbes recently delivered a lecture on the above subject in London. Speaking of the frequency with which water power is brought into the question of obtaining energy in the form of electricity, he refers to the idea of utilizing the water power to charge accumulators, which are to be placed upon cars and wagons and used to drive them over tramways. At first sight that seems very feasible, he says; but, as he believes that compressed air tramcars are a success, he pertinently asks, in effect, why the water power has never been used to compress air. Sir W. Thomson's question at the York meeting of the British Association was whether 40 acres or 100 horse power is the more valuable, the 40 acres representing the area of the reservoir that would be required to give that power with a fall of six feet seven inches (two meters). He was alluding to the construction of reservoirs around the coast to utilize the tides; but electricians mean the utilization of waterfalls, running streams, and the rise and fall of the water in river gorges, and there is obviously no difficulty whatever in causing water wheels and turbines to drive dynamo machines. The question is rather, How is the current to be conveyed to the places where it can be utilized? In Deprez's latest experiments he obtained a return of 47½ per cent, and 4·4 horse power of work was actually given off by the motor. Professor Forbes calculates that turbine and dynamos to transmit 6 horse-power through a resistance of 12 ohms will cost in their places £200. Neglecting the cost of the conductor, he points out that such an amount of power from a steam engine, with coals at 20s. per ton, will cost £60 per annum. (He takes 300 days of twenty-four hours, and allows 3 lb. of coal per horse power.) The interest and depreciation on the boiler and engine would be about £30 per annum, making altogether £90 as the running expenses, without reckoning wages, which may be considered as equal in the two cases. Electrically transmitted, the interest on plant, at 15 per cent, would be £30 per annum, leaving £60 from which to deduct the cost of the conductor, or rather the interest and depreciation, and therefore a very large margin in favor of current as compared to steam.

Cork.*

Cork is yielded by the cork oak, *Quercus liber*, which chiefly flourishes on the shores of the Mediterranean. There are, in Spain and Algeria, large forests of this tree, which is also cultivated in the departments of Lot-et-Garonne and Var, in the south of France, and in Corsica.

The cork oak arrives at its full growth in about one hundred years, when, in hot climates, it attains a height of sixty or seventy feet, with a diameter of six to eight feet. The bark consists of two distinct portions, the inner formed of a fibrous tissue, and the outer tuberous, and of a porous and elastic consistency, which constitutes the cork proper. The first cork naturally produced by the tree is called the male, and has scarcely any value; but if this be removed, a second layer is formed, finer, more elastic, and less irregular, which is known as the female cork; and this it is which is generally used. The stripping of the cork takes place in summer, when the circulation of the sap facilitates the separation of the outer from the inner layer of bark. The removal of the first growth is effected when the tree is twenty to twenty-five years old. Several annular incisions, and one vertical incision, are made with a hatchet, care being taken to cut the cork only, without touching the inner bark; the layer of cork is then easily detached. A young oak yields about 10 lb of cork at the first stripping, while it is capable, ultimately, of yielding over 300 lb. The first cork has a thick and hard exterior, which diminishes with each successive growth. Formerly, after the first stripping the tree was left to itself, without any protection. Being very tender, it was liable to be killed by exposure to variations of temperature, while numerous insects, attacking the tender surface of the tree, reduced the value of the future cork. Besides, a thick and irregular crust formed, which it was necessary to remove, thus causing a loss of thirty per cent of cork.

A better plan is to employ the method of M. Capgrand-Mothes, which consists in covering the tree, during several months after stripping, with the cork which has been removed. A few vertical incisions are made in the inner bark, to prevent irregular furrows being formed. The pieces of bark are then restored, being fastened by iron wire; and the joints are made good underneath with strips of cellulose cardboard. After three months, in the autumn, the pieces of bark have become quite dry, and are taken off. The effect of this practice is to induce the formation of a protecting layer, tuberous, homogeneous, and elastic, under which the growth of the cork goes on without danger of injury.

