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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 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 vold 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 cylinthe cylinder, and then, as the piston descends, the water

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 ther 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 pressared epressing 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 ren der any resistance, since, if anything, it is a little greater at the lower end of the siphon, and go 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, in stead 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 of the human mouth when engaged in sucking liquid through in the number of patents granted, and the less the necessity rails. This, in the opinion of the author, would indicate that, of maintaining so large a standing army of officials as w have now at the Patent Office. We are glad to perceive that the Ex-Commissioner has a 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 der. After a few strokes, the water will be forced into inventors. But there are some indications of a contrary policy. For example: In some of the classes, he permits inwill rise through the valve in the piston, and be carried out ventors to be harassed by long delays; while in respect to

on the upward stroke. If the pump cylinder is placed at a 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 Pat. ent 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, Superinten. dent 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 memalleable, 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 BAILWAY BAILS.

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 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 sails when used corride less than the same rails when not off the rust formed, so as to prevent its prolonged contact taken for a viaduct on the Liverpool and Manchester Railwith the metallic iron from accelerating the corrosion of the way, the first for passenger traffic ever constructed. It was latter.

----THE MECHANIC OF THE FUTURE.

An esteemed correspondent desires us to call attention to the difficulty in finding mechanics able to fill situations where special knowledge is required, and to the hindrances thrown in the way of capable men by trade rules and customs, prescribed and enforced in the interest of the worthless and incompetent.

This country is almost overstocked with professional men; and whenever education and ability are united in a young man, he is almost sure to quit the practical part of his trade, and become a consulting engineer and an expert, living by fees instead of by wages, and selling his knowledge and not his skill. Thus, men of brains are taken out of the really working class; and many manufacturers look in vain, in the rank and file of their establishments, for men capable of being master mechanics. The question as to where our leaders and foremen are to come from is deserving of our best consideration; for there are many influences at work which are retarding the progress of the American working man. Boys and young men should especially bear in mind the value of acquiring a thorough knowledge of all branches of the trade by which they intend to earn their bread, so as to become capable leaders and instructors of others, less gifted and fortunate than themselves. The gentleman above referred to recently needed a first class machinist to super intend a certain branch of business, the specialties of which would require a few months of attentive study and practice. It is difficult to believe that the rules of a trade society, ostensibly organized for the protection of the rights of work ing men, prevented a skilled artisan from leaving an inferior position to be a superintendent: but it is nevertheless a fact. He stated that the union to which he belonged would not allow him to work for an hour at less than a certain rate, even though his temporary reduction should certainly lead him to permanent employment of great responsibility and credit, and consequently large remuneration. The employer, naturally averse to having his liberal offer thus treated, at once declined to promote the man on any terms whatever, as no one who would thus debar himself from getting on in the world was fit to be put over others, who would naturally follow his example and imbibe his ideas.

So many qualifications are wanted in a manager and su perintendent of a machine business that fitness for the post is rare, and the ambition to fill it creditably ought to stimulate our workmen to study and improvement.

--CHARAOTERISTICS OF A BUSINESS KING.

During his career as a great contractor, the late Thomas Brassey was engaged in the construction of railways in England, France, Spain, Italy, Belgium, Saxony, Bohemia, Aus tria, Hungary, Moldavia, Syria, Persia, India, Australia, Cana da, and South America, aggregating something like six thousand five hundred miles, besides water works, drainage schemes, docks, bridges, and other important undertakings. In the execution of these great works, he had, at various times, twenty-seven different partners; four hundred million dollars of other people's money passed through his hands; and at times the army of workmen to which his contracts gave employment numbered as many as eighty thousand men.

Such a record, to say the least, entitles Mr. Brassey to a high place among the great captains of industry to which the age of railway construction has given birth and occupation; and as one of the pioneers of a new order of men, his charac ter is peculiarly worthy of study, more especially as he re presents a type of man which the world is likely to have more and more need of with the spread of the industrial civilization which distinguishes our modern times.

Abundant materials for the study of Mr. Brassey's qualifi cations for an industrial leader are furnished in the volume on his "Life and Labors," prepared by Sir Arthur Helps: and though it is never safe to assume that all the characteristics of a successful man were essential or helpful to his career, and therefore worthy of imitation by those who would aspire to similar success, we may nevertheless easily detect those which were strikingly helpful; while the doubtful ones, even those most widely at variance with the popular ideal, may possibly have been factors worthy of recognition.

