difficult, and it is to be doubted whether the author could have steered us through the really controversial questions in his field. He mentions controversies which have arisen, but a little regretfully. On one question, that of security, he takes a forthright stand, pointing out the danger, even from the strictly national point of view, of too much "negative security".

The book does give a reasonable account of the status of the main national atomic energy projects, and is perhaps at present the best compact source of this information. On the whole, however, I find it too responsible, too comfortable, and too non-controversial. A determined and well-meaning layman who worked through it would scarcely know what all the fuss had been about. G. O. Jones

QUADRUPOLE RESONANCE

Nuclear Quadrupole Resonance Spectroscopy

By T. P. Das and E. L. Hahn. (Solid State Physics: Advances in Research and Applications, Supplement 1.) Pp. ix+223. (New York: Academic Press, Inc.; London: Academic Books, Ltd., 1958.) 7 dollars.

THE subject-matter of "Nuclear Quadrupole Resonance Spectroscopy" is the resonance phenomenon associated with transitions between states the energies of which depend on the interactions of the nuclear electric quadrupole moment with the field gradient provided by the environment of the nucleus. A small magnetic field may be applied in certain cases and its influence is then treated as a perturbation. The converse case of nuclear magnetic resonance in which the quadrupole effects may occur as a perturbation was dealt with in an earlier volume of this series.

The basic physics of the subject is now well understood and quadrupole resonance thus takes its place as an analytical technique of use both to the solid state physicist and the chemist. This book consists of about 80 pages of theoretical discussion, 10 pages on experimental technique and a little more than 100 pages on applications. The reader is referred elsewhere for a discussion of the fundamental theory, and the account of the applications is not claimed to be exhaustive; but in other respects the book is fairly complete.

One of the practical advantages of quadrupole resonance spectroscopy is that it may be carried out without the use of large and expensive magnets associated with nuclear magnetic resonance experiments. On the other hand, the apparatus employed must be made to tune through a very wide band of frequencies and it is therefore usual to use the damping of what is essentially a super-regenerative receiver as a means of detecting resonance. In such a system it is only necessary to vary one tuned circuit. The descriptions of several satisfactory circuit arrangements have been published and references are given.

The applications discussed in most detail are the determinations of the orientations of molecules in the unit cell and the study of the nature of bonding in various solids.

The work as a whole provides a valuable general introduction to the subject and is likely to be of particular interest to chemists. It is to be regretted that the proof reading was not carried out with more care. R. H. Tredgold

RATIONAL DISCUSSION

The Logic of Scientific Discovery

By Prof. Karl R. Popper. Pp. 480. (London: Hutchinson and Co. (Publishers), Ltd., 1959.) 50*s*. net.

IT is customary to believe that scientific method has been explained by Bacon and Mill once and for all. Yet science has changed greatly since these two men—who were not scientists—wrote; and so its methods must have changed as well. Einstein, in his Spencer Lecture given at Oxford in 1933, was the first to point out this change. We do not gain knowledge by reading 'the book of Nature' or by following 'a principle of induction'. We start, instead, by inventing a hypothesis and then proceed to test it by its consequences.

This hypothetical-deductive method was developed in detail by Prof. Karl Popper in the German version of the present book, "Logik der Forschung", published in Vienna in 1934. Pre-war conditions prevented the book from being easily accessible in the English-speaking world. Nevertheless, its ideas infiltrated, so that to-day there exists scarcely a philosopher or scientist who does not reject 'inductivism' and accept the hypothetical-deductive method.

The crucial experiment, according to Popper, is the means by which we decide whether or not to accept a hypothesis or theory. In such an experiment, like Michelson's, we try to falsify a hypothesis. If the outcome is positive, that is, if the singular statements derived from it have not been falsified, the hypothesis has withstood the test and is accepted. A hypothesis is never conclusively verified, for it is usually a universal statement; and no finite series of tests could ever establish its truth or falsity. Such a statement, however, is logically equivalent to a negative existential one, and this can be overthrown by a single experiment. Thus a hypothesis 'proves its mettle' or a theory is 'corroborated'. 'Confirmation', which is the common term describing this situation, is rejected by the author, for it suggests that we can firmly establish a hypothesis; and this is never so in science.

Another reason for rejecting induction is that it does not provide a criterion which would allow us to separate science from empty speculation or physics from metaphysics. This is, indeed, a basic problem, well known from the history of science: many attempts have been made to solve it. Physicists usually speak in this connexion of 'meaning'. Factual statements are meaningful if they can be tested by experiment, at least in principle. For example, statements referring to the simultaneous and exact values of position and momentum of a particle are meaningless in quantum mechanics, since they are ruled out by the uncertainty relations. Prof. Popper altogether rejects a criterion of meaning and replaces it by one of demarcation that is agreed upon by convention and "ultimately a matter of decision, going beyond rational argument". Indeed, what we accept as factual or real changes with the progress of science and is not decided by words; but a criterion of meaning could, in my view, do this job as well.

The more falsifiable a hypothesis is, the more it forbids, the more does it say about the world. This is the well-known inverse relation between logical range and factual content of a statement. The hypothesis which is falsifiable in a higher degree can also be corroborated better; and this depends less on the number of favourable instances than on the severity