REVIEWS

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A SPECIAL REVIEW: PETERS' "CHECK-LIST OF BIRDS OF THE WORLD" AND A HISTORY OF AVIAN CHECKLISTS

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Check-list of Birds of the World: A Continuation of the Work of James L. Peters, vol. XI.—Ernst Mayr and G. William Cottrell (Eds.). 1986. Cambridge, Massachusetts, Museum of Comparative Zoology. xii + 638 pp. **Vol. XVI, Comprehensive Index.** Raymond A. Paynter Jr. 1987. Cambridge, Massachusetts, Museum of Comparative Zoology. xi + 550 pp.—Sometime late in 1928, before the birth of most ornithologists living today, James Lee Peters of the Museum of Comparative Zoology decided to prepare a multivolume "Handlist" of birds of the world. In a letter to Alexander Wetmore (28 January 1929), Peters informed his old friend that "For a further dissertation upon the postal service between Washington and Cambridge, I refer you to a little correspondence between C. W. R.[ichmond] and myself. If anyone should ask you, (but not unless they do) you might inform them that the handlist is now in active preparation and the manuscript of the first volume about 3% completed" (Wetmore Papers, General Correspondence, Box 49, Smithsonian Inst. Archives). (Note: All references will be to material in the Smithsonian Institution Archives unless otherwise stated.) Wetmore replied, "With the new handlist under way you will have something to occupy yourself in spare times from now until about 1940 so that I wish you joy" (Wetmore Papers, Box 49). The wish was sincere; Alex Wetmore and Jim Peters were close friends from early 1921, when they met in Argentina, and they referred to each other as "Doc" and "Patagonia Pete," respectively. But Wetmore was too optimistic by far in his estimate of the finishing date. Only four volumes, through the Coraciiformes, were completed by 1940 when Peters justifiably received the Brewster Medal of the American Ornithologists' Union at the annual meeting. At the time of his death in 1952, Peters had completed seven volumes, not quite through the suboscines. These volumes represented just under half of the species of birds and considerably less than half of the taxa eventually included in the work. Happily, the two organizing editors who continued "Peters' Check-list," James Greenway and Ernst Mayr, had the good fortune to complete their task in 1986. My copy of Vol. XI is inscribed by Ernst Mayr, "At last the millstone is off my neck"—a major understatement.

With the publication of Vol. XI of "Peters' Check-list," work on the most comprehensive and exhausting project in avian systematics came to a close some 60 years after it was started and almost 50 years later than Wetmore's initial estimation. As icing on a delicious cake, we were presented with another useful volume in this series in the form of a previously unplanned Vol. XVI, The Comprehensive Index. Rather than a standard review of these volumes, which would be boring to both the reader and me, I present a historical overview of the "Peters' Check-list" project and some comments on earlier synopses of birds.

Work on Vol. XI, edited by Ernst Mayr and G. William Cottrell, began in the 1950s but was long delayed for a series of reasons, partly because the groups included—the Sylviidae, Muscicapidae (*sensu stricto*), Maluridae, Acanthizidae, Monarchidae, and Eopsaltriidae—constitute some of the most taxonomically difficult families of oscine birds. It is the thickest volume of the entire Check-list, 100 pages longer than the revised Vol. I and almost two times larger than any of the first seven volumes. G. E. Watson was responsible for the Holarctic and Oriental forms of the Sylviidae, Muscicapidae, and Monarchidae. M. A. Traylor covered the African members of these groups plus the Platysteiridae, and E. Mayr the Australasian members of these groups plus the Maluridae, Acanthizidae, and Eopsaltriidae. A comment about the last name is in order. The Australian robins had traditionally been placed in the Muscicapidae (*sensu lato*) and rarely in a separate family-level taxon. I agree with the decision to recognize this group as a distinct family, but disagree with the name used. The name Eopsaltriidae Mathews, 1946 (type genus *Eopsaltria* Swainson, 1832) lacks priority with respect to Petroicidae Mathews, 1919–1920 (type genus *Petroica* Swainson, 1830); moreover, the generic name *Petroica* is the oldest one in the family. No basis exists for claiming well-established usage for Eopsaltriidae before 1961, when priority was extended to family-group names under the new Code of Zoological Nomenclature. Hence, the valid name for this group should be the Petroicidae, with the Eopsaltriidae a junior synonym.

Credit for Vol. XVI, The Comprehensive Index, must

go to Raymond Paynter, who conceived the idea and was responsible for the whole project. The MCZ Bird Department secretary, Ms. Alison Pirie, keyed all the names into the computer. She has the distinction of being perhaps the only person to have typed the names of all avian taxa, as recognized by the authors of Peters' Check-list. Volume XVI is an index to all of the taxa included in the 15 current volumes of Peters'. It covers the second edition of Vol. I, but not the first edition. This last decision is unfortunate, as it would have been useful to have the names in the original first volume included. The volume comes with a handy, two-sided laminated index card to the families and subfamilies. I urge the MCZ to make this card available separately, as many ornithologists will like to have several copies and it would be useful to be able to replace lost cards. A single index volume precludes thumbing through the indices of several volumes. Paynter points out that it is a credit to the authors and editors of the Check-list that he did not find a single homonym in the approximately 55,000 entities in the index. He also includes a brief history of "Peters' Check-list."

James L. Peters was responsible for the first seven volumes of the Check-list, published from 1931 to 1951. All the nonpasserine birds and six families of New World suboscines were covered for a total of 106 families. After Peters' death (19 April 1952) the responsibility for the remaining volumes passed to Greenway and Mayr, who organized these volumes and invited numerous ornithologists to undertake work on the diverse families. The remaining eight volumes and revised Vol. I were edited by Mayr, Greenway, Paynter, Traylor, and Cottrell. Melvin Traylor was the non-MCZ person who contributed most to the completion of the Check-list. Mr. G. W. Cottrell, a retired librarian from the Harvard Libraries, worked painstakingly since 1960 to check citations and other details for the last several volumes. The following listing provides only a general idea of the magnitude of each individual's contribution because family sizes vary greatly and some workers were coauthors, but it is appropriate to recognize those who contributed to the post-Peters volumes. They are D. Amadon (7 families), E. R. Blake (4), J. Davis (1), J. Delacour (1), H. G. Deignan (6), J. Dorst (6), R. A. Falla (1), J. C. Greenway Jr. (11), T. R. Howell (1), P. A. Johnsgard (2), C. Jouanin (4), M. P. Kahl (4), G. E. Lowery Jr. (1), E. Mayr (25), A. H. Miller (1), B. L. Monroe Jr. (1), R. E. Moreau (2), J. L. Mougin (11), R. B. Payne (1), R. A. Paynter Jr. (8), J. L. Peters (3), A. L. Rand (6), S. D. Ripley (2), F. Salomonsen (2), D. W. Snow (6), J. Steinbacher (1), R. W. Storer (4), E. Stresemann (4), M. A. Traylor (9), C. H. Vaurie (4), G. E. Watson (2), C. M. N. White (1), and J. T. Zimmer (1). My apologies to anyone I missed or for errors in the contribution of any author.

The overall coverage of "Peters' Check-list" is excellent. To date, no one has identified any species known at the time of publication of a volume which has been omitted. But there have been additions and other corrections. The genus *Psilorhamphus*, placed in the Formicariidae by Cory and Hellmayr, was believed by Peters to be a member of the Sylviidae. Subsequently, Plótnick showed it to be a member of the Rhinocryptidae (Vol. VII), and *Psilorhamphus* was so treated in the Addenda (Vol. X: 456). The genus *Hypositta*, long believed to be a member of the Sittidae but shown by Dorst to belong to the Vangidae, is treated under the heading "Genus Incertae Sedis" (Vol. XII: 124), just before the Sittidae. The two non-Australian species of the genus *Cracticus* are covered in the Addenda (p. 284) of Vol. XV, not with the rest of the genus (see footnote, p. 167). The genus *Neospiza*, known only from two old specimens from São Tomé, was first included in the Ploceidae (Vol. XV: 32) and later in the Carduelinae (Vol. XIV: 231, see footnote). This is the only instance of a taxon listed twice in the Check-list.

A History of Earlier Synopses

Biologists working with any group of organisms have always been keenly interested in a complete list of species of that group, but even today this goal is not easy to reach. Avian biologists are most fortunate. Good synopses of birds of the world were available early in the development of ornithology as a science, but these works are unequal in their coverage. Neither Erwin Stresemann in his "Ornithology from Aristotle to the Present" (1975, Cambridge, Massachusetts, Harvard Univ. Press) nor Paul Farber in his "The Emergence of Ornithology as a Scientific Discipline: 1760–1850" (1982, Dordrecht, Netherlands, Reidel) presented a detailed analysis of the history of synopses of birds of the world; indeed, these works are scarcely mentioned. Stresemann's account is most uneven in its coverage, especially of English-language publications, and he did not mention books such as Gray's several Handlists. A history of synopses is not an easy task. Most of the published lists provide little to no information on why the author undertook the work, perhaps because the reasons were believed to be self-evident. The necessary documentation for a detailed history of synopses of the birds of the world may not even exist in archives. An analysis of the extant publications reveals a definite pattern in the development of their coverage of birds, such that their history can be divided into four periods.

1) The initial period.—Starting with the many editions of Linnaeus and continuing until 1840, the earliest synopses, such as Buffon's "Histoire Naturelle des Oiseaux" (1770–1786), Brisson's "Ornithologie" (1760), Latham's "A General Synopsis of Birds" (3 vols., 1781–1785) and "Index Ornithologicus" (1790), Illiger's "Prodromus Systematis Mammalium et Avium" (1811), Temminck's "Manuel d'Ornithologie" (1815; 2nd ed., 1820–1839), Rafinesque's "Analyse de

la Nature, ou Tableau de l'Univers et des Corps Organisés" (1815), Vieillot's "Analyse d'une Nouvelle Ornithologie Élémentaire" (1816), Cuvier's "Le Règne Animal" (1816; 2nd ed., 1829), Lesson's "Manuel d'Ornithologie" (2 vols., 1828), and Swainson's "Natural History and Classification of Birds" (2 vols., 1836–1837), examined the overall system of birds, but gave most attention to orders and families. These works included an analysis of variation within the higher-level taxa as reflected in the known genera and species. Although some authors endeavored to list all of the genera and species known to them, little attempt was made to prepare a complete list of avian genera and species. Indeed, in these early decades of systematic ornithology, such attempts would have been impossible because of inadequate distribution of pertinent literature, lack of good representative collections, and frequent duplicate description of the same species. Thus, until 1840 ornithologists could readily prepare a complete list of recognized family-level groups, but not of genera and species.

