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BLUE-CROWNED MOTMOT

Momotus momota coeruliceps

The northernmost genus of the motmots, which belong by origin to the North American Element. From a water color made by George Miksch Sutton near Gomez Farias, Tamaulipas, Mexico, April 24, 1941.

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HISTORY OF THE NORTH AMERICAN BIRD FAUNA

BY ERNST MAYR

THE bird student cannot help becoming envious on observing with what accuracy and amazing detail the student of mammals reconstructs the history of that class. Rich finds of fossils have enabled the paleomammalogist to determine the probable region of origin not only of families but also of genera, sometimes even of species, and to trace past modifications in their ranges. The student of birds is far less fortunate. Bird bones, being small, brittle, and often pneumatic, are comparatively scarce in fossil collections. The majority of Tertiary species of birds described from North America belong to zoogeographically unimportant families of water birds. Even fewer fossil birds are known from South America. The absence of certain families or orders from the fossil record of either North or South America proves nothing as far as birds are concerned. Furthermore, the history of birds is more difficult to reconstruct than that of mammals for two other reasons. Birds seem to be a more ancient group than the mammals, many or most of the Recent families having been in existence at the beginning of the Tertiary. And secondly, since birds cross water gaps more easily than mammals, the isolation of a land mass does not necessarily result in the isolation of its bird fauna. It would seem on these premises that it would be almost impossible to trace the history of the components of a local bird fauna, but this is by no means the case. Indirect methods of faunal analysis lead to fairly reliable results, since most families of birds are rich in genera and species. A quantitative analysis is, of course, impossible in small families, and their place of origin (as, for example, that of the limpkins) can be determined only with the help of fossils. In a paper read in 1926 before the International Ornithological Congress at Copenhagen, Lönnberg (1927) demonstrated the productivity of the indirect method by applying it in an investigation of the origin of the present North American bird fauna. Although most of Lönnberg's conclusions are still valid today, so much additional knowledge has accumulated during the past 20 years that a fresh analysis seems timely.

Faunal and Regional Zoogeography

There have been trends and fashions in the science of zoogeography as in any other science. The zoogeography of the nineteenth century—the classical zoogeography of Schmarda (1853), Sclater (1858), and Wallace (1876)—was merely descriptive, essentially regional, and non-dynamic. It was based on the premise that different parts of the world are inhabited by different kinds of animals; and each of these major areas was called a zoogeographical region. This method seemed successful while knowledge of the distribution of animals was still incomplete. As far as the boundaries between these regions were concerned, it was recognized that they "depend upon climatic conditions, which are in a measure determined or modified by features of topography" (Allen, 1893:120). However, as the various parts of the world became better known, it became evident that the various regions proposed were of unequal value. This led to the proposal of new regions or to the fusion of previously separated regions into larger units. It is impossible to give here the history of the never-ending attempts to find a "perfect" zoogeographical classification. For example, it was soon found that the fauna of North America was somewhat intermediate between that of Asia and that of South America, which resulted in conflicting proposals concerning the zoogeographic position, or rank, of North America.

According to one school, North America was only part of a larger region combining North America, Europe, and north Asia. Gill (1875:254) called this region the Arctogaean, while Heilprin (at the suggestion of Newton) called it the Holarctic (Heilprin, 1883:270). This region (with the Palearctic and Nearctic as subregions) is perhaps even today the most frequently adopted zoogeographical classification of the northern hemisphere. Reichenow (1888:673 ff.) took emphatic exception to this classification. He showed that, as far as birds were concerned, North America was much closer to the "Neotropical" than to the Old World, and that North and South America should be combined in a "Western Zone" or "New World Region." This point is well substantiated by his statistics. J. A. Allen (1893:115) showed that the Old World element in the warm temperate parts of North America amounted to only 23 to 37 per cent of the genera, but he did not draw any conclusions from these figures. Subsequent writers almost completely ignored Reichenow's conclusions. Heilprin (1883) went to the opposite extreme. He refused to recognize the Nearctic even as a subregion. He drew a zoogeographic boundary right across North America, putting the northern half into the "Holarctic Region," the southern half in the "Neotropical Region." Wallace himself thought (1876:66) that it was a question "whether the Nearctic Region should be kept separate, or whether it should form part of the Palaearctic or of the Neotropical regions." The literature, particularly of the 1880's and 1890's, was filled with discussions of this question.

Eventually it was realized that the whole method of approach—*Fragestellung*—of this essentially static zoogeography was wrong. Instead of thinking of fixed regions, it is necessary to think of fluid faunas. As early as 1894, Carpenter said: "No zoological region can be mapped with the hard and fast line of a political frontier, and the zoologist must always think more of faunas than of geographical boundaries" (1894:57). The faunal approach made slow but steady progress in Europe and in America. In Europe it has led to such excellent studies as those of Stegmann (1938a) on the birds of the Palearctic and of Stresemann (1939) on the birds of the Celebes. In America it was E. R. Dunn who was the pioneer of this concept. In a spirited attack on the older, static, regional zoogeography, he stated (1922:336):

> There has been a constant search for some sort of scheme whereby ranges of animals might be reduced to a common denominator. . . .
>
> By far the most generally used of these philosophical methods is that of Realms, Regions and Zones. These are all based on the idea that large numbers of species have the same range, and that by picking out some of the conspicuous forms and mapping their ranges one has *ipso facto* a set of regions, to which other ranges may be referred, and with which other ranges should agree.
>
> This is, in some degree, true, but in nearly every case in which the ranges of any two species agree, the agreement is due to the geographic factors and not to the zoologic factors.
>
> It is obvious that the zoogeographical realms are nothing save and except the great land masses with lines drawn to corespond to the physiographic barriers. There is a great philosophical difference between such terms as Holarctic Fauna and Holarctic Region. In the first case we speak of zoological matters in terms of zoology, in the second of geographical matters in terms of mythology.
>
> The Palearctic fauna is an aggregate of species and may invade (in fact *has* invaded) Australia without forfeiting its name.

Following up these thoughts, Dunn (1931:107) analyzed the reptile fauna of North America and found that it could be classified into the following three groups:

> (1) A northern, circumpolar, modern element. This would be truly *Holarctic.*
>
> (2) A more southern, older element, which I shall call *Old Northern*. . . .
>
> (3) A still more southern, still older element, the original fauna of South America, with its analogues in the Australian or Ethiopian regions. This I shall call *South American,* as I wish to avoid the term Neotropical. . . .

I have attempted in the following sections to classify the North American bird fauna in a similar manner. This classification, tentative as it is under the circumstances, is very useful as a test of the various arrangements proposed by regional zoogeographers. It provides at least provisional answers to such questions as: "Is it justifiable to recognize a neotropical fauna and a nearctic fauna?" "Is the nearctic fauna, if it exists, part of a New World or of a holarctic fauna?" "Does North America have a fauna of its own, or is it merely an area of intergradation between the Eurasian and the South American faunas?" "Are the faunas of given geographical areas sufficiently homogeneous to justify the recognition of zoogeographic regions, or does the delimitation of zoogeographic regions convey an erroneous impression?"

Recent Advances

We are in a much better position today to answer these questions than was Lönnberg 20 years ago. First, there has been a general advance in the whole field of zoogeography—a complete change in the concept of the functions of the science—signalized by the important publications of Simpson, Stegmann, and Stresemann. Classical zoogeography asked: What are the zoogeographic regions of the earth, and what animals are found in each region? The modern zoogeographer asks when and how a given fauna reached its present range and where it originally came from; that is, he is interested in faunas rather than in regions. In the light of this new concept of the science, such familiar terms as holarctic, nearctic, and neotropical acquire completely new meaning. Secondly, there have been many very specific recent additions to our knowledge, contributed partly by the paleontologist and partly by the taxonomist, which permit a more accurate analysis than Lönnberg could give.

Recent contributions of the paleontologist. The number of important discoveries of fossil birds has been greatly augmented in recent years, the Californian school and Alexander Wetmore having made the most valuable contributions. Finds of particular zoogeographic significance concern the following groups (Wetmore, 1940): 1. The Aramidae. The limpkin (*Aramus*) is the only living representative of this family; and, as Lönnberg said (1927:24), "if one has to judge only from the present distribution, [it] would certainly be regarded as South American"; but the fact that there are two extinct Tertiary genera (*Badistornis* and *Aramornis*) in North America favors a North American origin for the family. 2. The Old World vultures (Aegypiinae), which are now restricted to the Old World. Nobody would suspect the former occurrence in the New World of this subfamily of the Accipitridae if fossil remains of three extinct genera had not been found in the Miocene (*Palaeoborus*), Pliocene (*Palaeoborus, Neophrontops*), and Pleistocene (*Neogyps, Neophrontops*) of North America. No conclusion can be drawn, however, as to the origin of the family. 3. The New World vultures (Cathartidae), which Lönnberg (1927:22) listed as a South American family. The fact that Wetmore (1940 and 1944) has found several striking genera in the early Tertiary of North America indicates either a North American or pre-Tertiary origin for the family. 4. The Cracidae (curassows and guans), whose present center of distribution is in South America, where the vast majority of the species occur and where most of the genera are endemic. Even though seven Recent species occur in Central America and two genera are endemic there (*Penelopina* and *Oreophasis*), this family would surely be considered a comparatively recent arrival in North America, were it not for the occurrence of two species in the Tertiary of North America (*Ortalis tantala* in the lower Miocene; *O. phengites* in the lower Pliocene) and for the occurrence in the Wyoming Eocene of the related (fossil) family Gallinuloididae.

Recent contributions of the taxonomist. Unsound classifications have caused much confusion in zoogeography, as ably pointed out by Simpson (1940b) in a discussion of the so-called evidence for an antarctic land bridge. Of particular zoogeographic significance are the following recent changes in the classification of birds.

"New World Insect Eaters." From a study of a number of South American genera it would seem that the tanagers (Thraupidae)—including the South American swallow-tanagers (Tersinidae), honeycreepers (Coerebidae), wood warblers (Parulidae—formerly "Compsothlypidae"), vireos (Vireonidae) — including the shrike-vireos (Vireolaniidae) and the pepper-shrikes (Cyclarhidae), blackbirds and troupials (Icteridae), and some of the finches (the subfamily Emberizinae) are closely related, constituting a single superfamily, perhaps the New World equivalent of the Old World family Muscicapidae of recent authors (J. T. Zimmer, verbal information).

Troglodytidae. Sharpe's Hand-list (vol. 4, 1903) and other older taxonomic works included among the wrens a considerable number of south Asiatic genera (*Pnoëpyga, Elachura, Spelaeornis, Sphenocichla,* and sometimes *Tesia*). Lönnberg (1927:9–10) consequently had considerable difficulty in proving an American origin for this family. Recent taxonomic work has clearly established the fact that none of the listed Asiatic genera (superficially wren-like babbling thrushes and Old World warblers) belongs to the Troglodytidae and that *Troglodytes troglodytes* is the only wren that occurs in the Old World. The strictly American character of the wren family is now beyond dispute.

"Chamaeidae." The Wren-tit (*Chamaea*) is not the sole representative of a separate family, but a member of the Paradoxornithinae (parrot bills and suthoras), and possibly not even generically separable from *Moupinia* of southwest China.

Fringillidae. The so-called finches are an assemblage (probably highly artificial) of seed-eating birds with cone-shaped bills. Three major groups can be distinguished within the fringillids that are established in North America: (a) Carduelinae—the cardueline finches; (b) Emberizinae—certain buntings and American sparrows; and (c) Richmondeninae—the cardinals, or South American finches. (See Sushkin, 1924 or 1925.) There is little doubt that the Carduelinae are Old World in origin; the Emberizinae North American, although some species are found in the Old World; the Richmondeninae South American, although some genera have become thoroughly established in

North America. (It should be noted that no final decision can be reached on the last two groups until it has been determined whether certain South American genera belong to the Emberizinae or to the Richmondeninae. A discussion of the characters of the fringillid subdivisions, as well as an incomplete listing of the genera, will be found in Sushkin.)

The Geological History of North America

The North America of today is connected with South America by an isthmus and is separated from Asia only by a narrow oceanic strait. These connections with the two adjoining faunal areas are of the greatest importance, and a study of their history, both geologically and climatically, is a prerequisite to full understanding of the faunal history of North America. There is also a loose connection directly with Europe through the arctic islands of the North Atlantic (Greenland, Iceland), but it is doubtful whether it ever played a greater role for land birds than it does today. The Wheatear (*Oenanthe oenanthe*) is one of the few birds that has come to us via this bridge.

Figure 1. Tertiary water gaps between North and South America. A = Tehuantepec gap (late Miocene to middle Pliocene), B = Nicaraguan gap (late Eocene to middle Miocene), C = Panamanian gap (late Eocene to ? late Oligocene), D = Colombian gap (middle Eocene to late Miocene). (*Free reconstruction from various geological sources.*)

The coast line of North America in former geological periods was not always where it is today. There is, for example, good evidence for a former land connection across Bering Strait, as well as for oceanic gaps across what is now Central America (Figure 1). The extent of these changes in the outlines of land areas is being debated rather vigorously by the geologists and paleogeographers, who tend to interpret the available evidence to fit the concepts of one of the following three schools. The oldest concept is that of a continuous large-scale change in the surface of the earth. Some land masses sink to the bottom of the ocean while others arise by buckling up. Old continents break to pieces as new ones are being formed. Today few authors believe in such violent upheavals. The prevailing theory today is perhaps that of "permanence of continents and oceans." The continents, as well as the major oceanic basins, are relatively stable according to this school of thought. "Sea bottoms" that dry up and lands that become submerged are merely the shallow "amphibious" zones on the continental shelves. The relative position of continents and oceanic basins has not changed materially, according to this theory, since Mesozoic times or even before. The third theory includes elements of the other two, but combines them in a very original way. It agrees with the second theory that continents will always remain continents and ocean bottoms will stay ocean bottoms, but denies that their relative positions are fixed. Rather it holds that the continents are floating on the magma of the earth like ice floes in the arctic sea and that they are continuously shifting their position (Wegener's theory of continental drift). As Simpson (1943a) and others have pointed out, the zoogeographical evidence is on the whole opposed to the theory of continental drift, at least for the Mesozoic and Tertiary periods.

Although some points are still controversial, the following facts seem to be well established:

(1) South America was separated from North America for the greater part of the Tertiary. The isthmus between Colombia and central Mexico was broken into a series of islands by several ocean channels between the Pacific and the Caribbean (Figure 1). A complete land connection between South and North America probably did not exist between the lower Eocene (50 to 70 million years ago) and upper Pliocene (about 2 million years ago).

(2) Asia and North America were repeatedly connected by dry land across Bering Strait during the Tertiary. There is no evidence that this bridge was ever much more extensive than the present shelf, nor is there any evidence for a complete land bridge to Asia across the Aleutians. The Bering Strait bridge may have existed as recently as the last ice age.

A few more words about the nature of these land bridges before we examine what faunal elements have reached or left North America on them. The ocean gaps between North and South America must have been considerable (perhaps even wider than shown in Figure 1), since they almost completely prevented an interchange of the mammals of

North and South America. Ground sloths were apparently the only South American mammals to reach North America during the period of separation; only raccoons (procyonids), with possibly also monkeys and opossums, crossed from North to South America (Simpson, 1940a:158). For birds, these ocean channels were much less of a hindrance, as will be shown below.

Most important for an understanding of the origin of the North American fauna is the fact, emphasized by Lönnberg (1927), Dunn (1931), and Simpson (1943b), that the whole southern half of North America was subtropical or tropical during most of the Tertiary, when it was separated from South America by oceanic gaps. Even in the later Tertiary, a tropical climate prevailed in the southernmost section of North America. This means that (with the exception of those animals that cross water gaps easily) there was not merely one tropical American fauna, the "Neotropical," but two quite distinct ones: one south of the ocean gaps, the other north of them. F. M. Chapman (1923) showed that the motmots (Momotidae), usually referred to as a "typically Neotropical" family, had actually originated in Middle America "where the ancestral forms of the existing genera were possibly developed during the Oligocene when this region consisted of scattered islands which would afford the isolation favorable to differentiation" (p. 58). Lönnberg (1927:12) states correctly that the same would probably be found to be true, if other families were examined as "thoroughly and masterfully" as the Momotidae were by Chapman. In the meantime, Dunn (1931), Simpson (1943b:428), and Hubbs (1944:271) have emphasized the importance of this Middle American (i.e. tropical North American) element among reptiles and fishes.

The mid-Tertiary fauna of North America was probably not only highly peculiar but also rather homogeneous. To visualize its composition, one must look at the South America of today. The temperate zone of South America, which admittedly is rather small because of the continent's triangular shape, does not have a fauna which is basically different from that of the tropical areas. It has its share of endemic species and even genera, but its fauna (although poorer) is composed more or less of the same families as that of the warmer portion. A similar faunal homogeneity was perhaps true for North America during Tertiary times, the faunas of the tropical, of the subtropical, and of the warm-temperate zones being very much alike in composition. The present-day contrast between the fauna of tropical-subtropical Central America and that of temperate North America, has two causes: (1) the climatic deterioration in the late Tertiary and Pleistocene, which eliminated all tropical elements then existing in North America, (2) the invasion (from South to North America) of a new tropical element after the closing of the Central American water gaps. This faunal mixing during the late Pliocene and the Pleistocene led to a complete reshuffling of faunal elements. As far as birds are concerned, we can see only the final result of the opposing processes of range expansion on the one hand and extinction on the other. Simpson (1940a:158) has shown in detail what happened to the mammalian faunas. "Just before the two continents were united, South America had about 29 families of land mammals and North America about 27. With two doubtful exceptions [Didelphidae and Procyonidae], they did not then have any families in common. Shortly after the union of the continents, in the Pleistocene, they had 22 families in common, 7 of South American origin, 14 North American, and 1 doubtful." Considerable extinction and further migration have resulted in the Recent fauna, which consists of 38 families of land mammals, of which 14 are common to both continents, 15 confined to South America, and 9 confined to North America. Four North American families (tapirs, camels, peccaries, and short-faced bears) have become extinct in all or nearly all of their original home country, but are surviving in South America. Obviously it would be a zoogeographical error to classify such families, which were originally North American, with the truly autochthonous* South American families. Yet, nearly all the older zoogeographical treatises classify as "Neotropical" what is really a mixture of North and South American faunal elements. An effort has been made in the following classification to avoid this error. (In this paper zoogeographical North America is considered to extend southward to the edge of the tropical rain-forest.)

Classification of the Faunal Elements of the Americas

Three Tertiary land masses are the primary contributors to the present fauna of the Americas: South America, North America, and Eurasia. It would therefore appear that the simplest classification of faunal elements would be into the same categories: South American, North American, and Eurasian (or "Old World"). These three classes undoubtedly must be recognized, but they are not sufficient to cover all families and genera of birds. First, an additional category must be recognized for groups that cannot be analyzed for one reason or another (to be stated below). Second, there are certain groups ("holarctic," or "panboreal," elements) which have moved back and forth across Bering Strait so freely that they cannot be assigned with certainty to either continent. Others ("pan-American") crossed the Central American water gaps sufficiently freely to obscure their center of origin. Finally, there is an old tropical element ("pantropical") which is of such similar composition in the Old World and New World tropics that it is impossible at the present time to determine the original home.

* In this paper I have used the terms "endemic" and "autochthonous" as follows: Endemic = restricted to a given region; not found elsewhere. Autochthonous = having originated in a given region; now sometimes found beyond the borders of that region.

It is into these categories (Figure 2) that I have tried to classify all the families of birds known to occur in the Americas, whenever possible carrying the analysis even further: to subfamilies, genera, and occasionally to species. This is particularly necessary in the case of families that originated outside of North America, for parts of which North America became a secondary center of evolution (e.g. quails, jays, thrushes), and of those other families that reached North America repeatedly at different geologic periods (e.g. the swallows).

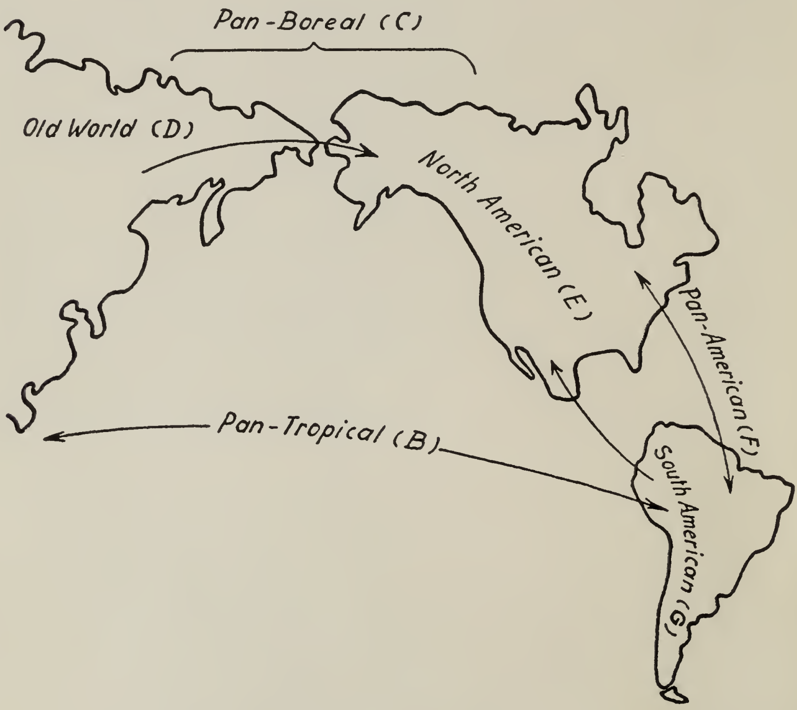

Figure 2. Diagram of the faunal elements of North America. The unanalyzed Element (A), whose geographical origin cannot be determined is, of course, omitted from the map.

Criteria

Unfortunately the bird geographer has, as stated above, relatively few fossils to guide him in his analysis. He is therefore forced to utilize indirect evidence, which is often difficult to evaluate. For example, both the Ruby-throated Hummingbird (*Archilochus colubris*) and the Horned Lark (*Otocoris alpestris*) are widespread North American birds. But the Horned Lark is obviously only a recent arrival in the New World; it is the only member of the Alaudidae, a typical Old World family, to occur in North America and is not even an endemic species; whereas the hummingbird is clearly South American in origin. These cases indicate what evidence can be used. The larks are a family of more than 70 species and are represented in all parts of the Old World. Only certain subspecies of a single species occur in the New World. There can be no shadow of doubt concerning the family's Old World origin. Sometimes the distribution of the nearest relatives can be used as a clue. The gnatcatchers (Polioptilinae), for example, seem to be a branch of the rich Old World group of Insect Eaters (Muscicapidae) and they are without near relatives in the New World; these facts indicate an Old World origin for the subfamily.

These indirect methods are fully reliable only in richly developed families. The value of the evidence is uncertain in regard to families consisting of only one or merely a few species. Mammalogists like to cite in this connection the present distribution of the llamas (relatives of the camels) and the tapirs, two groups formerly widespread in North America but now surviving only in tropical or South America and (the tapir) in southeast Asia. However, both these groups would probably be considered northern elements, even without fossil evidence, because of the distribution of their relatives.

A. The Unanalyzed Element

The separation of land masses, which is responsible for the divergent development of terrestrial faunas, has little bearing on the evolution of sea bird faunas. Roughly, the oceanic birds can be classified into (1) a southern group: penguins (Spheniscidae) and sheath-bills (Chionidae); (2) a tropical group: tropic-birds (Phaëthontidae), boobies and gannets (Sulidae), frigate-birds (Fregatidae); (3) a northern group: skuas and jaegers (Stercorariidae); (4) a world-wide group: albatrosses, shearwaters, fulmars, and petrels (Tubinares), gulls and terns (Laridae). A further analysis and determination of the point of origin of these sea birds is outside the scope of this paper.

Equally obscure is the place of origin of the partly oceanic, partly fresh-water, families of the pelicans (Pelecanidae) and the cormorants (Phalacrocoracidae). Among the true fresh-water groups, a number of families are so evenly distributed in the Old and New World as to make determination of their centers of origin impossible. These include the grebes (Colymbidae), herons and bitterns (Ardeidae), storks and jabirus (Ciconiidae), ibises and spoonbills (Threskiornithidae), flamingos (Phoenicopteridae), the ducks, geese, and swans (Anatidae), and the rails, coots, and gallinules (Rallidae). With most of these, it is not simply the family as a whole that is widespread, but also the subfamilies, many of the genera, and frequently even the individual species. This point is well illustrated by the duck family, of which an up-to-date classification is available (Delacour and Mayr, 1945). Of the nine recognized tribes (or "subfamilies"), only the monotypic torrent duck tribe (Merganettini) is restricted to a single continent. Of the 40 genera, no less than 18 are found on two or more continents. Many species are circumtropical or at least very widespread. For example, the White-faced Whistling Duck (*Dendrocygna viduata*): South America, Africa, Madagascar; the Fulvous Whistling Duck (*Dendrocygna bicolor*): America, Africa, India; the superspecies *Tadorna ferruginea* (which includes the four species formerly separated as *"Casarca"*): Europe, Asia, South Africa, Australia, New Zealand; the black duck–mallard group of river ducks (*Anas platyrhynchos–fulvigula*): spread over most of the world except South America; the superspecies *Aythya nyroca* (white-eyed ducks): Madagascar, Eurasia, east Asia, Australia, and New Zealand; the Muscovy Duck group (*Cairina,* including *"Pteronetta"* and *"Asarcornis"*): America, Africa, India; the mergansers (*Mergus,* including *"Mergellus"* and *"Lophodytes"*): Holarctic region, Brazil, Auckland Islands; the southern ruddy ducks (*Oxyura australis,* including *maccoa, ferruginea,* and *vittata*): South America, Africa, Australia.

Widespread genera and species are typical also of other families of fresh-water birds. A few examples are: the grebes (*Colymbus* [*Podiceps*]), which occur on all continents; the gray heron group (*Ardea cinerea–herodias*), the green heron group (*Butorides virescens –striatus*), the Egret (*Egretta alba*), the night heron group (*Nycticorax nycticorax–caledonicus*), and the bitterns (*Ixobrychus* and *Botaurus*), all of which are world-wide. Many additional examples could be cited from other fresh-water families, particularly from the rails.

Most of the families of shore birds also are so widespread as to make it impossible to trace their origin. This is particularly true for the oyster-catchers (Haematopodidae), the plover family (Charadriidae), avocets and stilts (Recurvirostridae), and thick-knees (Burhinidae). In the case of the snipes, woodcock, and sandpipers (Scolopacidae) an origin in the northern hemisphere appears probable.

Though all these families of fresh-water and shore birds cannot be analyzed at the present time, it seems certain that new evidence may bring us a good deal further. Most of them are composed of medium-sized and large forms, which we find represented in fossil recoveries to an ever-increasing extent. Furthermore, certain subdivisions within these families are sometimes clearly Old World, New World, or even more specifically South American. Finally, a study of their parasites might facilitate the finding of the center of origin, as Szidat (1940) has suggested.

Among the strictly terrestrial birds, there are eight families that are so widespread or so evenly distributed as to make analysis difficult at the present time. These families are the hawks and eagles (Accipitridae), the osprey (Pandionidae), falcons and caracaras (Falconidae), nightjars (Caprimulgidae), swifts (Apodidae), woodpeckers (Picidae), and swallows (Hirundinidae). The evidence indicates that all of these families originated at such an early date (Eocene or Cretaceous) that subsequent shifts in distribution have obliterated most of the clues.

Indirect clues, however, permit a guess for two of these families. The Caprimulgidae may well be of New World origin, since this is the home not only of the entire subfamily nighthawks (Chordeilinae), but also of 10 of the 15 genera of goatsuckers (Caprimulginae). However, a comparison of the numbers of genera in the two regions does not give an entirely accurate picture, since the American birds are more finely split by the taxonomists. Students of New World Caprimulgidae employ 14 genera for 29 species, while Old World ornithologists recognize only 6 genera for 37 species. The woodpeckers (Picidae) are represented about equally well in the Americas and the Oriental regions. They are rather poorly developed in Eurasia and Africa and are absent from the Australian region and from Madagascar. This pattern of distribution suggests a New World (but very early) origin for the family, although the fact that their nearest relatives, the wrynecks (Jyngidae), are exclusively Old World would seem to indicate the opposite.

The swallows are also a very ancient family; it is particularly rich in species in South America and Africa but also extends to Madagascar and Australia. The place of origin of the family as a whole is uncertain, but it is fairly easy to determine where each of the (approximately) seven major subdivisions (Mayr and Bond, 1943) of the family first developed. The specialized mud-nest builders, *Hirundo* and *"Petrochelidon,"* as well as *Riparia,* are of Old World origin, being recent arrivals in America from the Palearctic. It is uncertain whether the family originated in South America, and retained one primitive branch in the Americas (*Progne–Atticora–Stelgidopteryx*), sending another branch to the Old World (*Psalidoprocne,* etc.) that gave rise to the specialized mud-nest builders and other Recent Old World forms, or whether the "old-American" swallows are descendants of early invaders from Asia. Parallel cases in other animal groups favor the second alternative.

B. The Pantropical Element

While representatives of the hawks, owls, and swifts are found in several climatic zones, there are certain other families which are also widespread but only within the tropical belt. For five families of freshwater birds (in some cases, partly marine), the area of origin is difficult to fix because each of them is found both in the Old World and New World tropics, though represented only by a single, or merely a few, species. These families are the snake-birds (Anhingidae), sun-grebes (Heliornithidae), jacanas (Jacanidae), painted snipes (Rostratulidae), and the skimmers (Rynchopidae). All of them now have widely disrupted ranges, as can be easily seen from the map of the sun-grebes (Figure 3). It is also remarkable that the Recent Old World and New World representatives are often the members of a single species or superspecies (*Anhinga, Rostratula benghalensis, Rynchops*). This would indicate either extremely slow evolution or an enormous capacity for transoceanic dispersal.

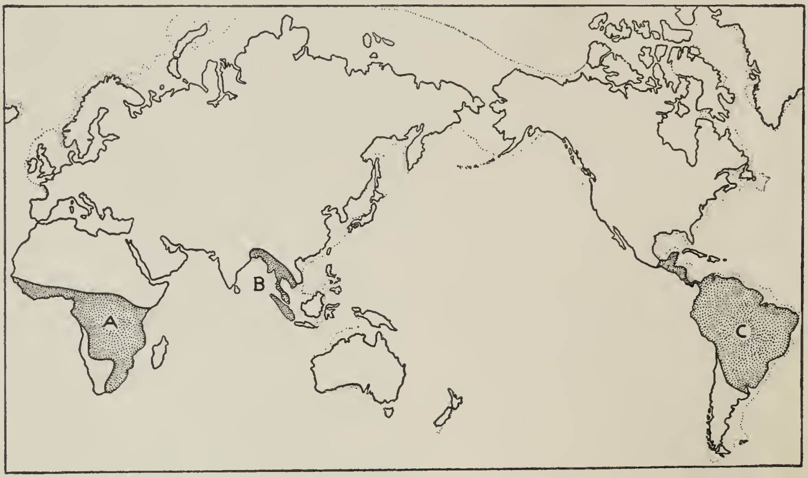

Figure 3. Present distribution of the sun-grebes (Heliornithidae), a typical family of the pantropical group. A = *Podica,* B = *Heliopais,* C = *Heliornis.*

Among the land birds, three families are pantropical. The barbets (Capitonidae) and the trogons (Trogonidae) have a notably similar distributional pattern. The ranges of both families are restricted to the humid tropics, and are bounded in the east by Wallace's Line. Fossil trogons have been found in the Eocene of France, and this fact, together with the scarcity of trogons in South America, has led most authors to assume an Old World origin for the family. On the other hand, trogons are much more diversified in Central America than in the Old World tropics; in fact, all the African and Indian species could be included in a single genus. Tropical North America or the Oriental region is the most likely place of origin. The barbets, with a similar distributional picture, are so much more richly developed in the Old World tropics than in the New that an Old World origin is probable (cf. Ripley, 1945:543–544).

The distribution of the parrots (Psittacidae) is considerably more extensive than that of the barbets and trogons. The parrots, with about

315 species, are one of the richest of all bird families, but about an equal number are found in the Old and the New World. However, most of the more aberrant types, such as the lories (Loriinae), cockatoos (Cacatuinae), and pigmy parrots (Micropsittinae), are found in the Old World, more specifically in the Australian region. It is, therefore, probable that the Psittacidae originated in the Old World, but the great number of endemic genera and species in America indicates a very early arrival in the New World. This might well have taken place before the Eocene separation of South America from North America.

The present ranges of these circumtropical families are widely disrupted, and they have therefore been used as "evidence" of former transatlantic or transpacific land connections by the advocates of such land bridges. We shall investigate in a later section how well founded their argument is.

C. The Panboreal Element

The loons (Gaviidae) among the fresh-water birds, the phalaropes (Phalaropodidae) among the shore birds, and the auk family (Alcidae) among the sea birds are typical of a large class of circumboreal birds. All three families are distributed in the arctic or in the north temperate zone and are about equally well represented in the Old and the New World. The auk family and the loons are known from the Tertiary of both North America and Europe. The temperate zones of Eurasia and America were in such direct contact for a good part of the Tertiary (by means of the Bering bridge) that it will be very hard to determine which of the two land masses was the giver and which the taker of the members of this temperate zone group. Among genera and species, this circumboreal element is much stronger than among families. Well over 80 per cent of the species of the circumboreal tundra zone belong to it, and it is impossible to determine their ultimate source. Stegmann (1938a) believes that Asia, more particularly Siberia, has probably made the greatest contribution to the group because it is the largest land mass in the temperate zone.

D. The Old World Element

It is generally admitted that the connection between Asia and North America across Bering Strait is very ancient (pre-Tertiary). As far as birds are concerned, a more or less active faunal exchange probably took place right through the Tertiary, even during periods when the two land masses were separated by water. This long-standing accessibility of North America to Old World immigrants is reflected in the taxonomic composition of the Old World element in America. According to the date of their immigration, these birds have either (1) not changed at all, e.g., the Alaska Yellow Wagtail (*Motacilla flava alascensis*), the Red-spotted Bluethroat (*Luscinia* ["*Cyanosylvia*"] *suecica* *robusta*), and the Wheatear (*Oenanthe oe. oenanthe*); (2) they have become subspecifically distinct, e.g., Kennicott's Willow Warbler (*Phylloscopus* [*"Acanthopneuste"*] *borealis kennicotti*), the Northern Shrike (*Lanius excubitor borealis*), Brown Creeper (*Certhia familiaris americana*); or (3), if they arrived very early, they have evolved into separate species, genera, or even subfamilies—that is, America has become for them a secondary center of evolution.

The third case is true of the Old World pheasant family (Phasianidae), which has produced the American quails (subfamily Odontophorinae). And it is probably true of the cuckoos (Cuculidae). In this family, Peters (Check-list, vol. 4, 1940) recognizes six subfamilies. Three of these, the Cuculinae, the Couinae (Madagascar), and the Centropodinae, are restricted to the Old World; the Crotophaginae are American; the Neomorphinae have five genera in the New World, one in the Old; and the Phaenicophaeinae have nine in the Old World, three in the New. The evidence points toward an Old World origin of the family, and to tropical North America as a secondary center of evolution for three subfamilies.

It is highly probable that the typical owls (Strigidae) originally came from the Old World, since the closely related family Tytonidae is clearly of Old World origin (only one of its species occurring in the New World) and since in the Old World there are twice as many endemic genera of Strigidae as in the New World. However, this must have been a very early invasion, since there are now six endemic genera in the New World, and since four fossil species of the extinct family Protostrigidae are known from the Eocene of North America (Wetmore, 1940:66–67).

The gnatcatchers (subfamily Polioptilinae, comprising the three genera *Polioptila, Microbates,* and *Ramphocaenus*) offer a puzzling problem both to the taxonomist and the zoogeographer. They are usually treated as a subfamily of the Old World warblers ("Sylviidae"), but there seems little beyond the fine bill to support such a classification. They are surely one of the branches of the Old World Insect Eaters (Muscicapidae), but what their nearest relatives are is still obscure. Although more species of Polioptilinae are found in South than in Central America, it seems probable that tropical North America was the secondary evolutionary center of this group after its arrival from the Old World. Lönnberg (1927:17) expressed a similar opinion.

The pigeons (Columbidae) are world-wide in distribution—which indicates their great age. However, the rich development of the family in the Australian region, where the most aberrant members of the family occur (e.g., *Caloenas, Goüra, Otidiphaps,* and *Didunculus*), and the fact that most American species belong to just a few phyletic lines, prove an Old World origin. It seems probable that some species reached

South America as early as the middle Tertiary and established a second evolutionary center.

Both the crow family (Corvidae) and the thrushes ("Turdidae") are examples of Old World groups which have established minor secondary evolutionary centers in North America, particularly in the tropical part. For the Corvidae, Amadon (1944:16–20) has presented detailed evidence. The blue jay group (*Cyanocitta*) developed in America, but since there is not a single endemic genus in South America, it is obvious that the jays reached there only after the closing of the Central American water gaps in the late Tertiary. The genera *Corvus, Nucifraga,* and *Perisoreus* represent separate later invasions of the Corvidae into North America. In view of the early arrival of the jay group, it seems conceivable that some of the palearctic genera (*Perisoreus, Nucifraga, ? Garrulus*) evolved in America and crossed back to Asia by Bering Strait, but it would be impossible to prove this.

