BOOK REVIEWS

NUFFIELD BIOLOGY

The Nuffield Foundation Science Teaching Project

Biology. Teacher's Guide 1: Introducing Living Things. Pp. xviii+152. 15*s*. Text: Pp. x+179. 15*s*. 6*d*. Teacher's Guide 2: Life and Living Processes. Pp. xviii+125. 15*s*. Text: Pp. 162. 13*s*. Teacher's Guide 3: The Maintenance of Life. Pp. xviii+248. 20*s*. Text: Pp. vii+238. 17*s*. 6*d*. Teacher's Guide 4: Living Things in Action. Pp. xviii+205. 20*s*. Text: Pp. 313. 21*s*. Keys to Small Organisms in Soil Litter and Water Troughs. Pp. 27. 2*s*. (London: Longmans, Green and Co., Ltd.; Harmondsworth, Middx.: Penguin Books, Ltd., 1966. Published for the Nuffield Foundation.)

THESE books consist of a series of students' texts and teaching guides, intended to cover 5 years' work in biology from age 11 to 16, leading to "O" level at age 16. The examining boards for the General Certificate of Education (GCE) have agreed to set alternative examinations on this syllabus, and the first candidates, from schools which have been experimenting with the scheme, took the examination in 1965. The books have been prepared under the direction of the Nuffield Foundation by a group of teachers seconded for the purpose, with advice from scientists in universities and research institutes, and with the help of teachers and pupils in 170 schools which have tried out the syllabus, in whole or in part, and have reported on their experiences. In addition to the books, a number of 8 mm films have been prepared, and costed lists of the apparatus required are available. Although the syllabus has been planned as a coherent whole, the authors believe that the final 3 years could be used without the first two, and that particular experiments could be introduced into a more orthodox syllabus.

I find it difficult to restrain my enthusiasm for these volumes. They seem to me admirable both in what they attempt to do, and in the way in which they do it. First, their objectives. Science is presented as an activity directed to the solving of problems and the satisfaction of curiosity. On page after page, experiments are described which will enable children to answer for themselves questions about how animals live. One of the great potential virtues of biology as a school subject is that it abounds in problems which can be answered with little or no apparatus in a school classroom. It therefore lends itself to teaching the scientific method, which is, after all, intended for the solution of problems and not for the demonstration of truths stated in text-books. Another virtue of biology as a school subject is that its problems are not abstract ones, of interest only to the philosophically minded, but have an obvious human relevance. This relevance is also admirably brought out.

But what differentiates these volumes from other text-books is not their objectives but the care with which they have been prepared. Reading the pupil's texts and the teacher's guide, it is at once apparent how much has been gained by trying out the syllabus in a variety of schools before presenting it in its present form. All sorts of snags are pointed out, and the methods of avoiding them explained, with a degree of foresight which could not be achieved in any other way. The result is a series of suggestions for experimental work which are at the same time ambitious and practicable.

Is too much being asked, either of pupils or of teachers? This question is bound to be asked. The best answer is that these courses have already been followed successfully in many schools which have been collaborating with the Nuffield Foundation. If the syllabus seems modern in comparison to that followed in many universities, this merely reflects the fact that university courses in biology are still in many cases following a direction which was anachronistic when it was laid down a hundred years ago by T. H. Huxley.

It seems clear that the syllabus is one which children can follow, and that teachers, given adequate facilities, can teach. But will teachers be given adequate facilities? A course consisting of experiments on living organisms is inevitably more expensive, both in apparatus and time, than the examination of dead material. But if new methods of teaching will help to produce a generation of schoolchildren for whom science is a means of satisfying curiosity, instead of the impersonal, incomprehensible and often distasteful business it so often is today, the small additional cost will surely have been worth it.

J. MAYNARD SMITH

GALILEO 400 YEARS AFTER

Homage to Galileo

Edited by Morton F. Kaplon. (Papers presented at the Galileo Quadricentennial, University of Rochester, October 8 and 9, 1964.) Pp. xii+139. (Cambridge, Mass., and London: The M.I.T. Press, 1965.) $6; 45*s*.

IT is easy to say "Let us now praise famous men", but very difficult to do so adequately. The four-hundredth anniversary of Galileo's birth produced a large number of celebratory conferences; so far as I am aware, this is the first "book of the conference" to appear in print. It is a small book, handsomely produced, but suffers as so often in such cases from excessive diversity. Two of the essays, that by Philip Abelson on "Science and Government" and that by Erich Kahler called "Science and History", have nothing to do with Galileo: the first discusses the relation of science and government in the United States; its author, currently editor of *Science*, argues in favour of more university control of research funds. The second, by an international scholar, deals with the philosophy of history. The other essays deal, mainly in a fairly general way, with Galileo as a historical figure. Giorgio de Santillana glowingly sketches the drama of Galileo's view of science. Gilberto Bernardini's eulogy describes Galileo as a modern physicist sees him—Galileo the experimenter. N. R. Hanson analyses Galileo's real discoveries in dynamics from a philosophical point of view, and argues, first, that Galileo was truly a mathematical analyst and, secondly, that Galileo the empiricist is a mythical creation of later ages. E. W. Strong, on the other hand, in "Galileo on Measurement", compares Galileo's method to Newton's, and argues for "Galileo's clear recognition that the search for general invariant laws requires quantification of properties of bodies that can only be provided by mensuration". These two last are the only papers to be based squarely on Galileo's own words; they deal with a problem very much alive in current history of science and are of real relevance to the philosophy of science as well. The positivist school of the history of science at the beginning of this century naturally assumed that as Galileo was a successful early modern physicist he must be an empiricist. Twenty-five years ago the late Alexandre Koyré called attention to the mathematical, even Platonist, aspects of Galileo's thought and presentation, and readers of Galileo began to distinguish between empiricism and thought experiment. Latterly there has been a swing the other way, and younger historians have shown that many of Galileo's experiments, like that of the inclined plane, could produce the results that he describes, and therefore have argued that he did perform them. They receive support from Professor Strong, though he by no means discounts the role of mathematics in Galileo's thought, and he has inter-