2) The Gray-Bonaparte period.—The next period began in 1840 with G. R. Gray's "A list of the genera of birds, with an indication of the typical species of each genus" (1st ed. 1840, 2nd ed. 1841, London). His three-volume "The genera of birds: Comprising their generic characteristics, a notice of the habits of each genus and an extensive list of species referred to their several genera" (1844–1849, London) followed. His "Catalogue of the genera and subgenera of birds contained in the British Museum" (1855, London) came next, and finally his opus, the "Handlist of genera and species of birds, distinguishing those contained in the British Museum" (1869–1871, London). Gray provided some information on his intent. He stated in his 1840 list that it was desirable to have a proper classification and nomenclature as the basis for the rearrangement of the ornithological collection of the British Museum (Natural History). Gray attempted to clarify and synonymize all generic names in ornithology, and thereby to provide a complete list of genera. He included many species, but made no statements as to the completeness of this part of his analysis. In 1855 Gray repeated that this catalogue of genera was to provide a complete list of genera and subgenera of birds, but he made no statement about species. Finally, in his "Handlist" Gray wrote that it was to be a "complete list of all genera with their subdivisions and also a comprehensive list of the species of birds." He stated that it includes 2,195 genera and 11,162 species. It is curious that Gray used the word "comprehensive" to describe the list of species, which indicated that the analysis of avian species was broadly based but not necessarily complete. The catalogues and handlists prepared by Gray were based largely on study of collections in the British Museum plus, of course, information in the literature. Gray's work served as the precursor to the later monumental work of Sharpe.

Gray's contemporary, Prince Charles Lucien Bonaparte, was also devoted to the preparation of a synopsis of birds. He published a large number of papers on the classification of birds and of individual orders and families, and finally his opus "Conspectus Generum Avium" (1850–1857, Leiden). Again in this synopsis, stress was placed on the genera of birds, with an extensive, but not necessarily complete, list of species. Unfortunately, Bonaparte died before he finished this work, and it was not completed by any other worker. Bonaparte based his synopsis of birds on examination of specimens in most of the major collections of Europe, including the British Museum, and, earlier in his life, on collections in the United States, mainly the Philadelphia Academy of Science. Bonaparte frequently modified his conclusions on avian classification, certainly on the family-group level and presumably equally on the generic level. He was inconsistent in nomenclature, coined many new names for the same family-level groups and genera, and thereby caused great confusion for contemporary and later ornithologists. It is not clear whether his "Conspectus" should be considered as his final thoughts on avian classification because Bonaparte published a series of classifications of avian families during the 1850s in which he modified his conclusions from those in the "Conspectus" and introduced many new names. Bonaparte's paper "Conspectus Systematis Ornithologiae" (1854, Annales Sciences Naturelles, Zoologie [Paris], ser. 4, vol. 1: 105–152) is the last complete and perhaps the best statement of his ideas on the system of birds, but it differs from the system he used in his "Conspectus."

An important independent synopsis is Sundevall's "Methodi Naturalis Avium Disponendarum Tentamen" (1872, Stockholm; translated into English and republished as "Sundevall's Tentamen," 1889, London, R. H. Porter). It was based on his earlier "Ornithologiskt System" (1836, Kongl. Vetenskaps Academiens Handlingar for 1835: 43–130). Sundevall's analysis was derived from examination of avian genera in the Stockholm Museum, to which he added many taxa from the literature. He stated (1889, p. x) that only a very small number of principal genera are missing. Other than the type species of genera, species were not listed.

The period from 1840 to 1870 was dominated by Gray and Bonaparte, and no other ornithologist attempted to prepare a complete list of avian species. Knowledge of birds had advanced sufficiently for these workers to feel secure in presenting a complete list of genera, but not of species.

The first worker to claim to have published a one-volume catalogue that contained all species of birds was Adolphe Boucard. Boucard was a French amateur who lived much of his life in England (Isle of Wight) and published his major works in English. In 1876 Boucard published his "Catalogus Avium" (London); whether he was even close to this professed goal of

"all species" is another matter. His "Catalogus Avium" contained 2,456 genera and 11,031 species, which is remarkably similar to the numbers in Gray's "Handlist" and suggests that it may have been based closely on Gray's work. Boucard also discussed a plan to prepare a catalogue of all known genera and species of birds, but this was never published. He did produce the "Genera of Humming Birds, being also, A Complete Monograph of These Birds" (1893–1895, London).

3) The Sharpe period.—The next period, 1870–1910, was dominated by Richard Bowdler Sharpe, who supervised the preparation of the "Catalogue of the Birds in the British Museum" (27 vols., 1874–1898, London). This first complete list of the avian species of the world was accomplished in a period of 25 years, mainly by Sharpe's efforts as an author, editor, and manager of the entire project. The magnitude of this accomplishment can be appreciated only if one realizes that the "Catalogue" includes complete synonymies, literature citations, careful descriptions of the plumages and distribution of each species, *and* a listing of all specimens in the British Museum. The catalogue was modeled on the "Catalogue of the Fishes in the British Museum," edited by Albert Günther. Günther, Keeper of Zoology, appointed Sharpe head of the bird collections in 1872 after Gray's death. Sharpe must have begun work on his new "Catalogue" directly on his appointment because the first volume appeared just two years later. The "British Museum Catalogue" is a multiauthor work. The authorities of the British Museum realized immediately that the task was too large for Sharpe to complete alone and provided funds for associates to work on this project. No sooner was the "British Museum Catalogue" completed than Sharpe wrote his "Hand-list of the Genera and Species of Birds" (5 vols., 1899–1909; Index, 1912; London). Both works are the direct descendents of the publications of G. R. Gray, but they represent a further step in the quest for a complete list of the known taxa of birds because all known species of birds were included. These synopses were based largely on the bird collections in the British Museum plus, of course, information in the literature. The classification used in the "Catalogue" was old and dated to the early decades of the 19th century. Sharpe presented a new classification of birds in his address on "A review of recent attempts to classify birds" (1891, Budapest) to the Second International Ornithological Congress. The revised classification was used by Sharpe in his "Hand-list," so that this aspect of his system was modernized. To the end of his days, Sharpe rejected the subspecies concept and insisted on a binomial system in the "British Museum Catalogue" and his "Hand-list." Many of the species recognized were geographic representatives (=present-day allospecies and subspecies). A total of 2,810 genera and 18,939 species are treated in Sharpe's "Hand-list." Sharpe's works became the standard immediately and served as the foundation for similar publications. Alphonse Dubois wrote his "Synopsis Avium. Nouveau Manuel d'Ornithologie" (1899–1904, Brussels) based on the "Catalogue of the Birds in the British Museum"; he recognized 16,478 species and varieties of birds in 2,252 genera.

4) The Peters period.—For 20–30 years after the end of the Sharpe era, no advances were made on a world-wide avian checklist. The Peters period spans most of the 20th century; its core, from 1931 until 1986, coincides with the appearance of the first and last volumes of "Peters' Check-list." The period was dominated by this work and hence by J. L. Peters and the later editors, of which Ernst Mayr is the preeminent figure. This latest synopsis represents the final step in the hopes of ornithologists to complete a list of all living avian taxa because all subspecies were included. The description of geographic variation in birds with the use of subspecies taxa and a trinomial nomenclature, which began with Hermann Schlegel in 1844 ("Kritische Übersicht der europäischen Vögel," Leiden) and was expanded greatly by the American ornithologists during the second half of the 19th century and later by Hartert for Eurasia, was finally reflected almost a century later in a global checklist of birds.

The early part of the Peters period saw many important advances in regional works. These include the several editions of the AOU Check-list, Ridgway's "Birds of North and Middle America," Cory-Hellmayr's "Birds of the Americas," Hartert's "Vögel der paläarktischen Fauna," Baker on Indian birds, and Mathews on Australasian birds, among others. These works were not based on a single standard classification because Sharpe's "Catalogue" was badly outdated before it was completed. Starting in the 1870s, younger ornithologists increasingly accepted the concept of the subspecies and used the trinomial system to describe geographic variation in birds. With the work of a small group of avian morphologists-systematists that included T. H. Huxley, W. K. Parker, A. H. Garrod, W. A. Forbes, F. Beddard, W. P. Pycraft, R. W. Shufeldt, and especially H. Gadow and M. Fürbringer, great advances were made in understanding the relationships and classification of avian orders and families. Yet no one at any major center of systematic ornithology in the first decades of the 20th century took steps to produce the needed replacement for Sharpe's "Catalogue." Major exploratory surveys and collections were being made in many parts of the world. Workers, such as Stresemann and Rensch in Berlin and Chapman, Chapin, and others in New York, were deeply involved in applying new concepts of genetics and evolution to avian systematics and distribution. Perhaps most of these workers understood all too clearly the enormous undertaking involved in replacing the "Catalogue" and understood that starting it would end any other research they might wish to do. In any case, the beginning of the next step in

the development of synopses was delayed for almost 30 years after completion of the "British Museum Catalogue." Two major advances were to characterize the next step in avian synopses, namely the use of a new classification and sequence of orders and families, and the acceptance of the subspecies concept. Perhaps it was beneficial that a new synopsis was delayed for three decades. This provided sufficient time for ornithologists to consolidate new morphological and other information into a revised classification and to combine the allopatric taxa listed in Sharpe's "Catalogue" into polytypic species.

A natural progression in the coverage of synopses of birds took place as empirical knowledge of birds increased and systematic theory changed with better understanding of organic evolution, genetics, and ecology. The modification of worldwide synopses, from those covering only orders and families to those dealing with all genera, began in 1840, followed by Sharpe's "Catalogue," which covered all species (1875), and finally by Peters' "Check-list," which covered all subspecies (1931), and is in fairly close concordance with the time when the taxa at each successively lower-level category became reasonably well known on a worldwide scale. Reflection on this development indicates that it would not have been possible for Gray or Bonaparte to include all species of birds in their handlists, nor would it have been possible for subspecies to be listed in Sharpe's "Catalogue" even if he had accepted this concept. This simple empirical correlation presumably holds for all groups of organisms, and most likely it is still not possible to prepare, even today, a worldwide checklist of all subspecific taxa for most classes and orders of living organisms.

Development of Peters' Check-list

What is interesting is why and how Peters decided to do what others had not and why he was successful. Some but not all of these matters were covered by Paynter in his introductory remarks in Vol. XVI.

Peters at the Museum of Comparative Zoology.—A few words should be said about James Lee Peters (1889–1952; for details see Wetmore's Memorial, 1957, Auk 74: 167). After he graduated from Harvard College in 1912, Peters spent the next decade doing fieldwork and collecting for the Biological Survey and for the Museum of Comparative Zoology, with a 2-year stint in the U.S. Army in World War I. In early 1921 he spent several months in the field with Alexander Wetmore, and the two formed a close friendship. While he was a student at Harvard, Peters met Outram Bangs, Curator of Ornithology in the Museum of Comparative Zoology, and subsequently Peters worked as a volunteer at the MCZ whenever he was in Cambridge. In 1921 he was appointed an Associate of the museum (unpaid of course) and started as a full-time, resident volunteer in 1923. Peters was first listed as a member of the Bird Department in the Annual Report of the MCZ for 1925–1926, suggesting that he was finally placed on the museum's payroll. In 1928 Peters was appointed Assistant Curator of Ornithology, and became Curator in 1932 upon the death of Bangs. Peters was originally a field-man and collector, but he was primarily an alpha-level taxonomist. His interests were at the species and subspecies level. He was little interested in generic systematics and generally used relatively narrow generic limits, as was typical for the period. He adopted without change the ordinal and familial classification of Wetmore. Peters was deeply involved in zoological nomenclature and relied heavily on the nomenclatural decisions of Richmond, Mathews, and others. He was a strict priorist in nomenclature, as were many at that time. Peters was a member of the International Commission of Zoological Nomenclature and was elected President a few years before his death.

