sadness—why we have been so singularly unsuccessful in conveying our understanding of natural selection to interested nonscientists, for Koestler's confusion is shared by most critics in the humanities and constitutes the greatest gulf between the two cultures' understanding of evolutionary theory. And it must be our fault.) Moreover, Koestler's narrow view of modern Darwinism leads him to see as exceptions to it a large set of phenomena—the "Baldwin effect" and pedomorphosis, for example—that comfortably reside within it.

A man cannot wear the mantle of Galileo simply because he stands against an establishment that treats him badly; he must also be right, or at least brilliant. If he isn't, his story will probably become the farce that Marx recognized as the historical repetition of tragedy—Galileo the tragedy, Velikovsky the farce.

I must end by citing two ironies:

1) Even if we accept Kammerer's experiments on the midwife toad—and I do—they constitute no case of Lamarckian inheritance. Few Lamarckians would claim that so complex a structure as the nuptial pads could arise from nothing in so few generations. Since nuptial pads occur in more primitive, related species and even, occasionally, in the midwife toad itself under natural conditions (p. 167), their appearance in Kammerer's experiments represents the fixation of an atavism—that is, the genetic potential for forming nuptial pads already existed in natural populations of *Alytes obstetricans*. Kammerer performed a good Darwinian experiment and unconsciously selected for them in the following way: He took hundreds of eggs from females and tried to raise them in an unnatural aqueous environment. Only a few percent survived (pp. 155–56). He then repeated this procedure over several generations. In other words, in each generation he imposed a powerful selection for whatever genetic factors allow an egg to develop successfully in water. His final population differed markedly from natural ones in its progressive accumulation of genes conferring success in aqueous habitats. Is it then surprising that the nuptial pads—an aqueous adaptation—gained expression where they had before remained latent? This phenomenon—the gradual fixation by selection of traits that first appear as adaptations acquired during life—is well known to modern Darwinians and has been termed "genetic assimilation" by Waddington. Koestler's plea for a repetition of Kammerer's experiment should be heeded, but its interpretation will probably be in this context. If *all* eggs survived in water and all offspring contributed an equal number of eggs to the next generation, and if the nuptial pads still appeared and attained hereditary fixation, then that would be a different, and indeed a Lamarckian, matter.

2) Kammerer was an ardent socialist. His Lamarckian views were motivated as much by a vision of the perfectibility of man as by any empirical consideration, a point Koestler fails to make. Kammerer's a prioris were as rigid as the staunchest Mendelian's. Kammerer's suicide prevented his assuming the research position he had accepted at the Moscow Academy of Sciences. His case became the basis for a slightly fictionalized, full-length Soviet propaganda film, directed by the Commissar for Education himself. Kammerer became a hero of Lysenkoist biology. How ironic that Arthur Koestler, contributor to *The God That Failed* and author of *Darkness at Noon*, should now take for his hero the delight of his former enemies. Dubious science, it seems, makes as strange bedfellows as dubious politics. Poor Rubashov must be spinning in his grave.

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**References and Notes**

1. Nonetheless, as Derek Freeman notes (*New Scientist*, 2 March 1972, p. 509), eyewitness H. Graham Cannon reported in his *Lamarck and Modern Genetics* that Bateson, during a cursory examination of the specimen, mumbled to him, "It looks to me like a spot of black ink." This needn't mean much, since Bateson was notoriously unfair during the whole debate and didn't even bother to remove the specimen from its jar on this occasion. Still, I am puzzled by Koestler's silence on this statement, since he claims that he "quoted all available eyewitness reports, without omissions" (p. 105). Koestler must have encountered it, for, as Freeman remarks, he cites Cannon's work frequently and even "makes polemical use of quotations taken from the opening and closing sections of the very paragraph in which Professor Cannon's report is located."
2. P. Kammerer, *Rejuvenation and the Prolongation of Human Efficiency* (Boni and Liveright, New York, 1923).
3. W. B. Provine, *The Origins of Theoretical Population Genetics* (Univ. of Chicago Press, Chicago, 1971), p. 36.
4. W. Bateson, "Evolutionary faith and modern doubts," *Science* **55**, 55–61 (1922).
5. E. Mayr, personal communication.
6. A. Koestler, *The Act of Creation* (Macmillan, New York, 1964) and *The Ghost in the Machine* (Macmillan, New York, 1967).

