Editors' Introduction

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Knowledge is power. To understand something is to have the potential to control it. If you know what causes an effect, and if you can control the cause, you can produce the effect at will.

Taking this as an article of faith, human beings have studied the world around them, and that world includes other human beings. Even with only modest ability to remember and learn, an examination of experience reveals certain regularities. The recognition and identification of correlational sequences then permits the application of inductive logic to hypothesize causal relationships; identification of causes allows prediction of specified outcomes. The appearance of a specific event of the class which has in the past always preceded an outcome allows for the prediction of another such outcome.

We may recognize this process and formalize it by calling it the Scientific Method, but there is nothing terribly mysterious or complex about the process itself. It may be recognized as a description of a learning process used by every child who reaches the age of reason. The first portion of this process may be found in every creature capable of learning and merely assumes that the past is a predictor of the future, that is, what has happened regularly in the past will continue to happen in the future. If two events have always occurred together in our past experience, then whenever we see the first, we look for the second.

The next portion of the process requires an ability to manipulate the environment so that the effect can be produced by gaining control over the cause. When we formalize the process, we call the testing of the relationship between two events, by producing one at will and looking for the second, an experiment.

The original collection of experience, or data, has been called empiricism and the induction of explanations, which permit the generation of specific hypotheses, is theory building. Only those theories which can be used to deduce specific future outcomes, in situations which can be produced and replicated at will, are considered in the domain of Science. It is not enough that the predictions be logically true as derived from the postulated

premises, reality testing (or experimentation) looks to see if the specified outcomes occur. If the experimental outcome is as predicted, we feel that there is some support for the relationships postulated in the theory, whereas if we fail to find the predicted outcome, we have cast doubt on the premises leading to the prediction.

Inasmuch as we can never exactly duplicate our past experiences, and inasmuch as particular outcomes may result from more than one preceding set of events, our tests cannot produce absolute proof and we can only generate probability statements concerning various alternative explanations. Since experimental outcomes contain an element of uncertainty, certain risks are inherent in testing presumed relationships. Where outcomes may prove dangerous, we proceed with some caution. When we are concerned with the effect of a variable upon some important process in ourselves, and are fearful of the potential risks, then we seek a substitute, or a model for ourselves. Such a substitute should be as much like ourselves as possible so that the influence of the original manipulation will not be modified by interaction with elements not found in our own systems.

This then accounts for the development of animal models in research, and for our particular fascination with nonhuman primates. Problems which are impossible to examine with human subjects, or where the risk to humans would be too great, are examined using a substitute species. We have considerable latitude in the selection of subjects when the processes are basic and general, but when the processes reflect specializations absent in many lineages, then we turn to the primates as animals which are likely to share common features with ourselves, due to common origins and similar development in the face of similar selective pressures.

In the study of social behavior we may ask questions about the basis of common social patterns, when the origins of such patterns are buried in the history of human origins and are no longer directly observable. An animal model may be examined to search for common basic elements and to ask how the primitive condition could have evolved into the present expression.

Many people from diverse disciplines have addressed themselves to the study of social behavior and social organization. They have examined particular environmental conditions in which alternative forms of organization and behavior exist in order to try to understand what factors account for the observed variance in expression. Some have viewed societies as immediate responses to ecological conditions, while others have tried to

derive modern social systems from a presumably more primitive state responding to ecological pressures in time. Many have marshalled comparative data, available fossil and paleoecological data, and argued for one interpretation or another of early hominid society. These explanations account for data in logically acceptable fashions and build cases arguing that a particular sequence should have logically come about.

The difficulty with such models is that they are all logical and satisfactorily "explain" the same data, and yet may be contradictory. It is apparently all too easy to argue for the rationality of any logical model. It is far more difficult to design a test for such models, especially if the events being described are buried in the past.

We have, therefore, turned to the nonhuman primates in our search for understanding of human social organizations and social behavior. First, we asked what was basic and general in the order. Next we asked if there were particular conditions which produced particular variations. Then we asked if there were suitable primate subjects living under conditions sufficiently similar to the circumstances of early hominid groups such that we might argue that the organization of the nonhuman primate group would be similar to that of early hominid groups.

The first models were proposed after examining our accumulated knowledge of different kinds of primates (and other animals) under captive conditions and in their natural habitats. The pioneers in this field included Sir Solly Zuckerman (1932), C. R. Carpenter (1939), and M. F. Ashley Montagu (1943). They found themselves faced with a paucity of data which would allow only very general statements. It was clear that much more information would be required for proper theory building. The pioneering field work of such people as C. R. Carpenter revealed the inadequacies of much of the available information, which consisted of little more than anecdotes and hasty generalizations, many of which proved unreliable. A whole generation of investigators then returned to the field to collect the basic data required. This did not prove an easy task, for not only were working conditions difficult, but the task itself was difficult to define. Neither social organization nor ecology can be placed on a unidimensional scale for measurement, and we are still identifying the component variables of each.

As values for identified variables became available, new theories were generated. Washburn and DeVore clearly exemplify the interest in theory building which motivated some of the first modern primate field studies (DeVore, 1963). It, nonethe-

less, took nearly ten years before a sufficient diversity of studies had been completed to permit correlational approaches. Crook and Gartlan (1966) tried to relate selected aspects of social organization to five conceptual habitat types. They reviewed the new data on primate social organization and tried to relate it to the descriptions of field study locations. They recognized this as only a beginning and have continued to review new data and revise their original hypotheses.

