Large Bicycles Versus Small Ones.

A striking result of the popularization of the bicycle, says the *Literary Digest*, has been the bringing home of the importance of mechanical problems to the individual. Everybody now talks of cranks and chains, sprockets and wrenches, and every wheelman has his own opinion regarding the merits or demerits of light machines and small wheels—an opinion often based on a very small foundation of knowledge, either practical or theoretical. In the *Revue Encyclopedique*, Paris, August 1, in an article entitled "Actual Problems of Cyclism," M. Charles Henry discusses these and other questions from the standpoint of the mechanic. We translate so much of the article as relates to the weight and size of the bicycle. What the author has to say regarding these points is in part a review of an article in *La Bicyclette*, signed "The Old Man of the Mountain." Says M. Henry:

"During the past two years . . the weight of machines has decreased. Machines of 12 kilograms [26 pounds] and even of 9 kilograms [20 pounds] have been turned out. Is there a notable advantage in gain of speed or economy of effort in this diminution of weight? . . . If we consider a wheelman weighing 68 kilograms [150 pounds] and a machine of 12 kilograms [26 pounds], and if we increase the whole weight by one kilogram [2 1-5 pounds], a superficial observer would conclude that the effort would be augmented by one-eightieth. This is an error. To decided the question we must obtain the expression for the work done, which comprehends two terms, one term whose preponderant factor is the weight and another whose preponderant factor is the speed. The resistance of the air and of the chain is independent of the weight, and the resistance of friction is independent of the speed. We find thus that the total resistance of the machine of 13 kilograms [28 pounds] will be, for the same speed, and whatever this speed may be, that of the machine of 12 kilograms, increased by 8 grams [124 grains]. The extra weight of one kilogram imposes on the rider an increase of work of $\frac{1}{153}$ at the speed of 24 kilometres [14 miles], $\frac{1}{833}$ at the speed of 50 kilometres [30 miles]. Both these are far from $\frac{1}{80}$. And we need not believe that this increase of one kilogram will make itself evident in a sensible loss of space traversed. On a track of 333 meters [yards] the space lost will be .83 meter [2½ feet] at the speed of 32 kilometres [19 miles] and .39 meter [1 foot 2 inches] at the speed of 50 kilometers [30 miles]. It is a vain objection that the heavier machine will involve much greater effort; the passage from the speed of zero to that of 36 kilometers, in a handicap for example, according to the principle of energy, will require 6 kilogrammeters [40 foot-pounds] extra with a 13-kilogram machine than with a machine of 12 kilograms; now the difference of pushing force exerted by the rider may be double this; the effort necessary to cause the machine to pass from a speed of 36 kilometers to one of 50 kilometers will require only 9 kilogrammeters [60 foot-pounds] more with the first machine.

"'The old Man of the Mountain' tries to show that even on the road and with grades of five per cent. and more there is no advantage in light machines. . . . An increase of 1 kilogram in steep grades increases by only 12 thousandths the total resistance and consequently the push to be given to the pedal. 'Who will dare to pretend that a cyclist could ever feel in his legs such a very small increase of work?'

"Here the learned disputant goes too far; physiology teaches us that an increase of 12 thousandths or $\frac{1}{83}$ in the sensation of pressure exerted upon exterior bodies, for it is generally recognized now that the two orders of sensations (pressure undergone and pressure exerted) are conducted by the same nervous apparatus. The fraction, called 'the differential fraction,' reaches $\frac{1}{14}$ in the experiments of Hering with a series of eleven weights increasing upward from 250 grams [2,875 grains] when the weight to which the supplementary weight is added is 2,500 grams [5½ pounds]. This fraction is not constant; it diminishes, in general, with the greatness of the pressures undergone or exerted. According to Helmholtz, in optics, this fraction has a minimum value. The least increase of work when the work is notable and the person is fatigued, will be sensible. From this point of view, there are incontestable advantages in light machines, but in what degree? This is the question, and it is necessary to limit the greatest efforts demanded of the cyclist within the boundaries that assure to the differential fraction its greatest possible value. Experiments on a great number of cyclists would be very interesting.

"Successive variations of work within ordinary ratios can also, as we see, augment this differential fraction and diminish correspondingly the sensation of fatigue, which is only the decomposition of a given effort into a too great number of successive degrees of the sensation of effort.

"The friction is inversely proportional to the diameter of the wheel. 'The Old Man of the Mountain' has sought to find what the resistances would become if we should substitute the diameter of 1 meter [1 yard] for 0.7 meter [2 feet] commonly adopted. Allowing that by this increase of diameter the weight is increased 6 kilograms [13 pounds] and the surface opposed to the air by $\frac{1}{50}$, we find for a run of 20 hours on a level track at the speed of 30 kilometers [18 miles] an economy of work of 9.72 kilogrammeters, corresponding to a reduction of 32 kilometers [19 miles] in the length of the run. The advantage is also sensible in long speed-runs (for example, an hour's run at the speed of 40 kilometers [24 miles]); it is small in very short runs at extreme speed, but in ordinary runs on the road the reduction of friction gives considerable economies of work; for example, in a 24-hours' run from Bordeaux to Paris at a speed of 24 kilometers [14 miles], there would be a reduction of 153,000 kilogrammeters, corresponding to a decrease in distance of 66 kilometers [40 miles].

"According to the communication of an engineer, M. L. Boraine, in the same journal, *La Bicyclette*, one meter [a yard] represents the maximum diameter of wheels for the maximum of slope, and it is the diameter that gives on the road the maximum return for the efforts of the rider; in fact, we see easily that the economy of work realized by a turn of the crank, independent of the speed, on a wheel of one meter, compared with one of 0.7 meter decreases proportionally to the increase of the slope; as we must take account of the resistance of the air, which is all against the large wheel, we must conclude that at a grade of seven per cent. the work would be the same for the two wheels, and that a diameter greater than one meter would be disadvantageous in comparison with the small wheel."

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A shower of fishes is reported from Bjelina, Bosnia, where it occurred on July 23 between midnight and 4 a.m. The fishes, which were picked up everywhere on streets and in fields, seemed to be of the species known as bleak or blay. As in other similar cases, the fishes were doubtless drawn into the air by a whirlwind from some lake or other body of water.