The detached pieces of cork, flattened by being piled up with the outside uppermost, are freed from their external surface by boiling and paring. The boiling of the cork, which lasts about half an hour, is effected in large cubical boilers fired with refuse cork, and closed by a cover which presses upon the pieces. The paring is done by hand, or by means of horizontal rollers provided with iron blades; but this last-named operation may be dispensed with when the practice of covering the tree with the detached pieces of bark is adopted.

The principal use of the outer bark is to make bottle corks. They are more frequently cut by hand, though sometimes by a machine, a horizontal knife giving a rotary motion to the piece of cork, and thus cutting into a cylindrical form. Cork is also used for making life buoys, swimming belts, floats, non-conducting linings, etc. It is moreover used advantageously in the form of powder, for packing fragile objects, as a substitute for lycopodium powder, and for the manufacture of linoleum and cork-leather. Cork is, however, on account of its elasticity, reduced to powder with great difficulty. To effect this, mills with grinders in the shape of rasps, mill-stones revolving in a pan, and artificial stones revolving at great speed are employed.

Linoleum consists of cork powder consolidated with dried linseed oil. The mixture, in the proportion of about three parts of oil to one of cork powder, is passed under heavy rollers, and then stuck on to cloth by means of drying oil. It is allowed to dry for about three months, when the product is ready to receive various designs, and may be readily washed. Linoleum is adulterated by adding sawdust to the cork powder. Cork leather, which is waterproof and very elastic, is cork powder consolidated with India-rubber.

* From a paper by M. Henri Mamy, Ingenieur des Arts et Manufactures, in the columns of the *Moniteur Industriel*.—*Jour. Soc. Arts.*

Cork refuse is used for making partitions that do not conduct heat or sound; it also yields a light and porous charcoal. M. Combe d'Alma has proposed to distill them, so as to obtain a very rich gas, free from sulphureted hydrogen. Old bottle corks are sometimes collected, boiled and washed in acidulated water for again serving to cork bottles.

A Chance for Inventors.

In the heavy thunder storms which occurred in various parts of the country last week the lightning manifested its well known affinity for petroleum. Three large oil tanks were struck. One of them was near Olean, in this State, another at Muncy Station, Pa., and the third in the yard of the Standard Oil Company at Communipaw, N. J. This last one had very little oil in it, and was not consumed, but the others, with their contents, were burning at the latest accounts.

The attractive influence exerted by petroleum, or its vapor, which renders these great oil tanks so liable to destruction by thunderbolts, does not seem to be very well understood. If it was, we should hardly be without any efficient means of guarding such structures against lightning. The subject is well worthy of attention and study on the part of men of science. At present the safeguards are so inadequate that an oil tank is not only very likely to be destroyed by any thunder storm, but to act also as a firebrand to every building anywhere near it.

The inventor who devises a method which shall afford to oil tanks absolute protection against lightning, ought to be able to make a million of dollars by the invention.—*N. Y. Sun.*

Solemn Science.

An article in *Science* takes exception to the small tricks of thoughtless newspaper paragraphists in using strictly scientific terms as a means of ridiculing study and investigation in pure science; and cites an instance in which a newspaper of deservedly high character characterized by the heading, "A Thrilling Government Report," a bulletin from the United States Geological Survey on "Hypersthene Andesite, and on Triclinic Pyroxene in Augitic Rocks."

Progress in true knowledge requires attention to particulars and to details; and such attention is to be fixed and such details defined only by the use of the most exact language—language allowing of no deviation from its literal meaning and of no room for differing readings. So the language of science is an exact language, and although it may sound odd to one who puts all his thoughts into the changing vernacular, it conveys a distinct meaning, and the same meaning, to every one of the large and increasing army of men and women who are gradually exploring and expanding the stores of Nature as applicable to human weal. The use of the stable and unchanging terms of the preserved and petrified languages of Greece and Rome is entirely applicable to the unvarying facts of Nature, and it affords no legitimate opportunity for cheap and ignorant wit.

A Chinese War Ship.

