the principal food of the eagle is rabbits, the control of which by the eagle actually betters the conditions for sheep.

The book before us was conceived in the 1950's when Leslie Brown, then chief officer for agriculture in the British Crown Colony of Kenya, searched in vain for works on the birds of prey. Recognizing that his own experience in Africa, India, and Europe fitted him for authorship of a serious work on eagles and falcons, he approached Dean Amadon of the American Museum of Natural History, who was familiar not only with New World species but with those of Australia as well, as co-author. Thus began a long and at times frustrating experience, with authors on widely separated continents and the London publisher on a third. Eventually publication was taken over by McGraw-Hill in New York. The text was largely completed in 1963 (but updated in places as new material became available); the plates were not completed for another five years.

Brown and Amadon's treatise brings before the general reader the best information the authors could find on each species in the raptor assemblage, not only the well-known species but the comparatively unknown ones as well. The most detailed information presented is not about the generally familiar golden eagle of the Northern Hemisphere but about the crowned eagle of Africa. In 1959 Brown discovered a crowned eagle building its nest in a great syzygium tree in view from his study window. The discovery of the nesting pair at the end of his own property allowed him to continue detailed studies on a species on which he had already made most important studies at his research station, Eagle Hill, near Mount Kenya. The alternate-year breeding of this eagle near the equator is explained by the extraordinarily long post-fledgling period of 11 months, during which the eaglet is fed by the parents.

The backbone of this work is the species accounts (290 species in 81 genera, all illustrated in 165 plates). This is preceded, however, by 16 chapters on subjects of general biological interest, including the functions of raptors in ecosystems, particular habits subserving particular functions, and, in turn, anatomic and physiologic adaptations furthering these functions. Chapters range over classification and distribution, physical attributes (the visual acuity of many birds of prey is probably eight times that of man), molt, flight, migration, hunting methods, productivity, longevity, and other topics. There are no photographs, but drawings illustrate some characteristic displays and flight. Ninety-four maps present ranges, migration routes, and in some cases even the distribution of subspecies (17 races of the peregrine falcon), and 15 halftone plates give flight and underwing patterns of 200 forms. There is a bibliography arranged by chapter and region, as well as a list of selected titles after most species accounts. The index is particularly useful, because many general characteristics are considered in introductory chapters which are not later described in the species accounts.

I find much that is new to me, even in the general chapters, some things which I question, and in some places views that may need altering with information that has appeared since the book was written. Although a kestrel (*Falco sparverius*) does have a postjuvenal molt, I know of no other example, and such a molt certainly is not general among Falconiformes. The juvenal plumage usually molts directly into the adult early in the bird's second year, and the molt is complete. The larger eagles have a more complicated plumage succession.

It is curious that there is so much difference of opinion with regard to classification, but of course the explanation is just that: it is opinion. In an arrangement of genera indicating phylogenetic trends in the Accipitridae, the Old World vultures are placed quite far from the aquilid eagles. This is not supported by observations on egg-white protein electrophoretograms, of which those of such birds as the white-headed vulture and Verreaux's eagle are closely similar. Further, in the family Falconidae electrophoretograms of *Polyborus*, *Herpetotheres*, *Polihierax*, and 15 species of *Falco* show varying degrees of intrafamilial resemblance but no resemblance to other families of the Falconiformes. The question of a polyphyletic origin of the falconiform assemblage is not given much attention in the treatise, and the work really concerns living eagles and falcons in the field rather than laboratory investigations or armchair philosophy.

I think one shortcoming of the treatise stems from the necessity to please not only ornithologists but also a wider public. The investment in color plates demands a considerable sale, and publishers do not like a "cluttered" text for the general reader. The serious student, however, wants to refer to the original sources for more information and, particularly in a nonexperimental science, feels the need for independent evaluation of the original accounts. The absence of text citations of pertinent literature is therefore distressing. There are also typographical errors, some of labeling, and some of factual detail.

The task of producing the plates (135 of which are in color) was distributed among eight artists, and the general accuracy and beauty of the plates will go a long way toward overcoming the price hurdle. Many of the plates are outstanding, not only in delineation and color but in "lifelike" pose as well, and there are many by less well known artists in addition to ones by such artists as Eckelberry, Peterson, and Reid-Henry. I liked particularly the remarkably delicate work of Albert Gilbert and C. E. Talbot Kelly, each of whom produced beautiful two-tone as well as color plates. I wish there were color plates of some nestling down plumages, particularly in such species as the bateleur, the osprey, and the martial eagle. All in all, however, I find this book hard to put aside. It will probably remain a chief reference for many years to come.

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Neural Linkages

The Interneuron. Proceedings of a conference, Los Angeles, Sept. 1967. MARY A. B. BRAZIER, Ed. University of California Press, Berkeley, 1969. xviii, 554 pp., illus. $20. UCLA Forum in Medical Sciences No. 11.

This nicely produced book, containing a series of papers and attendant discussions from a symposium held at the Brain Research Institute of the University of California at Los Angeles, is somewhat misnamed. It deals not with interneurons as individual entities but rather with groups of interneurons considered as interrelated sets.

