

REVIEWS

Zoogeography.—Edited by Carl L. Hubbs. 1958. (Published January 16, 1959.) Publication No. 51 of the American Association for the Advancement of Science. x + 509 pp. \$12.00 (\$10.50, prepaid to AAAS members).—Symposia on broad problems that cut across several disciplines have become one of the modern features of large scientific meetings in which diverse societies participate. In 1957 two such symposia in the field of zoogeography were held. The first was at Stanford University in August 1957 under the auspices of the Pacific Section of the Society of Systematic Zoology, as a feature of the joint meeting of the American Institute of Biological Sciences and the Pacific Division of the American Association for the Advancement of Science. It was cosponsored by the American Society of Ichthyologists and Herpetologists (Western Division), American Society of Zoologists, California Academy of Sciences, Pacific Coast Entomological Society, Society for the Study of Evolution, and Western Society of Naturalists. The variety of sponsoring societies is indicative of the interdisciplinary approach for the solution of problems in zoogeography. The symposium, entitled "The Origins and Affinities of the Land and Fresh-Water Fauna of Western North America," consisted of 14 papers, which were presented in two sessions, and was under the general chairmanship of Carl L. Hubbs. The second symposium, presided over by E. Raymond Hall, included six papers that were delivered at the meeting of the American Association for the Advancement of Science at Indianapolis on 28 December 1957. It was entitled "Geographic Distribution of Contemporary Organisms" and constituted Part I of a general symposium on "Some Unsolved Problems in Biology, 1957." This was a joint program of the AAAS, Sections F (Zoological Sciences) and G (Botanical Sciences), and was extensively cosponsored by the Society of Systematic Zoology, Ecological Society of America, Genetic Society of America, American Society of Naturalists, and Botanical Society of America. Fourteen of the papers from the first symposium comprise Part I of the book; three papers from the second symposium comprise Part II. In addition there is a final chapter, "General Conclusions," by Carl L. Hubbs.

In Part I, 10 papers deal specifically with the origins and affinities of parts of the fauna of western North America: Donald E. Savage, fossil land mammals; William H. Burt, recent land mammals; A. H. Miller, birds; Robert C. Stebbins, present amphibians and reptiles; Frank E. Peabody and Jay M. Savage, present amphibians and reptiles; Robert Rush Miller, fresh-water fishes; Robert W. Pennak, fresh-water invertebrates; Herbert H. Ross, northern and montane insects; James A. G. Rehn, dermaptera and orthoptera; E. Gorton Linsley, cerambycid beetles. Of these papers, Miller's is in the form of an editor's note and Stebbins' paper is an abstract. One additional paper by William Hovanitz deals with the distribution of butterflies, but it is concerned with the New World and not just western North America. A second group of three papers is concerned with the related data and problems from geology, paleontology, paleoclimatology, and physiology, which are an important part of the foundation needed to determine the origins and affinities of the fauna of western North America: Phillip B. King, evolution of modern surface features; H. D. MacGinitie, climates since the Cretaceous; George A. Bartholomew, physiology and distribution of terrestrial vertebrates. Part II, emphasizing some unsolved problems in the geographic distribution of contemporary organisms, comprises three papers:

Paul S. Martin, pleistocene ecology and biogeography of North America; Kenneth C. Parkes, palearctic element in the New World avifauna; W. Frank Blair, distributional patterns of vertebrates in the southern United States in relation to past and present environments.

