Book Reviews

The Mountain Gorilla: Ecology and Behavior

Within a few years the monkeys and apes may replace the seals as the mammalian group in which the natural systems of social organization have been best studied. The combined effort of anthropologists, psychologists, and zoologists, which stems in part from demands made by the health-oriented sciences for better information, has instigated a wide range of field studies of primates. It is remarkable that the most careful and thorough study already completed, which will serve as a model for others, is concerned with such an elusive and hitherto mysterious animal as the gorilla. Early in 1959 John T. Emlen and George B. Schaller arrived in Africa to undertake intensive study of this species. After 6 months during which they surveyed extensive areas in the Congo, Ruanda-Urundi, and Uganda, Emlen returned to Wisconsin, but Schaller and his wife remained for rather more than a year. In the Congo the Schallers made detailed observations of several groups which altogether comprised about 200 animals. The results of this study, meticulously documented and beautifully illustrated, have been assembled in Schaller's book, *The Mountain Gorilla* (University of Chicago Press, Chicago, 1963. 449 pp. $10).

By allowing the animals to become accustomed to his presence gradually, Schaller was able to observe groups for long periods of time with very little disturbance. Gorillas are primarily terrestrial and quadrupedal, and they live in bands which vary somewhat in size and composition. In one well-studied area the mean group size was 17 animals, with an average of 1.7 mature males (characterized by the silver back or saddle), 1.5 subadult males (black backs), 6.2 females, 2.9 juveniles, and 4.6 infants. The groups were fairly stable over periods of many months and foraged through a home range of about 10 to 15 square miles. They are vegetarian and eat a wide variety of leaves, bark, pith, and fruit, and sometimes soil. This diet also satisfies the demand for water. Free-living animals were not seen drinking. Their appetites are large, and they deposit huge amounts of dung, which provides one of the best means of tracking them. The other conspicuous signs of their presence are nests which the animals construct each night on the ground or in low trees, wherever they find themselves at sundown. By pulling vegetation towards a center point, each animal makes a crude sleeping platform on which it spends the night. They sometimes build nests for the midday siesta. The presence of their nests on the ground shows a lack of concern for predators, which is unusual among primates. Probably their most serious enemy is man. Otherwise, the wounds which Schaller quite commonly saw were probably caused mainly by accidents.

Group Behavior

Conspicuous individual variations in the shape of the nostrils and markings on the nose made it possible for Schaller to identify a considerable number of animals. He detected a dominance hierarchy within the group, with males dominant over females. The silverbacked male at the top of the hierarchy is the leader who "by his actions determines the behavior of the whole group." Although the hierarchy can be detected, friction is rarely observed and dominance is most commonly shown in asserting right-of-way. This is in striking contrast to the constant bickering in groups of macaques and baboons. Schaller characterizes the temperament of gorillas as "introverted." They show little drive to explore their environment, either visually or manually. No tool using was observed, such as that recently recorded for chimpanzees in the wild. Here, as in most of their social behavior, gorillas are characteristically stable and phlegmatic, quite different from the volatile, inquisitive chimpanzees. Sexual activity is less prominent than in some other primates. "Masturbation and various forms of erotic behavior, commonly exhibited by captive gorillas, were never observed in the wild." It seems that copulation can take place in ventroventral and ventrodorsal positions, a striking confirmation of the labile sexual patterns which comparative psychologists have led us to expect in higher primates. Just as sexual behavior is rarely seen, mutual grooming is also much less common than among macaques and baboons. In those species the constant concern with active dominance relationships calls forth a variety of behavior patterns, such as grooming and invitation to mounting, which seem to function as ways to divert a potential aggressor. The lack of emphasis upon these patterns among gorillas is perhaps related to the much less prominent role that intragroup aggression plays in their lives.

Modes of Communication

The conflicts that do arise within the group are resolved by slight, subtle gestures and vocalizations. When two groups meet they may ignore each other or mingle for short periods of time, or there may be repulsion. If there is repulsion more dramatic behavior patterns come into play. As in the case of many animals, the manner of looking at the opponent has great communicatory significance; a direct, full-face glare signifies aggression, and a shifty, evasive gaze implies submission. The gorillas formalize the latter into a side-to-side head shake, a gesture that Schaller himself found it useful to make when animals came too close. In more violent encounters one animal may make bluff charges at the other. Although Schaller saw many exchanges, he did not see actual combat. At longer range the encounter may be resolved by the remarkable display of chest beating, which is the main signal used by the gorilla for communication over distances. The complete sequence, which may last up to 30 seconds and which is given only by silverbacked males, begins with a series of hoots. As the hoots are accelerated, the male plucks leaves and may place one between his lips; he then rises on his hind legs, grabs a handful of vegetation, and

throws it as he does so. Reaching the climax of the display, the gorilla beats his chest with open cupped hands and makes a "pok-pok" sound; presumably the prominent air sacs act as resonators. He may raise a foot, and as the chest beating ceases he runs wildly sideways, swiping at branches and saplings; he terminates the display with a loud thump by striking the ground with the flat of his hand. As Schaller justly points out, this behavior pattern is of great interest not only as a social signal, but also as a rare example of an extended, relatively highly stereotyped behavioral sequence from mammals. It is no less interesting that this occurs in an ape, in which labile behavior is almost a diagnostic feature.