Interneurons are nerve cells which serve as links for transmission of information between other nerve cells. Virtually all of the neurons within the central nervous system of vertebrates (and of many invertebrates) can be classed as interneurons, and consideration of central nervous system function in terms of interneuronal mechanisms

may thus become staggeringly complex in very short order. Such complexity sometimes results in a certain degree of pessimism, as in the first paper, in which Horridge wrestles with the problem of how an investigator is to observe, let alone recognize, the phenomena within the central nervous system which are really relevant to its proper function, which in the broadest sense is behavior. Clearly, problem formulations must be simpler in order to permit attack, and the *modus operandi* employed by most of the contributors to this volume has been to examine the operation of restricted numbers (but at least two) of related interneurons considered as a set, with little or no emphasis on the possible functional relation of the set to the remainder of the nervous system outside it. The primary focus of many of the investigations reported here seems to have been a search for interneurons connected in definable ways, with identifiable input sources and output elements.

In a sense, the sort of interneuron sets described above can be considered as modular neuronal circuits which may be represented repeatedly within the same nervous system and possibly within the central nervous system of other species as well. The material presented in the papers, and the discussions following each, indicate that the participants in this symposium shared the conviction that information gleaned from studies of particular neuronal sets may yield general principles that can be applied elsewhere. The position of the modular sets of interneurons within the flow diagram of the entire nervous system need not be specified in order to draw meaningful conclusions as to their internal operation. The extent to which interneuronal sets can be defined experimentally as modular circuits varies considerably, but several situations come remarkably close, notably in studies of some invertebrate ganglia (Kandel, Maynard), of certain spinal reflex systems (Lundberg), and of cerebellar cortical (Llinás) and subcortical (Ito) mechanisms.

The astonishing variety of effects observable in two-neuron synaptic interaction in molluscan ganglia is reviewed by Tauc. The work reported by Kandel, dealing with small, defined sets of mollusk ganglionic neurons, illustrates the elegance with which neuronal circuits can be studied in situations where the individual elements can be defined anatomically and physiologically. These two papers, particularly, give evidence of what Horridge refers to as "the subtlety of interaction" possible even in small ensembles of interneurons. The papers of Kennedy and of Wiersma represent something of a bridge between the invertebrate work and studies on the less accessible vertebrate nervous systems in that they describe the input-output relations of interneuronal networks with relatively undefined internal arrangement.

Among the papers dealing with vertebrate interneuronal systems, several are devoted primarily to the problem of identifying patterns of connectivity among groups of neurons by anatomical methods (the Scheibels, Larramendi, Blackstad). Blackstad's contribution is particularly important for his clear appraisal of the caution with which such studies must be interpreted. The experimental approaches available to vertebrate physiologists in their attempts to define interneuronal circuitry are well illustrated in the papers of Lundberg and of Willis (dealing with the spinal cord), of Ito and of Llinás (cerebellum), and of Andersen (hippocampus). The enormous difficulties encountered in the study of interneuronal systems in which the input sources cannot be clearly defined and in which there is no identification of specific intermediate elements are clearly evident in the papers of Purpura and of Stefanis, which deal with the mammalian thalamus and cerebral cortex respectively.

This book constitutes a quite reasonable survey of many of the methods and approaches used by investigators in trying to delineate the specific neuronal operations within modular subsystems in the central nervous system. As such it should be useful to a rather wide audience of those interested in current ideas about the nervous system. The logical connection between the contributions, undoubtedly reflecting careful planning on the part of the symposium organizers, makes it more than just a convenient collection of disparate reviews. The utility of the book is considerably enhanced by the preservation of group discussions, several of which are quite incisive and air important, and as yet unresolved, problems.

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Excited States

Elementary Excitations in Solids. The Cortina Lectures and selected lectures from the Conference on Localized Excitations, Milan, July 1966. A. A. MARADUDIN and G. F. NARDELLI, Eds. Plenum, New York, 1969. x, 526 pp., illus. $35.

Four years after the fact, Plenum Press offers this volume of summer institute lectures and conference proceedings. The book is perplexing: it's handsomely printed but awash with misprints, some confusing; informative about several different physical systems but illogically organized; aimed partly at providing an understanding of the essentials of physical processes and partly at detailed presentation of then-current experimental findings—and the two do not always overlap. Still, the understanding and enthusiasm of a very distinguished group of contributors come through, and the book can serve quite usefully as a belated companion volume to the proceedings of the 1967 Irvine Conference on Localized Excitations in Solids.

Four kinds of excited states of solids are defined and examined: excitons, electron-hole pairs and plasmons in an electron gas, spin waves, and phonons. The last two receive most attention, with emphasis primarily on the exceptional spin-wave and phonon excitations caused by the introduction of lattice defects or impurities. These localized or resonant modes are treated in the T-matrix language of scattering theory in articles by Nardelli and Callaway; the Callaway articles also contain a particularly clear demonstration of how the T-matrix may be factorized by exploiting the point-group symmetry of the crystal. Maradudin discusses the same impurity-mode problem via the Lifshitz Green's function approach and collaborates in a model calculation showing how this same formalism predicts spin waves localized near a free surface.

The observation of localized and resonant modes through their interaction with light is treated, primarily experimentally, in articles by Burstein, Balkanski, and Sievers. Both infrared and Raman techniques are discussed, but the reader who doesn't already know what Raman scattering is will be confused. Pohl's article shows that information about phonon resonant modes obtained in lattice thermal conductivity measurements is often complementary to that accessible by optical techniques.