# The Evolution of Communication

**Non-verbal Communication.** R. A. HINDE, Ed. Cambridge University Press, New York, 1972. xiv, 444 pp. + plates. $17.50.

The study of animal communication is enlivened by the faith, first generated in 1872 by Charles Darwin in *The Expression of the Emotions in Man and Animals*, that its findings will illuminate the evolutionary origins of human communication. The human side of the link is most likely to be provided by "paralinguistics," that bewildering array of facial expressions, eye movements, hand waving, postures, variation in pitch and loudness of voice, and other nonverbal signals used to mediate a substantial portion of communication in all human cultures. The evolutionist routinely asks: Are these signals primitive? If primitive, are they homologous with signals in lower animals, representing in some fashion the precursors of our own unique, verbal speech?

At the same time that zoologists have begun a sustained effort to extend their concepts to the study of human communication, a few social scientists are trying to adapt zoological techniques to their vastly richer and more difficult data. The ultimate goal of this combined effort is the elucidation of human speech and social behavior within the framework of evolutionary theory. In H. L. Teuber's words,

> It has become clear . . . that linguists are ethologists, working with man as their species for study, and ethologists linguists, working with non-verbalizing species.

From 1965 to 1969 a study group sponsored by the Royal Society met on 12 occasions to explore the subject in depth. Prior to the 13th and final meeting, in September 1970, drafts of chapters based on the earlier conferences were circulated among the members for criticism. The result is *Non-verbal Communication*, a valuable book that draws together an exceptionally difficult and heterogeneous subject. Much of the credit for superior organization must go to W. H. Thorpe, who chaired the meetings and wrote three of the more

general chapters, and to R. A. Hinde, who edited the book and provided a series of insightful introductory and concluding essays. Another agreeable feature of *Non-verbal Communication* is the free exchange among its authors within the main text of their own chapters. As a result there are no major inconsistencies between the chapters to baffle the reader. Disagreements in opinion and emphasis are often discussed explicitly and then further elucidated by Hinde's commentaries.

Among the stronger chapters is one by Thorpe summarizing the numerous discoveries, a few truly startling in nature, that have been made during the past ten years on vocal communication in birds. For example, it is now well established that individuals of many species can distinguish their mates, their territorial neighbors, and their own offspring by recognizing subtle personal differences in certain components of the calls. Some of the musicality of bird song evidently serves just this function, while the remarkable voice mimicry of the Indian mynah appears to be adapted to unifying local segments of populations on the basis of individual recognition. Another useful contribution is D. M. MacKay's abstract analysis of communicative processes. Writing as an information theorist interested in psychology, MacKay makes the most earnest and systematic attempt I have seen to define biocommunication. The effort is more than an exercise in semantics, since the discussion takes the author—and his critics later in the book—into several explorations of cybernetic properties of responding organisms and the meaning of Darwinian adaptation at the level of the central nervous system. There is also a welcome chapter by R. J. Andrew on his method of deducing the evolutionary origin of displays. Close attention is paid to the behavioral and physiological conditions that influence animals immediately prior to the evocation of particular components of their displays. For example, a variety of obviously functional facial responses occur when a mammal recognizes sudden danger: the eyes close, the brows lower as the two orbiculares contract, the ears are pulled back, the mouth is opened and the teeth are bared, and so forth. These responses are also among the elements that have evolved into components of aggressive displays. Each species has acquired its own particular combination of components and degree of ritualization of the displays. Andrew is one of the investigators who have broken the analysis of vertebrate displays out of the overly tight constraints of the "conflict theory," which holds that displays originate from opposing "drives" in the higher coordinating centers of the brain.

