The Significance of Play

Animal Play Behavior. ROBERT FAGEN. Oxford University Press, New York, 1981. xviii, 684 pp., illus. Cloth, $29.95; paper, $14.95.

Study of animal play historically has languished at the fringes of behavior research. Suspicions that play did not really exist or that it was a trivial phenomenon kept many investigators away. However, like an unwelcome guest, play continued to present itself to fieldworkers. Thus in many general studies of mammalian social organization one may find brief descriptions of play, along with guesses about its function. The older play literature is diffuse, contradictory, and often exasperating. Quite recently, a few workers have begun to study play seriously and in detail. The general question behind this research is as follows: young animals expend considerable energy and risk injury in play but apparently gain no immediate benefit; what, then, is the delayed benefit? In what way does play contribute to individual survival and reproductive success?

This book is successful, throughout most of its 495 pages of text, in keeping the above question before the reader. Fagen first documents the existence of play in many mammal and bird species, then systematically explores ways in which its adaptive significance may be deduced. Existing data are carefully discussed, hypotheses designed to test current theories are presented, and new directions of study are suggested. More than a treatise on play, this book also is a demonstration of the versatility of evolutionary theory in illuminating many sides of a behavioral question.

The book also highlights an important more general question: why does behavior develop? More precisely, why is there plasticity in the development of behavior in some vertebrates (mammals, especially) when in others (many reptiles) neonates act like miniature adults? This is a thorny issue, and Fagen for the most part simply indicates the question without suggesting answers. Overall, argument is made from the position that, because natural selection may act on all ages, juvenile behavior should be designed, as much as is adult behavior, to maximize fitness. Developmental constraints on optimal juvenile behavior are not considered.

I think the most valuable parts of the book are chapter 3, "Natural history of play behavior," and chapter 5, "Biological effects of play." In chapter 3, Fagen reviews all that is known about play in 16 orders of mammals (Dermoptera, Tubulidentata, and Hyracoidea missing) and 14 orders of birds. Where information is sufficient, treatment is by family or even subfamily. A general description of play in the taxon is given, and all pertinent references are cited. For most species, the only information available is a list of the motor patterns used in play. Where data on the age distribution or frequency of play exist, they are reported. There is an uneven attempt to relate the structure of play to body form, social organization, ecology, and brain size; most of this information is at best suggestive. Taxa in which comparative studies of play would be particularly valuable are identified. Finally, at the end of the chapter are extensive tables in which references on play are listed by species. Chapter 3 is unquestionably the most complete summary of the structure of animal play ever published and is a valuable reference document. The only easily available reference I am aware of that Fagen missed is Hendrik Hoeck's Encyclopaedia Cinematographica film of hyrax play.

In chapter 5, it is argued that, because play has definite costs (risk of injury, energy expenditure), it must as well have counterbalancing benefits that result in an overall enhancement of fitness for the playing animal. The possibility that play is neutrally adaptive or maladaptive is not considered. Six hypotheses about the function of play are evaluated, and Fagen concludes that three (play as physical training and skill development, play as a regulator of developmental rate, and play as a mechanism that affects cohesion between individuals) are worth further investigation.

Much attention is given to the physical training and skill hypothesis, which has the most convincing theoretical and empirical support. Most play is vigorous, repeated, and often spectacular exercise. Repeated performance of motor tasks in mammals results in a physiological "training response" in which muscles and bones hypertrophy, endurance increases, and the economy and precision of the movements increase. Inactivity causes atrophy of muscle and bone and a loss of endurance conditioning. Training responses are often maximal early in life. Therefore, it is easy to view play as an adaptation that ensures optimal physical development. The best evidence for this hypothesis is that, in the few species studied, play accounts for almost all vigorous exercise performed by young animals and that players sometimes choose to play in locations that seem to offer the most effective physical training. Also, in the rhesus monkeys studied by Donald Symons, many aspects of playfighting are strikingly congruent with exercise programs designed to develop skill in humans.