The card catalogue.—Most important for the decision to begin work on a new checklist was the existence of the "card catalogue" of the MCZ Bird Department. This catalogue was started in 1923 (not 1921, as implied by Paynter in his introduction) and was the first major task assigned to Peters as a full-time (in-residence) volunteer in the bird department. In a letter to A. Wetmore (Wetmore Papers, 26 February 1923), Peters writes, "On March 1, I am due to start on a card catalogue of the birds in the MCZ. Some job. [John C.] Phillips estimates 2 years; my guess is 5 years and 2 mos! Whether it will be possible to break away for any field work during the cataloguing period I don't know. Possibly my days in the field are over, a most dismal prospect to contemplate." Successive letters repeat the same plaintive tale, with the estimate of the time required for completion continuing to increase. In a letter dated 4 September 1924, Peters writes "I figure on completing it by 1932 or later, mostly later." And almost a year later in a letter to Wetmore on 5 August 1925, Peters writes, "The card catalogue seems to be destined to be a life work. I have carded over 22,000 birds using for that purpose about 16,000 cards of all types and have reached p. 216 of the first vol. of the [=Sharpe's] Handlist!" This is quite an achievement as the birds of the world were covered in five volumes of this handlist. Little did Peters know how right he was and that this card index was to be his life work. He rarely returned to the field and was still working on his "Check-list," which developed from the card file, at his death on 19 April 1952, 29 years later. The Annual Report for 1927–1928 mentioned that a clerical assistant had been assigned to the card project and would relieve Peters of much drudgery, and the carding would go much faster. The card catalogue was not "completed" until the 1940s, and was constantly updated with acquisitions of new specimens in the MCZ and with changes in taxonomy and nomenclature. All work on it terminated in 1961. The card catalogue was moved from its prominent position in the hall just outside the door of the cu-

rator's office to a back collection room where it sits, largely unused, as a monument to the Check-list and to precomputer attempts to include all avian specimens in a major collection in a data bank.

This card catalogue is a repository for information on the known species and genera of birds, and on the specimens in the MCZ collection. It is a primitive version of what is done now with computers instead of paper file cards arranged and rearranged by hand. In a letter to C. W. Richmond (28 February 1927, Records, Division of Birds), Peters described the catalogue: "This is a catalogue of the collection at the M.C.Z. based on the arrangement of Sharp's [sic] Handlist. In cataloguing any group we have first gone over the zoological record to bring the literature up to date, noting the description of new forms, relegations to synonymy, changes of name, etc. When this is done I have gone over each species that we have very carefully, identifying and bringing identifications up to date when necessary. In the arrangement of genera, we have followed substantially the same genera recognized by Sharp, but, when in my opinion some of Sharp's splits have been unwarranted, I have not hesitated to lump, but the card covering each genus shows clearly what has been done, and why. Each valid genus proposed since the publication of Sharp's Handlist is recognized and spaced on an index card the same as any other genus. I have also included the generic synonymy since 1900. At the end of each genus I have a card listing forms not represented in the M.C.Z. collection and this card is frequently enlarged to include synonyms as well.

"I enclose a sample card showing just exactly what our arrangement is. I use as many cards as are necessary for a species leaving plenty of space for expansion. The general arrangement is from West to East and from North to South."

It is not clear who conceived of the card catalogue. It may have been O. Bangs. It was far more likely the brainchild of Thomas Barbour, then Curator of Reptiles and Amphibians at the MCZ, but more interested in ornithology. Later, when Barbour became director of the museum (1 November 1927), he instituted major changes in the physical plant and organization of the museum (see Barbour's Memorial by Peters, 1948, Auk 65: 432). Barbour was a fervent collector, and among other things he desired to have a specimen of every known genus of birds at the MCZ collection, a task made difficult in a time of intensive generic splitting in avian systematics. During his tenure at the MCZ, Barbour obtained many important avian collections for the museum. But to reach his desired goal, one must know the genera of birds, what is in the collection, and what is not. All of this information could be summarized in a card catalogue. Although no documents support this conclusion (suggested by Ernst Mayr), it is most reasonable that the genesis of the card catalogue was the collecting compulsion of Barbour. There is no evidence that Bangs was deeply interested, if at all, in the card catalogue. It definitely was not Peters' idea because he clearly hated this task, as reflected by comments in numerous letters to Wetmore. Peters, as a young man in the 1920s, would have preferred to spend most of his life in the field collecting birds, not in the museum organizing specimens into a card catalogue. Only when he had considerable time invested and could see the possibility of converting the catalogue into a worldwide checklist did Peters appear to reconcile his career to working on this "most dismal prospect."

The MCZ: its collection and library.—At the time the Check-list project was started, the MCZ possessed the fourth largest ornithological collection in the country. More important, the collection was an excellent representative collection of birds of the world. Further, Cambridge was within easy reach of the large collections in New York, Philadelphia, and Washington. Most important were the excellent libraries in the MCZ and elsewhere in Harvard University. These libraries are especially strong in the literature from 1750 to 1850 compared with other major zoological libraries in the United States. The literature of this period is critical for a project of the type undertaken by Peters.

Other ornithological centers.—Workers at most other major ornithological centers with the facilities to support a world checklist project were involved with major regional studies. These included collecting, biological surveys, and regional checklists, such as the Cory-Hellmayr and the Ridgway projects. Most workers in these other centers could not have undertaken a world checklist, even if they wished. Thus, a void existed, and when Peters decided that the time had come to replace Sharpe's "Catalogue," he had no competition.

There did not appear to be any discussion among Peters and other ornithologists on the idea of replacing Sharpe's "Catalogue" with a new checklist, at least not in written form. There is no mention of work on the new checklist in Annual Reports of the MCZ before 1930, although these reports continued to record the progress made on the card catalogue. Peters did not appear to have mentioned his idea to other ornithologists in his correspondence. Recall Peters' letter of 28 January 1929 to Wetmore in which he reveals almost hesitantly that he has started work on his handlist. By the late 1920s, Bangs was seriously ill, although he did not retire before his death in 1932. He did not seem to have been strongly involved with the workings of the department for several years. No record exists in the MCZ Archives to indicate that Peters discussed his idea with Barbour or other ornithologists in the Cambridge area. Thus, credit for the checklist concept must be given solely to Peters. He knew, as did other ornithologists at the time, that Sharpe's work had become largely obsolete. Peters also realized that in his hated card catalogue, he had exactly the resource needed to undertake this task.

Paynter suggests Peters started work on his new "Handlist" in 1927 when Thomas Barbour became director of the MCZ, and applied his great energies and enthusiasm to rejuvenate the then stagnant museum. This is reasonable, but does not fit with Peters' correspondence. In the absence of written documentation, it is not possible to say when Peters decided to undertake preparation of his new handlist, but evidence exists as to when he actually started work. This is Peters' letter of 28 January 1929 to Wetmore cited in the opening paragraph. If the "handlist" manuscript was 3% completed at this time, I estimate Peters began work on it in early 1929, or perhaps late in December 1928. In addition, there is the first mention of this work in the 1929–1930 Annual Report of the MCZ (p. 11), which reads, "Mr. Peters has been working actively in the preparation of a new checklist of the birds of the world. It is expected that the manuscript of the first volume will be ready for the press by the first of January [1931]. This proposed list had its inception in the card catalogue, where a list of the species is maintained that have been described since the publication of Sharpe's Handlist. Now that this catalogue has reached into the Passeres, it seems well to proceed with its amplification in to a new 'list.'" The 1930–1931 report states that "The first volume of Mr Peters's 'Checklist of Birds of the World' was sent to Press about 1 February [1931] and should appear before 1 October [1931]." From this evidence, I suggest that 1 January 1929 can be taken as the approximate date for the beginning of work on "Peters' Check-list."

A major choice Peters faced in the preparation of his new handlist was the classification and sequence of avian orders and families. A distinction must be made between a classification and a sequence, which are sharply different, although frequently confused, concepts in systematics (Mayr 1989, Auk 106: 508). The confusion stems from the fact that classifications are most commonly presented in the form of a linear sequence. A classification is the arrangement of recognized taxa in an inclusive, nonoverlapping Linnaean hierarchy; the arrangement can be depicted best as a three-dimensional phylogenetic diagram. A sequence is the representation of the taxa in a classification in a linear series that is required because of the one-dimensional structure of checklists, books, cabinets in collections, etc. Rules exist for the construction of sequences, but many different, equally valid sequences can be constructed from the same classification. The existence of a standard sequence of taxa is important for the numerous information-retrieval functions of classification. A standard sequence is a heuristic device, and by its very nature it is partly arbitrary, but it must be broadly accepted. Peters required an up-to-date classification but, even more importantly, a modern and broadly accepted sequence of avian orders and families for his checklist.

Clearly, Sharpe's system (including that proposed in 1891) was obsolete, and this aspect of systematics lay outside of Peters' ability and interest. No authoritative classification had been published for the orders and families of all birds since 1900. The extant systems were proposed by Fürbringer in his two-volume "Untersuchungen zur Morphologie und Systematik der Vögel" (1888), Gadow in his "Vögel. Part II. Systematischer Theil" (1893), and Sharpe (1891). These systems differed greatly from previously accepted ones, as, for example, the one adopted in Sharpe's "Catalogue." But the Fürbringer and Gadow systems usually did not include details of subfamilies, and neither provided a classification for passerine families, although Sharpe included both aspects. The American Ornithologists' Union Check-list Committee was concerned with the same problem in the preparation of the 4th edition of its Check-list because the previous Check-lists had used old and outdated systems. For the first edition, L. Stejneger was asked to provide a classification and sequence for North American birds based as far as possible on the existing Coues and Ridgway arrangements. Stejneger reversed the scheme in most earlier Check-lists of starting with the highest groups. He proposed an arrangement that began with the grebes and ended with the thrushes. No changes in the basic classification were made in the 2nd and 3rd editions of the AOU Check-list, although Ridgway and Stejneger had been asked to prepare a new one for the 3rd edition. Hence, it was imperative to have an up-to-date classification and sequence for the 4th edition of the AOU Check-list, and the AOU Check-list Committee appointed a subcommittee of A. Wetmore and W. deW. Miller (of the AMNH) to prepare them. Wetmore and deW. Miller (1926, Auk 43: 337) published a classification that was adopted essentially unchanged for the 4th (1931), 5th (1957), and 6th (1983) editions of the AOU Check-list. This classification was not adequate for Peters' purposes because it included only North American families and subfamilies. Shortly after informing Wetmore that he was engaged in preparation of of a new "Handlist," Peters asked Wetmore if he would send him a copy of the new classification of birds of the world that he was preparing. On 5 June 1929 (Wetmore papers, Box 49) Wetmore writes, "In accordance with my promise to you when I was with you recently I am sending you herewith a copy of the classification of the birds of the world that I have prepared for the article in the Encyclopaedia Brittanica." On 9 January 1930 Wetmore sent Peters a copy of his "A systematic classification for the birds of the world" (1930, Proc. U.S. Natl. Mus. 76 [Art.24]: 1), which Peters acknowledged in a letter dated 20 January 1930. Wetmore's classification was an expansion of that developed in 1926 with deW. Miller. It followed Gadow (1893) rather closely for the nonpasserine birds, and Stejneger (1885. Standard Natural History. Vol. IV, Birds. J. S. Kingsley, Ed. Boston) for the passerine birds. Stejneger ac-

cepted the earlier suggestion of Sundevall (1872 = 1889) to place the Conirostres (finches) at the end of the oscine sequence. Thus, Stejneger (1889, p. 483) argued that the finches are the most specialized songbirds, and placed the New World nine-primaried oscines and the Old World ploceids and estrildids last in the oscine sequence. Wetmore accepted this arrangement, and thereby advocated a system for the oscines based on the essentially pre-evolutionary approach of Sundevall. Several major differences exist between the Stejneger and Wetmore sequences of the oscines. Wetmore placed the swallows after the larks, and listed the corvid and parid groups early in the sequence before the Old World insect-eaters. He retained the shrikelike families, including the Australasian forms, late in the sequence with the Old World nectar-feeders just before the Old World finches and New World nine-primaried oscines, which ended the list. Peters clearly indicated that he would follow Wetmore's arrangement, but was concerned with the fact that, although Wetmore used an elaborate suprafamilial classification, he did not include subfamilies in his 1930 scheme, a practice maintained in all future editions of his classification. Peters had to recognize a number of subfamilies to provide an adequate classification of birds for his checklist.

