Hot Air and Steam.

As we stated last week the "Caloric" engine in a new shape is about to be tried again. This fact has been heralded by the press generally, but they seem a little more cautious than they were at this time last year. A burnt child, it is said, dreads the fire. Since those trial trips last winter, some of the "scientific" journals have been proposing various modifications, which were to increase marvellously the powers of the Hot Air Engine, and have backed up their "improvements" by mathematical calculations, which simply served to show that however well conversant they might be with algebra and Differential Calculus, they were sadly deficient in practical engineering. The very fact that different mathematicians have come to such widely different results in calculating the power of the "Ericsson's" engines should teach us to be very cautious in receiving *theoretical* calculations as to the capacity of any untried motive power. It is often very easy to say what such engines *cannot* accomplish, while it may be equally difficult to determine what they *can* do.

We do not undervalue mathematics: the solution of an intricate problem in analysis or calculus has been often the business of our leisure hours. But we simply mean to assert that where so many of the data are necessarily uncertain, as they must be in all cases of the kind of which we have been speaking; experiment, not mathematics, must be relied upon. Such calculations may sound large, but in reality amount to but very little. The case is altogether different when experiment has determined a fixed value for the elements of calculation as in the steam engine.

Ericsson, however, although he made quite a show of figures in attempting to keep up with Major Barnard, in "Appleton's Magazine," evidently has more confidence in the teachings of experiment than in the deductions of his own mathematical investigations. He proved, then, that his engines should possess 1313 horse-power, setting aside the losses, and says that the reason why they did not approach this figure in their trial was because "the yielding of the wrought-iron heaters prevented full pressure from being carried." To remedy this, he proposed to make them of cast-iron, but he wisely abandoned this scheme. At the time of writing his article, however, he still held that his regenerator was "the principal source of heat," and censures Major Barnard and others who had criticised the performance of his engine, for having overlooked this fact. Why, then, does he now employ "coolers?" Simply, we think, because although he has suffered himself to be deceived for years by the fallacious idea of using heat over again, he has at last been taught, and in a pretty dear school too, that we were right, and that he and many, others, of whom, from their claims to scientific knowledge, we expected better things, were wrong. Hence he may have produced an engine superior to his old one, but as he taught that the marvellous power of his engine was stored in the regenerator,—that it was by means of this that, in the language of another, "an ounce of coal could be made to pump the Niagara dry,"—that in the regenerator consisted the superiority of the hot-air over the steam engine—we would like to hear what new or marvellous principle he can claim for this one, in presenting it as a rival of the steam engine.

But as we said last week, the question now is solely between the relative merits of Hot Air and Steam, or in other words, will a given amount of heat produce a greater expansive force, when applied to air, than when applied to water, and if so, can it be used with the same economy? We have already stated (page 189, Vol. 8) that it takes 791 volumes of air, if heated 1180° above the temperature of the cold air to equal, in expansive force, one volume of water heated from the freezing to the boiling point, and converted to steam, in which process the same amount of heat is consumed (180° sensible heat and 1000° latent.) The effective horse-power of the Arctic is 2290. As the evaporation of a cubic foot of water per hour is called equal to the generation of a horse-power, this would require the evaporation of 2290 cubic feet of water $\times$ 791=1,811,390 cubic feet of air heated 1180° above atmospheric temperature. But taking it for granted that air cannot be readily heated in an engine of this kind more than 393⅓° above the atmospheric temperature, or to about 430°, and this is more than the "Ericsson" did, and the above amount will have to be increased three-fold, 1,811,390 $\times$ 3=5,434,170 cubic feet of air as the aggregate amount which will have to be expanded per hour to produce an engine of the power of the Arctic. But let it be borne in mind that while the above calculation states the actual duty of the Arctic's engines, it makes no deductions for any losses on the part of the hot air, and the trial trip of the "Ericsson" showed enormous losses somewhere, although her engines were acknowledged to be of superior workmanship.

[For the Scientific American.]

Subterranean Railroads.

