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Contents.

(Illustrated articles are marked with an asterisk.)

TRIUMPH OF AMERICAN HARVESTERS IN AUSTRIA—THE ENGLISH EXHIBITORS BACK OUT OF THE COMPETITION.

The result of the trials of the mowing and reaping machines, recently held at the Vienna Exposition, is a substantial and unequivocal triumph for the American inventions. We print elsewhere a full account of the experiments, extracted from the page of our English contemporary *Engineering*, a report which we have purposely selected in preference to many at hand from American correspondents, in order that our readers may have before them the acknowledgement of the victory as dictated by the most adversely prejudiced of all observers.

It will be noted that the tests were confined to American machines in a large majority—in fact, we might add, exclusively, for the German devices entered were merely German imitations of English copies of American originals. The British manufacturers were conspicuous by their absence, declining to compete for no reason that we are able to discover, other than that, after comparing their machines with those from this country, they considered their defeat a foregone conclusion. Their machines, presumably of the best types made, were entered for competition; and according to their own showing, the circumstances of the trials were particularly favorable for them. But in spite of all their facilities for improved construction, in spite of their much vaunted progress in agricultural machinery, and in spite of medals and honors innumerable, won in domestic expositions, the English makers have fairly and squarely backed down, and this on a simple inspection of the American exhibit.

Engineering makes an ineffectual attempt to gloss over the fact by disparaging the nature of the trial and consequently the ability of our machines to perform difficult work; but conveniently forgets that the same conditions were free to the devices of its own country. It seems to us that it would have been much more just and fair for the English exhibitors to have taken part in the ordeal, and sustained, if need be, an honorable defeat, rather than to permit the inferiority of their products to stand publicly confessed by a deliberate and cowardly withdrawn from the contests. The part taken by our contemporary in decrying an honestly won success is neither generous nor graceful, nor is the clumsy subterfuge of ignorance, manifestly advanced in order to avoid a candid admission of superior merit, one worthy of a journal supposed to be upright and unprejudiced in its opinions and dealings.

TOWING SAILING VESSELS.

"Suppose a tug tows a sailing vessel at the rate of three knots an hour: would the vessel be propelled at the same speed, if the engines and propeller of the tug were placed in her?" This is a question recently asked by one of our correspondents; and we propose to give the answer at greater length than would be convenient in the columns devoted to "Answers to Correspondents."

When a vessel moves through the water, it encounters resistance: 1st. The resistance of the midship section, which is influenced by the form of the bow lines, it being a well known fact that a wedge-shaped body is more easily forced through the water than a blunt ended one with the same immersed cross section. 2nd. The skin resistance, which depends upon the amount of immersed surface of the vessel. Both forms of resistance are also dependent upon the speed of the vessel, the resistance offered by the water to the vessel's passage varying about as the square of the velocity. It will be seen, then, that however the vessel is forced through the water, whether by power applied at the bow, such as the action of a tow rope, or by the motions of a wheel connected with itself, there is a definite amount of resistance to be overcome, to produce any given speed. If the vessel is being towed by a tug, the motive power must overcome the resistance of the tug, in addition to that of the vessel; so that, if the engine and propeller were removed from the tug to the vessel, the resistance to be overcome would be lessened by the amount offered by the tug. It does not follow, however, that the vessel would go faster than before, or even as fast, under these new conditions. The propeller works in a yielding medium, and does not utilize all the power imparted to it by the engines. Part of the power goes to propel the vessel, and part is expended on slip, which produces no useful effect. It is well known that the propeller must be adapted to a vessel; and it might happen that, in changing the machinery from the tug to the sailing vessel, we should give the latter a propeller that was not suitable; so that the slip of the wheel would be increased, and she would not go as fast as before, with the same expenditure of power. In general, the propeller would not be adapted to its new position, for there is ordinarily a great difference in the hulls of steamers and sailing vessels. Tug boats, as usually constructed, have another advantage over sailing vessels, in their capacity for utilizing the power imparted to their wheels. Our readers have doubtless noticed that the stern of a tug is constructed to overhang the immersed hull. The effect of this projection is to partially confine the water thrown up by the propeller in its revolution, thus creating a more solid medium for the action of the screw. The under part of the overhanging portion is also made in the form of an inclined plane, and the effect of the concussion of the water thrown up is to force the tug ahead. If the propeller were transferred to the sailing vessel, and given the same immersion as before, the loss of this overhanging portion would be perceived at once by the increased slip. We conclude, then, that, under the ordinary circumstances which occur in practice, the effect of changing the motive power and propeller to the sailing vessel would be to decrease the speed. It may be interesting to consider whether there are any conditions under which this transfer could be made to advantage.