The thrush subfamily Turdinae (see Mayr, 1941:106) presents a very similar distributional pattern and probably had a similar history. Thrushes are rich in species in South America (where there are no less than 20 full species of *Turdus*), but all the genera (even the solitaires, *Myadestes*, and the nightingale-thrushes, *Catharus*) belong to a single natural group; and even with the two (not very pronounced) West Indian genera (*Mimocichla* and *Cichlherminia*), there are only a total of 12 genera in the New World—excluding the recent immigrants, *Oenanthe* (Wheatear) and *Luscinia* (the Bluethroat, *"Cyanosylvia"*). This compares with several dozen widely divergent genera of thrushes in the Old World, such as the Old World nightingales, redstarts, robins, and chats. There are about 244 Old World and 60 New World species. Since also all of the closer relatives of the Turdinae—babbling thrushes (Timaliinae) and Old World flycatchers (Muscicapinae)—are Old World in origin, there can be no question of the Old World origin of the subfamily. The interesting aspect of the American thrushes is, however, that they demonstrate very graphically the effect of the continuous availability of the Bering bridge. There was an early immigration of a *Turdus*-like stock which produced some of the endemic South and Central American genera; there was the later arrival of another group which gave rise to the solitaire, nightingale-thrush, and hermit-thrush groups (*Myadestes, Catharus, Hylocichla*); then the immigration that resulted in the bluebird genus *Sialia;* then additional members of the genus *Turdus,* which changed specifically but not generically; and finally the most recent immigrants, the Bluethroat (Alaska) and the Wheatear (Alaska and Labrador), in which not even subspecific differences have developed.

The cranes (Gruidae) are known from North America as far back as the middle Pliocene—perhaps even earlier (see Wetmore, 1940). However, they would seem to be an unquestionably Old World family on the basis of their present distribution. There are 13 species (4 genera) in the Old World as compared with 2 species (one genus) in the New World.

The kingfishers (Alcedinidae) are a rich Old World family of which only one branch (Cerylinae) has reached the New World. This colonization cannot have been very recent, since a few species (the neotropical group *Chloroceryle*) are sufficiently distinct from their nearest Old World relatives to be considered by most authors a separate genus.

The cardueline subfamily of the Fringillidae is an Old World group, but one of the lines seems to have arrived in America rather early, since it has produced a number of endemic South American species (*"Spinus"*) and an endemic West Indian genus, *Loximitris* (Hispaniolan Siskin), which is closely related to *"Spinus." Hesperiphona* (Abeillé's and Evening Grosbeaks) is the only endemic North American genus, but it is closely related to the Himalayan *Mycerobas*—if at all separable from it. The purple and house finches (*Carpodacus*), pine grosbeaks (*Pinicola*), crossbills (*Loxia*), and rosy finches (*Leucosticte*) are even more recent arrivals from the Old World.

The Paridae (titmice) are a mainly Eurasian family, which has repeatedly invaded North America, where it has even developed two endemic genera, verdins (*Auriparus*) and bush-tits (*Psaltriparus*). But the latter genus seems closely related to the Asiatic genera *Aegithaliscus* and *Psaltria,* while the other American titmice are still more closely related to Asiatic species; some are even conspecific. They must have crossed Bering Strait during or after the late Pleistocene.

As stated above, the genus *Chamaea* (wren-tit) of the west coast of North America is not the sole representative of a separate family, but a member of the Paradoxornithinae (parrot-bills and suthoras) and probably congeneric with *Moupinia* of China. All the other genera of the Paradoxornithinae are palearctic, as are those groups of babbling thrushes (Timaliinae) which are the closest relatives of this subfamily.*

The wagtails and pipits (Motacillidae) are a definitely Old World family, about equally well represented in Africa and Asia. The family is a rather recent arrival in America but has developed six endemic species in North and South America.

Six additional Old World families (or subfamilies) have colonized the Americas so recently, and the New World representatives are still so similar to the Old World forms (congeneric or even conspecific), that North America cannot be considered, for them, a secondary evolutionary center. These are: barn owls (Tytonidae), larks (Alaudidae), nuthatches (Sittidae), creepers (Certhiidae), Old World warblers and

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* As J. T. Zimmer has pointed out to me, it may be necessary to call the subfamily "Chamaeinae," a name first used by Baird in 1863. The name Paradoxornithidae seems to have been used first by Oates about 20 years later. However, I have not made a thorough investigation of this nomenclatural complication. Furthermore, it may not be possible to separate the group from the Timaliinae.

kinglets (Sylviinae), and shrikes (Laniidae). The Old World origin of most of these groups has been discussed by Lönnberg (1927) and earlier authors. Only two of them (the larks and barn owls) have reached South America, and that so recently that the South American representatives are no more than subspecifically distinct.

E. The North American Element

The fauna that developed in North America during the Tertiary, while this continent was separated from South America and connected with Asia only by the Bering Strait bridge, is of great zoogeographical importance. It was much neglected in the past, when some of its components were labelled "Holarctic," others "Neotropical." The greater part of the Tertiary North American continent had a subtropical or tropical climate, as mentioned above, and it is therefore not surprising that tropical families and genera are well represented in this North American element.

The reasons have already been stated why the New World vultures (Cathartidae) and the limpkins (Aramidae) have to be considered North American in origin. Lönnberg (1927:7–12) considered that the thrashers and mockingbirds (Mimidae), vireos (Vireonidae), wood warblers (Parulidae), the waxwings (Bombycillidae) with their relatives the silky flycatchers (Ptilogonatidae), the wrens (Troglodytidae), and motmots (Momotidae) are also North American in origin. The monotypic family palm-chats (Dulidae) also belongs to this group. In all these cases there are so many more endemic genera in North than in South America that no fault can be found with Lönnberg's conclusions. Among the Mimidae, for example, only two genera have reached South America, one of which, the mocking-thrush (*Donacobius*), is endemic. Five genera (three endemic) occur in Central America, five genera (four endemic) on the islands of the Caribbean, and four genera (two endemic) in North America. The tropical origin of the family is indicated by the fact that none of the United States species has entered the Canadian zone.

The vireos, shrike-vireos, and pepper-shrikes have six genera (two endemic—*Neochloe* and *Vireolanius*) in Mexico and Central America, as compared with four genera (none endemic) in South America. The single genus occurring in North America is rich in species (11), of which 2 (*solitarius* and *philadelphicus*) are at home in the Canadian zone. There are 7 endemic species in the Caribbean. Even though no less than 20 species are found in South America, the combined weight of the other facts favors a North American origin for the family.

The wood warblers (Parulidae) present a very similar picture. There are 16 genera in North America (many endemic) and only 6 in South America (none endemic). However, the genera *Myioborus* and

Basileuterus have respectively 6 and 17 endemic South American species. In the genus *Dendroica* alone there are about 20 endemic North American species, a good many of which are restricted to the Canadian zone coniferous forest. All the facts combined indicate a North American origin for the family.

A North American origin may also be postulated for the turkeys (Meleagrididae), grouse (Tetraonidae), dippers (Cinclidae), and the subfamily Emberizinae.

The evidence is unequivocal as far as the turkeys are concerned. The two Recent genera and the only known extinct one (*Parapavo*) have been found only in North America.

The grouse family presents a more difficult case. It has a wide distribution in the northern hemisphere, from Spain to Kamchatka, and from Alaska to Newfoundland and southward almost to Mexico. Absent from the subtropical and tropical belts of the Old and New World, the grouse show the typical distributional picture of a holarctic family. As both Lönnberg (1927:12) and Stegmann (1938a) have pointed out, there is much that favors an American origin for the family. Only three genera are endemic to the Old World (*Tetrao, Lyrurus,* and *Tetrastes*), all three being more or less Siberian taiga (moist coniferous forest) elements which have apparently radiated only quite recently into the western palearctic (Stegmann, 1932:396–397). The Old World has no equivalent of the American grassland genera *Tympanuchus, Pedioecetes,* and *Centrocercus*. Extinct genera of grouse have been reported from the Miocene and Eocene of North America.

The dippers (Cinclidae) are a family with only a single genus and too few species for a reliable analysis. There are three closely related species in the New World and two in the Old; one of the latter (*Cinclus pallasii*) is restricted to the eastern Palearctic. Relationship to the wrens (Troglodytidae), which is assumed by most authors, would indicate a North American origin.

The subfamily Emberizinae is apparently of North American origin, though (as mentioned above) no final decision can be reached without first determining which of the South American genera actually belong to the Emberizinae. Perhaps there was a continuous faunal exchange with South America throughout the Tertiary. One single branch of the Emberizinae, consisting of closely related forms, has reached the Old World. Even though more than 30 species are now found there, they all belong either to the genus *Emberiza* or to *Fringillaria, Miliaria,* and *Melophus,* which hardly deserve to be called more than subgenera. It can therefore be assumed that the invasion of the Old World by the Emberizinae must have taken place rather late in the Tertiary.

As stated in the preceding section, on the Old World element, North America became a secondary center of evolution for several Old World groups: American quails (Odontophorinae), the blue jay (*Cyanocitta*) group of the family Corvidae, the *Myadestes–Catharus–Hylocichla* group of thrushes, and some others. In particular, the Odontophorinae, a whole subfamily restricted to North America, and known there as far back as the Miocene, well deserve to be included among the typically North American fauna. Part of the pan-American element (certain Icteridae), discussed below, has also now become sufficiently well established in North America to be considered part of the North American element.

F. The Pan-American Element

The water gaps that existed between North and South America from the lower Eocene to the late Pliocene produced an almost complete separation of the mammalian faunas of the two continents (Simpson, 1940a:157–163). The intervening chain of islands (Figure 1) permitted colonization by only a few groups especially adapted to "island hopping." On the whole, the geographical picture of this line of islands was apparently very similar to that of the Malay Archipelago, where colonization by mammals was almost completely prevented, even though the islands were more numerous and the water gaps comparatively small. For birds, these inter-island straits of the Malay Archipelago were much less of a barrier, as I have recently pointed out (Mayr, 1944a:171–194). The same is true for the inter-American island belt. It explains many of the difficulties of the bird geographer. There are quite a number of American families that are so rich, both in North and South America, in endemic genera and species that it is impossible to determine their primary country of origin without fossil evidence. It is rather obvious that these are the families able to utilize islands as stepping stones from one continent to the other. During the greater part of the Tertiary, the whole southern part of North America was apparently more humid, and certainly warmer, than it is today. It would have been more difficult for many of the species that developed in this climatic zone to enter the more temperate parts of North America than to cross into tropical South America. In the reverse direction, the same was true for species of tropical South America. This is one of the reasons that the contrast between the North and the South American Tertiary faunas is much less pronounced in birds than in mammals, and much less than one would expect on the basis of the length of separation of the two continents. On the other hand, the factor of age should not be left out of consideration. In the Eocene, when North and South America were connected, there were more bird families than mammal families with representatives on both continents.

Families almost certainly South American in origin, known to be successful transoceanic colonizers (West Indian fauna!), and rich in elements endemic to Central and North America, are the hummingbirds

(Trochilidae), the tyrant flycatchers (Tyrannidae), the tanagers (Thraupidae), and the blackbird–troupial family (Icteridae).

It is significant that not one of these families has crossed Bering Strait into the Old World although all four are rich in species and all four have at least a few species in temperate North America, some extending even as far as Alaska.

Among South American families of the suborder Mesomyodi, only the aggressive tyrant flycatchers (Tyrannidae) have penetrated far into North America. But many of these have reached the Canadian zone, and they were undoubtedly the first birds of this group to become established north of South America. There is every reason to believe that the invasion took place prior to the connection of the two continents in the late Pliocene. Nevertheless, their arrival must be considered comparatively recent. Of the 117 currently recognized genera of this family, only 10 are not indigenous to South America, and none of these is particularly distinctive; in every case the relationship to South American genera is more or less obvious, viz *Tolmarchus* (related to *Tyrannus*); *Hylonax, Deltarhynchus, Eribates,* and *Nesotriccus* (related to *Myiarchus*); *Blacicus* and *Nuttallornis* (related to *Contopus*); *Aechmolophus, Xenotriccus,* and *Aphanotriccus* (related to *Praedo*)—according to James Bond (*in litt.*).

The tanagers are more poorly represented in North America. There are a few genera in Central America; there are 5 endemic genera and 11 endemic species in the West Indies, but only one genus (*Piranga*) reaches the United States (with 4 species).

The blackbirds and troupials include 35 genera, of which no less than 16 are endemic to South America. There are two endemic genera in Central America, two in the West Indies (11 endemic species) and three in North America. (See also Lönnberg, 1927:10.) The family is well established in the temperate zone of North America with such hardy birds as the Bronzed Grackle (*Quiscalus quiscula*), Cowbird, (*Molothrus ater*), Meadowlark (*Sturnella*), Rusty Blackbird (*Euphagus carolinus*), and Red-wing (*Agelaius*). These species are so thoroughly at home in North America that a very early immigration is indicated.

Elements of the pan-American fauna that were perhaps originally North American are the curassow(Cracidae) and the cuckoo (Cuculidae) families. Both families are now richer in South, than in North, America, but both have relatives in the Old World (the mound-builders, family Megapodiidae, are at least distant relatives of the Cracidae). In the Cracidae, 5 out of 11 genera, 38 out of 46 species, are restricted to South America. On the other hand, the chachalaca *Ortalis* is known from the Pliocene and lower Miocene (Wetmore, 1940:42) of North America. The case of the Cuculidae has been discussed above in the section on the Old World element.

All of the families listed in this section have endemic genera or species in both North and South America. These are sufficiently peculiar to make it exceedingly unlikely that they could have developed in the short time since the re-establishment of the Panamanian land connections at the end of the Tertiary. They must have had as ancestors birds with the faculty of transoceanic colonization. On the other hand, there is not sufficient difference between the North American and the South American groups of genera to force us to assume an Eocene split of any of these families (by the separation of the two continents) into a northern and a southern section.

For the sake of completeness it will be useful to mention here those groups of Old World birds, discussed above, that arrived in North America at an early date and then crossed to South America with the help of the insular stepping stones. This includes, apparently, the pigeons (Columbidae), gnatcatchers (Polioptilinae), some thrushes (Turdinae), and some cardueline finches.

G. The South American Element

Certain families are very richly developed in all parts of South America, relatively scarce in Central America, even in the tropical parts, and extremely rare, or completely lacking, north of the tropics; and with these families, there can be no doubt about their South American origin. This is true for the tinamous (Tinamidae), potoos (Nyctibiidae), jacamars (Galbulidae), puff-birds (Bucconidae), toucans (Ramphastidae), oven-birds (Furnariidae), wood-hewers (Dendrocolaptidae), antbirds (Formicariidae) and two small related families, the ant-pipits (Conopophagidae) and tapaculos (Rhinocryptidae), the cotingas (Cotingidae), manakins (Pipridae), honey-creepers (Coerebidae), and the cardinal group (Richmondeninae). A South American origin is very probable also for the following families (though each contains less than five species, and some caution is therefore advised): rheas (Rheidae), screamers (Anhimidae), hoatzins (Opisthocomidae), trumpeters (Psophiidae), sun-bitterns (Eurypygidae), cariamas (Cariamidae), seed-snipe (Thinocoridae), oil-birds (Steatornithidae), sharp-bills (Oxyruncidae), and plant-cutters (Phytotomidae).

The cotingas (Cotingidae) may be cited to illustrate the distribution pattern characteristic of a typical South American family. Of the 31 genera of the family, only 12 reach Central America, and only one the United States; 19 genera are restricted to South America, not a single one to Central or North America; only one species (*Platypsaris niger*) has reached the West Indies (Jamaica). The oven-birds, wood-hewers, and antbirds are even more closely restricted to South America, and none of them has reached the West Indies.

The cardinals (Richmondeninae) apparently belong to the South American element, but, as already stated, nothing final can be said about this subfamily without first determining which genera belong to it.

As stated above, some of the families listed with the pan-American element are also of primary South American origin. This is reasonably certain for the hummingbirds (Trochilidae), tyrant flycatchers (Tyrannidae), tanagers (Thraupidae), and the blackbird–troupial family (Icteridae).

It is most remarkable that none of the families that are clearly South American in origin has developed any species that have crossed into the Old World. Old World families, on the other hand, have sent many branches into South America. Perhaps this means that a temperate zone family can more easily become adapted to the tropics than a tropical family to a temperate climate.

The above analysis is summarized in Table 1.

TABLE 1

Analysis by Origin of American Bird Fauna

A. Unanalyzed Element

Oceanic birds
- Spheniscidae, *penguins*
- Procellariiformes, *tubinares*
- Chionidae, *sheath-bills*
- Sulidae, *boobies, gannets*
- Fregatidae, *frigate-birds*
- Phaëthontidae, *tropic-birds*
- Stercorariidae, *skuas, jaegers*
- Laridae, *gulls, terns*

Shore birds
- Haematopodidae, *oyster-catchers*
- Charadriidae, *plovers*
- Scolopacidae, *snipes, woodcock, sandpipers*
- Recurvirostridae, *avocets, stilts*
- Burhinidae, *thick-knees*

Fresh-water birds (partly marine)
- Colymbidae, *grebes*
- Pelecanidae, *pelicans*
- Phalacrocoracidae, *cormorants*
- Ardeidae, *herons*
- Ciconiidae, *storks*
- Threskiornithidae, *ibises*
- Phoenicopteridae, *flamingos*
- Anatidae, *ducks, geese, swans*
- Rallidae, *rails*

Land birds
- Accipitridae, *hawks, eagles*
- Pandionidae, *osprey*
- Falconidae, *falcons, caracaras*
- N Caprimulgidae, *nightjars*
- Apodidae, *swifts*
- N Picidae, *woodpeckers*
- O Hirundinidae, *swallows*

B. Pantropical Element

Fresh-water birds (partly marine)
- Anhingidae, *snake-birds*
- Heliornithidae, *sun-grebes*
- Jacanidae, *jacanas*
- Rostratulidae, *painted snipes*
- Rynchopidae, *skimmers*

Land birds
- O Psittacidae, *parrots*
- N Trogonidae, *trogons*
- O Capitonidae, *barbets*

C. Panboreal Element

- Gaviidae, *loons*
- Alcidae, *auks, murres, puffins*
- Phalaropodidae, *phalaropes* (and many other groups of shore birds)

D. Old World Element

Early immigrants
- Gruidae, *cranes*
- Columbidae, *pigeons*
- Cuculidae, *cuckoos*
- Strigidae, *typical owls*
- Corvidae, *crows, jays* (part)
  - Turdinae, *thrushes* (part)

Fairly early
- Alcedinidae, *kingfishers*
- Corvidae, *crows, jays* (part)
- Paridae, *titmice*
- Sittidae, *nuthatches*
- "Chamaeidae," *wren-tit*
- Motacillidae, *wagtails, pipits*
  - Carduelinae, *cardueline finches* (part)

N = Probably originated in the New World. O = Probably originated in the Old World.

RECENT

Tytonidae, *barn owls*
Alaudidae, *larks*
Hirundinidae, *swallows* (part)
Certhiidae, *creepers*
Turdinae, *thrushes* (part)
Sylviinae, *Old World warblers, kinglets*
Laniidae, *shrikes*
Carduelinae, *cardueline finches* (part)

[Also of Old World origin are the Phasianidae, represented in the Americas by the quail (subfamily Odontophorinae); and the Muscicapidae, to which the American subfamily gnatcatchers (Polioptilinae) is undoubtedly related.]

E. NORTH AMERICAN ELEMENT

Cathartidae, *New World vultures*
Tetraonidae, *grouse*
Odontophorinae, *American quail*
Meleagrididae, *turkeys*
Aramidae, *limpkins*
Todidae, *todies*
Momotidae, *motmots*
Cinclidae, *dippers*
Troglodytidae, *wrens*
Mimidae, *mockingbirds*
Polioptilinae, *gnatcatchers*
Bombycillidae, *waxwings*
Ptilogonatidae, *silky flycatchers*
Dulidae, *palm-chats*
Vireonidae, *vireos, shrike-vireos, pepper-shrikes*
Parulidae, *wood warblers*
Emberizinae, *typical buntings*

[Some genera and species belonging to families listed under: A. (hawks, nightjars, woodpeckers, swallows); B. (trogons, barbets); D. (cuckoos, typical owls, pigeons, jays, thrushes, titmice, wren-tit, cardueline finches); are distinct enough to require mention under this heading.]

F. PAN-AMERICAN ELEMENT

APPARENTLY ORIGINALLY NORTHERN

Cracidae, *curassows, guans*

PROBABLY ORIGINALLY SOUTH AMERICAN

Trochilidae, *hummingbirds*
Tyrannidae, *tyrant flycatchers*
Thraupidae, *tanagers*
? Icteridae, *blackbirds, troupials*

[The cardinals (Richmondeninae) may have to be transferred from the South American group to this class.]

G. SOUTH AMERICAN ELEMENT

*Rheidae, *rheas*
Tinamidae, *tinamous*
*Anhimidae, *screamers*
*Opisthocomidae, *hoatzins*
*Psophiidae, *trumpeters*
*Eurypygidae, *sun-bitterns*
*Cariamidae, *cariamas*
*Thinocoridae, *seed-snipe*
*Steatornithidae, *oil-birds*
Nyctibiidae, *potoos*
Galbulidae, *jacamars*
Bucconidae, *puff-birds*
Ramphastidae, *toucans*
Dendrocolaptidae, *wood-hewers*
Furnariidae, *oven-birds*
Formicariidae, *antbirds*
Conopophagidae, *ant-pipits*
Rhinocryptidae, *tapaculos*
Cotingidae, *cotingas*
Pipridae, *manakins*
*Oxyruncidae, *sharp-bills*
*Phytotomidae, *plant-cutters*
Coerebidae, *honey-creepers*
Richmondeninae, *cardinals*

[Families marked with an asterisk contain less than five species, and their allocation is consequently somewhat doubtful. In most cases it is well supported by circumstantial evidence.]

Conclusion

The results of this analysis of the North American fauna can be summarized as follows: Most North American families and subfamilies are clearly either Old World in origin, South American in origin, or members of an autochthonous North American element that developed during the partial isolation of North America in the course of the Tertiary. Although many details of this analysis are still questionable, its major outlines are established facts. These facts are, however, merely descriptive raw material. It is only by correlating them with established concepts in related fields that their full significance becomes apparent. Such a correlation will be attempted in the following sections.

An Analysis of North American Bird Populations

In Table 2, the song birds of various areas in North America are analyzed according to their point of origin. The endemic North American genera among the swallows (Hirundinidae) and the blackbird–troupial group (Icteridae) were included with the North American element. It would have been most desirable to extend the type of analysis used in Table 2 to all the families of birds, but I failed in an attempt to do so. Many species of non-passerines were in the doubtful categories, *A, B,* and *C,* of Table 1; others belonged to the difficult families of cuckoos (Cuculidae), owls (Strigidae), and pigeons (Columbidae).

TABLE 2

Analysis by Geographical Origin of the Breeding Passerine Species of Several Districts of North America

	South American	North American	Old World
Yakutat Bay, southeast Alaska (Hudsonian Zone)[1]	3%	39%	58%
Oregon[2]	14	47	39
Nipissing area, southern Ontario, 46° N (Canadian Zone)[3]	13	57	30
New Jersey[4]	14	63	23
Florida[5]	20	59	21
Sonora, Mexico[6]	27	52	21

[1] Shortt, T. M. 1939. The summer birds of Yakutat Bay, Alaska. *Roy. Ont. Mus. Zool. Contr. No.* 17.

[2] Gabrielson, I. N., and S. G. Jewett. 1940. Birds of Oregon. Corvallis, Ore.

[3] Ricker, W. E., and C. H. D. Clarke. 1939. The birds of the vicinity of Lake Nipissing, Ontario. *Roy. Ont. Mus. Zool. Contr. No.* 16.

[4] Original data.

[5] Howell, A. H. 1932. Florida bird life. Tallahassee, Fla.

[6] van Rossem, A. J. 1945. A distributional survey of the birds of Sonora, Mexico. *La. State Univ. Mus. Zool. Occ. Paper No.* 21.

It might be claimed that the neglect of the non-passerines introduces so great a degree of uncertainty as to jeopardize the validity of the figures as indices of the composition of the North American fauna as a whole. This argument is not well founded for two reasons. One is that the families of Group A are composed of essentially the same mixture of South American, North American, and Old World elements, in essentially the same proportions, as are the analyzed families as a whole. This is quite obvious from a cursory study of the hawks and rails, for example. The second reason is that most of the families of Group A (composed chiefly of large birds and other non-passerines) are comparatively rare. In faunal lists in which the species have equal value, these birds may constitute a significant percentage. But they are negligible if each species is weighed on the basis of numerical frequency. To determine the faunal composition of the bird population of a given type of forest, it would be necessary to analyze the total number of pairs instead of the total number of species. I suggested (Mayr, 1944b) that this should be done to test the validity of Wallace's Line, but no data were available for such an analysis. Fortunately, however, good census data are available for North American birds in the Audubon breeding-bird censuses initiated by William Vogt (Hickey, 1937–1944). Table 3 shows that the unanalyzed element is negligible. It becomes important only in aquatic habitats.

TABLE 3

ANALYSIS BY GEOGRAPHICAL ORIGIN OF THE BREEDING PAIRS REPORTED [1] FROM FIVE NORTH AMERICAN HABITATS

	South American	North American	Old World	Un-analyzed	Total Number of Pairs
Red and White Spruce in Maine (No. 27, 1941 [1938 data])	0.0%	73.0%	25.9%	1.1%	85
Northern Forest in Idaho (No. 27, 1944)	12.5	62.5	25.0	0.0	56
Beech-Maple in Ohio (No. 20, 1941)	23.0	52.5	23.0	1.5	131
Southern Hardwood in Alabama (No. 21, 1944)	25.8	54.8	16.2	3.2	62
Desert in southern California (No. 5, 1941)	37.1	48.6	14.3	0.0	35

[1] Audubon breeding-bird censuses (Hickey, 1937–1944).

If Table 2 (species analysis) is compared with Table 3 (pair analysis), a few interesting facts are apparent. One is the basic similarity of the figures. In both cases, the North American element makes up a large proportion of the total (47 to 63 per cent * in the species analysis, 48 to 73 per cent in the pair). The South American and the

* Unless one includes the marginal Yakutat Bay area (39 per cent).

Old World elements share the rest. However, the Old World element, largely consisting of permanent residents, is significantly lower in the pair, than in the species, tabulation, indicating a lower density. The South American element, on the other hand, composed mainly of hummingbirds (Trochilidae), tyrant flycatchers (Tyrannidae), tanagers (Thraupidae), and cardinals (Richmondeninae), is higher in the pair than in the species list.

A number of additional facts become obvious from a study of these tabulations. There is a decrease of the Old World element from the north to the south, but even as far south as Florida or Sonora, one-fifth of the species, or one-sixth of the pairs, are still of Old World origin. In mountainous western North America there is, naturally, a higher percentage of Old World elements than in a similar latitude in the lowlands of the eastern states. It is not justifiable, as far as birds are concerned, to include North America either in a "Neotropical" or in a "Holarctic" region, since the autochthonous North American element comprises up to 50 per cent, or even more, of the North American fauna in all habitats except the arctic. As is to be expected, from north to south, there is an increase of the South American element. However, even as far south as Sonora, only 27 per cent of the species are South American. Finally, it appears, again as is to be expected, that the faunal change from north to south is quite gradual—there are no "step clines" anywhere. Since each of the approximately 200 species involved in these analyses has different ecological requirements and a different distribution-pattern, it is not surprising that there is no sharp change in the gradient. The most rapid faunal change appears to occur near the northern tree limit.

The exact line, north of which more than 50 per cent of the bird species belong to the Panboreal and Old World element, has never been accurately drawn, but it runs somewhere through the middle of the Canadian coniferous forest. This 50:50 line does not by any means coincide with any major physiographic feature. There is, however, as stated above, a sharp drop in the percentage of American elements along timber line. Those who want zoogeographic regions may do well to follow the lead of the zoogeographers who recognize an Arctic (circumpolar) region as distinct from the Palearctic region. This was, I believe, first proposed by Schmarda (1853:225–226), later adopted by J. A. Allen (1871:381–382), by Reichenow (1888:673), and by the recent Russian zoogeographers (Stegmann, 1938a). Similarly, it will be advisable to include all the wooded parts of North America in the "North American region," even though the North American element might be slightly in the minority along the northern fringe. Since the only major avifaunal break occurs along the tree limit, it seems legitimate to accept the tree limit as a regional border.

The Arctic or tundra zone is inhabited by few land birds. The bird fauna consists almost entirely of sea birds, fresh-water birds, and shore birds. This fauna is strikingly different from that of the wooded parts of the continent, but it is practically identical on the two sides of Bering Strait. There are 104 species of birds that now breed in the arctic regions. Of these, only the following species seem to be restricted to the American continent: Canada Goose (*Branta canadensis*), Ross's Goose (*Anser rossi*), Bald Eagle (*Haliaeëtus leucocephalus*), Eskimo Curlew (*Numenius borealis*), Bristle-thighed Curlew (*Numenius tahitiensis*), White-rumped Sandpiper (*Ereunetes fuscicollis*), Stilt Sandpiper (*Micropalama himantopus*), Buff-breasted Sandpiper (*Tryngites subruficollis*), and the Surf-bird (*Aphriza virgata*). (Certain additional species usually considered exclusively North American I would include in superspecies that occur in both North America and Siberia.)

The same small number (nine species) are restricted to the Old World: Lesser White-fronted Goose (*Anser erythropus*), Red-breasted Goose (*Branta ruficollis*), Dotterel (*"Eudromias" morinellus*), Temminck's Stint (*Ereunetes temminckii*), Siberian Pectoral Sandpiper (*Ereunetes acuminatus*), Curlew Sandpiper (*Ereunetes ferrugineus*), Eastern Asiatic Knot (*Calidris tenuirostris*), Spoonbill Sandpiper (*Eurynorhynchus pygmeus*), and the Red-throated Pipit (*Anthus cervinus*). Thus, except for 18 species (of which 12 are shore birds), the arctic bird faunas of Asia and America are practically identical in composition. Furthermore, the arctic fauna is remarkable in that more than 50 per cent of its species are restricted to the Arctic zone, and in its almost complete difference from the fauna of the coniferous zone. The northern tree limit is, so far as birds are concerned, one of the clearest faunal boundaries on the earth.

I shall refrain from drawing any zoogeographical boundaries south of the timber line. Simpson (1943b:427–429) distinguishes five regions in America: Boreal, Middle, and Southern, in North America (including Mexico and Central America); Equatorial and Austral, in South America. It seems to me that this attempt to reconcile the historico-faunistic findings with descriptive-regional zoogeography is not entirely successful. As far as birds are concerned, none of the five regions mentioned by Simpson is well characterized by its present faunal contents, nor are the boundaries between the regions clear. Distinctive faunas develop only in isolation, and zoogeographic regions can retain their faunistic integrity only if they are separated from other regions by geographical or ecological barriers. The union of the North American and the South American tropical zones at the end of the Pliocene has resulted in such a mingling of the respective faunas that it seems futile to draw a line through Panama separating a tropical "Southern North America" from an "Equatorial South America." The faunas of the two "regions" are today essentially identical. If one wants zoogeographic regions, one may have to go back to the solution of the classical zoogeographers, who looked for a physiographic border line and found it in Mexico along the northern edge of the tropical rain-forest belt. This is where Wallace (1876:79) placed the border between his Neotropical and Nearctic regions. So far as I can see, it is along this line that the only major faunal break occurs in the warmer parts of North America. However, I agree with Dunn (1931) and Simpson (1943b) that the term Nearctic is misleading. To call the region north of the tropics (i.e. north of the tropical rain-forest) simply the North American region is probably the best solution.

Comparison of Birds with Other Animals and with Plants

On a walk through the woods in temperate North America, one encounters flowers and trees which differ but little from species found in temperate Asia. The admixture of tropical South American elements is negligible. The same is true for mammals. The porcupine and the armadillos are apparently the only South American elements in the present North American mammal fauna, compared with a 13 to 20 per cent South American element in the bird fauna, except at the northern fringe (Table 2). I do not know of any exact published figures, but I gather from the writings of mammalogists that more than 50 per cent of the temperate North American mammals are of Old World origin. (Is the percentage even higher in plants?) In birds (again excepting the northern fringe), it is only a third or less.

There are mainly two reasons why the Old World element is so much weaker among North American birds than among most other animal groups—or perhaps I should better say: why the South American and warm North American element in temperate America is so much stronger in birds than in other animal groups. One of these reasons is the ability of birds to cross water gaps. Thus, while the indigenous mammals were imprisoned in South America during the Tertiary separation of the two continents, several groups of South American birds crossed the water gap into the northern continent. Among the invading groups that became thoroughly established in North America are the blackbirds and troupials (Icteridae), tyrant flycatchers (Tyrannidae), and cardinals (*Richmondena, Hedymeles, Passerina,* etc.). Some of these genera and generic groups must have arrived in North America at a very early date. Pre-empting many ecological niches, the 40 or 50 species of these originally South American groups have helped stem the influx of Old World species.

A second and more important factor is bird migration. It enables many tropical or semitropical birds to include in their breeding range the areas of the temperate zone that have a hot summer season and move back into their tropical home when the cool season begins. An analysis of the mid-winter avifauna of temperate eastern North America shows that it is composed almost entirely of Old World elements. The difference in migratory behavior between the autochthonous and the Old World elements is illustrated in the following statistics. Among the 28 species of permanent residents (excluding water birds and unanalyzable species) listed by Cruickshank (1942:25–26) for the New York region, no less than 23 (82.1 per cent) are of Old World origin. On the other hand, among 67 analyzable species of summer residents (which migrate south in the fall) only 8 (11.9 per cent) are of Old World origin. If the 95 species of the two categories are combined, it is found that of the 12 species of the South American element only one (8.3 per cent) is a permanent resident, of the 52 species of the North American element only 4 (8.3 per cent) are permanent residents, while of the 31 species of the Old World element no less than 23 (76.7 per cent) are permanent residents.* The Old World element, which, as Stegmann (1938a) has shown, developed for the most part in the always cold land mass of northern Siberia, is so thoroughly adapted to the cold that it can survive in this latitude without migration, whereas the autochthonous American element, most of which developed in a warm zone, survives the winter by avoiding it.

The combination of these two factors has resulted in the peculiar composition of the contemporary North American bird fauna. It is, therefore, obvious that no general zoogeographic scheme can be based on the distribution of birds, and that the ornithologist will find zoogeographical classifications inapplicable that are based on the distribution of mammals or reptiles. This difference between birds and other

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* I present these analyses of Cruickshank's data merely as an illustration of a trend. Because the classification by origin of the birds of such populations (with different migratory status) involves weighing evidence and probabilities, such an analysis inevitably varies somewhat with the individual. For the benefit of students who may wish to make similar analyses of other populations and compare results, I give the following outline of my classification of the populations.

List of Permanent Residents. South American: Cardinal; North American: Ruffed Grouse, Bob-white, Carolina Wren, Song Sparrow; Old World: Sharp-shinned Hawk, Red-tailed Hawk, Bald Eagle, Marsh Hawk, Duck Hawk, Sparrow Hawk, Barn Owl, Screech Owl, Great Horned Owl, Barred Owl, Long-eared Owl, Short-eared Owl, Pileated Woodpecker, Hairy Woodpecker, Downy Woodpecker, Prairie Horned Lark, Blue Jay, Crow, Black-capped Chickadee, Carolina Chickadee, Tufted Titmouse, White-breasted Nuthatch, Goldfinch. (Not analyzed: Cooper's Hawk, Red-shouldered Hawk, Red-headed Woodpecker, Water birds; not considered truly permanent residents: Flicker, Meadowlark, Fish Crow, Swamp Sparrow, Field Sparrow.)

List of Summer Residents. South American ($11 = 16.4\%$): Hummingbird, Kingbird, Crested Flycatcher, Phoebe, Acadian Flycatcher, Alder Flycatcher, Least Flycatcher, Wood Pewee, Scarlet Tanager, Rose-breasted Grosbeak, Indigo Bunting; North American ($48 = 71.7\%$): Flicker, Tree Swallow, Rough-winged Swallow, Purple Martin, Short-billed Marsh Wren, Long-billed Marsh Wren, House Wren, Catbird, Brown Thrasher, Cedar Waxwing, White-eyed Vireo, Yellow-throated Vireo, Red-eyed Vireo, Warbling Vireo, Black and White Warbler, Worm-eating Warbler, Golden-winged Warbler, Blue-winged Warbler, Nashville Warbler, Yellow Warbler, Black-throated Green Warbler, Chestnut-sided Warbler, Pine Warbler, Prairie Warbler, Oven-bird, Louisiana Water-thrush, Kentucky Warbler, Yellow-throat, Yellow-breasted Chat, Hooded Warbler, Redstart, Meadowlark, Bobolink, Red-wing, Orchard Oriole, Baltimore Oriole, Purple Grackle, Cowbird, Towhee, Savannah Sparrow, Swamp Sparrow, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Sharp-tailed Sparrow, Seaside Sparrow, Vesper Sparrow, Chipping Sparrow; Old World ($8 = 11.9\%$): Kingfisher, Bank Swallow, Barn Swallow, Fish Crow, Robin, Wood Thrush, Veery, Bluebird. (Not analyzed: First 31 species listed; added: 5 species from permanent-resident list.)

animal groups is the reason for much of the "New World" versus "Holarctic" controversy. Those who wanted to unite North and South America into a single "New World" based their conclusion mainly on a study of birds. Those who wanted to include North America with Eurasia in a "Holarctic" region based their conclusions on mammals or reptiles.

