Mechanisms of Animal Behavior: Recent Work and Theories

Reading assignments for courses in animal behavior can be something of a nightmare for the teacher, the student, and the librarian. Journals from several disciplines must be brought together, often from different libraries. Even the advent of inexpensive copying machines cannot alleviate the strain on students of lining up for a hurried reading of several reprints that are on 1-hour reserve. A solution to this problem is the book of collected readings or invited essays. For one reason or another, however, these often do not suffice. Sometimes they are too short, sometimes too narrow or eclectic.

The ideal collection would balance theoretical considerations against actual results in a variety of subjects. For a course concerned with the mechanisms underlying animal behavior, the only book hitherto approaching this ideal has been the excellent symposium volume *Physiological Mechanisms in Animal Behavior*, published in 1950 by the Society for Experimental Biology (S.E.B.). But this book has some serious deficiencies—in physiological psychology for example; also the relationship between hormones and behavior is hardly mentioned—and a lot has happened in the last 15 years.

The S.E.B. volume originated as a symposium. Given free access to the behavior literature, a collection such as this one, **Readings in Animal Behavior** (Holt, Rinehart, and Winston, New York, 1965. 592 pp., $12), should achieve more complete coverage. The editor, Thomas E. McGill, has gone a long way toward this ideal, with 55 papers arranged under seven headings: Introductory Readings; Behavior Genetics; Neural, Hormonal, and Chemical Control of Behavior; Development of Behavior, Critical Periods, and Imprinting; Sensory Processes, Communication and Orientation; Learning and Motivation; and Social Behavior, Ethology, and Evolution. Generous space is given for several authorities to speak their minds on questions of theory and tactics. Ethology gets a prominent hearing in reviews by Hess, Thorpe, Hinde, and Tinbergen. Two well-known papers by Beach chastise comparative psychologists for not being comparative and question the value of the concept of instinct. They move toward a synthesis of ethological and psychological viewpoints and set the tone for much that follows.

The value of juxtaposing theoretical discussions and presentations of experimental results is well illustrated in the section on behavior genetics. Hirsch and McClearn set the scene by reviewing the history of the neglect of genetic considerations, particularly in behavioristic psychology. Several papers then demonstrate genetic contributions in domestic mouse strains to variation in such behavior as susceptibility to audiogenic seizures, alcohol preference, exploration, wheel running, and copulation. These studies are largely concerned with establishing for behavioral traits the validity of genetic principles already worked out for morphological characters. It remains to be seen whether behaviorists need to develop new genetic theories. Otherwise the most exciting developments are likely to come from genetic approaches to other types of problems such as those that arise in studies of motivation or of ethological isolating mechanisms.

The history of exchanges between behavioral research and physiology is longer than that between genetics and behavioral research, and the interplay between experiment and theory is also more intricate. Papers by Brown and Hunsperger and by Delgado show how behavioral insights can illuminate the interpretation of brain stimulation experiments. Hormonal factors in the control of reproductive behavior are described in three beautifully complementary papers. The late W. C. Young and his colleagues review the effects of perinatal testosterone on the organization of sexual behavior. Aronson considers the apparent independence from hormonal control of reproductive behavior in some species. Lehrman and his associates relate one phase of their developing story on hormonal contributions to avian reproductive behavior. Not the least valuable part of such papers is the introduction to techniques, sometimes exquisitely precise as in Dethier and Bodenstein's paper on the physiology of feeding behavior in flies. New frontiers in brain chemistry and behavior are broached in two papers—one by Krech, Rosenzweig, and Bennett, and the other by Davis and Miller.

The interaction of exogenous and endogenous factors in behavioral development is the subject of ten papers. Schein and Hale and Moltz and Stettner consider effects of early experience on bird behavior, but most of the papers are concerned with mammalian development. Genetic and environmental effects, pre- and postnatal, on the emotionality of rats are explored by Levine, Broadhurst, and Thompson. King considers methodological problems that arise in this work. Scott's review of the importance of critical periods in behavioral development is accompanied by copies of his ensuing correspondence with Schneirla and Rosenblatt, as well as by the latter authors' own paper on the development of social bonds in ants and kittens. With the articles by Denenberg on critical periods of development in rats and by Mason and Harlow on the behavior of socially deprived rhesus monkeys, this group of papers illustrates nicely a coherent program of research, one of the aims of the editor in compiling the book.

Integration of the disciplines of animal behavior and physiology is particularly complete in the area of sensory physiology, as Wells shows in his review of the sensory abilities of the octopus. Some of the more spectacular behavioral achievements of animals, such as echolocation by bats and porpoises, described by Griffin, Webster and Michael, and by Kellogg, and the homing abilities of salamanders and birds, demonstrated by Twitty and Matthews, challenge our understanding. The abilities of the honey bee to orient by celestial cues and to communicate the position of food sources, reviewed by von Frisch and Lindauer, were frankly disbelieved by a generation of biologists. The sensitivity of electric location discovered by Lissmann in fishes strains the imagination. Roeder and Treat's demonstration that moths can detect and avoid the sounds of bats, and several of the other studies reprinted here, have led directly to reexamination of the physiological capabilities of receptors and a reappraisal of how they operate.