In all his letters to Wetmore, Peters referred to his project as his "Handlist," using the old and honorable term from Gray and Sharpe. Without any explanation, Peters switched to the term "check-list" in a letter to Wetmore dated 28 January 1931, and from then on he used "check-list." No reasons were given for this change, nor could I find anything in the MCZ archives on the change from handlist to "check-list."

The first volume of Peters' "Check-list of Birds of the World" was published in 1931 and was reviewed by Witmer Stone (1932, Auk 49: 112). Stone was concerned that the first volumes would be out of date before the last ones were completed, and estimated that the new Check-list would be completed in 10 volumes. Although Stone urged that other ornithologists be asked to prepare some of the families, he suggested that this approach was impractical. Stone was correct that the first volumes would be outdated before the completion of the Check-list, but not on the impracticality of multiauthorship. It is not clear why Stone felt that a multiauthored approach was not practical; this was used successfully in the British Museum Catalogue. Multiauthorship should have been instituted by Peters and the MCZ from the onset of the Check-list.

Peters provided a checklist of all taxa of living birds. He listed avian fossil families, but not genera and species. His criterion for living vs. fossil birds is charming (Vol. I: vi–vii): "It has been necessary to draw the line somewhere between fossil and recent birds, and for this purpose any bird is considered as belonging among the fossils if it is not known from at least a fragment of skin and feathers." This rule was not quite followed as such remains no longer exist (and may never have) for all members of the Raphidae (dodos), which are included. At least one species of moas is known from mummified remains that include skin and feathers, but all moas were excluded. Peters' distinction between fossil and living birds is a good one and is still accepted by ornithologists. The basic taxonomic unit is the subspecies or the monotypic species, for which Peters provided the citation to the original description, distribution, and synonymies of those names not included in the excellent synonymies in Sharpe's "Catalogue" and "Handlist" and in Hartert's "Vögel der paläarktischen Fauna." He excluded extensive citations to the literature and descriptions of the plumages, as provided by Sharpe; these aspects were no longer needed.

Some comparisons can be made between Sharpe and Peters and their respective projects. Sharpe was 24 when he was appointed head of the Bird Collection, BMNH, and presumably decided to begin his "Catalogue." Peters was 34 when he became a full-time resident volunteer in the MCZ and started the card catalogue. At 39 he began work on his "Check-list." Sharpe was 26 and Peters 42 when their first volumes were published, and 32 and 51 years old, respectively, when the fourth was published. A most important difference in the histories of these projects existed almost from their beginnings. Sharpe's superior, Albert Günther (Keeper of Zoology), realized the enormity of the "Catalogue" project perhaps because he was involved in a similar project for fishes. Consequently, he provided Sharpe with a series of assistants. As a result, the "Catalogue" volumes varied considerably in quality. Those by Gadow were regarded to be the poorest and those by Salvadori the best. Overall, the quality of the different volumes of the British Museum Catalogue is high. Work progressed apace, and the "Catalogue" was completed in 27 volumes in 1898 when Sharpe was 51. Sharpe then finished his five-volume "Handlist" just three months before he died at 62 in 1909. The index appeared in 1912 after his death.

Peters did not have an equally sensible director and received no assistance other than a technical clerk to assist with the card catalogue. Perhaps he did not wish any assistance, as he never discussed the Check-list or requested help from Greenway, who started work at the MCZ in 1930 and served as Assistant Curator in the bird collection of the MCZ from 1932. Thus, Peters completed Vol. VII only in 1951 when he was 62 years old. Both Sharpe and Peters died at the same relatively young age of 62, which should not be taken as an indication of the consequence of working on global avian checklists. James Greenway and Ernst Mayr are exceptions that disprove the rule. Only about 1950 did Peters realize that he would never be able to complete this project unassisted, and he asked John Zimmer (AMNH) to revise the Tyrannidae and related families for the Check-list. But Peters apparently

did not formulate a comprehensive plan for the continuation of his project and did not ask anyone to succeed him, in spite of the fact that it was obvious he would not be able to complete this work. Moreover, Peters suspected he might die at a somewhat young age from a heart attack, as had his father. He told Greenway on a number of occasions that there was no sense to call an ambulance if he collapsed in the museum. His premonition came to pass when Peters collapsed in the museum in April 1952 and died a few days later. At this time, Peters was working on the first volume of the oscines and had completed the chapters on the Alaudidae and the Hirundinidae for Vol. IX (1960).

At Peters' death, James Greenway became curator and served from 1953 until 1961, when he resigned and moved to the AMNH. He served the AMNH as a Research Associate in the Department of Ornithology until his death in 1989. Raymond Paynter, who was appointed Assistant Curator in 1953, became Curator after Greenway's resignation. Ernst Mayr assumed his duties as Alexander Agassiz Professor of Zoology at the MCZ in 1953. The later history of "Peters' Check-list" is associated closely with Greenway and Mayr, and subsequently with Paynter. Much of the following analysis is based on my interviews with all three, but mainly with Greenway and Mayr, who formulated the overall plan to complete the Check-list.

The Check-list project was officially turned over to Greenway after Peters' death. Greenway did not want the Check-list project, and basically did not know what to do because he was never taken into Peters' confidence. Wisely, Greenway waited until September 1953 when Mayr arrived at the MCZ. Mayr's appointment was negotiated independently of Peters' death. By chance space was available on the fifth floor of the MCZ, and Mayr's office was immediately adjacent to the ornithology collection. Greenway spoke to Mayr soon after he arrived, and the two agreed to codirect the project, much to Greenway's relief. The basic decisions and responsibility for developing the overall plan for completion of "Peters' Check-list" were Mayr's. Essentially the oscines remained to be covered in the Check-list, but these birds comprise just under half of all avian species and a high percentage of the subspecies. An overall plan was needed to complete the oscine volumes as rapidly as possible.

The first, most important, and wisest decision made by Mayr and Greenway was to not attempt to prepare the oscine volumes themselves. They decided the volumes would be multiauthored. The editors would solicit avian systematists worldwide to prepare manuscripts for the individual families. Some of the larger, complex families were treated by several authors. The volumes would not appear in taxonomic order, but as they were completed. A classification and standard sequence for the oscines had to be prepared, which led to a major controversy in the Check-list project. Estimates were needed on the number of species and subspecies in each family-level taxon so that families could be assigned to volumes of approximately equal size. This worked rather well, except for an arithmetical error by Mayr that resulted in the larger-than-usual Vol. XI. A successful grant application was submitted to the National Science Foundation by Mayr and Greenway for the years 1956–1957 to support publication. Proceeds from sales of each volume were to go into a special fund to support publication of future volumes. An attempt was made to increase sales and broaden the distribution of the Check-list by reducing the price per volume. This was not successful. Another attempt to increase sales was made by including English names for each species in Vol. IX, the first one published (1960) after Peters' death. This idea was dropped because reviewers discussed only the English names rather than the scientific content of the Check-list.

An immediate problem was the classification and sequence of families and subfamilies of the oscines. Mayr and Amadon had recently published their "A classification of Recent birds" (1951, Am. Mus. Novit. No. 1463), in which they proposed a different arrangement from that of Wetmore for this suborder. This classification divided the oscines more finely into subfamilies and tribes and arranged them in a different sequence. Considerable divergence of opinion had developed between the systematists who followed Wetmore's classification (the so-called "American system") and those who used other systems, for example, those stemming more directly from Hartert. Most post-1900 avian classifications originated from those proposed by Fürbringer and by Gadow, with broad agreement on the classification and sequence for the nonpasserine birds. Neither Fürbringer nor Gadow provided details on the classification of the passerine birds, and this part of the system became contentious. Wetmore had presented his classification in 1926 and again in 1930 with no explanation, as was the custom of most other workers. His later revisions (1934, 1940, 1951, 1960) differed little from the 1930 scheme, and explanations were provided only in the last two. Although still brief and clearly inadequate, Mayr and Amadon provided some 30 pages of explanation to support their arrangement of the oscines, far more than had other authors. Not only was there a problem in the sequence of the oscines, but the classification of many Australian (especially), African, and Oriental groups had to be resolved. These families of oscine birds were largely neglected in Wetmore's classifications. Mayr and Amadon paid special attention to non-Holarctic Old World groups and proposed a number of new family-level taxa. The conflict between the Wetmore arrangement used previously in "Peters' Check-list" and the Mayr-Amadon system for the oscines had to be resolved fully before work could be continued.

Independently of the decision facing the editors of

"Peters' Check-list," Professor Stresemann proposed that a discussion be held at the XI International Ornithological Congress (Basel, May 1954) to consider the classification and, more importantly, the sequence of passerine birds. He advocated that attempts be made to reach an agreement on a standard sequence of passerine families for use in checklists, regional faunas, and similar works. This meeting was arranged under the chairmanship of G. C. A. Junge (Leiden). The very brief report in the XI Congress Proceedings (Basel, 1955: 34) is inadequate to determine what occurred at this meeting, or the purpose of the committee appointed as a result of the meeting. The proceedings state clearly that the committee was to recommend a sequence of avian families for European publications, but others more reasonably interpreted the goal of the committee to be a standard global sequence. Junge was a weak chairman, and the meeting rapidly became chaotic (letter, K. H. Voous to W. J. Bock, February 1987). Erwin Stresemann took over the discussion and proposed that Hartert's sequence be followed for the world avifauna—an untenable idea. Finally, an international committee with Junge as chairman was appointed by Sir Landsborough Thomson, president of the Congress, to decide these issues. Many American workers were furious because they felt the committee was intentionally loaded against Wetmore's classification. But the task of the committee was not to decide on classification, but to express their preference on a standard sequence for oscine families. Almost all oscine classifications divided these birds into three major complexes, namely: (1) Old World insect-eaters and relatives, (2) New World nine-primaried oscines and other finches, and (3) crows, birds of paradise, and their allies. The major decision facing the committee was the sequential order of these three complexes.

Because the classification and sequence to be used in "Peters' Check-list" would have important implications, Mayr and Greenway pledged to adopt for the forthcoming volumes of Peters the sequence proposed by this committee. They pushed for prompt completion of the committee's work because they could not plan the future volumes without agreement on a standard sequence. The committee's deliberations were conducted by mail, and its report published by Mayr and Greenway (1956, Breviora No. 58). It must be stressed that the title of this report and its entire analysis dealt with sequences of passerine birds, *not* with their classification.

