social groups. Blurton-Jones obtains quantitative data on certain fixed action patterns in small groups of children 4 to 5 years old. The patterns studied were a combination of gross behaviors (run, jump, wrestle, and the like), and facial expressions (laugh, low frown, pucker brows, fixate, red face, cry, and the like). Tabular data on correlative frequencies are given but are not clearly explained or discussed. In fact, some of the first rules of ethology are violated in the presentation. There is not an accurate identification of group sizes or sex and age ratios, and no data are given on classroom size, physical conditions, observation times, or individual differences.

Blurton-Jones points out various problems of ethologic studies in children, but also discusses strengths and potential values of these methods. He notes, for example, that the rough-and-tumble play is accompanied by a rich array of signals which differentiate it from hostile behavior. This leads to speculations on the role of rough-and-tumble play in social development, and to the possibility of direct comparisons with nonhuman primates. Though this comparative study is commendable, it was only a pilot effort of seven months' duration. It does not present a strong or effective case for ethologic methods in human sociology. The great need for descriptive studies of human behavior is generally recognized, and all objective efforts in this direction are certainly desirable, but they must be done with at least the same care afforded the best animal studies.

Despite the fact that many of the individual chapters are good, this book does not leave one with a satisfactory general view of primate behavior, nor does it add up to significantly new concepts of primate characteristics. Many specific topics are well covered, but others of equal importance are totally neglected. For example, there are no general discussions of grouping patterns, activity rhythms, movements, home ranges, food habits, habitat preferences, behavioral profiles, social traditions, or subcultural differences within primate species. Although other topics such as territoriality, dominance hierarchies, adaptive capacities, and ecologic limitations are occasionally mentioned, they do not receive sufficient attention to appear in the index. Nearly 50 percent of the book (171 pp.) is devoted to facial displays, socio-sexual signals, and communication. Another 40 percent (150 pp.) is devoted to mother-infant relations, play, and grooming. Only 17 pages are given to social organization. This book will be useful to primate behaviorists, but it neglects, in my view, too many important aspects of primate behavior to be a good introduction for the general scientific reader.

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New Results in Qualitative Dynamics

Problèmes Ergodiques de la Mécanique Classique. V. I. ARNOLD and A. AVEZ. Gauthier-Villars, Paris, 1967. iv + 243 pp., illus. Paper, 48 F. Monographies Internationales de Mathématiques Modernes.

This review begins on a scolding note.

At the present time the earnest student of the foundations of classical statistical mechanics could peruse most of the existing review articles, summer school proceedings, and advanced textbooks in English and never realize that in the last 14 years there has been a revolution in analytical mechanics. Perhaps this is to be attributed to the natural arrogance of theoretical physicists who believe that physicists make the discoveries and mathematicians make theorems out of them afterwards. But whatever the cause of this cultural lag in mechanics, there is no doubt of its existence. Not only do the statistical mechanics books show no trace of the era ushered in by Kolmogorov's address at the International Congress of Mathematicians in 1954, but none of them even mentions the important discoveries of E. Hopf on the qualitative nature of flows in phase space responsible for the phenomena of "irreversibility." (The main theorems on mixing flows were proved in the period 1932–34.)

The book under review will change all that. Based on lectures given in Paris in 1965 by its first author, it is a veritable catalog of the beautiful new results in qualitative dynamics accompanied by a choice collection of illustrative examples. The whole is put out in the elegant typography and layout one expects from Gauthier-Villars.

The format is a bit unusual. There are four chapters which, together with a bibliography, occupy 104 pages, but there are 34 appendices occupying another 144 pages. The proofs of the majority of the theorems are in the appendices. Chapter 1, "The notion of a dynamical system," defines the classical (concrete and smooth) and abstract dynamical systems to be considered. Chapter 2, "Ergodic properties," introduces the standard definitions of true average, ergodicity, and mixing as well as the new (1958!) notions of K(olmogorov)-system and entropy. This notion of entropy should not be confused with that used in thermodynamics. It is a measure of the rate at which information is lost by the mixing action of the flow in phase space. A K-system is one which has a characteristically "irreversible" behavior. (Incidentally, these two ideas are explained very clearly and in much more detail in another context, that of probability theory, in P. Billingsley's *Ergodic Theory and Information*, Wiley, 1965.) Chapter 3, "Unstable systems," introduces the notion of C-system, a classical dynamical system whose flow displays a characteristic instability: in a neighborhood of a given segment of orbit there is a family of orbits that run away from the given one with exponential rapidity as well as one of orbits that approach it with exponential rapidity. The great theorem of Anosov, which says, roughly, that every C-system is a K-system, is discussed. Chapter 4, "Stable systems," studies the structure of the flow associated with a classical dynamical system, with special emphasis on periodic orbits and invariant tori.

The authors have taken for granted that the reader understands a little of the jargon of modern mathematics. For example, within a few pages one encounters without explanation "le fibré unitaire tangent d'une variété riemannienne compacte," "une bijection," "une automorphisme." To the younger prospective reader still capable of learning new languages without agony, the reviewer can only say that the contents of the book make such an effort worthwhile.

It may be helpful to note that an English translation of the book will be off the press within a few weeks (to be published by W. A. Benjamin, New York). Also, the address by Kolmogorov referred to earlier is translated into English as an appendix in R. Abraham's *Foundations of Mechanics* (Benjamin, 1967).

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