On the 10th ult. the Chinese Ambassador at Berlin invited a select and distinguished company to Stettin to witness the trial trip of the Ting Quen, or Everlasting Peace, a fine ironclad corvette, built for his government by the Vulcan Shipbuilding Company there. The vessel was launched some time ago, and has now received her proper equipment of guns, etc. The *Times* Berlin correspondent says the trip was most successful, the corvette, with engines of 6,000 indicated horse power, achieving a speed of 14½ knots an hour. This ship is of peculiar construction, with a rather shallow draught, having been specially constructed for coast defense. She will soon proceed to the East—all the sooner, perhaps, that a French fleet threatens to make its appearance in Chinese waters. A sumptuous repast was served on board to the guests of Li Fong Pao—among whom was the British Consul General in Berlin.

New York and Liverpool Large Steamers.

The City of Rome, having had additional boilers put in and other improvements made, is now probably one of the fastest of Atlantic steamers, as on her trial recently she reached a maximum speed of 18·7 knots, or 21½ miles an hour. The engines developed 12,000 horse power, as against 8,000, which was all that could be obtained from them previously. The City of Rome is over 8,400 tons measurement.

The new Cunard liner Aurania, which enjoys the reputation of being the broadest vessel afloat in connection with the Atlantic trade, also attained a maximum speed of 18·7 knots. The Aurania is 470 feet long, 57 feet broad, and 38½ feet depth of hold. She measures 7,500 tons, and has engines capable of indicating 10,000 horse power.

Diffusion Engine.

At a recent meeting of the London Physical Society, Mr. Woodward described an experiment illustrating motion produced by diffusion. A porous reservoir of clay containing air was suspended from one end of a weighted balance beam. A glass tube projected from it below and dipped into a vessel of water. A jet of hydrogen gas was allowed to play on the outside of the reservoir, and the balance beam began to oscillate. This is an adaptation of Graham's well-known experiment, and is, in fact, a diffusion engine.

Tomato Flour.

The Italians dry and pulverize the pulp of the tomato. Large districts are devoted to the culture of the fruit for this purpose, the plant being usually raised between rows of vines in vineyards for the sake of economy of land. The ripe fruit is macerated in water, and when reduced to a thin pulp is strained to take out the seeds, cores, etc., and then spread in the sun to dry. It is afterward ground and put up for market. There seems to be no reason why evaporating ovens, so much in use for drying less succulent fruit, as apples, might not be utilized in this country for preparing tomatoes by drying.

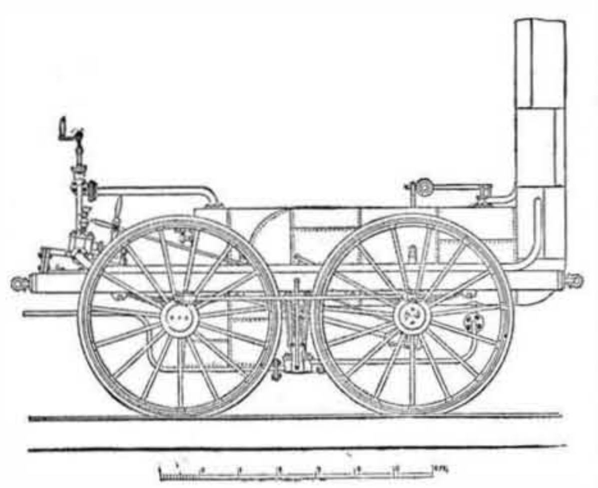
Of course powdered tomato might not supersede the canned fresh fruit. Its chief use would be for soups, sauces, and other auxiliary uses in cooking. But there are many consumers of the fresh tomato who refuse the tinned canned tomato from fear of the action of the acid of the fruit on the leaded tin of the can, the resultant being in their estimation a virulent lead poison. Tomatoes put up in glass—quite high priced—have therefore been welcomed by lovers of the fruit—or vegetable. Possibly there is room here for an addition to our list of dried or evaporated food articles.

A Lack of System.

It is the general impression that system and uniformity were becoming the rule in practical mechanics, the reduplication of parts and machine-produced articles not being confined to a few departments, but being gradually extended so as to promise eventually to embrace most of our industries. In railroading, especially, it has been the common belief that uniformity was gradually taking the place of independent diversity, an indication being the growing adoption of the ordinary gauge for width between rails.

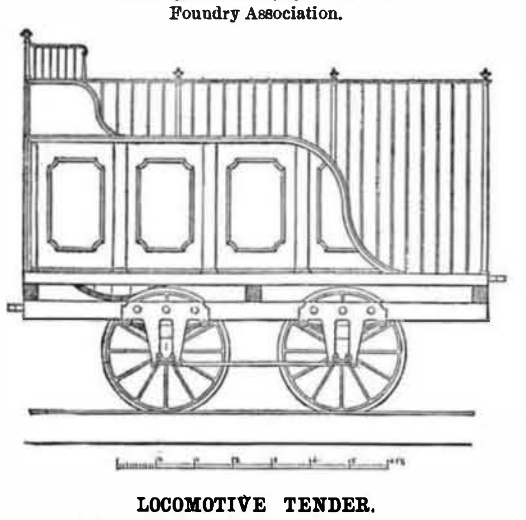
But from a circular issued by the secretary of the Master Car Builders' Association it appears that the very opposite of uniformity is the rule among car builders for railroad companies. The master car builder of the Boston and Albany Railroad says he has forty different kinds of brake heads and shoes, eleven of journal boxes, thirty-seven journal bearings, ten cast iron and five or six wrought iron draw bars, eight or ten different draw bar side castings, and a multitude of various other different parts of a car. The master car builder of the Baltimore and Ohio road reports sixty-five different kinds of journal bearings, and in eleven other articles in common use varieties numbering from twenty-five to six. And similar reports have been sent from other railroad authorities.

It is a singular exhibit. It would seem almost that human perversity and not mere chance, or individual convenience,



"DE WITT CLINTON."

Copy of original drawing of the "De Witt Clinton," the third locomotive engine built for actual service on a railroad in the United States. Made for John B. Jervis for railroad between Albany and Schenectady, A. D. 1831, by the West Point Foundry Association.



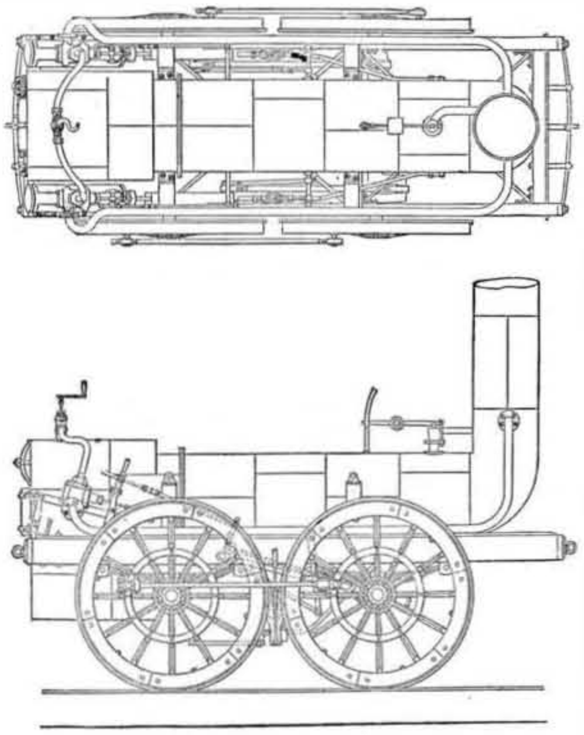
LOCOMOTIVE TENDER.

Built by the West Point Foundry Association.

had produced this wide diversity. It was generally known that human lives—brakemen's lives—were sacrificed to the lack of uniformity in the height of couplings, but it is appalling to learn that "the most careful estimates show that from 1,200 to 1,500 railroad employes are killed in this country annually, and from 5,000 to 10,000 more or less seriously injured; and a very considerable proportion of this sacrifice of life and limb is preventable by improved and uniform methods of constructing cars."