Almost all published opposition to this "Basel sequence" came from American ornithologists (Wetmore 1957, Condor 59: 207–209; Storer 1971, Avian Biol. 1: 1–18). Amadon's discussion of passerine classification (1957, Proc. Zool. Soc., Calcutta, Mookerjee Mem. Vol: 259–268) was submitted before the publication of Mayr and Greenway (1956). Unfortunately, most of the argument centered around the trivial issue of whether the crows and their relatives or the New World nine-primaried oscines should be placed last in the sequence of oscines. And most adversaries failed to recognize that the central issue was agreement on a standard sequence of passerine families for purposes of information retrieval. Classificatory questions of the family-level taxa recognized and the grouping of these taxa within the oscines were also significant. The basic problem in these discussions, both pro and con, was that there was little solid evidence on which to classify the oscine birds. The controversy will continue without resolution until much more evidence is amassed and until antagonists distinguish between classifications and sequences, especially standard sequences. What was needed in 1954 was a standard sequence for oscine families that would facilitate communication. This was what the "Basel sequence" was intended to provide.

"Peters' Check-list" is, and will remain for many years, the only detailed checklist of the world's avifauna. It provides a classification and a standard sequence of birds for regional avifaunas, museum collections, and the host of other informational retrieval systems used by avian biologists. The most sensible decision to facilitate communication is for all ornithologists to adopt the entire sequence in the 15 volumes of Peters whether one agrees with it or not. If a justification is requested of the sequence used in the oscine volumes of "Peters' Check-list," the answer is simple. No elaborate justification or scientific evidence is required to support it. Mayr and Greenway agreed to undertake the huge task of completing the Check-list; therefore, it was their responsibility to decide which sequence to use for the oscines, just as it was Peters' responsibility to adopt the then-new Wetmore (1930) classification and sequence of avian families for his Check-list. These editors, fortunately, did adopt broadly accepted standard sequences for the volumes under their charge.

After establishing the framework for the oscine volumes, including which families were covered in each volume, the editors invited specialists to analyze the classification and prepare manuscripts for individual families and subfamilies. Almost all invited systematists agreed to contribute to the Check-list, which is a testimony to the importance of "Peters' Check-list," to the efforts of the organizing editors, and to the altruistic spirit of cooperating specialists. Considerable time was required to reactivate the Check-list project. The first post-Peters volume to be published was Vol. IX, which appeared in 1960. It contained a brief statement on procedures adopted by the editors. The final volume on the suboscines proved to be a problem. At his death in 1957, Zimmer had almost completed the manuscripts for the Tyrannidae and other New World families assigned to him. Although these were done carefully, Zimmer had limited himself to questions on the species and subspecies levels. He followed closely the familial and generic classifications of the Hellmayr volume. This manuscript

stagnated for more than 10 years. Melvin Traylor accepted the task of editing the entire volume as well as undertaking a review of the subfamilies and genera of the Tyrannidae. His efforts resulted in a major improvement over the original manuscripts prepared by Zimmer. Volume VIII was published in 1978, almost 30 years after Peters asked Zimmer to undertake these most difficult groups.

Most volumes were printed in small editions, and supplies ran out well before satisfying the demand. About 1960, the editors decided to reprint the volumes for which the supply was exhausted. Not surprisingly, the information in Vol. I was badly out of date, and the editors decided to prepare a complete revision rather than reprint it. Several workers were asked to revise the individual families. Professor Stresemann completed his work on the Falconiformes promptly, and his manuscript sat for many years before other authors finished their work. Stresemann was unable to revise it before his death in 1972, and Dean Amadon completed the necessary revisions. The revised Vol. I was published in 1979. Its preface provides figures for the numbers of taxa covered, which gives an idea of the advance in ornithological systematics between 1931 and 1979.

Ornithologists are fortunate to have in "Peters' Check-list" a resource not available for any other group of animals. This is a worldwide checklist for all described taxa down to the subspecies with the needed information on the citation of the original description, synonymies, and distribution. Unfortunately, as for all published works, the early volumes of "Peters" dating from the 1930s and 1940s are seriously obsolete. It is fortunate that Vol. I was revised, but there are no plans to my knowledge to revise any of the other volumes. It is doubtful whether "Peters' Check-list" will ever be revised. The difficulty of dealing with all subspecies of birds has become an almost insurmountable task. One has only to note that the 6th edition of the AOU Check-list (1983) expanded its area of coverage but excluded subspecies. Even so, it was delayed for many years. Subspecies are to be included in the 7th edition of the AOU Check-list, with publication planned for 1992; one hopes it will appear as scheduled.

There are numerous recent checklists of the species of birds of the world ("A Coded Workbook of Birds of the World," Edwards 1982–1986, 2nd ed., two vols.; "Reference List of the Birds of the World," Morony, Bock, and Farrand 1975). Unfortunately, a good, updated treatment of the geographic taxa of birds of the world, including superspecies, allospecies, and well-marked subspecies in addition to taxonomic species, is lacking.

With the completion of the "Peters' Check-list," all ornithologists are indebted to Peters for deciding to transform his despised card catalogue into his most valuable "Check-list," to Greenway and Mayr for continuing the project both as editors and authors of a number of families, to Paynter and Traylor for editing several volumes and writing the manuscripts for a number of difficult families, to Paynter for the index volume, to Cottrell for his painstaking editorial work and checking of original citations in the last several volumes, and to all ornithologists who contributed chapters. As avian biologists, no matter what our research, we are indebted to these workers. All volumes are still in print, thanks to the far-sightedness of the editors, and I urge all serious ornithologists to be certain that this invaluable set is in their personal library or at least in those of their institutions. It is one of the prized and most-used items in my personal library, close at hand to my computer desk and frequently with one or more volumes opened on the desk.

I thank the officials of the Smithsonian Archives and of the Museum of Comparative Zoology Archives who permitted me to examine material under their care, and for assistance in my research. Ernst Mayr, James Greenway, and Raymond Paynter must be thanked for the many hours given to me in interviews on their contribution to the Peters' Check-list project and many related topics. Ernst Mayr and Raymond Paynter read several drafts of the manuscript, made many corrections and provided valuable suggestions. Lastly, I thank Alan H. Brush for his excellent editing of the manuscript.

Raptors in the Modern World.—B.-U. Meyburg and R. D. Chancellor (Eds.). 1989. Proc. III World Conference of the World Working Group on Birds of Prey (International Council for Bird Preservation). 611 pp., 273 tables, maps, 63 drawings of raptors by F. Weick. (Available from R. D. Chancellor, 15b Bolton Gardens, London SW5 A0L, U.K.) $45.00 (prepaid).—This conference was held at Eilat, Israel, where vast numbers of migrating raptors funnel in and out of wintering quarters in Africa from eastern Europe and Asia. The published results are too diverse and extensive to be reviewed in any detail, as will be evident from the following summary. There are 72 papers by 112 authors from 27 countries, comprising by subject: Raptors on migration and wintering grounds (19 papers), Population biology and breeding (10), Biology and conservation of rare species (24), Raptors in polluted environments (11), Habitat analysis and census techniques (4), and Promotion of legislation (4).

Many of the contributions add to the basic biology of raptors. For example, for resident Golden Eagles (*Aquila chrysaetos*) in Scotland, the amount of carrion (sheep and deer) available in winter controls (nesting) density, while the amount of live prey (hares and grouse) in the summer controls productivity (J. Watson and D. R. Langslow). Eurasian Sparrowhawks (*Accipiter nisus*) in England have permanent territories, which expand in size in years of prey shortage. The

number of nonbreeding individuals leading a somewhat marginal existence may approach, in females at least, one-half that of the breeders, and some females do not breed until 5 years of age. Herr Weick's excellent unlabeled drawings are listed in the introduction and thus provide an identification quiz.

Both the amateur and professional interested in hawks and owls will find much of interest here.—D. AMADON.

Where Have All the Birds Gone?—J. Terborgh. 1989. Princeton, New Jersey, Princeton University Press. xvi + 207 pp., 31 figures, 14 tables. ISBN 0-691-02428-6. Paper, $14.95; cloth, $45.00—No one familiar with either birds or hot conservation issues needs to be introduced to the notion that migratory bird populations face serious problems. What is surprising is that for all of the attention migratory birds have received, until now no single sourcebook exists that gives a scientifically accurate overview of the problems. "Where Have All the Birds Gone?" appears at a perfect time and will likely become one of the most important books on bird conservation. It should be read by everyone interested in birds.

At the risk of sounding trite, the problems facing migratory birds are global and complex. Often what has passed for analysis of the issues has been narrow in scope and technocratic in style. John Terborgh has an excellent background for highlighting the Wagnerian themes of migratory bird ecology. His research and writings have characteristically pursued the big picture. His papers on structure in Amazonian bird communities provide a framework that avian ecologists will test and modify with detailed data for decades. Similarly, "Where Have All the Birds Gone?" lays out the problems, both realized and potential, that face migratory birds. Hopefully, it also will be a watershed for encouraging research and activism.

The thesis of the book is simple. We are witnessing large, perhaps unprecedented changes in habitat both in North America and the Neotropics. Migratory birds have shown, or very shortly will show, serious population declines. As the migration system is slowly degraded, the least common and perhaps most interesting bird species (e.g. Cerulean Warbler) will give way to a world of the ordinary (e.g. European Starling). Finally, the problems facing migratory birds require a more concerted and less piecemeal effort.

In his attempt to present a political message and a synthesis of scholarly ideas in a popular style, Terborgh has created an unusual book. Readers from the academic community may be a little frustrated at the meandering structure of the argument. For example, we are told in the preface that the book will address problems related to Neotropical land-bird migrants. Along the way, however, we are treated to a chapter on the waterfowl of the Chesapeake Bay and an account of the spectacular shorebird concentrations along the east coast of the United States. More disturbing is that the book seems to build to a synthetic conclusion, but really does not.

At least for the first 12 chapters I recommend relaxing and going with the flow. The book is written as a series of essays with a pleasant blend of personal insight and analysis of research. Anyone enjoying the articles in *Natural History* or *Smithsonian* magazine will find Terborgh's book stimulating as well. I would not let the personal, semipopular style discourage people from using the book as supplemental reading in an undergraduate conservation biology course or as the core reading in a graduate seminar. In fact, in the latter role it would be excellent for the breadth of topics and ideas covered. I would supplement its use, however, with a large dose of reading from articles from the ecological and environmental conservation literature.

The intended audience for this book goes beyond the academic. There is also an effort to reach the great mass of bird enthusiasts. Toward that goal I find that the writing is friendly but much of the graphic illustration unimaginative and ineffective. Several of the maps and line drawings are difficult to read or have shading and numbers not defined in the legends. The centerpiece consists of 19 black-and-white pictures of tropical habitats occasionally populated by Princeton University students. Unfortunately, the printing of these pictures is low contrast, and the entire exercise of habitat photos seems anachronistic. The book looks a bit too much like an academic book.

The book has two interrelated purposes. The primary purpose is to raise the public awareness of both domestic and international environmental crises that affect migratory birds (among other things). The second is to inform and excite the reader, particularly about new discoveries concerning the basic natural history of migratory birds.

