REVIEWS

EDITED BY KENNETH C. PARKES

Animal species and evolution.—Ernst Mayr. 1963.[1] Cambridge, Massachusetts, Harvard Univ. Press. Pp. i–xiv, [ii], 1–797, illus. 9¼ × 6 in. $11.95.—This book is both physically vast and intellectually great. I should like to bang it on the heads of those narrow-minded biochemists and physiologists who tell us so confidently that theirs is the only worthwhile biology, and then compel them to read it right through. It is a magnificent and original synthesis of population genetics, variation, adaptation, and origins, and consequent speciation and changes in ecology leading to adaptive radiation. (Never should it be confused with a poor, thin, weak, elementary volume by one A. J. Cain, entitled—by the publishers and a striking piece of convergent evolution—*Animal species and their evolution.*) It appears just 21 years after Mayr's *Systematics and the origin of species* and one can see that 21 years of further work by Mayr and a host of others have gone into this new tome—yet I still often turn to the old book, which for short but adequate and beautifully clear exposition, not cluttered up with too many examples, remains a classic. In spite of its bulk the new book is good reading for the advanced scholar in evolutionary studies and indeed for most other people interested in them, but it is likely to be less useful at the early undergraduate level than the old book. Not the least of its attractive features is the author's ability to subordinate himself to the demands of the subject and to publish candid retractations of statements he now thinks wrong or to accept amendments, an ability confined to really well balanced personalities. The presentation of the vast and highly complex mass of the information and inference in this book is excellent and what might well be as dry as dust is in my opinion eminently readable. It is refreshing to find an American author who understands that the word *masterly* (in the manner of a master, highly competent) is not the same as *masterful* (overbearing, domineering, bullying, determined to have one's own way), which is the usual word of praise in the U.S.A., often perhaps rightly. There is little in the book to criticize in the areas of style and English. Occasionally there is needless obscurity (I can't make head or tail of the situation in *Millepora*, p. 48) but this is rare considering the size of the book. There are occasional unfortunate colloquialisms, and metaphors which don't really illuminate the situation, and there is a remarkable use of inverted commas (quotation marks) which at times gets really irritating. Inverted commas when not used to mark direct speech are used to indicate slang or a nonce-word or a word used in a strained sense, or well outside its literal meaning. Mayr often uses them for this purpose (in fact such words are rather more common than is desirable in scientific prose) but not infrequently he puts them around a word which in the context can be taken perfectly literally.

The subject matter is exactly that expressed by the title, but the author is careful to point out that he is talking mainly of sexually reproducing forms. Agamospecies are mentioned, of course, but only briefly as they are evolutionary side lines incapable of giving rise to further forms indefinitely. (This is true but as they are so well

[1] Many months ago the editor set out upon a long and difficult quest for an individual at once sufficiently bold, humble, qualified, and unencumbered with prior commitments to review this important book. His efforts were finally rewarded when Dr. Cain generously contracted to undertake the task. The completion of this, unfortunately, was unavoidably delayed by an illness of its author. Happily the latter, according to his letter of transmittal, is again in sound health.—R.M.M.

represented in so many of the so-called lower groups of animals, and often seem successful ecologically, one might wish for a more sympathetic treatment.) Birds are of course particularly well treated for the excellent reason that so much work has been done on their geographical variation and speciation; they are the type group for such studies. But Mayr's wide zoological outlook is splendidly seen in the many chapters in which he produces a synthesis, relying necessarily very heavily on *Drosophila*, of what we know about the genetics of wild populations in general and how this illuminates the processes of speciation. The great importance of this synthesis in the book and its relation to other topics can be well seen in the chapter headings: 1, Evolutionary Biology; 2, Species Concepts and Their Application; 3, Morphological Species Characters and Sibling Species; 4, Biological Properties of Species; 5, Isolating Mechanisms; 6, The Breakdown of Isolating Mechanisms (Hybridization); 7, The Population, Its Variation and Genetics; 8, Factors Reducing the Genetic Variation of Populations; 9, Storage and Protection of Genetic Variation; 10, The Unity of the Genotype; 11, Geographic Variation; 12, The Polytypic Species of the Taxonomist; 13, The Population Structure of Species; 14, Kinds of Species; 15, Multiplication of Species; 16, Geographical Speciation; 17, The Genetics of Speciation; 18, The Ecology of Speciation; 19, Species and Transpecific Evolution; 20, Man as a Biological Species. These chapter headings give an idea of the range of subjects dealt with, a range which makes this work an excellent reference book on speciation. Mayr's own contribution to the theory of gene pools appeared some years ago in an important paper in "Evolution as a process," which has not received the recognition it deserved. His ideas of the effect on the gene pool of cutting a population into two, still more of taking out a very small sample to found a new population, are expanded in the new book into a general theory of the integrated nature of the gene pool of a population that every student of evolution must consider thoroughly. It is inevitable that this part of the work, based mainly on *Drosophila* studies in which so little is known of the ecology of any stage of the life history, should at first seem rather detached from the rest. But in fact the inferences drawn from it can color one's thinking about populations to a surprising degree. Good examples can be worked out only when we know far more of the contents of the gene pools of different populations and (most important) the selective forces acting from outside in each locality than we do for any species at all at present. It would be easy to point to two populations which differ considerably but *seem* to live in much the same circumstances and state categorically that because the circumstances *are* the same (an unjustifiable and almost certainly untrue statement), therefore the differences observed must be due to different integration of the genotype. Nevertheless, Mayr's general line of argument that genotypes are integrated entities held together in large populations by the flow of genes which are good mixers and that the cutting off of this flow may produce a very different set of integrated genotypes perhaps amounting to a genetic revolution is surely right.

