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Contents:

(Illustrated articles are marked with an asterisk.)

HAVE THE MECHANICAL APPLICATIONS OF STEEL REACHED THEIR LIMIT?

The great number of the useful applications of steel in the arts, which characterize the present age, have given to it the appropriate title of the "Age of Steel." It has been commonly predicted that the number of uses to which this metal can be put will be largely extended, and that iron will eventually give place to steel on railways, in bridge construction, and in many other important applications.

Sir William Armstrong in his recent address to the mechanical engineers at Newcastle, made some statements upon this subject that will attract the attention of the mechanical world, and will not probably pass unquestioned by those who are perhaps not less authorities on the subject than even Sir William Armstrong himself.

The conclusion at which he arrives is, to use his own language, "that although steel has a much greater tensile strength than wrought iron, it is less adapted to resist concussive strain." This conclusion is based upon the assertion that "the vibratory action attending excessive concussion, is more dangerous to steel than to iron," and also upon "the want of uniformity in steel, which still continues to be an objection to its use."

It must be admitted that these views were supported with much ability. The speaker alluded to experiments made by him some years since, on the toughening of steel in large masses by plunging it, when heated, in oil, from which he was led to expect that he would be able to produce armor plates of extraordinary resisting power. An armor plate of steel was made specially for the experiments, and was tempered in a large bath of oil. Its quality was then tested by cutting off pieces, bending and subjecting them to tension. The speaker asserted that although the result showed a very high tensile strength, combined with so much toughness that he was unable to match it by any sample of iron he could compare with it, yet when the plate was sent to Portsmouth for trial in the fullest confidence of its success, two shots from a 68 pounder sufficed to break it in various directions, and it was justly pronounced a failure.

Here then we are presented with an anomaly. The best and only tests which are available to the iron master, in order to prove the strength of iron and steel, having demonstrated the great strength and tensile power of the steel in the armor plate described, it utterly failed under a trial that an iron plate of similar dimensions would undoubtedly have withstood.

Now, whatever plea may be made against the validity of the preliminary test, will not avail to controvert the fact that steel is not understood, and in that fact we find, if not the proof that Sir William Armstrong is wrong in opinion in regard to the limit of the availability of steel, at least the ground for the hope that he may not be right.

There are yet unpenetrated mysteries in the nature of this wonderful material, which, notwithstanding the unremitting efforts of investigators, still elude their grasp. Even the nature of the common process of tempering is, as yet, a matter of theoretical discussion, about which absolutely nothing is known positively. To entertain the belief which Sir William Armstrong avows, and in which he is partially backed by *The Engineer*, is to entertain the unwelcome idea that the limit of knowledge in this field is reached.

The mind of most scientists would shrink from such a conclusion; the progress made in the manufacture of steel within the last decade forbids it; and the name and fame of the man who thus avows it, will fail to add weight enough to his views to lead to their extensive adoption.

WOOD AND CONCRETE PAVEMENTS.

That the days of the barbarous cobble-stone pavements, and of all other roadways approximating to them in character, are numbered, must, we think, be evident to every careful observer. This is an age of progress, but it is an age which favors smooth and rapid progress, and is intolerant of jolting and jarring. It has sickened of the intolerable nuisance of stone blocks and cobbles, and now demands something that will exact less of man and beast and vehicle, and it will get what it wants by and by.

The construction of good and durable roads is no easy problem, especially in a climate like ours, where giant frosts annually get under the surface and upheave it, unless some adequate means can be devised to prevent them. To dig down below the reach of frost, and carry up a solid structure to the surface as in a foundation for a building, would, of course, do away with this difficulty; but it introduces another, even worse—enormous expense.

The problem may, perhaps, be stated as follows: Required to make a roadway impermeable to water (which alone renders the action of frost destructive to roads), and at the same time sufficiently thick and strong to withstand the heaviest traffic for a reasonable period of time; smooth on its upper surface, but not so hard as to fail to afford good footing for horses; and *cheap*. But cheapness does not by any means mean small outlay in the first instance. A road costing four dollars per square yard at first, and having the capability to endure for twelve years, is cheaper than one costing two dollars, and lasting only three years. And a road that will transfer a great proportion of the wear and tear from beasts of burden and vehicles to itself, may wear out rapidly and still be a very cheap road.