The last two sections are on learning and social behavior, and these sections seem the least satisfactory. Perhaps they lack the impact of a body of recent work organized around a common point of view. Bitterman, the Warrens, Dews, and the Brelands develop their rationale for pursuing the comparative study of learning abilities, and present examples

of interspecific variations. Butler and Woolpy, and Thompson explore the types of visual stimuli, social and otherwise, that are rewarding to cockerels and monkeys. McConnell's well-known paper on memory transfer through cannibalism in planarians is reprinted. As an example of learning in a naturalistic context that has evolutionary implications, the Browers demonstrate stimulus generalization in avoidance learning by toads. Having learned to avoid bumblebees, toads also refrain from feeding on robber flies, which have evolved as harmless mimics of the bumblebee. Still further removed from psychological learning theory is Hinde's critical review of the energy motivation models of Freud, McDougall, Lorenz, and Tinbergen, which perhaps would have been better placed in the introductory readings.

The section on social behavior, ethology, and evolution is prefaced by Scott's discussion of social organization and processes of socialization. King writes on interspecific competition between deermice and a strain of domestic house mice, Shaw on the development of schooling in fishes. Dilger's study of captive love birds serves well to introduce methods of observing and describing social behavior and is complemented by DeVore's field study of mother-infant relations in baboons. Tinbergen presents evidence that the gulls' habit of removing broken egg shells from the nest has survival value in that it reduces predation.

The bias of this collection is, if anything, psychological rather than zoological. Some issues that loomed large in the S.E.B. Symposium in 1950 —such as the embryology of behavior and the analysis of behavioral rhythms —are not included. Modern research on circadian rhythms can provide excellent illustrations for many of the principles underlying behavior, and I would want to assign the Cold Spring Harbor Symposium on biological clocks as a companion to these readings. But, if all such suggestions were added to the book, it would soon become too cumbersome and too expensive to serve its purpose. In its present form, as an introduction to the recent works and theories of some of the more vital contributors to animal behavior, it will be a boon to teacher, students, and librarians alike.

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Machine Data Processing and Plant Taxonomy

A few years ago we were told that the handwriting was on the wall; some even saw it: "Taxonomy by the numbers!" Among biologists today, despite widespread distaste for even simple mathematics, fear of sacrificing individuality to bureaucracy and technology, and suspicion of change *per se*, its instruments and advocates, there is an accelerated conversion to the belief that electronic processing of numerically coded data can contribute to the solution of taxonomic problems to such a degree that to ignore or disregard it is unthinkable. Even those who reject machines as a partner in making taxonomic decisions (a baseless fear of displacement, or a well-based fear of "speed-up"?) must admit that primitive filing and indexing methods are no longer capable of storing and retrieving the vast amount of biographic, bibliographic, biogeographic, and nomenclatural data necessary to document taxonomy. In the Index Nominum Algarum being prepared at Berkeley, the diatom genus *Navicula* is represented by more than 4000 specific and infraspecific names. Let anyone who can demonstrate his ability to do taxonomic work in *Navicula* without resorting to machine data processing step forward to receive well-deserved kudos. The usual practice is to make a superficial search through the literature and, if a suitable description or figure does not happen to be encountered, to describe the material at hand as a new taxon. Thus, large genera become disproportionately larger.

In the face of deeply rooted prejudice as well as sound criticism, Sydney W. Gould has persisted in his zealous attempt to bring the importance of electronic processing of documentary data to the attention of plant taxonomists. So far two parts of a monumental program have been published as the first two volumes of the **International Plant Index**: vol. 1, *Family Names of the Plant Kingdom* (122 pp., $2.50) by Sydney W. Gould; and vol. 2, *Authors of Plant Genera* (336 pp., $6) by Gould and Dorothy C. Noyce. Both volumes were published by the New York Botanical Garden and the Connecticut Agricultural Experiment Station.

The volumes should not be mistaken for definitive indices; rather, they are the results of pilot-plant operations and thus are intended to serve as procedural guides as well as to inform the public of the purpose, scope, and methodology of the project. Taxonomists are urged to read carefully the introductory material to both volumes before criticizing the work.

If the typography of the first volume is crude, the second is handsome. Printing was accomplished by electronic copysetters using programmed magnetic tapes. Of the two volumes, the first, which presents alphabetical and phylogenetic lists of familial and ordinal names, is most immediately useful. *Authors of Plant Genera* may evoke the initial response, "Who cares?" Perhaps the alphabetical author index, which constitutes the bulk of this volume (pp. 17 to 240), was an unfortunate choice of a print-out to introduce to the public at this time. This list is of use mainly to Gould's group. The author code index (pp. 241 to 302), on the other hand, is a key to a code and hence essential for any user of the *International Plant Index*. The coverage of authors is not clear; some of the workers listed have named neither genera nor any other taxon.

It would be unrealistic to expect universal agreement on the details of coding, but taxonomists hopefully will save their thought and energy for a consideration of the principles and expected results. Some conceivably useful print-outs that can be obtained from the stored data are suggested by Gould (vol. 1, p. 10-R). At the moment, I would greatly appreciate having a print-out of all species of marine algae with type localities in California.

But, after agreeing that machine data processing offers tremendous advantages and after granting Gould's group freedom of choice of coding details, there is a residual feeling that something is amiss. The clue lies in Gould's writings, in which there is abundant evidence of a failure to distinguish taxonomy from nomenclature and a lack of understanding of the principles of both. The potential uses of computerization in the documentary aspects of taxonomy are remarkable, but are