A useful summary is given of the arguments against sympatric speciation in necessarily sexually reproducing forms such as birds. The marshaling of these lines of argument is a notable contribution of Mayr's to evolutionary theory. It was necessary to get some clear thinking into the mess of biological races, ecological races, and similar terms that formerly obscured the subject. Mayr's objections are undoubtedly valid; still one may wonder how far what I have called semi-sympatric speciation is possible, that is, when only a few individuals penetrating into a new habitat survive long enough to reproduce, but the resulting progeny are highly selected for in the new habitat even though within the range of occasional further immigrants. We do not yet know enough about the mathematics of disruptive selection acting in such situations to be sure that speciation cannot occur. (Some have objected to Mayr's ideas by arguing that Thoday has shown how fast very strong disruptive selection in the same population can produce very different forms and that this is the beginning of sympatric speciation; but in Thoday's experiments the population was forcibly kept polymorphic for both the lines selected for, a most unlikely situation in the wild.) But whether such semi-sympatric speciation turns out to be possible or not the clarification of thought following on Mayr's discussion of allopatric and sympatric speciation in sexually reproducing forms will always be a major contribution to evolutionary theory.

It would be possible to go on at length listing and discussing the topics dealt with in this book; this, however, the reader should do for himself. I wish here to mention one or two points on which I think further discussion is necessary. Mayr is, and always has been, greatly puzzled by sibling species, which as he says do not seem to be the result of recent speciation nor subject to unusually low mutation rates and so incapable of variation. His discussion of them reflects this bewilderment, but what is there to be puzzled about? Related species usually differ because they usually have different modes of life and require some structural differences to adapt to them; and these are the related species we know about simply because they can be seen to differ, so we have already recognized their taxonomic distinction. But if species live exactly the same mode of life except that they feed on different species of yeast they might well differ only in their gut enzymes and (to avoid hybridization) in the odors they produce at courtship. Siblings, as Mayr shows well, are only the extremes of a series, not a class by themselves, and we are in no position to say by how much (structurally) extreme sibling species must differ, nor that because they do not differ by obvious specific characters therefore they cannot vary at all. The statement (page 402) that sibling species usually will be monotypic is not justified.

An unfortunate feature of the book is the continued use of the word *deme* for geographically defined and sexually reproducing populations. The history of this term is instructive, being a type of what often, perhaps usually, happens when an author has been at pains to work out and define a new term for a definite purpose. It was originally proposed as a root word signifying any collection of entities, whatever, that an author wished to talk about as a group. Various prefixes were proposed to define more exactly what type of group was being talked about. The intention was to provide a terminology for taxonomists and evolutionists that would not be tied to the standard taxonomic hierarchy, which is often unsatisfactory at and below the species level. It was a good short word suitable for international circulation and its intended use was clearly stated in the original publication and later. Nevertheless, several authors to my knowledge (two in the U.K.), who were accustomed to think in terms of geographically definable populations (chorodemes) and usually only sexually reproducing ones, instantly seized on the term deme and restricted it to this use, thereby ignoring its generality of application. It may be that this use is now too widespread for the mischief to be undone, but I do not think so. Certainly Mayr's objection to deme as originally proposed, namely that it could apply to anything (page 358) is, comically enough, exactly the reason why it was proposed.

As might be expected Mayr accepts Dobzhansky's arguments that polymorphism is adaptive, in spite of the objections that have been raised. It has been found that, under standard conditions, polymorphic populations of *Drosophila* produce more individuals and more biomass than non-polymorphic ones. But if as is possible this is due to the superiority of the heterozygotes then the polymorphism is still not proved to be adaptive—in fact it may be regarded as the opposite, since what is wanted is a pure population of heterozygotes and the homozygotes are merely poorly adapted individuals that are automatically produced but are not wanted. It is frequently stated that the different morphs in *Drosophila* are adapted to different sub-niches and Mayr seems to accept this idea. Certainly, if different morphs did different things which other morphs could not do, the population would in this sense be better adapted the more morphs it had and would exploit the environment more completely. A good example would be those polymorphic mimetic butterflies in which different morphs mimic different distasteful models; presumably the addition of a new morph to a population would mean an increase in total population size and a better exploitation of the available distasteful properties of the models. Such a situation has never yet been shown to occur in *Drosophila* although it is usually stated, as here, to be the reason for the adaptiveness of polymorphism.

