write to me **by 30 November**. The committee will then work through all the suggestions made and a further article with recommendations will appear.

Yours sincerely,

JOHN HERSEE (Chairman of Teaching Committee)

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Let's take mechanics seriously

DEAR EDITOR,

Few people doubt the importance of newtonian mechanics; its applications include all motion that men have achieved and much of what they have observed. Yet in British schools the subject is dying by a thousand cuts—why?

I suggest three reasons:

I. "Applied mathematics is wider than mechanics and newer applications are interesting."
II. "Other countries don't teach mechanics as a part of school mathematics."
III. "Newton's laws are simple in their basic expression, so there is not much to learn."

Besides these reasons there is a psycho-social cause, alias "fashion". However, I believe this is a schoolteacher's fashion; engineering and physics have not changed their nature. School level linear programming, game theory and electrical circuits use a pretty narrow range of mathematical tools and, although their results are considerably less than 300 years old, they are a long way from the boundaries of modern knowledge. It is irresponsible to drive out most of mechanics simply to give ourselves a fresh set of lessons to teach. Reason I is also weakened by this argument.

As for II, our history and present system are different from those of other countries and our national record in science and engineering is extremely good, though we have not done so well at exploiting our ideas and selling the products. The sequel to our sixth form preparation is a three-year degree course. But we do not teach mechanics only for vocational reasons. Newtonian mechanics is a major human achievement with a bright future; extensions, refinements and alternatives start from it and are compared with it. Imaginatively taught, even at school (on the lines of Kilmister and Reeve's *Rational mechanics*), it fosters understanding of the real world and our models of it.

Reason III is the subtlest, for it *is* true that Newton's laws can be stated simply and the applications to the usual set of sixth form problems are quite short. *It does not follow that mastery of these problems can be achieved quickly*. Traditional single A level courses give three periods a week for two years to mechanics, and quite clever pupils need a good year and a half to learn to apply the equations successfully. The ideas often begin to 'click' (despite all the teacher's repetitions) only in the second year. There is a perfectly good reason for this slowness, and a philosophical term for the circumstances. Newtonian mechanics is wide, powerful and applicable to something convincingly like the real world. A broad range of problems can be tackled, often with the aid of subsidiary assumptions, empirical laws and such approximations as inelasticity, a coefficient of friction or a constant gravitational field. Gaining experience of these problems takes time, but it is time well spent. Complexities such as elasticity, inverse square law gravitation and non-linearity can extend the simple models. Professor T. S. Kuhn's *Normal science* describes just this situation in which a "paradigm" is systematically learnt, applied and extended; he demonstrates that such activities form the main activity of most scientists most of the time.

I believe that it is our responsibility to see that we choose a scientifically respectable paradigm that is of central importance in as many fields as possible for our applied

https://doi.org/10.2307/3617493 Published online by Cambridge University Press

mathematics. The two systems that qualify, to my mind, are newtonian mechanics and Kolmogorov probability (though his *axioms* are inappropriate at school level). Our sixth form mathematics pupils should serve a sound apprenticeship in one of these, and not be fobbed off with a two-chapter glimpse of it.

Yours sincerely,

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Reviews

CRAC degree course guide: Mathematics and statistics 1975/6, by M. Stone. Pp 50 1975. SBN 0 86021 036 7 (Hobsons Press (Cambridge), for the Careers Research and Advisory Centre)

The new edition of this CRAC guide (it is revised every two years) begins with a very readable introduction on "what mathematics, statistics and computer science are like beyond school level and how they relate to career opportunities". The various courses available at universities, polytechnics and colleges of technology are summarised in tabular form, with added discussion of common features and differences. Terms like "thin sandwich" are explained, and the teaching and assessment methods used are discussed. Entrance requirements and selection procedures are explained, with references to other relevant publications. *Appendix A* lists courses not covered by this guide which involve a mathematical component, while *Appendix B*, besides giving addresses to which to write for further information on particular courses and careers, includes a list of introductory mathematical books (e.g. *What is mathematics?* by Courant and Robbins).

The guide is directed at the student, to help him "decide whether a degree course in mathematical subjects is of interest" to him and then to assist him "in choosing from the wide variety of combinations available". Any sixth former (and many fifth formers) will find it easy to read and informative, but it should also be read by all teachers of mathematics. Copies should be available in mathematics classrooms, besides the careers room!

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Modern mathematics and its implications for physics teaching. Pp 40. 1975 (obtainable from the Scottish Centre for Mathematics, Science and Technical Education, Dundee College of Education, DD5 1NY; price 27p, cheques payable to Dundee College of Education)

The booklet makes a helpful contribution to mathematics and physics teachers who are concerned about the divergences of approach to their two subjects. The conclusion states that "transfer (between the Maths lesson and the Physics lesson) will not just happen (by itself)", and the identification of major differences in approach used by mathematics and physics teachers, and the considered recommendations made within the 40 pages, can only help achieve better transfer and more efficient use of classroom time.

The research reported in the booklet involves an analysis of the Scottish Ordinary Grade Physics and Mathematics syllabuses and the results of a manipulation test given to 850 certificate pupils. The comparison of the subject syllabuses gains clarity from a