Most of the natural history in the book is oriented toward the winter behavior and distribution of migratory birds. I believe this is a well-chosen focus. This is not to say that we know everything about their behavior in North America. This has been an exciting two decades, however, and interesting phenomena associated with overwintering migrants continue to be discovered. Many fascinating insights were summarized previously in the symposium "Migratory Birds in the Neotropics" (A. Keast and E. S. Morton, Eds., 1980) and subsequent review articles. Terborgh, however, presents a very readable overview and does an excellent job of conveying the diversity of behavior of migratory birds, as well as the diversity of habitats that are designated by the rubric "the tropics." His prose is less adept at providing a feel for how little we still know. Many of the details of behavior and biogeography are based on the most anecdotal or sketchy evidence. I hope the next decade will bring the numerous well-designed field studies of demog-

raphy, foraging ecology, and social behavior of winter migrants necessary to fill in the huge gaps in knowledge.

The discussion of the myriad problems facing migratory birds is well balanced between breeding-season and wintering-grounds habitat alteration. On the North American front, the most important lesson that has emerged from recent work on forest fragmentation is that assessing habitat quantity may become less important than habitat quality. Threats to forest migrants have been ignored primarily because the gross amount of forest habitat in eastern North America is large and (until recently) was rebounding from postsettlement clearing. Terborgh argues persuasively that total acreage figures are misleading; much of the forest cover is in small woodlots and plantation monocultures. The book lays out most of the discoveries and issues that surround the pattern and mechanism of declines due to fragmentation. Our knowledge of mechanism is still in its infancy, and perhaps new material on this subject will develop for the next edition.

Terborgh's discussion of tropical deforestation shies away from some of the oversimplifications and false dichotomies that plague the topic. He correctly attempts to identify particular habitats (and the species they support) that are threatened, and particular species most dependent on those habitats. There is a tendency, however, for Terborgh to overemphasize the distinction between "primary" and "secondary" habitats. These terms are often difficult to define in a region that has been heavily settled over the past few millennia. The tendency to focus on this distinction distracts from the primary problem: the conversion of all ages of forest to pasture and farmland. In general Terborgh captures the essence of the problems. However, many of the specifics of his analysis will undoubtedly change with results from quantitative studies of land use and bird distributions (for example, Chestnut-sided Warblers are not restricted to "undisturbed" forest, and only male Hooded Warblers are found primarily in mature evergreen forests).

If all Terborgh did was wax philosophical on the passage of yet another natural wonder, the entire book would be another exercise in romantic lamentation. In this age of global warming and Asian cockroaches, it is not sufficient to raise awareness of problems without presenting some tangible solutions or directions. Terborgh offers a number of ideas for future actions. These fall into the areas of improved monitoring and conservation action.

Terborgh begins the book with a thoughtful review of the state of long-term censusing of land-bird populations. This is a timely discussion. The Mitchell amendment made it a legal mandate of the U.S. Fish and Wildlife Service (USFWS) to monitor the populations of "non-game" birds. With the amount of effort that goes into censusing about 58 species of game birds (including the North American Waterfowl Survey), a much more comprehensive land-bird program could be implemented. Terborgh's suggestions for a series of large long-term plots to complement the Breeding Bird Survey is excellent. It will require leadership and resources to make certain that the methodologies are sound and standardized. His more modest suggestion that the Breeding Bird Survey incorporate vegetation data has been made repeatedly by others. Even the simplest of habitat categorizations would make the survey much more valuable. Both of these recommendations are well within the abilities and resources of the USFWS and other private groups interested in bird populations. As Terborgh points out, it is too bad (but understandable) that an adequate monitoring program does not exist for forest bird populations. If we miss this opportunity to set up adequate monitoring programs for the future, there will be no acceptable excuses.

After the first 12 chapters, it is no secret that Terborgh is using migratory birds to interest bird enthusiasts in global environmental problems. And much of the readership should be ready for action, as the author moves in for the kill. Unfortunately, many of the threads that are partly woven in the first 12 chapters are dropped rather than tied together in the ending.

It is understandably difficult to identify root causes and offer prescriptions for the many environmental problems that impinge on migratory birds both in North and tropical America. Therefore, Terborgh has chosen to focus on a few issues. Most of his summary discussion focuses on the tropical end, with relatively little specific analysis of what can be done to mitigate the effects of suburbanization and cowbird parasitism. Even within this more narrow framework, the threads connecting the first part of the book and the final two chapters are thin. For example, we learn earlier in the book that the Amazon Basin supports relatively few species of migrants and is covered with forest that, because of its sheer size, poor economic prospects, and inaccessibility, has a relatively long life expectancy. It therefore seems odd that the summary discussion focuses on the development of Amazonian forests rather than the dwindling forests of Mesoamerica and the Caribbean.

There seem to be opportunities outside of strict forest protection for preserving habitat for migrants. For example, we learn in Chap. 11 that much of the agricultural development of the Caribbean Basin, where a large share of the Neotropical migrants reside, may have less impact on many migrants than certain large-scale commercial uses (sugar plantations, etc.) because it creates a patchy quilt of field and forest patches. Further, Terborgh supports the long-held belief that certain commercial agricultural habitats, such as shade-coffee plantations, are much better than others. When it comes to the final chapter, however, there is little discussion of creative ways to

improve habitat for migratory birds outside of forest reserves.

Much of the discussion on tropical forest conservation is curiously dated. There is no feel in the discussion for the tremendous amount of energy and some of the new developments in this field. For example, the past policies of the World Bank and USAID are repeatedly castigated, usually in the same breath. USAID, however, is light years ahead of the World Bank in its environmental policies. The Pichis-Palcazu project was originally funded through a World Bank loan to create a new breadbasket for Lima. USAID came in to complete the road and ultimately refocused the project on sustainable resource management. Under this plan, much of the valley is slated for a silvicultural project that was designed using known ecological principles of forest regeneration.

The book accurately reflects the mood of much of the international environmental community by focusing on sustainable development rather than park establishment. Still, the overall view expressed is that the root causes of tropical deforestation are structural flaws in the operations of third world governments and international assistance institutions based on ignorance and mismanagement. The possibility that Terborgh has underestimated the depth of the problem can be illustrated by the apparent contradictions in two of his major recommendations. On one hand he suggests that the United States stop funding (through the World Bank, Interamerican Development Bank, and AID) all road-building projects into unexploited tropical forests. On the other hand, he recommends the widescale development of multiple-use forestry with silvicultural management. How can such a system be established without building roads that will simply be conduits for further colonization? Can this and other similar conundrums be solved by ecologically minded tinkering with development plans? Or are deeper questions concerning the social control of land and natural resources involved? The reader hopefully will be inspired to look elsewhere for a more in-depth discussion of the issues surrounding tropical deforestation.

One way to stop being mired in the global issues surrounding deforestation is to focus on the specific and the positive; big changes often come from the bottom up. Perhaps the greatest omission is a discussion of home-grown environmental movements in third world countries. This includes some straightaway conservation groups, such as ANCON in Panama. It also includes other social and cultural groups and movements, such as the Kuna in Panama, the rubber tappers in Brazil, and the Maya of Quintana Roo, which have all organized around forest conservation and sustained use. In most cases, these groups are fully engaged and require only resources and technical assistance. Clearly, we do not have to invent the wheel for international efforts to conserve habitat for migratory birds (and other threatened organisms). Many of the pieces are in place. What is lacking are resources and coordination. Perhaps we should look to the Western Hemisphere Shorebird Reserve Network as inspiration for the development of international interest and cooperation for the conservation of land birds and habitat.

Terborgh has raised the issue involved in migratory bird conservation masterfully. He also has excited the imagination about the migratory bird phenomenon. He has left it up to the readership to hunt down the details and flesh out a specific plan of action.—RUSSELL GREENBERG.

Bird Flight Performance: A Practical Calculation Manual.—C. J. Pennycuick. 1989. Oxford, England, Oxford University Press. xi + 153 pp., 47 text figures. ISBN 0-19-857721-4. $49.95.—This book instructs the reader how to build machines that report the behavior of flying objects. The machines reside in the memory of a microcomputer, and the instructions for building them are computer programs written in BASIC. The programs appear in an appendix and take up 28 kilobytes on a 5¼ inch floppy disk that comes with the book. The disk can be used in an MS-DOS computer with a BASIC interpreter and printer. Once programmed, the computer reports the behavior of the flying objects in tables of numbers printed on paper. I shall call these objects "ideal birds."

One type of ideal bird flaps, and the other glides. The ideal birds have several characteristics of real birds: for example, body mass, some types of aerodynamic drag, the ability to fly in a horizontal direction at a constant speed when flapping, and the ability to change wingspan and area when gliding. They lack other characteristics: for example, some types of aerodynamic drag, the ability to hover, and the ability to change speed in flight or to fly up or down when flapping.

A person using the programs must specify the body mass and wingspan of the ideal flapping bird plus the wing area of the ideal gliding bird. The user may specify the values of other characteristics, such as the amount of energy in metabolic fuel, the energy spent in circulation and respiration, the profile drag coefficient, the induced drag factor, and the temperature and pressure of the air. The computer displays these characteristics on a menu. If the user chooses not to change their values, the programs use default values.

The computer then prints the tables that show the "flight performance" of the ideal bird. The phrase refers to the motions of the bird relative to the air, and the metabolic energy required to make these motions. Examples of quantities in the table for a flapping bird are airspeed, work rate to flap the wings, metabolic rate, and the airspeed at which metabolic rate is minimum. Examples for a gliding bird are airspeed, wingspan, glide ratio, stall speed, circling ra-

dius, and the optimal speed for traveling cross-country using thermals. It is remarkable that this much information can be generated from only two or three morphological measurements on a bird.

The computer programs obviously answer important questions about avian energetics, assuming that the flight performance of a real bird is similar to that of an ideal bird. They have an additional use, however, when combined with the text. The reader can investigate the aerodynamic relations described in the book by experimenting with the programs. Pennycuick opines that students who spend a rainy afternoon feeding data on birds' wings and bodies into the programs are in for endless surprises. He also suggests using fanciful data: a penguin flying in air or a bird transported to another planet with a different atmosphere and gravitational acceleration.

My description so far is of the "practical calculation manual" referred to in the title, but there is much more to the book than that. The book offers an excellent introduction to the aerodynamics of avian flight. This subject links measurable characteristics of a bird in the hand to the performance of the bird in flight through several interconnected chains of reasoning. It is a classic example of hierarchically organized scientific knowledge. First come observations, verbally expressed, followed by measurement procedures that turn the observation into quantities. Some quantities are related to others, as shown by equations in mathematical notation. Several equations contain common quantities, and the computer programs organize the equations. Given the values of certain quantities, the programs calculate values for all the rest. This sort of organization provides a degree of understanding that I would like to see in many areas of biology.

The book also includes a chapter on the performance of flight muscles. This chapter describes with equations what I shall call "ideal muscles," although it does not include computer programs. Ideal muscle performance includes force, speed of shortening, frequency of shortening, and the energetic cost of maintaining a steady force, as in holding the wings out during gliding. The chapter is an elegant analysis of how various aspects of muscle performance vary with the mass of a bird and influence its flight performance.

Pennycuick presents this material in a way that will appeal both to readers who are mathematically inclined and those who are not. The book is mostly words, with equations and graphs where needed. The equations are short and, with one or two exceptions, use notation found in a high school algebra course. Pennycuick emphasizes dimensional analysis, a traditional tool in aerodynamics, and makes the appropriate point that it is useful in biology as well.

The book is well organized and easy to read. Pennycuick writes in an informal, witty style, interspersed with opinions that carry weight, since he has been a (I wouldn't argue with "the") major contributor of original concepts in this field for more than 20 years.

