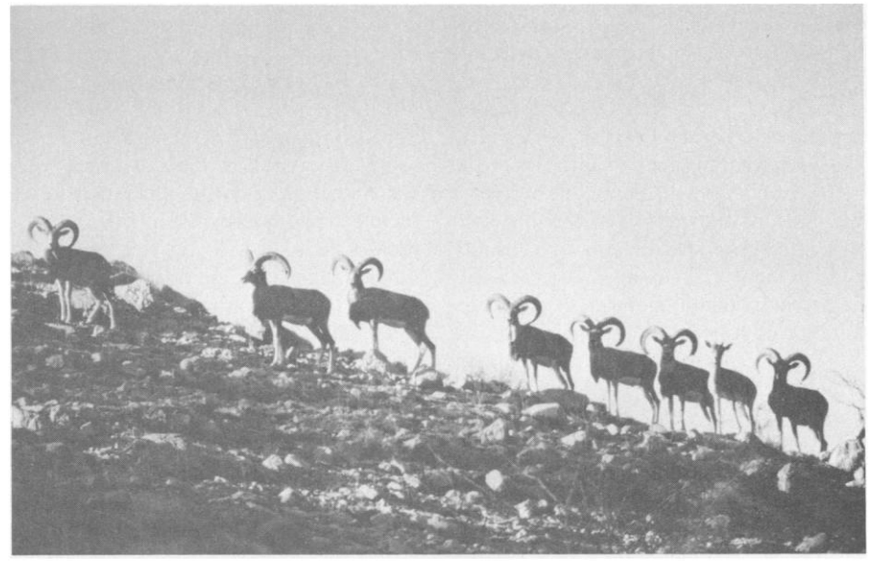
1968 to 1975. It was a study in which he had to be versatile and opportunistic, contending among other hazards with an almost continuous state of war between certain of the countries whose borders cross the area. He has drawn his observations together into a comprehensive account of the environment and biology of the Himalayan bovids, particularly those that belong to the subfamily Caprinae, goats and their relatives.

I started the book at the beginning, reading the captivating account of the Himalayan region and learning much from the review of the taxonomy of the bovids and from the account of their distribution. But then, I must confess, I could contain my curiosity no longer and turned to a heading in the last chapter that reads; "Is the bharal a sheep or a goat?" I had an urgent feeling of wanting to know.



Punjab urial rams and one ewe, in December. All rams have conspicuous throat ruffs. [From *Mountain Monarchs*]

The bharal or blue sheep, *Pseudois nayaur*, has physical attributes of both sheep and goats. The horns are rolled, superficially like a sheep's, but are in structure closer to the goat's, being most like those of *Capra cylindricornis*, the Dagestan tur. Like sheep bharal lack beards and have no calluses on the knees, but like goats they have a broad, flat tail with a bare ventral surface. Schaller had hoped, I believe, that studies of behavior might indicate affinities clearly; there emerges, however, a cautionary tale showing that behavioral attributes, like anatomical ones, reflect adaptation to habitat and may also be convergent. In general the behavioral evidence fits the view of most taxonomists that bharal are basically goats. Many sheeplike traits have evolved, the species having settled in a habitat usually occupied by sheep. But Schaller suggests that the precursor from which sheep and goat diverged would have resembled a bharal in many ways. And here is such an animal still surviving in a region that is the probable evolutionary center of the sheep, the goats, and their allies.

The major contributions to new knowledge that are embodied here relate to the behavior and ecology of the caprine species, but Schaller also presents a valuable compilation of data on the physical attributes of the animals. He finds a place, at last, for those embarrassing pieces of biological information provided by record heads and trophies. I found some shortcomings in the presentation of this section, however, in that the units of measurement are not stated for many of the tables and must be inferred from other tables. In the figures in which horn measurements are plotted it is not stated that these are for males only, but I presume that to be the case. The females of many species do carry horns, but it requires some searching in the book to discover just which species.

In a consideration of style of combat and horn shape the tahr and the bharal provide important examples that support a general theory. The tahr has the more primitive, pointed, and potentially lethal horns and fighting is appropriately inhibited; display, using threat gestures and exhibiting the ruff of hair, is the means of attaining dominance. The bharal, on the other hand, engages in exaggerated and frequent clashing of horns, the horns being adapted for bashing and not for wounding. Also in contrast to the tahr, the bharal live in large flocks and exhibit very marked sexual dimorphism.

Reproductive behavior was intensively recorded during the study, and the Punjab urial, the wild goat, and the bharal provided data for analysis. No less valuable, although sometimes too meager to qualify, were observations on tahr and markhor. All species have similar courtship patterns, although they exhibit differences in the frequency with which the elements of display are combined. The differences are possibly too small to serve as reproductive isolating mechanisms. It may be significant, therefore, that contiguous and closely related species differ greatly in appearance. Female selection based on visual characters would then be important in averting hybridization.

The book contains a wealth of unique information that will be extremely useful for making comparisons with other large herbivores, but after a first reading my foremost feeling is one of gratitude that the author has made me familiar with these strange and remote mammals.

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Signaling Systems

The Behavior of Communicating. An Ethological Approach. W. JOHN SMITH. Harvard University Press, Cambridge, Mass., 1977. xii, 546 pp., illus. $20.

In one way or another, the majority of ethological work concerns the study of communication between animals. But, although the last 20 years have seen a lot of data collection on this subject, the amount of theory has, if anything, declined. Many of the neat and simple ideas of early ethologists have got lost in the mass of complexities, species differences, and exceptions that have come to light, and rather few novel ideas have emerged to replace them. But of those that have, the view set forth by W. John Smith has been among the most stimulating and influential.