The papers that are concerned with the distribution of specific parts of the fauna are rich in information and are presented for the most part in the best traditions of zoogeography. They contain the data that constitute the foundation of zoogeography and are a valuable addition to the literature because of the great competence of each of the authors in their specialized fields. Paradoxically, the strength of the volume is also in part its weakness, since, in the opinion of the reviewer, what is needed in zoogeography is more emphasis on the factors and processes involved in the development of patterns of distribution in contrast to mere descriptions of such patterns. This is not to belittle the value of descriptive biogeography. Sound taxonomy, extensive collections, and accurate descriptions of ranges are the foundation of biogeography. But what is not recognized often enough is that zoogeography must go beyond the mere accumulation of data. In order to derive explanations and to define the factors and processes involved and their interrelations the distributional data must be integrated with the data, concepts, and theories of many diverse fields. This is recognized in the present volume, and a good beginning is made in the group of three "background" papers that introduced the first symposium. King states fairly that there are wide gaps in the geological record, that much evidence is equivocal rather than decisive, and that there is much divergence among geologists as to what the evidence means. MacGinitie describes changes in climate since the Cretaceous, emphasizing changes in temperature, and relies heavily on past floras as indicators. He states strongly that the explanation of changing climates is not to be found in theories of wandering poles and drifting continents, but he does not evaluate the recent paleomagnetic and geologic data. In the reviewer's opinion, no amount of biologic or climatic evidence will be able to negate acceptable geophysical evidence of crustal displacement. The biologist and paleoclimatologist can only relate their interpretations to geophysical findings or theories. Bartholomew, in his sound and original analysis of the role of physiology in the distribution of terrestrial vertebrates, concludes that "... assignments of distributional limits on the basis of assumptions about the physiology of an animal are unrealistic." "Available knowledge of physiology helps to explain how a vertebrate can live where it does, but rarely reveals why it does not occur beyond the observed limits of its distribution. Physiological tolerances are permissive in that they set the environmental parameters within which a species can occur." On the basis of present knowledge "it appears to be more reasonable to look for the determinants of distribution of the higher vertebrates in behavioral and ecological factors, rather than in terms of physiological tolerances."

In view of the controversies and lack of fundamental knowledge in these related areas, it is obvious that the interpretations of origins and affinities that are given in the other papers must be evaluated in terms of the geologic, paleoclimatologic, and biologic knowledge that is used or implied. Despite the fact that the first symposium was concerned with origins and affinities of a fauna, there is no paper on the general problem of the methods for determining origins and affinities. Only two authors, D. E. Savage and W. H. Burt, discuss them, and it is obvious that the criteria they use are not valid for all groups or under all circumstances. As several authors emphasized, there is usually little or no basis for postulating

a region of origin and direction of dispersal with regard to the members of the Palearctic and Nearctic faunas.

In the final chapter, "General Conclusions," Hubbs superbly summarizes and evaluates the symposia. A succinct table provides an index to the subject matter under headings of geographical, background, and evolutionary and systematic considerations.

This volume is exceedingly valuable for its many excellent factual summaries of distributional data, for its diversity in groups of organisms considered, for its interdisciplinary and multidisciplinary approaches, for its demonstration of the need for a more dynamic approach to the problems of biogeography, and for its objectivity in considering some fundamental issues in zoogeography and evaluating our present state of knowledge. It could have been improved with more papers on the fundamental, theoretical questions of zoogeography and more papers on paleogeography, paleoclimatology, and paleoecology, with presentations of alternative points of view. It is the reviewer's hope that these papers will appear in future symposia.—ALBERT WOLFSON.

Biologische Studien am Alpensegler.—Hans Arn-Willi. 1960. Verlag Vogt-Schild AG, Solothurn, Switzerland. 204 pp., 54 photographs, 43 tables, charts and text figs. 19.60 Swiss francs.—Since the late forties, I have had a reasonably good idea of the magnitude and trends of Hans Arn's long-term researches on the Alpine swift (*Apus melba*) as they progressed, year after year; and, the longer the program continued, the more interesting and valuable it has become. Now, with a quarter century of original data behind it, Arn's monograph brings together the findings from his very intensive, accurate, and well-planned investigations of the biology of a highly specialized and distinctive form of life.

The book summarizes a vast amount of life history and behavior data, based upon field observations, laboratory examinations, marked nest sites, banding, etc. To me, the discussion of food habits was particularly informative, not only as illustrating the types of insects that the swifts take in their feeding flights but also in relation to the starvation that unfavorable weather can mean for a species dependent upon such sources of food. From June to the end of August in 1948, the year of the great "*Segler-sterben*," the weather was almost uninterruptedly rainy, with low temperatures; as a consequence of the unavailability of food, the young suffered nearly total mortality. Pronounced mortality associated with unfavorable weather was also recorded in 1953 and 1957.