This is evident, for example, in their production of sounds. Chest beating serves as a visual and as a sound signal. Schaller has sound spectrograms of this and of some of the other sounds produced. Gorillas are not highly vocal. The number of distinct vocalizations is more or less on a par with that of other vocal animals. However, as in baboons and macaques, sounds are variable, so that they constitute sets of continuously graded signals rather than series of discrete, nonoverlapping categories. This variability apparently aids in the communication of subtle changes of mood that underlie the coordination of group activities. The main function of both visual and auditory signals seems to be that of maintaining order within the group, and there is no evidence that certain sounds are associated with particular objects in the environment.

Basis of Behavior

The developmental basis of gorilla behavior remains to be explored. Schaller has described the gradual appearance of such behavior patterns as chest beating and nest building in the young, and he suggests that genetic factors must play a prominent part in shaping them, even though learning is undoubtedly involved as well. Youth is extended; females become sexually mature at 6 to 7 years, males at 9 to 10 years. Mature animals probably survive up to about 20 years of age. With overlapping age classes in the group, there is ample opportunity to transmit traditions from one generation to the next. On the whole the evidence suggests that such traditions are no more prominent in the gorilla than in other animals, such as geese, various carnivores, and the rhesus monkey. Local food traditions seem to exist and without doubt trails are maintained from one generation to the next, but there is no evidence of vocal traditions for example, here or in any other primate. To explore such questions further, the next approach must be an experimental one, if the processes of development are to be properly understood. Now that field recordings of primate vocalizations are available, perhaps someone will try to teach apes to utter new ape sounds, rather than human speech.

While much of modern biological endeavor is concerned with tracing the characteristics which organisms have in common, to explain the causes of the remarkable diversity that is an equally fundamental attribute of living things remains a constant challenge. Nowhere is this diversity more conspicuous than in the patterns of social behavior of animals. Yet there has been little concerted effort to explain its underlying causes. What are the laws that have governed the evolution of sociability in one species and of excessive intolerance in another? Why are the preludes to the act of mating brief in some species but extended over several months in others? How can we explain the occurrence of life-long monogamy in some species and promiscuity in others? Answers to such questions can be found only in studies like Schaller's, studies which describe systems of social organization as they occur in their natural environment by following the history of the individuals, plotting their movements, noting their food, and observing their fights, their matings. and their births.

In whatever direction further work on primates may proceed, either toward the experimental analysis of behavioral development and physiology or toward the comparative synthesis of information on social systems and their behavioral consequences and ecological significance, the debt to Schaller's pioneering study will be a lasting one. His study sets standards that will be a challenge for future investigators to maintain. And, leaving scientific interests aside, we must also acknowledge that an intimate introduction to an animal so close to man has a fascination of its own; this is made all the more dramatic by Schaller's scrupulous care in leaving the reader to introduce his own inevitable anthropomorphisms.

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Plant Physiology

The Growth of Plants. G. E. Fogg. Penguin Books, Baltimore, Md., 1963. 288 pp. Illus. Paper, $1.65.

The author states that one of his aims is to present "a general account of present-day plant physiology for the reader with little or no background knowledge beyond a smattering of chemistry." That mission has been creditably accomplished, although rather more than a "smattering" of chemistry is requisite to the comprehension of the sections that deal with the "Chemical Machinery" and "Mechanisms of Synthesis" and the text figures that illustrate those sections. This book might well be useful in advanced biology courses at the secondary level, if the teacher is sufficiently prepared to plan the course and includes appropriate supplementary references.

In the first chapter, the introduction, Fogg presents a summary account of the factors and constituent processes in plant growth and development. In the chapters that follow he discusses, in succinct detail, the major processes involved in the growth of plants. He has subdivided the book into four parts. The first covers the nature and uptake of raw materials and the energy by which the plant's chemical and synthesizing facilities transform these materials. Part 2 deals with growth hormones and the differentiation of cells and tissues. Part 3 develops the interrelationships between plant processes and plant parts. In the final one the author discusses the significant aspects of various environmental influences on plant growth.

The book, a paperback, is a gem for the science-educated layman. The size and low cost are appealing. The text figures are well selected. The organization of the subject matter is a departure from the conventional treatment found in textbooks, and the material is fairly up-to-date. Most of the works listed in the bibliography are serious, advanced references by outstanding plant scientists. The author, in his next edition, might well consider adding a selection of papers and articles to the bibliography.

Fogg has prepared a comprehensive coverage of a broad field, even though the subject matter is severely condensed. This book will undoubtedly be a worthwhile addition to anyone's library.

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