This issue brings up a more general question: why should physical development incorporate play as a necessary step toward optimal performance? Why not simply "preprogram" optimal development of muscles, bones, and motor control? Fagen suggests, as have other workers, that play may have evolved as an extension of prenatal motility, which is a necessary precursor of normal development in some vertebrates. Fagen's unique explanation for the phenotypic plasticity that makes prenatal motility necessary is that it is an adaptation to cause the embryonic death of "organisms that genuinely fail to thrive." This suggestion is illustrative of the adaptationist logic that is used throughout the book and that is its principal weakness. Play and all of ontogeny are considered to be completely malleable by natural selection, and it is assumed that young organisms always behave and develop in an optimal manner. Phenotypic plasticity (behavior-contingent development) is probably not, in my opinion, an isolated adaptation. Certainly plasticity in brain development and plasticity in muscle growth cannot be considered to be the same phenomenon. On this issue, which is really central to a book on play, Fagen rests too heavily on facile ultimate explanations.

According to the play as cohesion hypothesis play is a mechanism by which social bonds are formed between individuals. Fagen points out that, stated in this way, the hypothesis is vague and seems to require evolution by group selection. The evidence in support of the hypothesis is a correlation between the amount of social play and the degree of sociality in several taxa. All references to such correlations are cited. Fagen correctly notes that there are other plausible explanations for these correlations and that there are also taxa in which the correlation does not exist. The cohesion hypothesis needs critical evaluation. A

beneficial effect more specific than "social bonds" must be identified.

The remainder of the book is taken up with mathematical models and theoretical discussion of play. Models for the optimal placement of play in ontogeny, for play as a cooperative social behavior, and for play as a mechanism by which novel adaptive behavior is discovered are presented. There is extensive discussion, from an individual-strategy point of view, of how social play should be structured. Fagen points out that two individuals engaging in social play may have opposing optimal goals and that the structure of social play is therefore open to interpretation in a game-theoretical framework. Much of the material in these chapters probably will promote interesting debate.

This book is carefully and thoughtfully produced and will be a valuable reference document for many years. There are useful appendixes, an extensive bibliography, and well-done author and subject indexes. The quality of most of the photographs is only fair, but, as Fagen notes, good photographs of play are rare. On p. 201, a photograph of a Dall sheep lamb is mislabeled as representing a Siberian ibex.

In addition to its reference value, the book should serve as a stimulus to more and better research on play. Most of the current ideas about play are fairly summarized, and functional hypotheses are thoughtfully critiqued. The extensive theorizing in the latter part of the book will introduce readers to the complexity of issues in behavioral development. Those who have not followed the play literature can catch up with those who have by reading this book.