The History of the Pantropical Element

In a previous section I discussed a number of families which are more or less restricted to the tropics, but are found in the Old as well as in the New World. A similar distribution has been documented for various families and subfamilies of turtles (Simpson, 1943b), and other reptiles (Dunn, 1931), as well as for mammals (e.g. tapirs) and other groups. Various explanations have been advanced to account for this type of distribution. In a few exceptional cases, for example, the White-faced and Fulvous Whistling Ducks (*Dendrocygna viduata* and *D. bicolor*) and the Southern Pochard (*Netta erythrophthalma*), it is reasonably certain that transoceanic colonization is the answer. This explanation is, however, exceedingly improbable for most of the other groups, which have closely related representatives in the tropics of both the Old and the New World, for example, some of the snake-birds (Anhingidae), the sun-grebes (Heliornithidae), jacanas (Jacanidae), barbets (Capitonidae), trogons (Trogonidae), and parrots (Psittacidae) among the birds that I have classified with the Pantropical element; as well as some of the storks (Ciconiidae), ibises (Threskiornithidae), flamingos (Phoenicopteridae), nightjars (Caprimulgidae), woodpeckers (Picidae), and hawks (Accipitridae and Falconidae). A different explanation must be found for their movement from one continent to another.

The "land-bridge builders" considered this pattern of distribution as evidence of a former land connection across the Atlantic and Pacific. The objections to their theories were summarized by Matthew (1915), who showed that fossil finds indicate that many of these families formerly had much wider ranges (probably continuous across the Bering Strait bridge) in the temperate zones. A faunal agreement is particularly close between tropical-subtropical North America and the Old World tropics. It indicates that the present separation of the faunas is of comparatively recent date and that it must have been preceded by a long period of faunal exchange. Matthew (1915), Simpson (1943a:9), and others have postulated that the Bering Strait bridge was the pathway of this faunal exchange, which continued until late in the Tertiary (and, as far as non-tropical elements are concerned, down to the present). Stegmann (1938b) objects to this solution. He quotes considerable evidence from the field of paleobotany and paleoclimatology which indicates (p. 485): "that the climate in the region of Bering

Strait was at times warmer than it is now, but never reached tropical temperatures. Indeed it is quite certain that in northwestern America and in nearly all of Siberia the climate was never tropical or even subtropical during the entire Cenozoic and Cretaceous. . . . The Bering region was thus far outside the tropics during the entire period that needs to be taken into consideration for the evolution of Recent birds, so that it is without the slightest significance as a 'land bridge' for tropical groups." The records of American plant paleontologists support this contention. Chaney (1940) shows that as far back as the Eocene only a temperate climate existed in the countries east and west of the Bering Strait bridge. (See Figure 4.) One has to go as far south as the State of Washington on the American side, and to China on the Asiatic side, to find fossil plants that indicate even a subtropical climate.

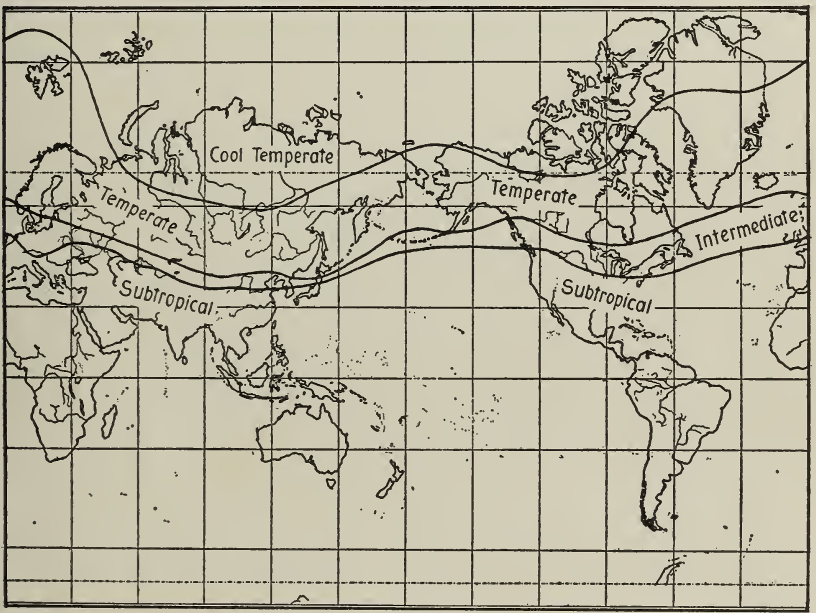

Figure 4. Eocene climatic zones as indicated by fossil plants. (*Based on Chaney, 1940.*)

A generation ago the opinion was widespread among paleogeographers that there were past periods during which a uniformly tropical climate prevailed all over the world. Reputed finds of Tertiary palms in Greenland seemed to strengthen this theory. However, these botanical reports have since been found to be erroneous; furthermore, certain geophysicists have made it abundantly clear that climatic zones must have always existed on the earth. This is a corollary of the earth's curvature. Less radiated heat from the sun will reach a given area in the higher latitudes than will reach the equatorial districts, where at noon the sun is nearly overhead during the greater part of the year. Furthermore—and this is a factor strangely neglected in books on past climates—the axis of the earth is inclined at an angle of 23½° to the perpendicular to the plane of the ecliptic. This inclination causes our seasons. The northern hemisphere is turned away from the sun during the winter and turned toward the sun during the summer. Geophysicists believe that this angle of the ecliptic has not changed significantly during the geological past. This means that north of the Arctic Circle an Arctic winter night has existed at all times, including the so-called "warm periods" of the earth. The Arctic Circle goes exactly through Bering Strait, and there can be little doubt that an Arctic "winter" (in terms of daily sunlight) must have existed at least as far south as the Aleutians, in other words beyond the southern edge of the Bering shelf. Surely this would not be a favorable condition for tropical faunas and floras to pass freely back and forth between Asia and America.

Yet the close relationship between the Old and New World members of the Pantropical element, whose ranges are now widely discontinuous, proves that such a faunal exchange must have taken place, and this places the zoogeographer in a real quandary. The customary solution for the problem is to ignore it. Stegmann (1938b:492) and other authors of the Russian school (e.g. Wulff, 1943:173–196) attempt to solve it by suggesting a modified Wegenerian land connection across the North Atlantic lasting at least until the middle of the Tertiary. Simpson (1943a:20–22), however, objects to this proposal on the basis of the small number of early Tertiary mammalian forms that were common to Europe and North America. A similar objection comes from the field of botany. The Eocene floras of Europe and North America "were remarkably different" according to Reid and Chandler (1933:70–88). There could have been no direct land connection between the two areas. Additional indirect evidence against a transatlantic bridge is provided by the fact that the American fauna is much closer to the southeast Asiatic than to the European-African fauna.

In view of the improbability of a North Atlantic land connection, various attempts have been made to find new routes for the transpacific migration. I shall refrain from a discussion of the various proposed transpacific land bridges. They are faunistically possible, but find no geological support. There is, however, some evidence for considerable recent tectonic activity in and south of the Aleutian island region, as well as for a pronounced lowering of the floor of the Pacific as a whole. Malaise (1945) and other authors have therefore made the assumption that the Bering Strait bridge was formerly very much wider than it is now, wide enough, in fact, to reach southward into a tropical climate.

Another assumption sometimes made is that there was, during the Tertiary, a much stronger contrast than now on the Bering bridge between the warm climate of its southern shore and the temperate climate of the interior, owing to the shutting off of the Arctic Ocean and the stronger influence of the warm Japan Current. This theory can account for the strictly temperate climate character of all fossil plants found in the Bering bridge area only by assuming that they have come exclusively from inland stations. Also this theory necessarily minimizes the effects of the arctic winter season.

Strict adherents of the theory of permanence of oceans and continents will look for a different explanation of the intercontinental migration of tropical faunas. Perhaps the common ancestors of the tropical faunas in the Old and New Worlds were not so narrowly tropical as are their living descendants. Furthermore, many representatives of tropical families are not nearly so heat-loving as is generally assumed—although they live in equatorial latitudes, their habitat is not tropical. In the characteristically "tropical" family of trogons, for example, *Harpactes wardi* (Burma, Indochina) lives in the mountains between 2,500 and 3,000 meters; *Trogon personatus* and other South American species reach even higher altitudes. The climate at these altitudes is distinctly temperate. Most other "tropical" families of birds, particularly the parrots, have some members that live in an equable humid temperate climate. Species with similar ecological requirements might have been able to exist in the warm temperate parts of Bering Strait bridge, even during the rather dark winter days. It must not be overlooked that the tropical regions were apparently more arid at earlier geological periods than they are today. Perhaps the warm temperate zone was in the late Mesozoic to early Tertiary a refuge for species with a preference for an equable humid climate, just as the tropics are today.

These comments may suffice to indicate that the problems of the faunal exchange between Old and New World are by no means solved. However, the questions that need to be asked are beginning to crystallize, and the information needed to answer them is beginning to accumulate. We have advanced beyond the stage of pure speculation.

Faunal Zoogeography and Ecology

We are all familiar with the fact that among the birds of the northern coniferous woods there is a high percentage of recently immigrated palearctic species. The South American element, on the other hand, is almost non-existent in these forests. It would be a rewarding task to analyze the bird life of all the major North American habitats and determine their faunistic composition from the point of view of origin. To do this in detail would require much more space than can be given in this paper; furthermore, there are not enough reliable published tabulations of the characteristic species of the various habitats to provide the material for such a study. For example, I have looked in vain for a good tabulation of the typical birds of the chaparral or of some of the more specialized habitats in the Southwest. No comprehensive account of the breeding birds of the various types of prairie is available.

One of the striking features of North American faunal history is that not a single species of the originally South American fauna has crossed the Bering Strait bridge into the Old World. On the other hand, numerous Old World birds have been able to invade South America. Some became adapted to life in the tropics, for example, certain jays, thrushes, kingfishers, and cardueline finches. Others—the Short-eared Owl (*Asio flammeus*) and Horned Lark (*Otocoris alpestris*)—simply jumped the tropical gaps.

It would be tempting to reconstruct the climate on Bering Strait bridge throughout the Tertiary by analyzing the ecological requirements of the birds that passed this bridge at a given period. At present, for example, the bridge is passable only for birds of the tundra and of the coniferous belt (taiga = "Hudsonian"). Stegmann (1938b) lists the birds that could pass Bering Strait under climatic conditions similar to or slightly warmer than the present. But as we go further back in time, the analysis becomes more difficult. Again it seems that the Old World contributed more than the New. The only birds of North American origin that have spread into the Old World are the grouse (Tetraonidae), the finches of the subfamily Emberizinae, one species of wren (*Troglodytes troglodytes*), and—if these are indeed North American—two species of dippers (*Cinclus cinclus, C. pallasii*), and two species of waxwings (*Bombycilla garrula, B. japonica*). Even such richly developed North American families as the mockingbirds (Mimidae), vireos (Vireonidae), and wood warblers (Parulidae) * have not crossed for reasons that are difficult to understand. On the other hand, nearly every family of temperate Eurasia has entered North America, and most of them have sent at least one representative as far as South America.

It is conceivable that the fauna of each of the major habitats or ecological formations of North America would have its peculiar composition from the point of view of origin. However, a glance at Table 3 shows that there are no major differences, at least as far as forest habitats are concerned. What differences there are can be attributed mainly to latitude. Also there seems to be no striking difference from the point of view of origin between the faunas of climax and second growth. Among 159 breeding pairs listed in two years (1932, 1934) on a study area in a climax Maple-Beech-Hemlock forest Saunders (1938:32–33) records 10.0 per cent South American, 71.1 per cent North American, and 18.9 per cent Old World pairs. Among 104 pairs

* The Myrtle Warbler (*Dendroica coronata*) and the Northern Water-thrush (*Seiurus noveboracensis*) have recently crossed into Anadyrland.

(listed in 1932, 1933) in near-by second growth Cherry-Aspen there were 6.8 per cent South American, 71.1 per cent North American, and 22.1 per cent Old World pairs. The figures were thus almost identical.

In specialized habitats there are sometimes significant deviations from the faunal composition exemplified in Tables 2 and 3. For example, all of the species usually listed as typical for the mid-western prairie are of North American origin: Prairie Chicken (*Tympanuchus cupido*), Upland Plover (*Bartramia longicauda*), Burrowing Owl (*Speotyto cunicularia*), Western Meadowlark (*Sturnella neglecta*), Bobolink (*Dolichonyx oryzivorus*), Grasshopper Sparrow (*Ammodramus savannarum*), and Savannah Sparrow (*Passerculus sandwichensis*). This may mean that the great humidity of both the Bering and the Panama bridges prevented an influx of the faunas of the more arid habitat of Eurasia and South America. The ecological niche of the North American grasslands thus could be filled by the autochthonous North American element. The land birds of marshes also tend to be prevailingly (80 to 100 per cent) North American. For example, the Long-billed Marsh Wren (*Telmatodytes palustris*), Short-billed Marsh Wren (*Cistothorus stellaris*), Swamp Sparrow (*Melospiza georgiana*), Sharp-tailed Sparrow (*Ammospiza caudacuta*), Seaside Sparrow (*A. maritima*), Red-wing (*Agelaius phoeniceus*), and Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). The Old World element, on the other hand, is, as a rule, comparatively strong at the higher altitudes in the mountains.

It would be interesting to analyze in a similar manner other specialized habitats, such as the Californian chaparral, the creosote bush–mesquite thickets of the Southwest and the Caribbean mangroves, but adequate census data are not available. This brief discussion is to be considered merely as a hint at the interesting relationship between ecology and faunal history, which constitutes a fertile field for future investigators.

Literature Cited

Allen, J. A.

1871 On the mammals and winter birds of east Florida, with an examination of certain assumed specific characters in birds, and a sketch of the bird faunae of eastern North America. *Bull. Mus. Comp. Zool.*, 2, No. 3, pp. 161–450.

1893 The geographical origin and distribution of North American birds, considered in relation to faunal areas of North America. *Auk,* 10:97–150.

Amadon, Dean

1944 The genera of Corvidae and their relationships. *Amer. Mus. Novit. No.* 1251.

Carpenter, Geo. H.

1894 Nearctic or Sonoran? *Nat. Sci.,* 5:53–57.

Chaney, Ralph W.
1940 Tertiary forests and continental history. *Bull. Geol. Soc. Amer.*, 51:469–488.
Chapman, Frank M.
1923 The distribution of the motmots of the genus Momotus. *Bull. Amer. Mus. Nat. Hist.*, 48:27–59.
Cruickshank, Allan D.
1942 Birds around New York City. *Amer. Mus. Nat. Hist. Handbook Ser., No.* 13.
Delacour, Jean, and Ernst Mayr
1945 The family Anatidae. *Wils. Bull.*, 57:3–55.
Dunn, Emmett Reid
1922 A suggestion to zoogeographers. *Science*, 56:336–338.
1931 The herpetological fauna of the Americas. *Copeia*, 1931:106–119.
Gill, Theodore
1875 On the geographical distribution of fishes. *Ann. and Mag. Nat. Hist.* (Ser. 4), 15:251–255.
Heilprin, Angelo
1883 On the value of the "Nearctic" as one of the primary zoological regions. Replies to criticisms by Mr. Alfred Russel Wallace and Prof. Theodore Gill. *Proc. Acad. Nat. Sci. Phila.*, 1883:266–275.
Hickey, Joseph J.; Margaret B. Hickey
1937–1944 Bird-Lore's [Audubon Magazine's] breeding bird-census. 1–8. *Aud. Mag.* [formerly *Bird-Lore*], 39–46.
Hubbs, Carl L.
1944 [Review of "Studies in the genetics of Drosophila. III"]. *Amer. Nat.*, 78:270–271.
Lönnberg, Einar
1927 Some speculations on the origin of the North American ornithic fauna. *Kungl. Svenska Vetenskapsakad. Handl.* Ser. 3, vol. 4, no. 6, pp. 1–24.
Malaise, René
1945 Tenthredinoidea of southeastern Asia. *Opusc. Entom.*, suppl. 4.
Matthew, W. D.
1915 Climate and evolution. *Ann. N.Y. Acad. Sci.*, 24:171–318.
Mayr, Ernst
1941 List of New Guinea birds. Amer. Mus. Nat. Hist., New York.
1944a The birds of Timor and Sumba. *Bull. Amer. Mus. Nat. Hist.*, 83:123–194.
1944b Wallace's Line in the light of recent zoogeographic studies. *Quart. Rev. Biol.*, 19:1–14.
Mayr, Ernst, and James Bond
1943 Notes on the generic classification of the swallows, Hirundinidae. *Ibis*, 85:334–341.
Peters, James Lee
1940 Check-list of birds of the world. vol. 4. Harv. Univ. Press, Cambridge, Mass.
Reichenow, A.
1888 Die Begrenzung zoogeographischer Regionen vom ornithologischen Standpunkt. *Zool. Jahrb., Abtheilung für Systematik, Geographie und Biologie der Thiere*, 3:671–704.
Reid, Eleanor Mary, and Marjorie Elizabeth Jane Chandler
1933 The London clay flora. Brit. Mus. (Nat. Hist.), London.
Ripley, S. Dillon
1945 The barbets. *Auk*, 62:542–563.

SAUNDERS, ARETAS A.
1938 Studies of breeding birds in the Allegany State Park. *N. Y. State Mus. Bull. No.* 318.

SCHMARDA, LUDWIG K.
1853 Die geographische Verbreitung der Thiere. vol. 2. Vienna.

SCLATER, PHILIP LUTLEY
1858 On the general geographical distribution of the members of the class Aves. *Jour. Proc. Linn. Soc. London for Feb.* 1858, pp. 130–145.

SHARPE, R. BOWDLER
1903 A hand-list of the genera and species of birds. vol. 4. Brit. Mus. (Nat. Hist.), London.

SIMPSON, GEORGE GAYLORD
1940a Mammals and land bridges. *Jour. Wash. Acad. Sci.,* 30:137–163.
1940b Antarctica as a faunal migration route. *Proc. Sixth Pac. Sci. Congr.* (1939), vol. 2, pp. 755–768.
1943a Mammals and the nature of continents. *Amer. Jour. Sci.,* 241:1–31.
1943b Turtles and the origin of the fauna of Latin America. *Amer. Jour. Sci.,* 241:413–429.

STEGMANN, B.
1932 Die Herkunft der paläarktischen Taiga-Vögel. *Arch. f. Naturg.* (N.F.), 1:355–398. [Leipzig]
1938a Principes généraux des subdivisions ornithogeographiques de la région paléarctique. *Faune de l'URSS* (N.S. 19), *L'Oiseaux,* vol. 1, no. 2.
1938b Das Problem der atlantischen Landverbindung in ornithogeographischer Beleuchtung. *Proc. Eighth Internatl. Ornith. Congr.* (Oxford), 1934: 476–500.

STRESEMANN, ERWIN
1939 Die Vögel von Celebes. Teil 2. Zoogeographie. *Jour. f. Ornith.,* 87:312–425.

SUSHKIN, PETER P.
1924 [Résumé of the taxonomical results of morphological studies of the Fringillidae and allied groups]. *Bull. Brit. Ornith. Club,* 45:36–39.
1925 A preliminary arrangement of North American genera of Fringillidae and allied groups. *Auk,* 42:259–261.

SZIDAT, L.
1940 Die Parasitenfauna des Weissen Storches und ihre Beziehungen zu Fragen der Oekologie, Phylogenie und der Urheimat der Störche. *Z. Parasitenkunde,* 11:563–592.

WALLACE, ALFRED RUSSEL
1876 The geographical distribution of animals. vol. 1. Harper & Bros., New York.

WETMORE, ALEXANDER
1940 A check-list of the fossil birds of North America. *Smiths. Misc. Coll.,* 99, no. 4.
1944 A new terrestrial vulture from the upper Eocene deposits of Wyoming. *Ann. Carnegie Mus.,* 30:57–69.

WULFF, E. V.
1943 An introduction to historical plant geography. Chronica Botanica Co., Waltham, Mass.

THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK 24, N. Y.

COVER PREFERENCES, SEASONAL MOVEMENTS, AND FOOD HABITS OF RICHARDSON'S GROUSE AND RUFFED GROUSE IN SOUTHERN IDAHO

BY WILLIAM H. MARSHALL

FROM September 1938 to September 1940, while carrying on field studies of fur-bearers in the Boise National Forest in southern Idaho, I gathered data on Richardson's Grouse (*Dendragapus obscurus richardsoni* [1]) and the Idaho Ruffed Grouse (*Bonasa umbellus phaios* [2]) with a view to determining their occurrence in the various timber types and other cover, their seasonal movements, and their food habits.[3] All of the field work was done on foot or on snowshoes, most of it in the vicinity of the Deer Park Guard Station in the center of the Forest, although trips were made to various other places in the Boise, as well as to the Payette and Idaho National Forests. A wide-ranging bird dog was used when the ground was not covered with snow. These particular grouse were chosen for study because, of the six upland game birds native to Idaho, only these two have borne a substantial hunting burden since 1937, and ecological data concerning them were particularly desirable as a basis for planning management to increase their numbers.

Half the records on Richardson's Grouse and a quarter of those on the Ruffed Grouse were made on the drainage area of Horseheaven Creek, between 4,500 and 8,750 feet above sea level; the cover relationships of the area are shown in Figures 1 and 2. The nearest weather station is at Atlanta, some 20 miles away, at an elevation of 5,400 feet. There the mean annual rainfall is 23.5 inches, which includes an average of 138.9 inches of snowfall; in July and August, less than an inch of rain falls, and temperatures up to 106° F. have been recorded (U. S. Dept. Agric., 1941). Figure 3 shows where the two species of grouse were found in the Horseheaven Creek area.

Richardson's Grouse

From October through March, Richardson's Grouse were found above 6,000 feet elevation in the Douglas fir-pole, Douglas fir-protective (Figure 4), and subalpine types (Figure 5).[4] After snow covered the

[1] J. W. Aldrich, in a letter dated August 28, 1942, describes skins taken in the area as "intermediate between *richardsoni* and *pallidus* but probably a little closer to the latter."

[2] J. W. Aldrich and H. Friedmann, *Condor*, 45 (1943):98.

[3] H. H. T. Jackson directed the study; Guy B. Mains cooperated in many ways; Robert E. Stewart made many of the food habits analyses and helped with others. Figures 4, 5, and 6 are Fish and Wildlife Service photographs taken by the author.

[4] A protective type is "any stand of scattered trees which is principally of value for watershed protection" (U. S. Forest Service, 1928). A subalpine type is "a stand containing a varying mixture of subalpine species—at the upper limit of tree growth" (U. S. Forest Service, 1925).

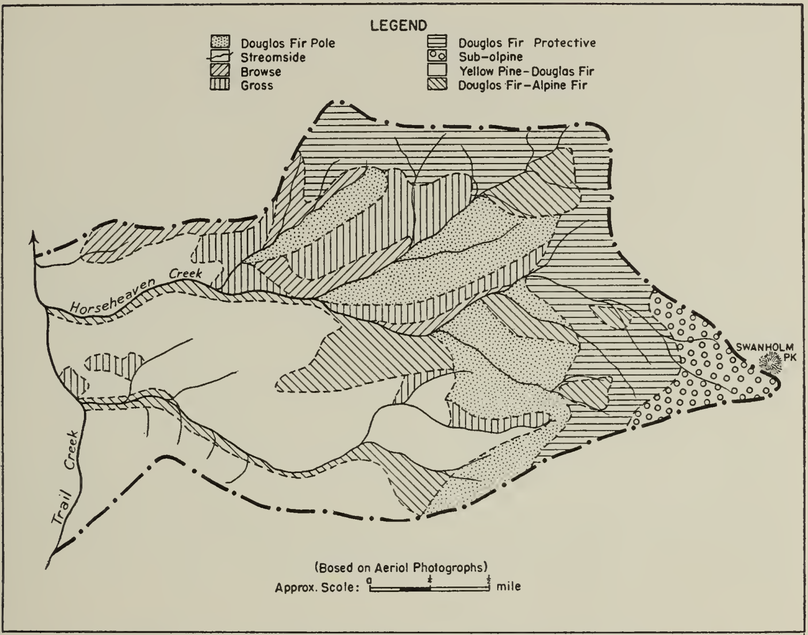

Figure 1. Cover map of the Horseheaven Creek drainage area.

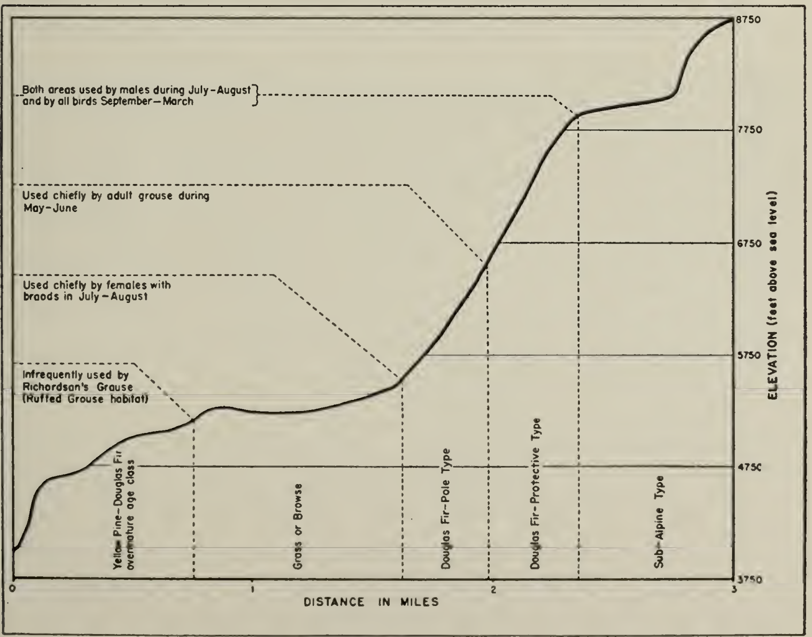

Figure 2. Diagrammatic representation of cover relationships and Richardson's Grouse movements in the Horseheaven Creek drainage area.

ground in mid-November, the birds spent most of their time in trees, and one might snowshoe an entire day at this season without seeing a track. In the Deer Park area they were most commonly found in trees of Douglas fir (*Pseudotsuga taxifolia*), although whitebark pine (*Pinus albicaulis*), alpine fir (*Abies lasiocarpa*), and Engelmann spruce (*Picea Engelmannii*) were also present, and grouse were flushed from them on occasion. Observations in other areas showed that where these other trees were more abundant they were more extensively used by the grouse. The birds sometimes burrowed into the snow to roost at night.

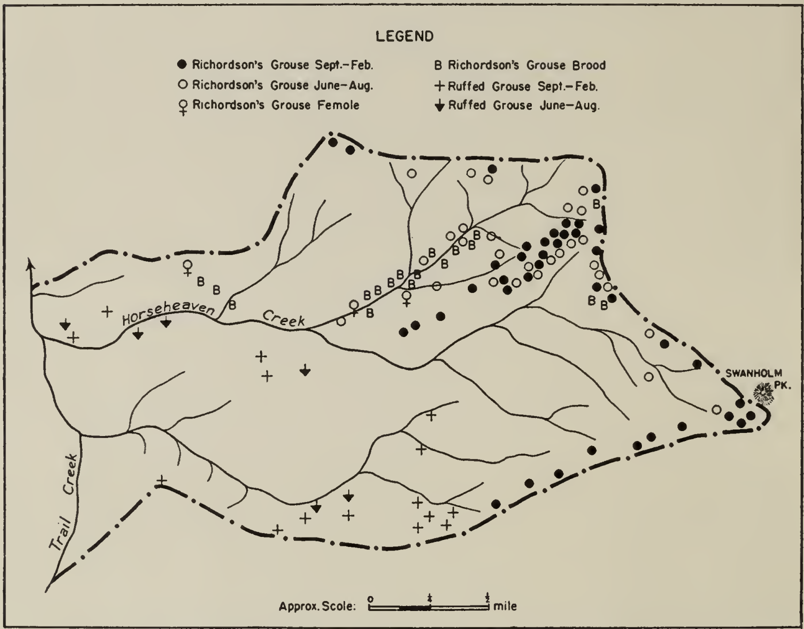

Figure 3. Distribution of grouse records in the Horseheaven Creek drainage area, 1939–1940.

In these months, evergreens were used not only for shelter but also for food. Droppings, often one-half to one inch deep under certain trees, were found upon repeated field examinations to be composed entirely of the needles and buds of conifers. The contents of the crops of nine birds killed in the study area in the winter months consisted of 99 per cent needles and buds of Douglas fir. The remaining one per cent consisted of buds of western chokecherry (*Prunus demissa*),[5] found in two stomachs.

An interesting detail of the winter food habits of this bird is the retention of grit in the gizzard. For at least four months of the year, Richardson's Grouse stay in areas where the snow is 6 to 15 feet deep,

[5] The *Range Plant Handbook* (U. S. Forest Service, 1937) was used for names of plants other than trees.

Figure 4. Douglas fir-protective type. Horseheaven Creek, September 27, 1939. The conifers are Douglas fir; the shrubs, wax currant and snowberry.

Figure 5. Subalpine type. Hunter Creek, February 20, 1940. The conifers are whitebark pine.

and where there are no bare spots (Figure 5). Gizzards of four birds shot in February contained as much quartz gravel (7.5 to 8.0 cc. each) as the gizzards of eight birds taken during July and August, when the ground was bare. Beer (1944:40) reports that the amount of grit in 121 gizzards of this subspecies (taken in all months of the year except March and May) "varied from none to 16 cc., and averaged about 6 to 8 cc." per bird.

In May, June, and early July, Richardson's Grouse were found at lower elevations in the Douglas fir-pole stands. They continued to use the trees for escape but remained on the ground until they were disturbed. Ninety-four per cent of the crop contents of five adults taken

Figure 6. Opening in ponderosa pine type. Horseheaven Creek, August 17, 1940. The conifers are ponderosa pine and Douglas fir; the shrubs, mountain ash, service berry, willow, and snowbrush.

during this period consisted of the flowering parts of various plants.

In late July and early August the females and broods were concentrated at still lower altitudes near the stream (Figure 3), where during mid-day they remained in a narrow band of alder (*Alnus tenuifolia*) and willow (*Salix* spp.). In the mornings and evenings they moved into the adjacent "browse" (brush) and grass to feed. The plant materials in the crops of 10 birds collected in early August consisted almost entirely of the fruits and leaves of various shrubs, with wax currant (*Ribes cereum*) predominating. Every bird had taken some insects, while one was "stuffed" with grasshoppers (*Melanoplus bivittatus*). During this period, single birds (those identified proving to be adult males) were found in the higher timber types, above 6,000 feet, frequently at considerable distances from water, as shown by the open circles in Figure 3.

By mid-August the broods began to move upward to the higher ridges, and a month later all the birds were found in the Douglas fir (pole or protective) types or in the subalpine type. Here the birds were usually in or near extensive patches of wax currants, although they were returning to a conifer needle diet, as shown by the contents of two crops.

In the Horseheaven Creek area, these seasonal movements involved distances up to two miles and elevational changes of at least 2,000 feet. However, elsewhere in the region, both the distances and elevational changes were much more extensive. This was particularly true of Trinity Ridge, which lies between the middle and south forks of the Boise River and connects large areas of "browse" and grass types of the middle watersheds with the tremendous acreage of protective and subalpine types of the Sawtooth "high country." In July 1940, I spent four days in this high country with a wide-ranging dog and was unable to find a single grouse, but numerous droppings, consisting entirely of conifer needles and buds, were found under dense trees, indicating that many Richardson's Grouse had wintered in the area.

Table 1 shows the frequency of occurrence of Richardson's Grouse by month and cover type.

Idaho Ruffed Grouse

During the entire year the Idaho Ruffed Grouse were found in the overmature ponderosa pine and Douglas fir-spruce types of the Deer Park study area (Table 2). These forest types have a rather broken canopy, and a wide variety of shrubs grow under the many openings (Figure 6).

Snowfall at these lower elevations was considerably less, and snow interception by the crowns of trees much greater, than on the higher ridges. Hence many shrubs were not covered by snow, and there were often small bare areas during the winter. The crops of three Ruffed Grouse collected during the winter months contained leaves and buds of the herb phacelia (*Phacelia* spp.), mountain ash (*Sorbus scopulina*), service berry (*Amelanchier alnifolia*), and Douglas maple (*Acer douglasii*). The birds descended to the snow frequently, walking and feeding among the branches of the shrubs. Sixty-three records of plants taken (as shown by tracks and the accompanying fresh marks on the shrubs) during January, February, and March were distributed as follows: 18 at western chokecherry, 11 at willow, 10 at Douglas maple, 10 at service berry, 6 at mountain ash, 5 at black cottonwood (*Populus trichocarpa*), and one each at dogwood (*Cornus stolonifera*), mountain snowberry (*Symphoricarpus oreophilus*), and snowbrush (*Ceanothus velutinus*).

In contrast to Richardson's Grouse, the movements of this bird were apparently quite restricted. Certainly there were no general shifts in

TABLE 1

Monthly Distribution of Richardson's Grouse Records by Cover Types

Cover type	Times observed												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Streamside								15	9	1*			25
Grass								1					1
"Browse"								3	2				5
Douglas fir (pole)	3	11	3		3	4	6	8	7	2	5	6	58
Douglas fir (protective)	1	6				1	6	3	4	6	1	1	29
Subalpine	4	9	1				1	6	12	1	6	1	41
Total records	8	26	4	0	3	5	13	36	34	10	12	8	159
Total individuals	12	41	4	0	3	6	21	78	93	20	22	13	313

* Bird apparently driven down by shooting on opening day of deer season.

TABLE 2

Monthly Distribution of Idaho Ruffed Grouse Records by Cover Types

Cover type	Times observed												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Douglas fir-spruce	13	10	3		2		2	7	1	1	3		42
Ponderosa pine	13	21	2		3	1	1	1			1	1	44
Total records	26*	31*	5*	0	5	1	3	8	1	1	4	1	86
Total individuals	4	6	1	0	5	1	13	18	1	1	6	1	57

* Many of these were track observations.

use of different altitudes or cover types. As indicated in Figure 3, Ruffed Grouse broods were concentrated near the streams during the summer months.

Discussion

Use of conifers as escape cover. The two species showed very similar reactions to my approach. They nearly always "froze" and rarely flushed until I had approached to within 20 feet. When flushed, they almost invariably used conifers for cover, where they remained very still. Thus, of 258 Richardson's Grouse seen to alight after being flushed, 250 chose conifers and only 8 the ground; of 42 Ruffed Grouse, 41 were seen to alight in conifers. Except in the case of broods, whose members usually flew only a short distance, and often all to one tree, this was a very effective procedure, because the birds blended perfectly with the foliage and had to be searched for diligently even when I had observed the particular branch on which they had stopped.

Movements of Richardson's Grouse. Judging from the food habits data from the study area, which agree closely with reports by Stewart (1944) and Beer (1943), it would seem that the Richardson's Grouse movements were correlated with the increasing delay in plant development with increasing altitude. Costello and Price (1939) state that "the rate of development [of plants] varies with altitude, being delayed from 10 to 14 days with each 1,000 feet increase in elevation." Thus the downward spring movements, when the birds changed from a diet of conifer needles to one of various flowers and fresh tender leaves, "gained" 20 to 28 days in the Horseheaven Creek area and at least 50 days in the Trinity Ridge area. Further, the return of the birds to a higher altitude in August apparently coincided with the late ripening of the wax currants in the subalpine type. At this time, the fruits of service berry, chokecherry, and snowberry had deteriorated at lower elevations. Beer (1943:41) states: "Blue grouse tend to follow the ripening of the berries in the fall migration to the higher levels where they spend the winter." Anthony (1903), Saunders (1921), and Lincoln (1939), as well as Wing, Beer, and Tidyman (1944), have also noted these seasonal movements.

Relation to land use. During the winter, Richardson's Grouse are in areas practically unaffected by man. These protective forests have no commercial value; the forage can be used by sheep to only a limited extent, and only in the late summer. Further, much of the area is inaccessible to the flocks. The opposite is true of the nesting and rearing areas of this grouse, which are accessible and are intensively used for spring and early summer range by domestic sheep. Renner (1930) and Spence (1937) reported serious deterioration of natural cover on the Boise River watershed due to over-grazing by sheep at these lower elevations, which are the browse, grass, and streamside types used by the grouse in June, July, and August. Sheep grazing in these areas, however, is being steadily reduced. The Ruffed Grouse is found in timber types where there is little grazing by domestic sheep. Some lumbering is carried on in these types, but under the present policy of administering public lands, this will probably not become an actual danger to the grouse habitat. Other land uses of the area include trapping, mining, and recreation. None of these has been destructive of grouse habitat in the past. However, all of them increase the drain on grouse populations through poaching.

