mation contained in the display. Smith illustrates this in his interesting discussion of the calls of tyrannid flycatchers, in which he demonstrates that one call is given only during hesitation in locomotion. Once this is known, then the situation in which hesitation occurs allows quite specific deductions to be made, such as that "the approaching individual, because hesitant, is unlikely to attack." The subject deserves far more lengthy treatment in a book of this type. Two out of many possible examples may illustrate this. Reflexes indicating the state of postural tonus, such as tail elevation in dogs or the degree of limb extension, allow estimations of confidence in social situations. Orientation reflex components such as pricking of the ears can indicate how interesting a stimulus is, and protective movements such as ear flattening show at what distance it is thought to be dangerous.

Surveys of communication in different systematic groups form the main part of the book. Alexander surveys insect displays, and uses them to exemplify the way in which the signals of closely related species have changed in every possible parameter during evolution in order to be readily distinguishable. He also gives the clearest account of the causation of cricket calls I have yet read. It is interesting to compare Blair's chapter on reptiles and amphibians, which shows that many of the same selective pressures have acted on amphibian calls as on those of insects such as the Orthoptera. The chapter also can be recommended as an account of general amphibian behavior: to take only one example, I learned from it for the first time that defense of territories by fighting occurs in some anurans.

A number of the other vertebrate surveys are disappointing, despite the great experience of the authors. Tavolga devotes much of the short section on fishes to a discussion of a classification of communication into vegetative, tonic, phasic, signal, and higher levels, which seems irrelevant to real problems of communication. Hooker summarizes competently our knowledge of song learning, but touches on communication in birds only in passing. I was particularly disappointed that Altmann confined himself to what is basically an expanded bibliography of primate displays.

Tembrock gives a detailed and useful descriptive account of mammal displays, order by order. The section on marine mammals by Poulter differs from all the rest in that it consists largely of original observations. This is clearly useful, but out of place in a book that gives so little space to groups about which far more is known. We still have less knowledge of vocal communication in seals and dolphins than in dogs (let alone gulls or robins), and I remain unconvinced that much progress will be made by treating cetacean sounds as a language whose phonemes have the same specificity of meaning as those of human speech.

The final sections are concerned chiefly with human communication. Diebold gives a concise summary of the role of direction of gaze which shows that, in one field at least, quantitative experiments are both possible and valuable in the study of human nonverbal communication. He includes at one point, without further discussion, the intriguing statement that an observer can tell that he is being stared at even if the starer is not in his visual field. Otherwise, straightforward descriptive accounts of human communication are almost absent. Instead, attention is concentrated on the relation and the differences between human language and animal communicatory devices. The clearest position is that of Lenneberg, who argues for a "discontinuity theory," which states that human language is so different from primate communication that it is quite misleading to consider the first to be evolved from the second. Most of his discussion is, in fact, concerned with a different and quite acceptable thesis, namely, that it will be very difficult to establish when and how human beings began to talk. Those arguments which directly attack the belief of Kohler and others that it is now possible to trace the early evolution of many basic features of human language do not convince me. Thus Lenneberg states that human infants do not ordinarily imitate sounds. I would have thought it obvious both from observation and on a priori grounds that they do. What is more, if we can demonstrate why vocal mimicking evolved in some birds, then we are nearer to understanding how the same condition might have evolved in human ancestors before language appeared [see R. J. Andrew, *Science* **137**, 585 (1962)]. Readers may like to turn back to Hooker's account of vocal mimicking in birds and speculate for themselves.

Diebold raises, but does not resolve, another difficulty, that of demonstrating intention in animal communication. This problem will be clarified when the reinforcers are identified which can increase or decrease the frequency of particular displays. It will then be possible to identify those signals which the animal learns to use to regulate social interactions in the same way other operant responses are used to regulate more conventional rewards.

In conclusion, *Animal Communication* is a valuable book (as at the price it should be), but not an invaluable one. It mirrors accurately the present state of the subject. Most interest among anthropologists and psychologists concerned with communication centers around the establishment of general principles that will be applicable to animals and men. On the other hand, it is from the detailed experimental studies of communications in particular groups that principles can be seen to emerge. It would seem best that the study of animal communication should remain for a little longer a pursuit conducted within more established disciplines, and not attempt to find a premature independence.

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Vocalization

Bird Song. Acoustics and Physiology. CRAWFORD H. GREENEWALT. Smithsonian Institution Press, Washington, D.C., 1968 (distributed by Random House, New York). viii + 196 pp., illus., + 2 records. $12.50. Smithsonian Publication 4750.

A valuable extension of analytical methods into the study of animal sounds is made in this book. For the most part, studies of bird song have been concerned with variation within species or with behavioral aspects of these sounds. This book explores in detail an area long neglected but essential to a complete understanding of bird sound—its structure and production. It includes a synthesis of many papers, some not readily available.