There are also some minor requisites for roads in cities, such as facility in getting up and repairing gas and water-pipes and sewers, which may not be disregarded.

In no field of construction, perhaps, can mere theorizing be less relied upon than in the improvement of our roads, proverbially bad both in city and country. Everything proposed must be brought to the test of actual and prolonged experiment, before it can be pronounced either good or bad. Hence it is impossible at present to pronounce intelligently upon the merits of many new claimants upon public favor. And in the cases of many of those which have been for some time under trial, it is equally difficult to decide, as the circumstances under which they were tested have been in many cases the worst possible, and in no manner of accordance with the intentions of their originators.

Thus the *American Builder* informs us that "The manner in which the wooden pavements are being put down this season in Chicago is enough to make the dead inventor of the Nicolson pavement laugh in his coffin. Indeed it is a ghastly joke. To avoid paying an honest and just royalty, the city authorities are compelling the sorely taxed people to throw their money away."

The Nicolson pavement, if not the most durable, is certainly the most agreeable of roads, but we insist that in very few instances have its promoters been able to secure for it anything like a fair chance. Its durability depends upon the manner in which the work of laying is performed perhaps more than any other pavement possessing equal merit, and so long as the work is performed as the *Builder* states it is now being done in Chicago, there will not be lack of those who will saddle the shortcomings of contractors upon the character of the pavement.

We are informed by one of the promoters of the Nicolson pavement, that an important improvement has been made in the method of constructing it. It originated with Mr. De Golyer, of Chicago, we believe, and consists of replacing the wooden pickets hitherto used to separate rows of the blocks, with a layer of concrete rammed as hard as possible. This supports the blocks laterally in a much more efficient manner than was attainable by the old method, and greatly adds to the durability of the pavement.

We believe that experiment will ultimately lead to the construction of concrete roads which will answer all the requisite conditions.

In fact, some statements made in regard to the Scrimshaw pavement, if they are to be relied upon, would seem to give hope that this ultimatum has already been reached. We are informed that this pavement has been tried in Portland, Maine, on a piece of road exposed to very severe wear from heavy trucks used to carry large blocks of granite, and has stood the test of wear and weather for eight years.

This pavement is now being put down on Bedford avenue, in Brooklyn, and also in Fifth avenue, New York. It consists, first, of a foundation of stone laid like the cobble or block pavements. The earth and sand being carefully swept from the interstices of these stones, a layer of gravel and asphalt mixed with coal ashes is spread over the surface, and the whole rolled down with heavy rollers. Successive coats of fine gravel, asphalt, and coal ashes complete the work. Each coat is heavily rolled down as applied; and the road when finished has an elegant appearance, and is delightful to drive over.

The method of laying the concrete upon the old pavement without previously relaying it, is, we think, not likely to prove so efficient as when the stones are relaid, although on account of diminished expense it is done in some instances.

Per contra to the above favorable statements in regard to the Scrimshaw pavement, we hear rumors of unsatisfactory results in Montague street, Brooklyn, where it has been recently laid, and some assert that no such results as the above, given on the authority of the committee, appointed to investigate the merits of the Scrimshaw pavement, previous to its adoption in Bedford avenue, can be realized.

Without crediting or discrediting the statements put forth in regard to this pavement, we shall patiently await the result of the experiments now in progress and, while we yet prefer the Nicolson pavement when properly and honestly laid, to any road we have yet seen, that does not prevent us from hoping and expecting something which will prove an advance on anything yet devised for American roads.

RAILWAY CONSOLIDATION.

Our able and spirited cotemporary, the Philadelphia *Public Ledger*, in a recent issue discussed this subject in a manner which leads us to believe that it not only anticipates rapid and extensive consolidation of various railroad interests in this country, but that it favors such consolidation under the plea that it would prove beneficial to the country at large.

It sees in the struggle, now taking place between rival lines, the indications that the big fish are to eat up the little ones, and, in an able review of the various railway routes of the country, comes to the conclusion that in this process the traveling and commercial public will be great gainers, even though the little fish suffer. It says: "By thus consolidating the companies, the expense and the evils of a variety of managing boards will be avoided, and the public will have greater regularity, less changing of cars, and uniform rates of fares. There will probably be sufficient competition between the great companies to insure the transportation of goods and passengers at reasonable rates."