Effects of hunting. Hunting of the two grouse decreased greatly in popularity with the development of pheasant populations in the irrigated portions of the state. Grouse hunting seasons in southern Idaho opened during August for many years. Until 1927, the seasons were from August 1 to September 30 or even later, and the bag limit was six or more. Then the season was shortened to two weeks, and in 1939, the bag limit was cut to four. In 1940 the season was shifted to September 1-10. There has been no grouse season since that year. Because most of the mountain roads are along canyon bottoms (in the Boise Forest an estimated 750 of 850 miles are thus located), the August season made young birds and the accompanying females particularly vulnerable to hunting pressure. A season in September, when the broods are at higher altitudes farther from the roads, automatically provides protection. Also, instead of being able to shoot at very young birds that have flown to the nearest tree, the hunter is confronted with older birds that, when flushed, strike out strongly and sail *down* from the high, open ridges. This type of flight calls for a different shooting technique from that required for most other upland game birds, which fly *up* and away when flushed.

Estimating numbers. The concentration of broods of both these species of grouse along stream bottoms in July and August simplifies the problem of brood counts. The streams are the most accessible areas, and their gradient is, as a rule, very steep. Since young grouse fly *down* hill, a bird dog trained to flush birds at close range can be worked upstream, and the birds counted, as they fly overhead, without fear of duplication.

Management possibilities. Since forest areas in Idaho are managed by a small staff, no intensive program of development for these grouse seems possible at present. Continued improvements in range management practices on the spring and early summer ranges and a flexible September hunting season based on brood estimates made in early August will build up the present grouse populations without interfering with the several other uses of the area.

Summary

Field observations over a two-year period (1938–1940) were made in the Boise National Forest on the cover preferences, seasonal movements, and food habits of Richardson's Grouse (*Dendragapus obscurus richardsoni*) and the Idaho Ruffed Grouse (*Bonasa umbellus phaios*).

From October through March, Richardson's Grouse lived on the higher ridges, where they were dependent on scattered stands of conifers for both food and cover. In May, June, and early July, they stayed at lower elevations and ate chiefly the flowering parts of various plants. In late July and early August, broods and females were concentrated along water courses, while single birds (those identified proving to be adult males) were in the higher timber types. The food at this time consisted largely of insects, berries, fruits, and leaves of various shrubs. By mid-September the females and broods had moved to the higher ridges, where at first they continued to feed on berries and leaves of shrubs and later shifted to a diet of conifer needles and buds.

Idaho Ruffed Grouse were found in the overmature ponderosa pine and Douglas fir-spruce types at middle elevations throughout the year. During the winter they fed largely on the buds of a wide variety of shrubs which grow under openings in the forest canopy. The movements of this grouse are apparently quite restricted.

Both species of grouse were dependent during the entire year on coniferous trees for escape cover.

The movements of the Richardson's Grouse seem to be influenced by the differing rates of plant development at different altitudes.

The summer range of the Richardson's Grouse is in areas intensively used by man and livestock, but the winter range is in areas relatively unaffected by man. Although some lumbering is carried on in the range of the Ruffed Grouse, it does not seriously endanger the grouse habitat. Grouse hunting has decreased in recent years.

Brood counts along water courses in August furnish a dependable basis for estimates of yearly population increase.

Continued improvements in range management practices on the spring and summer ranges and the use of a flexible September hunting season based on August brood counts should be adequate to build up the grouse populations of the area.

Literature Cited

Anthony, A. W.

1903 Migration of Richardson's Grouse. *Auk*, 20:24–27.

Beer, James

1943 Food habits of the blue grouse. *Jour. Wildl. Manag.*, 7:32–44.

Costello, D. F., and R. Price

1939 Weather and plant development data as determinants of grazing periods on mountain range. *U. S. Dept. Agric. Tech. Bull.* 686.

Lincoln, Frederick C.

1939 The migration of American birds. Doubleday Doran & Co., N. Y.

Renner, F. G.

1930 Conditions affecting erosion on the Boise River watershed. *U. S. Dept. Agric. Tech. Bull.* 528.

Saunders, Aretas A.

1921 A distributional list of the birds of Montana. *Pacific Coast Avifauna No.* 14.

Spence, L. E.

1937 Root studies of important range plants of the Boise River watershed. *Jour. For.*, 35:747–754.

Stewart, Robert E.

1944 Food habits of blue grouse. *Condor*, 46:112–120.

U. S. Department of Agriculture

1941 Climate and man: Yearbook of Agriculture.

U. S. Forest Service

1925 Instructions for making timber surveys in the national forests.

1928 Region 4 timber management handbook. (Mimeographed.)

Wing, Leonard, James Beer, and Wayne Tidyman

1944 Brood habits and growth of 'blue grouse.' *Auk,* 61: 426–440.

University of Minnesota, St. Paul 8, Minnesota

GENERAL NOTES

Burrowing Owl at sea.—On November 11, 1943, at 1:30 p.m., while aboard U.S. Destroyer "C. K. Bronson" en route with two other naval vessels from the Canal Zone to San Francisco, California, I observed with 7x binoculars a Burrowing Owl (*Speotyto cunicularia*). The ships were off the mouth of the Gulf of California in latitude 20° 30′ N, longitude 109° 20′ W, and moving at a speed of 18 knots. From the wing of the destroyer bridge, I watched the bird at intervals during a 2-hour period as it flew to one ship, rested a while, then flew to another in our formation.

It alighted several times aboard our vessel, on whaleboat davits or on gun mounts. In both locations the owl was in full view and within 15 feet of many observers on the bridge and deck areas. Neither fright nor weakness from extensive flight was apparent from the bird's actions. After a minute or two it would fly off, moving rapidly low over the water, toward one of the other two ships 3,500 yards distant, where it would land.

The sea was calm, with no unusual wind or weather disturbances in the vicinity. The nearest points of land were Cape San Lucas, Lower California (130 miles); Cape Corrientes, Mexico (185 miles); and Revilla Gigedo Islands (125 miles).

A bird in such a position at sea could well be migrating from Lower California to the Mexican Provinces southward. The Florida Burrowing Owl has been reported in localities that seemed to indicate extensive migrations over water (Barbour 1943, "Cuban Ornithology," pp. 80-81), but there is apparently no previously recorded observation of Burrowing Owls over oceanic waters at any great distance from land.—Robert L. Patterson, *University of Michigan, Ann Arbor.*

Late nesting of Barn Swallow in Saskatchewan.—On September 26, 1945, Fred G. Bard showed me a nest of a Barn Swallow (*Hirundo rustica erythrogaster*) in a shed on the outskirts of Regina, Saskatchewan. The nest contained one dead young bird which—judging by its large size and well-developed plumage—must have been nearly ready to leave the nest. No adults were observed in the vicinity.

Bard told me that when he visited this nest on September 24 it contained two young birds, alive and seemingly in normal condition. He saw no adults. For a week previous to his visit, night temperatures at Regina averaged as low as 30° F. On the night following his visit, the minimum temperature was 22° F. It seems logical to suppose that, because of the low night temperatures and the resulting curtailment of insect food, the parent birds had deserted the nest and young to undertake southward migration.—Olin Sewall Pettingill, Jr., *Carleton College, Northfield, Minnesota.*

Returns of winter-resident Mockingbirds in Arkansas.—In nine years of banding at my home in North Little Rock, Arkansas, 13 banded Eastern Mockingbirds (*Mimus polyglottos polyglottos*) have held two winter territories, one at the east of the house, the other at the north. Of these 13 individuals, one returned to the same territory for a sixth winter, one for a third, and two for a second. A fifth individual that returned to the area for a second winter held, not the same territory, but one 150 yards away.

The bird that returned for a sixth winter (37-220602) was a female that held the east territory in 1936-37. From her plumage, which had been damaged in an ice storm, she was known at sight even before she was caught at the start of my banding in February 1937. Each year, until the fall of 1942, she returned about the middle of October and left between March 15 and March 23 of the following spring. The winter of 1938-39, however, she was apparently unable to hold her territory; she returned in October 1938 but disappeared early in November, a new male (banded November 17) then occupying the territory. She was presumed dead but returned the following year, 1939, and again in 1940 and 1941. She was trapped each season but was also known at sight since she was banded on the left tarsus and all the other Mockingbirds were banded on the right. She was last seen on March 23, 1942.

The Mockingbird that returned for a third winter was a male (39-209852), banded October 30, 1939, that held the north territory that winter and all of the next winter, 1940-41. He returned again on or before October 10, 1941 (when he was retrapped), and was caught on December 11 by a hawk that was not positively identified.

When the six-winter resident of the east territory failed to return in the fall of 1942, a Mockingbird (40-270849) that had been trapped as a juvenile, on August 28 of the same year, held the east territory, staying until the middle of March 1943. In 1943-44, there was no resident in this territory; up to December 16 it was held by the owner of the north territory, but on that day a new Mockingbird arrived and succeeded in taking it. The bird was banded on the same day but was such a nuisance chasing Bluebirds (*Sialia sialis sialis*) that it was captured three days later and released eight miles away across the Arkansas River. On January 19, a new Mockingbird claimed the east territory, was banded with both aluminum (39-218021) and colored bands, and remained until April 4. He was retrapped on December 2, 1945, having returned and settled in the east territory on October 17, although not then positively identified because he had lost his colored band.

The other Mockingbird that returned for a second winter (a female, No. 40-270871) was one of the two breeding birds of the territories that have stayed for the winter in the nine years of banding. She and her mate (40-270877) nested in the north territory in the summer of 1943, and though they were not seen together the following winter, each was caught several times in the territory. There was no record for either in the summer of 1944, but early in October the female returned to winter here, and on being trapped was given a colored band in addition to her metal band. She disappeared December 31 and is believed to have been killed by the Screech Owl (*Otus asio*) that spent its days in a woodpecker's box in the territory. Mockingbird feathers were found in the box. On January 2, 1945, a Mockingbird, not banded but known by a smudge of coal on its cheek, moved in from the territory north of our north territory.

The fifth bird that returned was a male (37-218158) that owned the north territory in 1936-37. The following winter another Mockingbird held this territory, and the former owner was trapped December 14, 1937, in the territory at the foot of the hill on which our house is located.

While 5 of the 13 banded winter residents returned, there were 8 for which there were no later records. There were 4 cases of a Mockingbird coming into a territory on the death or disappearance of the first owner, indicating that there is some winter movement, although, as in the case of the bird with the coal smudge, the moves may have been from next-door or other near-by territories.—RUTH HARRIS THOMAS, *Route 3, North Little Rock, Arkansas.*

EDITORIAL

We have the pleasure of welcoming two new officers, both old Members returning, after war service, to active participation in Wilson Ornithological Club work.

Burt L. Monroe, our new Treasurer, made a fine record several years ago as Chairman of the Membership Committee.

President George M. Sutton, because of the pressure of his military duties, resigned in August 1943, before the end of his first year as President of the Club, and he now resumes his interrupted work. He has again generously allowed us to publish—as frontispiece of this volume—one of the paintings of rarely-figured tropical birds made on his expedition to Tamaulipas, Mexico, in 1941.

The number of Life Members of the Club has now risen to thirty-eight, and more are promised. The Club is much indebted to George B. Thorp who, as Chairman of the Endowment Fund Committee, directed the Life Membership campaign. Pictures and biographical notices of two of the new Life Members appear in this issue of the *Bulletin*.

The prospects of the Club Library have never been so favorable. The record list of donors, published in this issue of the *Bulletin*, is matched by the steadily increasing library circulation figures. Current periodical literature is also coming to the Library in larger amount and greater variety than ever before. European journals, such as *Alauda, Ardea, Dansk Ornithologisk Forenings Tidsskrift, Le Gerfaut,* and *l'Oiseau,* are again reaching the Library after the interruption resulting from the war. New exchanges recently established include: *Avicultural Magazine, Bulletin of the British Ornithologists' Club, Bulletin of the Museum of Comparative Zoology, Elepaio, Emu, Florida Naturalist,* and *N. Z. Bird Notes.* A complete list of the serials currently received will be published in a later *Bulletin.*

OBITUARY

Thomas Barbour, for eighteen years Director of the Museum of Comparative Zoology at Harvard, died in Boston on January 8, 1946, aged 61. Although by profession a herpetologist, he was a Fellow of the American Ornithologists' Union and the author of two books on the birds of Cuba, as well as of many shorter papers on American birds. He also made important contributions to mammalogy, ichthyology, malacology, and paleontology.

Allan Brooks, the noted ornithologist and bird painter, died at Courtenay, British Columbia, January 3, 1946, at the age of 76. His many bird paintings and his ornithological writings brought him world-wide recognition. He was a Fellow of the American Ornithologists' Union and a British Empire Member of the British Ornithologists' Union.

Ornithological News

Frederick N. Hamerstrom, Jr., Associate Editor of the *Bulletin,* and former Chairman of the Wilson Club's Conservation Committee, is back from war service and is resuming his duties as Curator of the University of Michigan's George Reserve.

The museum of the New York Historical Society is holding a special exhibit of about a hundred and fifty of the finest of Audubon's water colors—a number of them unpublished. This exhibit, the largest and most comprehensive showing of Audubon's original work since his death in 1851, will be open until July 14.

The Illinois State Museum at Springfield recently held an exhibit of the bird and mammal paintings made by Richard P. Grossenheider in Australia and New Guinea while he was serving in the army. The artist is a member of the Wilson Club Illustrations Committee.

ORNITHOLOGICAL LITERATURE

A Distributional Survey of the Birds of Sonora, Mexico. By A. J. van Rossem. Louisiana State University Museum of Zoology Occasional Paper No. 21, October 25, 1945: 379 pp., 26 maps. $3.50.

The publication of this report is an important milestone in the ornithology of Middle America. For the first time, the bird life of a Mexican mainland State is thoroughly reviewed, with discussion of the local status, migration, and breeding localities of each form. Those interested in the birds of the southwestern United States will find in the book information on the excellent collections and notes made by Mearns and Holzner along the Mexican border between 1892 and 1894. Van Rossem has examined and critically identified specimens that are scattered far and wide, and he has cleared up the confusion of the Sonora–Chihuahua boundary.

After a brief foreword and historical résumé, van Rossem lists the 69 persons known to have done field work on Sonoran birds, with comments on their itineraries and the present locations of their specimens. He then lists in systematic order the 111 names originally based on Sonoran specimens and gives the present allocation of each, the type locality of each form, and the collectors of the type specimens. The avifaunal areas of Sonora are shown in a colored map and described in a short chapter. A distributional synopsis is given for each subspecies of Sonoran bird, consisting of the scientific and English name; a synonymy with the bibliographical citations for the original description and all Sonora references in the literature; a brief statement of the bird's status and the dates of its occurrence. There are 25 helpful maps which show in detail the distribution of 7 genera and of 25 additional species. The footnotes (occasionally lengthy) are mainly on taxonomic matters and include descriptions of two new orioles, *Icterus bullockii parvus* (p. 238) and *I. cucullatus restrictus* (p. 242). In all, 407 species, or 533 forms (given as 532 on page 26), are recognized for Sonora. A list of 37 "species of unverified occurrence" follows, and the work closes with a useful gazetteer, a full bibliography, and an index of scientific names. The book is well printed on good paper.

Though it covers all data available to 1944, this is decidedly a preliminary report, and the author expresses the hope that it will stimulate new work. Indeed, before van Rossem began this study in 1930, aside from such general works as those by Ridgway or Salvin and Godman, only eight papers of any importance had appeared concerning the birds of Sonora. Most of these were mere lists of names or short, unreliable accounts of birds seen; none of them treated the interesting country inland and south of Guaymas. Van Rossem, whose field work and extensive museum researches had already added 162 forms to the Sonoran list, here adds 32 more. Evidence of how much work is still needed in the Sonoran field is the fact that several species (particularly geese and shore birds), recorded only once, were then recorded in numbers, while several fringillids (Evening Grosbeak, Pale Goldfinch, Crossbill, and such juncos as the Slate-colored, Cassiar, and Thurber) that occur regularly in southern Arizona have not been recorded for Sonora at all.

Taxonomically, the International Code is followed, and several nomenclatural innovations result. Further, the genus *Hedymeles* is merged with *Pheucticus; Myiarchus cinerascens mexicanus* and *Icterus cucullatus nelsoni* are revived; and a number of proposed, or even accepted, races (e.g. *Lophortyx douglasii languens, Otus guatemalae tomlini, Dendrocopos scalaris agnus, Empidonax difficilis immodulatus, Vireo gilvus leucopolius, Dendroica nigrescens halseii, Aimophila carpalis bangsi, Melospiza melodia bendirei*) are considered synonyms. On the other hand, a hummingbird (*Amazilia florenceae*) is recognized, though known only from a single skin, and two races (*Aratinga holochlora brewsteri, Empidonax difficilis culiacani*) are recognized although their breeding range is unknown. *Myiarchus nuttingi* and *cinerascens* are considered distinct species, though van Rossem admits "hybridization on a mass scale." The ranges of several races (*Ardea herodias sancti-lucae, Sayornis saya quiescens, Polioptila caerulea obscura, Guiraca caerulea salicaria,* and *Carpodacus mexicanus ruberrimus*) are extended, and *Psaltriparus minimus cecaumenorum* is recorded from Arizona.

Where Sonora data are deficient, van Rossem quite properly cites records for contiguous border localities. Apparently, however, records for Menager's Dam (Papago Indian Reservation, Arizona) are not cited, though this is only a mile or so from Sonora, and a few of the birds on the Sonoran list (notably the Bronzed Cowbird and Rufous-winged Sparrow) occur there.

Sonora data have been critically analyzed, and in most cases migration, breeding, and winter records are carefully distinguished. It is perhaps doubtful whether future observations will confirm the migration of the Prairie Falcon, Green Kingfisher, and Rufous-winged Sparrow which van Rossem predicates on the basis of the Sonoran records for these species. On the other hand, further field work will probably produce evidence of migration in the Turkey Vulture, Virginia Rail, White-throated Swift, Bridled Titmouse, Desert and Rock Wrens, and Mockingbird; it will perhaps contract the winter ranges van Rossem assigns to the Western Sandpiper, Black-necked Stilt, Avocet, Wright and Western Flycatchers, Rough-winged and Violet-green Swallows, and Clay-colored Sparrow. The two swallows, in particular, migrate north much earlier than is sometimes realized, and February 23, given by van Rossem for the Rough-winged Swallow, is most assuredly *not* a winter record; also, California and Arizona are not as van Rossem states, within the winter range of the Rough-winged.

Van Rossem has revised the breeding ranges of several birds and discredited some alleged breeding records. One might desire further details on the supposed breeding in Sonora of the Mallard, Western Tanager, and Black-headed Grosbeak, and a statement on how far south the Elf Owl breeds. It is interesting to learn that the breeding range of none of the Horned Larks, Meadowlarks, Red-wings, or Song Sparrows extends over the main part of Sonora; that there are gaps in the distribution of the Bob-white and Yellow Warbler, and apparently only isolated colonies of several species, notably flycatchers. Some historical data are given for the Black Vulture and Sonora Motmot, but nothing seems to be known of the history of the English Sparrow and Bronzed Cowbird in Sonora.

Van Rossem adopts a middle course in the matter of sight records, including several species and even two subspecies on sight records alone, and it would seem that in places a more critical attitude would have been better.

Ecology is not extensively treated. Most birds are, quite correctly, assigned to life zones; yet the opening discussion is based on the "provinces" of Dice and others. The correspondence of the distributional maps of species with the map of the Sonoran avifaunal areas is often merely general. Here and there, however, there are some interesting ecological data, as, for example, that for the Inca Dove, Olivaceous Flycatcher, and Botteri's Sparrow. Van Rossem suggests that the Long-billed Dowitcher (*Limnodromus scolopaceus*) prefers fresh-water localities in the Southwest, while *L. griseus hendersoni* prefers the coast.

Like all large works, this one has its minor flaws—the terms "vagrant" and "casual" are used loosely at times; the author, in identifying Audubon's "Rancho La Sone" with Sonoyta (p. 320) may have placed it too far to the west. But such details are trivial in comparison with the magnitude of the task accomplished. The report stands as a monument to the industry and scholarship of the author.—Allan R. Phillips.

BIBLIOGRAPHY *

Physiology (*including weights*)

Dehner, Eugene. An Apparatus for Determining the Respiratory Volume of Large Aquatic Birds. *Science,* 103 (2667), Feb. 8, 1946:171–172, 1 fig.

Hartman, Frank A. Adrenal and Thyroid Weights in Birds. *Auk* 63 (1), Jan. 1946:42–64.

Kelso, Leon. Bioelectronic Observations (IV). *Biol. Leaflet No.* 32, Dec. 18, 1945:1–5. (Observations on birds in relation to electromagnetic waves.)

Anatomy (*including plumage and molt*)

Pitelka, Frank A. Pterylography, Molt, and Age Determination of American Jays of the Genus *Aphelocoma. Condor* 47 (6), Nov.-Dec. 1945:229–260, figs. 35–47.

Spofford, Walter R. Observations on two Golden Eagles. *Auk* 63 (1), Jan. 1946:85–87.

See also *Migration and Flight:* Pitelka.

Distribution and Taxonomy

Aldrich, John W. Birds of a Deciduous Forest Aquatic Succession. *Wils. Bull.* 57 (4), Dec. 1945:243–245. (Part 2 of Wilson Ornithological Club symposium, "Bird Distribution and Ecological Concepts," directed by V. E. Shelford.)

Cook, Faxon W. Occurrence of the Hudsonian Curlew on National Wildlife Refuges along the Atlantic Coast. *Auk* 63 (1), Jan. 1946:90–92.

Crowell, Ethel M., and Sears Crowell. The Displacement of Terns by Herring Gulls at the Weepecket Islands. *Bird-Banding* 17 (1), Jan. 1946:1–10. (Massachusetts.)

Gabrielson, Ira N. Trumpeter Swans in Alaska. *Auk* 63 (1), Jan. 1946:102–103.

Ganier, Albert F. Alder Flycatcher at Memphis. *Migrant* 16 (2), June 1945:29.

Goldman, Edward A., and Robert T. Moore. The Biotic Provinces of Mexico. *Jour. Mamm.* 26 (4), Nov. 1945 [Feb. 1946]:347–360, 1 map.

Hickey, Joseph J. Birds of the Deciduous Forest. *Wils. Bull.* 57 (4), Dec. 1945: 245–246. (Part 3 of Wilson Ornithological Club symposium, "Bird Distribution and Ecological Concepts," directed by V. E. Shelford.)

Jung, Clarence S. A History of the Starling in the U. S. *Passenger Pigeon* 7 (4), Oct. 1945:111–116, 2 maps, 1 fig.

Mayr, Ernst. The Number of Species of Birds. *Auk* 63 (1), Jan. 1946:64–69.

Miller, Alden H. Vertebrate inhabitants of the piñon association in the Death Valley region. *Ecology* 27 (1), Jan. 1946:54–60.

Monson, Gale. Brewster's Booby in Arizona. *Auk* 63 (1), Jan. 1946:96, pl. 3.

Munro, J. A. The Birds of the Cariboo Parklands, British Columbia. *Canad. Jour. Research, D,* 23, June 1945:17–103, pls. 1–5, 1 map.

Orr, Robert T., and Milton S. Ray. Critical Comments on Seed-eaters of the Genus Amaurospiza. *Condor* 47 (6), Nov.-Dec. 1945:225–228, 1 pl.

Peterson, Roger Tory. Coniferous Forest Birds. *Wils. Bull.* 57 (4), Dec. 1945: 247–248. (Part 5 of Wilson Ornithological Club symposium, "Bird Distribution and Ecological Concepts," directed by V. E. Shelford.)

Shelford, V. E. The Relative Merits of the Life Zone and Biome Concepts. *Wils. Bull.* 57 (4), Dec. 1945:248–252, map. (Part 6, Summary, of Wilson Ornithological Club symposium, "Bird Distribution and Ecological Concepts," directed by V. E. Shelford.)

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* Titles of papers published in the last number of *The Wilson Bulletin* are included for the convenience of members who clip titles from reprints of this section for their own bibliographic files. Reprints of this section are available at a small cost.

SHELFORD, V. E. (ed.) Bird Distribution and Ecological Concepts. A Symposium. *Wils. Bull.* 57 (3), Sept. 1945:191–201; (4), Dec. 1945:243–252, map. (Wilson Ornithological Club symposium in 6 parts, by Eugene P. Odum, John W. Aldrich, Joseph J. Hickey, O. A. Stevens, Roger Tory Peterson, and V. E. Shelford.)

SOPER, J. DEWEY. Ornithological Results of the Baffin Island Expeditions of 1928–1929 and 1930–1931, Together with More Recent Records. *Auk* 63 (1), Jan. 1946:1–24, pls. 1–2, 2 maps. (To be continued.)

SPRUNT, ALEXANDER, JR. Northward extension of the summer range of the Limpkin. *Auk* 63 (1), Jan. 1946:101.

SPRUNT, ALEXANDER, JR. Survey Of The Tern Colonies Of The Dry Tortugas Season Of 1945. *Fla. Nat.* 19, (2), Jan. 1946:26–32.

STEVENS, O. A. Grassland Birds. *Wils. Bull.* 57 (4), Dec. 1945:247. (Part 4 of Wilson Ornithological Club symposium, "Bird Distribution and Ecological Concepts," directed by V. E. Shelford.)

SUTTON, GEORGE MIKSCH. Notes on the Winter Bird-life of Fairbanks, Alaska. *Condor* 47 (6), Nov.-Dec. 1945:264–267, fig. 48.

VAN ROSSEM, A. J. The Earliest Name for the San Francisco Brown Towhee. *Condor* 47 (6), Nov.-Dec. 1945:268–269.

WILLETT, G. Remarks on Some Resident Birds of the Santa Barbara Islands. (Contrib. Los Angeles Mus. Channel Islands Biol. Surv., No. 30.) *Bull. South. Calif. Acad. Sci.* 44 (Part 2), May-Aug. 1945:51–54.

WILSON, GORDON. Birds of The Mammoth Cave National Park. 1946. 24 pp., 8 photos, 1 map. (Obtainable at College Heights Bookstore, Bowling Green, Ky. 40c.)

MIGRATION AND FLIGHT

BRYANT, HAROLD C., and AMY M. BRYANT. Another Nighthawk Migration on an Arizona Desert. *Condor* 47 (6), Nov.-Dec. 1945:268.

PITELKA, FRANK A. Age in relation to migration in the Blue Jay. *Auk* 63 (1), Jan. 1946: 82–84.

See also *Distribution and Taxonomy:* Cook; *Life History and Behavior:* Allard, Moore (1946), Smith; *Techniques:* Cooke, Mason.

ECOLOGY

BALDWIN, WILLIAM P. Laughing Gull robs Brown Pelican. *Auk* 63 (1), Jan. 1946:96–97, pl. 3.

See also *Distribution and Taxonomy:* Aldrich, Crowell and Crowell, Hickey, Peterson, Shelford (2 titles), Stevens; *Life History and Behavior:* Austin.

LIFE HISTORY AND BEHAVIOR

ALLARD, H. A. Rumbling noise made by Chimney Swifts in chimney. *Auk* 63 (1), Jan. 1946:84.

AUSTIN, OLIVER L. The Status of the Cape Cod Terns in 1944: A Behaviour Study. *Bird-Banding* 17 (1), Jan. 1946:10–27.

BEADEL, H. L. Purple Gallinule robs nest of Green Heron. *Auk* 63 (1), Jan. 1946:87–88.

BRACKBILL, HERVEY. Robin using abandoned Cardinal nest. *Wils. Bull.* 57 (4), Dec. 1945:261.

DAVIS, MALCOLM. Morning display of the California Condor. *Auk* 63 (1), Jan. 1946:85.

DEGARMO, W. R., and WILLIAM F. STRUNK. Nesting of Eastern Purple Finch in Randolph County, West Virginia. *Auk* 63 (1), Jan. 1946:95–96.

Guhl, A. M., N. E. Collias, and W. C. Allee. Mating Behavior and the Social Hierarchy in Small Flocks of White Leghorns. *Physiol. Zoöl.* 18 (4), Oct. 1945:365–390.

Leupold, Norbert. A nesting record for the Golden Pileolated Warbler. *Auk* 63 (1), Jan. 1946:95. (Oregon.)

Lovell, Harvey B. Banded Song Sparrow Nestlings Removed by Parent. *Bird-Banding* 16 (4), Oct. 1945:144–145.

McClure, H. Elliott. Mourning Doves in Nebraska and the West. *Auk* 63 (1), Jan. 1946:24–42, 1 fig.

Moore, A. D. Winter Night Habits of Birds. *Wils. Bull.* 57 (4), Dec. 1945:253–260.

Moore, A. D. Chimney Swift 'Thunder.' *Auk* 63, (1), Jan. 1946:70–72.

Mousley, H. Unusual nesting site of Magnolia Warbler. *Auk* 63 (1), Jan. 1946: 93–94.

Racey, Kenneth. Bird Nesting Notes from Western British Columbia. *Murrelet* 26 (3), Sept.–Dec. 1945:38, 46.

Rea, Gene. Black and White Warbler feeding young of Worm-eating Warbler. *Wils. Bull.* 57 (4), Dec. 1945:262.

Shackleton, Walter H. Nesting of the Prothonotary Warbler. *Kentucky Warbler* 22, (1), Winter 1946:1–3, 1 fig. (Kentucky.)

Sims, Eleanor. An unusual site for the nest of Swainson's Warbler. *Auk* 63 (1), Jan. 1946:93.

Skutch, Alexander F. Studies of Central American Redstarts. *Wils. Bull.* 57 (4), Dec. 1945:217–242, pl. 12. (*Myioborus miniatus hellmayri, M. miniatus aurantiacus,* and *M. torquatus.*)

Smith, J. Donald. The Canvas-back in Minnesota. *Auk* 63 (1), Jan. 1946:73-81.

Sprunt, Alexander, Jr. Unusual nesting of two birds in South Carolina. *Auk* 63 (1) Jan. 1946:94–95. (*Tyrannus tyrannus* and *Sialia sialis.*)

Sutton, George Miksch. A baby Florida Sandhill Crane. *Auk* 63 (1), Jan. 1946: 100–101, pl. 4.

Throne, Alvin L. A Nesting Study of the Eastern Song Sparrow. *Passenger Pigeon* 7 (4), Oct. 1945:99–105, 1 photo.

See also *Ecology:* Baldwin.

Food and Feeding Habits

Cowles, R. B. Snail-eating by the California Jay. *Condor* 47 (6), Nov.-Dec. 1945:269.

Grant, Chapman. Drone Bees Selected by Birds. *Condor* 47 (6), Nov.-Dec. 1945: 261–263.

Mousley, H. English Sparrow eating salt. *Auk* 63 (1), Jan. 1946:89.

Packard, Fred Mallery. Some Observations of birds eating salt. *Auk* 63 (1), Jan. 1946:89.

Philippe, Lionel. L'alimentation hivernale de la Gélinotte à fraise, *Bonasa umbellus togata* L., dans la région de Montréal. *Naturaliste Canadien* 72 (9–10), Sept.-Oct. 1945:235–240. (With English summary.)

Sutton, George Miksch. Great Blue Heron swallows large snake. *Auk* 63 (1), Jan. 1946:97.

See also *Life History and Behavior:* Rea.

Population (*including age, and mortality rates*)

Campbell, Louis W. A 16-year-old Marsh Hawk. *Auk* 63 (1), Jan. 1946:88.

Eklund, Carl R. Mortality notes on the Trumpeter Swan. *Auk* 63 (1), Jan. 1946:89–90.

Kimball, Heathcote M. H., and John T. Nichols. Blue Jay Population of a Long Island Village. *Bird-Banding* 16 (4), Oct. 1945:130–134.

LASKEY, AMELIA R. Catbird Age and Return Records. *Bird-Banding* 17 (1), Jan. 1946:35–36.

LASKEY, AMELIA R. A Nine-Year-Old Mockingbird and his Mates. *Bird-Banding* 17 (1), Jan. 1946:36–38.

LASKEY, AMELIA R. One-Eyed Robin Returns Three Seasons. *Bird-Banding* 17 (1), Jan. 1946:38.

WHARTON, WILLIAM P. Chickadee Over Nine Years Old. *Bird-Banding* 17 (1), Jan. 1946:39.

WHARTON, WILLIAM P. A Ten-Year-Old Cardinal. *Bird-Banding* 17 (1), Jan. 1946:39.

See also *Migration and Flight:* Pitelka; *Life History and Behavior:* McClure.

TECHNIQUES (including banding)

COOKE, MAY THACHER. Transoceanic Recoveries of Banded Birds. *Bird-Banding* 16 (4), Oct. 1945:123–129.

MASON, C. RUSSELL. Pelican Travels. *Bird-Banding* 16 (4), Oct. 1945:134–143, 2 figs.

MILLER, ALDEN H. A Method of Determining the Age of Live Passerine Birds. *Bird-Banding* 17 (1), Jan. 1946:33–35, 1 fig.

SCHORGER, A. W. Absorbent for use in the preparation of scientific skins. *Wils. Bull.* 57 (4), Dec. 1945:261.

WHARTON, WM. P. The Return of Robins to Their Birthplaces. *Bird-Banding* 17 (1), Jan. 1946:38–39.

WHARTON, WILLIAM P. Return of White-throated Sparrow to Groton, Mass. *Bird-Banding* 17 (1), Jan. 1946:39–40.

WOOD, HAROLD B. Names of Age Groups of Young Birds. *Bird-Banding* 17 (1), Jan. 1946:27–33.

See also *Anatomy:* Pitelka; *Life History and Behavior:* Lovell; *Population:* Kimball and Nichols.

HISTORY, BIOGRAPHY, BIBLIOGRAPHY, AND INSTITUTIONS

SCHORGER, A. W. Franklin Hiram King. *Passenger Pigeon* 7 (4), Oct. 1945:117–121, 1 photo.

STEPHENS, T. C. An Annotated Bibliography of South Dakota Ornithology. 1945. 28 pp. Publ. by the author, Sioux City, Iowa. ($1.00.)

PALEONTOLOGY

HOWARD, HILDEGARDE. A Review of the Pleistocene Birds of Fossil Lake, Oregon. *Carnegie Inst. Wash. Publ.* 551, Jan. 25, 1946:141–196, 2 pls.

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WILDLIFE CONSERVATION

Status of the Redhead in Southern Manitoba

Ten years ago ducks were in the depths of their "depression"; by 1945 the U. S. Fish and Wildlife Service reported "local over-populations" and concluded that "waterfowl have increased almost to the full carrying capacity of the environment in the early forties" (1945, Wildlife Leaflet 274).

However, the reported increase (which was followed, in any case, by the recent disheartening reports on the situation) related to waterfowl as a group and did not apply to every species. In fact, the upswing was less rapid in some of the diving ducks than in the Mallard, Pintail, and other river ducks; and the Redhead, which responded more slowly than the Canvas-back and Lesser Scaup, is actually suffering a serious population decline in a considerable portion of its breeding range in the Canadian Prairie Provinces.

In Manitoba, the Redhead (*Aythya americana*) breeds in marshland areas through the southern and central portions of the Province west of the Pre-Cambrian Shield. The Netley Marsh, where the Red River empties into Lake Winnipeg, and the Delta Marsh, on Lake Manitoba, are probably the two most important breeding areas of the species in Canada. On both these marshes the Redhead has suffered severe reductions during the last two years; further, I made a survey of other important Redhead breeding marshes in southern Manitoba in early August, 1945, and found the Redhead generally uncommon. I saw few Redheads, though I frequently encountered Canvas-backs, which resort to the same ecological associations as the Redheads during the breeding season. The Canvas-back is less tolerant in its choice of breeding sites than the Redhead; where Canvas-backs are found, one expects to find Redheads as well.

The 1945 spring flight through the Delta region was the lowest for Redheads in seven years. The 1945 breeding population there was lower than that of the previous year. The 1945 fall movement of Redheads through the Delta region was the lowest in seven autumns; indeed, the extreme rarity of Redheads was the outstanding feature of the disappointingly small autumn passage of ducks.

Yet this decrease occurred in the face of improved environmental conditions. The land in southern Manitoba during 1945 was in excellent condition for breeding waterfowl. Late rains of the previous autumn had given a wet freeze-up (the first in several years), and consequently the spring run-off was good. Many sloughs and potholes that had been dry in April and May of the previous year held water in 1945 from the spring break-up through the rearing season. Many, indeed, held water right through the summer and autumn. Thus the area of available breeding sites about the permanent marshes was greatly increased. Moreover, many small scattered depressions through the agricultural region of the Province held water through the season for the first time in at least a decade. Many of these isolated waters, by virtue of the summer rains of 1944, held healthy stands of emergent vegetation of the type required by nesting Redheads.

It is highly unlikely that the species moved elsewhere to breed, for (in contrast to the favorable conditions in Manitoba) large regions of Saskatchewan and Alberta experienced serious drought.