Before entering upon any analysis of Mr. Brassey's character, it is proper to notice, first, an important condition of his success in the great business of his life. a condition without which every other qualification would have been wasted. His business training was such as to give him a practical knowledge of nearly every kind of labor necessary to be understood for the accomplishment of great works of construction. This we put before any personal characteristic, since no man, however well fitted by Nature for the rank of master, can command to good purpose without a minute personal knowledge of the work to be done, a fact which ambitious youngsters are very apt to overlook. Mr. Brassey was fortunate in not being sent to school until he was twelve years old. At sixteen, he was apprenticed to a surveyor and real estate agent,-something different, by the way, from what the term implies with us-who subsequently took him into partnership. His first work of consequence was in connection with the laying out of the once celebrated Holyhead road, of which all England was very proud. At the death of his instructor, Mr. Brassey became sole agent and representative of the owner of a large estate, in the care of which he had brickyards and limekilns to superintend. Later he

used, is because the vibration of the used rails tends to shake had the management of a quarry, from which stone was in connection with this quarry that Mr. Brassey made the acquaintance of George Stephenson, under whose advice he made his first (unsuccessful) tender for a railway contract. His next attempt was to better purpose; and at the age of twenty nine, Mr. Brassey entered upon his life work as a railway contractor. His first undertakings received his personal supervision to their minutest details, thus laying the foundation for the higher and more valuable art for which he became celebrated in after years, the art of dealing with details in masses.

Thus Mr. Brassey was prepared by education for dealing with the great problems of railway construction. Let us consider briefly the personal qualities which he brought to the work. In the first place, he had the energy needful for great accomplishment. Said one who worked under him for many years: "If he'd been a parson, he'd have been a bishop; if a prize fighter, he would have had the belt." The physical basis was sound and enduring, and his activity untiring. With great capacity for hard work, he keenly en joyed working hard, not so much for the profit it would bring as for the pleasure of doing. He could not bear to have work drag, nor to leave anything which he undertook undone or half done. Even when the pushing forward of work, arrested by accident or otherwise, involved the taking upon himself responsibility for expense which belonged elsewhere, he did not hesitate to go forward.

A striking illustration of this spirit occurred in connection with the Paris and Rouen Railway, his first great foreign contract. In the carrying out of this work, he was restricted in his choice of certain materials to French products; and in consequence of inferior lime for mortar, a rapidly built via duct-a huge brick construction, a hundred feet high and a a third of a mile long, costing \$250,000-fell down in utter ruin. It was suggested that, on representing the facts of the case to the directors of the company, some alleviation of his loss might be obtained. His reply was: "No: I have contracted to make and maintain the road, and nothing shall prevent Thomas Brassey from being as good as his word.' Without stopping to discuss the question of responsibility in the matter, new materials were secured, and the work was reconstructed with a rapidity that was accounted marvelous. It is a satisfaction to record that the company voluntarily assumed the cost of the new structure.

With all his anxiety to have work done rapidly and well Mr. Brassey never wasted his energy in worry. Having given his best efforts to ensure success, he was content to await the result and abide by it with perfect equanimity. This, as Sir Arthur justly remarks, is a great felicity of tem perament. It gives a man of much work the staying quality known as "bottom" in a racer, and enables him to meet inevitable reverses without being crushed or disconcerted. It is the basis of the two-o'clock of the morning courage, which the first Napoleon used to rejoice in, a quality which Mr. Brassey had to an eminent degree. If called up suddenly in the middle of the night, upon some urgent peril or difficulty, he met the alarm with perfect coolness; sat down to consider and calculate what was the best mode of obviating the danger; and before break of day, when he had to proceed to the scene of action, he was ready with his plan. Like mas ter, like man. His example could not but be felt by his assistants, who took courage at his stability of mind, and gave their fullest confidence to a leader who always seemed ready for any emergency. In addition to this imperturable pre sence of mind, Mr. Brassey evidently possessed singularly quick and comprehensive powers to take in the essential conditions of a problem at a glance, uncommon power of rapid calculation, and great ability for organization-qualities which not only inspired his staff with confidence in times of difficulty or danger, but enabled him to administer compli. cated affairs with a royal ease and facility.