Now we not only feel some pangs of pity for the little fish, whose bones are so complacently crunched by the remorseless jaws of more powerful monsters, but also some fears that when the supply of minnows falls short, the public may itself become the food of fat railroad sharks, whose hunger seems to be of that chronic kind which no amount of stuffing can allay.

It seems to us that the *Ledger* entirely ignores the great power of combination, or the plainly-indicated will of large capitalists to combine whenever there is money to be made by it. Though the railway kings of the present are, some of them, fighting among themselves with a bitterness which, to the outside observer, might seem irreconcilable, let them see how some millions might flow into their coffers by united movement, and you shall see them to-morrow as loving as brothers. So well is this understood on Wall street that in the last great Erie fight no one would have been surprised at a *denouement* which would have exhibited the principal contestants as partners in some deep game for the mutual interests of both.

It is difficult to see how the reduction of the number of rival interests could reduce competition, as the *Ledger* seems to think it would. This view seems to us as altogether opposed to both experience and the general law of supply and demand. How has it been with the great express companies? Has competition reduced their rates or has combination enabled them to maintain prices at a high standard? We do not at present see how such combinations can be prevented; but, at the same time, we are far from deeming them desirable. With the facilities afforded for manipulation by our present railway system, almost anything surprising seems to be possible, if not probable. It is a very difficult thing to see how a repetition of the extraordinary transactions which have within the last two years so astounded the world can be prevented at any time the "kings" again will it, unless some means can be devised to prevent consolidation. Let these men once secure full control of the great trunk lines and their tributaries, and with it the power to enforce their demands upon the commerce of the country, and who doubts that those demands would be despotically exorbitant?

GRANTS versus PATENTS.

We believe it was proposed recently, by Lord Stanley, to substitute grants from the national purse, instead of allowing patents for new and meritorious inventions. His lordship appears to have forgotten the fact that this system of grants was tried a century ago in England and abandoned. It encouraged imposture and gave no advantage to the public, as can be shown by reference to some examples. One Johanna Stevens obtained $25,000 for disclosing the secret of her cure for the stone. A Mr. Blake got $12,500 to assist him in perfecting his scheme for transporting fish to London by land; while a Mr. Foden was greatly overpaid with $2,500, to enable him to prosecute a discovery made by him of a paste as a substitute for wheat flour. If we mistake not, the British Parliament granted a considerable sum of money to pay Lady Webster for divulging the secret of her celebrated dinner pills, which were made up of aloes, mastic, red roses, and sirup of wormwood. The pills, perhaps, afforded a very comfortable relief to aristocratic gourmands, who, no doubt, were astonished to find of what simple elements they were composed.

Give a man a sum of money for his invention and you run the risk of paying him either too much or too little. Give him a patent and you secure the invention for the public, while his remuneration in money is determined according to its value. If the invention enrich him, it must also have benefited the nation. If the invention be a delusion, the public suffers no loss and the patentee reaps no gain. As a means for providing that the reward shall be fairly apportioned to

the service rendered, and shall be paid by those who profit by it, the grant of Letters Patent takes precedence of any arrangement hitherto made, and of every proposition yet advanced.

WHAT IS MATTER?

The author of "More Light: A Dream in Science," has published a treatise purporting to answer that, in our opinion, never-to-be-humanly-answered question, "What is Matter?" We have always denounced speculation upon topics which we believe to lie beyond the boundary of physical inquiry; believing that scientific methods cannot be applied to such investigation, if that may be called investigation, which is nothing more than either conjecturing what may be the causes of existing facts, or deducing a system from a basis of conjecture. Such speculations are generally a patchwork of guesses, with new names for old facts, which only transfer the mystery surrounding the ultimate causes of things.

The best illustrations of this statement we could possibly give are some short quotations from the work in question.

The universe is filled with centers of force; each center the center sphere; each sphere a compound of two spheres, having the same center, one a sphere of attraction, the other a sphere of repulsion.