THE CHICAGO RAILWAY EXPOSITION.

Among the interesting things to be seen at the Chicago Exposition of Railway Appliances, lately opened, are the original drawings of several early locomotives, diagrams of which we give herewith. The drawings were presented by the West Point Foundry Association to the American Society of Civil Engineers. Our diagrams are from larger cuts given in the *Railroad Gazette.*



"THE WEST POINT."

Copy of original drawing of "The West Point," the second locomotive engine built for actual service on a railroad in the United States. Made for the South Carolina Railroad, A. D. 1830, by the West Point Foundry Association.

The inscription in each of the engravings is copied from the original drawings, and gives the date when the engines were built.

The "Best Friend" was shipped to Charleston, and arrived there in October, 1830, and, according to Brown's "History of the Locomotive," "continued to do the necessary work of the road, hauling materials, workmen, ballast, lumber, etc., used in the construction." On June 7, 1831, its boiler exploded, being, it is said, the first locomotive boiler explosion on record.

The "West Point" was the second locomotive built for actual service. It was ordered from the West Point Foundry, and constructed from plans sent by Horatio Allen, Esq., then Chief Engineer of the South Carolina Railroad. It arrived in Charleston in February, 1831.

The locomotive "De Witt Clinton" was ordered by John B. Jervis, Chief Engineer of the Mohawk and Hudson Railroad, and was the third locomotive built in America for actual service upon a railroad. It was built at the West Point Foundry, and taken to Albany in the latter part of June, 1831, and was put upon the road and run by David Matthew. The first experimental trip was made on July 5, 1831.

A variety of illustrations of these engines have been published, which differ materially from each other. The engravings herewith have the merit of being authentic, as they have been made direct from tracings of the original drawings.

The Bower-Barff Process for Preserving Iron and Steel Surfaces.

At a recent meeting of the Society of Engineers, London, a paper was read by Mr. George Bower, on "The Bower-Barff Process of Preserving and Ornamenting Iron and Steel Surfaces."

The subject of the paper was of necessity interesting to all those who had to use iron and steel for constructive purposes, but although the author's and the Barff process of coating these metals with magnetic oxide had been before the world for several years, yet it was astonishing how few there were who really understood what these processes were.

There were two methods of producing the film of magnetic oxide, one of them, the Barff, by means of subjecting the articles at a red heat, inside an iron muffle, to the action of a superheated steam; the other, the Bower, by subjecting articles, at a similar heat, inside a brick chamber, to the action of products of combustion and of superheated air.

The Bower-Barff Company having acquired both patents, a furnace had now been devised which embraced the good points of both systems.

Iron at a sufficiently elevated temperature decomposes water; the oxygen entering into combination with the iron, in certain definite proportions, forms magnetic oxide, which is impervious to rust. This is especially applicable for wrought iron.

The Bower process was more especially adapted for cast iron, and it proceeds on the principle of first forming sesquioxide and then reducing it to magnetic by hydrocarbon gases or carbonic oxide. The Barff process produces magnetic oxide at one operation, but it is costly and takes a long time, while the Bower is obtained in two operations, and a very cheap and effective coating is produced in less than half the time of the other.

A model of a Bower-Barff furnace and drawings were exhibited as well as specimens of various articles which had been treated, consisting of stoves, ornamental castings, kitchen utensils, etc., which were most interesting.