The Alpine swift population of Arn's principal study colony, that for the Jesuit church in Solothurn, increased over most of the period of his study from 32 pairs in 1932 to 175 by 1955, thereafter (1956–1958) to drop somewhat. The most rapid rise took place between 1946 and 1954. Except for the wet and cold summers, the production of young in the colony followed rather closely in proportion to the numbers of nesting pairs. Substantial losses of young through predation, apparently largely due to cats and rats, were noted in 1937 and 1942—nothing comparable in severity to losses through the influence of weather on availability of food.

It is difficult to say what is most outstanding about a study as exhaustively carried on as this one has been, but certainly the banding results deserve special mention. From 1932 to 1956, 453 adult Alpine swifts and 4,561 nestlings were banded in Solothurn (though not all in the Jesuit church). Of these, 231 adults

and 597 young gave returns. Forty-eight birds banded elsewhere were also handled. From these results, data were obtained on fidelity to nest sites, longevity (average of 5.6 years, with two birds reaching 19 years, six reaching 18 years, four reaching 17 years, and one returning 17 years after having been banded as an adult), migration routes, and wintering quarters. Some banded birds were used in novel transportation experiments.—P. L. ERRINGTON.

Wildlife of Mexico.—A. Starker Leopold. 1959. University of California Press, Berkeley. 568 pp., 1 colored plate, 194 numbered figs. (including 1 colored map and numerous range maps, line drawings, and photographs). \$12.50.—One of the cardinal tenets of reviewing is supposed to be that an author should not be criticized for his objectives, and that his work should be judged entirely by his success in achieving those objectives. In this respect, the present book poses a curious problem. Its style is impeccable, its insights are deep, its judgments are scientifically sound, its format is superb, and its illustrations, executed by Charles Schwartz, are at once striking and profuse. Yet the work is impaired by a lack of central focus that verges on a serious shortcoming.

The major difficulty is spotlighted on the jacket, where in bold, black letters one-inch tall appears the title WILDLIFE OF MEXICO. Below in inconspicuous 3/16-inch white letters, pallid against a yellow background, is the qualification THE GAME BIRDS AND MAMMALS. A question immediately leaps to mind—what is properly game and what is not? A dictionary would answer that game is "wild birds, fish, or animals hunted for sport or for use as food." But the translation of this definition into operational terms is not the same in Mexico as it is in the United States. Below the border the mass of the people judge game in terms of the cost to procure. Only the larger, edible animals are considered worth the expenditure of a rifle bullet or a shotgun shell. On the other hand, a host of lesser creatures, songbirds that can be knocked down by slingshot and small mammals that can be snared, bulk large in the average Mexican's conception of fair game. Wood Rats (*Neotoma*) are even offered in the markets.

Against this background, Leopold's selection of game birds and mammals seems highly artificial—an exportation of our own conceptions to a foreign scene. Though he frankly acknowledged the difficulty, he does not effectively remove it. In dealing with birds he is highly selective; in dealing with mammals he adverts to the criterion of size alone and devotes discussion to everything as large as or larger than a cottontail with a special dispensation to include the squirrels and the weasel *Mustela frenata*. As a result his accounts include such dubious game as the Howler and Spider Monkeys, the Collared Anteater, the Nine-banded Armadillo, the Mexican Porcupine, and the Grison, but omit such economically important food producers as the various species of Wood Rats and Pocket Gophers. But despite these incongruities, the systematic sections of the book are a storehouse of valuable information, much of which is new.

Part I of the book, which is devoted to a general treatment of Mexico's wildlife resources and the management of these resources, is an important milestone in the conservation movement in North America. Here the author discusses, with a profound degree of discernment that could have come only from one of his experience and background, the land-use practices employed in Mexico and their sometimes devastating effects on the country's vegetation and its wildlife. He then delves into Mexico's existing program of wildlife conservation and

describes, without pulling his punches, the measures he believes are required to improve it and to insure the future of this resource. Most encouraging is the fact that this book was prepared with the blessings and the help of the leading game officials of Mexico, who are therefore surely cognizant of the problems of which Leopold speaks and of the difficulties with which they are faced. Under this informed wildlife administration the situation cannot escape general improvement, in which case Leopold's book will have served admirably the cause of conservation in that part of the continent where the need is most critical.—
GEORGE H. LOWERY, JR.