The rate of data acquisition has not diminished, but the fundamental attributes of ecology and social organization are still not fully identified. Model building has become more sophisticated and correlational models have suggested more fundamental relationships. Denham (1971) tried to define ecology more explicitly in terms of two attributes of food distribution: quantity and dispersion. Although dealing with only a limited aspect of ecology, this model allowed for measurement and prediction. If food were the primary selective pressure operating on social organization, then this model would account for the greatest portion of the variance in social organization.

Populations are surely shaped primarily by the most intensive selective pressures operating. Evolutionary processes produce adaptive changes which relieve the pressures, but any time a pressure is relieved, it becomes less important relative to other pressures, which in their turn now become the primary pressures operating. Populations are therefore shaped first by one pressure and then by another, not only because the pressure itself may change, but also because adaptive processes may reduce the strength of the pressures. Morphological and behavioral responses will therefore accumulate according to the history of their adequacy in dealing with past and present situations, and at any one time will be most influenced by the factors which most limit genetic fitness. The history of such adjustments lies in phylogeny, and, to the extent that these adjustments are now carried in the genetic system, we may expect certain attributes of individuals to reflect adjustments to past "primary pressures" rather than the paramount pressures of today. This is no more than to say that present behavior is a result of the interaction of the individual's responses to present situations and his genetic inheritance.

Many social scientists trained in various behaviorist traditions may find this statement too strong. Perhaps it should be restated, then, to say that since morphology is clearly at least partially an outcome of genetic coding, and since morphology

includes: (1) the receptor system which delimits stimuli which an organism may receive, (2) the motor system which delimits the responses which an organism may make, and, (3) the nervous system which acts to link and modify the connections between the receptor system and the motor system, it follows that the range of behavioral response is clearly limited (rather than determined) by genetic inheritance. This syllogism need be carried but one step further to demonstrate that social organization, a reflection of the behavioral interactions of individuals, is itself subject to evolutionary processes.

In searching for the means by which evolution could modify social organization, Goss-Custard *et al.* (1972) presented a description of the theoretical mechanisms which might apply. Accepting the idea of phylogenetic input to social organization, Eisenberg *et al.* (1972) developed a model of evolutionary stages in primate grouping patterns and categorized existing knowledge in accordance with their stage model. Altmann (1974) later reviewed some of the multiple parameters which must be considered in identifying ecological pressures on social organization. Emlen and Oring (1977), in their model of avian social organization, further make the point that ecology must be considered as permissive rather than determinant in the development of certain social systems. This perhaps only emphasizes the broader principle that selection is for the tolerable and not the optimal. Hans Kummer (1971:90) reminds us of this when he states "Discussions of adaptiveness sometimes leave us with the impression that every trait observed in a species must by definition be ideally adaptive, whereas all we can say with certainty is that it must be tolerable, since it did not lead to extinction. Evolution, after all, is not sorcery."

This book, therefore, represents, not an attempt to prove how various social organizations must have necessarily resulted in response to the ecological settings in which they are found, but rather, a further refinement of our thinking about the relationships between social organization and ecology. We will indicate some of the considerations which must go into theories relating these two complexes and we will reexamine selected hypotheses relating variables within the complex of social organization to factors of ecology. Although the extent to which such hypotheses account for the available data gives them some credence, the ultimate test is always the ability of a theory to accurately predict the outcome of studies not yet undertaken. Ideally, these studies will examine: (1) the same species in multiple habitats (habitat

influence), (2) multiple species in the same habitat (phylogenetic influence), (3) multiple populations of the same species in similar habitats (to test for variability of expression), and (4) multiple species in multiple habitats (to determine the range of possible adaptations). As we gain confidence in our understanding of the processes which account for the social organizations of living primates, we may gain confidence in our models of the evolution of social organization in our own species.

The order Primates is noted not only for its sociality, but also for behavioral flexibility, coupled with long periods of immaturity and biological dependence. Such a combination surely produces many responses which are acquired during the lifetime of each individual, more specifically, during the long developmental period. This acquired behavior will develop in response to the experiences accumulated in an environment which is often largely social. Humans, with the maximum potential to adjust behavior as a function of experience, should therefore be most responsive to immediate ecological situations. However, with increasing emphasis on the transmission of information from generation to generation rather than individual problem solving, it is also true that human adaptations will be retained so long as they are tolerable solutions to the problem of life (rather than optimal solutions). Traditions and acquired behavior will then follow some of the same principles as evolving genetic patterns. Variability of solution as well as conservatism in change may thus occur in both cases, although the potential time courses may differ.

In the chapters that follow we will consider:

1. What do we mean by an "adaptive" social pattern
2. What is the "quality" of the habitat
3. How selection operates on life history processes, and the implications thereof
4. The influence of random drift factors and local ecology on demographic processes
5. The significance of acquired behavior
6. A specific human social organization and its adaptation to a range of habitats
7. The significance of variability in nonhuman primate social organizations
8. The variability possible in sympatric species
9. Some correlations among population characteristics
10. Ecological, phylogenetic, distributional factors, and their interrelationships
11. Some factors which marked major shifts in human adaptation
12. The impact of major habitat changes on the development of human social organization
13. A theoretical approach showing how social behavior is organized and relates to the ecology.

The reader is then asked to decide to what extent we can have confidence in models of human social organization and its origins given the available data base and the limits of the methodology so far employed. This approach may not produce any revolutionary or exciting new theories of human social origins, but we hope that the conservative statements which we can make may endure the tests of new data somewhat longer than some of the flashier speculations which sometimes attract both serious students and the public alike.

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