It was in dealings with his agents, however, that his most striking characteristics were displayed. In the course of his career, he carried into execution nearly two hundred contracts, many of them involving hundreds of miles of railway. The works for which he made unsuccessful tenders amounted to upwards of seven hundred million dollars. It is obvious that no man could examine the details of works of such variety and magnitude. He must necessarily trust largely to his agents; and it was in the choice of these, and his subsequent treatment of them, that Mr. Brassey's business sagacity came into full play. He chose his agents with great care and with consummate judgment. After that, he to the highest degree. placed implicit trust in them; and though capable of exercising the most minute supervision and criticism, he never judged by details, but looked to results. His system of keeping accounts was what most men would consider loose, and his agents were entrusted with vast sums of money to be expended almost at their discretion; yet his financial secretary and confidential adviser upon all monetary matters testifies that not one of his representatives was ever known to deceive or rob him. When asked if this was to be taken as a proof of the general honesty of mankind, Mr. Tapp replied: "Not exactly that. I think it rather more shows that he placed so much confidence in those whom he employed, and put them, as it were, so much upon their honor, that they would not deceive him; and that people, who might not have acted uprightly with other masters, did so with him because they felt responsible to him, and also a certain amount of pride in being confided in by him to such an extent that they really carried on the business as if it were their own." His biographer adds his personal belief that the system of trust which Mr. Brassey adopted uniformly, in respect to all those who worked under him, was of this paper for particulars.

such as would be generally successful if carried out with that perfect faith and completeness which he always manifested in these transactions-a belief which might be considered Utopian had it not such a substantial backing in Mr Brassey's large experience.

In another connection, Sir Arthur observes that where mostmen fail in governing is in not entrusting enough to those who have to act under them. Most men intend well, and try to do their best as agents and subordinates; and he is the great man who succeeds, with the least change of agents and subordinates, in making the most of the ability which he has to direct and supervise. Besides, men must act according to their characters; and he who is prone to confide largely in others will mostly gain an advantage in the general result of this confidence, which will far more than counteractany evil arising from that part of the confidence which is misplaced.

That a man whose ruling passion was the execution of great works in a way which should win him renown for faithfulness, punctuality, and completeness in the execution of his undertakings should succeed, as Mr. Brassey did, by such a mode of dealing, with those on whose faithfulness and integrity his reputation depended, is cogent evidence that his plan of action was not far from correct. Not only did Mr. Brassey trust his subordinates, but they trusted him as implicitly. In the earlier part of his career, when each contract had his personal supervision, he allotted to each nominal sub-contractor his portion of the work, and fixed the price for it. Says one of them : " They did not ask him any questions. He said: 'There is a piece of work for you. Willyou go into it? You will have so much for it.' And then they accepted it, and went to work." Their invariable willingness to take the work at his valuation was accounted for by the conviction, which each of them had, that if any mistake had been made, to their injury, Mr. Brassey always stood ready tomakegood the loss. In case a job turned out more difficult than had been anticipated, no appeal would be made; the work would go on according to contract until Mr. Brassey made his customary tour of inspection, when he never failed to recognize the contractor's position, and voluntarily set it right. When his undertakings became too extensive to be thus minutely inspected, the same policy was carried out through resident agents. To many this course may seem very unbusiness-like, but the result uniformly proved the wisdom of it. By treating his agents generously, he secured generous service in return, and was able to withdraw his attention more and more from matters of detail. He never wasted his time in doing work that an agent or subcontractor could do just as well. As to mere money grubbing, one of his principal agents testifies that he had not any of that in his composition, but he knew the value of money as well as any one, and how far a pound would go: nevertheless he had no greediness to acquire wealth, and he was always ready to give away a portion of his profits to anyone who was instrumental in making them, and that to a remarkable extent.

For illustrations of Mr. Brassey's hatred of contention, his uniform courtesy, his large-hearted unselfishness, his frank appreciation of merit of all kinds in others, and other qualities which pertain to the man rather than the contractor, we have no space. At the busiest period of his life, he would travel hundreds of miles to be at the bedside of a sick or dying friend or associate, to give what aid or consolation he could: a spirit which his staff rewarded as it deserved. The regard and affection which Mr. Brassey won from all those who served under him were most strikingly manifested during his last fatal illness. Men of all classes, humble navvies as well as trusted agents, came from great distances solely for the chance of seeing once more the old master they loved so well.

At a time when there seems to be a growing belief that a masterly man must be a stern disciplinarian, rough rather than gentle, brusque rather than courteous, exacting, watchful, a believer in the vile theory that every man must (in business) be treated as a rascal until he proves himself something better, it is singularly pleasing to review an exceedingly successful career, throughout the whole of which the opposite qualities are conspicuous. At a time, too, when financial treachery and eye service are supposed to be predominant, when the most minute and exacting checks upon the free conduct of agents fail to prevent "irregularities." it gives one fresh confidence in the general honesty of human nature to see the spirit of trustfulness made the basis of a great business, and to see it justified by service honorable

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