Birds of the West Indies.—James Bond. 1961. Houghton Mifflin Company, Boston. 256 pp., 8 color plates, 186 line drawings. \$6.—The third of James Bond's West Indian bird guides carries the same title as the first (1936), but the approach is that of his *Field Guide to Birds of the West Indies* (1947) with minor changes. Geographical coverage has been extended to include the southwestern Caribbean islands of Old Providence and St. Andrew. Accounts of distribution have been brought up to date. The text is otherwise not greatly changed from the 1947 guide, but improvements in typography and in the arrangement of material make the information more readily accessible.

Of the 480 species admitted to the West Indian list, 430 are treated in the main text and the remainder retired to a "List of Vagrants." The typical account for species that breed in the West Indies gives "Local Names," "Description," "Voice," "Habitat," "Nidification," and "Range." Subspecies are not discussed as such, although geographical variations noticeable in the field often are mentioned under "Description." English and scientific names are indexed, but the index to local names, a useful feature of the earlier editions, is not included.

By some 80 changes in recommended English names Bond achieves a considerable advance toward a uniform English nomenclature for New World birds. As always, the advance is made at the expense of some appropriate and colorful names long in use. English names for species in common agree about 95 and 90 per cent, respectively, with those of *The Species of Middle American Birds* (Eisenmann, 1955) and the *Check-list of North American Birds* (1957).

With this edition the West Indian guide closely approaches standard North American guides in its wealth of illustration. About 75 per cent of the birds that breed in the West Indies and some of the commoner transients and winter residents are figured in line drawings by Earle Poole and eight new color plates by Don Eckelberry. The uniformly excellent plates (80 individuals of 66 species) are an important contribution to bird study in the West Indies. Additional plates for some groups still rather sparsely illustrated, such as the pigeons, quail-doves, and vireos, would be welcome.

Bond's guide remains indispensable to anyone with an interest in West Indian birds. One hopes that this attractive new edition will focus attention upon the critical need for protection of the region's many rare and threatened species.—
WILLIAM B. ROBERTSON, JR.

Mammalian Hibernation.—Proceedings of the First International Symposium on Natural Mammalian Hibernation, 13–15 May, 1959. Edited by Charles P. Lyman and Albert Dawe. 1960. Bulletin of the Museum of Comparative Zoology at Harvard College, 124. 549 pp. Paper, \$3.00; cloth, \$4.50.—This important symposium, supported by the Office of Naval Research and sponsored by the

American Institute of Biological Sciences, brought together more than 40 active investigators of this interesting phenomenon. The 26 papers, the panel discussion, and the general discussions, as presented in this volume, will constitute for the more general reader a useful inventory of progress in this field since the last extensive general summaries by Lyman and Chattfield (*Physiol. Rev.*, 35: 403-425, 1955), Eisentraut (*Der Winterschlaf mit seinen ökologischen und physiologischen Begleiterscheinungen*. Jena, 1956), and Kayser (*Rev. Canad. Biol.*, 16: 303-389). Although it is true that this volume is of primary interest to mammalogists, mammalian physiologists, and comparative physiologists, it nevertheless has substantial interest for ornithologists. The so-called torpidity, accompanied by hypothermia, which occurs under certain conditions among some caprimulgids, micropodids, and trochilids, is certainly very similar to the hibernation of some mammals. Torpidity in birds is reviewed very well in this volume (pp. 93-103) by Oliver P. Pearson. Of further interest in this conjunction is the temporary nocturnal hypothermia that has now been observed in other species of birds. It is probable that further similarities will emerge, particularly between the processes of premigratory fat deposition in birds and prehibernation fat deposition in mammals. Possibly also important comparisons will emerge from studies of fat metabolism in migration and in hibernation, despite the great differences in metabolic rates. But the volume is to be recommended to ornithologists, and to biologists in general, primarily as a most interesting exposition of many of the facets of this striking adaptive phenomenon.—D. S. FARNER.