Suppose the tug were secured behind the sailing vessel so as to form virtually an addition to the length of the latter: it is evident that it would propel the vessel quite as well as if it were in advance, and employed a tow rope. Now conceive the stem of the vessel to be cut down, so as to be exactly similar to the stem of the tug, and a transfer of machinery to be made. Then it is reasonable to assume that the propeller would be as effective as before, and that the vessel would now go somewhat faster, since the resistance to the motion of the tug would no longer be encountered.

We do not think that this matter has ever been investigated by actual experiment. We have endeavored to lay down clearly the principles governing the case so as to point to reasonable conclusions. As our readers know, however, stubborn facts have often overturned many finely constructed theories, which were defective on account of not noting all the data; and we do not claim to give an infallible opinion. The question under discussion has been often propounded, eliciting a variety of answers; and we have thought it well to treat the matter somewhat at length on account of the many interesting points involved in its consideration.

LIGHTNING RODS.

Perhaps one of the most fruitful sources of mischief is found in the practical application of imperfectly understood or incorrectly interpreted scientific theories. Inventors are not unfrequently misled by what they take to be scientific truths, because their understanding of them squares with some favorite idea. Take an illustration. Notwithstanding the reiterated statement, in the SCIENTIFIC AMERICAN and other exponents of practical science, that it is impossible to utilize water as a fuel, because it takes as much heat to decompose it into oxygen and hydrogen as one can get from the recombustion of these gases, men continue to waste their time in inventing apparatus to accomplish it. In other cases again, a misunderstanding of the principles involved may cause not only the waste of time and energy, but the destruction of life and property. The construction of lightning rods is a case in point. If the reader of the literature on the subject happens to find the experiments of Professor Henry and others, he will note their conclusion that electricity of high tension passes along the surface of bodies and not through their substance, and this will suggest to him to increase the surface of his lightning rods at the expense of their solidity, by making them hollow tubes of greater diameter. Or, perhaps, he will recollect that in all electrical measurements of conductivity, as for example in testing submarine cables or telegraph wires, the conducting power is in proportion to the thickness of the wire, and he will find it difficult to reconcile the two principles. The difference in the nature of the two kinds of electricity, however, will easily explain it. By means of an electrical machine we obtain a very small quantity of electricity at a time, but it is under great pressure; the moment it is delivered therefore, its self repellent nature causes it to fly off towards the surface of any conductor. This was the kind of electricity experimented upon by Professor Henry. On the other hand we have means for developing large quantities of electricity having very little tension or pressure, which will consequently flow quietly through a wire in a mass sufficiently great to permeate its whole substance. Professor Morton very aptly compares the former kind to the water in a hydraulic press; it is under enormous pressure, but extremely little is delivered at every stroke of the pump. The latter kind, on the other hand, would resemble a large mass of water, such as a river or a canal, slowly flowing along with so little "head" as to be incapable of breaking down the slightest obstacle or projection of its banks. Now of which kind is the electricity of a thunder cloud? Manifestly of both; it is there under high pressure, and at the same time a cloud, say a square mile in area, would contain a vast quantity. It follows from this that, although considerable surface is an advantage, it should not be obtained by a sacrifice of solidity.

