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Contents:

(Illustrated articles are marked with an asterisk.)

THE MECHANICS OF WALKING.

A discussion has commenced in regard to the asserted gain in the application of power by the use of the velocipede. One party states there is a decided gain by its use. The negative argument may be fairly put as follows: Equal bodies moving with different velocities require different powers to maintain their motion, that moving with the greater velocity requiring the greater power. If moving at equal velocities the powers required to move them will be equal. The amount of power necessary to transport a man say ten miles, will be the same, no matter how it may be applied, hence it takes the same muscular exertion to propel him ten miles on a velocipede as it would to walk the same distance. Now, so far as the gain in the application of power in the use of the velocipede is concerned, there can be no doubt of its existence on level and descending grades. The facts prove it indubitably. It may not be amiss however to reconcile facts and theory, and thus show how the gain is made. Those who take the negative side in the argument, and whose position we have fairly stated above, are right in their views so far as premises are concerned, but wrong in their conclusions. If all the power exerted in walking were expended in propelling the body forward, and friction were the same in both cases, there would be no gain in the use of the velocipede. But only a small portion of the power expended in the act of walking or running is applied to forward propulsion, as will be seen upon a review of the mechanics of walking.

In walking the heel is first placed on the ground; the weight is next thrown on the ball of the foot, and the body is raised so as to permit the free limb to swing by the one upon which the body rests. As soon as the free limb has passed the center of gravity, the body is allowed to descend, until the heel on that side receives the weight, when the body is again raised. This alternate rising and falling of the body causes the center of gravity to pass through an undulating curve. We have performed a series of experiments to graphically determine the amount of this undulation, and find it to average about three inches in adults of different hights, and varying lengths of the lower limbs.

Now, allowing the rate of speed attained in walking to average three miles per hour, and the length of step to average three feet, we find that the body is raised in walking 5,280 times during a walk of one hour or three miles. Reckoning the average weight of men to be 140 lbs. we have for the work expended in raising the body during an hours walk $\frac{5280 \times 3 \times 140}{12}$ = 184,800 foot-pounds per hour, or 3,060 foot-pounds per minute.

According to Silliman, the power of a man when applied to the best advantage (the treadmill) is equal to 2,000,000 foot-pounds for eight hours or 4,166·6 foot-pounds per minute. We see then that fully three-fourths of the entire muscular power of the lower limbs is expended in raising the body during the act of walking, less some deductions to be noticed hereafter.

It is not to be inferred on this account, that the apparatus for locomotion provided for us by Nature is defective. On the contrary we shall find when we examine it, that it is a marvel of perfection. Nature's is "nae journey wark" in any of her constructions. Direct forward propulsion is only *one* of the requirements of the feet and legs. They are adapted to climbing steep ascents, stairs, ladders, etc.; for descending abrupt declivities, for leaping, turning, and a variety of other movements, which wheels are incapable of performing. They possess great elasticity to save the body from injurious shocks. Their joints are self-lubricating and their weight is the smallest possible relatively to the work they are required to perform. No art would be able to fulfill all these conditions as nature has done, but art, has in the velocipede been able to apply power to direct forward propulsion better than Nature has done, hampered as she is by all the other requirements of the case.

It is undoubtedly true that a small portion of the power expended in raising the body while walking is converted into forward motion when it descends, and is thus utilized. It is also true that the elasticity of the limbs, stores up a portion of the power acquired in the descent of the body and applies it to the ascent of the body in each succeeding step. The loss of power is thus somewhat diminished, but making these deductions there must remain a large loss, when walking upon level ground. In walking up a grade there would be less loss in proportion to the steepness of the ascent. In going up hill, where the grade is over one inch to the foot, the power lost in walking upon level ground will be entirely utilized. In any steeper grade than this, the unassisted legs would be able to accomplish a greater distance than the velocipede, provided the latter utilized all the power of the lower limbs, which, of course it does not. There are losses from friction, and other causes, so that the legs would be found to have an advantage over the velocipede in ascending grades of considerably less than one inch to the foot; our opinion is that they would be found by experiment to be about on an equality in ascending gradients of one-third of an inch to the foot. On the contrary in going down a grade the velocipede has an increasing advantage with the steepness of the grade.

