

volume are here laid by a consistent use of tensor and geometrical methods.

The book is full of wise saws and modern instances, all eminently quotable if space did but permit. It is cheerful in style, profusely illustrated by diagrams, and beautifully printed. That its author himself directs attention to the debatable nature of some of his work in no way lessens its interest, but on the contrary makes it all the more stimulating. The pure mathematics in it is alone sufficient to make it an important contribution to the literature of relativity.

H. S. RUSE

THE ORIGINS OF INTELLECT

The Child's Construction of Reality

By Prof. Jean Piaget. (Translated from the French by Margaret Cook.) Pp. xiii + 389. (London: Routledge and Kegan Paul, Ltd., 1955.) 25s. net.

THIS is a companion volume to Prof. J. Piaget's earlier book on "The Origins of Intelligence in the Child" and should be studied in close connexion with it. In his earlier work, Prof. Piaget aimed to define the processes by which the young child comes to create an external world; in the present volume, he devotes his attention more specifically to the nature of the world created. In short, we are now concerned with the products of the child's thinking rather than with the thought processes themselves. None the less, the two aspects—subjective and objective—are so closely related that an independent treatment of either is scarcely possible. For this reason, it is necessary to consider the two books essentially as one.

The growth of the child's conception of external reality is treated by Prof. Piaget under four main aspects: first, the development of object-concepts and the correlated treatment of objects as being both individual and permanent; secondly, the evolution of a spatial framework common to all sensory modalities; thirdly, the development of ideas of causal relationship; and fourthly, the organization of a temporal field endowing external events with some measure of coherence. These four processes, which are of course closely inter-related, are supposed by Piaget to develop through a series of well-marked stages, and his main task in the present book is to reconstruct the nature of the child's world at each stage. In some measure he would appear to succeed. The main theoretical conclusions derived from the two studies are brought together in a final section of this volume.

Although Prof. Piaget's systematic psychology is difficult, and at times obscure, his work brings out a number of points of the highest interest and importance. For example, his careful observations of the earliest reflex patterns make it clear that some measure of adaptation of response to the finer characteristics of the stimulus field appears to be present *ab initio*. This makes possible a theoretical treatment of reflex action much less rigid and mechanistic than is *de rigueur* in present-day psychology, and permits an altogether easier transition from the more to the less automatic varieties of behaviour. Again, Prof. Piaget's treatment of spatial perception clearly brings out that this activity, from a genetic point of view at least, cannot be considered apart from the study of movement. Space, as he rightly points out, is an organization of movements such as to impose

upon perception spatial relations that are increasingly precise and coherent. More generally, space may be regarded as a product of interaction between the organism and the environment in which it is impossible to dissociate the content perceived from the motor activity of the percipient. Although statements of this kind are perhaps too broad to convince, they serve at least to focus attention upon the role of action in the growth of our knowledge of the external world. Prof. Piaget's evidence may also be of great value to neurologists and others interested in the breakdown of spatial perception in abnormal states of the central nervous system.

Although Prof. Piaget bases his arguments throughout on empirical considerations, it cannot be said that the material presented in this volume possesses any great evidential value. It consists in the main of some two hundred observations—some little better than anecdotes—which the author has made on three young children (presumably his own), and no attempt is made to confirm the findings by means of appropriate large-scale inquiry. Indeed, many of these observations, despite their undoubted perspicacity, do little more than provide apposite illustrations of the author's theoretical contentions. Examples have great value so long as they are not confounded with evidence. Can we be quite sure that Prof. Piaget is himself free from this source of confusion?

This book is original and thought-provoking. Prof. Piaget is perhaps the last of the great psychological system-builders. Although a whole host of empirical researches have been woven into the fabric of his system, it remains at bottom personal, speculative and unverifiable. It is not science, but it may well be the necessary precursor of a scientific psychology.

O. L. ZANGWILL

ARRESTED GROWTH IN ARTHROPODS

The Physiology of Diapause in Arthropods

By Dr. A. D. Lees. (Cambridge Monographs in Experimental Biology—No. 4.) Pp. x + 151. (Cambridge: At the University Press, 1955.) 12s. 6d. net.

THE periodic arrest of growth or reproduction that is so characteristic of the life of arthropods in temperate latitudes forms one of those subjects which provide problems of the greatest theoretical interest and at the same time are of much practical importance to the applied biologist and the farmer. As his title implies, in this latest volume in the Cambridge Monographs in Experimental Biology Dr. A. D. Lees is concerned primarily with the more fundamental aspects of diapause: the physiological nature of the arrest and the ways in which its timing is regulated to fit in with the possibilities of life at each season. At one time diapause was regarded primarily as a state of subdued metabolism. Then it came to be thought of rather as an arrest of growth, the reduced metabolism being secondary; and when growth in the insect was shown to be dependent upon the secretion of hormones, the theory was put forward by Wigglesworth that the immediate cause of diapause was a failure in this secretion. By and large that conception has been supported by experiment: in the pupa in diapause the neurosecretory cells in the brain are inactive.