In 1823, Gay Lussac presented a report to the French Academy of Sciences, in which the most advantageous manner of constructing lightning rods is described in detail. It is from this source, and from a subsequent report by Pouillet in 1854, that the text books on the subject have chiefly drawn their information. The following are the principal points of interest there stated and subsequently developed by experience:

The object being to make so good a passage for the lightning to the ground as to remove all danger of its leaping to some conductor in the house, the end of the rod should be sunk deep enough to reach moist soil. The greatest care must be taken not to have any break in the conductivity. As it is inconvenient to manufacture or transport the rods in one piece, the different parts must be in intimate connection when they are put up; it is best to have them soldered and the joints protected from the air and moisture.

If moist soil cannot be struck, the end of the rod should branch out in various directions to insure a speedy dissemination of the electricity in the ground. The material most generally used in constructing the rods is iron, but the point is best made of copper. Platina was at first recommended, because it is unaltered by the action of the atmosphere; but copper is so much better a conductor of electricity that it is now preferred. Whenever a thunderbolt struck a platina joint, it almost invariably melted it, while copper would mostly conduct the electricity so fast as to prevent melting. Its greater cheapness is, of course, another and not inconsiderable advantage. Sir W. Snow Harris, F. R. S., states that a copper rod of one inch in diameter, or an equal quantity of copper under any other form, will resist the effect of any discharge of lightning hitherto experienced. The reason for terminating lightning rods in a point is as follows: When a thunder cloud highly charged with positive electricity comes up, it repels the positive electricity of all bodies on the surface of the earth coming within its influence, and causes negative electricity to accumulate in them. This is called induction, and it always takes place before a discharge. Now, it has been discovered that, when electricity is accumulated in a body in this manner, it can most readily escape by sharp points because in them it meets with the least resistance. A lighted candle held near the prime conductor of an electrical machine furnished with a point will be nearly blown out by the current of air produced by the escape of the electricity. Lightning rods are therefore provided with sharp points to allow the accumulated negative fluid to pass off readily into the air and neutralize the positive fluid of the thunder cloud.

It was supposed by Charles and Gay Lussac that a lightning rod protected an area whose radius was double the hight of the rod extending above the building, but this rule is no longer reliable by reason of the extensive use of metals in the shape of pipes, etc., in the construction of the buildings of our day. When electricity finds several paths to the ground, it will prefer the best, it is true; but some portion will also pass along the poorer conductors. If, therefore, any metallic substances lie within the area supposed to be protected, they are in danger of being struck. This is especially true where the lightning has a chance to jump to the gas and water pipes of a building. It is a good plan to connect these pipes with the lightning rod; if the rod is struck, the electricity will then have an excellent path into the ground and will be rapidly diffused over the vast underground network of pipes. The danger to the inmates of the house of being struck from these pipes is less than that of receiving a shock from the powerful induced currents, liable to be developed in them, if unconnected, during a thunderstorm.

Houses constructed entirely of iron manifestly stand in no need of lightning rods at all, because the electric fluid, on striking so good a conductor, would rapidly diffuse itself in all directions and flow into the ground, provided, of course, that the construction of the building is such as to allow its free escape. If on the contrary any obstacles oppose the free passage of the electricity into the ground, such buildings become highly dangerous and utterly unsafe, for the storage of inflammable material, from the tendency of the lightning to leap across the interior of the rooms. Whenever, therefore, the iron portion of the building does not extend clear down into the ground, prudence would command the establishment of a sufficient ground connection on every side by means of metallic rods.

People are apt to be indifferent whether their houses and stores are provided with lightning rods or not, and are always ready to give an example where some building so provided was struck in spite of its protection. Such cases have undoubtedly occurred, and they are often quoted by the old fashioned "practical men" with much satisfaction, because they hail in them what they are pleased to call the victory of their sound common sense and the discomfiture of the scientific man. This class is, however, rapidly diminishing in numbers under the influence of the extensive diffusion of scientific education among the people by popular lectures and by the press. It may be well to assure unbelievers that the efficacy of the lightning rod is no longer an open question, and that any failures are attributable to bungling or ignorant construction. It would be an easy matter to multiply statistics in proof of the assertion; but none would carry with them more force than the following statement obtained from the records of the British navy: