is that it inspired a more successful and more frank farce, the play *Inherit the Wind*. A serious enquiry into present-day anti-evolutionism, not attempted by this book, is urgently needed. GEORGE GAYLORD SIMPSON

IN DEFENCE OF PERSONAL KNOWLEDGE

The Knower and the Known

By Marjorie Grene. Pp. 283. (London: Faber and Faber, Ltd., 1966.) 42*s*. net.

THE first thing to notice about *The Knower and the Known* is its dedication to Prof. Michael Polanyi; a direct pointer to an emphasis on personal knowledge, indeed an extension and defence of that outlook. Prof. Grene's contribution has come at an appropriate moment, and her analysis, coupled with a pleasant style, will repay careful study. There are three main sections: knowledge as conjecture; the structure of experience; and the complexity of things. At the end is a competent discussion of the late Sir Ronald Fisher's *Genetical Theory of Natural Selection*, which forms a separate appendix. If there is one quality which these pages rightly place on a pedestal, it is that of intellectual humility. Descartes believed that he had solved every problem which had confronted, or could confront, the human race, while the genius of Newton had produced the perfect picture of a mechanical cosmology. Yet, all this was to predict and, if need be, to falsify, but not to understand. Whitehead once remarked that it was the medievalists who walked by reason, whereas we walk by faith. Nevertheless, credulity will always seek to understand, and that is what personal commitment means, as contrasted with sheer objectivity. If we are to recover from dead things, then we have to reckon with the unspecifiable element in knowledge, which is never explicit. It is possible, naturally, to cogitate in terms of billiard balls, hard lumps of matter, and so forth, but this is not comprehension, which involves an element of passion, which lies at the root of all great discovery. Aristotle's taxonomy was magnificent, and his logic superb, yet devoid of commitment or revelation.

This throw-back to the Stagirite is no accident: Grene is at home with the philosophy of the Lyceum; one can almost hear the steps of the peripatetics in the background. An epistemology fitted for the study of the living there must be, if existence in an arid waste is to be avoided. This connotes a large measure of responsibility in research; discovery is not detached spectatorship.

Now the odd feature about all this—as everybody will realize who has worked in any branch of higher education during recent years—is that the present generation of students has sensed this very thing without any trained ratiocination or prompting. There is a widespread reluctance to enter the (purely) mathematical sciences; the urge is to do something more in keeping with the needs of the living. Hence the pressure on the biological and social sciences. That there is a lurking danger in this, nobody can deny. (Lord Rutherford is reported as having observed, on one occasion, to Sir Gowland Hopkins, "How delightfully easy it must be to be a biologist".) If there are many unable, or unwilling, to face a mathematical discipline, there are a few who are looking towards a new kind of differential equation, capable of dealing with systems of giant molecules. It remains to be seen whether this attitude will prove constructive or destructive: whatever happens cannot obliterate the quest for personal knowledge, but it may well shift the burden of appreciation from a direct aesthetic appeal to one of more abstract type. In which case, the battle for subjective entailment will begin all over again.

Prof. Grene, in her copious references, seems to have overlooked the particular approach of the late Dr. Agnes Arber in this very context of morphology. She demonstrates the influence of Spinoza as a turning-point in the exploration of form.

Perhaps this volume reaches its zenith in Chapters 8 and 9, where the discussion ranges over the multiplicity of forms, time and teleology. We are still bidden—almost coerced—'to understand', but the price of doing so is clearly revealed. In terms of psychology this is very close to the Gestalt-concept, the apprehension of the whole in terms of its parts, and not only so, but the explicit recognition that an aim is a function of the means taken to attain it. The transition from here to teleological processes is easy in principle; few ventures have generated greater heat than this in scientific argument. To the naturalist, ends, goals, and even purposive behaviour, stand out sharply against the strict 'yes–no' of classical thought. Nobody expressed the fundamentals of the situation better than the late E. S. Russell (*The Directiveness of Organic Activity*), though not in the exact idiom of the author of *Personal Knowledge*. Probably such tendencies in natural systems can be transferred to the creative arts, wherein theories of minimal energies can suggest, even if they cannot prove, the existence of an *extremum*, in which satisfaction is found for eye or ear. It was not for nothing (p. 204) that Kekulé dreamt of snakes chasing their tails, which is alleged to have been the basis of his discovery of the benzene ring. Quite recently, in Holland, a concept of this character has produced a number of patterns of surprising beauty, dependent on the crystallographic symmetry of close-packing.

All in all, there is little doubt that we are moving away from mechanics as a powerful element in methodology (never to be confused with logic) in brave attempts to create a new theory of knowledge which will abandon explicit knowing as unattainable in this life. Having made this sacrifice (if ever we do), a happier epistemology may arise on the embers of determinism in the seventeenth century sense. Volumes like the one now under review will help. It should appeal to a wide circle of readers, who would do well to keep it near at hand if any of them are directors of research. For no discovery has ever been made without zeal—zeal to believe that there is a problem to be solved, and joy of a passionate kind on reaching journey's end. Prof. Polanyi himself pleads for a strong measure of patience and forbearance with existing theories before they are deliberately overthrown. Savants are not professional iconoclasts, and reverence for tradition is at least an element in true scholarship.

On p. 252, Prof. Grene refers to the problem of pain, and considers that "it makes life wholly present, and therefore wholly meaningless". One may doubt whether this view, plausible as it sounds, represents much more than a superficial reaction. To judge from their writings, this was not the experience of the saints and mystics (experts in the pursuit of personal knowledge) who, far from being deprived by it of their transcendence, found in it their finest hour. F. I. G. RAWLINS

AN IMPERFECT ANALOGY

The Railroad and the Space Program

An Exploration in Historical Analogy. Edited by Bruce Mazlish. (Technology, Space and Society.) Pp. xix + 223. (Cambridge, Mass., and London: The M.I.T. Press, 1965.) 7.50 dollars; 57*s*. net.

IN 1962 the U.S. National Aeronautics and Space Administration, wishing to find out more about the probable long-term effect of its space activities, made a modest grant for an academic study of the subject. A committee of the American Academy of Arts and Sciences decided that the study should take the form of a historical analogy with some previous enterprise, and Bruce Mazlish, the editor of this book, chose to direct attention towards the development of the American railroad. After