In general, however, Mayr's treatment of the vast variety of subjects relating to speciation is exceedingly careful and fair. No author can satisfy everyone in his expositions and even where one disagrees with them one cannot ignore Mayr's summaries and arguments on particular topics. One must congratulate him on so wide ranging, thorough, and stimulating a presentation of the most important single process in evolution.—ARTHUR J. CAIN.

Catalogue of fossil birds.—Pierce Brodkorb. 1963–64. **Part 1** (Archaeopterygiformes through Ardeiformes). *Bull. Florida State Museum, Biol. Sci.*, 7(4): 179–293, 1963. $1.40. **Part 2** (Anseriformes through Galliformes). *Ibid.*, 8(3): 195–335, 1964. $1.75.—In the more than 30 years since the publication of Lambrecht's monumental *Handbuch der Palaeornithologie*, many new fossil birds have been described, but only slight progress has been made on our understanding of the phylogenetic relationships of the families and higher categories of birds. The great value of Brodkorb's catalogue lies in his having brought together the widely scattered literature on fossil birds and having listed the known species.

Accounts of the paleospecies include the name, citation of the original description, nature of the material constituting the type, the location of the type, a synonymy, and a list of localities from which the species is known, with pertinent references to these occurrences. Information on neospecies includes only localities of occurrence (both fossil and prehistoric) and references to these. Synonymies and original citations are given for the names of all higher categories. There are no illustrations or descriptions of the species, and with the exception of new taxa proposed in this work, there are neither diagnoses of the taxa nor reasons for shifting genera and families from one major group to another.

The classification which Brodkorb uses is based on that of Wetmore (*Smiths. Misc. Colls.*, 139 [11], 1960), but with several major changes. Three subclasses are used: Sauriurae for *Archaeopteryx*, Odontoholcae for the Hesperornithidae, and Ornithurae for all other birds. The last group is in turn divided into three infraclasses: Dromaeognathae for the tinamous, Ratitae for the ratites, and Carinatae for the remaining groups. The basis for this grouping of the Ornithurae appears to be the statement (part 1, page 196, footnote) "Both ratites and carinates could have arisen from a tinamou-like stock."

Major changes in the placement of fossil groups from Wetmore's classification include the transferral of the Opisthodactylidae from the Phororhacoidea to the

Rheiformes, and the Enaliornithidae and the Baptornithidae from the Hesperornithiformes to the Gaviiformes and the Podicipediformes, respectively. The Spheniscidae are placed next to the Procellariiformes and not maintained as a separate superorder. The families Teratornithidae, Gallinuloididae, Tetraonidae, and Meleagrididae are reduced to subfamily rank. Several suborders and superfamilies have been dropped.

On the basis of priority, the Ciconiiformes become the Ardeiformes; the Falconiformes and Falcones, the Accipitriformes and Accipitres, respectively; the Cathartae, the Sarcoramphi; the Anomalopterygidae, the Emeidae; the Hydrobatidae, the Oceanitidae; the Threskiornithidae, the Plataleidae; and the Cathartidae, the Vulturidae. These changes, while presumably based on valid grounds, will cause considerable confusion if adopted; and it may be that a proposal will be made to have some of the old names placed on the "Official List of Family-group Names in Zoology" by the International Commission on Zoological Nomenclature.

At the higher levels, Brodkorb's classification tends to revert toward the older classifications in which birds with similar ways of life were grouped together without regard to possible convergent evolution. This may be a result of the fact that many bones found as fossils represent the structures most strongly modified for locomotion and hence particularly subject to the results of convergent evolution.

For example, I believe it far more likely that the resemblances between *Enaliornis* and the modern loons (*Gavia*) reflect convergent evolution than the close phylogenetic relationship implied in Brodkorb's classification. *Enaliornis* is known from leg bones found in lower Cretaceous deposits (100 to 130 million years old). The early loon *Colymboides* is known from many bones of far more recent geological age (25 to 40 million years old) and was far less strongly modified for diving than either *Enaliornis* or *Gavia*. Yet *Colymboides* was clearly a loon and appears to provide a connecting link between the loons and the Charadriiformes (Storer, *Condor*, 58: 413–426, 1956), a relationship supported by studies of egg-white proteins (Sibley, *Ibis*, 102: 234, 1960). The idea that *Gavia* evolved from *Colymboides* or *Colymboides*-like stock between Lower Miocene and Lower Pliocene times (25 to 10 million years ago) is incompatible with the idea that modern loons belong in the same order as birds which were strongly adapted for diving over 100 million years ago. I think there is more evidence for the former view than for the latter.

Similarly, placing the North African genera *Eremopezus* and *Stromeria* (known from fragmentary leg bones of Eocene and lower Oligocene age, respectively) with the elephantbirds (Aepyornithidae) of Madagascar, all Pleistocene or sub-Recent in age, implies an extremely early ancestry for the elephantbirds or a far later land bridge between Africa and Madagascar than most geologists or zoogeographers would concede.

It should be emphasized that classifications, which people may accept as gospel, are in essence guesses based on the available evidence, which is frequently meager, and are subject to revision when new evidence is brought forth or when old evidence is re-evaluated. Controversy over proposed classifications is healthy and often provides the stimulus for studies which may lead to better understanding of phylogenetic relationships.