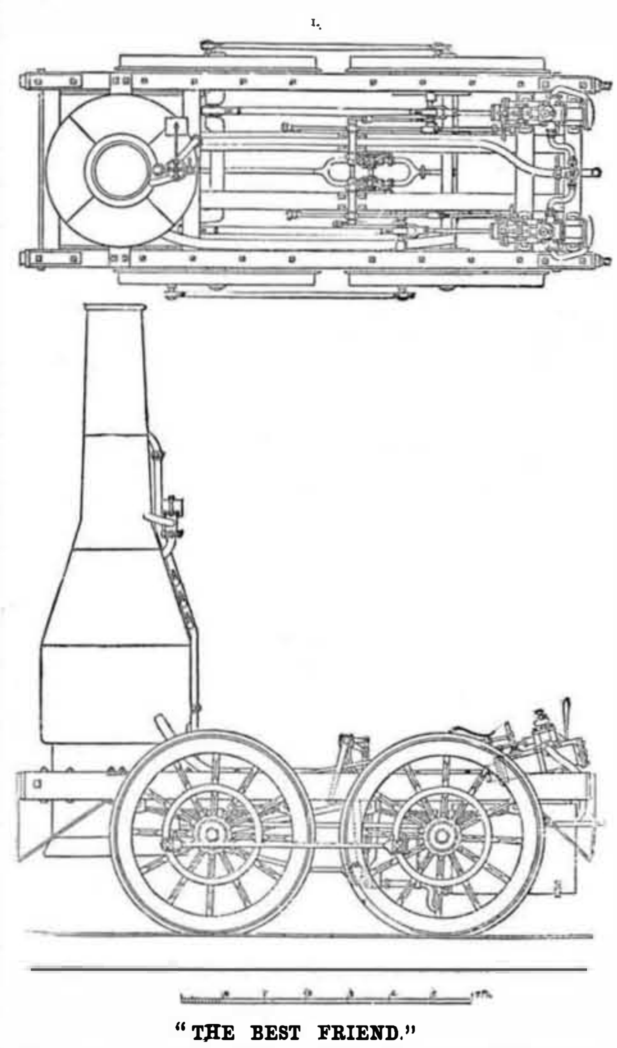
NOVEL MODE OF DEPOSITING METALS ON IRON.

The author showed a very curious property of magnetic oxide. He applied a brush formed of wires of different metals, first of all, to a casting which was not coated, and on which no effect was produced; then to a similar one which had been coated, when it was immediately covered at all parts touched by the brush with a beautiful shining coat of the metal of which the brush was formed. The author attributes this to the fact that magnetic oxide not being metallic, and to some extent gritty and porous, it had rubbed off by attrition some of the metal from the wires; and he expected that this would supersede the existing methods of bronzing and of depositing metals for the commoner kinds of Birmingham goods.

The author concluded a very interesting paper by saying that iron and steel were the kings of British industry, and he trusted it would be acknowledged at some time or other that the Bower-Barff process had contributed in some degree to maintain them in their supremacy.

Carbonic Acid and Bisulphide of Carbon.

At a recent meeting of the Royal Society, a paper was read "On a Hitherto Unobserved Resemblance between Carbonic Acid and Bisulphide of Carbon," by Dr. John Tyndall, F.R.S. He said: "When, by means of an electric current, a metal is volatilized and subjected to spectrum analysis, the 'reversal' of the bright band of the incandescent vapor is commonly observed. This is known to be due to the absorption of the rays emitted by the hot vapor in the partially cooled envelope of its own substance which surrounds it. The effect is the same in kind as the absorption by cold carbonic acid of the heat emitted by a carbonic oxide flame. For most sources of radiation carbonic acid is one of the most transparent of gases; for the radiation from the hot carbonic acid produced in the carbonic oxide flame, it is the most opaque of all. Again, for all ordinary sources of radiant heat, bisulphide of carbon, both in the liquid and vaporous form, is one of the most diathermanous bodies known. The analogy between the two substances extends to the vibrating periods of their



"THE BEST FRIEND."

Copy of original drawing of "The Best Friend," the first locomotive engine built for actual service on a railroad in the United States. Made for the South Carolina Railroad, A. D. 1830, by the West Point Foundry Association.

atoms, and the bisulphide, like the carbonic acid, abandons its usually transparent character, and plays the part of an opaque body, when presented to the radiation from the carbonic oxide flame. Of the radiation from hydrogen, a thin layer of bisulphide transmits 90 per cent, absorbing only 10. For the radiation from carbonic acid, the same layer of bisulphide transmits only 25 per cent, 75 per cent being absorbed. For this source of rays, indeed, the bisulphide transcends, as an absorbent, many substances which, for all other sources, far transcend it."