Lorenz's Concept of the Origins of Adaptive Behavior

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In the course of its short history the biological study of behavior, known as ethology, has burgeoned into a popular discipline with investigators in many countries pursuing many different lines of research. Yet behind this present diversity the core of ethology has remained in some ways a matter of controversy. This core is the fact of biological adaptation, and the two different processes by which this adaptation is achieved. The longer-term adaptive process is the action of natural selection, acting in evolutionary time to structure genotypes such that all of the characteristics of an organism, including its mode of living, function well in its native environment. In defense of his views on the effects of natural selection on behavior, Konrad Lorenz has revised and extended a paper which he first published in German in 1961, and which now appears as a book—**Evolution and Modification of Behavior** (University of Chicago Press, Chicago, 1965. 125 pp., $3.50).

Lorenz's main purpose in this book is to support the concept of the innate by criticizing attacks that have been directed against the validity of the concept, and by explaining a type of experiment by which evidence for it can be gained. He begins by taking exception to the claim that innate and learned can be distinguished only by mutual exclusion. His central theme is that there are two, and only two, means by which information about the requirements of the environment can be acquired by an organism. One is adaptation via evolution in which the environmental exigencies determine what information is stored in the gene pool of a species. The second source of environmental information is via the sensory receptors of an individual organism.

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The Innate Vis-à-Vis the Learned

Two means of dealing with sensory input provide the key to his distinction between the terms *innate* and *learned.* Both inherited information and sensory inputs are present in an individual simultaneously, but there are aspects of some responses which depend for their adaptiveness only on genetically stored information, while other aspects require modification based on information acquired during individual experience. The adaptive modification of responses based on individually acquired sensory information is learning, and the other instructions governing behavior are innate. (Lorenz's definition of learning is both broad and loose, but, as he applies it, the definition appears to serve his purpose without confusing the issue.) It is further important that learning cannot *automatically* achieve adaptive improvement and yet does usually lead to adaptation. Only chaos could result if learning were to lead to random changes in behavior patterns, so Lorenz infers that there must be innate instructions determining the choice of behavioral possibilities to be reinforced and of those to suffer extinction. "The central problem of all reinforcing and/or extinguishing mechanisms lies in their content of innate information telling them what is 'good' and what is 'bad' for the organism" (p. 17). Lorenz believes that what he calls learning "mechanisms" are evolved to exploit individual experience, and as a biologist he sees this experience in terms of a species' natural state in which its evolution occurred. Laboratory investigators can become prone to overlooking phylogeny and survival function because they customarily deal with animals in extremely unnatural surroundings, and, indeed, with extremely unnatural animals.

Another claim which has been leveled against the concept of the innate is that it is impossible in practice to exclude the possibility that learning occurs in the very earliest states (stages that are inaccessible to the investigator) of an organism's ontogenetic development. Lorenz grants that within almost any "functional unit" of behavior some or much of the adaptedness may be due to learning, but points out that an organism cannot extract from its environment something that is not there. Thus, a developing male stickleback fish may improve its swimming, its perceptual abilities, and so forth, and may need to do so if he is to be able to respond correctly to a rival male when he is sexually mature. But the feature that sets off this response is the red undersurface of his rival, and it will set off the response even if the experimenter has established conditions in which his test animal could not have learned the stimulus. This withholding from a developing animal information that is critical for the performance of some behavior pattern is what Lorenz calls a "deprivation" experiment; he describes the technique and its limitations in detail, as it is of considerable importance in proving his views.

In addition, Lorenz does not subscribe to what he calls the attitude of modern English-speaking ethologists, that phylogenetic adaptation and individual adaptive modification of behavior are so thoroughly mixed that "all behavior, down to its smallest elements, owes its adaptedness to both processes." Again, he exemplifies with the stickleback and other animals the point that deprivation experiments can show the existence of both genetically fixed receptor patterns (usually simple) and fixed motor patterns (usually more intricate). He admits that the former are usually made more selective by learning, and that integration of the latter with other behavior may require learning before the motor patterns become fully functional. These influences of learning do not, however, obscure the existence of the unlearned "chunks." As a second argument he advances the hypothesis that "the survival function of learning presupposes phylogenetical programming" (p. 106)—for which programs he had earlier coined the happy description "innate schoolmarm" in rebuttal to a psychologist's critique. He admits candidly that the rebuttal bounced back on nearly all of the "older ethologists," himself included, for never having asked why learning usually resulted in adaptation of behavior.

