we take with regard to the interpretation of science, whether we lay the onus on the scientist for expressing himself in terms and in ways that the layman can understand, or whether, like the Duke of Edinburgh and Sir Henry Tizard, we look rather to the improvement of the scientific education of the layman, without a reasonable mastery of English the scientist is unlikely to be able to communicate fully even with those in other scientific fields. It is not simply a matter of avoiding unreasonable demands on the scientist to express himself in non-technical language; unless his choice of technical terms is restrained by the sense of perspective and balance which an adequate knowledge of his mother-tongue confers, no improvement in the technical and scientific knowledge of the ordinary citizen will avoid confusion and misunderstanding. Mr. Ritchie Calder has quite rightly insisted that the communication of knowledge and ideas depends fundamentally on the careful and skilful handling of words, and this is as true of the scientific or technical paper as of popular exposition.

The success of this experiment at the Imperial College of Science and Technology will really depend on two things: first, whether the College can secure and maintain a teaching staff of the requisite standard and breadth of vision, capable, within the limits set by the scientific and technological disciplines to be taught, of inspiring their students with that same breadth of vision and understanding, no less than with the capacity for clear and critical thinking. Secondly, it will depend no less on a continuing entry of students of sufficient capacity. Any relaxation of standards in either respect—in the recruitment of staff, or the selection and elimination of students—would be fatal. For that reason alone, the progress of the experiment should be closely watched, and particularly carefully by the University Grants Committee and the Parliamentary and Scientific Committee. For although the recent broadsheet on "Graduates' Jobs" issued by Political and Economic Planning is only a preliminary survey, it gives at least a hint, which is supported elsewhere, that there is a strict limit to the number of students qualified to profit by courses such as an institution of the standard of the Imperial College provides. Part of the solution to Britain's problem of scientific and technical manpower lies in the wiser and more efficient use of the limited supply of really first-class minds.

PURPOSE IN EDUCATION

Education and the Modern Mind

By Prof. W. R. Niblett. Pp. 155. (London: Faber and Faber, Ltd., 1954.) 8*s*. 6*d*. net.

MANY books are published dealing with educational topics; surprisingly few are written about education itself. Prof. W. R. Niblett has attempted to do this, and by all except the confirmed materialist, his book will be welcomed both for its inspirational qualities and for its practical suggestions on means of achieving ends which are admittedly difficult to attain.

Throughout the book Prof. Niblett emphasizes that it is no good considering the purpose of education without discussing the purpose of living itself; it is impossible to evolve a satisfactory philosophy of education without having evolved a satisfactory philosophy for life. Unfortunately, so many people in the Western world assume that the reason for existence is to 'get on' and be 'happy'. This superficial attitude to life has bitten deep in many people and seems to be an accompaniment to the mentality associated with the Welfare State.

Prof. Niblett questions whether the acquisitive attitude can provide a satisfactory philosophy of life, since it leaves out a whole dimension of human experience; it is very doubtful whether it leads to 'happiness'. Much of the so-called 'happiness' to-day is there only when there is something 'going on'; too often this is succeeded by a vacuum of despair when people come face to face with themselves.

There are signs, however, that the determination to 'get on' is failing to satisfy and that the possession of material resources may be temporarily satisfying but fail to satisfy those fundamental requirements of man which are of an intangible nature. As a result, a new challenge is being presented to all who help to educate the young. Some educationists respond to this challenge by seeking to increase the number of schools and laboratories and community centres. Others, and Prof. Niblett is one, believe that these things are desirable only if they are used to extend and strengthen fundamental values and that much more could be done with existing facilities.

Fundamental values, he says, have been weakened by two main causes—one minor and one major: the minor cause is two World Wars; the major, the spread of the scientific temper of mind. As an instrument of analysis, the latter is indispensable, and there is need for its wider extension throughout the world if, as is desirable, more and more people are to benefit from material progress. Yet extension carries certain dangers. The application of scientific disciplines like psychology and sociology to problems of man himself leads many to believe that all man's experience is amenable to detached analysis. At this point Prof. Niblett stands firm and, in words of rare poignancy, argues with conviction that there is much in human experience which no known methods of analysis can explore. There are different kinds of facts, different kinds of knowledge, and different kinds of human experience. Some of these can be acquired by direct 'education'; some by providing the right kind of environment, inside or outside the schools. Others can only be arrived at by living itself and by the transmission of standards and values from one person and one group to others.

In the latter part of his book Prof. Niblett suggests ways in which educational institutions can effectively pass on the basic requirements for living like the three 'r's' as well as the basic requirements for life like analytic detachment, humour, humility, responsibility, sympathy, unselfishness and courage. Here some educationists will quarrel with his choice of subjects and the suggested methods of treatment. Few will withhold their respect for views which bear the hall-mark of original thought and which do not regard long-established curricula as sacrosanct or immutable. With many children, for example, Prof. Niblett thinks that much time is wasted in trying to teach them arithmetic despite years of failure; why, for such children, should it not be dropped at, say, fourteen years of age? Much valuable time could

also be saved if a bolder policy of omission were carried out in all kinds of schools with foreign languages and subjects like drawing and woodwork.

Many sixth-form science teachers will feel that Prof. Niblett's strictures on the teaching of science in grammar schools are a little harsh. Yet most will agree that there is the ever-present danger that, to many sixth-form boys, "his science, instead of being a discipline, becomes an end, itself degenerated to a technique, a know-how of getting through examinations and later a know-how of technical progresses, and not the beginnings of a philosophy". Science can, and should, be taught to nourish the imagination and to add to the power to generalize. With teachers who possess both a philosophy of science and a wide scientific knowledge, it is not too difficult for students to catch the meaning and method of scientific inquiry and the humility which goes with it.

The final chapter is concerned with the release of leadership. The value of tradition in the life of the school is well brought out—as is the difficulty of building one in many secondary modern schools which are too tightly controlled by local education authorities. If ground is to be prepared, however, in which leaders may grow, there must be a constant succession of teachers of high quality—men and women whose own lives reflect the most worthy characteristics of a good society. Does our society want such a flow of teachers? What status have they in the community? What salaries are they paid? How many teachers are asked to serve on representative national committees—even committees upon education itself? How many teachers ever appear in New Year or Birthday Honours lists?

These are questions which a good society would be able to answer in a way that would recognize the importance of the teaching profession at all levels to the community as a whole. They have been sharply pointed by an author who has thought deep and writes with such skill and lucidity that his book deserves to become as well known as Sir Richard Livingstone's "The Future in Education".

T. H. Hawkins

TEXT-BOOKS OF NUCLEAR PHYSICS

Nuclear Physics

By Dr. Irving Kaplan. (Addison-Wesley Series in Nuclear Science and Engineering.) Pp. xi+609. (Cambridge, Mass.: Addison-Wesley Publishing Company, Inc., 1955.) 10 dollars.

Nuclear Physics

By Prof. Alex E. S. Green. (International Series in Pure and Applied Physics.) Pp. xv+535. (London: McGraw-Hill Publishing Company, Ltd., 1955.) 64*s*. 6*d*.

In the first of these two books under review, Dr. Irving Kaplan requires no more of his reader than "a two year course in college physics and a familiarity with integral and differential calculus". From such small beginnings he has produced a thoroughly readable and clear account of most features of 'pure' nuclear physics, and found room for such items of 'nuclear technology' as the design of accelerators, nuclear reactors and isotope separation.

In the first quarter of the book the nucleus is approached no more closely than Rutherford's early researches on α-particle scattering allowed. The starting-point is the earliest chemical evidence for an atomic theory and a periodic table of elements. The classical experiments on cathode and 'canal-rays' are described next, and the discovery of radioactivity and elementary methods of radiation detection follow. Particularly well treated is the derivation of the Rutherford scattering law and its verification, in which the original experimental results confirming the predicted dependence on the element, the α-particle energy, the angle of scattering and foil thickness are tabulated. An account of Moseley's work on X-rays is followed by chapters on the quantum theory of radiation, the special theory of relativity and the Compton effect, and the hydrogen spectrum and its interpretation with the Bohr model. The hybrid nature of this model receives proper emphasis; the introduction of wave mechanics completes the first part. A plausible derivation of Schrödinger's equation is included, without any examples of its solution; the interpretation of the periodic table in terms of the electron configuration and the operation of the Pauli exclusion principle are particularly clear.

The second part of the book, approximately one-half of the total, is concerned with the nucleus proper. The difficulties of the 'electron proton' model for the nucleus and its replacement by the 'neutron proton' model, the magnetic and electric moments, statistics and parity are dealt with first. The accurate determination of nuclear masses is described; but the interpretation is left to later chapters. Chapters follow on the laws of radioactive decay, with tables of the natural radioactive series, on the types of nuclear disintegration which may be produced by accelerated particles, on artificial radioactivity and on the details of the interactions with matter and the spectra of α-, β- and γ-radiations. At this point, there is a return to nuclear reactions, the discussion concentrating on the nuclear physics, rather than nuclear chemistry as earlier. The approach is descriptive throughout, and the experimental methods, results and interpretations are kept closely together. The classification of reactions follows that of Blatt and Weisskopf; reactions in the lighter nuclei are dealt with in a separate section and the emphasis in this field on the details of nuclear energy-levels, rather than the reaction mechanisms, is well brought out. The second part of the book closes with a chapter on nuclear forces and nuclear structure. The summary of results on the interaction of two nucleons is perhaps condensed too much, but the evidence for the magic numbers is well set out. The descriptions of the shell model, and Bohr's collective model, are very short indeed, and there is no account of the 'cloudy crystal ball'.

The third part of the book, approximately one-quarter, deals with special topics and applications. 'Neutron physics' is concerned mainly with the detection of neutrons, diffusion and slowing down, and the measurement of the various cross-sections in different energy regions, with little interpretation of results. The remaining chapters are devoted to fission, nuclear reactors, accelerators and isotope separation.

The main general impression is that the book is extremely readable. The line of development is neither strictly historical, nor by subject-matter (certain topics are discussed several times in widely separated sections), but is always clear. All relevant major review articles together with many references