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SUCTION.

As our readers may have observed, a number of inquiries have recently been made in regard to the action of pumps and siphons: whether the water delivered by these machines was sucked up by the action of the mechanism, or forced up by the pressure of the atmosphere. To these questions we have answered: that there is, properly speaking, no such principle as suction, meaning thereby that water would not rise in a void space unless some pressure was applied to force it up. Until it was demonstrated by Torricelli that the atmosphere had weight or pressure, it was popularly believed that a liquid would rush into an empty space, because "Nature abhorred a vacuum." We judge, from the tenor of many of the letters sent to us, that this belief is not, as yet, wholly dissipated; and some elementary works on natural philosophy treat the subject in such an obscure manner as to confirm their readers in this opinion. It may be added, also, that one of the earliest accomplishments acquired by the infant is that of sucking, although we venture to assert that the exact nature of this process is not generally understood. It may be useful and interesting, then, to examine the action of the common pump, and compare it with that of the human mouth when engaged in sucking liquid through a tube. The common pump, in its simplest form, consists of a cylinder containing a tightly fitting piston, a pipe connected to the bottom of this cylinder extending into the water; at the bottom of the cylinder is a valve which opens when pressed from beneath, and there is a similar valve in the piston. Now suppose the piston to be at the top of the cylinder, which, together with the pipe, is filled with air. As the piston is forced down, it compresses the air in the cylinder, so that the valve in the piston opens and allows the air to escape. When the piston is pulled up, there is a void space beneath it in the cylinder, so that the pressure of the air on the water outside of the pipe forces it up some way in the pipe, opens the valve in the bottom of the cylinder, and forces some of the air from the pipe into the cylinder. After a few strokes, the water will be forced into the cylinder, and then, as the piston descends, the water will rise through the valve in the piston, and be carried out on the upward stroke. If the pump cylinder is placed at a greater distance above the surface of the water than the hight of a column of water equal in pressure to the atmosphere, no water will be forced into the cylinder—showing, as Galileo ironically asserted to the advocates of the suction theory, that, if Nature does abhor a vacuum, its abhorrence only extends to a hight of 34 feet. Again, if the water be placed in a tight vessel from which all the air is exhausted, and the pipe from the pump extends into the water with an airtight joint, the pump will cease to draw water, no matter how perfect the suction may be. A similar experiment conducted with the human suction apparatus, the mouth, will give a like result, proving that something more than the removal of the air is necessary in elevating water. To show that the suction of the mouth is similar to the action of the common pump, suppose a short tube to be held between the lips, the other end being immersed in water. The first operation is similar to the downward motion of the pump piston, the tongue being moved forward or upward against the palate, commencing at the root and filling the mouth. Next, as in the case of the ascending piston, the tongue is drawn back or bent down, creating a void, into which the water is forced by the pressure of the air, this pressure depressing the cheeks at the same time. The tip of the tongue is then applied to the teeth, to prevent the return of the water, and this action corresponds to the closing of the valve in the bottom of the pump cylinder. Finally, the tongue is pressed against the palate, commencing at the tip, forcing the water back; and the mouth being relieved of the water, the former operations are repeated.

This is only one illustration of the many that could be given to show that natural operations are conducted on truly scientific principles, so that the investigations of scientific men for the discovery of natural laws are among the most important and practical of the labors of the human race.

The action of the siphon may properly be considered in this connection. It appears to be the belief of many of our correspondents that the column of water in the long leg of the siphon, being heavier than the short column, pulls it along, and that the pressure of the atmosphere cannot render any resistance, since, if anything, it is a little greater at the lower end of the siphon, and so would rather tend to force the water back. A simple experiment, that can readily be made, is to place the short end of the siphon in an exhausted receiver, filling the tube with water, when it will be found that the liquid is discharged into the receiver, instead of flowing out at the other end; so that by this means the action of the siphon can be reversed, water being drawn through the long leg and delivered at the short one. The correspondents above referred to seem to think that the water in a siphon is something like a rope over a pulley, the part on one side being longer than that on the other, so that the weight of one part overbalances the other and draws it down. The trouble with this conception is that the water is an exceedingly weak rope; and if the heavy part starts to draw the other along, the rope will break in two, unless it is forced from behind. In reality, then, the action of a siphon is something like that of a rope over a pulley, the strength of the rope being about fifteen pounds per square inch. Thus, as long as the distance from the highest point of the siphon is no greater than the hight to which the pressure of the air will raise the water, this pressure keeps the rope of water together, and the flow goes on continuously. But if this hight is exceeded, the air can no longer force the water up, and the rope breaks, leaving in the upper part of the siphon that vacuum which Nature was said to abhor. It would appear, therefore, that the heavy column in the long leg of the siphon only draws or sucks along that in the short leg when there is something to push, that does all the work until the water is transferred to the long leg; and the sucking force gives out simultaneously with the failure of the pushing force to elevate the water to the highest point of the siphon.

OPERATIONS OF THE PATENT OFFICE.

We publish on another page an abstract from the annual report of General Leggett, now Ex-Commissioner of Patents, showing the operations of the Patent Office for the year ending September 30, 1874

The Ex-Commissioner dwells with commendable pride upon the increased proportion of patents granted, and the diminished proportion of rejected cases—a result due, he suggests, to the publication, in a popular, accessible form, of weekly abstracts of all new patents, together with the full specifications thereof. We have, on several occasions, expressed the opinion that the more widely the publication of the patents was extended, the greater would be the increase in the number of patents granted, and the less the necessity of maintaining so large a standing army of officials as we have now at the Patent Office.