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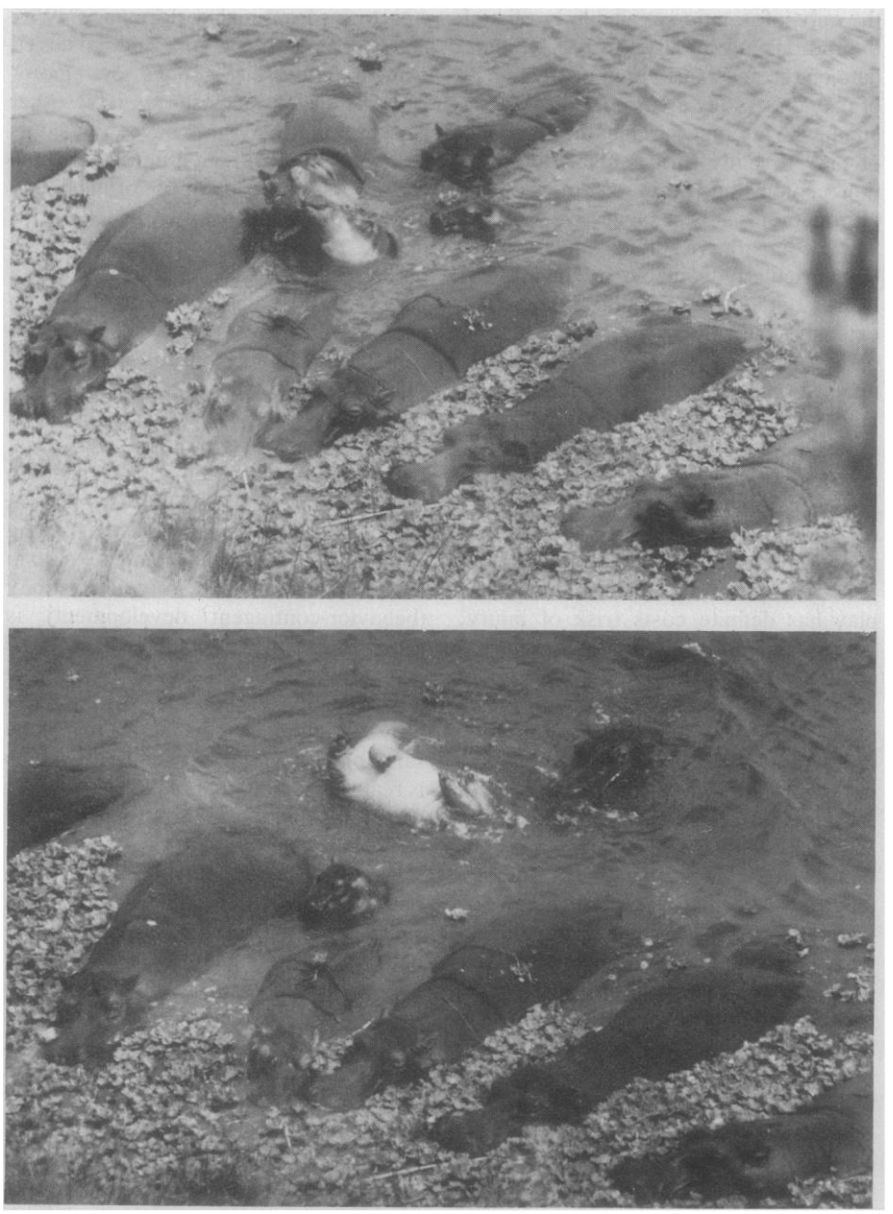

A bout of locomotor play by a hippopotamus (*Hippopotamus amphibius*) calf, Kazinga Channel, Uganda. *Top*, "Calf play-nibbles conspecific's lips." *Bottom*, "After rearing, vigorously waving its front legs, and leaping over its playmate, the . . . calf does a back flip with all four feet waving." [Maitland A. Edey; reproduced in *Animal Play Behavior*]

Data from a Satellite

X-Ray Astronomy. Proceedings of an institute, Erice, Sicily, July 1979. RICCARDO GIACCONI and GIANCARLO SETTI, Eds. Reidel, Boston, 1980 (distributor, Kluwer Boston, Hingham, Mass.). viii, 406 pp., illus. $47.50. NATO Advanced Study Institutes Series C, vol. 60.

An instrument of vastly increased sensitivity often leads not primarily to a resolution of long-standing observational questions but rather to a deeper appreciation of the difficulty of their solution. The second High Energy Astronomy Observatory, "Einstein," an orbiting satellite capable of detecting celestial x-ray sources 1000 times fainter than previous instruments have been able to detect, is an excellent example of such a situation. Results from Einstein dominate in this book of proceedings. The proceedings differ from those of many previous x-ray astronomy gatherings in that they appear promptly enough to be useful and stimulating both as a reference for researchers in the field and as the basis for a graduate course in extrasolar x-ray astronomy. A sprinkling of theoretical papers supplies a means for placing many of these new data in proper perspective.

A review of the topics covered in the book is simultaneously a recital of the questions in x-ray astronomy that have been intriguing but unsettled for a period of 10 to 20 years. It is perhaps instructive to restate some of these and to ask how data from Einstein have changed our viewpoint on them. What is the origin of the diffuse, isotropic x-ray background radiation? This question has been with us for 20 years; two competing models have been proposed, one invoking a superposition of distant point sources and the other invoking truly diffuse radiation from a hot intergalactic gas, whose inferred mass density would have great cosmological significance. Results from Einstein provide support and difficulties for both models, with no resolution of the argument. Giacconi and Tananbaum describe in detail how large numbers of