* * * * *

It is by the separation of these two spheres of attraction and repulsion, and therefore by the calling forth and exercise of their powers by each, that we have the different modifications of matter.

The Divine Mind caused a certain immense, but yet finite, portion of space to be marked off from His immediate presence as a center—a great sphere—of space. This, by some manifestation of His power and presence, was filled with centers of force, the seeds, as it were, of that which was to be known as matter, round each of which two forces, attraction and repulsion, were in abeyance.

If the reader is not disgusted with the absurd and visionary character of these propositions, he will perhaps be interested in their analysis. The propositions may be thus restated. *Matter is force. Force has a Divine origin.* The latter proposition may be considered as foreign to the purpose of the work, which is to tell us what matter is, not from whence it originated.

But somehow the idea that matter is force does not seem satisfactory. We do not get a very good notion of it by calling it force, a term which is as mysterious as was matter before our author had poured upon it the brilliant light of his powerful intellect.

He would doubtless tell us were we to ask "What is force?" that force is—is—in fact—is matter, which would be perfectly intelligible and satisfactory. We should then have got to the ultimatum, and further inquiry would be superfluous.

We are not surprised at the severe lashing this book has received from the reviewers. Dreamers in science are out of place in the present age. The world does not need or want them. Dreaming and speculation are not just now in favor. There is too much work to do, to waste time and thought in such futile occupations.

DIVERSITY OF SPRINGS AT SARATOGA---NEW DISCOVERIES.

The visitor for the first time at Saratoga invariably expresses surprise at the great number of springs he finds there, and the variety of mineral ingredients analysis shows the waters of the different springs to contain. For many years waters from the Congress and Empire springs have been very widely known for their medicinal qualities, and an extensive business in bottling and shipping to all parts of the world has been profitably carried on. But how few, except visitors at Saratoga, have ever heard of the score and more of other springs within a radius of two miles, each possessing chemical ingredients in every case, varied in quantity, and generally very unlike in quality. Within a few yards of each other one spring produces a cathartic water, and the other gives a water having astringent properties. In the first no iron can be detected by chemical analysis, in the other particles of the oxide are seen by the naked eye. Every year new discoveries are made and new springs developed. Last year quite a sensation was produced by the discovery of a sulphur spring, and a commodious bathing house, erected after last season closed, has been extensively patronized this year. In removing some rubbish on the site of a barn, which was burnt last summer near Congress Hall, a new spring was discovered, which has been named "Hathorn Spring," after the proprietor of the hotel, by whom it is owned. It has been a favorite water this summer, and is believed by many to be the best cathartic spring yet discovered.

Mr. C. R. Brown, the enterprising jeweler on Broadway, opposite the Congress Spring grounds, has recently discovered a spring which he has named "Crystal Spring," on a valuable plot of ground he recently purchased, between his store and the Columbian Hotel, which he is about to have tested, and by next season the public will be invited to try its medicinal merits.

An analysis has just been made by Prof. Chandler, of the School of Mines in this city, and his report indicates the water to contain some valuable properties not to be found in like proportions in any of the many other springs at Saratoga.

The spring is located in a most central position, within a few feet of Broadway, and is more accessible to most of the hotel visitors than even the Congress. We hope the owner's sanguine expectations as to the value of his newly-acquired possession may be fully realized, and from its location and the analysis of the water, we have no doubt of the great value of the property. A stock company will probably be formed before many months for carrying on the business of bottling on an extensive scale. Any one desiring an analysis of either of the new springs can procure printed copies by inclosing ten cents and addressing Mr. Huling, office *Saratogian*, Saratoga Springs, N. Y.

HINTS ON THE BURNING OF ANTHRACITE COAL.

The burning of anthracite coal requires appliances quite different from those used for the burning of wood, or bituminous coal, but the reasons for these differences, are not well understood by the mass of people who use anthracite, and as we are constantly receiving inquiries suggested by imperfections in the construction of stoves, furnaces, and heaters, we deem it timely to give some hints on this subject.

In doing this we shall necessarily be obliged to repeat in substance much that we have said in former seasons upon the same and kindred subjects, but the importance and practical nature of the topic must be our excuse.

