I believe that (2) is correct, for no energy is restored when a contracted muscle is again extended either by the action of outside forces or by the contraction of other muscles.

(3) also is true, but in what way the leakage varies with muscular stress is not known. It probably lies between "as the force" and "as the square root of the force," and in this note I shall assume the latter hypothesis.

If P, P_A, P_L are respectively the total power developed and the powers lost by acceleration and leakage, then, f and v being the force and velocity, $P=fv$, $P_A=A/f^3$, and $P_L=Bf^{\frac{3}{2}}$.

The useful power is $P_E=P-P_A-P_L$, and the efficiency $E=1-\frac{P_A+P_L}{P}$. Differentiating E with respect to f it will be found that the minimum of P_A+P_L occurs when $f=\left(\frac{2A}{B}\right)^{\frac{2}{9}}$.

The constants A and B may be determined by the conditions that, when the whole power is expended in accelerating the limbs $A=f_a^3P$, where f_a is the force which can be maintained at the greatest practicable velocity, and $B=P/f_L^{\frac{3}{2}}$, where f_L is the greatest average force which the muscles can apply.

In the case of the bicycle I will assume (1) that the gearing is 70 with a 7-inch crank; (2) that the power available is 40 ft. lb. per sec. (about 1/14 H.P.); (3) that the greatest speed attainable with that power and in the absence of air resistance is 40 ft. per sec. (about 28 M.P.H.); and (4) that the greatest average force which can be continuously exerted on the crank is 30 lbs., from which it may be deduced that A = 5000 and B = ·24.

These values were used in computing the curves in Fig. 1.

The minimum of P_A+P_L is 12·5 ft. lbs. per sec., thus leaving 27·5 ft. lbs./sec. for useful work, which, with the assumed length of crank and gearing, would

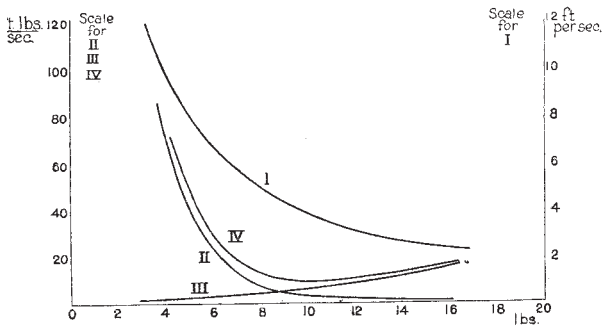

FIG. 1.

Curve I is the hyperbola $fv=P$; f in lbs., v in ft. per sec.
" II P_A, the power lost in acceleration of the limbs.
" III P_L, the power lost by leakage from the strained muscle.
" IV P_A+P_L, which has a minimum value of 12·5 ft. lbs./sec.

suffice to lift a load of 200 lbs. (weight of rider and machine) up a gradient rather less than one in thirty. Hence even with this gentle gradient it would pay to ascend the hill obliquely, *i.e.* in a series of tacks.

The P_A+P_L curve, however, is very flat near the minimum, so that a considerable increase of gradient would not do much to diminish the efficiency.

Whether the assumed maxima of speed and force are anywhere near the truth I do not know, and it would be interesting to have laboratory experiments on these quantities.

A. MALLOCK.

9 Baring Crescent, Exeter, May 10.

"G. B. M."

I FIRST saw the late G. B. Mathews on June 4, 1884, at the Queen's Hotel, Chester, when the staff of the newly founded University College of North Wales was appointed. He was chosen for the Chair of Mathematics, and almost from that time we were linked together in friendship as well as in our offices as teachers of intimately related subjects in the same institution. I well remember his youthful and striking yet attractive appearance. He was the senior wrangler of the previous year, and came full of eager enthusiasm for the teaching of mathematics and for original mathematical work, and for ten years laboured hard in the hope of founding something like a school of mathematical study in North Wales. But alas! these hopes were dashed. Perhaps he was a little impatient, and I certainly did my best to counsel him to wait, and to find out the effect of the new Welsh university on the studies of the place, but without effect. The best of the Welsh students were at that time attracted by the Neo-Hegelian philosophy, and some of them, as seems to be the way of such students, seemed not a little proud that their mental tendencies were not mathematical. To this curious type of intellectual pride Mathews referred eloquently in the posthumous paper published in NATURE of April 22.

In that paper he lamented the revival of the fallacious arguments for the supremacy of the Latin-Greek classics as an educational instrument; but he in no way undervalued classical culture, only he thought that to an Englishman, the inheritor of a copious and flexible language, and of a literature unequalled in the past, a training in Latin and Greek was far from indispensable, and might have its disadvantages. Certainly many classical people, tutors of colleges and old-fashioned classical schoolmasters, often write English which can scarcely be regarded as a model to be imitated, as any one can convince himself by reading the prefaces and introductions to editions of classical texts. He always thought Greek more important for students of science than Latin. And truly the technical language of zoology and physiology, and in a less degree that of physics, is much more exclusively of Greek than of Latin derivation.

Mathews had a knowledge of Latin and Greek as minute and accurate as that generally possessed by professional classical scholars. He wrote pure and elegant Latin. I remember his amusing himself by turning into Latin prose an original philosophical dissertation which happened to come into his hands and arrested his attention. I remember also some Latin verses which he published anonymously and which were much praised by a very eminent scholar.

He wrote also charming English essays in the style of Charles Lamb, of whom he was a great admirer. These I fear are lost, but one of them, "On a cock-loft," was a perfect gem, a charming piece of the most natural and simple prose, somewhat after the manner exemplified more recently by Kenneth Grahame in his "Golden Days." He gave much time to Arabic in later years, and it is to be hoped that his translations of Arabic poetry will ultimately be published. I have seen some of them, which certainly seemed very remarkable. His most valuable work was done in mathematics, and this has been well appraised by a mathematician who knew him well in later years. It is, I think, a pity that the variety and strength of his interests distracted him from mathematical work, and prevented him, until it was too late to take it up again, from finishing his work on the Theory of Numbers. But in his NATURE articles his extraordinary wealth of knowledge and his keen and yet genial criticism must have helped innumerable students.

A. GRAY.

The University, Glasgow.