When it comes to theories, Pennycuick is a lumper, not a splitter. He states his position explicitly: "As a general rule, the best theory is the simplest that predicts the results within acceptable limits of accuracy." This rule fits his knack for describing a seemingly complex phenomenon with a simple equation. For example, he uses just two variables in an equation to describe the relation between wingspan and wing area of a gliding bird. Analyzing this relation in terms of bone and feather positions on an actual bird is a much more complicated process.

Simple theories risk being incomplete, however. For example, both body-drag coefficients and profile-drag coefficients of the wings depend on Reynolds number, which varies with body size, air density, and speed. The program for gliding birds, however, adjusts the body-drag coefficient for body size, but does not change either coefficient with speed or as the user selects different air densities. Whether the results are accurate within acceptable limits cannot be judged by the user, who will expect the body-drag coefficient to change with Reynolds number but will not know from the text that the profile-drag coefficient should change as well.

The program also holds the profile-drag coefficient constant as the lift coefficient changes. Pennycuick warns the reader that this simplification introduces an error that is greatest at low speeds. Other theories of gliding flight cited in the book use a more complicated program that allows the profile-drag coefficient to change with both Reynolds number and the lift coefficient.

What is the relation between the ideal birds described by Pennycuick's programs and real flying birds? Pennycuick specifically leaves this important question for the reader to answer. I should have liked more help from him. He does show that the metabolic rates of pigeons flying in a wind tunnel compare well with the predictions of the programs, but states that data from other metabolic studies of flapping birds are not presented explicitly enough for the comparison to be made. It is not clear why some data are inadequate. With regard to gliding birds, the reader gets no advice on choosing the profile-drag coefficient or information on where the default value in the program comes from. The reader also gets little help in choosing the planform slope, which appears in the relation between wingspan and area. Several published values for these quantities can be found in the original literature, as well as measurements of gliding performance that can be compared with the printed tables.

This book is unique in two ways. First, it collects scattered information from the literature into a comprehensive and detailed analysis of avian flight. Second, it provides computer programs that predict flight

performance. Anyone who does research on avian flight performance will want this book on the shelf, and anyone interested in flight will profit from reading it and using the programs. University or museum libraries with students of avian biology among their clientele should have the book. It may be useful in some community libraries, but it goes far beyond a verbal description of how birds fly and is not meant to be a comprehensive description of various flight adaptations found in different species.—VANCE A. TUCKER.

The Ecology of Bird Communities. Vol. 1, Foundations and Patterns; Vol. 2, Processes and Variations.—John A. Wiens. 1989. Cambridge, England, Cambridge University Press, Cambridge Studies in Ecology. Vol. 1: xiv + 539 pp., 129 text figures, ISBN 0-521-26030-2, $80.00; Vol. 2: xii + 316 pp., 62 text figures, ISBN 0-521-36558-9, $65.00.—The take-home message of John Wiens' massive two-volume set may well be that "doing community ecology is not easy" (Vol. 1: 68). When I first saw the advertisement for these books I immediately ordered them, in spite of the rather extravagant price. I was eager to read what Wiens had to say about the future of avian community ecology now that the great competition debate of the late 1970s to mid-1980s has abated somewhat. How do we incorporate new ideas about habitat fragmentation, the role of predation, and scale effects into our subdiscipline? Is there a new "paradigm" emerging to replace the competition-based MacArthur approach that is based on equilibrium models? What does avian community ecology tell us about the important issues of conservation biology?

Ultimately, I was not disappointed, but the reader should be warned that a very large portion of these volumes is a review of the shortcomings of previous studies of avian communities, especially studies advocating interspecific competition. Wiens' topic is "community ecology as it has been practiced on birds rather than bird communities *per se*" (Vol. 1: xi). Wiens does not explicitly deal with the future of community ecology until Vol. 2, after more than 600 pages of mostly critical reviews of previous studies. Fortunately, Wiens writes well and shows enthusiasm for the future of community ecology in spite of the difficulties he documents so well.

The book is split into two volumes, each with different, but overlapping, emphases. Volume 1 deals with the patterns that have been documented in bird communities. Part I briefly reviews the history of avian community ecology (Chap. 1), the philosophical and logical underpinnings of community ecology in general (Chap. 2), and the methods that have been used (Chap. 3). Wiens argues that most community studies have been subject to both logical and methodological flaws, and reviews Kuhnian "paradigms" and Popperian philosophy of science. Part II presents and criticizes patterns of community assembly (Chap. 4), species numbers and abundances (Chap. 5), niches and guilds (Chap. 6), ecomorphology (Chap. 7), species distributions (Chap. 8), habitat selection (Chap. 9), resource use (Chap. 10), density compensation and niche shifts (Chap. 11), community convergence (Chap. 12), and bioenergetic approaches (Chap. 13). Volume 1 closes with an examination of trends in the recent literature (Chap. 14). Volume 2, on the other hand, deals more with the processes that underlie community patterns and the importance of variation. The first two chapters describe competition as a mechanism, and then in Chaps. 3–5, Wiens explicitly examines other processes that may influence community patterns. These include predation, parasitism, disturbance, history, patchiness, and scale effects. Wiens concludes Vol. 2 with a list of how we can improve future studies.

As the chief proponent of the nonequilibrium view among avian community ecologists, Wiens brings clear biases to these volumes. Wiens follows a consistent pattern in his treatment of each of the patterns in Vol. 1, Chaps. 4–12. First, he describes general patterns in fairly neutral terms. If the patterns have been used to support competition and equilibrium-based interpretations of community structure, he criticizes specific studies on the basis of the logic, methods, statistics, underlying assumptions, lack of consideration of alternative hypotheses, or general applicability. Wiens often constructs an alternative scenario, which is based on different processes, that cannot be ruled out with the available data.

The works of Martin Cody, Jared Diamond, James Brown, and John Terbough come under particularly frequent criticism, often in considerable detail. For example, Terborgh's study of elevational distributions in the Andes is criticized on the basis of methodological limitations (overreliance on mist nets) and the assumption that the different elevational gradients being compared are ecologically similar except in their bird species composition. The latter problem, which Wiens calls a "*ceteris paribus*" (all else being equal) assumption, is a basic element in Wiens' criticisms of all studies that compare species abundances and distributions in different geographical areas. Wiens does not accept "natural experiments" unless the resources, vegetation structure, climate, and other ecological factors such as predation have been measured and shown to be similar in the sites or years being compared.

At times, Wiens seems overeager to leave no established pattern unchallenged. Consider the following quotation: "Simberloff and Boecklen (personal communication), however, criticized Moulton and Pimm's analysis of the Hawaiian Islands introductions [which showed evidence of competition between species with similar bill sizes] on several counts (e.g. inappropriate statistical tests, incomplete documentations of introductions and/or extinctions, incorrect definition of

species pools) . . ." (Vol. 1: 205). Basing such strong criticisms on an unpublished "personal communication" seems a bit risky, regardless of whether or not Simberloff and Boecklen's objections are correct or have been published subsequently. Similar references to unpublished studies that refute competition-based interpretations occur on pages 87, 94, and 368 (Vol. 1) and page 177 (Vol. 2). Passages such as these give the impression that Wiens is determined not to let those who advocate some patterns have the last word.

In contrast, studies that criticize established patterns or that show patterns suggesting processes other than competition are subjected to only mild criticism or are accepted at face value. The work of Scandinavian ecologists, for example, receives extensive, largely uncritical coverage in both volumes, perhaps because they tend to treat interspecific competition as just one of many processes that influence bird communities. Not surprisingly, Wiens also frequently uses his own work in shrub-steppe habitats where he and his co-workers (especially John Rotenberry) have consistently failed to find patterns suggesting community equilibrium. Wiens also effectively uses his own work to illustrate scale effects, patchiness, and, above all, year-to-year and site-to-site variability. Wiens acknowledges Dunning's (1986, Am. Nat. 128: 82) assertion that shrub-steppe bird communities may not be typical of North American bird communities because they contain so few numerically dominant species. He counters this argument by saying that "because there is a wide range of species richness in bird communities . . . , it seems doubtful that one can label any of them as 'typical' of bird communities in general" (Vol 1: 370). Nevertheless, shrub-steppe communities are at the low-diversity end of the continuum of bird communities.

Wiens accepts an important role for interspecific competition in several of his "featured" cases. He exhaustively reviews the work of Peter Grant and his colleagues on Galapagos finches and concludes that species do track resources and compete in certain situations. Wiens questions the applicability of "closed" island situations in which dispersal and migration are limited to mainland situations where events occurring far from the study site may influence populations of migratory species. Similarly, he devotes an entire chapter of Vol. 2 to evidence of competitive interactions among nectarivores, which he finds "convincing" (Vol. 2: 87). Wiens adds, however, that the "distinctive features of nectar as a resource and the high degree of specialization of many nectarivores predispose these systems to be competitive," and "that it would be a mistake to generalize from them to other sorts of bird communities" (Vol. 2: 88). He might have added studies of tropical birds that follow army ant swarms (Willis and Oniki 1978, Ann. Rev. Ecol. Syst. 9: 243) to the list of situations where competitive interactions are particularly obvious.

Wiens hypothesizes that short-lived environmental crunches characterize many bird communities, especially the shrub-steppe communities. If food is superabundant most of the time, community structure and resources may be only "coarsely" related (Vol. 2: 158), and communities are unlikely to be in equilibrium. Wiens gives only the briefest mention of the Hubbard Brook bird community in which periods of food superabundance occur at long, irregular intervals, and "food resources are apparently often limiting and competition may be important" (Vol. 2: 159). Given my own biases (which are closer to the "equilibrium" view than Wiens'), I would have liked to see Holmes' studies at Hubbard Brook given more emphasis. Wiens cites the many Hubbard Brook studies frequently, but usually only in passing. Sherry and Holmes' (1988, Auk 105: 350) experimental documentation of competitive interactions between Least Flycatchers and American Redstarts, for example, is mentioned only parenthetically on page 193 (Vol. 2). Holmes and his colleagues do not argue that competitive interactions dominate community structure. If anything, they argue that community structure is dictated by individualistic responses of species to a wide variety of factors, of which interspecific competition is just one. They have, however, provided the best documentation of the processes underlying long-term population changes, some of which clearly involve interspecific competition. The Hubbard Brook study might also have provided an excellent example of a study that documents both patterns and processes in a reasonably diverse mainland community. These volumes could use more "success" stories to encourage future community ecologists.

Volume 2 has the most to offer current practitioners of avian community ecology. The first two chapters deal with interspecific competition as a process. For the most part, these two chapters repeat points he has already made, albeit in greater detail. Wiens continues to advocate experimental and long-term studies that measure populations, resources, climate, and vegetation structure simultaneously. He also emphasizes the difficulty of predicting whether or not niche overlap will increase or decrease when resources become scarce or abundant. On page 62, Wiens acknowledges that there is a "basic asymmetry between the weight of evidence required to falsify and that required to corroborate an hypothesis." This disparity is one of the most discouraging aspects of community ecology. Perhaps for this reason, community ecology in the 1980s sometimes seemed to be making a dogma of rejecting hypotheses, especially those relating to competition rather than constructing new biological (as opposed to "null") hypotheses (Martin 1986, Curr. Ornithol. 4: 181).