These controversial points in the classification impair but little the usefulness of the catalogue; rather they point up the fact that Brodkorb's work when completed will provide a valuable starting point for studies of the phylogeny of various groups of birds.—ROBERT W. STORER.

Subantarctic Campbell Island.—Alfred M. Bailey and J. H. Sorensen. 1962. Denver Museum of Natural History, Proc. No. 10, 305 pp., illus. $7.00 ($5.50 in soft covers).—This beautifully illustrated and well produced volume provides a general introduction to Campbell Island. Its authors both know the island well. Sorensen lived there for several years during and after World War II, while Bailey was leader of the Denver Museum expedition to the island in January-February, 1958. This expedition collected birds and mammals, now displayed in excellent dioramas in the Museum.

The only major criticism of the book, in my view, is its too comprehensive title in relation to the contents. One expects a reasonably balanced treatment of *all* aspects: zoology, botany, etc., but no less than 211 pages are taken up with ornithology. Even making allowances for the fact that both authors are keen ornithologists and that the birds of Campbell Island are its outstanding attraction, there is still room for more detailed treatment of other aspects of the island's natural history. The geology of the island is admittedly treated in detail by Oliver, Finlay, and Fleming in Bulletin No. 3 of the Cape Expedition Series, but one would in particular expect more botanical information in the work reviewed as one of the authors (Sorensen) was co-author of the Cape Expedition Bulletin No. 7 on the botany of this island. Of the higher vertebrates, other than birds, only mammals are discussed in fair detail.

Having said this on the limitations of the book, the wealth of information given on the mammals and birds makes it a valuable addition to any library of the antarctic and subantarctic. A historical sketch gives the background to the present use and former misuse of this island (sheep were farmed between 1895 and 1931 with serious effects on the flora). Campbell Island was discovered in 1810 by Captain Hasselbourgh in the brig "Perseverance," owned by Campbell and Co., Sydney, a firm with interests in sealing.

The dominant vegetation of Campbell Island is tussock, with scrub on the lower slopes. Right whales enter the bays and harbors, and the book describes in some detail the several species of seals, including the large elephant seal, which breed on the island. Norway rats are widely distributed and probably escaped from ships anchoring there about the turn of the century.

The bird life is the outstanding zoological attraction of Campbell Island, in particular the widespread colonies of Royal Albatrosses. This photogenic bird is well described and shown in a long series of mostly excellent photographs (if the book suffers in layout, it is from repetition in places of very similar photographs). The remainder of the birds nesting on the island are also described and well illustrated. Throughout the text are a great many measurements, observations, and various biological data, some new, some from other publications. Many of Sorensen's journal entries are published *in extenso*, and while perhaps boring to the general reader, they add appreciable detailed material to an otherwise popularly written account.

The list in this book of "Birds recorded from Campbell Island" contains 61 species but a number of these (20, or a third) are marked that no specimen is available. Of the six penguins observed, three species breed on the island and one of them (the Rockhopper) possibly totals several millions. Campbell Island is also the southernmost breeding locality within the limited range of the Yellow-eyed Penguin. A few Wandering Albatrosses nest among the plentiful Royal Albatrosses. Of the smaller albatrosses (called mollymawks in New Zealand), the Black-browed and Gray-headed albatrosses nest in many thousands on the steep cliffs of Courrejolles Peninsula, while the Light-mantled Sooty Albatross nests singly or with a few pairs together on rock ledges.

While the discussion of albatrosses and penguins takes up no less than 130 pages of this book, other species of birds are treated in less detail. Other spectacular members of this island's avifauna are the Campbell Island Shag (or Cormorant) and the Campbell Island teal, originally described as a new genus and species (*Xenonetta nesiotis*) but now considered a subspecies (*nesiotis*) of the New Zealand Brown Teal (*Anas castanea*). The passerines on Campbell Island are interesting: the New Zealand Pipit is rare while the Silvereye (*Zosterops lateralis*) was found breeding commonly as early as 1874 by a French expedition. Silvereyes, wind-blown to New Zealand from Australia before the middle of the last century, probably came to Campbell Island from the New Zealand mainland. However, direct immigration of this species from Tasmania is possible, and such other Australian forms as Spur-winged Plovers, White-faced Herons, and Welcome Swallows have reached both New Zealand and Campbell Island. Of the European passerines, now so common in New Zealand, only the Hedge Sparrow and Redpoll have acclimatized well on Campbell Island; other species like the Starling, Blackbird, and Chaffinch occur in very low numbers and must have found their way south from New Zealand.

A few northern hemisphere migrants, regularly wintering in New Zealand, sometimes "overshoot" this country and appear on Campbell Island; thus the Bar-tailed Godwit occurs quite regularly, while the Hudsonian Godwit and Knot have been observed.

The literature of the antarctic and the subantarctic islands (south of New Zealand and South America in particular) is steadily increasing. This book presents little new information but, well illustrated and well written, it ably supplements papers and bulletins already available.—KAJ WESTERSKOV.

Avifauna Svalbardensis.—H. L. Løvenskiold. [1964.] Norsk Polarinstitutt Skrifter no. 129; 460 pp., 42 tables (3 folding), 5 figs., 18 pls. (9 in color), 34 maps (1 geographical, 33 species-distributional) in rear pocket. 44 kronor.—This treatise, in English, on Spitzbergen and adjacent islands and surrounding waters, consists of three parts: general (pp. 7–48)—mostly about environmental factors affecting the avifauna; special (pp. 49–373)—an annotated list of species and subspecies; and bibliography (pp. 377–455)—published references, briefly annotated, and other sources such as diaries, for the years 1598–1959! There is also an author index. Year of publication is given correctly on cover, but incorrectly (as 1963) on title-page and again under printer's imprint on next following page.

For abundant birds, many useful data are given on such topics as local distribution, breeding cycle, habits, and food. There are lengthy accounts of *Fulmarus glacialis, Somateria mollissima, Lagopus mutus, Calidris maritima, Larus hyperboreus, Rissa tridactyla*, and *Plectrophenax nivalis*. All species reported from the area are included, even those erroneously reported—a feature helpful to compilers of distributional records. Løvenskiold states that, because of the language barrier, some relevant papers were unavailable to him. This becomes evident, for example, in lack of mention of *Gavia stellata squammata* which was described by Portenko as having Spitzbergen included in its breeding range. Again loons: there is an account of a presumed male *Gavia immer* and female *G. arctica* apparently behaving as a mated pair; in a letter to the reviewer, however, it is stated that these birds were not collected—hence their sexes not really known. Perhaps both were females, competing for the same nest.—RALPH S. PALMER.

The role of olfaction in food location by the Turkey Vulture (*Cathartes aura*).—Kenneth E. Stager. 1964. Los Angeles County Mus., Contr. Sci. no. 81; 63 pp., 19 figs.—The method, whether by sight or smell, through which vultures discover the animal bodies that form their food has been argued by naturalists for centuries. Proponents of the two theories since the days of Audubon have recorded observations and occasional somewhat casual experiments that have seemed to favor both hypotheses but with no general agreement on either. The present paper presents the results of a series of carefully controlled experiments that, though concerned mainly with the Turkey Vulture, cover also observations on other cathartine species, and on the aegypiine vultures of the old world.

Following a review of published discussions pro and con of olfaction in these birds, the author describes personal observations that led to a lengthy study, with experiments to dispense odor with elimination of all visual clues. In one series animal bodies, ranging in size from kangaroo rats and cats to parts of a deer, were placed in a closed chamber with a seven-foot stack in which an exhaust fan drove out air drawn from the hidden carcasses. In other tests, similar carrion was enclosed in perforated fiber-board boxes that were hidden in vegetation where they could not be seen. Both series were placed under cover of darkness in canyons bounded by sharp ridges where air currents were constant in direction. In due course Turkey Vultures that encountered the odor-laden air were observed to circle repeatedly over the location of the containers, but after a time, when they could see nothing attractive, they passed along.

In another set, in a region where dead mule deer (*Odocoileus hemionus*) were a usual source of vulture food, a mounted deer posed to resemble a dead animal was exposed in an open pasture. Turkey Vultures that coursed over the decoy regularly for a five day period evidently were aware of it by sight, but did not approach it. Then before dawn the mounted body was replaced by a deer carcass similar in size and position. Two days later, as the body decomposed so that it gave odor, Turkey Vultures came to feed on it.

There is also described an operation of oil company engineers used to locate leaks in natural gas lines by introducing a concentration of ethyl mercaptan, a volatile organosulfur compound used as a fuel gas odorant. Gas leaks were located along a 42-mile line by observing the congregation of Turkey Vultures in the air and on the ground at points where the odor was pronounced. In experiments the author found this gas attractive to the species of vulture under study.

To test the theory that vultures might find hidden carrion by visual observation of concentrations of flesh flies, a ground squirrel burrow in an open pasture was treated with a mixture of casein and brown sugar in water. While this drew many flies, hunting Turkey Vultures that passed regularly over the burrow during five days paid no attention to the insects.

In summary the evidence shows that the Turkey Vulture "possesses and utilizes a well-developed olfactory food-locating mechanism." Though full detail in observation is not available, it is believed that the King Vulture (*Sarcoramphus papa*) also may have this faculty. The Black Vulture (*Coragyps atratus*), with only minor development of the olfactory lobe, depends on sight alone, and the present indication is that this is true also of the two condors.

Experiments with hidden baits in India with three species of Old World vultures, *Pseudogyps benghalensis, Neophron percnopterus*, and *Sarcogyps calvus*, gave no indication of olfactory powers. All came without delay to flesh or carcasses exposed in the open, but paid no attention to carrion that was completely hidden, in spite of the strong odors and of the swarms of flesh flies.

In anatomical studies of the five genera of American vultures it is shown that the Turkey Vulture, small in body size compared with the others, has the largest external nares, especially larger than those of the great Andean Condor (*Vultur gryphus*). Casts of the brain cavity in skulls of these birds show that *Cathartes* has the largest olfactory lobes, physically larger in fact than those of the condor or of the even greater *Teratornis* of the Pleistocene.