I noticed in a late number of the "Scientific American" an article under the title of "Tunnel Railways in Cities," and consider the proposition to construct a subterranean railway through London beneath the streets, as behind the age. Independent of the enormous expense attendant on the work, there is the inconvenience and interruption to business arising out of the necessary excavation, accommodation of masonry materials, deposits of earth excavated, and many other objections consequent on the operations. Besides this there is the injury to the health of the passengers in travelling through such a tunnel from the rumbling noises above their heads and fears excited by the knowledge of where they are. The expense of this subterranean system may be inferred from this statement:—"The company commence (this work) with a capital of £1,500,-000" ($7,500,000); the distance is not named nor the final cost of the work, but we may infer that it will not be less than £100,000 per mile, —whatever it may be it will prove a failure.

In the same number of your paper, you refer to a similar proposition of a tunnel railway through Broadway, in your city. According to the view I have taken of this plan, I consider it objectionable on the grounds referred to in noticing the proposition in London, stated above. While it is possible to effect the same object above ground, which the plan referred to proposes below the ground, there is every reason to prefer the former to the latter. Independent of the comfort and pleasure arising from passing through the city above ground, there is the great difference in expense between the two plans. The object of resorting to the subterranean plan is to avoid the danger of the train running through a crowded city street. But cannot this be effected equally above ground as below it? Certainly, must be the response. Then why should we resort to the under-ground plan, which is both inconvenient and expensive? Let us show a better system of passing our railroad trains throughout cities, by elevating them here so that the trains will pass above the heads of the pedestrians travelling at the same time.

I would submit this plan to the good sense of my fellow citizens, when they shall require its execution under like circumstances, and should this communication reach the eye of our British friends, I would respectfully submit it to their consideration and adoption. Many years ago, when the railroad, as a system, was first introduced into our country (1820), I took into consideration this very problem, how these roads should pass through the crowded thoroughfares of our cities? The proposition then was to elevate such roads here, above the heads of the street passengers. The necessity of such a case as this has never occurred in our cities. The crowded state of Broadway, in your city, has called for some plan of getting rid of the travel of the numerous omnibusses along its causeway, and I have suggested to the Municipal authorities of your city to place the system of omnibuses upon an elevated railway over the edge of each sidewalk, so high as to enable passengers to land upon the second floor of the houses there. These omnibuses may be of a peculiar structure, so as to run upon a single rail only, which need no platform above, and thus do no injury to the light below, and which will require but a single range of pillars for the support of the car track above, and thus not the least injury to the light, or the passage below will be experienced. As there will be a similar track on the other side of Broadway, provision will be made for the going out and returning trains without interfering with each other.

This brief exhibit will convey some idea of this plan and its advantages over the subterranean track. May we not hope that where the necessity exists in cities to resort to some plan of passing a train of cars through their thoroughfares, the air plan here suggested will be preferred to the subterranean or tunnel plan.

ROBT. MILLS,
Washington City. Engineer and Architect.

[We do not look with much favor upon the plan of elevating omnibusses upon a railway above the heads of pedestrians. The same objections which are urged against the subterranean railroads, "noises above the heads of the people," can be urged against the elevated omnibus track.

A very good plan has been proposed to us lately, to relieve Broadway of its dangers and troubles to foot passengers. It is very often both dangerous and difficult to cross from one side of that street to the other, owing to the great number of omnibusses and carriages passing and repassing. To obviate this evil, it is proposed to have elevated iron sidewalks running the whole length of the street, on a level with the second stories of the buildings, and to make these intersect one another at all, or nearly all the crossings, in the form of an × across Broadway, the center being a platform supported by the stairs at each corner. By this plan, stores on the second stories might become as valuable as those on the ground floor. To allow pedestrians to cross Broadway, elevated foot tracks merely might be erected at the crossings only. Stairs, of course, would have to be put up at the foot of each crossing, and they form the support for the platform.— This is certainly a feasible and a not very expensive plan for the relief of Broadway to foot passengers.

The Nervous System.

In two lectures recently delivered in this city by Marshall Hall, M. D., of England, he demonstrated the new discoveries which he had made in relation to the nervous system.

The nervous system is divided into the cerebral, spinal, and ganglionic. Through the cerebral we are brought in connection with the external world. We perceive through it, and through it we recognize sensations of pleasure or pain. The spinal system presides over all our ingestions and ejections; guards all the avenues that connect the internal organs with the external world; governs the spincters; retains what we have within; and prevents the introduction from without of what would prove noxious if admitted. The ganglionic system relates to all the operations of assimilation; manages the secretions; presides over the growth of the body; and, when deranged, is the immediate cause of marasmus.