The temperatures at which different kinds of fuel ignite, vary greatly, and as anthracite is the most difficult to kindle of all the fuels in use in this country, novices in its use often find trouble in lighting it. This can only be done by the use of some more easily kindled fuel, wood or charcoal being generally employed for the purpose. Anthracite coal being a much more dense material than the other fuels named, requires a concentrated and powerful heat to raise it to the temperature at which it will commence to combine with the oxygen of the air. A common fault with those unaccustomed to it, is to use too coarse wood for kindling, and too much of it. This, while it generally succeeds in lighting the coal, leaves a bed of ashes below the coal which interferes with the draft unless raked out; an operation which always retards the combustion of partially ignited coal.

The wood should be of some rapidly burning variety which gives a quick and high heat, and should be split fine. It should be so placed that the coal will remain on the top of it and not fall through to the grate, leaving the kindling on the top of any part of the coal. The amount of kindling wood required depends much upon the size of the coal. A common mistake is to use too large sized coal. A good rule, where stoves or furnaces have a good draft, is to use coal as small as can be used without inconvenience from its sifting too freely through the grate.

Grates should have their bars closely set for stoves that are cleaned out daily, and have fires lighted in them each morning, while those which are intended to have fire kept in them continuously for days or weeks will not admit of fine grates, on account of the accumulation of ashes and small "clinkers."

There is much difference in coal in regard to the formation of clinkers. These are nothing but vitrified, or partially vitrified earthy matters, and only can form when a high heat is maintained; they are apt to be troublesome when there is too great draft. A coal stove or furnace should therefore be so constructed that its draft can be perfectly controlled. The bottom draft should admit of being closed air tight, as nearly as is possible to make it, and there ought always to be provision made for a top draft. If, however, the draft of a chimney should be so strong, that air in too great quantities is drawn in at the bottom when the dampers are closed, a damper in the pipe which will close it partially must be employed, though in sluggish chimneys such a damper is apt to force the gases of combustion into the room, and therefore it ought always to be avoided when possible.

The practice of putting ashes on the top of a fire to keep it, is very productive of clinkers, although it answers the purpose very well in other respects. Damp coal screenings are better, and may be economically burned in this manner.

If a coal fire gets very low, the quickest way to extinguish it, is to rake it at the bottom. To preserve a fire under such circumstances, a little coal should be placed on the fire, and when it has caught more may be added, and the raking deferred until it has got well ignited.

When the fire bricks have become burdened with clinkers which have fused and adhered, they may be cleaned by throwing oyster or clam shells into the fire box when the fire is very hot, and allowing the fire to go out. The clinkers will generally cleave off without the use of much force the next morning. From two quarts to one-half a peck, will be sufficient for most stoves, and the operation can be repeated if some of the clinkers still adhere.

In a subsequent article we shall say something on the proper regulation and adjustment of apparatus for warming buildings by hot air

GAS FROM THE LIGHT HYDROCARBONS.

We notice a description of a new(?) gas machine in the *Mechanics' Magazine*, of Aug. 6. This machine is described as being of any size desired, within certain limits, and the journal alluded to, considers it as an improvement upon anything hitherto known or employed in this direction.

Some of our American inventors will have a hearty laugh over this, when they read the description of the apparatus, the principle of which has been unsuccessfully tried over and over again in this country, in various forms, including the one described. The machine is stated to be "cylindrical in form, having a space between an inner cylinder which receives the charge of rock oil and the outer case. From the charge cylinder the oil exudes slowly into the space referred to, at the bottom of which it is absorbed by a layer of wool. The vapor rising from this oil in the saturated wool furnishes the essential element in the gas to be produced; the only other element is atmospheric air, with which the vapor is diluted. The air, which is only introduced into the machine when the consumption of gas is going on, is regulated in its admission by a piece of machinery actuated by a spring barrel movement, similar to that of a spring timepiece. The pump, which admits the atmospheric air, and the machinery with which it is connected, are put in motion as soon as gas begins to be drawn off, and the process of manufacturing the gas, the mixture simply of the atmospheric air with the vapor of the oil, at once commences and continues self-acting, as long as the charge of oil lasts, and gas continues to be drawn off. The process is beautifully simple, the gas being made instantaneously, without the application of heat, or any labor or attention whatever."