What of the presumptive bridge between animal and human communication? Two chapters are concerned exclusively with attempts to identify it. J. A. R. A. M. van Hooff tries to infer evolutionary origin of human laughter and smiling by tracing the phylogeny of facial displays through the apes and monkeys. He concludes that the two extremes of the signal continuum in man, the broad-smile and the wide-mouth laugh, are respectively homologous with the silent bared-teeth and the relaxed open-mouth displays of the nonhuman primates. From a communicative device that displayed aggression or submission in his ancestors, man has evolved a richer and more subtle array of signals conveying every shade of conciliation, playfulness. friendliness, and other social attitudes and emotions. This "liberation" of facial expressions in evolution has probably occurred as ancillary to the origin of true speech. A different approach is taken by I. Eibl-Eibesfeldt, who has turned his research from animal ethology to human ethology and now searches for universals in human paralinguistics. He asks, "Is there a signalling code—a language without words—common to all men?" The implication is that such a code, if it exists, is genetically fixed and thus available for phylogenetic comparisons with the displays of nonhuman primates. The examples cited by Eibl-Eibesfeldt include the eyebrow flash, a friendly greeting within virtually all cultures, and head nodding (meaning yes almost everywhere) and wagging (no). Penile display is a widespread but not universal cultural trait which Eibl-Eibesfeldt interprets to correspond to similar territorial displays in baboons and a few monkey species.

*Non-verbal Communication* both summarizes much of the conventional wisdom of ethology and reveals its essential weaknesses. Among the latter can be counted the traditional stress laid on vertebrates, especially birds and mammals, together with the honeybee. This peculiarity needs no comment except to point out that the vertebrates make up less than 5 percent of the known species of animals. There exists a vast and fascinating literature on invertebrates which can be mined with great profit by essayists, who will I hope come to read *Zeitschrift für vergleichende Physiologie* with the same attention now paid *Zeitschrift für Tierpsychologie*. They will also find that there is at least as much useful information on animal behavior in the *Journal of Insect Physiology* and the *Annals of the Entomological Society of America* as in *Behaviour* and *Ibis*. Further characteristic of vertebrate parochialism is an excessive concern with the auditory and visual channels as opposed to the chemical. Chemical communication, now the subject of a large and swiftly growing literature (Thorpe acknowledges this fact but reviews the subject only sketchily), is the principal or exclusive mode of communication for the vast majority of species of animals and microorganisms. It is also the most primitive form of communication. Evidence continues to mount that chemical signals play key roles in the lives of most mammals, including perhaps even man. Yet *Non-verbal Communication* largely omits the subject, and N. G. Blurton Jones seems to be speaking for his fellow authors when he says,

> As far as this reviewer can discover, little or no work has been done on communication by odour in man, perhaps because it is a subject which arouses such strong feelings in our culture. This of course indicates that it may have a great communicative importance.

In fact, there exists a substantial but still inconclusive literature on the subject, fully supporting Blurton Jones's premonition.

The book also suffers intrinsically from the attempt to treat communication as a separate subject. As the zoologist authors stress, communicative repertories make sense only as adaptations to particular environments. At the present time impressive advances are being made in the effort to correlate signal variables with either the environment or the social system. Thus the mobbing calls of many species of small birds, used to summon other small birds to join the harassment of a resting predator such as a hawk or weasel, have been shown to be exquisitely designed in frequency range and note duration to aid in localization. By contrast, the hawk-warning calls of the same birds, used to announce the presence of a flying hawk or owl in the air above, possess opposite properties that make the calls very difficult to pinpoint. The size and distinctiveness of the crest in different populations of Steller's jays are correlated with the openness of the environment and hence (presumably) with the extent to which the crest can be

used in visual display. Perhaps the most sophisticated correlations of all are the ones that have been made in the past ten years between the environments and social systems of various species of African canids, antelopes, and primates. It is not a criticism of all this work but rather a prediction of its logical sequel to say that what is still lacking is a theory that will lend both generality and precision to the stated relationships. This theory will almost certainly be built out of the machinery of population genetics and population ecology, the processes of which form the black box connecting the input of environmental pressures and the output of programmed social responses. Most ethologists, including the authors of *Non-verbal Communication*, do not yet seem to have grasped the enormous potential of this connection. Another curious hiatus is the lack of attempts to conduct formal phylogenetic analysis. Although phylogenetic reconstruction is a central procedure in much of ethology, and some ethologists are in fact just phylogenists using behavioral characters, the reconstruction is typically of an intuitive, 19th-century nature. Reference is seldom made to the modern field of phylogenetic systematics. Perhaps useful applications are still out of reach, but it nevertheless seems curious that so little attention has been paid to such a potentially fundamental discipline.