The advantage possessed by the velocipede on level ground consists in the more economical application of power to direct forward propulsion, than can be obtained in walking or running, and is another illustration that a simple rotary motion is the most economical way in which power can be applied to the production of simple effects.

PRETENDED MECHANICS.

A correspondent, writing from Springfield, Mass., speaks in very harsh terms of a class of men who offer their services as those of competent machinists, yet have never served an apprenticeship and do not understand, either theoretically or practically, the business. He calls them "dead beats," a term perhaps more expressive than elegant. He says: "The proprietors of shops are imposed upon by their assumption and pretension, the trade injured by their incompetency, and the capable workman disgraced by their ignorance. Their 'cheekiness' is equaled only by their perseverance, for if discharged in one shop for spoiling a job (their usual way of finishing work) they go to another, making plausible representations as to ability, etc. They are generally graduates of some gun-shop, where they run a drilling or milling machine, and, at the close of the war when this occupation was gone, went forth full-fledged machinists. Hardly a foreman of a machine shop in the country but has been imposed upon by these trade impostors; the consequence is that bosses have no confidence in the statements of strangers applying for work, and honest and capable men suffer because of ignorant pretenders. Now, Messrs. Editors, something ought to be done to remedy this state of affairs. Can you help?"

The above is the "gist" of the communication the language of which we have somewhat changed, as the indignation of the writer seems to have governed his style. The statements he makes are, however, undoubtedly correct; the trade is cursed with a class of hangers-on, who, incapable of doing journeymen's work and too proud to take apprentices' position, force themselves, temporarily, into places they are unfit to fill, by simple audacious pretension. It will be seen our correspondent does not include in his strictures honest workmen, who, not having served an apprenticeship, make no pretension to qualifications they do not possess, but only those who impose by misrepresentation.

The evil is not a small one, and the complaints of our correspondent have more foundation than a low jealousy; but it seems to us that the remedy is easily found. First, these pseudo-machinists must inevitably find their level in the shop. It is so everywhere; pretension will not always keep the leaky hulk afloat on the sea of life under the influence of the gale of experience. In our late war, many an officer who went out to the field with the insignia of rank returned discomfited, while many an enlisted man rose by rapid gradations to the proper level. The skilled and competent machinist cannot hide his light; he will be appreciated. The pretender will invariably subside to his proper position of obscurity.

Second, the impositions practiced upon foremen and employers can be prevented by themselves. Let them adopt a rule not to engage an applicant unless he can bring recommendations or certificates of competency from his former master or employer; or, in case this is impossible, as when the applicant cannot, on account of distance from his former place of employment, produce, at once, his evidences of capability, let him be taken on trial, after an examination by interrogations, and let his work be his recommendation. One week will be amply sufficient in any case to determine the proper status of the new comer. Then, if he proves to be a workman whose services are valuable he may be employed, and if he proves to be a pretender, incapable of carrying his professions into practice, his services will not be required.

THE EAST RIVER BRIDGE.

The Board of Consulting Engineers of the East River Suspension Bridge, to connect Brooklyn with New York, have lately held several meetings to consult on the plan of the proposed structure in its details, with such results as will serve to remove many of the doubts in the minds of the unprofessional and induce them to share the confidence of the Board. The gentlemen comprising the Board are the well-known engineers, Horatio Allen, W. J. McAlpine, J. Dutton Steel, Benjamin H. Latrobe, John Serrell, J. P. Kirkwood, and J. W. Adams. They unanimously decided, after a careful and detailed examination of Mr. Roebling's plans, that there is no insurmountable obstacle to building a suspension bridge of 1,600 feet span and even much greater.