Nor can predation be considered a major factor in the decline. The role of the predator, I believe, is greatly over-played in popular propaganda emanating from the Canadian breeding grounds. I do not deny the seriousness of predation; I merely question the importance of widespread amateur predator control as a means of increasing a population. Regardless of what stand is taken on this question, it is clear that the Redhead is less open to predator losses than are some other species that are increasing. Because of its insular nesting sites in emergent vegetation, the Redhead is less vulnerable to such terrestrial predators as the skunk, ground squirrel, fox, and coyote, all of which regularly prey upon land-nesting species.

Clearly, then, the reasons for the decline in the Redhead population rest in the behavior and the physical make-up of the species. Let us consider these as they relate to reproduction:

Numbers.—The critical population level for an endangered species is unknown. The history of those species which have been exterminated suggests that when a certain low point in population level is reached, the species does not recover, despite improved environmental conditions and the forces of "management." We cannot say that the Redhead is an endangered species. We don't know. We simply know that the continental population, when compared with many other species, is relatively small, and that a species whose population is low even in the face of favorable conditions is endangered. At Delta (though Delta is within the best breeding range of the species), the Redhead is the least common of all ducks during the spring flight. The average ratio of Redheads to Canvas-backs over a seven-year period is 1:3, and the ratio to Lesser Scaup is 1:15. In 1945 the ratio of Redhead to Canvas-back was 1:6. I do not have the figures for the continental population as a whole, but the 1945 statement of the U. S. Fish and Wildlife Service that the Redhead "must be watched" suggests its low numbers (1945, Wildlife Leaflet 274). The very fact that the Redhead is declining while most other species of ducks are increasing is evidence of racial debility.

Sex ratio.—The sex ratio of 926 Redheads (538 males and 388 females), tallied at Delta during the spring flights 1939–1945, was 58%:42%. While this is a small sample spread over a period of years, it suggests a rather heavy preponderance of males. If such an unbalanced ratio obtains in the population as a whole, it is clear that the actual productive portion of the population is considerably less than census estimates—low as they are—would indicate. An unbalanced ratio is characteristic of many other ducks, notably the Canvas-back and Lesser Scaup; but the condition obviously threatens productivity the more seriously as a population is reduced, hence may be a greater handicap in the Redhead than in the other species.

Breeding range.—The breeding range of the Redhead is one of the smallest of the ranges of important North American game ducks (Kortright, 1942, "The Ducks, Geese and Swans of North America," map, p. 234). Because it is southern in its range (as compared with north-ranging species such as the Mallard and Pintail), the Redhead has suffered severely from the changes brought about by agriculture. The whole picture of the Redhead's breeding range is not to be seen in a glance at a map, for the species is greatly restricted within the overall pattern of the range. Since the Redhead depends largely upon emergent vegetation, it is confined mainly to established marsh areas. More tolerant species (such as the Mallard and Pintail, which nest on land and therefore do not demand such a close relationship between territorial water and nesting cover) find acceptable habitat widely spread through their breeding range, and these species regularly pioneer to new areas in wet years. Thus in the wet spring of 1945, a heavy population of river ducks (though almost no diving ducks) pioneered to the agricultural prairie, which had not held so many breeding waterfowl in a decade. The emergent vegetation that is so important to the Redhead requires at least a season to produce its stands; hence there is a lag in the response of this species to improved water conditions. The Redhead is locally concentrated, then, even in wet years. Concentration of a low population is dangerous, for when disaster strikes, it strikes an important segment of the population. In 1944 and 1945, for example, summer floods seriously reduced Redhead production on the great Netley Marsh in Manitoba.

Hunting pressure.—I rate the Redhead the most vulnerable to hunting of all local duck species. The young, which make up the most important portion of the autumn Redhead population in the Delta region, are, with little doubt, the least wary of all young ducks. These juveniles may be seen moving about the marsh when little else is flying; they come readily to the stool, and they are easily stalked by the wandering hunter. The rankest beginner can bag Redheads in early season, even on a calm day when duck hunting in general is unproductive. Experienced hunters in the Delta region let young Redheads pass as undesirable, but with the increasing number of novices, the species may suffer increasing pressure.

Evidence of its vulnerability is given elsewhere. In 1945, more returns from banded Readheads were received than from Lesser Scaups, although fewer Redheads than Lesser Scaups had been banded (U. S. Fish and Wildlife Service, Wildlife Leaflet 274).

Nesting behavior.—Though there is some individual variation, and the Redhead sometimes nests on dry land, it is in large measure dependent upon emergent vegetation in shallow water for nesting cover, and this tends to concentrate nesting populations. Beyond this, it is clear that a species nesting over water is more vulnerable to seasonal changes than are land-nesters. Floods cause heavy loss in the Redhead. In their classic nesting study, Williams and Marshall found a 26 per cent flood loss in the Redhead, the next highest figure being a 16 per cent flood loss in the Ruddy Duck (Williams and Marshall, 1938, "Duck Nesting Studies, Bear River Migratory Bird Refuge, Utah, 1937," *Jour. Wildl. Manag.*, 2:46–47, Tables 6 and 9 [Note that in a text statement on p. 43, the authors have apparently reversed the figures given in the tables for the two species.]). Low (1940, "Production of the Redhead (*Nyroca americana*) in Iowa," *Wils. Bull.*, 52:163) found that "instability of the water levels, resulting in flooded nests, was the most destructive factor in the production of the Redhead."

Not only floods, but declining levels as well, limit production. In dry years, nests are left far above the receding water, many being abandoned before hatching time.

Although some Redhead nests have been found in hay meadows, and occasionally a serious fire will sweep over emergent vegetation, it is clear that nesting losses due to haying and fire are less severe in the insular-nesting Redhead than in land-nesting species. Thus, the Redhead does not respond as rapidly as river ducks do to management of fire and of hay cutting.

In southern Canada, the Redhead, like the Canvas-back, begins nesting in early May, two or three weeks after Mallards and Pintails. The Canvas-back sees most of its population nesting by early June, but there is a heavy lag in the Redhead—many nests are started after the middle of June. Some of the late nests may be re-nesting attempts, but I am convinced from courting behavior and the size of clutches that many individuals do not start nesting until late, and thus, in case of failure, no substitute nest is possible.

Further, because of an unexplained trait of the species, there is heavy wastage of reproductive energy in the Redhead. Compound nests, holding 20 or more eggs, the product of two or more females, are frequent. Generally such nests are abandoned before incubation is complete.

Young.—The long span of the nesting period brings off a considerable portion of the young late (Hochbaum, 1944, "The Canvasback on a Prairie Marsh," p. 109). In southern Canada, the young Redhead requires 9 to 11 weeks to attain the flying stage. Thus the products of even the first nests are not a-wing until the second week in August, while most young do not fly until late August or early September. Young from late nests are not a-wing until after the hunting season opens, and some of them are still flightless at the freeze-up. It is clear that the number of young produced from a given number of eggs laid is far below that of a "successful" species such as the Mallard, which nests early and produces flying young by midsummer.

I suspect that in species such as the Mallard or Pintail, which begin to fly in July and have two or three months to condition themselves for autumn migration, the role of experience is important to survival. Most young Redheads are a-wing barely on the advent of the shooting season and but little ahead of their southward movement. Moreover, the young of Redheads and other diving ducks are more vulnerable to late-season declines in water level.

Conclusion.—From this discussion we see that waterfowl management, as it is broadly considered and locally practiced, is not necessarily Redhead management; that when we speak enthusiastically of the increase in ducks, we must modify our statements to cover the less favorable outlook for the Redhead. Clearly the Redhead population is below the carrying capacity of its range; clearly the Redhead is not responding rapidly to improvements in environment.

Whether or not the decline in the Manitoba Redhead population, together with the recent drought in Saskatchewan and Alberta, is sufficient to materially reduce the continental population, I cannot say. I suggest: (1) that a permanent, regionally distributed committee be drawn up to maintain a close watch on the Redhead and other species whose numbers are low; (2) that ornithologists challenge all falsely optimistic propaganda relating to waterfowl management and the status of ducks. Waterfowl management policy is to a considerable degree dependent on public opinion, and public opinion is all too often based on reports consisting of half-truths, seriously distorted truths, or complete fabrications. A statement published in July 1945 reported that there was a big hatch of Redheads in southern and central Manitoba, and this was widely reprinted in current periodicals. The statement published later that Redhead production on the Netley Marsh was an almost complete failure and that there was a 1945 decrease in Redheads in the Prairie Provinces does not balance the original error; there is no place in waterfowl policy for hasty "flash" reports. The unfounded optimism resulting from such propaganda may be reflected in unwise and dangerous management policy.—H. Albert Hochbaum.

Conservation News

Insect, weed, and rodent controls.—The end of the war has made possible the release of quantities of the insecticide DDT for civilian purposes. The Bureau of Entomology has prepared a release ("Suggestions Regarding the Use of DDT by Civilians," U.S.D.A. Mimeograph 1574-45, August 22, 1945), outlining specific recommendations for the effective use of DDT and the necessary precautions in relation to beneficial insects and DDT's toxicity to fish and other cold-blooded animals. The publication should help biologists to appraise the importance of DDT in wildlife conservation as well as its value as a pest control.

The recent development of 2,4 D (2,4 Dichlorophenoxyacetic acid) as a weed control agent carries with it important biological implications. It is a growth-regulating substance with a selective herbicidal action that is favorable to weed control in lawns, crop fields, fencerows, and other places. The better lawn grasses, such as Kentucky bluegrass, are not injured by concentrations of sufficient strength to kill a number of "noxious" weeds such as plantain (*Plantago* spp.), dandelion (*Taraxacum officinale*), pigweed (*Amaranthus retroflexus*), and ragweed (*Ambrosia elatior*). Experiments with water hyacinth (*Eichornia crassipea*) in Florida indicate that many aquatic plants may also be susceptible. Although 2,4 D injures broad-leaved crop plants, such as tobacco, cotton, and most vegetables, it apparently can be used in fields without danger to grain and other members of the grass family. Thus, more miles of clean fencerows, more acres of weedless fields, and more weedless lakes and ponds may be expected to result from widespread use of this material. The probable effects on available animal cover and on populations of insect- and seed-eating birds and mammals are obvious. Tests are now being made to determine whether the material has any directly harmful effects on animals or on soil.

Among the new material at man's disposal for destroying life that seems inimical to his interests is the compound known as "1080" (sodium fluoroacetate). Used as a poison to control rodents and other animals, it has given excellent to phenomenal results. Perfected by the Wildlife Research Laboratories of the Fish and Wildlife Service, 1080 is fortunately under the control of the Service, which recently issued a statement that it will not distribute 1080 "in any form to the general public."

G.I.'s and conservation.—A large number of former servicemen are entering professional conservation training under the provisions of the G.I. Bill of Rights and the Army Rehabilitation program. A sharp increase in the number of students interested in conservation has been reported by several institutions that offer training in the fields of soil, water, forest, and wildlife conservation. Records at Ohio State University indicate that 19 per cent of the students who inquired about enrolling during the fall of 1945 expressed a desire to major in some phase of conservation. A large number of these students are interested in professional careers in wildlife administration, management, or research.—C.A.D.

Wildlife Conservation Committee
Charles A. Dambach, *Chairman*

REPORT OF THE SECRETARY FOR 1945

Once again, despite the interruptions of war, the Wilson Ornithological Club has enjoyed a prosperous year. As of December 1, 1945, we had a membership of 1,200, an increase of 116 during the year. The membership roll shows 172 persons joining the Club during 1945, and a loss of only 56 members.

Following is the distribution by classes of our membership. The corresponding figures for 1944 are shown in parentheses for comparison: Founders, 3 (3); Life Members, 34 (24); Sustaining Members, 67 (58); Active Members, 412 (385); Associate Members, 684 (614); total, 1,200 (1,084).

The annual election of officers was conducted by mail ballot, with the following results:

President: George Miksch Sutton
First Vice-President: Olin Sewall Pettingill, Jr.
Second Vice-President: Harrison F. Lewis
Secretary: Maurice Brooks
Treasurer: Burt L. Monroe
Councillors: Milton B. Trautman, Rudolf Bennitt, George H. Lowery, Jr.

At its annual business meeting, October 13, Columbus, Ohio, the Council reelected Josselyn Van Tyne editor of *The Wilson Bulletin.*

Plans for an annual meeting in 1946 (the first since 1941) are going forward, and details will be announced in a later issue of the *Bulletin.*

The Secretary, speaking for the Club, wishes to thank the many Members whose efforts have contributed toward keeping the Club active during the difficult war years.

Respectfully submitted,
December 1, 1945 Maurice Brooks, *Secretary*

The Report of the Treasurer for 1945 will be published in the June issue of the *Bulletin.*—Editor.

NEW LIFE MEMBERS

Harold F. Wing, of Jackson, Michigan, has long been a student of ornithology. Especially interested in the migration of birds, he was one of the earliest to band birds in the State of Michigan, and has continued active in that field. He is now President of the Michigan Bird Banders, a member of the Board of Directors of the Michigan Audubon Society, and an enthusiastic worker in the field of conservation.

Vera Carrothers is a graduate of Ohio Wesleyan University and received the Master's degree from Western Reserve University. She is a teacher of mathematics in Rawlings Junior High School, Cleveland. She was one of the Founders and is now President of the Kirtland Bird Club, a group of active bird students associated with the Cleveland Museum of Natural History. Miss Carrothers has been a contributor to the *Cleveland Bird Calendar* and to the *Audubon Magazine's* breeding-bird censuses, and she has now undertaken a study of mortality factors and other problems in the ecology of the Redwing.

The Wilson Bulletin Publication Dates

The actual dates of publication of the four numbers in 1945 were: March 31, August 3, October 5, December 21.

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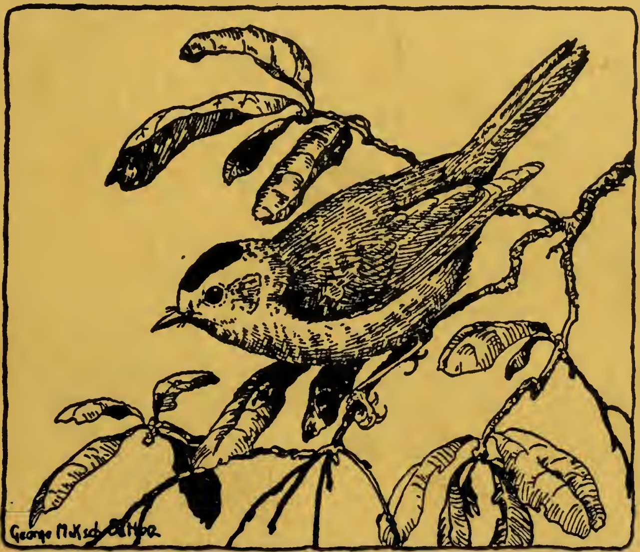

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THE WILSON BULLETIN

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THE WILSON ORNITHOLOGICAL CLUB

Founded December 3, 1888

Named after ALEXANDER WILSON, the first American ornithologist.

Membership dues per calendar year are: Sustaining, $5.00; Active, $3.00; Associate, $2.00. *The Wilson Bulletin* is sent to all members not in arrears for dues.

TAWNY FROGMOUTH

Podargus strigoides

Water color from a live specimen captured in early August 1943 in open eucalyptus forest near Wacol, Queensland, Australia.

When captured, the bird emitted loud, rasping wails, then clamped my finger in its bill, nicking the skin with the point of its beak.

The species, which breeds from August to December, is fairly common in Australia and occurs also in Tasmania. Male and female are similar, but some adult females show more reddish in the plumage. It is a nocturnal bird with a silent, owl-like flight. By day it sits upright on a branch in a "dead-stick" attitude, feathers drawn tight, bill pointed in the air, the eyes mere slits. It feeds, usually from a perch, on phasmids and other insects. The call, a repetition of a deep *oom oom*, carries great distances.

The nest of the Tawny Frogmouth is an open platform of loose sticks placed on a horizontal limb, sometimes as high as forty feet from the ground. The eggs are two or three in number, white, and rounded.—Richard P. Grossenheider.

THE WILSON BULLETIN

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FOOD AND FEEDING HABITS OF MEXICAN HUMMINGBIRDS

BY HELMUTH O. WAGNER

HUMMINGBIRDS have been variously reported to feed on nectar alone, on nectar and insects in varying proportions, or (at least for limited periods) on insects alone. The viewpoint that hummingbirds feed chiefly on nectar, using insects only as occasional supplementary food, has steadily gained ground (Stresemann, 1927–34; W. Moller, 1930; Porsch, 1926–30). But this opinion is apparently based on merely casual observations, while the results of stomach analyses and field records published by a number of authors lead to a different conclusion.* Wetmore's very careful investigations (1916), in particular, deserve attention. He found 100 per cent animal content in 64 stomachs of three species of hummingbirds from Puerto Rico; while in 59 stomachs of two other species, 98.57 per cent of the contents was animal, 1.43 per cent vegetable. My own observations on the food and feeding habits of hummingbirds, as well as on the related activities, drinking, bathing, and cross-pollination of flowers, are given below. They are limited to Mexico and include data on 19 species.†

Variation In Food With Locality and Season

The food of hummingbirds is determined primarily by habitat and season. A given species may feed mainly on nectar or mainly on insects, depending on the time of year. The majority of the hummingbirds found in Mexico are not dependent on flowers, their migrations being determined by food supply in general rather than by the supply of a particular kind of food. When flowers are lacking, or when the food they provide is inadequate, hummingbirds live on insects and other small animal life.

In the high mountains, hummingbirds depend on animal food for the greater part of the year. They do migrate locally, avoiding the extreme temperatures of winter, but it is only during late summer when

* See, for example, Gould (1861) and the authors quoted by Bent (1940:319–472).

† Thanks are due to Dr. F. Miranda of the Biological Institute, University of Mexico, for identifying the plants; to W. J. Gertsch and C. H. Curran, of the American Museum of Natural History, New York, for carrying out the stomach analyses; to Dr. Erwin Stresemann for the encouragement that has led me to devote an increasing amount of my time to the study of this group of birds; and to Dr. Ernst Mayr for his invaluable suggestions and painstaking correction of the translation.

everything is in flower that they consume nectar in any quantity. Similarly, in regions with a pronounced dry season an adequate supply of nectar is available for only a few months of the year, and hummingbirds of such regions live chiefly on insects. These birds are, however—and probably without exception—also forced to make regular local migrations. They are found during the dry season in the gallery forests along the streams intersecting their range, where an abundant insect life ensures them adequate food the year round. Following the first rainfall in summer, when the arid regions and barren mountains are green and in blossom again, the hummingbirds return there, and then supplement their animal food with nectar.

On the other hand, there are some species that feed largely on nectar and are in consequence dependent on blossoming plants. I have found them only in the tropical regions of Mexico. Individuals of such species occur in the more northern regions only as summer residents. They do not occur in the high mountains or in areas with a pronounced dry season, even as visitants. Flowers the year round are for them a vital necessity, and consequently they can live only in regions, such as the tropical forests, where climatic changes are slight. Even here their specialized feeding habits force them to make regular local migrations.

An independent confirmation of the pronounced difference in food habits between tropical and highland hummingbirds is supplied by the following observations: On several occasions I took some 40 or 50 live hummingbirds from Mexico and the West Indies to European zoological gardens. En route they were fed the usual mixture of honey, raw sugar, etc. It was not possible to give them the live insects (*Drosophila* sp.) that they are fed in zoological gardens. In the course of years I found that species from the coast of Veracruz and from Havana fared better in captivity than those from the highlands of Mexico. Since species from the warm tropical coasts feed regularly on nectar, they can live without difficulty on the artificial food mixture, which is very similar to their natural food. The birds from the high mountains, on the other hand, had been feeding at the time of capture (March to April) almost entirely on insects. They readily took the syrup offered to them, but it was not an adequate substitute for the food they had been eating, and they soon died of an intestinal affection.

Data from zoological gardens show that Brazilian hummingbirds endure captivity especially well, surviving as long as two years. Since these birds come from the tropical valley of the Amazon, where they feed mainly on nectar, the artificial food given them in captivity suits their requirements.

Modes of Feeding

Hummingbirds feed while on the wing, whether they are extracting nectar from flowers, gathering insects from the vegetation, or capturing flying insects. Usually hummingbirds while perched will capture an insect only if they chance to see one in their immediate vicinity. I have seen but one species assume a perch for the purpose of feeding. In April, near Mexico City, I regularly observed Heloise's Hummingbird (*Atthis h. heloisa*) feeding at the blossoms of a large tree (*Erythrina americana*). They sometimes hovered before the blossoms but immediately perched on the stem whenever the position of the flower made this possible (Figure 1). Then they inserted the bill between the long bifurcate petals.

Nectar

On the Pacific coast of Chiapas, I observed two species of hummingbird that were predominantly nectarivorous. Near my camp, an enormous leafless tree was in full bloom. It was filled morning and evening with Cinnamomeous Hummingbirds (*Amazilia r. rutila*) and Prevost's Mangos (*Anthracothorax p. prevostii*). The two species divided the tree between them, the Cinnamomeous Hummingbirds taking complete possession of the lower branches of the tree, the Prevost's Mangos occupying the top. If a bird of either species crossed the invisible boundary line that divided the two parts of the tree, it was immediately driven back to its own territory.

From this tree I collected 2 Prevost's Mangos and 8 Cinnamomeous Hummingbirds; the stomachs and crops of all 10 specimens were filled with nectar, a thick whitish liquid, sweet and palatable. With the

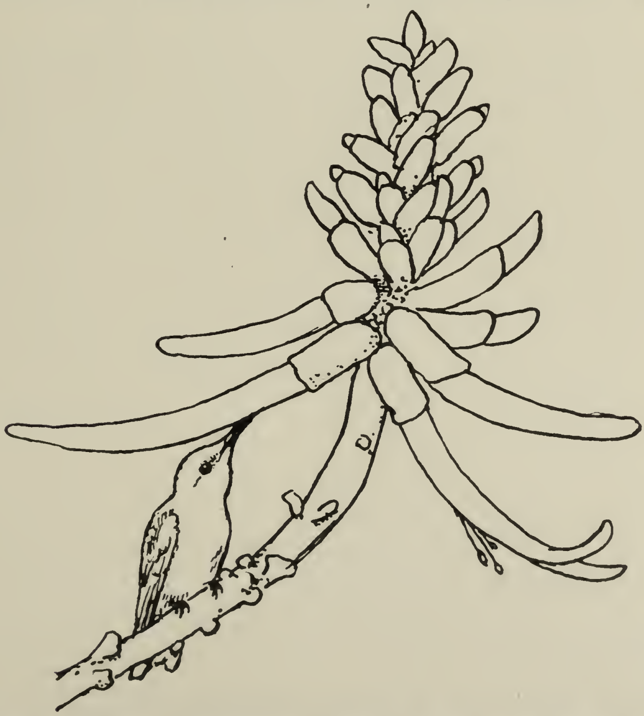

Figure 1. Heloise's Hummingbird feeding at the blossoms of *Erythrina americana.*

nectar a few insects had been taken by one of the Mangos, and two spiders by one of the Cinnamomeous Hummingbirds, but possibly only by accident.

Nectar is so very rapidly used up that large quantities must be stored in the crop for use in periods of inactivity—during the night and during the middle of the day when the temperature of the habitat often reaches 104° F. in the shade. It is known that captive hummingbirds drink daily a quantity of liquid equal to twice their own weight, but this actually tells us very little. In my experience, the amount of liquid consumed by captive birds varies with the sugar content. Since the syrup fed them is more concentrated than the rather watery nectar from flowers, the volume of natural nectar consumed is probably much greater than the amount of syrup determined for captive birds. The fact that carbohydrates are rapidly consumed is probably related to the fact that nectar is the chief food only for birds that live near the equator, where night is never longer than day. Only an insectivorous hummingbird, with crop well filled with insects, can withstand the long winter nights of the temperate zones when the temperature is below freezing. I have observed that captive hummingbirds fed on the honey solution were unable to survive 14 or 15 hours without food.

Insect and Other Animal Food

Most Mexican hummingbirds feed chiefly on insects, spiders, and other small animal life, but there is great variation in their methods of procuring such food. The method is largely determined by environmental conditions, though it also varies in part with the individual species. The prey may be extracted from tubular flowers, picked off from shallow flowers, captured in the air, or taken from crevices in bark, from young shoots, withered leaves, spider webs, fresh fruits that have burst open, and even from the surface of water.

Flowers as a source of food. Whenever possible most species procure their animal food from flowers. When flowers furnish abundant insects, hummingbirds only occasionally hunt them elsewhere.

The exact method of procuring insects from tubular flowers is unknown. Probably the tongue, thrust into the flower, gropes about until an insect adheres to it. The various shapes of tubular flowers are significant in relation to the birds' visits to them. When different types of such flowers bloom simultaneously at the same place, each is usually visited by a different species of hummingbird. In the mountains surrounding the Valle de Mexico, one finds at many spots in August and September the White-eared Hummingbird (*Hylocharis l. leucotis*) at *Salvia mexicana* and *S. polystachya,* the Mexican Violet-ear (*Colibri t. thalassinus*) at *Salvia mexicana* and *S. cardinalis,* while the Blue-throated Hummingbird (*Lampornis clemenciae*) visits only *S. cardinalis.* Convenience is apparently the determining factor. Each species visits the flower from which it can most easily obtain insects or nectar with its peculiar shape of bill. The calyces of *Salvia cardinalis* are too deep for the White-ear, and those of *S. mexicana* are so small that it is not easy for the large-billed Blue-throated Hummingbird to obtain food from them (although observations have shown that it is possible).

Many species choose shallow flowers when these are available, and the shape of the bill is then not a factor; I have seen species with long straight bills, short and thin bills, and even more or less curved bills, visit the same blossoms.

I have found no evidence for the theory that the long curved bill is a specific adaptation for feeding from certain species of flowers. In fact, not a single species of Mexican hummingbird is adapted to a specific shape of flower. This is not to say that the peculiar bill shapes did not originate as special adaptations during evolutionary development in a different environment. But probably such specialization is not possible in northern latitudes with their extreme climatic changes.

The theory that flowers of a certain color have a particular attraction for hummingbirds has often been discussed. Although the point is not a difficult one to settle by experiment, and observations by Woods (1927:306–307), Sherman (1913), and others seemed to contradict the theory, Bené (1941) was the first to prove conclusively that an innate preference for red does not exist in hummingbirds.

In the summer and fall of 1941, I conducted an investigation similar to Bené's. In a spot frequented by many hummingbirds, I hung several feeding flasks of the usual type covered with paper of different colors. At intervals of 30 minutes to an hour I measured the amount of syrup taken from each flask, in order to determine the comparative frequency of visits to the various colors. I found that the flask most frequently visited was always of the same color as the flower most visited at that particular season. It was purple in July when the purple *Pentstemon campanulata* was in full bloom and was visited by hummingbirds almost to the exclusion of other flowers. In October, when the dark blue *Salvia mexicana* was in bloom, the liquid in the dark blue flask was almost entirely used up, while the purple flasks that had been favored in July were frequently left full and untouched. Further evidence was the observation that, at a given place and time, each species of hummingbird would choose the flask of the color that corresponded with the color of its preferred flower then in bloom. Thus, in season, the Mexican Violet-ear showed a preference for red flasks, in accordance with its preference for the red flowers of *Salvia cardinalis;* while the White-ear, which visited the blue flowers of *S. mexicana* almost exclusively, patronized the blue flasks almost exclusively.

Summarizing his results, Bené says (p. 242): "Color preference may be conditioned by training, as when a hummingbird trained to feed on a colorless syrup remains constant to it, even when the colorless syrup is placed among feeders containing syrup of different colors." It appears that the same conditioning to a given color (varying with the species, the locality, and the season) occurs under natural conditions when a flower of that color provides particularly abundant food.

Hawking insects. The capture of insects by hummingbirds in flight is frequently doubted or else considered an exceptional phenomenon (e.g. Moller, 1930: 677). But I have often observed Mexican hummingbirds capturing insects in the air, and this means of procuring food is essential to some species at certain seasons.

Skill in capturing insects in the air, as well as the method employed, varies from species to species. The technique of capture used by a number of species is described in the following pages and illustrated in Figures 2 to 9. In each drawing, arrows indicate the direction of flight; a dot in the path of flight indicates that the bird hovered at that spot for a certain length of time.

Species that regularly capture insects in the air hover at a given spot and then suddenly dart forward about a meter's distance to seize an insect. Presumably the bird must be at a certain distance from the prey in order to see it and instantly dart upon it with accurate aim. How the bird seizes the insect is difficult to determine since the movement usually takes place too rapidly and at too great a distance from the observer to be accurately followed by the eye. I once observed under favorable conditions, and from quite near by, a Deville's Hummingbird (*Amazilia beryllina devillei*) capturing insects. This hummingbird did not make its capture by using the bill but by darting out the tongue for a fraction of a second so that the insect was caught upon it. Occasionally I saw the bill open to a 15- or 20-degree angle, but this seemed to occur after a successful attack, when the insect adhering to the tongue needed to be moved to the back of the bill.

Deville's Hummingbirds and Pale-crowned Star-throats (*Heliomaster longirostris pallidiceps*) spend the month of April in the gallery forests near Villa Flores in the dry areas of interior Chiapas, where the water level is very low at this season. Innumerable dipterous larvae develop in the many stagnant pools of the drying stream beds, and the insects dance morning and evening in thick swarms.

Deville's Hummingbirds were numerous at these spots and fed chiefly on insects caught in the air though I occasionally saw one hovering at the inconspicuous flowers of a Chalu tree (*Inga* sp.). They would perch on a small twig, some 8 to 15 meters above the ground, at a spot near a dancing swarm of insects, and from there make attacks on the swarm at intervals of three to five minutes (Figure 2). The bird approached the swarm by direct flight, hovered for an instant beneath it, then attacked an insect by darting obliquely upward. Whether the bird captured the prey or the insect escaped could not be determined from a distance, but the bird would hover at the spot for an instant and then attack anew in the same manner. After several flights directed obliquely upward (three to five, depending on the size of the swarm), the bird would reach a point above the insects, hover there for two to four seconds, then return to a point underneath the swarm and again dart upward through it capturing insects. Occasionally I observed two in-

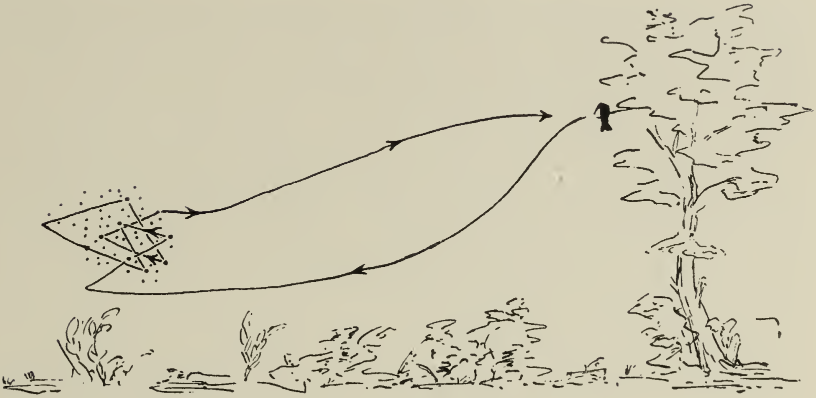

Figure 2. Deville's Hummingbird capturing flying insects.

dividuals of this species hunting alternately through the same swarm.

I have only occasionally observed insect-hawking by Pale-crowned Star-throats, which rarely appeared in my observation area. Like the Deville's Hummingbird, they use a look-out post to which they return after each series of captures. The bird flies out to the swarm of insects and remains for a few seconds beneath it to aim for the first victim (Figure 3). After each attack the bird hovers for an instant to take aim for the next insect. The method of capture is essentially the same as in Deville's Hummingbird, but the individual attacks are less sudden and swift and the line of flight curved. When the bird has reached the highest diptera, it returns in gliding flight to a spot beneath the swarm and again proceeds upward. When it has hunted through the swarm from three to five times, it returns to the look-out post on a

Figure 3. Pale-crowned Star-throat capturing flying insects.

curved line of flight. The length of each period of hunting probably depends on the number of successful attacks. In this species, also, I repeatedly saw the bill opened widely after an attack on an insect; this probably has no connection with the actual capture of the prey.

As a non-migratory forest dweller, De Lattre's Sabre-wing (*Campylopterus h. hemileucurus*) is dependent on locally available food. During the season when a certain ornithophilous flower (*Marcgravia* sp.) produces large quantities of nectar, the Sabre-wing feeds from this, either drinking the nectar or eating the insects caught in it. But during the rest of the year, when flowers are scarce, its chief food is animal, as stomach analyses show. I watched a Sabre-wing capturing gnats from a swarm that danced over a large forest brook (Figure 4). The bird hovered at a distance of 50 to 100 cm. from the swarm

Figure 4. De Lattre's Sabre-wing capturing insects from a swarm over a forest stream.

and then suddenly darted straight forward. It hovered a moment in the midst of the swarm, then flew back to its starting point. After some six or eight such sorties, it disappeared into the neighboring woods. Several times I saw what was probably the same individual capturing insects at the same place.

The Rieffer's Hummingbirds (*Amazilia t. tzacatl*) that occupied the garden of my house in Chiapas used the same method of capture. However, they also hunted assiduously in the blossoming orange trees, whose fragrance attracted countless insects. Blossoming plants were rare at the time of my observation (January and February) outside this small cultivated area, and hence another means of procuring food was necessary. With this species the habit of hawking insects was apparently so firmly fixed that they hawked—at least at this season—even where blossoming plants were plentiful.

In contrast with the species discussed above, there are some that wait on a perch until an insect comes within aiming distance. Heloise's Hummingbird hunts its prey in this fashion, darting out at an insect when it approaches within a meter or a meter and a half. The bird pauses for a fraction of a second at the spot where the insect has been caught. Usually it does not return to the same perch but goes to one near by. In the instance pictured in Figure 5, a female Heloise's Hummingbird perched again and again on the outermost tips of maguey (*Agave*) leaves. At the edge of a field bordered with maguey plants, several hummingbirds were busy capturing insects at the same time, each maintaining its own territory. Feeding conditions were favorable here because the larvae of the insects, a species of minute fly, developed in countless numbers in the damp mouldering stalks of the maguey plants destroyed by the pulque makers.

In the same group were also White-ears, which live in the high mountains of central Mexico and are among the few hummingbirds that remain (at least in part) in the breeding range even during the non-breeding season. To survive the food scarcity of winter (when the temperature is sometimes as low as 15° F.), as well as the hot rainless season from March to May, they must employ every possible method of procuring food. During much of the year, this species "gathers" almost all of its animal food, for the organisms that form its prey are mostly sedentary in cold and inclement weather. But occasionally it

Figure 5. Heloise's Hummingbird capturing single insects along a field border.

catches insects in the air—which it is able to do with great dexterity. It waits on a perch until an insect approaches within 30 or 40 cm., then suddenly pounces upon the prey, hovers for a moment, and returns to the same perch or, exceptionally, to one near by. Very rarely—apparently after missing its prey—it makes a second attack from closer range. The attempts at capture occur at intervals whose length apparently depends on how often an insect comes near the bird. Occasionally they occur in quick succession, as I have observed when a White-ear was perched near a swarm of gnats dancing in the sun. It would remain only two to four seconds on the perch before aiming at new prey.

Besides the habitual insect hawkers noted above, I observed a number of occasional hawkers—so described not only because I rarely observed them hawking, but also because their technique (as shown by the frequency of unsuccessful attempts) was less well developed.

To this group belongs the Mexican Violet-ear, which is very common in late summer in the mountains surrounding the Valle de Mexico. It obtains its food mainly from flowers, and most individuals of the species migrate as soon as flowers in the high mountains begin to diminish in fall. A few males remain for the winter in especially favorable localities (Wagner, 1945:166), but even these feed chiefly in the sparse *Salvia cardinalis, S. elegans,* and *Calamintha macrostema,* which in sheltered places do not freeze. Rarely, however, I have observed a Violet-ear awkwardly catching insects in the air. On one occasion, when the conditions for observation were extremely good, the hunting took place from a perch in an oak sapling. Near the tree danced a small swarm of gnats in which my eye could follow the movements of individuals. Again and again I saw the hummingbird miss a gnat for which it had aimed or a gnat evade capture at the last moment. The Violet-ear perched on the outermost tip of a twig and waited until an insect approached, then took aim and darted forward—usually with negative results. Before returning to its perch, the bird usually made several attempts at capture, hovering momentarily each time to take aim at the nearest insect. Several such sorties are shown in Figure 6.