The action of the nervous power upon the muscles is threefold:—direct, reflex, and retrograde. Of the direct action, it is a general law, which is centuries old in the books, yet, while, it was supposed to be the only action of which the nervous system was susceptible, never was applied to physiology,—that it is always downward, *i. e.*, from the center to the extremity; from the point where the action commences along the course of the nerve till it is too small further to be traced. The doctrine of the reflex action is Dr. Hall's own. He was studying the phenomena that transpire within the lungs of of the frog, when he noticed that a slight irritation of the toe of the animal created a spasm of the extremity. He fell to wondering what was the cause of the spasm. He had excited nervous action, but he had not touched the brain. He had stimulated the excitability of the muscles of the part, doubtless, through the spinal system, since all motion is communicated to the muscles through the medium of that system, yet he had not reached the medulla oblongata. The jerking of the frog's foot was to him like the apple falling to Newton. He suspected, and subsequent experiments confirmed his suspicions into convictions, that in touching the skin he had touched the extremities of nerves, whose office it was to carry back to the centers, messages of communication with the external world. This point established, the circle was completed, and the threefold nervous action—direct, reflex, and retrograde, was easily demonstrated. In illustration of these principles, Dr. Hall performed some experiments.

He divided the spinal marrow of the frog.— By this operation all sensibility was removed. He laid it upon its back; there it would lay till it was dead, unless something should irritate the skin, and through the reflex action spoken of, cause the muscular contractions.

The frog was then pinched, but did not respond by a spasm. This state of shock, said the Doctor, is temporary. It passes rapidly away. And in a moment after, pressing on the skin of the toe, the whole body was convulsed. Here was an illustration of Dr. Hall's new law, of an ascending movement from the skin to the center, yet not acting through the brain, but reflected from the spinal center.

Next he took off the skin of one foot. No irritation of the denuded flesh caused any excitability of the muscles. Next he grasped the spinal nerve in his forceps, and both legs were violently convulsed. Then he severed the lumbar nerve of the extremity that was not denuded; the part supplied by that nerve was convulsed. Now, no irritation of the skin produced any spasmodic action, for, though the cutaneous nerves carry the impression to the center, there was left no medium for their direct action to reach the muscles.

The learned lecturer then deduced some very important practical lessons from these experiments. A paralysis caused by a shock is generally curable. Sometimes the patient's paralysis passes away while he does not know it, but from disuse of the paralyzed part, the inaction in it may remain. The determined will of the enlightened physician works almost miracles in such a case, and the bystanders may add the case cured by moral means, to the list, wherein the imagination is said greatly to aid the cure. Paralysis, in which there is no spasmodic action is very generally of cerebral origin. Where there is spasmodic action, the spinal column is also affected. The practical physician will see how his treatment should vary with these varying causes and seats of the disease.

The lecturer dropped a small quantity of the solution of strychnine upon another frog, and, whereas he had before been dull and half asleep, as is his custom in winterish weather, he suddenly exhibited a great deal of life and energy. Soon his muscular activity took the form of hydrophobia. When let alone, he lay still and motionless. Touching him ever so gently on the back produced a spasm. These spasms being frequently provoked, he stretched himself out, and, to all appearances, died. Rubbing him would secure a slight spasm, but each returning one grew fainter and fainter, till the muscles ceased to respond to the irritations of the skin. Dead as he seems, remove him to a cool place, and in the morning he will be well and strong, and ready to be useful as the subject of another experiment. Just so it is with patients suffering under hydrophobia. We must place them in quiet, cool and comfortable quarters, and, for their lives' sakes, let them alone. Handling them hurries back the spasm, and each new spasm hurries the life out of them. Hydrophobia kills in three ways: First, by laryngismus; second, by the repeated excitation causing repeated shocks: and third, by the effect of the poison upon some internal organ.— Tracheotomy is the remedy for laryngismus.— Perform it, and death from that cause is impossible. The second cause is removed, if at all, by perfect quiet and the avoidance of every possible thing that can annoy the patient. The third, when the disease reaches that stage, is probably beyond the cure of man.

Baron Humboldt proclaims himself the first introducer of guano to the world as a manure. He explained its advantages, published an analysis of it, and endeavored to introduce it extensively, for forty years, but in vain.