Biological Clocks.—*Cold Spring Harbor Symposia on Quantitative Biology*, Vol. XXV, xiii + 524 pp. 1960. Long Island Biological Association, Cold Spring Harbor, New York. \$8.—Biologists have long been aware of the prevalence of a plethora of functions with daily, annual, and other periodicities. However, it is only in the very recent decades that there has been intensive effort to characterize these functions accurately and, more importantly, to investigate the timing mechanisms involved. The almost explosive increases in investigations and investigators have been accompanied by an unusual number of differences in interpretation and generalization. Some of the differences have been semantic, but many are genuinely substantive, having their origins in the choice of experimental organisms, choice of experimental functions to be observed and measured, and the breadth of generalization employed in subsequent interpretations. It was thus extremely appropriate that the 1960 symposium concerned itself with "Biological Clocks." The participants included a substantial fraction of the current investigators of these interesting phenomena.

Much of the symposium was concerned with the so-called *circadian rhythms*, functions with periodicities of approximately 24 hours. It is this type of periodic function that has generated most of the controversy concerning the nature of biological clocks. The core of the controversy is centered on the question of the extent to which the biological clock is truly autonomous and intrinsic to the organism and the extent to which it simply represents a response to a periodic function in the environment. Roughly the positions of interpretation vary from the concept of genuinely internal periodic mechanisms that are relatively insensitive to temperature, and that can be entrained or phased by environmental periodicities such as cycles in light and temperature, to the concept that the biological clock is totally dependent on periodic functions in the environment. The former concept is analagous to an imperfect spring-operated clock that re-

quires frequent setting. The latter is analogous to the electric clock operated by a synchronous motor whose periodicity is wholly external in origin. These two positions are best presented by Colin S. Pittendrigh (pp. 159-182) and Frank A. Brown (pp. 57-70), respectively. Regardless of which analogy is acceptable, there is ample evidence that biological clocks operate at a cellular level as well as at whole-organism level. The symposium did not resolve the problem concerning the true nature of the biological clock. Possibly the perspective of time may ultimately show that it is naive to expect that resolution to a single type is possible. The wide occurrence of circadian rhythms suggests that they confer adaptive advantages and are not simple responses to environmental periodicities. If this is true, we must not exclude the possibility that the circadian rhythms, as we see them, may represent convergence by multiple solutions involving both types of clocks or even combinations thereof. There is an obvious need for investigations that will yield details of the mechanisms involved, but the reviewer is well aware of the difficulties involved.

It must be emphasized that biological clocks have functions other than that of controlling circadian rhythms. Astronomical orientation, for example, requires a chronometer. The contributions of Max Renner (pp. 361-367) on time sense and orientation in bees, Martin Lindauer (pp. 371-377) on sun orientation in bees, Klaus Hoffman (pp. 379-387) on the orientational clock in birds, Klaus Schmidt-Koenig (pp. 389-393) and Georg Birukow (pp. 403-412) on innate chronometry in insects, and Wolfgang Braemer (pp. 413-427) on the sun azimuth hypothesis all have an important bearing on this interesting subject. Of particular interest to ornithologists are the somewhat peripheral papers, "Does Celestial Navigation Exist in Animals," by Hans G. Wallraff, in which it is concluded that astronomic bicoordinate navigation has not been proved for any species, and "Star Navigation of Nocturnal Migrating Birds," by E. G. Franz Sauer and Eleonore M. Sauer, in which the hypothesis is reasserted. The attention given to annual and quasi-annual periodicities is disappointingly slight, especially in view of the many similarities in principle with the circadian rhythms and possible relationships between them. Indeed more attention to these annual and quasi-annual cycles might have been most useful in view of the indication of a rather broad spectrum of relationships between intrinsic timing mechanisms and mechanisms operating from environmental periodicities. Actually there are only three contributions that bear on this type of periodicity. The first is A. D. Lees (pp. 260-268), on "Some Aspects of Animal Photoperiodic Control of Annual Events." A. J. Marshall (pp. 499-505), in "Annual Periodicity in the Migration and Reproduction of Birds," discusses possible relationships between exogenous and endogenous control mechanisms in the control of reproduction and migration. Finally, Albert Wolfson (pp. 507-514), in "Regulation of Annual Periodicity in the Migration and Reproduction of Birds," presents new data and discussions bearing on photoperiodic mechanisms, reaffirms his assertion of photoperiodic mechanisms in equatorial species, discusses the differences between his interpretations and those of Marshall, and finally emphasizes quite correctly that as yet no endogenous annual periodicity has been demonstrated in any species of bird.