The Broad-tailed Hummingbird (*Selasphorus p. platycercus*), which is common in the Valle de Mexico, especially in late summer, has still another technique. I have on a number of occasions watched this bird catching insects from a perch on the tip of a corn stalk. Apparently seeing an insect, the Broad-tail would fly to a point some three to five meters away, then turn sharply, and suddenly begin darting back and forth, hovering for an instant before each change of direction (Figure 7). After several such attempts to capture one insect (whether with or without success did not appear), the Broad-tail would suddenly dart after another that came in sight a few meters away. It repeated this a few times before returning to its perch on the corn stalk. This occurred at a season (August and September) when there was no lack of

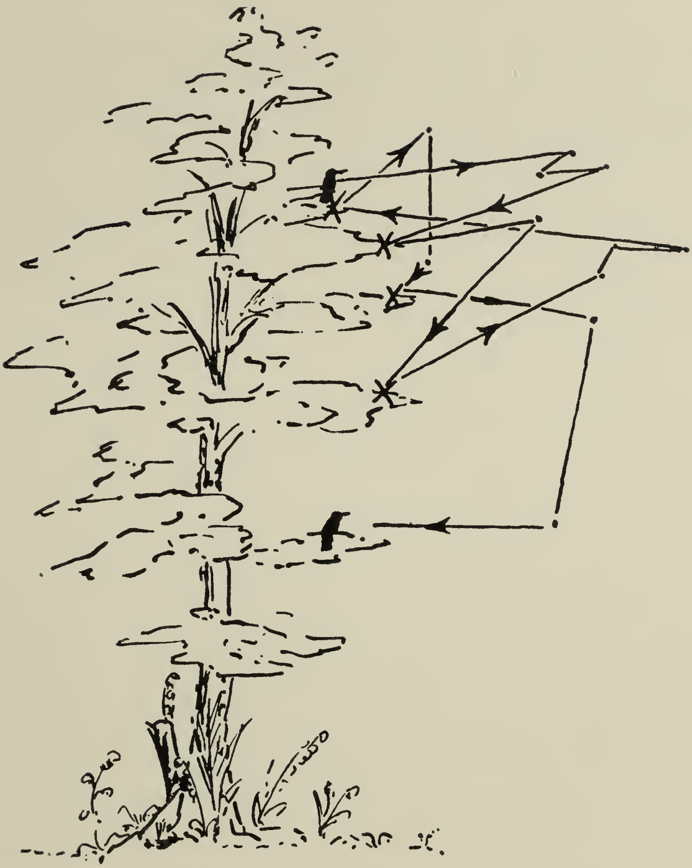

Figure 6. Mexican Violet-ear capturing flying insects that pass its perch.

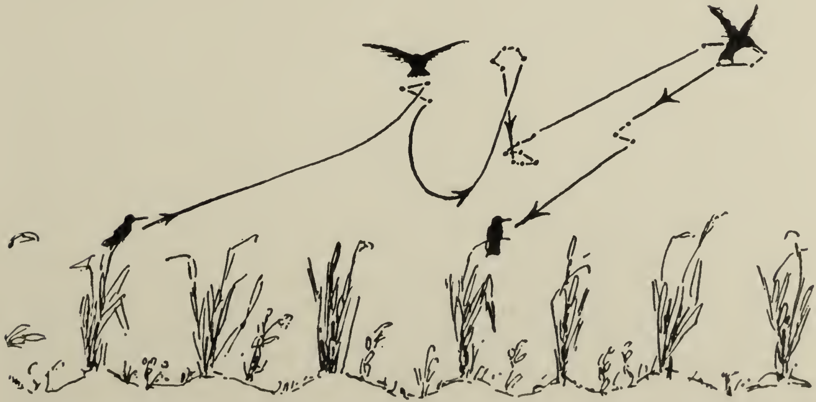

Figure 7. Broad-tailed Hummingbird capturing insects above a cornfield.

flowers holding a rich medley of insects. I never saw Broad-tails capturing insects in the air when feeding conditions were unfavorable; instead they always "gathered" them. And I consider these instances of their hawking merely a form of play.

Rivoli's Hummingbirds occasionally capture insects in the same manner. In contrast to the quick, darting flight of other species, that of Rivoli's Hummingbird is slow, almost deliberate. In the spring, in the Valle de Mexico, I observed Rivoli's Hummingbird attacking the diptera dancing in the sun a few meters from its perch in the top of an oak or pepper tree (Figure 8). After flying out to the insects, the bird moved back and forth in almost horizontal flight, attacking insects at ranges of 20 to 40 cm. It is amazing to see this species turn from one direction to another while hovering at one spot.

The Blue-throated Hummingbird has a different method of capture from those described above. The bird darts here and there to the points where it sees its prey, without hovering even an instant when it changes direction. In the mountains, early one morning in October, I saw a Blue-throat attempting to capture a few flying insects from a perch in the top of a spruce some 20 or 25 meters high (Figure 9). The bird was not a skillful hunter, and it zig-zagged back and forth again and again, apparently in an attempt to capture a single insect. When the weather is inclement and flowers scarce after this hummingbird arrives in the high mountains in spring, it obtains the necessary food by gathering small animal life from bark and vegetation; capture of insects in the air is of minor importance to the species.

Collecting food from bark, vegetation, spider webs, and fruit. When gathering animal food from various surfaces and crevices, a hummingbird first sees the prey, hovers to take aim, then suddenly pounces. The importance of this "gathering" method varies greatly, from species such as Abeillé's Hummingbird (*Abeillia abeillei*), which takes only an occasional insect that it happens to see, to those such as the White-ear, which hunts its food almost entirely in this manner.

The short bill of Abeillé's Hummingbird (measuring between 9 and 11 mm.) is less suited to obtaining food from flowers than that of most other hummingbirds. I have often observed the species in the humid primeval forest of Chiapas; it lives in the half-darkness of the undergrowth beneath the tall thick-crowned forest trees and is very rarely seen more than a few meters above the ground. Only a few and rather inconspicuous flowers grow in this habitat. In May the arum plants (Araceae), with their large, thickly-flowered spadices, are in bloom, and Abeillé's Hummingbird is then seen gathering the insects attracted to these flowers by their fragrance. But they usually hunt their food on leaves and young shoots. I have also seen them moving in their characteristic hovering flight up and down the trunk of a tree, stopping suddenly to pick an insect from a crevice, from moss, or from

Figure 8. Rivoli's Hummingbird capturing diptera near its look-out in a treetop.

Figure 9. Blue-throated Hummingbird capturing flying insects.

a smooth stem. Microscopic analysis of the stomach contents of two of these birds collected in May showed only fine insect pulp with no admixture whatever of vegetable substance.

Unlike Abeillé's Hummingbird, the White-ear has a bill well adapted to procuring food from flowers, but individuals of the species that do not leave their mountain habitat in fall obtain their food for seven months of the year from crevices in bark, from withered leaves, and similar places. Sleet storms, or heavy snows, which occur occasionally and cover the prey, may have catastrophic results. Only a fraction of the normal White-ear population will be found in such areas in the next breeding season. In mild winters, plants such as *Euphaterium glabratum, Stevia salicifolia,* and *Physalis acuminata* begin to bloom in well-protected spots as early as January, and where these are available, the White-ear obtains the greater part of its insect food from their minute flowers. In spring, the new green spruce shoots are a productive source of food. A small species of aphid (plant louse) is then found in great abundance among the needles and attracts this and other species of hummingbirds. I also once watched a male White-ear picking around in a spider's nest where the young were hibernating. The disturbed young spiders ran in all directions from the nest and were captured one by one.

In May, when the Blue-throated Hummingbird returns to its breeding range in the vicinity of the Capital, no flowers are in bloom, for the rains have not yet begun. The species then resorts to the new green spruce shoots to find its food. In a few places *Salvia elegans* and *Bouvardia ternifolia* grow under the trees, but the hummingbirds do not visit them, apparently because they are a much less productive source of food during the drought than spruce shoots. Examination of 50 blossoms from these plants yielded only three insects, two of them very small.

In the high mountain rain forest of Chiapas, the Guatemalan Cazique (*Lampornis amethystinus salvini*) hovers at thick moss-covered tree trunks looking for small animal prey. For some time it rises and sinks in hovering flight for a distance of about 30 cm. along the trunk, then suddenly stops for an instant and quickly projects its tongue to capture the prey. The next instant the bird is rising and sinking again in steady quiet flight at a place farther along the same trunk. In the spruce woods near the Capital, I observed another race of this species, *Lampornis a. amethystinus.* Usually it fed at flowers, but occasionally I saw it hunting along tree trunks.

During the dry season Rieffer's Hummingbirds occasionally come to the coffee plantations. They hunt over the young coffee shoots for small animal organisms and gather the insects caught in spider webs among the twigs. Near Mexico City I noticed a female Elliot's Hummingbird (*Atthis heloisa ellioti*) in July eagerly hunting food among spruce shoots. Since at this season there was no lack of flowers there, I assumed that the bird was hunting spiders for its young.

Some Broad-tailed Hummingbirds breed in the neighborhood of the Capital from the end of September through November. The breeding territories are frequently in the Petregal lava fields, which have a luxuriant vegetation during the rainy season. At the time of the birds' arrival everything is in full bloom. But in many years the dry season begins so early that when the young are developing and require abundant nourishment, the greater part of the flowers are already withered. At such times I saw the females seeking food among dry shrubs and foliage. The numerous males go elsewhere (exactly where is unknown) as soon as feeding conditions become unfavorable, whereas the females are held to the spot until their young are independent and can leave with them.

On several successive days I observed Prevost's Mangos feeding at the dried out, open fruit husks of a certain tree. They hovered about the bare branches, stopping at the old husks, apparently feeding on various small animal organisms.

Ripe fruit is also occasionally a source of insect food. Thus in May, in Teotitlan, Oaxaca, I regularly observed Dusky Hummingbirds (*Cynanthus sordidus*) at the burst open fruits of the candelabrum cactus (*Cephalocereus*). Stomach analysis proved that the birds consumed only animal food, disregarding the sweet watery pulp of the fruit. I had supposed that this juice was taken like nectar, since the feathers about the base of the bill were sticky with the substance.

In the coffee plantations, open stands of Chalu trees (*Inga* sp.) are cultivated as shade trees, and these are in bloom for a week or two in March. The small pale green flowers are far less conspicuous than pear blossoms but resemble them in structure. With a twig in the hand, one can readily see the great numbers of insects that crawl about the blossoms. When these trees are in bloom, hundreds of hummingbirds visit the coffee plantations, which at other times are visited by only an occasional individual. I have estimated 10 to 15 hummingbirds to a thousand square meters. They stream in from all directions, the radial distance depending on the type of terrain but estimated to extend up to 20 kilometers. They gather during the first week of the blossoming in constantly increasing numbers from the surrounding forest, from the oak-pine forest lower down, and from the savanna, which at this season is quite parched and dry. I have watched the following species collecting insects at these trees: De Lattre's Sabre-wing; White-bellied Emerald (*Amazilia candida*); Deville's Hummingbird—in numbers; Red-billed Azure-crown (*Amazilia c. cyanocephala*)—in great numbers; Pine Star-throat (*Heliomaster constantii leocadiae*); Dupont's Hummingbird (*Tilmatura dupontii*)—in numbers; and Dusky Hummingbird. As soon as the blossoms fall, the birds disappear.

Capturing insects from the surface of water. I have only once observed a hummingbird capturing insects from the surface of water. I was unable to identify the bird positively, but it was probably a Red-billed Azure-crown, which at that place was very common. (Anyone who has done field work in the Tropics knows how difficult identification is when there is no distinctive peculiarity of pattern or form. The light usually makes color recognition impossible.) The bird appeared suddenly and hovered some 50 cm. above a quiet spot in a mountain stream. At intervals of 5 to 20 seconds, the bird darted upon the small aquatic hemiptera (*Rhagovelia* sp.) moving along the surface of the water. The bird hovered there for a brief instant and rose again. After three to six of these attempts it would disappear for a few minutes in a tangle of vegetation, then return to resume its hunting.

Composition of animal food. The animal food consumed by hummingbirds includes all sorts of small organisms, size, apparently, being the only limitation—bugs, flies, gnats, and plant lice, mosquitoes, leaf hoppers, ants, parasitic wasps, beetles, weevils, spiders, daddy-long-legs, as well as other organisms, have been found in analyses of stomach contents (Wetmore, 1916:70–73; Cottam and Knappen, 1939:160–162; Beal and McAtee, 1922:13–15). I have found that diptera often constitute the major portion of the diet of hummingbirds. This is not necessarily because the hummingbirds have a preference for them; the habits of the diptera may make them easy prey. In some species, as shown by crop analysis, spiders constitute a large proportion of the food given to the young during the first weeks.

It is surprising how large an insect a hummingbird can swallow. Mosquitoes of the genera *Anopheles* and *Culex,* which are quite bulky, were captured in flight and apparently swallowed whole. The largest prey that I have found intact in the crop of a White-eared Hummingbird was a spider of the genus *Neosconella.* The total length was 4.8 mm.; the body diameter, 2.6 mm. In the crop of a Blue-throated Hummingbird, which is larger than the White-ear, I found, in addition to many large diptera, a spider of the genus *Metepeira* 5.4 mm. long.

Formation of pellets. I have twice found pellets (consisting of chitin) in the stomachs of hummingbirds. Fine pieces of chitin are ground by ordinary stomach action and excreted through the intestine, as analysis of feces shows. But pieces of chitin too large and hard for digestion are apparently regurgitated in the form of pellets. I found both pellets in March, when the drought was most severe and the species I encountered were feeding entirely on animal prey. A specimen of the Red-billed Azure-crown had in its stomach a round pellet, 4 mm. in diameter, made up entirely of coarse pieces of chitin pressed tightly together. The other pellet, found in a specimen of the Pine Star-throat, was the same size, but rather more oval in shape. Wetmore (1916:73) says that Green Mangos (*Anthracothorax viridis*) "undoubtedly regurgitate waste matter, in the form of pellets, from which the nutriment has been digested. Several of these, 2 millimeters long by 1 wide, ready to be expelled, were found on opening the stomachs, and in each case consisted of a firmly compressed pellet containing chitinous fragments of insects and spiders."

Drinking and Bathing

Hummingbirds drink and bathe far more often than is generally supposed. When nectar is abundant, they doubtless have little need of water to quench their thirst—which would explain why they are rarely seen drinking except during the dry season, when they are feeding on insects.

In the vicinity of the Capital in winter and spring, I regularly saw White-ears drinking and bathing in a forest stream. At the foot of a small gorge, there was, during the latter half of the rainy season, a waterfall with a drop of some five meters over rocks; this, during the dry season, became a mere trickle of water. The White-ear would hover near the tiny fall and plunge its tongue into the water. After drinking several times in this manner, the bird would disappear unless a bath was to follow. This is the simplest and easiest method of drinking but not always possible, and the White-ear employs others. It will hover close above the surface of a stream, then suddenly plunge downward, rising again immediately. Thus, for an instant, either the bill or the tongue is dipped. The White-ear also drinks when it has settled in shallow water to bathe; then only the tongue is dipped. Elliot's Hummingbird quenched its thirst in a similar way (Figure 10), but it remained hovering close above the water for a longer time and from that position dipped its tongue or bill, causing each time a tiny ring to appear on the water.

When bathing at the waterfall described above, the White-ears would hover beneath a spot where the water fell drop by drop and thus in a minute or two become quite wet. They would then perch on a

Figure 10. Elliot's Hummingbird drinking.

sunny twig, spread their wings and tail, and preen and arrange their feathers as they dried in the sun. A female Blue-throated Hummingbird that was building a nest in the gorge bathed in the same fashion. Three times in one morning she bathed, preened, and arranged her feathers—apparently because she frequently gathered nest material from steep overhanging slopes and trunks, and her plumage was soiled by the dust and dirt she dislodged.

White-ears also bathe at shallow spots in small streams, alighting in the water and splashing their feathers. Rising from the water again seems to cause them no difficulty. Some mornings after the sun was up I would see two or three hummingbirds bathing and drinking together. C. C. Lamb (1925:90) observed nine Xantus Hummingbirds (*Hylocharis xantusii*) bathing at the same time. They would sit in the water and splash themselves with their wings, then fly into a tiny waterfall near by. I twice surprised several Red-billed Azure-crowns bathing early in the morning at a curve in a small stream where the water was shallow and the shore sandy. They seemed to be familiar with the spot, for they alighted in the flowing water without hesitation.

One of the White-ears that I held captive would bathe at once when in the mornings I put a saucer of water in the cage. Its cage mates (of the same species) paid no attention to the water—perhaps because they were liberally sprinkled with water while the other was bathing. I have never observed hummingbirds drinking dew drops or flying through wet leaves to dampen their feathers (see, for example, Woods, 1927:307; Skutch, 1931:482).

Cross-pollination by Hummingbirds

The importance of hummingbirds to pollination of flowers is far greater in tropical South America than in Mexico. Since hummingbirds probably immigrated to Mexico in relatively recent times, it is understandable that there are very few ornithophilous plants * in Mexico compared with the abundance there of plants primarily adapted to pollination by insects. The ornithophilous plants of Mexico are without exception also immigrants from tropical South America.

The Marcgravia group of ornithophiles has a wide range in the tropical belt of the continent. Southern Mexico is the northernmost limit of their range, and only two species are known from there: *Marcgravia mexicana* and an unnamed species discovered by F. Miranda in northern Oaxaca, shown in Figure 11. The Marcgraviae are epiphytic, a character that limits them to the rain forest where the humidity is high. They thrive on more or less horizontal branches in the crowns of the forest trees. The flower of the Mexican species is a chandelier-like inflorescence with the fertile blossoms—numbering 120 to 150—arranged

* In my opinion, the term 'ornithophilous' is correctly applied only to flowers that are phylogenetically adapted to pollination by hummingbirds, not to those originally adapted to pollination by insects and whose evolutionary development is in no way correlated with birds.

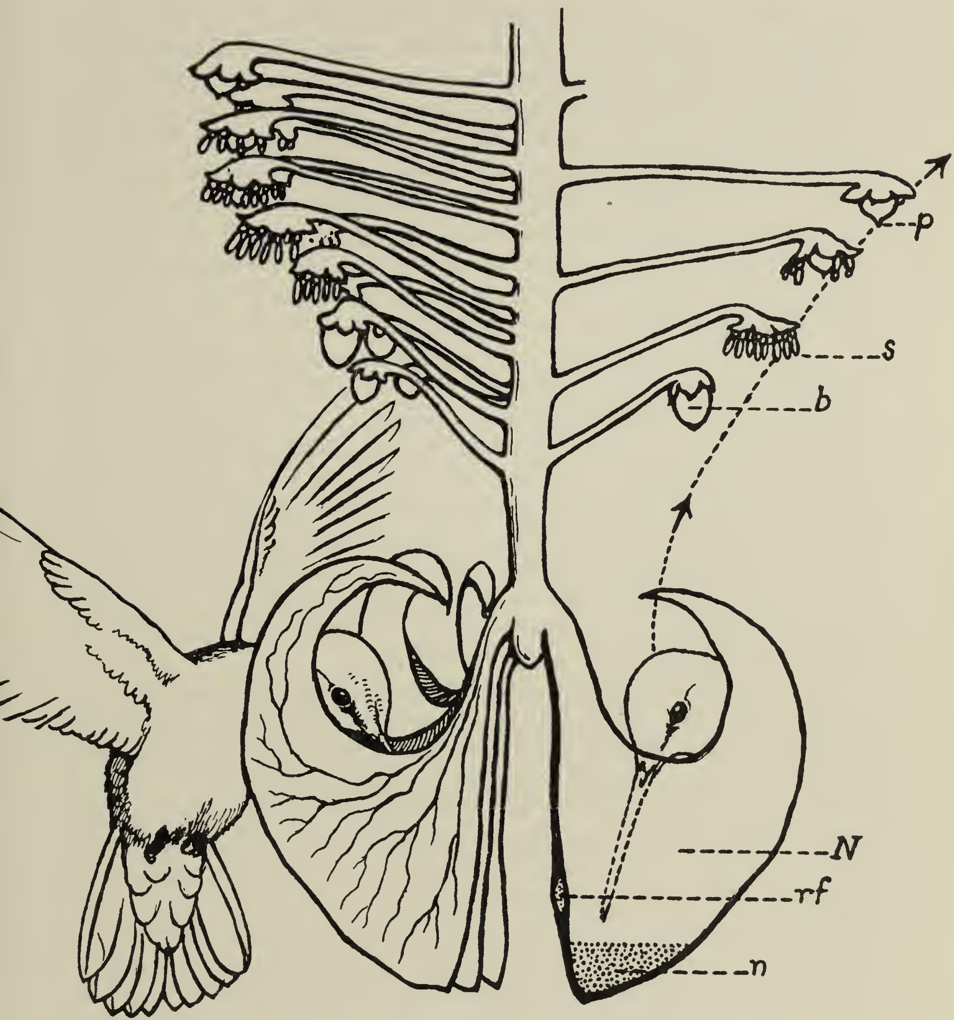

Figure 11. Hummingbird feeding at a flower (*Marcgravia* sp.). *After* F. Miranda. p = pistil; s = stigma; b = bud; N = nectary; rf = rudimentary flower; n = nectar.

on long thick stalks (pedicels) about the upper part of the hanging main axis (rachis). These blossoms face downward at right angles to their pedicels, which, in turn, are arranged at right angles to the rachis. These fertile blossoms are protandrous, that is, in each blossom the pollen-bearing anthers develop first, the stigmas later. The blossoms at the lower tip of the hanging inflorescence (morphologically speaking, the *upper* flowers) are abortive; the pedicel and bract of each are transformed into a narrow bag-like nectary with a horn-shaped extension above and a pointed lower end where quantities of honey collect.

Because of the upward curving horns of the nectaries, a hummingbird seeking honey is forced to push close to the central axis of the inflorescence between two nectaries. In moving away again, its flight upward and backward brings it in contact with the fertile blossoms above, so that pollen is brushed from the anthers of blossoms in the first stage of development and picked up by the stigmas of blossoms in the second stage. The path followed by the bird's forehead is indicated by dots on the sketch. The shape of the nectary prevents flight directly backward once the bird's bill has been inserted.

Ornithophilous flowers such as *Marcgravia* produce nectar in great quantities, which is the reason that the flower is visited. This is not generally true of flowers originally adapted to pollination by insects. Their small supply of nectar is readily taken by birds, but for the most part it is insects that are attracted to such flowers either by the nectar or by the structure of the flower (as a hiding place and shelter).

In two plants—*Centropogon cordifolius* (Lobeliaceae) and *Lamourouxia exserta* (Scrophulariaceae)—I was able to study both the structure of the blossoms and the manner of their pollination by hummingbirds. (Both plants are also frequently pollinated by large insects, notably bumblebees of the genus *Bombus*.)

In *Centropogon cordifolius* the pistil reaches maturity only after the stamens have withered. When the stamens are mature they droop forward in such fashion that the crown of a hummingbird coming to sink its bill in the flower grazes them in passing and is covered with pollen (Figure 12). Hummingbirds that have hovered at these shrubs wear broad caps of pollen. The stamens wither in a few days and tilt upward, making room for the pistil, which now increases in length and droops forward, the stigmas coming in the way of the crown of a bird feeding at the flower. When a hummingbird comes to a flower in the second stage of development after having visited a flower that is still in the first stage, the stigmas brush pollen from the bird's crown, and thus fertilization is accomplished. Pickens (1927) describes and illustrates the pollination by the Ruby-throated Hummingbird (*Archilochus colubris*) of a flower (*Macranthera LeContei*) that has similar stages of development.

Centropogon cordifolius produces only a small quantity of nectar. Insects and other small animal organisms come to the blossoms less for the nectar than for shelter from inclement weather. Mornings before the sun begins to shine there are four times as many insects and other small organisms in such shrubs than later when it becomes warmer—which explains the large number of birds attracted during the early part of the day.

In the mountains near the Capital, above 3,000 meters, my interest was aroused by several Violet-eared Hummingbirds with crowns yellow

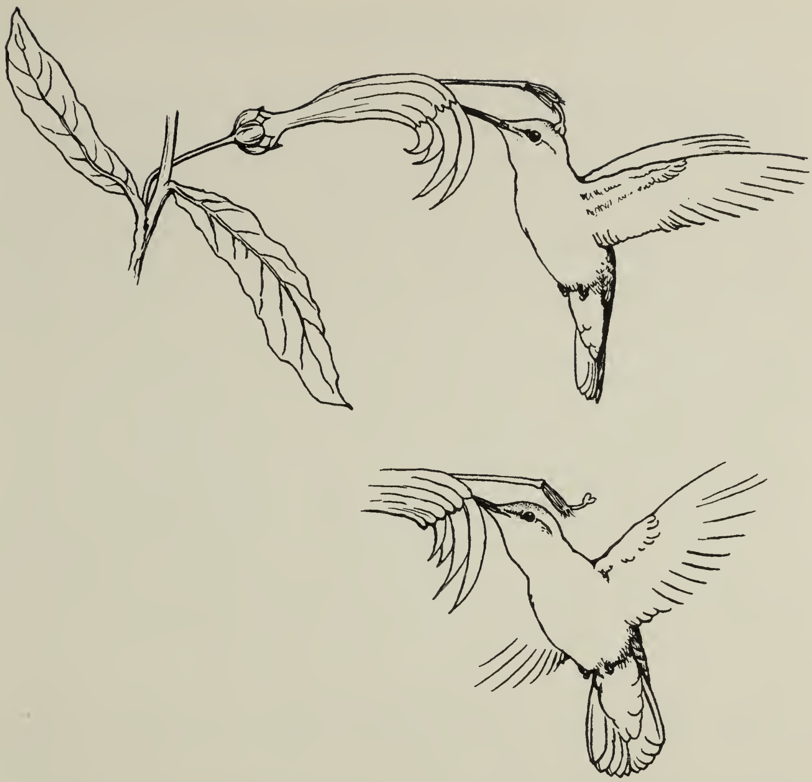

Figure 12. Hummingbird feeding at *Centropogon cordifolius. Upper.* During the first stage of the flower's development, when the bird's crown brushes the pollen-bearing anthers. *Lower.* During the second stage of the flower's development, when the stamens have withered and the bird's pollen-covered crown brushes against the stigmas.

Figure 13. Hummingbird feeding at *Lamourouxia exserta.* The tuft of stigmas brushes the flower's own pollen, or pollen brought from another flower, from the bird's forehead. In the flower shown here, the stamen is not fully developed, and only cross-pollination can occur.

with pollen, and I observed another typical example of pollination by hummingbirds. *Lamourouxia exserta* is a small bush with red and yellow flowers that thrives both in woods and in clearings. It is very resistant to frost and blooms in January and February. The nectaries produce honey only in small amounts and only during the first few days. After that the hummingbirds are attracted by the insects that have sought shelter in the blossoms. The stigmas of each blossom are ready for the pollen before the stamens produce it, although for a short time both parts are mature so that if cross-pollination has not occurred, self-pollination may be possible. When the petals have opened, a small capsule bursts, releasing a brush-like stigma. This tuft brushes the pollen from the forehead of a bird that has visited a flower in a later stage of development as shown in Figure 13. Later, the four stamens mature and droop forward. The stigma then withers, while the stamens remain in the middle of the calyx and continue to cover visiting hummingbirds with pollen. At this time the production of nectar ceases. Neither the flowers of *Centropogon* nor of *Lamourouxia* are strictly ornithophilous, since insects are in both cases the primary agents of pollination.

Conclusions

Many investigators of the bill and anatomy of the tongue of hummingbirds are of the opinion that nectar is the birds' chief food. But, as we have seen, most field observation and stomach analyses do not support this opinion.

Granted that flower visiting, with its associated consumption of nectar and small insects, is the favored mode of feeding, it is not a vital factor for the majority of Mexican species. With them, on the contrary, the vital factors in the struggle for existence are frequently the capture of insects on the wing and the various methods of "gathering" insects.

Phylogenetically the shape of the bill is presumably an adaptation to the extraction of small animal life from tubular flowers. (The ontogeny of the bill, tongue, and stomach anatomy, as well as the food given the young during the first weeks, shows that the original food was animal.) I imagine that the taking of nectar and the correlated transformation of the tongue first began when the form of the bill had become so modified that it easily reached the nectar in the flowers. Then, with the progressive development of the tongue as a pump, nectar became more important as a food. The bird's preference for nectar is not surprising. If a captive bird is given the choice between sweetened water and pure water, it uses the sweetened, and the amount of liquid taken by the bird daily is greatly increased.

In connection with food we can distinguish three stages in hummingbird phylogeny:

1. Insect food as the chief item of diet
    a) Captured in flight with a broader bill—indicated by the

morphology of the young and the hummingbirds' relationship to the swifts.

b) Extracted from flowers with a bill becoming progressively longer as it adapts itself to this mode of feeding.

2. Nectar as the chief item of diet
The tongue develops into a highly specialized pump.

3. Return by a certain number of species to insects as major item of diet

The third stage is contemporary. We are familiar today with all the transitions, from birds that feed chiefly on nectar to birds that feed almost exclusively on insects. There is no evidence so far of any morphological adaptation to the renewed preference for animal food, but this is not surprising, since it is a well-known phenomenon of biology that when an organ has reached a high degree of specialization it seems to have less plasticity for radical transformation.

The fact that hummingbirds hover while procuring their food, even when capturing insects in the air, is also significant. I have never observed them catching insects in the manner of swifts, swallows, or flycatchers. This fundamental difference in method of insect capture indicates that hummingbirds developed their present method after they had in the course of their evolution become adapted to other modes of feeding.

There remains the question of what made the change in feeding habits necessary. The family Trochilidae originated in tropical South America, perhaps late in the Cretaceous or in the early Tertiary—at any rate, at a period of exceptionally stable tropical climate (Mayr, 1946). This permitted an adaptation to a diet consisting largely of nectar, and not subject to shortage caused by the pronounced flowering seasons that characterize all temperate, and even subtropical, regions. The deterioration of the climate in the latter part of the Tertiary, and the development of pronounced seasons nearly everywhere except in a small portion of the tropics, favored a return to a greater utilization of insects. This was particularly true for the species that had colonized subtropical and temperate zones, where nectar food was not available at all seasons. Such species either became migratory or adapted themselves to a seasonal diet of insects.

Summary

Observations were made on 19 species of Mexican hummingbirds to determine the composition of their food, techniques of procuring food, manner of drinking and bathing, and method of pollinating ornithophilous flowers.

The food of hummingbirds is determined by the ecological conditions under which the individual species live. Every degree of dif-

ference occurs between feeding, at least temporarily, exclusively on animal food to feeding temporarily exclusively on nectar.

In areas with pronounced dry seasons, in the high mountains, and in the temperate zones, a medley of small animal organisms constitutes the principal food. In many of these regions the birds migrate at seasons of unfavorable feeding conditions. In tropical habitats, nectar predominates in the food.

Under natural conditions, hummingbirds are conditioned to the color (varying with the species, and with locality and season) that corresponds with the color of the flower that is the most productive source of food.

As long as nectar from flowers is available, it is the preferred food. When the supply of nectar is inadequate, insects are eaten, preferably from flowers, but when these are insufficient, hummingbirds are forced to feed on insects gathered from other vegetation and from crevices, or captured in flight.

Hummingbirds feed while on the wing whether they are extracting nectar or insects from flowers, gathering insects from the vegetation, or capturing flying insects.

The method of capturing insects in flight varies from species to species.

The animal food consumed by hummingbirds includes all sorts of small organisms, size, apparently, being the only limitation.

Pellets are formed of the larger pieces of chitin and regurgitated.

Hummingbirds drink and bathe far more often than is generally supposed.

Two flowers especially adapted to pollination by hummingbirds occur in Mexico (*Marcgravia* sp. and *Marcgravia mexicana*). Both hummingbirds and ornithophilous plants are tropical in origin, having spread in recent times into Mexico from the south. In many cases where pollination by hummingbirds occurs, pollination by insects is also possible.

Hummingbirds were originally insectivorous. At a later stage of development, nectar became their principal food. Paralleling this change, the tongue developed as a suction pump. With the general deterioration of climate in the latter part of the Tertiary and the colonization by hummingbirds of the subtropical and temperate zones, certain species were forced to return to a greater utilization of insects as food.

Literature Cited

Beal, F. E. L., and W. L. McAtee
1922 Food of some well-known birds of forest, farm, and garden. *U. S. Dept. Agric. Farmers' Bull. No.* 506 (revised ed.).

Bené, Frank
1941 Experiments on the color preference of Black-chinned Hummingbirds. *Condor,* 43:237–242.

Bent, Arthur Cleveland
1940 Life histories of North American cuckoos, goatsuckers, hummingbirds, and their allies. *U.S. Natl. Mus. Bull.* 176.

Cottam, Clarence, and Phoebe Knappen
1939 Food of some uncommon North American birds. *Auk,* 56:138–169.

Gould, John
1861 An introduction to the Trochilidae, or family of humming-birds. London.

Lamb, Chester C.
1925 Observations on the Xantus Hummingbird. *Condor,* 27:89–92.

Mayr, Ernst
1946 History of the North American bird fauna. *Wils. Bull.,* 58:3–41.

Miranda, F.
1944 Los secretos de las flores. *Folletos de divulgación cientifica.* Instituto de Biologia, Chapultepec, D.F.

Moller, W.
1930 Über die Schnabel- und Zungenmechanik blütenbesuchender Vögel I. *Biol. Generalis,* 6:651–726.

Pickens, Andrew L.
1927 Unique method of pollination by the Ruby-throat. *Auk,* 44:24–27.

Porsch, O.
1926–30 Kritische Quellenstudien über Blumenbesuch durch Vögel. *Biol. Generalis,* 2–6.

Sherman, Althea R.
1913 Experiments in feeding hummingbirds during seven summers. *Wils. Bull.,* 25:153–166.

Skutch, Alexander F.
1931 The life history of Rieffer's Hummingbird (*Amazilia tzacatl tzacatl*) in Panama and Honduras. *Auk,* 48:481–500.

Stresemann, Erwin
1927–34 Aves. Handbuch der Zoologie, vol. 7, part 2. Berlin.

Wagner, Helmuth O.
1945 Notes on the life history of the Mexican Violet-ear. *Wils. Bull.,* 57: 165–187.

Wetmore, A.
1916 Birds of Porto Rico. *U.S. Dept. Agric. Bull. No.* 326

Woods, Robert S.
1927 The hummingbirds of California. *Auk,* 44:297–318

Apartado 7901, Sucursal 3, Mexico, D. F.

SPECIATION IN THE WHITE-CHEEKED GEESE *

BY JOHN W. ALDRICH

IN an attempt to identify certain specimens of white-cheeked geese from various parts of the United States it was necessary to review all of the forms, using the specimens in the United States National Museum and others, borrowed from various collections, totaling 254 birds.† With a few exceptions the results of the study bore out the conclusions of Taverner (1931) and Todd (1938). The results reported here are for the most part supplementary, rather than contradictory, to their findings.

Variation trends.—When specimens of white-cheeked geese are arranged by color and size, the following geographic trends are noticeable: increasing size from north to south; and increasing darkness from east to west, except in the more southern regions of the breeding range, where the geese show the pallor usual in arid plains and basin country. In other words, the smallest geese are those that breed on the Arctic tundra, the largest those that dwell in the more southern, forest and grassland, regions; pale geese breed in the Atlantic maritime region, while darker geese occur in the interior, from Minnesota north to Hudson Bay, where the trend is reversed, so that the palest of all white-cheeked geese are found in the plains and basin country from Lake Athabaska southward, and west to Utah and eastern California, Oregon, and Washington, with then a rather abrupt change to the darkest white-cheeked geese breeding on the Pacific coastal strip of western and southern Alaska and British Columbia.

Speciation.—On the surface, such trends look like normal subspecific variation. However, naturalists and Eskimos alike have observed sharp differences in the behavior of the birds which seem to indicate that two distinct species are involved. In the vicinity of the seacoast, in the eastern Arctic as well as in the western Arctic (coastal Alaska, and apparently certain islands of northeastern Asia), two kinds of geese breed close together. They differ from each other in voice, nesting habits, habitat, and time of migration, as well as in color and size. In both regions, the voice of the smaller goose is described as a cackle, distinct from the honking of the larger birds. The cackling goose nests on small islands in ponds near the coast, while the larger one usually nests on higher ground a considerable distance inland, and, at least in the north country, frequently in willow thickets along streams. There is an almost unanimous agreement among those who have studied these birds on their breeding grounds that in both the Hudson Bay and Alaskan

* The term "white-cheeked geese" is used to include all of the races formerly included under *Branta canadensis*, not merely to refer (as in the fourth edition of the A.O.U. Check-List) to *Branta c. occidentalis*.

† For the loan of specimens I am greatly indebted to the National Museum of Canada, Carnegie Museum, Philadelphia Academy of Natural Sciences, Museum of Comparative Zoology, and the American Museum of Natural History.

regions two distinct species are present (Conover, 1926:175; Sutton, 1932:30–31; H. W. Brandt, 1943:276; and Soper, 1946:18).

None of these observers, however, has suggested that the small, dusky, cackling goose of the northwestern Alaskan coast belongs to the same species as the small, pale, cackling goose of the more eastern Arctic islands. Yet, I can see no reason for not doing so. They replace each other geographically, and in size and habits they are very similar. The validity of Taverner's assumption (1931:40) that the wide gap between their ranges argues against subspecific relationship is questionable; there are many recognized examples of conspecific races separated by equally wide gaps, particularly in species found in both the New and the Old World. The color differences between the eastern and western cackling geese seem to be bridged by the population inhabiting Bering Island, Siberia.