We are glad to perceive that the Ex-Commissioner has at last reached the same view. He has heretofore been an advocate for the increase in the number of examiners; but his present conclusion is that, by extending the printing, the present large force of examiners may be diminished.

Since the presentation of this report, the Hon. J. M. Thacher has assumed the duties of Commissioner of Patents, and the public will look with interest for the development of the line of policy that is to characterize his administration. He has on former occasions given expression to views which would lead us to suppose that, under his rule, the Patent Office would surely be conducted in the interest of inventors. But there are some indications of a contrary policy. For example: In some of the classes, he permits inventors to be harassed by long delays; while in respect to that large class of applications known as compositions, especially medicines, he is daily sending out, under his official signature, decisions like the following: "This application is finally rejected on the ground that physicians' prescriptions are not patentable."

The author of such stuff is evidently a quack in patent law, whatever may be his pretensions in medicine. Such decisions are not only absurd, but they are in direct violation of the law and the previous practice of the Patent Office. The 24th section of the patent law expressly provides that any person who has invented any new and useful composition of matter, or any new and useful improvement thereon, may obtain a patent therefor. Medical compositions or prescriptions rank among the most important of discoveries. Hundreds of such patents have heretofore been granted, and have resulted in the production of many new and valuable medical remedies, by which life has been saved and health promoted.

With a few exceptions, such as above indicated, we believe that the examiners of the Patent Office are animated by a desire to serve the country according to the best lights they have. But we fear they are not sufficiently awake to the real purpose and intent of the patent laws, which is to encourage and assist the inventor. There is a tendency to looseness, inefficiency, and injustice on the part of the Patent Office in its decisions. This is strikingly shown by the astounding fact that some 7,500 applications for patents were last year condemned to the category of the rejected. The conclusion is irresistible that, if the claims of these applicants had been properly considered, if the Patent Office officials had in every instance, as in duty bound, extended the encouraging word and the helping hand to these inventors, the number of rejections would have been far less. We earnestly hope that the new Commissioner will bestir himself and try to promote the needed reforms.

WHAT IS STEEL?

At the time of the Vienna Exposition, this question was brought up and resulted in numerous discussions among the metallurgists assembled at the Austrian capital. Professor Jordan, of the Central School, and M. Greinert, Superintendent of the Seraing Steel Works, proposed that the proper definition of steel was "all malleable siderurgical products obtained in a melted state," and to reserve the name wrought iron (*fer*) for such malleable products as were not submitted to fusion. According to this, however, natural steel, puddled or forged, and cemented steel would be no longer steel, in spite of the properties which distinguish these from soft iron. In a word, steel, whether melted or not, is a product which places itself, from all points of view, between cast iron and wrought iron. The various ferrous products encountered in the arts form a continuous series from the softest and purest iron up to the most impure cast metal; or rather, there are two continuous but diverging series, both commencing at pure soft iron. The one ends at black or dark gray pig, including untempered or unannealed steel; the other, terminating at white cast iron, more or less manganiferous, includes tempered steel.

M. Gruner, in his recent report of the progress of the coal and iron industries, as developed at the late Vienna Exposition, after advancing the views last given, arrives at the conclusion that we should understand, by the term steel, all iron (whether melted or not, more or less pure) which is susceptible of tempering, but which is malleable, hot or cold, so long as it has not been submitted to sudden cooling. Soft iron, whether melted or not, is metal malleable, hot or cold, but not susceptible of tempering.

As puddled, as well as refined and cemented steel, is distinguished from melted, Bessemer, and Martin steel, etc., so also should soft iron be divided into puddled and homogeneous iron. This last may be especially subdivided into the homogeneous metals of Bessemer, Martin, Siemens, etc. It should not be forgotten, however, that, though the types are well characterized, there is a gradual passage from one to the other. Thus homogeneous iron passes in an insensible manner to cast steel, as soft iron, simply refined, passes to hard steely iron, then to properly called natural steel, which itself terminates in wild steel (*wild stahl*) for wire drawbenches, before attaining the true white cast iron.

RUSTING OF RAILWAY RAILS.

At the recent session of the American Association for the Advancement of Science, Professor Haldeman read a paper on this subject, showing that railway rails when in use oxidized but very little, but when not in use were subject to rapid oxidation. In fact, disuse for one day, for example, Sunday, resulted in a visible increase of rust of the track rails. This, in the opinion of the author, would indicate that, in chemical combination, vibrations may interfere with the molecular arrangement of the elements. In the discussion which followed, Professor Vander Weyde took the same view, and thought that molecular relations tended to prevent rust. But other speakers combated this view, and it was suggested that possibly the oil employed upon the locomotives might be more or less spread in a thin film over the rails in use, and thus prevent their oxidation.

Professor Robert Mallet, of London, has had his attention called to this discussion, and in a recent note to *The Engineer* states that some thirty years ago he was requested to examine and report upon the same matter on behalf of the British Association for the Advancement of Science, a grant of money being allowed for the purpose. He made a variety of experiments and examinations, all of which were duly reported. He found, in brief, that one of the reasons, why rails when used corrode less than the same rails when not