That the action of this machine is a repetition of the experience of many American inventors is evident from the following quotation from the journal referred to.

"The gas, as we saw it produced, was not very brilliant, but experience as to the qualities of the oils used, and practice in the use of the machine, will probably lead to the production of as high a quality as can be desired. According to the inventor's statement, a gallon of oil at 2s. 6d. will produce 1,000 cubic feet of fifteen-candle gas, and a charge of 3½ gallons will burn for 750 hours through an argand burner. The apparatus is adapted for use in houses, shops, theaters, churches, or other public buildings."

It might have been added, that its adaptation to the above purposes yet remains to be demonstrated, and we can promise, that when the oil becomes impoverished by the evaporation of its more volatile portions, or when its volatile character is decreased by a low temperature, the light will be still less brilliant than when exhibited to the editor of the *Mechanics' Magazine*.

Such experiments have had their day in this country, and it is well understood, that the principle upon which they are based is wholly inadequate. Eight years ago we experimented with and tested a large number of similar devices. The results of our investigations were the following conclusions. First, only the lightest of the hydrocarbons will volatilize at, say, 50 degrees, with sufficient rapidity to supply even a few burners with air saturated with hydrocarbon vapor in the proper proportions for illuminating purposes. Second, the oils, even if sufficiently light at first, rapidly become heavier by the consumption of their more volatile constituents, so that only a small proportion can be consumed ere the light begins to deteriorate. Third, if heat be applied to any machine of this construction, even admitting the safety of such an application, the amount of condensation in the service pipes will soon generate a train of evils well known to those who have been "through the mill," and which it is, therefore, unnecessary to specify here.

These difficulties have compelled the abandonment of the principle, and with its renouncement, to the adoption of better plans for utilizing the valuable illuminating properties of the light hydrocarbons.

One of these improvements was recently illustrated and described at length in these columns, and something which shall admit of adjusting the flow of the air to the volume of vapor generated, so that recondensation in pipes can be obviated, will be found an absolute essential to the success of any device for manufacturing gas from the distillates of petroleum.

STARCH AND ITS ADULTERATIONS.

This substance, which is of great importance in the arts, more especially in printing and finishing cotton and linen goods, is often adulterated, and in other respects may be of such a quality as to disappoint the manufacturer. Some inquiries which we have recently received upon this subject will be concisely and fully answered in the following extract from O'Neill's "Dictionary of Dyeing and Calico Printing:

"Starch is a widely-diffused vegetable product; it exists in a vast number of plants, fruits, and trees, and seems to be one of the fundamental bodies of organic life. Its composition is very similar to that of sugar, being a compound of carbon with hydrogen and oxygen, in the proportions requisite to form water. It is extensively used in printing and finishing, but does not in either case exercise any actions of a purely chemical nature; as a thickening it is only a vehicle for conveying the color or the mordant to the fiber; as a finish it is only to give stiffness or fulness to the cloth. But its actions in many cases involve the play of chemical affinities, and should be minutely known. Pure wheaten starch, when closely examined under the microscope, is found to be composed of very small globules. In commerce it is found in a peculiar state of aggregation, incorrectly said to be crystallized; the quality of the starch is often judged and determined by the appearance of these columnar masses called crystals. No other starch but that from wheat takes the same form in drying. It is not prudent, however, to depend too much upon this as a test, for I believe the crystalline character can be communicated to other starches, and that it is not an essential character of wheaten starch, but rather an accidental one, due to a partial decomposition and breaking up of some of the globules, which communicate a gummy nature and adhesive character to the remainder, or to a residue of unremoved glutinous matters. Starch does not dissolve at all in pure water when cold, it mixes up, but then settles down, leaving the liquid clear; it dissolves in hot water, swelling out to a great extent; it begins to dissolve, or the particles to burst, at about 150° F., but color cannot be well thickened at this heat, it must be boiled to get a good result. Starch boiled with acids, or acid liquor, thickens at first but afterwards becomes thin, owing to the destruction of the starch and its conversion into sugar; colors should not, therefore, as a general rule, be boiled until they begin to grow thin again—although in special cases this is prescribed, and is an advantage, but it is usually unnecessary, and likely to injure the color.

"A good wheaten starch is white and clear, has a sweet taste