Nomenclature.—The earliest available name for the cackling geese is *Anser Hutchinsii* Richardson (1831 [1832]:470). Since this name was based on a very small bird from the Melville Peninsula, it almost certainly refers to the eastern race of the cackling goose, which becomes *Branta hutchinsii hutchinsii,* while the Alaskan cackling goose may be known as *Branta hutchinsii minima.* The very small goose of Bering Island, Siberia, and probably also the Kurile Islands (Taczanowski, 1893:1110), which also apparently breeds in the same region with a larger species, seems intermediate between *minima* and *hutchinsii* in appearance, although not in range. It seems to represent a distinct race, which may be called:

Branta hutchinsii asiatica, new subspecies. Asiatic Cackling Goose.

Type.—Adult ♂, No. 92827, U. S. National Museum; Bering Island, Siberia; June 9, 1883; Leonhard Stejneger; original number, 2165.

Subspecific characters.—Similar to *Branta hutchinsii hutchinsii,* but darker above. Similar also to *Branta hutchinsii minima,* but lighter below.

Measurements.—Adult ♂ (3 specimens from Bering Island): wing, 363–377 (Av. 368) mm.; tail, 110–119 (114.7); exposed culmen, 30.5–32.5 (31.7); tarsus, 65.5–77 (70.1); middle toe without claw, 57–62 (58.8). Adult ♀ (1 specimen from Bering Island): wing, 373; tail, 128; exposed culmen, 33; tarsus, 71; middle toe without claw, 54.

Geographic distribution.—Breeds on the Commander Islands, Siberia, and probably also the Kurile Islands (Bergman, 1935:225). Probably migrates southward at least to Japan (Taczanowski, 1893:1110). Confusion in the nomenclature makes it impossible to be sure whether these references are for the present form, or for *B. canadensis leucopareia,* of which there is one breeding specimen, from Bering Island, in the American Museum of Natural History (No. 730928), first noted by Hartert (1920:141).

Among the medium-sized geese of the *Branta canadensis* group, which, as pointed out above, are a species distinct from *Branta hutchinsii,* two races seem to be recognizable, viz., a relatively dark bird from the islands of northeastern Asia east to Baffin Island, for which the name *Anser leucopareius* J. F. Brandt (1836:37) is available, and an extremely pale bird which breeds in the northern portion of the Prairie Provinces of Canada, which I believe should be called *parvipes.* Both seem to be subspecies of *Branta canadensis.* I have examined the type of *Anser parvipes* Cassin (1852), evidently a migrant bird, from Veracruz, Mexico, in the collection of the Academy of Natural Sciences of Philadelphia, and it agrees very closely with the pale medium-sized goose which breeds in the Lake Athabaska region. *Bernicla leucolaema* Murray (1859) is, in my opinion, unidentifiable but probably a hybrid.

The large Canada geese experience the widest range of ecological conditions on their breeding grounds and are also the most subject to racial separation. The extremely dark *B. canadensis occidentalis* occupies the relatively narrow area of southeastern Alaska and British Columbia south to Vancouver Island (Rand, 1943:60) during the breeding season. In the region from Hudson Bay south to Minnesota occurs a large intermediately-colored goose recently given the name *B. c. interior* by Todd (1938:662), who at the same time restricted the name *B. c. canadensis* to the pale-breasted bird of the Atlantic coasts of Quebec, Labrador and Newfoundland. This leaves a rather extensive area in which geese breed, at least scatteringly: the Great Plains of the northern United States and central-southern Canada, and the Great Basin from Utah west to northeastern California, and north to southern British Columbia. Breeding specimens from these regions are very large, a fact which has long been noted by residents in the Plains states (Wetmore, field notes 1922, and McAtee, 1944:136). These birds are even paler above than typical *canadensis,* from which race they are geographically separated by *interior,* a race which is darker than *canadensis* both above and below. Also the ecological conditions under which the plains and basin goose lives appear to be quite different from those of other races. There seems to be no alternative to recognizing it as a distinct subspecies, which may be known as:

***Branta canadensis moffitti,*‡** new subspecies. Basin Canada Goose.

Type.—Adult ♂, No. 365117, U. S. National Museum (Fish and Wildlife Service collection); Blue Lake, near Coulee City, Washington; April 26, 1938; V. Clifford.

Subspecific characters.—Similar to *Branta canadensis canadensis,* but larger and paler in general coloration. In fresh autumn specimens the brown areas of upper parts and flanks are between olive brown and buffy brown, rather than mummy brown. Under parts average somewhat less whitish.

‡ Named for James Moffitt, who had begun a revision of these geese just before his death in July 1943.

Measurements.—Adult ♂ (11 specimens): wing, 480–522 (Av. 502.8) mm.; tail, 144–177 (161.1); exposed culmen, 52–68 (57.9); tarsus, 84–106.5 (93.9); middle toe without claw, 76.5–92.5 (83.5). Adult ♀ (6 specimens): wing, 435–503 (474.3); tail, 121–166 (141.8); exposed culmen, 50–61 (54.8); tarsus, 85–93.5 (89.6); middle toe without claw, 76–84.5 (80.1).

Geographic distribution.—Great Plains and Great Basin regions of the United States and Canada west to eastern Washington and Oregon and northeastern California, east to northeastern North Dakota (Dawson), and south to Great Salt Lake, Utah, and central-western Nebraska, north to southern British Columbia and southern portion of the Prairie Provinces of Canada.

Relationship of races of Branta canadensis.—*B. canadensis moffitti* is the breeding Canada goose of the prairie and basin marshes of the more arid portions of interior North America, as compared with the more heavily forested region farther east, in which *B. c. interior* breeds, or presumably bred formerly, from Arkansas north to Hudson Bay, and east to Kentucky, Michigan, and western Quebec. Presumably *B. c. moffitti* intergrades with *B. c. parvipes,* a goose of similar pale coloration but of smaller size, in the middle section of the Prairie Provinces. It intergrades with *parvipes* also in British Columbia, as is indicated by an August specimen from Big Salmon River, British Columbia, which is distinctly smaller than the smallest *moffitti,* but too large for *parvipes* and much too pale to be considered *leucopareia.*

Although *B. c. moffitti* most closely approximates *B. c. canadensis* among the larger geese, it is larger, and enough paler above to be easily distinguished in series. Its habitat is evidently quite different from that of the maritime form, and its range is and probably always was completely cut off from that of *canadensis* by the still darker *B. c. interior.*

B. c. interior must have intergraded with *moffitti* in the general region where forest merges with grassland in the middle western region. It presumably intergrades with *leucopareia* along the western side of Hudson Bay and apparently also in southern Baffin Island.

Soper (1946:18) describes the decreasing size of breeding geese of the *canadensis* group along the southern coast of Baffin Island, saying that the smallest population breeds in the same general region with *hutchinsii* in the Cape Dorset region. His measurements of birds which he called *hutchinsii* from Cape Dorset certainly indicate that they were of that species, although the average which he gives for the wings of these birds, 12 inches [305 mm.] for males, and 11.77 inches [299 mm.] for the females, are remarkably small. Apparently he was not aware that *leucopareia* breeds in western Baffin Island, a fact disclosed by specimens in the National Museum of Canada and the Museum of Comparative Zoology, which I have examined. Average measurements which he gives for geese from the Fox Basin coast of western Baffin Island

MEASUREMENTS (IN MM.) OF ADULT BRANTA HUTCHINSII AND BRANTA CANADENSIS *

Male

Subspecies†	Wing (chord)	Tail	Exposed culmen	Tarsus	Middle toe without claw
B. hutchinsii					
minima (4)	353–373	109–116	26–28.5	64–70.5	48–53.5
	(363.8)	(113.3)	(27.3)	(66.9)	(49.6)
asiatica (3)	363–377	110–119	30.5–32.5	65.5–77	57–62
	(368)	(114.7)	(31.7)	(70.1)	(58.8)
hutchinsii (6)	360–393	116–133	31–35	67–77	54–61
	(377.8)	(123.7)	(33.7)	(70.3)	(57)
B. canadensis					
leucopareia (22)	388–456	113–136	34–45.5	70.6–86	55–69
	(410.2)	(127.3)	(37.8)	(76.6)	(60.9)
parvipes (7)	413–442	113–145	38–46	74–88	63.5–73
	(430.9)	(132.7)	(42.6)	(81.7)	(68)
occidentalis (9)	446–493	137.5–162	45.5–54.5	84–99.5	75–83
	(473.9)	(150.2)	(50.5)	(93.5)	(79.4)
interior (9)	430–473	131–149	46–55.5	81–91.5	67–80.5
	(456.8)	(143.9)	(50.7)	(89.1)	(73.2)
canadensis (7)	444–485	131–149	53–58	88–95	72.5–83
	(466.3)	(143)	(56)	(90.8)	(79.2)
moffitti (11)	480–522	144–177	52–68	84–106.5	76.5–92.5
	(502.8)	(161.1)	(57.9)	(93.9)	(83.5)

Female

Subspecies	Wing (chord)	Tail	Exposed culmen	Tarsus	Middle toe without claw
B. hutchinsii					
minima (11)	332–371	97–117	26.5–32.5	58–70	47–58
	(353.5)	(104.2)	(28.2)	(65.7)	(50.9)
asiatica (1)	373	128	33	71	54
hutchinsii (7)	350–381	116–117	31–32.8	65–68.5	52–55.5
	(365.5)	(116.6)	(31.6)	(67.4)	(54)
B. canadensis					
leucopareia (22)	384–422	110–140	33–42	69–82	53–64.5
	(400.3)	(124.5)	(37.3)	(73.4)	(58.6)
parvipes (2)	410–423	123–135	36–45.5	73–82	57.5–67
occidentalis (6)	437–471	139–152.5	44.5–50.0	84–92	72.5–79
	(448.5)	(144.1)	(48.4)	(89.1)	(76.4)
interior (10)	427–467	133–155	45–53	76–90	68–76
	(445.5)	(145.4)	(49.7)	(83.6)	(71.5)
canadensis (7)	435–488	134–158	51.5–56.5	81–88.5	72.5–80
	(465)	(147.3)	(53.9)	(85.9)	(76.1)
moffitti (6)	435–503	121–166	50–61	85–93.5	76–84.5
	(474.3)	(141.8)	(54.8)	(89.6)	(80.1)

* The measurements of immature specimens (detected by the plumage criteria described by Elder, 1946:98) were omitted from these tables.

† Figures in parentheses after the subspecies name indicate the number of specimens measured.

are somewhat larger than those of his Cape Dorset birds, and could have included some specimens of *leucopareia.*

B. c. leucopareia intergrades with *parvipes* in western Mackenzie. A specimen from Fort Simpson, Mackenzie, which is the type of *Bernicla barnstoni* Ross (1862), is referable to *parvipes,* as is also a specimen from the site of Old Fort Hope, 100 miles below Good Hope, Mackenzie. On the other hand, a breeding specimen from Great Bear Lake seems referable to *leucopareia.* In other words, *parvipes* is the interior, pale, representative of *leucopareia.*

The very much greater geographical range of *leucopareia* as compared with that of *parvipes* is further shown by the great preponderance of migrant specimens of the former race in collections. Although relatively few migrant specimens of *parvipes* have been examined, they are from extremely widely separated localities, as may be seen from the appended list of specimens.

Migrations.—From specimens of migrant geese and from bird-banding returns it would seem that there is considerable fanning out and crossing over by the various races during migration, as well as a distinct northward movement of Great Basin breeding birds. Although the summer residents of the Maritime region (*B. c. canadensis*) seem to remain fairly close to the Atlantic coast in migration, many birds of the Hudson Bay region (*B. c. interior*) cross to the Atlantic coast while others proceed down the Mississippi Valley. In fact, a big majority of the geese banded at the Mattamuskeet National Wildlife Refuge, on the coast of North Carolina, came from Hudson Bay, as indicated by both specimens and banded birds. All of the New England banded birds, however, were recaptured in the Maritime region and are therefore *B. c. canadensis.* Since *B. c. interior* has been found on the Atlantic coast only from Maryland southward it is apparent that the crossover occurs south of New England.

Another crosswise movement is found in *B. c. moffitti.* There are even extensive post-breeding northward movements of this race. There are records of breeding geese of Great Salt Lake, Utah, being retaken in December at Platte, South Dakota; and of breeding geese of Los Banos, California, being retaken at Scapa, Alberta, in October; of breeding geese of Great Salt Lake retaken at Brooks and Rocky Rapids, Alberta; of a goose from Voltage, Oregon, retaken at Del Bonita, Alberta; and of a goose from Burns, Oregon, retaken at Grand Prairie, Alberta.

Apparently *Branta canadensis occidentalis* and *Branta hutchinsii minima* confine themselves rather closely to the Pacific coast of North America in migration, the latter wintering chiefly in the interior valley of California (Swarth, 1913), although individuals wander to the Hawaiian Islands (for example, the type specimen of *"Bernicla munroii,"* which, I find, is a typical example of *B. h. minima*). *Branta c.*

leucopareia, as might be expected from its almost transcontinental breeding range, is found in migration from the Atlantic to the Pacific coast, but is particularly numerous from the Central Flyway westward.

Because of the paucity of records, we know much less about the migrations of the Athabaska Canada goose, *Branta canadensis parvipes,* and of the Hutchins cackling goose, *Branta hutchinsii hutchinsii.* On the whole, they both appear to follow chiefly the Central Flyway to New Mexico and Mexico. Occasionally they reach the Atlantic seaboard, and there are specimens of *hutchinsii* from as far west as Solomon, Alaska, and Klamath Falls, Oregon.

List of Specimens Examined

Branta hutchinsii minima, Alaskan Cackling Goose.—*Alaska:* Attu Island, 1 ♀; Hooper Bay, 1 ♀, 1 ?; Kotlik (mouth of Yukon), 1 ♂, 1 ♀; Nushagak, 1 ♂; Nushagak (Bear River), 1 ♀; Point Constantine, 2 ♀; St. Michael, 1 ♂, 2 ♀, 1 ?; St. Paul Island, 1 ♂ im. *California:* Gridley, 1 ♂, 2 ♀; Stockton, 1 ♀, 1 ?; Tule Lake, 1 ♀ im.

Branta hutchinsii asiatica, Asiatic Cackling Goose.—*Siberia:* Bering Island, 3 ♂, 1 ♀, 1 ? (head only).

Branta hutchinsii hutchinsii, Hutchins Cackling Goose.—*Alaska:* Solomon, 1 ♂ im.; *Illinois:* Andalusia, 1 ? im.; Chicago, 1 ?. *Iowa:* Whiting, 1 ♀; Wolf Creek Slough, 1 ♀. *Mexico, Chihuahua:* Guzman, 1 ♀ im.; *Jalisco:* La Barca, 1 ♂ im. *Nebraska:* Wood River, 1 ?. *Nevada:* Washoe Lake, 1 ? im. *North Carolina:* Crow Island, 1 ♂ im.; Fairfield, 1 ?; Lake Mattamuskeet, 1 ♂ im. *North Dakota:* Lac-aux-Morts, 1 ♂. *Northwest Territories, Franklin:* Baffin Island, 1 ♀; Baffin Island (Camp Dorset), 1 ♂; Baffin Island (Camp Kungovik), 2 ♂, 3 ♀; Melville Peninsula, 1 ♂. *Keewatin:* Southampton Island (Ranger Brook), 1 ♂. *Oklahoma:* Kiowa Agency (4 mi. from, on Wachita River), 1 ♀. *Oregon:* Klamath Falls, 1 ♀ im.

Branta canadensis leucopareia, Lesser Canada Goose.—*Alaska:* Agattu, 1 ♂; Barter Island, 1 ♂; Chogiung, 1 ♀ (head only); Egushik River, 1 ♂; Fort Kenay, 1 ?; Kotlik, 1 ♂; Kuskokwim River (North Fork, base Mt. Sishwoo), 1 ♂; Nulato, 1 ♂; Nulato River, 2 ♂; Nushagak, 1 ♀; Nushagak River (80 mi. up), 1 ♂; Old Crow River (mouth Black Fox Creek), 1 ♀; Putnam River, 2 ?; St. Michael, 1 ?; St. Paul, 1 ?; Tanana Crossing, 1 ♂, 1 ♀, 1 ?; Tanana Crossing (15 mi. below), 1 ♂. *British Columbia:* Puget Sound (Semiahmoo Camp), 1 ♂, 1 ?. *California:* Gridley, 1 ♂, 4 ♀; San Francisco, 1 ?; Stockton, 1 ?; Locality ?, 1 ?. *Florida:* St. Marks River (Wakulla County), 1 ♀. *Illinois:* Chicago, 1 ♀ im., 1 ?. *Iowa:* Sloan, 1 ♂; Sloan (near), 1 ♂. *Minnesota:* Red River, 1 ?. *Nebraska:* Platte River (Elm Creek), 4 ♀, 1 ?; Wood River, 2 ♂, 4 ♀, 1 ♀ im. *Nevada:* Stillwater (3 mi. N.), 1 ♀; Washoe Lake, 1 ♂. *New Mexico:* San Antonio, 1 ? im. *Northwest Territories, Franklin:* Baffin Island (west coast), 2 ♂;

Dolphin and Union Strait (between Franklin and Mackenzie), 1 ♂; Victoria Island (Walker Bay), 1 ♀. *Keewatin:* Kazan River (lower), 1 ♀ im. *Mackenzie:* Cape Fullerton (Hudson Bay), 1 ?; Franklin Bay (island in), 1 ♀; Great Bear Lake, 1 ♂; Thelon River (The Gap), 1 ♂. *Yukon:* Herschel Island (Mackenzie Bay), 2 ♀; International Boundary and Arctic Circle, 1 ?; Old Crow River, 1 ♀; Old Crow River (Timber Creek), 1 ♂, 1 ♀; Old Crow River (Timber Creek, 15 mi. above), 1 ♀. *Oregon:* Silver Lake, 1 ♀. *Siberia:* Bering Island, 1 ♀. *South Dakota:* Vermillion, 1 ♂. *Virginia:* Neabsco, 1 ?. *Washington:* Kiona, 1 ♂. [*Washington*]*:* Camp Lopez, 1 ♀; Columbia River, 1 ?.

Branta canadensis parvipes, Athabaska Canada Goose.—*Alberta:* Athabaska River (near Sled Island), 1 ♂ im.; Egg Lake (15 mi. N. W. Fort Chipewyan), 1 ♂; Lake Athabaska (Goose Island), 1 ♂, 1 ♀. *Georgia:* Brady County, 1 ♀. *Manitoba:* Steel River (2 miles below mouth Fox River), 1 ♂ juv. *Mexico, Veracruz:* Locality ?, 1 ?. *Nevada:* Camp 26, 1 ♂; Truckee Meadows (Camp 26), 1 ♂. *New Mexico:* Rio Rita (near Laguna), 1 ?. *North Carolina:* Currituck Sound, 1 ?. *Northwest Territories, Mackenzie:* Fort Simpson, 1 ♂; Hope (100 mi. below Good Hope; site of old Fort Hope), 1 ♂.

Branta canadensis occidentalis, Pacific Canada Goose.—*Alaska:* Chichagof Island (Hoonah Sound), 1 ♂, 1 ♀; Gustavus Point, 1 ♂; Juneau, 1 ♂; Keku Pass, 2 ♂, 2 ♀; Prince of Wales Island, 1 ?; Sergif Island (mouth Stikine River), 1 ♂; Stikine River Flats, 2 ♂, 3 ♀, 1 ?. *British Columbia:* Semiahmoo, 1 ♂. *Washington:* Port Townsend, 1 ?; Puget Sound, 1 ?.

Branta canadensis interior, Interior Canada Goose.—*Alabama:* Leighton, 1 ♀; *District of Columbia:* Washington, 1 ?. *Illinois:* Chicago, 1 ?. *Maryland:* Marlboro, 1 ♂; Seneca, 1 ♂; Upper Marlboro, 1 ?. *Michigan:* Black Lake (Ottawa County), 1 ♀. *Minnesota:* Elk River, 1 ♀, 1 ?. *Mississippi Valley:* Locality ?, 1 ♀. *Nebraska:* Gibbon, 1 ♂; Platte (Elm Creek), 1 ♂; Wood River, 1 ♂, 1 ?. *North Carolina:* Currituck Sound, 1 ♀, 4 ?; Poplar Branch (Pine Island), 1 ?. *Ontario:* Belcher Islands (Tukarak Island), 2 ♀; Hudson Bay (Povungnituk), 1 ♀; Point Pelee, 1 ?; St. James Bay (Nattahisha Point), 1 ♀ im. *Pennsylvania:* Carlisle, 1 ♂. *Quebec:* Fort George (east side James Bay), 1 ?; Hudson Bay (Nastapoka River, 5 mi. S.), 1 ♂; Port Harrison, 2 ♂; St. Augustine (Portneuf), 1 ♂. *South Dakota:* Aberdeen, 1 ♂. *Texas:* Houston, 1 ♀, 1 ?; Lavaca Forks, 1 ♂. *Virginia:* Buckingham County, 1 ♀.

Branta canadensis canadensis, Eastern Canada Goose.—*Maine:* Merrymeeting Bay, 1 ♂ im. *Maryland:* Ewell, 1 ♂. *Michigan:* Schoolcraft County (Waterfowl Refuge), 1 ♂. *Newfoundland:* Addies Pond, 1 ♀; Humber River (upper), 1 ♂, 1 ♀. *North Carolina:* Avon, 1 ♂; Nanteo (Pea Island), 1 ♂, 5 ♀; Pea Island, 2 ♂. *Rhode Island:* Lake Worden, 1 ♂. *Virginia:* Back Bay (Princess Anne County), 2 ?; Uptonburgh, 1 ♀ im.

Branta canadensis moffitti, Basin Canada Goose.—*British Columbia:* Big Salmon River, 1 ?. *California:* Bodega, 1 ?; Brownell, 1 ♂; Camp Bidwell, 1 ?. *Missouri:* Macon, 1 ♂; *Montana:* Crooked Falls, 1 ♂. *Nebraska:* Wood River, 1 ?. *North Dakota:* Dawson, 1 ♂; Devils Lake, 1 ♀; Glasston (Pemberton County), 1 ♂; Robinson, 3 ♂, 2 ♀; Sweetwater Lake, 1 ♀. *Oregon:* Dary, 1 ♂ im.; Olene, 1 ? im. *South Dakota:* Platte, 1 ♂. *Utah:* Bear River Mouth, 1 ♂, 1 ♀ im.; Locality ?, 1 ?. *Washington:* Blue Lake (near Coulee City), 1 ♂, 2 ♀.

Literature Cited

Bergman, S.
1935 Zur Vogelwelt der Kurilen [*in* Zur Kenntnis nordöstasiatischer Vögel, pp. 1–268]. Stockholm.

Brandt, H. W.
1943 Alaska bird trails. Bird Research Foundation, Cleveland, Ohio.

Brandt, J. F.
1836 Note sur l'Anser canadensis et l'Anser pictus de la Zoographie de Pallas. *Bull. Sci. Acad. Imp. Sci. St. Petersbourg,* 1:37.

Cassin, J.
1852 Descriptions of new species of birds, specimens of which are in the collection of the Academy of Natural Sciences of Philadelphia. *Proc. Acad. Nat. Sci. Phila.,* 6:184–188.

Conover, H. B.
1926 Game birds of the Hooper Bay region, Alaska. *Auk,* 43:162–180.

Elder, W. H.
1946 Age and sex criteria and weights of Canada Geese. *Jour. Wildl. Manag.,* 10:93–111.

Hartert, E.
1920 The birds of the Commander Islands. *Novit. Zool.,* 27:128–158.

McAtee, W. L.
1944 Popular subspecies. *Auk,* 61:135–136.

Murray, A.
1859 Contributions to the natural history of the Hudson's Bay Company's territories. pt. 3. Aves. *Edinburgh New Philos. Jour.,* 9:210–226.

Rand, A. L.
1943 On some British Columbia birds. *Canad. Field Nat.,* 57:60–63.

Richardson, J. (In Swainson and Richardson).
1831 [1832] Fauna Boreali-Americana, pt. 2. London.

Ross, B. R.
1862 List of mammals, birds, and eggs observed in the McKenzie's River District, with notices. *Canad. Nat. & Geol.,* 7(Art. 13):137–155.

Rothschild, W.
1892 Descriptions of seven new species of birds from the Sandwich Islands. *Ann. Mag. Nat. Hist.* (6), 10:108–112.

Soper, J. D.
1946 Ornithological results of the Baffin Island expedition of 1928–1929 and 1930–1931, together with more recent records. *Auk,* 63:1–24.

Sutton, George M.
1932 The exploration of Southampton Island, Hudson Bay. *Mem. Carnegie Mus.,* 12, pt. 2, sec. 2.

Swarth, H. S.
1913 A study of a collection of geese of the *Branta canadensis* group from the San Joaquin Valley, California. *Univ. Calif. Publ. Zool.,* 12 (1):1–24.

Taczanowski, L.
1893 Faune ornithologique de la Sibérie Orientale. *Mem. Acad. Imp. Sci. St. Petersbourg,* 39.

Taverner, P. A.
1931 A study of *Branta canadensis* (Linnaeus), the Canada Goose. *Ann. Rept. Nat. Mus. Canada,* 1929:30–40.

Todd, W. E. C.
1938 A new eastern race of the Canada Goose. *Auk,* 55:661–662.

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SUPPLEMENTARY NOTES ON THE FAMILY ANATIDAE

BY JEAN DELACOUR AND ERNST MAYR

SINCE the appearance of our paper, "The Family Anatidae" (1945, *Wilson Bulletin,* 57:3–55), a few contributions to the subject have come to our knowledge, and some new facts have been reported. We think it worth while to mention them briefly.

To start with, certain of our statements might be modified as follows:

Some mergansers carry their chicks on the back, as do the Mute and Black-necked Swans (p. 9).

A few river ducks (Anatini) have no metallic colors on the speculum. Such is the case in *Anas strepera, A. angustirostris,* and in the aberrant forms: *Hymenolaimus malacorhynchos, Malacorhynchus membranaceus, Rhodonessa caryophyllacea,* and *Stictonetta naevosa* (p. 16).

The downy young of *Heteronetta atricapilla* is known, although so far undescribed (p. 54). We have examined two specimens: one is a mounted chick, lent by Herbert Friedmann, U. S. National Museum, Washington, which served as the model in the preparation of Figure 1. It was collected at Batuco Lake, 50 kilometers north of Santiago, Chile. The egg was found on September 23, 1938, in a nest of a Red-gartered Coot (*Fulica armillata*). The egg hatched on October 16, and the bird died five days later. The second is a skin lent by Josselyn Van Tyne, University of Michigan Museum of Zoology (No. 93120, ♀, 195–200 kilometers west of Puerto Casado, Paraguay, March 1, 1937, Schulze and Lopez). The accompanying figure by Alexander Seidel depicts accurately the very peculiar color pattern of this species. Unfortunately, the pattern gives no clue to the relationships of *Heteronetta.* Unique features of the duckling of this species are: unusual length of the yellowish tips of the dark down on the hind neck and upper back, and the speckled pattern on the yellow of the back, sides, and wings, produced by some long black tips. The general effect is that of a hairy and shaggy chick. The dark areas of the plumage are brown, becoming blackish-brown on the lower back, flanks, and tail. The supercilium is tawny; the sides of the head and throat are also tawny but a little darker. The breast is brownish-yellow, with a darker collar separating upper and lower throat; the abdomen paler. The markings on the wings and sides, as well as the lines on the back, are yellow. The Puerto Casado specimen is somewhat distorted by the make-up of the skin. It seems to differ from the Batuco Lake specimen in the following points: The lower abdomen and the flanks are heavily mottled with black. The superciliary stripes seem to be almost connected across the hindneck, though less pronouncedly so than in *Dendrocygna.* The longitudinal stripes on the back seem to turn toward the flanks at their posterior ends. It remains to be seen whether any of these characters is typical for the species.

About the habits of the Bronze-winged Duck, *Anas specularis* (p. 18) Lord William Percy (*in litt.*) says:

"I lived with them for a month on a river at sea level in south Chile and, except for the similarity in the plumage pattern of the wings to that of the Crested Duck (*specularioides*), they always struck me as typical river ducks with nothing else reminiscent of a Crested Duck in their manner and habits. As to their voice there should be no doubt about that, for it is the most remarkable of any duck I know. The female's bark is as perfect an imitation of that of a small lap dog as any bird could make and I frequently mistook their note for that of dogs in the distance. I was never quite sure whether the males bark too, but they certainly have a distinctive note of their own—a single

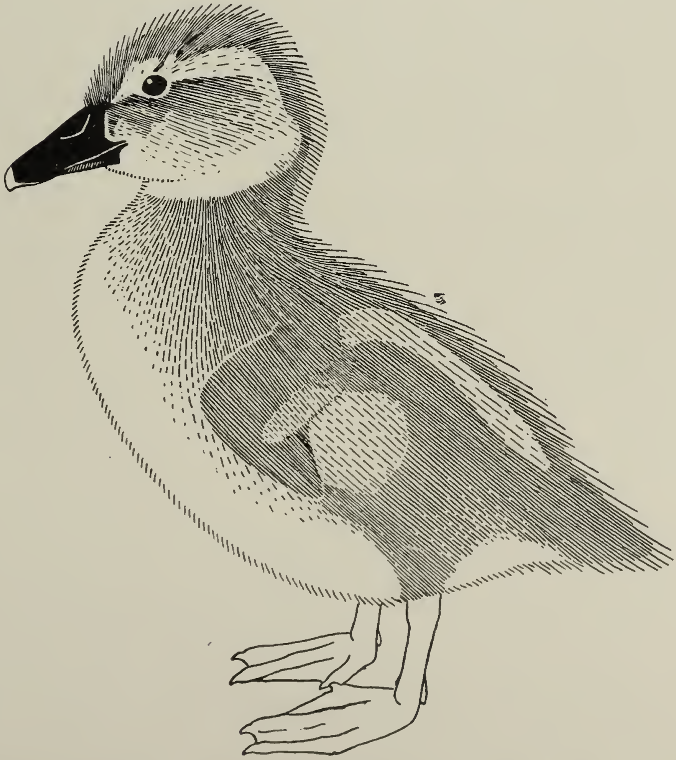

Figure 1. Black-headed Duck (*Heteronetta atricapilla*). Drawn by Alexander Seidel.

whistling note frequently repeated, but they either remain silent when the females are barking or bark too, because I never heard the whistle and barking at the same time."

Dr. John Berry, Edinburgh, Scotland, reports (*in litt.*) a case of fertility between a hybrid male *Anser anser* $\times$ *Branta bernicla* and a female of *Branta bernicla:*

"I consider that the fertility of one hybrid male of this cross was established when a Barnacle female to which he was mated, produced a gosling at Tayfield in 1944. Of course, one cannot absolutely rule out the possibility that the Barnacle mate, being full-winged, had paired with a Greylag gander. But so far as our observation went this did not occur, and all the observations pointed to the Barnacle's fertile egg having resulted from union with the hybrid gander. I was able to compare the one resulting gosling which I reared with direct hybrid goslings resulting from a Greylag $\times$ Barnacle cross. While this gosling was quite definitely not a pure Barnacle, it resembled that species much more closely than did the 'half and half' hybrids. This year the same pair of birds nested again but no eggs were hatched. At least one, however, was certainly fertile as the gosling was well formed in the egg."

Dr. Berry also rightly points out that in the Anserini, the voice of the male is usually shriller and more metallic than that of the female, which is lower, weaker, and not of a higher pitch as stated by us. He says:

"My own observations are restricted to comparatively few species, but so far as most of the true geese are concerned, I should have said the opposite. For example, in the Pink-footed Goose [*Anser fabalis brachyrhynchus*], the call note of the male is a shrill "wink wink," while that of the female is much lower. In the 'talking voice' the difference is equally marked, that of the gander being higher pitched, more nasal and metallic than the low 'muttering' of the female. The talking voice of the Bean Goose [*Anser f. fabalis*] shows a similar distinction between the lower muttering of the female and the higher more nasal voice of the ganders. The call notes of Greylag [*Anser anser*] are more or less similar, but the 'talking voice' of the female is again lower than that of the male, so too, with my White-fronted Geese [*Anser albifrons*]. I think the Snow Geese [*Anser caerulescens*] can also be sexed by the lower talking voice of the females. There may be wide variation between individuals of the same species in this matter of voice. The number of geese is small on which I have been able to determine sex beyond question by breeding or dissection, and on which I have previous precise notes of voice (confirmed by numbered rings on both legs). But in each such case I should have said, without a doubt, that the talking voice, at least, of the female was lower than that of the male."

Mr. C. L. Sibley, Wallingford, Connecticut, also reports an interesting secondary hybrid:

"You may be interested to know that this season I hatched three young from five eggs laid by a female which was herself a hybrid between a male Blue-winged Goose (*Cyanochen cyanopterus*) and a female Egyptian Goose (*Alopochen aegyptiacus*). This hybrid female mated with a Blue-winged gander which was her half-brother, and whether it was this close relationship, or inherent weakness of the three-quarters blood Blue-wing young, I lost all three.

"I had supposed that a hybrid of *Cyanochen* and *Alopochen* would be sterile, yet she laid normal-shelled eggs and hatched three. All five eggs were fertile."

New observations of the display of the Maned Goose (*Chenonetta jubata*) have been made and reported by Delacour (1945, *Wilson Bulletin,* 57:129). They confirm the relationship of this species with the Mandarin and Wood Ducks (*Aix*).

In 1941, Finn Salomonsen published a detailed study of the plumages of the Old-squaw (*Clangula hyemalis*) in which he disagrees with Sutton's conclusions that the species has only two molts and plumages per year. According to Salomonsen, the Old-squaw drake has no less than four plumages: a winter or courtship plumage, breeding or nuptial plumage, eclipse plumage, and autumn plumage. These are rather startling conclusions, but we lack the material to discuss them critically. It remains to be seen whether Salomonsen's interpretation of the plumages of this species are valid. In detail, his findings are as follows:

The winter plumage is worn until April. Around April 10 to 15 the molt into nuptial plumage begins and is completed toward the end of May. This molt affects only head, neck, throat, and the scapulars. The molt into eclipse plumage begins around July 1. There is a period of about three or four weeks in June during which practically no molt takes place. The eclipse molt is completed by the end of August. This molt affects the entire plumage not changed in the previous molt and, according to Salomonsen, also the scapulars. It appears to us that this molt is nothing but a continuation of the April-May molt, even though there may have been some lag during June. It is in this molt that wings and tail are renewed.

A new molt starts in September which affects the feathers of head, neck, throat, flanks, and scapulars. Most of these feathers remain as part of the winter plumage, but the white autumn feathers of the sides of the neck, lores, cheeks, and of the eye and ear region are replaced by the final feathers of the winter plumage.

Although Salomonsen records four molts and four plumages, it follows from his own data that no individual feather papilla has more than one or two molts per year, except the scapulars and some feathers of the head, which, according to him, are molted three times a year. His data also show that there is some scattered molting going on throughout the year, except from January to March. Thus, actually, Salomonsen's conclusions deviate less from previous descriptions than he implies.

Our knowledge of the molts and plumages of ducks has been notably advanced by Stresemann (1940). His conclusions are based on a series of molting summer ducks from Tibet, where it is apparently easier to get molting pintails and widgeons than in the United States or in Europe! The sequence of molting is different from that described in the current literature. Molt begins with the flank feathers, scapulars and upper tail coverts. Next is the central pair of tail-feathers and the tertials. When the molt of the central pair of tail-feathers is complete, about half the body plumage is in molt, namely, on the upper parts: all the feathers of the crown, many on the sides of head and neck, many of the scapulars, upper tail coverts, and feathers on the middle of the back; on the underparts: nearly all the flank feathers, many feathers of the breast and belly, and many under tail coverts. The last body regions to molt are upper back, rump, upper throat, and chin. In fact, some parts of the rump may never acquire the eclipse plumage. When two to four pairs of tail feathers have molted, the wing is molted. All the wing feathers, wing coverts, and axillaries are molted simultaneously. The tail-feathers molt in the sequence: 1, 2, 4, 6, 7, 3, 5, 8, with some variation in the outer 3 or 4 pairs.

The second half of Stresemann's paper is devoted to a stimulating discussion of the physiological factors that control the plumage. The starting point is the fact that gonadectomized (castrated) adult mallards (male and female) wear the nuptial plumage of the drake throughout the year. This is usually called the "neutral" plumage of the species.

Gonadectomized ducklings, however, retail the normal juvenal plumage (acquiring it again even after plucking), which is for them the neutral plumage. Gonadal hormones obviously produce the eclipse plumage of the male and the "henny" plumage of the immature duck, male and female. Why the juvenal plumage does not react to absence of sex hormones has long been a puzzle. Stresemann suggests that the nuptial plumage of the drake (the "neutral" plumage of the adult) is the mature plumage of the species, and that the maturation process occurs independently of hormones. This same interpretation was advanced some time ago: "All these observations and experiments allow the following interpretation: one of the phenomena of reaching maturity in birds is a gradual change in the structure and pigmentation of the feathers from an immature plumage to a neutral adult dress. This change appears to occur in steps as expressed in the successive molts required to produce the final plumage, but is actually caused by a slow physiological change, as has been proved by plucking feathers between molts. This process is modified by an additional differentiation caused by a female or male hormone, which changes the neutral plumage to a typical female or male adult plumage. This latter process can be reversed by the removal of the gonads, while the change from the immature plumage to the 'Neutral Plumage' seems to be irreversible and independent of any hormones thus far known" (Mayr, 1933:10). Stresemann feels that this interpretation is strengthened by the observation of Heinroth and Lorenz that the eclipse plumage of old drakes is less henny (more nuptial-like) than that of younger drakes. This Stresemann interprets to mean that the older ("more mature") the feather papillae become, the less subject they are to the inhibitory effects of the sex hormones.