Rejecting the ethological tradition of attempting to infer the motivation of an animal from the form of its signals and the contexts in which they occur, Smith advocates a more outward-looking, interactional, approach. This draws a useful distinction between messages and

their meanings. The message is the information that a signal makes available about its sender and may, like motivation, be inferred from the behavioral contexts in which the signal occurs. Meaning, on the other hand, is what the recipient makes of a signal, inferred from the way it responds. As Smith's own work on tyrranid flycatchers beautifully shows, the same message may affect different individuals in different ways depending on the context: some may ignore it, some approach, some withdraw. Among the diversity of possible responses, the advantageous ones must, in the long run, outweigh the disadvantageous to give the signaling system its function or selective advantage.

Smith's book depends heavily on this viewpoint, although he does discuss some other approaches more briefly. He is clearly a naturalist at heart, as have been most of the best ethologists. But many will find his observational and descriptive approach disappointing at a time when ethology is becoming more quantitative, more experimental, and, at least at the sociobiological end, more theoretical. He doubts the value of experiments because he thinks they are likely to introduce unwanted changes in the situation, making it hard to draw conclusions. One could equally plausibly argue in the opposite direction that, without experiment, no two occurrences are similar enough to enable the messages and meanings of signals to be determined with any degree of certainty. Just how Smith does conduct his analyses is left in some doubt: quantitative approaches are mentioned only briefly, and one might infer that he prefers the understanding that comes from many hours of patient observation to a more numerical and statistical strategy. This is, perhaps, what he means by "an ethological approach," and he has many distinguished precursors who have followed the same line. It works well, except that there are no data as such for others to doubt if they want to. One has to rely on the judgment of the observer. The lack of theoretical perspective is rather more worrying. Smith defines communication, loosely, as the sharing of information between individuals, and seems to view phenomena such as distraction displays and mimicry, signals that deceive, as rather strange exceptions. Yet a clear message that has come from the current wave of advance in evolutionary theory is that animals behave for the good of their genes. There seems little doubt that signals have evolved where they give such advantage to the individuals who produce them, regardless of whether any recipients benefit. This is a point Smith does not seem to accept, for he pays little attention to the possibility of deception in intraspecific communication and in his discussion of the function of signals sometimes invokes advantage to the recipient as an explanation. Perhaps he prefers to play safe on deception, for there is indeed a great deal of theory and rather few data on the subject. But the same could be said for the limited size of display repertoires, a matter on which he places some emphasis. Do we really know enough about the nuances of animal signals to suggest that most species have an upper limit of 40? Even if this were true, it is not easy to swallow the suggestion that a limit may arise because each signal in a larger repertoire would be less usual and thus likely to cause alarm. Pity the poor mockingbird!

These, then, are topics the book does not cover well. What it does do is to provide a useful review of a large number of examples, each one dealt with briefly and fitted into the author's frame of reference. The major concepts around which it hinges are message, meaning, context, and formalization, a term Smith prefers to ritualization because the latter tends to imply genetic change. Within these main areas, the book is concerned with the classification of phenomena, for example with the general classes of messages that many species are known to possess. Such a classification is a bold and difficult enterprise which, at this stage of knowledge, can only be partially successful; perhaps it is not surprising that a chapter called "Further messages" includes a section on "other messages." Such difficulties in classifying the material do not make for easy reading or a coherent theme; as a result the book will be more important as a work of reference than as a text that every budding ethologist should read.

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Social Behavior: A Quantitative Study

Play and Aggression. A Study of Rhesus Monkeys. DONALD SYMONS. Columbia University Press, New York, 1978. x, 246 pp., illus. $20.

The adaptive significance and evolution of developmental processes are of fundamental importance for behavioral ecology and social theory. A quantitative biological study that applies strategic intuitions from social theory to data on the social play-fighting tactics (nonagonistic wrestling and chasing) of free-ranging primates therefore potentially represents an important advance. The present book, a pioneering venture of this type, exploits only a few of the powerful analytic techniques and explanatory concepts of developmental behavioral ecology. Informal but sociobiologically orthodox genetic approaches and qualitative characterizations of skill-development mechanisms take center stage in the analysis while life-history theory, the ecology and evolutionary biology of age-specific feeding and social behavior, Waddington's and Levins's evolutionary analyses of development, and much, much more wait in the wings.

Symons's contribution is specialized but important. His work locates the study of nonhuman primate play behavior well within the framework of evolutionary theory and effectively dispels the erroneous view of play as group-adaptive in a classical sense. Symons administers a thoroughly deserved drubbing to the familiar doctrine that play is a mystical cohesive force, the behavioral glue that bonds individual primates together to form a social superorganism. In so doing he offers an object lesson to those in biology, primatology, anthropology, and developmental psychology who glibly discuss play and social cohesion as if these terms were well defined a priori.

Theoretical population biologists and social scientists may find fewer reasons to praise and more to criticize this work. After all, it represents one user's selective sampling of current social and developmental theory. I might cite a few specific omissions. Animal conflict theory, which is not taken into account, suggests that social play be interpreted in terms of an evolutionarily stable adaptive balance between interindividual competition and cooperation in societies of differentially developing juvenile mammals. A formal network model of the dynamics of a play bout might have been used to organize data on such processes as attempted initiation, refusal, acceptance, repetition, termination, and escalation, which Symons reports on separately, into a single theoretical framework in which defined rate parameter values explained such also separately reported outcomes as partner selectivity, bout durations, and age