The problem of a proper foundation for the towers presents the greatest difficulties. On the Brooklyn side it had been found by borings that there was a substratum of boulders which could not be disturbed by the current, and here a firm foundation could be obtained. But on the New York side the borings indicated only sand and decomposed rock, and the question was earnestly discussed whether the current of the estuary might not, in time, wash and scour out this sand, rendering the foundation of the tower insecure. By careful comparison of old charts with the present state of the river bed the Board concluded that the narrowing of the channel by artificial encroachments while increasing the force of the current, had not materially affected the margins, nor tended to scour the New York shore. Mr. Roebling firmly believed that it would not be necessary to dig as low as 107 feet below low water mark, at which point solid rock was found, and his opinion that a depth of 70 feet would be sufficient was concurred in by the Board. On digging the foundation for the dry dock, which is near the proposed site of the New York tower, Mr. McAlpine found the sand capable of sustaining a weight of ten tuns per square foot. The weight of the bridge towers is to be only four tuns to the square foot. The area of the foundation will be 165 by 100 feet, composed of heavy timber, the mass to be 20 feet thick and securely bolted together. On this the tower, of heavy stone masonry, is to be erected, 300 feet high. On the Brooklyn side it is believed no timber substructure will be required, the masonry resting directly on the rock. The rigidity, sustaining power, and durability of the bridge were severally considered, and the plans submitted to secure each of these elements were unanimously adopted; the great work will, it is believed, be very soon commenced. The Cincinnati bridge (of which we shall shortly give an engraving and description) has a span of 1,057 feet, and the second Niagara bridge one of 1,264 feet,—336 feet less than that of the proposed East River bridge.

ALEXANDER T. STEWART.--A NOBLE CHARITY.

In the last number of the SCIENTIFIC AMERICAN, we congratulated our readers upon the selection, by President Grant, of Alexander T. Stewart, of this city, to take charge of the Treasury Department. The appointment was unanimously confirmed by the Senate, but the discovery of a law made in 1789, which prevents an importer from holding the office of Secretary of the Treasury, operated to compel Mr. Stewart either to retire from business or to resign. Previous to sending in his resignation, Mr. Stewart signed an agreement to make over the entire profits of his business to trustees, to be applied by them to charitable uses; but this did not meet the legal objection. It is estimated that had this noble proposition been carried into effect, upward of six millions of dollars could have been distributed to charitable purposes within the next four years. The appointment of Mr. Stewart inspired general confidence in business circles; gold went down and Government securities went up; but the law was in the way, and it was deemed unwise to repeal or modify it to meet an individual case.

Mr. Stewart is about to carry into effect, in this city, his long contemplated project of erecting a home for the working women of this city, and hundreds of men are now employed in digging for the foundations on Fourth avenue, between Thirty-second and Thirty-third streets, and opposite the Harlem tunnel. The plot of ground contains twenty-two city lots, and cost $220,000, upon which Mr. Stewart proposes to erect an iron fire-proof building 198 × 205 feet, at a cost of $2,000,000. This is to be the working women's hotel, where sewing girls, female clerks, hard-working women of every trade, are to be provided with board and room for the smallest possible sum, and the house is to be managed in the best manner. The ground floor is to be let out for stores, the proceeds to be applied to the building of other similar institutions. The edifice will not be completed in less than two years. It is understood that Mr. Stewart also proposes to put up, in time, a working men's hotel on the same plan.

CANADIAN PATENTS--HOW NOT TO GET THEM.

We have received a printed circular, addressed to American inventors, by Alexander Anderson, of Canada, wherein he states "that the Canadian Government provides that its subjects may make discoveries of inventions in any foreign country, where the subjects of that country are prohibited from obtaining patents in the usual way; the British subject making an improvement on it, and combining his improvement with the discovery, may obtain a patent. I feel confident, from my long experience in the patent business, and my inventive powers, that I can make an improvement on almost every invention taken out. I can thus obtain the patent deed and then transfer it to the inventor."

This is a very astute proposition, and is well calculated to mislead inventors who are ignorant of the exact scope of the Canadian patent system, which provides "that *any person, a*