Fortunately, Wiens does discuss alternative processes in Chap. 3. The section on predation reviews the often underemphasized literature that shows that predation on nests and adults can modify or eliminate

the effects of interspecific competition. Wiens shows that predation also plays a major role in communities in small forest patches, where predation rates can be extremely high, and on islands, where predation rates may be very low. The tremendous year-to-year variations in predation rates in some systems suggest that the effects of predation on community structure may be difficult to predict. Martin (1988, Ecology 69: 74) has even hypothesized that predation pressures may be a "major selective force promoting partitioning of nesting heights or microhabitats by species with similar nest types" (Vol. 2: 98). Wiens cautions that we really do not know to what extent predation regulates bird populations. Wiens also acknowledges the possible importance of brood parasitism by cowbirds (especially in fragmented habitats), internal parasites, and such commensal and mutualistic interactions as multispecies nesting assemblages.

Chapter 3 also emphasizes the potential role of disturbance in bird communities. Wiens argues that birds may have a degree of resilience to small-scale disturbances because of their mobility and that site tenacity may cause time lags in responses to major disturbances. There are, however, some species that depend on disturbances in both forest and grassland habitats. Wiens might also have included references to tropical forest bird communities, which are strongly influenced by river-created disturbances (Terborgh 1985: 311–338 *in* Habitat selection in birds [M. L. Cody, Ed.], New York, Academic Press). Wiens concludes Chap. 3 with one of several enormous tables outlining the extent to which each pattern can have several underlying processes.

Part II of Vol. 2 deals with the ways communities vary in time and space. In Chap. 4 Wiens develops a verbal model of population "sources" that produce a surplus and population "sinks" that depend on immigrants from source areas (pp. 172–173). This model is proving to have a great deal of relevance in studies of avian population dynamics in fragmented habitats (Pulliam 1988, Am. Nat. 132: 652). Wiens also discusses possible causes of long-term population declines, some of which appear to be related to events on the wintering grounds, of European and North American birds. Wiens follows Holmes et al. (1986, Ecol. Monogr. 56: 201) in arguing that "there are plenty of reasons to be alarmed about the accelerating rate of destruction of tropical forests, but a loss of birds from forests in eastern North America is not unequivocally one of them" (p. 195). Wiens concludes his section on variation with a plea for long-term studies on both a local and a regional scale.

The first part of Chap. 5 deals with the effects of habitat fragmentation, which Wiens contrasts with gap formation. As usual, Wiens draws extensively on the European and Australian literature to shed light on the situation in North America. He observes that studies relying solely on presence/absence data are flawed because "the presence of a species in a fragment does not necessarily indicate the establishment of a breeding population" (Vol. 2: 206). Wiens argues that "to emphasize the effects of one aspect of fragmentation (typically area) to the exclusion of others is . . . unrealistic" (Vol. 2: 212) because other factors such as patch isolation, edge, forest structure, and floristic diversity also play a role.

Wiens also maintains that the "MacArthur-Wilson theory [of island biogeography] and the design principles derived from it are of quite limited value in planning nature preserves" (Vol. 2: 227). The debate over whether a single large reserve is superior to several small reserves is probably "largely irrelevant" (Vol. 2: 227), at least in part because establishing reserves "requires both a consideration of broad-scale landscape configurations and knowledge of the ecological requirements of the species that are important in particular situations" (Vol. 2: 220). Raptors, for example, clearly need larger preserves than small migratory passerines. I found the section on habitat fragmentation to be the most thought-provoking part of the whole book, perhaps because I believe that the strongest justification for continuing to study community ecology is its importance for conservation biology.

Chapter 5 concludes with a section on the importance of scale, which can be an overwhelmingly important consideration when designing and interpreting community studies. Wiens argues, for example, that populations seem more stable when viewed at a regional scale, but that temporal tracking of food resources occurs more at a local scale. Wiens states that the concepts of "source-sink patch relationships, for example, may provide some insights into the extinction and colonization dynamics of populations at the scales of regions or landscape mosaics, but they are inappropriate at the level of biogeographic ranges (where Brown has mistakenly applied them) or at a very local, within-patch scale" (Vol. 2: 233). Unfortunately, Wiens does not explain why Brown's approach is a mistake. He concludes that the "greatest insights may be obtained if one considers several levels of a hierarchy of scales" (Vol. 2: 240). I particularly share his view that we need to know more about dispersal because it "bears importantly on . . . the dynamics of populations and communities in patchy landscapes, as it influences the probabilities of local extinction in habitat patches or fragments, of their subsequent recolonization, or of their 'rescue' before extinction occurs" (Vol. 2: 246).

Volume 2 closes with a chapter on future directions that serves as both a summary of the take-home messages of earlier chapters and a rallying cry. Wiens echoes a universal concern among community ecologists that the "complexity, variability, and ambiguity of nature have made community ecology more difficult and lessened its allure" (Vol. 2: 251). He fears that many ecologists may "become discouraged in their attempts to understand communities and will

turn their attention to entirely different questions" (Vol. 2: 251) such as behavioral ecology. As a first step, theoreticians need to stop "doing violence to nature by oversimplification," especially in the assumptions underlying models. He advocates "operational theory" (Vol. 2: 253) that generates "predictions that are testable or are useful in management" with explicitly stated assumptions. "Theoreticians can offer a variety of possible explanations for a phenomenon, from which empiricists must determine which are likely to be correct" (Vol. 2: 254). Wiens claims to offer no new paradigm to replace the MacArthurian approach. He argues that "the traditional views have become transformed so that they are scarcely recognizable and the call for a 'pluralism of approaches' (e.g. Schoener 1986) has become almost a cliche" (Vol. 2: 257). Wiens argues that "no unified approach has yet emerged and I doubt that one will" (Vol. 2: 257), and closes with a list of points that need to be considered in new approaches.

After finishing the two volumes, I was left with mixed feelings about his view of the history and future of community ecology. Wiens tackled an enormous topic and did a remarkably thorough job. Each volume contains more than 900 references, and many studies are criticized in great detail. In addition to the topics I have mentioned, Wiens also gives thorough coverage of seabird ecology, ecophysiology, null hypotheses, island biogeography, ecomorphology, interspecific territoriality, and community convergence. I would have emphasized different studies, but I have different biases. Wiens' purpose seems to be to wipe the slate clean of the dogma of the 1960s and 1970s and start anew in more rigorous ways. He is remarkably consistent, if at times overzealous, in his criticisms of the traditional approaches. I strongly recommend Vol. 2 for graduate students interested in studying community ecology and conservation biology as well as those currently involved in research and management. Volume 1 will be more useful to those interested in the history of community ecology, especially in the great competition debate. Both volumes are well written with a minimum of technical jargon and could therefore also be used in an advanced undergraduate class. These volumes should be a high priority for all college and university libraries.

My qualms relate largely to the possibility that many students may be discouraged by the overall tone of these volumes. One could easily conclude that community ecology can be done properly only in long-term, multiscale research projects that measure resources and habitat structure and conduct manipulations that consider each of many alternative processes. In other words, community ecology seems to require lots of money and time, which are not available to many students. Perhaps the only way for students to get started is to join one of the few established long-term studies and do smaller, more reductionist or mechanistic projects for a thesis. For students who want to strike out on their own, avian community ecology may be too difficult or risky.—SCOTT K. ROBINSON.

OTHER ITEMS OF INTEREST

The Birds of Sicily.—Carmelo Iapichino and Bruno Massa. 1989. Tring, England, Br. Ornithol. Union Check-list No. 11. 170 pp., 8 figures, 16 black-and-white plates. ISBN 0-907446-10-8. Cloth. £16.00 (in U.K.), £18.00 (overseas).—This is the latest in the fine series of regional checklists produced by the British Ornithologists Union and covers an island that has received relatively little attention by ornithologists, compared with other Mediterranean islands like Cyprus, Malta, or the Balearics. This annotated checklist of the avifauna, following on the *Atlas Faunae Siciliae* produced by Massa (1985, Aves. Naturalista Sicil. 9 (spec.): 1–242), has now filled a gap in our knowledge.

The main body of the text comprises a systematic list of the 363 species that have occurred on the island through December 1987. A 22-page introduction covers the history of Sicilian ornithology, geography, climate, vegetation, migration, breeding, conservation, and aspects of the avifauna like isolation. At the back of the book are 16 pages of data on banding recoveries and that all-important but often overlooked item, which should be mandatory for every checklist, a gazetteer.

Although the main achievement of this work is ornithological, it is to be hoped that it may also have some impact on the conservation of what remains of Sicily's natural areas. Although the island has had a large human population for many years, habitat destruction has accelerated in the last 30 years, especially on the coast, where so much land has been given over to holiday resorts that few coastal wetlands or other natural areas remain. Hunting pressures remain intense, and efforts to restrict them meet with strenuous local opposition. If this book can help through education to reduce these destructive practices, it will have achieved a dual purpose.—STUART KEITH.

Birds of Colonial Williamsburg: A Historical Portfolio.—A. Feduccia. 1989. Williamsburg, Virginia, Colonial Williamsburg Foundation. 162 pp., 70 color illustrations by H. D. Pratt. ISBN 0-87935-113-6. $29.95.—This is a picture book with a twist: selected comments of historical observers. The Williamsburg area, Virginia's colonial capital, was visited by such luminaries as Mark Gatesby and John Lawson. Activity began in the area in the late 1500s, so there is a richness that comes from the epigraphs with each

species description. Feduccia connects the reader directly with the early observations and follows with further quotes in the text. The presentation is elegant.

Pratt's bird paintings include buildings and other background objects from Williamsburg. The pictures are generally well done. Feduccia's text is light, refers constantly to earlier writers, and is filled with natural-history notes.—A.H.B.

A Guide to the Birds of Panama.—R. S. Ridgely and J. A. Gwynne. 1989. Second ed. Princeton, New Jersey, Princeton University Press. xvi + 534 pp., 48 color plates text drawings. ISBN 0-691-08529-3. $49.50.—This is the second edition of a volume produced almost 15 years ago. It is significant because so much in it has changed. Ridgely and Gwynne have expanded the coverage geographically (Costa Rica, Honduras, and Nicaragua are included) and have added more than 200 species and 16 new color plates. Over the period since the first edition, the information on Panama's birds has increased many fold. This is reflected in the updates of essentially all the species accounts.

The book is organized very much like the others in the "guide" series and meets all the professional standards expected from Princeton University Press. The plates are clear and well executed, and the drawings are exceptional. Most important, it functions as a field guide. The accounts include all the standard information: description, habitat, similar species, status and distribution, habits, and range. Taxonomic disputes are noted briefly. The treatment is thorough, and this is easily the best guide to the area and will set the standard for years to come. It encompasses an up-to-date summary of the occurrence and abundance of the birds of central America (the checklist runs to 1,100 entries). More is yet to be learned, and this book will serve as a reliable and stimulating guide.

The "Panama Guide" arrived just about the time 23,000 U.S. troops landed in Panama City. Subsequently, a new government has been installed and the former "maximum Ruler" sits in a jail cell in Miami. As the news broke it became clear that places of ornithological interest (especially in Darien Province) were also of interest to the military and drug traffickers. Some of the birding sites in the east (p. 486 ff.) are thought to provide passage for pro-Noriega troops from Colombia. While these activities and bird study may not be mutually exclusive, it does give one pause. The prime issue is access and safety. Equally important is the potential destruction of habitat. Panama, which previously has been reasonably accessible, now becomes more risky, at least until the current situation stabilizes.—A.H.B.

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