Among the earlier suggestions about bird sound production which are supported are the dual-oscillator theory—that many birds can produce two nonharmonic sounds simultaneously—and the importance of the fundamental as a vehicle for coding messages, including the use of amplitude and frequency modulations. Among those refuted are

the use of the trachea as a resonator, and descriptions of the means by which birds such as the mynah produce imitations of the human voice.

An original hypothesis relates to the means by which harmonics are produced in bird sounds. Also new is the interpretation of data on frequency and time perception. These data point up the ability of birds to repeat behavioral displays (specifically, songs) with extraordinary precision. Sounds may thus provide a useful tool for studying the feedback necessary for the production of such precise patterns or displays.

The techniques of analysis used by the author are described, and details of the equipment are supplied separately. The discussion is documented with clear, well-prepared, and well-reproduced illustrations of sound spectrograms, oscillograms, plots of instantaneous frequency changes, and harmonic spectra. Of these only sound spectrograms have been used commonly in recent papers on bird sound. Here each sound usually is illustrated by more than one kind. The limitations and advantages of each thus become obvious. Two LP records provide aural examples of many sounds specifically studied by the author, and make possible individual corroboration.

The main problem in the book is due to the inadequacy of available information on syringeal anatomy and function. The gross anatomy and variation within the syrinx, in the traditional sense, have been described frequently. The functional anatomy of most syringeal components is based primarily on circumstantial evidence, and definitive experiments on their contribution to sound production are few. The author utilizes the available information well, and makes new hypotheses about the action of several components, based on his analyses of sounds. Here his greatest contributions are those hypotheses and his pointing out critical experiments which still need to be done. Such experiments may or may not support his hypotheses, but if not they should suggest refinements or better alternatives.

This book deserves the careful consideration of those interested in biological systems of communication, functional anatomists, many physiologists, ornithologists, ethologists, and those interested in the physics of sound. It is clear and readable and is of special value as an example of an interdisciplinary approach to biological and scientific problems.

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Ends and Meanings

Symbols in Society. HUGH DALZIEL DUNCAN. Oxford University Press, New York, 1968. xvi + 262 pp. $6.75.

This book is a clear, cogent distillation of many years of concern with its subject. There is considerable continuity in theme and standpoint with Duncan's earlier books, in which the classic contributions to a theory of symbolic communication were analyzed (*1*). Admirers of those books will be glad to have Duncan speaking now entirely in his own behalf, setting forth the propositions he has found essential. He writes out of concern not only for an impasse in sociological theory, but also for the needs of a democratic social order.

Duncan's basic question is: How do symbols create and sustain order in social relationships? His argument with what he regards as the "mechanist" school dominant in sociology is that symbolic communication is recognized as central to social order, yet either is left unanalyzed or is analyzed in terms of almost everything except itself. Communication is itself, however, a radical motive of human activity, requiring explanation in its own terms. To those who analyze it solely in terms of purposes and contents, Duncan insists on attention to structure (form, style) as well. How people communicate, the forms of communication available to and used by them, determine what is communicated as much as the what determines the how. Much talk of social action as patterned, integrated, or organized is mere assumption—of what the form consists is never demonstrated. To those who analyze "structures" alone or, worse, only one component of structure (such as media), Duncan insists on attention to personal purpose and social function. (In a trenchant phrase, "grammar cannot be separated from rhetoric.")

Duncan considers that games and (social) drama have been peculiarly American models of social interaction, both in social theory (George Herbert Mead, and Kenneth Burke, to whom the book is dedicated) and in ordinary life. Presumably he does not think that symbolic analysis of communication would be less essential elsewhere, only that it is especially relevant here. In any case, communication is not to be explained, in his view, in terms of cognitive models alone. To adapt Malinowski's terms, it is not only a "countersign of thought" but also a "mode of action." The crux of the matter is that communication must be explained through structure as it functions in action. The major part of the book develops this theme by way of sets of propositions. Twelve are axiomatic, intended to make clear basic assumptions about communication, significant symbols, and social hierarchy. Twenty-four are termed theoretical, and elaborate the initial assumptions in terms of a sociodramatic model of human relationships. Thirty-five are termed methodological; they contain more specific indications of how the model can be used as a tool in thinking about and analyzing social action. The propositions are summarized in the table of contents, which is an admirable guide to the book.

Duncan is committed to democracy and pessimistic about its chances, given the conclusion (adopted from Burke) that creation and maintenance of social order inexorably generate corresponding conceptions of disorder and real or symbolic scapegoats and victims, and the evidence of the principle in recent times. (*Mein Kampf* and Nazi Germany, the Stalin purges, McCarthyism and Vietnam are noted examples, but the real proof of the principle would lie in the everyday ubiquity of explanations that say it is not the particular institution that is to blame for trouble but some element foreign to it. It is not that such explanations never have part of the truth, but that their logic is to deny the possibility of internal causes of conflict and error.) For Duncan, the great revolution of our time is the creation of "sociodramas" (including public interpretation of