The symposium produced no novel ideas of importance. It did bring together many investigators whose data and hypotheses will have an important impact on the resolution of many of the problems associated with biological clocks. This volume is therefore of very great importance, and is highly recommended, as a

single inventory of much of the important current thinking about biological clocks.—D. S. FARNER.

Im unbekanntem Australien.—Klaus Immelmann. 1960. Verlag Gottfried Helène, Pfungstadt/Darmstadt. 231 pp. DM 14.80.—Dr. Klaus Immelman, an able young German zoologist, was in Australia for a year (1959–1960) primarily to extend his interesting investigations on the behavior of the Zebra Finch, *Taeniopygia castanotis*. During the year his travels took him to all parts of the continent. In a delightful and nontechnical manner he has described many of his observations on Australian natural history in general, with emphasis on birds. Of particular interest is his description of the reproductive “cycle” of the Zebra Finch and its relation to climatic and weather conditions. But unquestionably the most interesting descriptions are those of the Kimberley country of north-western Australia and the almost unbelievable contrast between the dry and rainy seasons. A thoroughly enjoyable and informative book.—D. S. FARNER.

A Field Guide to Western Birds. Field Marks of All Species Found in North America West of the 100th Meridian, with a Section on the Birds of the Hawaiian Islands.—Roger Tory Peterson. 1961. Houghton Mifflin Company, Boston. 366 pp., 28 line illus. (some showing many species), 60 plates (36 in color). \$4.95.—This new, greatly revised, and enlarged edition of Peterson's “Western Guide” has been long awaited, and now proves well worth its wait (even in gold!). It is not only a much more complete treatment of western birds than the 1941 edition, but is more profusely illustrated (with the very essential page references by each species figured), treats ranges in much increased detail (including Alaska and western Canada), and adds valuable sections on habitat, nest, and eggs for each species. Almost 600 species, exclusive of Hawaiian birds, are treated in detail, and notes on 104 accidental or marginal species are added. The 1957 A.O.U. *Check-list* is followed for scientific and vernacular names, but older, well-established vernacular names are also given. All of the plates are new, and as fine as in other recent Peterson guides. Altogether, one feels that this is much more a new book than a new edition.

The most notable addition, and one that will be especially appreciated by an increasing number of observers, is the inclusion of a brief but excellent and well-illustrated treatment of Hawaiian birds. As slight criticism here (p. 331), perhaps the Puaiohi and Ooaa need not yet be considered as “near extinct,” for John Bowles (who also should be given credit for observations on Kauai) and I found 12 or more individuals of each of these species. Such species might best be thought of as in danger of extinction if their restricted habitat is not preserved.

Another useful addition is a characterizing paragraph on each family and subfamily, and notes on the range, food, and number of species in the world and in the West for each family. Convenient check-lists on which to keep “life lists” are also added. The only feature present in the old edition, but lacking in the new, is an appendix on subspecies and their ranges. Perhaps, this feature, although valuable, will not be missed by many people.

Occasionally, field marks of species could have been added to or modified. The Omao (Hawaiian Thrush), for instance, has a markedly shorter and wider beak than the similar Puaiohi. Again, the females of the Red-winged and Tri-colored blackbirds could be better characterized. Nevertheless, the vast majority of field marks seem very well chosen.

The colored plates have generally come out beautifully, although it might be commented, for example, that the Vermillion Flycatcher and Apapane are not red enough. Typographical or other errors seem so rare and minor as not to be worth mentioning. All in all, the book should long stand as a tribute to the skill and care of Peterson and the many individuals who have helped him.—FRANK RICHARDSON.