The paper also outlines discussions on flight, general habits concerned in food location, and agonistic and predatory behavior in the American vultures. It is interesting that while Black and King vultures attack living animals unable to defend themselves, it is doubtful that this is true with *Cathartes*, regardless of published statements to the contrary. There is an extensive bibliography.

The author has called to our attention two principal printer's errors. On page 20, the second numbered item under "Precautions" should read: "2. All baits were placed in the blower at night to rule out any possibility of detection by turkey vultures. Baits were placed in the unit at 4:00 a.m. to prevent molestation by nocturnal carnivores." The legends for plates 16 to 19 should be on the right hand margin instead of at the bottom.

The entire account is an excellent contribution in a field of long controversy. The careful studies show clearly that the Turkey Vulture uses an olfactory sense in food location.

The reviewer, through personal experience with the Yellow-headed Vulture, *Cathartes burrovianus*, adds that this species resembles the red-headed *Cathartes aura* in general in its quartering flights in search of food. It tends however to range mainly in areas of swamp and marsh, where dead and dying fish are its principal source of sustenance.

There is also the little-known minor problem, not mentioned in this paper, of occasional utilization of vegetable food by Turkey Vultures. In Panamá the resident race of this species (*C. a. ruficollis*) eats the pulp of the large fruits of the Corozo palm. Possibly these may be found through odor as the trunk and leaf stems are so beset with needle-sharp thorns that the fruits would not be accessible until they were soft and had fallen to the ground.—ALEXANDER WETMORE.

Ecological studies on the Mute Swan (*Cygnus olor*) in southeastern Sweden.—B. E. Berglund, K. Curry-Lindahl, H. Luther, V. Olsson, W. Rodke, and G. Sellerberg. 1963. Acta Vertebratica, 2(2): 1–120. $4.89.—Wild swans have long been exploited for food and feathers wherever they occurred in the northern hemisphere. Fortunately, most governments began protecting these grand birds before wild stocks were completely exterminated. Concurrent with protection, however, some populations, both in the United States and Europe, have increased to such an extent that they have lately been accused of adversely affecting natural resources valued by man.

In Sweden, commercial fishermen in the 1950's charged that increasing populations of Mute Swans (*Cygnus olor*) were damaging the fishery on the south and east coasts. Accusations ranged from destroying the submerged vegetation to polluting waters, disturbing and frightening fish, and eating fish eggs, fry, and so forth. The Zoological Department of the Nordiska Museet and Skansen in Stockholm accordingly assigned a team of six specialists to carry out a comprehensive study of the Mute Swan directed at throwing light on these charges. The present work reports the important results of the six-year study.

Mute Swans occurred in Sweden at least as long ago as 1761 where they were noted by Linnaeus in two locations. After 1850 the development of the Swedish Mute Swan population is fairly well known, several changes in numbers and range (both expansions and contractions) having occurred since that time. The Mute Swan expanded its range rapidly from 1925–1960, as it has some other places in Europe, until breeding populations are now found in suitable habitat throughout southern Sweden and in capacity numbers in some locations.

Interestingly, the 1925–1960 period of Mute Swan prosperity in Europe parallels that of the Trumpeter Swan population in the United States south of Canada (though expansion of trumpeters has been expressed primarily in numbers rather than in range). In Sweden, as in the United States, the attitude of man appears to be the key factor governing the status of swans. When the birds have been protected, swan populations have increased; when they have been harassed and killed, numbers have declined and marginal populations have disappeared. Once breeding populations are exterminated, re-establishment may not occur for decades, if at all, as swans (trumpeters at least) are strongly traditional and do not pioneer readily. In Sweden, after World War II when the killing of swans generally ceased, the authors report that death from oil saturation became a serious decimating factor of Mute Swans, especially at wintering places. Natural enemies (other than man) were not found to be important in limiting populations, and this also agrees with findings related to trumpeters.

Unfortunately, the breeding biology and production of the Mute Swans in Sweden were not investigated as fully in this study as they might have been. It would have been interesting to learn, for example, whether the average initial breeding age of Mute Swans tends to increase as the habitat approaches "carrying capacity." There is some indication that Trumpeter Swans breed at earlier ages in "unsaturated" habitats than in abundantly populated areas, and information on breeding ages of Mute Swans would have been useful for comparative purposes. The breeding range of Mute Swans in the inner archipelagoes in Sweden is apparently far from saturated, and opportunities for continued expansion of numbers still appear good. Further, circumstances are such that the expected increase in the number of Mute Swans wintering in Sweden will not be restricted by lack of suitable habitat or food for some time.

Information relating to the effects of swans on the vegetation, especially the composition of the underwater flora, was obtained through the study of the plants grazed by swans during a three- to six-year period. Nutritional aspects were studied mainly through analyses of stomach contents. It was found that Mute Swans take their food non-selectively and almost exclusively from underwater meadows. Further, the authors showed that the sublittoral vegetation was particularly dynamic, there being an interplay between positive and negative changes, so that bare bottoms (for which swans were held responsible by fishermen) were in all probability primarily conditioned by edaphic factors, and represent a link in the natural chain of vegetation succession.