Behaviorists: Watsonian Connotations

A number of general criticisms could be made of this book. Lorenz is undoubtedly unfair in calling all American psychologists "behaviorists," especially as he appears to use the term with purely Watsonian connotations. And yet this does the book no harm, for he attacks neither the men nor their work, but only some arguments that they have raised against his work. Similarly, it is doubtful that all "modern, English-speaking ethologists" form a cohesive group, even with respect to the attitude to instinct theory he ascribes to them, yet he successfully deals with the inadequacies of this attitude (while ignoring the better results of their examination of the abundance of unlike phenomena sheltered under the term "instinct"). A prolonged attack on a paper exploring the concept of operationism with respect to differences between behavior patterns makes its point, but ignores the virtues of being able to deal with *differences* that are attributable to neither learning nor evolution *per se*, but to different experimental manipulations. Here he unfortunately skirts an important problem in casually dismissing the effects of pathology on behavior. This is not because he does not realize the potential magnitude of such effects, but because he believes (and with considerable reason) that he is capable of avoiding or recognizing pathology. Yet in many ways pathological and other changes can be extremely instructive and their intentional induction is a powerful technique (as it has been in some of his own imprinting studies). There are in addition a number of lesser cases in which his treatment of some terms and concepts is unnecessarily vague—for example, "information" (see especially p. 26).

What should be kept in mind is that Lorenz is arguing a very specific point, and the weaknesses of the book are all tangential to that point. We should possibly get a very different view of these issues if he chose to turn his attention their way. It is in fact enormously pleasing that he has produced such a clear statement of his views on the concept of the innate, and that he has largely eschewed the aggressive polemics which have occasionally marred discussion of this central topic in ethology.

A few minor criticisms are appropriate. In some late stage of editing it seems that frequently the written numeral "1" was transposed to the printed "7," and that many (but not all) page references which appear with the numeral "7" need interpretation (for example, "77" should be "11"). Also mildly annoying is an asterisk on page 12 which tantalizes but does not fulfill, and the use at times of the word chapter instead of section in reference to a preceding part of the same chapter. But such irregularities are few, and praise is due the publisher for producing an attractive format for this important little book. I strongly recommend the book to ethologists and comparative psychologists alike, as a lucid statement of the importance of phylogenetic adaptation in behavior.

Polar Cap Experiments

High Latitude Particles and the Ionosphere (Logos Press, London; Academic Press, New York, 1965. 328 pp., $16), edited by B. Maehlum, contains the proceedings of the symposium organized by the COSPAR Panel on Polar Cap Experiments and held in March 1964. Books of this type could be particularly useful to those who are unable to attend meetings but would like to keep in touch with their own fields of work. The inclusion of summaries of the discussion and the informal style of many of the contributions will be particularly helpful in this respect. The usefulness of such volumes as permanent records could be greatly enhanced by more rapid publication. Although the editor and the publisher have made this volume available with only a comparatively short delay, certain parts of the proceedings have already been published, and in a more detailed form, in recent issues of scientific journals.

The book will undoubtedly serve as useful source of references to the many new observations of particles and their ionospheric effects described in it; it also contains several good review articles.

The revolution in polar physics caused by the advent of rockets and satellites is discussed by R. L. F. Boyd, whose introductory lecture precedes several papers on ionospheric exploration by probe and propagation experiments from satellites and rockets.

Most readers will enjoy the stimulating discussion of particles and fields (including electric fields) by C. G. Fälthammer. Several other authors also stress the importance of electric fields and the difficulties of measuring them. Fälthammer's discussion precedes several descriptions of the methods used and the results obtained with particle detectors on the Injun I and III and the Alouette satellites and on rockets launched from Norway.

Observations of indirect effects of particles such as radio wave absorption and scattering, and changes in the phase of very low-frequency radio waves, form the subject of most of the remaining contributions.

I noted relatively few errors and misprints. One minor misprint, which could cause difficulties, is the reference to "injected positions," instead of "injected positrons" (p. 77). The book can be recommended as a source of references to recent observational results and as a review of research on high latitude particles.

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Optical Mineralogy

Microscopic Identification of Minerals (McGraw-Hill, New York, 1965. 427 pp., $10.50), by E. Wm. Heinrich, is intended as an elementary introduction to optical mineralogy, but the scope is more limited than is implied by the title. A brief introduction to the methods of studying minerals by the microscope (12 pp.) precedes a brief description of optical properties of minerals (15 pp.). The bulk of the book (337 pp.) is devoted to the description of 180 minerals, in detail, under the headings composition, indices, color, form, orientation, and diagnostic features; partial descriptions or tabulated data are included for 116 additional mineral species. The book differs from many textbooks in optical mineralogy in that special emphasis is placed on the characteristics of crushed fragments in immersion mediums; additional brief reference is made to the characteristics of selected minerals in thin section, or their appearance as detrital grains. Separate tables (27 pp.) give ranges of indices of refraction, colors of minerals by optical groups, twinning of minerals, birefringence, and relief in thin section. The tables are limited in the number of minerals for which data are given, and most of the tabulated data are organized to indicate rather broad ranges: