tensive tabular material in the appendixes, and much advice on numerical procedures make this book especially useful.

Cowan's book treats topics in an amount of detail that is not easily found outside the research literature. For example, anyone who has ever studied atomic structure knows Hund's rule, which states that for a given configuration the lowest energy term is the one with the largest value of S having the largest value of L. Most books give the rule and explain its plausibility. Cowan gives a critique of it. He writes:

> With the limited amount of experimental evidence available at that time, Hund thought the above relations to be quite general. Although they are now known to be misleading more often than not (note the two points of disagreement in Fig. 4-4), they are still sometimes invoked in an attempt to predict the lowest term of a complex configuration. *Hund's rule* can safely be applied only to configurations with a single open subshell or with one subshell plus an s electron, and then only in the restricted form: *The lowest-energy term of a configuration* l^w *or of* l^ws *is that term of maximum S which has the largest value of L* [pp. 124–125].

Cowan then compares this restricted rule with experimental evidence and discusses its plausibility.

Other topics treated in similarly useful detail are the numerical solution of the Hartree-Fock equations and the complications and instabilities that can occur (sections 7-5 and 7-6), the use of nonorthogonal basis states in atomic structure calculations (section 13-2), and the effects of cancellation on theoretically calculated oscillator strengths (section 14-15). The theory of continuum wavefunction normalization is treated very satisfyingly for students: all the limiting procedures used to obtain the end result—which are glossed over in most quantum mechanics textbooks—are spelled out (section 18-3).

Three topics of current interest are discussed in the last chapters of the book. Chapter 19 reviews highly ionized atomic spectra, of interest, for example, in plasma physics. Chapter 20 discusses rare earth and transition element spectra, which are of interest because of their unique properties associated with the filling of f and d subshells. Chapter 21 discusses statistical distributions of atomic energy levels and applications of the theory in analyzing plasma spectra.

Despite the size of the book, Cowan omits many topics that are now subfields of atomic structure theory. Thus no discussion is given of group theory, accurate methods for treating few-electron atoms, or accurate methods for treating electron correlations in many-electron atoms. Rather Cowan has chosen to emphasize less powerful but more straightforward theoretical procedures that permit the theorist to analyze a broad range of experimental spectral data. In its emphasis on comparing theory with experiment Cowan's book is probably closest in spirit of any of the modern books on atomic spectroscopy to Condon and Shortley's classic work.

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Ethology: A Reiteration

The Foundations of Ethology. KONRAD Z. LORENZ. Revised version of the German edition (Vienna, 1978). Translated by Konrad Z. Lorenz and Robert Warren Kickert. Springer-Verlag, New York, 1981. xviii, 380 pp., illus. $21.95.

More than anyone else Konrad Lorenz is the intellectual architect of ethology. In the 1930's he labored to reclaim behavior from the perennial philosophical and methodological struggles between the vitalists and mechanists. In these days of computerized observational methods, sophisticated experiments, and sociobiological theory we often do not appreciate the struggle that was required to wrest the study of animal action from mystical instincts, reflex machines, and, somewhat later, the simplicities of laboratory behaviorism and biologically naïve environmentalism.

Unintimidated by then current dogma about conditioned reflexes and brain mechanisms, Lorenz brilliantly combined the ideas of others (especially Charles O. Whitman, Oskar Heinroth, Jacob von Uexküll, Erich von Holst, and Wallace Craig) along with his own insightful observations to construct a scientific approach that was clearly articulated, intellectually stimulating, and, most important, did not sacrifice the complexity and diversity of animal behavior on a barren altar of scientific rigor. Naturally, to simultaneously take on several opposed and entrenched ways of thinking ("ideologies" in this book) was not easy, and the difficulty was compounded by the advent of World War II just as Lorenz's seminal papers of 1935–39 were beginning to gain recognition in the English-speaking world. Physics performed by former enemies may be readily appreciated and accepted; theories of behavior, even of animals, strike too close to cultural myths to be readily evaluated objectively.

While containing echos of his subsequent books, this work primarily represents the assertive, aggressive Lorenz of the pioneering papers of the 1930's. Lorenz admits that the book does not represent the current field of ethology. His aim is to introduce modern workers to the often ignored indispensable core of ethological knowledge and how it was obtained. Like his earlier writings the book is based largely on personal observations and the studies of friends, colleagues, and students. Lorenz provides us his view of the style, as well as the substance, of classical ethology.

The book consists of three major parts, following a forthright introduction by Theodore Bullock, an ingenious short preface, and an "introductory history" that is required reading for everyone interested in placing Lorenz and early ethology in the proper intellectual and scientific context. Here we learn, for example, about the timely and crucial theoretical support provided by the physiological demonstrations of von Holst. The book itself is dedicated to Niko Tinbergen, who provided ethology with an essential experimental methodology.

Part 1, headed Methodology, consists of four chapters. We are treated to Lorenz's approach to thinking in biological terms, the contrast with the physical sciences, and the role of reductionism, teleology, and teleonomy. Then we move to methods of observation, yet not methods in the mechanical sense. We go back to the very nature of perception itself, to the intuitive grasp of "wholes," to the respective virtues of studying wild and captive animals, to unobtrusive experimentation, and, of course, the deprivation experiment. Lorenz tells us of the faults of atomism, explanatory monism, and operationalism. A lengthy chapter on the comparative method follows, where the emphasis is on phylogenetic reconstruction and behavioral homologies.

Part 2, the longest, is entitled Genetically Programmed Behavior. Here we find a complete résumé of Lorenzian ethology. There are detailed explications of fixed action patterns, releasers, centrally coordinated movements, and a new, refined "hydraulic" model. There are long discussions of the stimulus in the innate releasing mechanism, orientation processes such as taxes and kineses (phenomena that have lost favor in modern ethology texts but are having renewed importance in the study of insect behavior), and problems of motivation. This section of seven chapters ends with a discussion of displacement behavior.

In the '60's Lorenz devoted much at-

tention to learning, perhaps as a way of bringing the battle to his critics in psychology. Thus we have part 3: six chapters on the Adaptive Modification of Behavior. Lorenz makes a positive attempt to integrate ethology and psychology, and many of the ideas he presents are testable. There are treatments of learning with and without association or feedback, motor learning, imprinting, operant conditioning, voluntary movement, insight, exploration, curiosity, and play. As in an earlier presentation of neurophysiological models, bold claims are made seemingly in ignorance of the latest and even not so recent findings. I winced when Lorenz flatly stated that all imprinting is irreversible, a claim he avoided in his early writings. But like many great teachers Lorenz makes a point strongly and then adds the fine print. Lorenz needs to be read the way he wants us to watch geese: look for the patterns, the gestalten, avoid linear thinking. Just as we must beware of being distracted by the "obvious" dominance of one bird into ignoring the subtle qualifiers, so must we approach Lorenz's own writings. Thus we discover that in regard to irreversibility filial imprinting is excluded because of the necessary and progressive waning of the parent-offspring bond.

The book ends with an appendix justifying the ethological approach to human behavior with sections on anthropology, conceptual thought, language, and cultural ethology. But there is no final pulling together, no summarization of where the field is today and where it should go. Though there are indications that Lorenz is familiar with more than he lets on, as in the footnote to the lone reference to E. O. Wilson, few studies from the last 20 years are cited in the book, and analysis of the current empirical status of core ethological concepts must be provided by someone else.

Lorenz, at 78, remains true to a qualitative model of behavior derived from close observation and an evolutionary attitude. Some sociobiologists accuse him of having a static view of evolution, one not in tune with modern population biology and the selfish gene. Though this is true to some extent, bringing evolutionary thinking back into the mainstream of behavioral science was Lorenz's greatest accomplishment. Additionally, Lorenz, the "instinctivist" of current introductory psychology texts, actually showed the way to a viable middle ground between genetic and experience-determined systems in behavior, a middle ground again in danger of being usurped by archaic jousting among sociobiologists, social scientists, and even some evolutionary biologists opposed to incorporating human behavior into Darwin's dream of the entangled bank.

Along with Tinbergen's *The Study of Instinct*, this volume needs to be read and reread, not to comfort us with how far we have come, but to teach us where ethology came from and to remind us how narrow, superficial, and uninspired behavior research often is when not infused with vision, mission, and passion. and passion.

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The Gorilla

The Natural History of the Gorilla. A. F. DIXSON. Columbia University Press, New York, 1981. xviii, 202 pp., illus., + plates. $19.95.

Gorilla Behavior. TERRY L. MAPLE and MICHAEL P. HOFF. Van Nostrand Reinhold, New York, 1981. xii, 290 pp., illus. $32. Van Nostrand Reinhold Primate Behavior and Development Series.

Although different in style and emphasis, these two volumes on the gorilla are in complete agreement that we are running out of time if preservation in the wild of this magnificent species endemic only to Africa is to be achieved. Their numbers are generously estimated to be between 5,000 and 15,000 in the field and less than 700 in captivity. An eastern subspecies, the mountain gorilla (*Gorilla gorilla beringei*) is particularly endangered, with extinction likely by the end of this century. It is a pitiful commentary indeed that we may witness the demise of these "gentle giants" well before consensus regarding their taxonomy is reached (some taxonomists would place the gorilla in the same genus as chimpanzees). Just as we have, for the first time, sufficient quantitative information to appreciate the dignity and intelligence of one of our closest concurrent evolutionary relatives, it might be too late to stop a chain of events that is destroying its habitat and precipitously reducing its populations. Human ignorance, poaching, and land encroachment are the primary hazards.

In addition to mountain gorillas, which range at altitudes from 6,500 to 13,500 feet in the region of six extinct Virunga volcanoes (straddling the Zaïre-Rwanda-Uganda border) and Mount Kahuzi, Zaïre, there are two other recognized subspecies, the eastern lowland gorilla (*G. g. graueri*) and the western lowland gorilla (*G. g. gorilla*). From sea level to under 8,000 feet, the eastern lowland gorillas are found almost exclusively in the rain forest of Zaïre, while the western lowland gorillas, at similar elevations, span an area from the west coast of Africa, including Gabon, Equatorial Guinea (Rio Muni), the southeastern tip of Nigeria, and Cameroon, to the southwest corner of the Central African Republic at its eastern limit. Some 600 miles of forest of the Congo basin separate the western gorilla from the eastern populations including the mountain gorilla. The relatively minor differences among the three forms suggest that their divergence is recent. It is thought that gorillas radiated by way of a montane forest bridge in the late Pleistocene (less than 500,000 years ago) either from west to east (in the traditional view) or the converse (according to more recent indications) and later (approximately 100,000 years ago) into the higher elevations of Virunga, where they evolved characteristics distinctive to colder regions (at times below freezing). It is proposed that contact between western and eastern gorillas was subsequently broken when the forest bridge retreated with climatic changes bringing hotter and drier periods.

Mountain gorillas have longer and blacker hair, a narrower skull, a less prominent underlying scalp pad of fibrous tissue, a longer palate, no "lip" or projection above the nasal septum, shorter arms, broader hands, and a more closely aligned big toe (possibly indicative of greater terrestriality) than western gorillas. The eastern lowland gorilla has a longer and narrower face than its mountain counterpart but is generally intermediate in anatomical characteristics between the other two subspecies. Differences in behavior of the three populations cannot be ascertained at this time, since nearly all field studies have involved mountain gorillas and studies in captivity, with rare exceptions, are of western lowland gorillas ($N = 635$ in zoos and research institutions: 138 captive-born; 293 males, 342 females). Further, distinction between eastern and western lowland gorillas is very recent in zoological gardens, not yet reflected in the studbook register, which lumps *G. g. graueri* and *G. g. beringei* together under the classification of "mountain" gorillas ($N \leq 24$; only 16 surviving in 1976, with no true mountain gorilla having been born in captivity).

As the title of his book indicates, Dix-