admitted. "Special devices," he says, "exhibited 'for this occasion only,' confer no independent power on the student." Doubtless the dodger cannot in general expect to make his pupils dodgers also. For he is able to dodge chiefly by virtue of his knowledge of the Calculus, ignorance of which on the part of the pupil makes the dodging necessary. And thus little independent power is evoked in the pupil by the study of this portion of the teacher's work. The result of the teaching is that the pupil is satisfied of the accuracy of a result which in the opinion of the teacher is worth the trouble of the dodging process. Thus it is by many regarded as worth this trouble to establish "the nature and properties of tubes of force, potential, etc.," not in the hope that the student may be able to establish independently any co-ordinate theorems, but because the properties referred to if once established may be very widely applied. For a different reason it is worth this trouble to determine the attraction of a uniform material spherical shell on an external particle. The student will find the law of its attraction assumed in elementary books on Electricity and Astronomy, and it is a great satisfaction to him to have been convinced of its accuracy, even though the method by which it was proved to him may not have been one which he could apply to other similar problems. While therefore we must admit that in general dodging does not tend to foster independent power, we claim for it other advantages which seem to justify its use.

When, however, Prof. Minchin says that "the processes of differentiation and of elementary integration are not difficult of acquirement, and it seems to me they ought to be studied before such an extensive inroad is attempted into Dynamics," and that "if more time were spent in teaching the mathematical principles on which quantitative Physics depends, there would be less need for such methods, and in the long run the student of Physics would be a gainer," I find myself able to agree with him. Calculus dodging seems to me to be in many cases justifiable; but its application would be in all such cases preferable. We would draw different conclusions, however, from this common opinion. He would postpone the serious study of Physics not only until Geometry, Algebra and Trigonometry have been studied in as great detail as at present, but also until the elements of the Differential and Integral Calculus have been studied. I would, on the other hand, venture to suggest to mathematical teachers, that they should take into consideration the introduction of the elements of the Calculus at an earlier stage of our mathematical courses. The former change would have the unfortunate effect of restricting the study of Physics to the few whose mathematical tastes lead them to devote a great deal of time to that subject. The latter would have the advantage of enabling the many, who undergo a shorter course of mathematical training, to acquire facility in the use of an instrument, which would render it possible for them to enter with advantage upon departments of Physics, to which the only entrance at present is through the dodger's gate.

In selecting branches of Mathematics as subjects of instruction in school and college classes, it should be borne in mind that this subject is studied, not only as an admirable species of mental gymnastic, but also as an indispensable instrument for pursuing study in other branches. And neither of these objects should determine what the course of instruction is to be to the exclusion of the other. Considering what important fields are opened up to the student by even a slight knowledge of the Calculus, it may rightly be introduced into elementary mathematical courses, even if its introduction should somewhat impair their gymnastic efficiency. I am not by any means sure that the details of Algebra, Geometry and Trigonometry, which might thereby be crowded out, would be more valuable educationally than the new matter which would be introduced. But there can be no doubt that the change would result in an enormous increase in the practical value of the elementary mathematical course. And the reconstruction of these courses on the most practical lines consistent with sufficient educational benefit, demands, I venture to think, more consideration from mathematical teachers than it has hitherto received.

Meantime, since there is a large body of men who must study Physics and who know nothing of the Calculus, the only course open to teachers is to dodge the Calculus to the best of their ability.

On the work prescribed for our elementary class, the study of Dynamics and of other departments of Physics, without the aid of Trigonometry, Prof. Minchin makes some very severe strictures. The immediate object of his criticism is the matriculation examination of the University of London, which requires of candidates a considerable knowledge of Dynamics, while at the same time requiring in Mathematics only four books of Euclid and no Trigonometry. In our elementary class we assume familiarity with six books of Euclid; and therefore some of Prof. Minchin's strictures do not apply to us. All those based on the lack of knowledge of Trigonometry, however, apply directly and hence I quote them. In assisting a young relative to prepare for the London examination, he "found it," he says, "quite impossible to impart anything that could