Far more worrisome to me, however, is the fact that ethologists, and particularly human ethologists, have not yet learned the methods of multiple working hypotheses and strong inference. Typically they still use what might be called the advocacy method of developing science. Author X proposes a hypothesis to account for a certain phenomenon, selecting and arranging his evidence in the most persuasive manner possible. Author Y then rebuts X in part or in whole, raising a second hypothesis and arguing his case with equal conviction. Verbal skill now becomes a significant factor. Perhaps at this stage author Z appears as an *amicus curiae*, siding with one or the other or concluding that both have a piece of the truth that can be patched together to form a third hypothesis—and so forth seriatim through many journals and over years of time. Often the advocacy method, which is displayed in egregious form in *Non-verbal Communication*, muddles through to the answer. But at its worst it leads to "schools" of thought that encapsulate logic for a full generation. There is no question that the superior method of multiple working hypotheses, together with strong inference based on precise models, can be used in even so complex a subject as sociobiology. A good recent example is M. L. Cody's study of the behavior of mixed finch flocks (*Theoretical Population Biology* **2**(2), 142–58 [1971]).

While reading *Non-verbal Communication* I kept having stray thoughts about whether the humanities and social sciences should become branches of biology. Perhaps this will really happen, but the humanists and social scientists involved in the Royal Society project are in no immediate danger of succumbing to the language and thoughts of biology. Edmund Leach has written a lucid essay on the influence of culture on communication, rich with allusions to linguistics and psychoanalytic imagery, but not perceptibly influenced by biology. The same is true of chapters by E. C. Grant on mental illness, Jonathan Miller on drama, and E. H. Gombrich on Western art, each of which would grace the pages of *Daedalus*. Nevertheless, it is notable that such a colloquium was arranged in the first place, and *Non-verbal Communication* is an admirable attempt to systematize what surely must be one of the most important of all emerging scholarly fields. Its failings are those of any exploratory expedition, its chief virtue the promise of important discoveries soon to come.

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## Rules and Rituals of Everyday Life

**Relations in Public**. Microstudies of the Public Order. ERVING GOFFMAN. Basic Books, New York, 1971. xx, 396 pp. $7.95.

Erving Goffman is well known for his seven previous books, in which he has written about the "presentation of self," the implicit rules of social behavior, how people become mental patients, and other aspects of social interaction in real-life settings. It is generally agreed that these books offer profound and original insights into the nature of social behavior, and that they are superbly written. On the other hand Goffman does not provide or make much use of experimental or quantitative empirical data (though he does use detailed descriptive materials), and he stands apart from those social scientists who do experiments and test hypotheses.

In this book Goffman develops his previous ideas by analyzing the detailed rules and rituals of certain sequences of social behavior. He suggests the rules governing human territorial behavior, greetings and farewells, and apologies and explanations following an offense, and describes how criminals and saboteurs maintain normal appearances and how mental patients fail to do so. This book introduces a number of new topics, but more important it also introduces some new ideas, or rather extends some of the author's earlier ideas. Social rules are portrayed as intricate, interlocking sequences, which make social systems workable if the different participants play their parts properly. The sequences are like language in that they have rules of sequence, which people follow without awareness. Certain linguistic analogies are noted, such as the "embedding" of greetings when a greeting itself includes a greeting and a farewell. Emphasis is also placed on various rituals—a greeting is an "access ritual," making the transition to a condition of increased access; it is an interaction sequence which is generally understood and which accomplishes a changed state. Once a farewell has been made it is impossible to repeat it, for example if a visitor has to return to collect a forgotten object.

Goffman's research method is still the same—perceptive observation in a wide variety of specific field situations, together with citation of rather offbeat descriptive studies, for example of saboteurs, gangsters, and spies. His method is to take a limited act of social behavior, such as holding hands or passing another person on the pavement, and to observe carefully how it is done, by whom, what the rules are, and what the subvarieties are. He then postulates concepts which make the act intelligible, and links it to related behavior. Like other sociologists Goffman is concerned with the meaning of events to those involved; however, he does not interview people (as cognitive psychologists and ethnomethodologists do) but infers meaning from what they do.

One way of looking at Goffman's work is to see it as like the rich clinical