Animal Sounds and Communication.—W. E. Lanyon and W. N. Tavolga (Eds.). 1961. American Institute of Biological Sciences, Washington, D.C. 443 pp., 112 figs., 12-inch long-playing record. \$9.50.—The decision to publish in a more extended form the Symposium on Animal Sounds and Communication held at the 1958 AIBS meetings is abundantly justified in the present volume. Quite simply, there is no other source available in which the diversities of animal sounds, the problems of their measurement, and the varieties of interpretation are so clearly delineated. The resurgence of interest in the field of animal communication probably represents, more than anything else, the technological developments that permit high-quality field recording and playback and relatively rapid and valid graphical representations of these recordings. This book is in a sense a prolegomenon to further research using the new devices.

Emlen's brief introductory chapter is followed by discussions by Kellogg of recording techniques and equipment, and by Borror on the analysis of sounds, particularly with the sound spectrograph. Both are essentially nontechnical and should prove of value to the neophyte.

The remainder of the book is devoted to sound communication in various taxonomic groups. Alexander's discussion of communication in *Orthoptera* and *Cicadidae* is the clearest, most comprehensive, and concise presentation the reviewer has seen. Bogert's chapter on sonic communication in amphibians and reptiles is also excellent, though not so concise. The chapters on underwater communication in fish (Tavolga), the ontogeny of bird vocalization (Lanyon) and its utility for mate selection (Marler), and the attempt to classify animal sounds (Collias) leave the reader, paradoxically, somewhat dissatisfied because they are so well done. In short, they clearly present the defects in the current approaches to animal communication. It would appear that the principal need now is for more adequate dependent variables.

In Lanyon's work, for example, early isolation or controlled contact with other species has an obvious effect on the primary song. The effect is described as variation in motif, but measures of similarity or differences along some dimensions that will define a motif are lacking. The seriousness of this should not be underestimated. Experimental tests of environmental or physiological influences on vocalization are not very convincing without some index of variability. Thus, the hypothesis that song imitation is a function of the number of exposures to the "tutor's" song cannot be tested unless certain quantifiable song dimensions are identified, and the within-group and between-group variances on these dimensions are assessed.

Marler clearly recognizes the problem of variability among songs but is not very explicit regarding the dimensions of variation. His chapter, entitled "Bird Songs and Mate Selection," is devoted almost exclusively to the demonstration that individual voices and dialects are identifiable by the human ear and by sound spectrograph. They are conceivably identifiable by birds as well, in which

case they may function in mate selection. The evidence is correctly described as circumstantial.

Collias has been more concerned than has Marler with behavior as a dependent variable, and he attempts to classify animal sounds with specific reference to the eliciting situation and the response of the communicant. It is clear, however, that identification of the essential information in, say, the "food-finding call" or the "all clear signal" will require more precise definition and quantification of the response to the calls.

Hockett in the concluding chapter presents 13 "design-features" of language by which communication of different species may be compared and evaluated. This is a competent summary and a well-written and highly provocative attempt at integration. It is somewhat puzzling that neither Hockett nor any of the other contributors considered their data from the standpoint of information theory. It would seem that channel capacity, storage load, uncertainty, equivocation, sequential dependencies, etc. could be highly useful concepts, and information theory itself could provide a conceptual framework for systematic analysis of animal communication.

The long-playing record is a valuable supplement, especially when one is able to compare the sound to the sound spectrographs. Ease of using the record in this manner varies considerably, however, with the Borror and Marler bands, clearly keyed to the text, representing a near ideal. Neither Bogert nor Lanyon keys the record to the book at all, the former presenting the calls in a different order than they appear in the book while the latter includes some calls that are not depicted at all. Commentaries on the various bands range from straight identification on most bands to the descriptive comment on the Collias band, which sounds as if written for high school students. A brief introduction to each of the bands would have been helpful.

Technically, the quality of the record is uneven and illustrates some of the difficulties of field recording. Extraneous sounds from wind, from other organisms, or from the recorder itself mar some of the recordings, as do low S/N ratio, print-through, and variations in sound level. The record was meant to be edifying rather than esthetic, however, and these shortcomings do not seriously affect the usefulness of the record.

The publication of book and record provides a much needed summary of the experimentation on animal communication, and an exceedingly rich source of hypotheses for further work. On the basis of the delineation of problems alone, the book would be a valuable one. Including as it does information from a diversity of organisms, and sampling the ingenuity and mentation of the most active investigators in the field, the book is a must for the serious student of animal communication.—F. D. KLOPPER.