Relationships between Mute Swan populations and water quality were studied directly. Extensive chemical and bacteriological tests showed that the swans did not pollute water to a degree seriously disturbing other organisms, even where large populations concentrated for considerable periods.

Most importantly, all six authors agree that no evidence was found that the concentrations of Mute Swans present in southern Sweden were in any way harmful to the interests of fishermen which stimulated the study. These were also the final conclusions of R. E. Stewart and J. H. Manning's work on Whistling Swans (*Olor columbianus*) in Chesapeake Bay (*Auk*, 75: 203–212, 1958) and Palundan and Fog's investigations of Mute Swans in Denmark (*Danske Vildlundersøgeler*, 5, 1956) which were undertaken as a result of damage claimed by shellfishing and duck hunting interests respectively.—WINSTON BANKO.

Avian anatomy.—W. M. McLeod, D. M. Trotter, and J. W. Lumb. 1964. Minneapolis, Minnesota, Burgess Publishing Company; ii + 143 pp., many line drawings grouped in 31 figs., 11 × 8½ in. $5.75.—In recent years several new or revised textbooks and laboratory manuals have appeared that deal partly or entirely with the anatomy of birds. Those intended for students of ornithology have stressed anatomical adaptations and the application of anatomy to taxonomy, while those for students of poultry science have stressed descriptive anatomy. The present work falls in the second category, being a textbook on the anatomy of domestic fowl and a guide to the dissection of the chicken. The text is arranged by organ systems, with most of the attention devoted to gross structures and little to histology.

The book benefits in several ways from the fact that the authors (principally Dr. McLeod) are or were professors of veterinary anatomy. Each system is introduced with an explanation of its basic features that is appropriate for students who have not previously had a course in anatomy. The descriptions are generally clear; they have the quality of material based on first-hand observations. At their best, as in the skeletal and respiratory systems, they give considerably more information and terminology than is usual for books of this kind. Several pages are devoted to joints, a subject that avian anatomists have commonly neglected. The organ systems are moderately integrated by statements on the location of their parts, on their vascular supply and innervation, and on their relations with ligaments, muscles, or viscera.

The text displays an undue orientation toward mammals, probably because veterinary anatomists are far more familiar with these animals than they are with birds. The authors appear to have been unaware of certain facts and terms that are well established in the literature of avian anatomy. The use of an outmoded terminology for the muscles is but one of numerous such cases. Anatomical conditions are sometimes illustrated with examples from mammals, although equally good or better examples could have been found in birds. This practice is all the more surprising because the preface reminds the reader that birds are different from mammals. The accounts of a few structures include comparisons between the classes, but more often the differences have gone unrecognized. This has resulted in several errors in the sections on the skeleton and the mesenteries.

The illustrations are the most obvious flaw in the book. They assault the eye with heavy lines and crude shading that does not convey the slightest sense of roundness. Even as diagrams, they are so carelessly drawn as to perplex the student. If one can interpret them they may help to identify structures, but they are practically useless for imparting information.

The guide to the dissection of the chicken is one of the most useful features of the book. It can be applied nearly as well to a pigeon or duck as to the bird for which it is intended. The directions are generally explicit and workable, showing that they are based on the authors' experience in teaching avian anatomy. The organization is systemic, and the systems are related by pointing out various structures as they are met in the course of dissection. Instructions are supplemented with questions, but unfortunately some of the latter can be answered directly from the text without much thought.

The "bibliography" is a list of references cited, and does not attempt to give an introduction to the literature of avian anatomy. The list is unbalanced and out of date, consisting mostly of textbooks on anatomy and a number of older papers on the respiratory, excretory, and reproductive systems. It omits five works that are cited in the text and lacks full bibliographic data for several entries.

This book is not of the caliber that many instructors and students would like to have. Its coverage of the integument, muscles, veins, endocrine glands, and nervous system is too brief and general. The weaknesses of the text, the illustrations, and the bibliography mean that the book cannot be used without guidance and supplementary material from the instructor. It will nevertheless be helpful for teaching avian anatomy on account of its dissection guide and the quantity of sound information it contains.—PETER STETTENHEIM.

Die Wirbeltiere des Kamerungebirges.—Martin Eisentraut. 1963. Hamburg and Berlin, Paul Parey; 353 pp., 52 figs. DM 68.—Mt. Cameroon is an isolated volcanic mountain in southeastern Nigeria, rising from sea level on the coast to a height of over 13,350 feet. Situated in the bight of the Gulf of Guinea and exposed to the southwest monsoon, it is one of the rainiest places in Africa; annual precipitation varies from over 380 inches at Isobi at the western foot to about 115 inches at the peak and less than 75 inches in the rain shadow of the lower northeastern slopes. The whole of the lower slopes of the mountain are covered with heavy tropical rain forest, continuous with the Lower Guinea forest of southern Cameroon and the Congo. In mid-altitudes at about 3,000 feet the tropical forest changes to a dense montane forest which extends up to 7,200 feet on the west side and to 5,000 feet on the drier east side. Above the forest is open grassland, with alpine-type lichens and mosses near the peak. The montane forest on Mt. Cameroon, with similar but smaller patches on the Cameroon highlands to the northeast and on Fernando Po, is isolated by 1,200 miles from the nearest montane forest in the East African highlands at Ruwenzori, and it is with the relationships and evolution of the endemic vertebrate fauna (less fishes) of this zone that Eisentraut is primarily concerned.

Following a short review of the history of scientific exploration on Mt. Cameroon and detailed discussions of his own three expeditions to the region, the author gives systematic lists of the terrestrial vertebrates of the mountain. These are complete on the basis of his own collecting and the current literature, and include a wealth of information on distribution, ecology, behavior, breeding seasons, and weights and measurements. He then concludes with discussions of the various altitudinal zones, the distribution of the fauna, the relationships of the zonal forms to faunas elsewhere in Africa, morphological changes associated with altitude, and the breeding seasons of the montane species.

In discussing the relationships of the montane fauna, Eisentraut is forced to rely most heavily on the knowledge of birds, since this class is comparatively much better known than the other vertebrates. However, the distribution of the other vertebrates in most cases supports the conclusions based on the avifauna, and I am not deliberately slighting them when I confine my discussion to birds.

The tropical forest of Mt. Cameroon is an integral part of the Lower Guinea forest which stretches from southern Nigeria to the Congo, Uganda, and northern Angola. The avifauna reflects this; of 142 forest species, 118 belong to the Lower Guinea race, 10 to the Upper Guinea, 9 are intermediate, and 5 belong to endemic races of eastern Nigeria and western Cameroon. The picture presented by the montane forest birds is entirely different. Of 42 species confined to this zone, 2 are endemic to Mt. Cameroon, 15 are found in the neighboring Cameroon highlands and/or Fernando Po, 2 are only racially distinct from forms in the adjoining lowlands, but 23 (55 per cent) reappear again in the East African highlands, 1,200 miles away. From consideration of this latter group it is apparent that there must have been a connection between Cameroon and East Africa in the recent past. The key to this connection lies in the drastic changes that took place in African biomes during the Pleistocene, which have been summarized recently by Moreau (*Proc. Zool. Soc. London*, 121: 869–913, 1952; *ibid.*, 141: 395–421, 1963).

During the last glaciation, roughly from 70,000 to 20,000 years ago, the mean temperature over Africa was some 5°C lower than at present, and montane forest was dominant and continuous from eastern Nigeria to East Africa and, south of the Congo basin, to Angola. During this period the montane avifauna likewise was continuous throughout this area, and undoubtedly much richer than it is now. With the coming of a warming trend in the late Pleistocene, the montane forest was replaced with tropical forest in the lowlands, and there were left isolated fragments of a homogeneous montane avifauna in highlands as far apart as Cameroon, East Africa, and Angola. The degree to which these relict populations have differentiated in the last 20,000 years gives us evidence of the rapidity with which speciation may take place. While in four of the montane species the same race still occurs in Cameroon and Uganda, the remainder all show some degree of subspeciation, often to such a degree that the two forms have been considered distinct species. Even among the species that Eisentraut considers endemic to Cameroon, *Nesocharis shelleyi* has its obvious representative *N. ansorgei* in Uganda. It would appear, then that under favorable conditions speciation can take place in the geologically short space of 20,000 years.

Although there has been rapid evolution among the isolated elements of the montane avifauna, there has been little or no altitudinal variation among those species that range up from the tropical into the montane forests. Eisentraut lists two species, *Polipicus elliotii* and *Turdus olivaceus*, in which he claims that such altitudinal subspeciation has occurred, but I think that in these cases he has misinterpreted the evidence. In both cases the altitudinal races, *P. e. johnstoni* and *T. o. nigrilorum* respectively, are sufficiently distinct to have been considered full species in the past, and the former is found in the Cameroon highlands, and both on Fernando Po, where the lowland representatives do not occur. The distributions of *P. e. johnstoni* and *T. o. nigrilorum* are typical of many endemic montane forms, and their meeting with *P. e. elliotii* and *T. olivaceus saturatus* on Mt. Cameroon is secondary. The failure of any altitudinal races to develop on Mt. Cameroon is probably due to the comparatively small size of the high altitude populations, so that any response to higher elevations would be swamped by interbreeding with the lowland birds.

Dr. Eisentraut's study is of great value not only for those interested in the study of African zoogeography but for those interested in montane faunas elsewhere. The concept of the much greater extent of montane forests during glacial times, if applied to South America, might account for the upper zonal bird life of Mts. Roraima and Duida and the *tepuis* of southern Venezuela without having to postulate, as Chapman once did, a continuous plateau of 8,000 feet in this area. Similarly, the alternate expansion and contraction of this forest throughout the whole of the Pleistocene glaciations may be the key to the proliferation of endemic zonal genera and species in the Andes.—MELVIN A. TRAYLOR.