Sounds of Nature.—Vol. 1. Songs of Spring. Vol. 2. A Day in Algonquin Park. Vol. 3. Birds of the Forest. Vol. 4. Warblers. Vol. 5. A Day at Flores Morales. Vol. 6. Finches. Recorded by D. J. Borror and W. W. Gunn. Six 12-inch 33 rpm records. Federation of Ontario Naturalists, Edwards Gardens, Don Mills, Ontario, Canada. \$5.95 each.—Now that the last of these records of bird song has been published, it may be appropriate to review the series as a whole. The task is complicated by the varied aims that the producers have set for themselves. Two of the records (Vols. 4 and 6), in which Dr. Borror was a major participant, are serious attempts to portray representative songs of two-

families of birds, the finches and the wood warblers. Two (Vols. 2 and 5) are "atmosphere" records, seeking to convey a sound picture, mainly through bird voices and some other sounds as well, of quite different areas, the Canadian forest, and the South American Llanos. The remaining two (Vols. 1 and 3) are designed primarily for instruction and to some extent for pleasure. This diversity of treatment is no accident. As the handout states, "since people vary in their tastes and needs, the Federation too, has varied its approach in the design and content of the records." The experiment has been remarkably successful. The volumes on warblers and finches provide remarkably complete coverage. Songs of several individuals are included in almost every case, together with a note of the approximate locality and date. There are often several songs from each individual. The songs are ordered according to pattern rather than by taxonomic criteria, which increases their usefulness as an aid in field identification. These unique records will be invaluable to every scientifically minded ornithologist, and indeed to anyone concerned with the analysis of animal vocalizations. *Songs of Spring*, and *Birds of the Forest* are likewise well designed for their appropriate audience, the intelligent layman. Fewer birds are represented, 25 and 22 species, respectively, only half as many as on the finch and warbler records. In one there is an extended spoken narrative. In the *Songs of Spring*, each species is represented twice, once identified directly, and the second time unnamed in a group sharing the same habitat, an ideal device for the instruction of school children and students. The Federation can also provide matching color slides for this purpose. Finally the recordings from Algonquin Park and Flores Morales are mainly esthetic in intent, and succeed admirably. They are guaranteed to evoke nostalgia in anyone familiar with the areas concerned, although relatively few North Americans will know the bird species in the Flores Morales volume. So perfect is the recording, here as in the entire series, that one almost wishes to hear some extraneous natural noise, but this is a minor point. We may hope that the success of this series will encourage the Federation to produce another of the same high standard.—P. MARLER.

Sounds of Midway: Calls of Albatrosses of Midway (J.B.-2808-D 1). Recorded by Hubert, Mabel and Carl Frings and H. Franklin Little of the Pennsylvania State University, 1958. A 12-inch 33 $\frac{1}{3}$ rpm microgroove record pressed on one side only, time 19 min.—This entire disc is devoted to the vocalizations of two species, the Laysan Albatross (*Diomedea immutabilis*) and the Black-footed Albatross (*Diomedea nigripes*). The vocalizations of the Albatrosses are presented under approximately 16 headings with voice commentary accompanying and explaining each type of vocalization. Emphasis is placed on the behavioral aspects of the sounds, and in some instances meaning is ascribed to the vocalizations. For each type of sound, generous samples are presented for both the Laysan and Black-footed birds. Some of the sounds described are: general colony sounds, incidental beak sounds, nest beak sounds, defensive beak sounds, rolling beak sounds, whistling calls for territory identification, nest calls when preparing to settle on eggs, challenge calls, sky calls, victory calls, fighting sounds, distress calls, and dancing sounds. Derivation of dancing sounds is proposed, and there is a brief discussion of Albatross language at the end.

This record is, in my opinion, a distinct scientific contribution in that it presents the sounds as only a record can, along with careful explanation and observational details. I predict that it will be followed as a model for the

presentation of the vocalizations of a species. Technically the recording is excellent. In only a few of the songs is wind or other objectionable noise noticeable.—P. P. KELLOGG.