An alternative hypothesis would be that it is not the reactivity of the feather papillae which changes, but the level of other endocrine antagonists, such as the hormones of thyroid, pituitary, and the adrenals. Only experiment can tell which of the alternatives is correct—or if the truth is a combination of both processes. Two recent papers throw some light on the problem: Boss (1943) showed that injection of male sex hormone in the chicks of Herring Gulls (*Larus argentatus*) causes them to assume a nuptial plumage in the next molt though they revert to the juvenal plumage as soon as the administration of hormones is discontinued. At least in this species, then, the change from juvenal to adult plumage is not entirely a matter of maturation. Even more significant are the experiments by Chu (1938) on the influence of thyroid hormone on the juvenal plumage of chicks. He shows that thyroidectomized chicks assume a juvenal plumage with the essential characters of the adult neutral plumage. Further work on this question is now being done at the University of Chicago by B. B. Blivaiss and L. V. Domm.

Stresemann's statement that the assumption of the eclipse plumage is not correlated with any special physiological condition of the testes is not convincing. It seems always to be true that the nuptial plumage is acquired during the resting stage of the testes, whereas the eclipse plumage is formed under the influence of an active testis (even though it may be rapidly decreasing in size). A superimposed influence of the thyroid hormone (affecting the growth rate of the new feathers) does not materially change this relationship.

In a final section, Stresemann discusses the manifold correlation between ecology, breeding cycle, and sequence of molts and plumages. It would lead too far to repeat here his many stimulating observations. Every student, either of ducks or of the plumage physiology of birds, should study this pioneer contribution in its entirety.

Lorenz's paper (1941) on the comparative ethology of river ducks has now also reached us. His conclusions on the interrelations of the Anatini are in nearly complete agreement with our conclusions. We hope that it will soon be possible to make this work available to American readers in an English translation, not only for the importance of his conclusions but also as a model of modern ethological technique.

Literature Cited

Boss, Willis Robert
1943 Hormonal determination of adult characters and sex behavior in herring gulls (Larus argentatus). *Jour. Exp. Zool.*, 94:181–209.

Chu, J. P.
1938 Studies on plumage in the male brown leghorn fowl. *Trans. Roy. Soc. Edinburgh,* 59:533–562.

Delacour, Jean
1945 The display of the Maned Goose. *Wils. Bull.*, 57:129.

Lorenz, Konrad
1941 Vergleichende Bewegungsstudien an Anatinen. *Jour. für Ornith.*, 89 (supplt. 3):194–293.

Mayr, Ernst
1933 Birds collected during the Whitney South Sea Expedition XXVII. Notes on the variation of immature and adult plumages in birds and a physiological explanation of abnormal plumages. *Amer. Mus. Novit. No.* 666:1–10.

Salomonsen, F.
1941 Mauser und Gefiederfolge der Eisente (Clangula hyemalis (L)). *Jour. für Ornith.*, 89: 282–337.

Stresemann, Erwin
1940 Zeitpunkt und Verlauf der Mauser bei einigen Entenarten. *Jour. für Ornith.*, 88:287–333.

The American Museum of Natural History, New York 24, N.Y.

GENERAL NOTES

The Redhead as a breeding bird of Michigan and Ontario.—A downy young specimen of the Redhead (*Aythya americana*) that, according to the label, was "with 5 others on back of female" when collected at Walpole Island, Lake St. Clair, Lambton County, Ontario, about 1900, has been in the collection of the Royal Ontario Museum of Zoology (No. 32, 8, 29, 53) since its receipt in 1932 incorrectly identified as a Lesser Scaup (*Aythya affinis*). The identification was made by the collector, W. G. A. Lambe, of Toronto, and I have twice recorded it as a Lesser Scaup. T. M. Shortt detected the error in 1941 in the course of studying the Museum's duck collection for the purpose of illustrating Francis H. Kortright's "The Ducks, Geese and Swans of North America."

Female Redhead (*Aythya americana*) with newly-hatched young, Delta, Manitoba, 1946. From a painting by H. Albert Hochbaum.

Although there is no evidence that the Redhead breeds at present anywhere in Ontario, that it did so formerly at Lake St. Clair and, once, at Toronto, is shown by the following records:

St. Clair Flats, 1877—Broods reported ("Rover," *For. & Str. and Rod & Gun*, 9, 1877:34).

St. Clair Flats, 1877—Bred in large quantities ("Venator," *For. & Str. and Rod & Gun*, 9, 1877:73).

St. Clair Flats, Michigan, 1879—Two nests (W. H. Collins, *Bull. Nuttall Ornith. Club*, 5, 1880:61–62).

St. Anne Island, Lake St. Clair, Lambton County, Ontario, May 27, 1882—Nest with 10 eggs; June 22, 1882—Nest with six eggs (John H. Morden, *Canad. Sportsman & Nat.*, 3, 1883:218–219). The second set of eggs is now in the Royal Ontario Museum of Zoology. Morden's article gives the locality as "Mitchell's Bay."

St. Clair Flats—Nesting (J. H. Langille, *For. & Str.*, 22, 1884:384).

St. Clair Flats—Nesting (J. H. Langille, "Our Birds in Their Haunts," 1884: 467–468).

St. Clair Flats, 1886—Most common nesting duck (J. H. Langille, *Bull. Buffalo Soc. Nat. Sci.*, 5, 1886:34–35).

Walpole Island, Lake St. Clair, Lambton County, Ontario, about 1900—Six downy young on back of female, seen by W. G. A. Lambe. One, collected, is in the Royal Ontario Museum of Zoology. (Recorded as five young Lesser Scaups by James L. Baillie, Jr., *Trans. Royal Canad. Inst.*, 21, 1936:16; and *Wils. Bull.*, 51, 1939:184.)

Toronto Island, 1900—Brood of 12 seen, according to C. W. Nash's journals in the Royal Ontario Museum of Zoology. The note, under date of August 7, states: "I have just heard of a brood of Redhead 12 in number that were hatched in Jim Crow pond Toronto Island this year; they were seen by Mr. George Warin, Hector McDonald & several others."

Dickinson Marshes, Lake St. Clair, Michigan, 1901—Pair reported nesting (Walter B. Barrows, "Michigan Bird Life," 1912:91).

Near Krauss's Hotel, Wayne County, Michigan, 1908—Four pairs nested (J. Claire Wood, *Auk*, 27, 1910:38).

The Redhead's status as a breeding bird of Michigan rested on the above records of its former nesting around Lake St. Clair until 1941, when a record of eggs from Saginaw Bay was received at the University of Michigan Museum of Zoology. —James L. Baillie, Jr., *Royal Ontario Museum of Zoology, Toronto, Ontario, Canada.*

Catbird "anting" with a leaf.—On August 20, 1945, at a few minutes after 6 a.m. (c.s.t.), I saw a male Catbird (*Dumetella carolinensis*) "anting" with a small, narrow, silvery-green leaf, apparently from one of the many plants of the weed pussytoe (*Antennaria neodioica*) growing in the lawn a few yards away. The Catbird appeared to rub the leaf at the base of the tail; at the same time he turned the tail forward under the body, losing balance, and all but toppling over. He then hopped off a few inches, keeping the leaf in his beak, and repeated the rubbing. He had done this twice more when a Blue Jay (*Cyanocitta cristata*) flew down beside him; then, still holding the leaf, he flew into a hedge and out of sight. H. R. Ivor (1941. *Auk*, 58:416) reports a captive Catbird "anting" with ants. Of the 19 species that he observed "anting," all used ants except one, a Bronzed Grackle (*Quiscalus quiscula aeneus*), which "anted" with choke-cherries. W. L. McAtee (1938. *Auk*, 55:98–105), reviewing the literature of "anting," reports no case of the use of leaves. The pussytoe leaf is very wooly but not pungent or aromatic. Although the Catbird that I watched seemed to rub its tail, Ivor (1943. *Auk*, 60:53) found by close observation of his birds that in every instance they were trying to reach "the very tip of the primary which often was resting on the tail."—Ruth Harris Thomas, *Route 3, North Little Rock, Arkansas.*

Bronzed Grackle "anting" with mothballs.—On the morning of April 5, 1946, five male Bronzed Grackles (*Quiscalus quiscula*) alighted in the back yard of my home in Cleveland, Ohio, and began scratching around in a flower bed that had been scattered with mothballs as a protection against dogs. Suddenly one Grackle was observed rubbing the underside of his spread wing and the part of the body under the wing with a mothball held in his bill. After several applications, he dropped the ball and preened his feathers. He then picked up the ball again and treated the other wing, as well as the belly, rubbing the mothball on the feathers as far back as he could reach with his head between his legs. He "anted" in this fashion approximately 20 times in about 15 minutes and then flew away. The Grackle followed no regular order in treating the various parts of his body but seemed to give them all about equal attention.—Raymond W. Hill, *3316 Kenmore Road, Shaker Heights, Cleveland, Ohio.*

Thure Kumlien and the early history of the Philadelphia Vireo.—Thure Kumlien, in the 1850's, recognized that one of the Wisconsin vireos differed from the Warbling Vireo (*Vireo gilvus*) but had no description of it, since the 1840 edition of Wilson by Brewer was his only ornithological reference book. Eventually the bird was determined to be the Philadelphia Vireo, but the history of this vireo in the 7 years following its discovery is a comedy of errors. Kumlien's observations have been underestimated in some quarters and overestimated in others. In 1921, P. V. Lawson wrote: "Why this rare and little known beauty of the orchard and forest was not properly given the name 'Kumlien Vireo' for its discoverer, the author cannot now ferret out. This late justice is accorded our modest naturalist." [1]

Recently Mrs. H. A. Main gave to the Wisconsin Historical Society the correspondence between Thomas Mayo Brewer and Thure Kumlien. Though there are gaps in the correspondence, especially in the Kumlien series, it is now possible to trace Kumlien's work on this bird with considerable accuracy.

On February 11, 1851, John Cassin [2] read a paper before the Academy of Natural Sciences of Philadelphia, in which he described as new a vireo (*Vireosylvia philadelphica*) taken by him at Philadelphia in September 1842. It was the only specimen that he had seen. Curiously, he later failed to recognize Wisconsin specimens of the same species.

It is possible that prior to 1854 Kumlien was aware that he had a new vireo, but the records do not show this. He had been in correspondence with Brewer since 1851, and if his questions about the bird had arisen prior to 1854, it is reasonable to suppose that he would have mentioned them in his letters. In 1854 he sent specimens to Brewer and apparently wrote of his inability to identify them satisfactorily: on the back of a letter from Brewer to Kumlien, dated November 10, 1854, appears the notation by Kumlien, "About the Virio—to Brewer." On November 20 of the same year Brewer inquired, "Is not the other species you speak of the white-eyed vireo?" On the twenty-fifth of the following March (1855) Brewer wrote that he was visiting John Cassin and Spencer F. Baird, adding: "The other vireo, smaller than the gilvus is supposed to be a new species—Bell's vireo." Again, on May 10, Brewer wrote: "Shoot birds with their eggs and you may thus come at Bell's vireo with its eggs." Who was responsible for this misidentification cannot be determined. Audubon, in 1844, had described Bell's Vireo from a specimen shot by John G. Bell, May 6, 1843, while they were on the Missouri River expedition; but Kumlien did not have access to this description.

There was doubt in Kumlien's mind whether he had Bell's Vireo. A draft of a letter to Brewer, dated January 15, 1856, shows how his bird differed from the known vireos, and there appears the line: "? 7. *Virio Bellii?*." In 1903, L. Kumlien and N. Hollister published on this subject the following wholly erroneous statement: "In the early forties Thure Kumlien procured specimens of a vireo which he called *belli,* of which he had no description, simply to distinguish it from *gilvus*. This led to some confusion with Lawrence, Baird, and others who had not seen the specimens. The bird referred to was later described by Cassin as *V. philadelphicus*." [3] Thure Kumlien did not find the vireo in the early forties, he did not name it *belli,* nor is there any clear evidence that he realized its distinctness before Cassin. No one in the east received any of Kumlien's skins until after Cassin had described the bird.

It will be shown below that Brewer received specimens of the Philadelphia Vireo from Kumlien in 1854. Others were forwarded to him in 1855. On January 11, 1856, Brewer wrote to Kumlien: "Nos. 5, 6 & 7 are vireo gilvus in an unusually fresh plumage." Kumlien was sure of his grounds, and his reply showed clearly the difference between his vireo and *gilvus:* "In regard to the Vireo which I sent you last being the *Vireo gilvus* 'in an unusually fresh plumage', I beg your perusal of the following remarks. You may think it bold in me, but so far as I read Wilson I am not satisfied in regard to this vireo matter.

"*Vireo gilvus,* Wilson—in every respect agreeing with Wilson's description—is common here from the 8th or 10th of May till September. It consequently breeds here. It is an excellent singer. I have a number of skins, and all agree in their markings. There is very little difference between its spring and autumnal dress. It is found in openings more than in thick timber, and frequently near farm-houses. Its length varies from 5½ to 6 inches; I have one that measures full six. *Vireo* – ? — that which I sent you, and which cannot be *V. gilvus* if the preceding is—is by no means so common as the other, and I have never observed it before May 15th, and only from the 15th to the 25th of May and in September. I never heard this bird sing a note. It keeps in the most secluded thickets; I never found it anywhere else. It is a smaller bird than the other. Its length is from 5 to 5¼ inches, which is the longest I have ever found. I admit that in general markings both birds are very much alike, but the *gilvus* is a more slender bird than the other, which appears stouter. Between the spring and autumnal dress of the *gilvus,* as I have said, there is but little difference in the markings, but the other, in autumn, is considerably tinged with yellow."[4] Kumlien also showed the important difference between the two species in the length of the primaries.

The above letter was convincing, for Brewer wrote on April 14, 1856: "I would like to have you identify if you can your Vireos with their eggs. I am in hopes you may thus be able to clear up the present mystery, though the facts of your last letter satisfy me that Mr. Cassin must have been a little hasty in his examination of your specimens. After what you say there can be no doubt that the two species are distinct." Kumlien replied that he thought his vireo distinct "though I don't know if it has been discovered before I did or not." On September 29, 1856, Kumlien wrote Brewer regarding some skins that he had prepared, including "my vireo 1 in autumn dress."

Cassin had been quite hasty in his examination, for Brewer wrote to Kumlien on December 28, 1856: "I showed him [Cassin] what you wrote me about that Vireo. We consulted together about it and have no doubt that you are quite right about it. It is a new species described by Cassin . . . as Vireosylvia Philadelphica. Its genuineness has been disputed but now you have verified his correctness and I have prepared a paper for our Boston society in which I mean that you shall have all due credit. Get all the skins of this that you can. I think I can get some tall prices for them out of Bell and others."

Early in 1857 Kumlien wrote to Brewer: "So Mr. Cassin makes a new genus of my vireo! [Kumlien was familiar only with the genus *Vireo* in Wilson's book.] Has it been found anywhere else? And has he any other specimens than those in fall plumage? There is a deal of diff[erence] in spring & fall plumage. Last spring only one was shot and that was unfit for skinning. Singular that all I ever got were shot in one small thicket."

Brewer, on January 7, 1857, read a paper on *Vireosylvia* before the Boston Society of Natural History, in which he praised Kumlien for his keenness of observation: "Two years since [1854], my attention was called by Thure Kumlien, Esq., a very accurate and careful ornithologist of Wisconsin, to a specimen of Vireosylvia obtained by him near Lake Koskouong, in the southwestern [*sic*] part of that State. He thought it a distinct species from any he had seen any description of, and quite distinct from the *V. gilva.* I gave the specimen to a friend, upon whose judgment I relied more than . . . upon my own, who pronounced it a *V. gilva.* Mr. Kumlien was not satisfied with this decision, and still insisted that its habits, even more than its plumage and size, showed it to be a distinct species. The following year [1855] he sent me several specimens which I gave to Mr. Cassin, who had no doubt that they were of the species he had described as *V. Philadelphica,* though others to whom I showed them were still unconvinced. In answer to a letter in which I informed Mr. Kumlien that his birds were supposed to be the *V. gilva* in an unusually fresh plumage, he wrote me the answer which I give below. It proves, to my mind, conclusively his correctness, establishing the species to be a good one, distinct from *V. gilva* and identical with that described by Mr. Cassin as *V. Philadelphica*. I take the greatest pleasure in thus giving Mr. Kumlien the credit of having worked it out, unaided by any suggestion or help from any one, in view of the disadvantages under which he labors in the want of access to any text-books. His letter is interesting, as throwing the first light that has yet been given to the public upon the habits and distribution of this new and little known species."[5]

Brewer wrote to Kumlien on May 1, 1857: "In the second place he [Cassin] will give you ... 50 cents each for as many of the vireo philadelphica as you can procure. ... He wants you particularly to send him specimens of *vireo gilvus,* just to demonstrate finally that you know the species, though of this he has not a doubt. ... He is pleased to compliment my paper about the vireo philadelphica in which I publish your letter to me written a year ago." There is an element of humor in Cassin's solicitude over Kumlien's ability to recognize *V. gilvus* when he himself did not distinguish Kumlien's specimens of *philadelphicus* from those of *gilvus.* In this connection it is curious that Kumlien should have recognized *philadelphicus* as a new species and at the same time confused *gilvus* (the Warbling Vireo) with so well marked a species as *solitarius* (the Blue-headed). After examining with Baird a shipment of skins from Kumlien, Brewer wrote to Kumlien on October 26, 1854, that "No. 5 and 6 are not vireo solitarius but vireo gilvus."

The classic ninth volume of the Pacific Railroad Survey (1858), by Baird, Cassin, and Lawrence, lists four specimens of *Vireo philadelphicus* from Dane County, Wisconsin (Nos. 6842, 4333, 4334, and 6841). I wrote Alexander Wetmore of the Smithsonian Institution for further data on these specimens. He kindly replied as follows:

"With regard to No. 6842, Baird made a curious error in connection with this specimen since it comes from Rockport, Illinois and reached us from Kirtland.

"As for the others, Nos. 4333, 4334 have identical data coming from Dane County, Wisconsin, spring 1854 and listed as 'obtained from' Dr. T. M. Brewer. They were entered in the catalogue October 24, 1854, as *'Vireo gilvus?'*

"No. 6841 comes from Dane County, Wisconsin, September 1855. 'Obtained from' Th. Kumlien. This was catalogued in 1857 as *'Vireo philadelphicus?'*

"None of these specimens is now to be found in our collections."

It is obvious that it was only through Kumlien's persistence that sufficient attention was drawn to the above specimens to have them entered in the Railroad Report as *philadelphicus.*

It would have been well had the vireo affair ended at this point, but this was not to be. Kumlien, in 1859, sent to Henry Bryant, of Boston, some birds' eggs and skins that Bryant had ordered. On November 29, 1859, Bryant wrote a criticism of the quality of the work done on the specimens. Apparently in atonement, he added: "I was informed by several people that it was in consequence of your observation that Cassin was led to describe V. philadelphia and therefore consider you as the discoverer if not the describer." In the Kumlien correspondence is a scrap of paper on which is written to Bryant, evidently in December, 1859, "It pleased you to state in one of your letters that you considered me the discoverer of V[ireo] P[hiladelphia]. Please do tell me why you think so." Bryant's reply, if made, cannot be found. On February 13, 1862, Kumlien wrote to H. Schlegel, Leiden, Holland: "Is not Vireo philadelphica (I was the first that found that bird) ... desirable . . .?"

Brewer, February 9, 1871, asked Kumlien, "Will you oblige me by giving me all the information you can in regard to Vireo philadelphica? What time it arrives in spring or goes in fall, if any remain to breed, its song, wildness or tameness, etc, etc." When writing on the Philadelphia Vireo in 1875, Brewer stated that he was informed by Thure Kumlien that he "has been familiar with this Vireo since 1849, and has collected it every year since that period. ..."[6] Whether the date

1849 should stand is not now determinable. Evidently Kumlien did not collect this vireo every year, for in a letter to Carl Gustaf Lowenhielm, written in 1859, he said: "I haven't this year nor last found one Vireo Philadelph., so if you have not sold all the specimens, it will be wise to not sell them for under price."

Kumlien, as we have seen, came very near being the discoverer of a new species. He knew far more about the bird we now call the Philadelphia Vireo than did Cassin, who named it. Though he cannot be credited with the discovery, Kumlien, through his accurate observations, convinced eastern ornithologists that this vireo was a good species.

References:
[1] P. V. Lawson, *Trans. Wis. Acad. Sci.,* 20 (1921):679.
[2] John Cassin, *Proc. Acad. Nat. Sci. Phila.,* 5 (1851):153.
[3] L. Kumlien and N. Hollister, *Bull. Wis. Nat. Hist. Soc.,* 3 (1903):133.
[4] T. Kumlien, *Proc. Boston Soc. Nat. Hist.,* 6 (1859):109–110.
[5] T. M. Brewer, *op. cit.*:109.
[6] S. F. Baird, T. M. Brewer, and R. Ridgway, North American Birds. Boston, vol. 1 (1875):367–368.

A. W. Schorger, *168 North Prospect Avenue, Madison 5, Wisconsin.*

The Evening Grosbeak in Kentucky.—Since March 1887, when Leon O. Pindar recorded the Evening Grosbeak (*Hesperiphona vespertina*) in the vicinity of Hickman, Fulton County, Kentucky, there has been no record of this species from the State. Pindar (1887, *Auk,* 4:257) observed a small group March 18, 22, 23, and 25, 1887. He saw seven on the last date and apparently collected three. Our efforts to locate these specimens have so far been in vain. There are three specimens of this finch taken just outside of our borders, near Cincinnati, Ohio, March 6, 1911, and two taken in the same locality June 8, 1911 (Woodrow Goodpaster, 1941, *Jour. Cincinnati Soc. Nat. Hist.,* 22:34).

On February 24, 1946, we collected an adult male Evening Grosbeak at Anchorage, Jefferson County, Kentucky. It was sitting all alone in a tree beside Monroe's house. A careful search of the neighborhood failed to disclose more of its kind. The specimen was very fat.

The collection of this specimen definitely establishes the Evening Grosbeak's place on the Kentucky list as a rare, or casual, straggler. The record is of special interest in connection with the marked invasion of Evening Grosbeaks in the northeastern states this winter.—Burt L. Monroe, *Anchorage, Kentucky,* and Robert M. Mengel, *Cornell University, Ithaca, New York.*

To the Members of the Wilson Ornithological Club:

The Annual Meeting of the Wilson Ornithological Club will be held in Omaha, Nebraska, November 29 to 30. A more detailed announcement will appear in the Secretary's letter, which all Members will soon receive, and in the September issue of the *Bulletin.*

Members should be considering what papers they will present, for the titles will be requested in the Secretary's letter above referred to. Information concerning drawings of birds made by men in uniform during the war should be given the Secretary, in case a special exhibit of these can be arranged.

Omaha is admittedly not a centrally located point, but the invitation to meet there was most cordial, certain more easterly cities are faced with a bad housing problem at the moment, and the opportunity to meet with the recently reaffiliated Nebraska Ornithologists' Union is one we cannot afford to miss.

George Miksch Sutton, *President*

June 26, 1946

EDITORIAL

This has been a record year for prompt payment of dues, and the Members deserve our gratitude. Early payment not only saves the Treasurer and the Editor considerable time; it greatly reduces the expense of mailing the *Bulletin*.

To facilitate a complete listing of "Lacks and Desiderata" for the Wilson Ornithological Club Library, all Members are requested to send to the Editor a complete bibliography of their published titles (even though a single title represents their complete bibliography). It would greatly simplify the work if the bibliography were sent to us in duplicate so that one copy can be returned to the Member with checks against those titles that the Club Library lacks and the Member may be able to supply. For convenience of permanent filing, the bibliographies should if possible be typed double-spaced on standard size ($8\frac{1}{2} \times 11$) paper.

Dr. Gordon M. Meade asks that records of the Snowy Owl made this past fall and winter in New Jersey, Pennsylvania and states south should be sent to him at the University of Rochester, Rochester 7, New York. He is preparing a report on the New York aspects of the 1945–46 Snowy Owl flight and wishes to include the more southern records. He would like to know the name of the observer; the date and place of each observation; the number of individual observations made; the approximate date for the peak of the invasion in the area; and first and last dates of observation.

John W. Aldrich of the U.S. Fish and Wildlife Service, Washington, D.C., asks for donations of good glossy prints (accompanied by data) of bird photographs taken in the State of Washington. With Stanley G. Jewett, Walter P. Taylor, and William T. Shaw, Dr. Aldrich is preparing a book on the birds of the State.

Contributors are again reminded that the date of publication of a manuscript depends as much on the amount of time required to prepare it for publication as on the date of receipt. Not only careless English, ambiguous expression, and inaccuracies in quantitative data and bibliographical references are in question; such apparently minor details as untidily marked-over manuscript, narrow margins, poor quality paper, and worn-out typewriter ribbons tremendously increase the editor's labors.

OBITUARY

Clinton G. Abbott, for twenty years director of the museum of the San Diego Society of Natural History, died March 5, 1946. In recognition of his very important services to the museum, the Society has established the Clinton G. Abbott Memorial Publication Fund. The income from the fund will be used for an enlarged publication program.

Thomas S. Roberts, familiar to all ornithologists as the author of "The Birds of Minnesota" and "Bird Portraits in Color," died in Minneapolis on April 19 at the age of eighty-eight. Formerly chief of staff at St. Barnabas Hospital, Minneapolis, and Professor of Pediatrics at the University of Minnesota, he became, after his retirement from medical practice in 1913, Professor of Ornithology and director of the Museum of Natural History at the University of Minnesota. His best known work in ornithology, "The Birds of Minnesota," first published in 1932, was awarded the Brewster Medal in 1938. Dr. Roberts had been a member of the Wilson Ornithological Club since 1914.

Ornithological News

The American Ornithologists' Union will hold its Sixty-fourth Annual Meeting at Champaign, Illinois, September 2–5.

Mrs. Walter W. Naumburg, who worked as a research associate under Frank Michler Chapman at the American Museum of Natural History, has founded a Chapman Memorial Fund "to promote the study of living birds of the Western Hemisphere." The income of the fund will be used to establish fellowships for students engaged in special field studies.

Lt. Col. W. P. C. Tenison, Editor of the *Aves* section of the *Zoological Record,* was recently elected Editor of the *Bulletin of the British Ornithologists' Club.*

An advance brochure announces the early publication of what promises to be a very fine (and certainly much needed) book on Chilean birds, by J. D. Goodall, A. W. Johnson, and R. A. Philippi B. The brochure includes sample pages with text and a selection of excellent color plates from paintings by J. D. Goodall. The authors' intentions are so commendable that they seem worth quoting at length: "It has been our aim to produce a comprehensive Manual covering all species and subspecies so far reported from Chilean territory, combining, in so far as possible, the scientific approach with a general text calculated to stimulate interest in the lay reader. Intended primarily for use in Latin-America, the book has necessarily been written in Spanish.

"A separate colour-plate for each bird being out of the question on account of the prohibitive cost, a careful selection has been made of the best known or most representative species in each family or in some cases, genus, so as to give the widest possible coverage and facilitate field identification of the other species by tying in their respective descriptions with the one illustrated. In every case, the drawings have been made from first hand knowledge of the actual bird and its natural surroundings or habitat."

O. J. Murie, the artist and naturalist, who has been a member of the Wilson Ornithological Club since 1934, is the new director of the Wilderness Society.

A. Starker Leopold, Director of Field Research in the Conservation Section of the Pan American Union, received a 1946 Guggenheim Memorial Fellowship for the preparation of a book on the gallinaceous game birds of Mexico.

The headquarters of the British Ornithologists' Union are now at the British Museum (Natural History), South Kensington. Communications for the Hon. Secretary and Treasurer and for the Editor of the *Ibis* should be addressed to them % Bird Room, British Museum (Natural History), Cromwell Road, London, S.W. 7.

Walter J. Breckenridge, the artist and naturalist, has been appointed director of the Minnesota Museum of Natural History to succeed Thomas S. Roberts.

Alexander F. Skutch, known to *Wilson Bulletin* readers for his excellent articles on the birds of Central America, has been awarded a Guggenheim Memorial Fellowship for 1946. He plans to make his headquarters at the University of Michigan Museum of Zoology while preparing a book on the life histories of Central American birds.

Charles W. Schwartz, of Columbia, Missouri, a member of the Wilson Ornithological Club since 1943, has been appointed Biologist of the Board of Agriculture and Forestry of the Territory of Hawaii. He will be in charge of the wildlife conservation and game management program.

ORNITHOLOGICAL LITERATURE

A Laboratory and Field Manual of Ornithology. By Olin Sewall Pettingill, Jr. Burgess Publishing Company, Minneapolis, revised ed., 1946: 8½ × 11 in., vi + 248 pp., illustrated by Walter J. Breckenridge. Ring or staple binding. $3.50.

This manual represents a work of great value to teachers and students of ornithology. The wealth of critically selected material which it contains is useful not only in teaching but also in research. The text is clearly written and well organized, but more important than even these desirable features is the degree to which this manual views birds from the standpoint of general biological problems.

The text is divided into 18 sections; each gives an outline of basic information, instructions for study, and (with three exceptions) a bibliography. The first 10 sections are designed for a spring or summer introductory course and deal with the following: topography of the bird, feathers and feather tracts, internal anatomy, classification and nomenclature, external structural characters, laboratory identification, plumages and plumage coloration, distribution and migration, field identification, and bird ecology. The remaining 8 sections are intended for an advanced summer course and deal with communities, territory, mating, nests and nest-building, eggs and incubation, young and their development, parental care, and bird populations.

The descriptive sections on anatomy leave little to be desired. For an introductory course, they are comprehensive, yet compact. Instructions are set forth with special effort to save a student's time by enabling him to focus attention on critical detail. Certain parts of the section on internal anatomy might be considered irrelevant, but the section is "not included in required laboratory work."

Perhaps the weakest part of the entire manual is that dealing with classification and nomenclature. The definition of "characters" (p. 53) might be clearer if it read "*distinctive or peculiar* points of structure or of habit." It should be made absolutely clear to the student that classification rests on characters that are *diagnostic* (a word not used in the section). The unmodified statement that subspecies "differ minutely" would seem to promote beginners' and non-systematists' misunderstanding of the bases and significance of subspecific distinctions. A thinking student will wonder why so many ornithologists concern themselves with subspecies. Just a sentence or two, with references to pertinent discussions in Mayr's book and other sources, would help. A hint that classification schemes are not static might be provided by the statement that there is a tendency, at present, toward elimination of subgenera in such "standard works" as the A.O.U. Check-List and that the category "superspecies" has never been used in that work. Pettingill suggests (p. 56) that the student "habitually rely upon it [the A.O.U. Check-List] for the proper presentation of all technical and vernacular . . . names." But for vernaculars in general, Peterson's Field Guides are a better source. The bibliography of this section does not list the works of Ridgway, Ridgway and Friedmann, or Hellmayr, all of which seem worthy of inclusion.

The sections on ecological factors, communities, and populations deal in concise and apt fashion with topics not easy to present. Here two points are worth some comment. First, in the procedure suggested for the study of bird communities (p. 142), separate mention is made of "effect of edge" and "effect of ecotones." But an edge may be considered an ecotone, usually a sharp one. Ecotones or transitions may be sharp or gradual, local or regional. "Edge" is a term of more restricted meaning, but the principle is the same, namely, community interdigitation, intermixture, or juncture. The second point is the fact that in the section on populations, equal emphasis is given to measurements of absolute abundance and those of relative abundance. The author, as a teacher, has excellent opportunity to encourage counts of actual populations and to point out the limitations of measurements of relative abundance. I have the impression that the latter often serve as an excuse for merely pleasurable "birding." The inclusion of road censuses (p. 202) as a method of measuring relative abundance may lead some students to take this "game" seriously.

Additional useful information is organized in seven appendices, as follows: Ornithological Field Methods; Preparation of a Paper; Bibliographies Pertaining More or Less to Ornithology; Bibliography of Life History Studies (including unpublished theses); Selected Bibliography of State Works on Birds; Books for General Information and Recreational Reading; Current North American Ornithological Journals. The bibliography of State works is of deliberately restricted scope, but the following additions seem worthwhile and significant supplements to the listed works: Brewster on the Lake Umbagog region of Maine (1937. *Bull. Mus. Comp. Zool.,* 66:1–620), Griscom and Crosby on southern Texas (1925–26. *Auk,* 42:432–440, 519–537; 43:18–36), Linsdale on the Great Basin (1938, *Amer. Midl. Nat.,* 19:1–206), and van Rossem on the Charleston Mountains of Nevada (1936. *Pacific Coast Avifauna No.* 24:1–65). B. T. Gault's "Check List of the Birds of Illinois" (Ill. Aud. Soc., 1922) is a list published earlier than Schantz' "Birds of Illinois" (1928) cited by Pettingill, but is, nevertheless, the more informative of the two. These, however, are minor points. Perhaps the only real criticism to be made of this bibliography is that it ignores Canada: Taverner's works, for instance, are nowhere cited.

The entire manual leads one to reflect on the pedagogic method of approach. Perhaps there is a danger that simplification in a manual of this type may become excessive; that in trying to cover a large amount of information the student may spend too much time filling in blanks and adding detail to base drawings without knowing why. But the extent to which this is a real danger depends not on the manual but on the teacher and on his demands in terms of the available time. Some will perhaps wonder if the rather detailed outlines Pettingill provides for the study of breeding biology would not stifle student originality. Here, however, I believe the approach of this manual is in the long run the most successful.

The manual is distinctly more than an entry book of details on the characters of bird groups, their world distribution, and the identification of local avifaunae. Although designed for teaching-needs, the manual can also serve—if only for its excellent bibliographies—as a handbook to investigators and as a check-list of the desired types of information on breeding biology.—Frank A. Pitelka.

BIBLIOGRAPHY *

PHYSIOLOGY (*including weights*)

ELDER, WILLIAM H. Age and Sex Criteria and Weights of Canada Geese. *Jour. Wildl. Manag.* 10 (2), April 1946:93–111, pls. 6, 7.

NICE, MARGARET M. Weights of Resident and Winter Visitant Song Sparrows in Central Ohio. *Condor* 48 (1), Jan. 1946:41–42.

PARASITES, ABNORMALITIES, AND DISEASE

COWAN, I. McT. Death of a Trumpeter Swan from multiple parasitism. *Auk* 63 (2), April 1946:248–249.

ANATOMY (*including plumage and molt*)

DAVIS, MALCOLM. A white Fish Crow. *Auk* 63 (2), April 1946:249.

* Titles of papers published in the last number of *The Wilson Bulletin* are included for the convenience of members who clip titles from reprints of this section for their own bibliographic files. Reprints of this section are available at a small cost.

Glenny, Fred H. A Systematic Study of the Main Arteries in the Region of the Heart—Aves XVII, Colymbiformes, Part 1. *Auk* 63 (2), April 1946:215–218, 2 figs.

Poor, Hustace H. Plumage and Soft-part Variations in the Herring Gull. *Auk* 63 (2), April 1946:135–151, pl. 5.

Vogel, Howard H. Jr. Albino Robin at Crawfordsville, Indiana. *Auk* 63 (2), April 1946:249–250.

Distribution and Taxonomy

Aldrich, John W. Significance of Racial Variations in Birds to Wildlife Management. *Jour. Wildl. Manag.* 10 (2), April 1946:86–93.

Barrett, Lewis L. The Greater Scaup in Minnesota. *Flicker* 18 (1), March 1946:13–14.

Conover, Boardman. The type locality of Franklin's Grouse. *Auk* 63 (2), April 1946:242.

Cowan, I. McT. Notes on the Distribution of *Spizella breweri taverneri*. *Condor* 48 (2), March 1946:93–94.

Kelso, Leon. A Study of the Spectacled Owls, Genus Pulsatrix. *Biol. Leaflet No.* 33, Mar. 1946:1–13, 1 pl.

King, Robert L. Summer birds of the Okoboji region 1938–1942. *Proc. Iowa Acad. Sci.* 51, (for 1944), 1945:467–470.

Lehmann V., F. C. Two New Birds from the Andes of Colombia. *Auk* 63 (2), April 1946:218–223. (*Bubo virginianus colombianus* and *Oxyura jamaicensis andina*, new subspecies).

Mayfield, Harold. The Status of Great Black-Backed and Glaucous Gulls in Michigan. *Jack-Pine Warbler* 24 (1), Jan. 1946:19–22.

Mayr, Ernst. History of the North American Bird Fauna. *Wils. Bull.* 58 (1), March 1946:3–41, figs. 1–4, col. pl.

Mierow, Dorothy. A Distributional Study of the Pine Siskin. *Annals Carnegie Mus.* 30, Feb. 1946: 249–261.

Miller, Alden H. Endemic Birds of the Little San Bernardino Mountains, California. *Condor* 48 (2), March 1946:75–79. (*Oreortyx picta russelli, Parus inornatus mohavensis,* and *Psaltriparus minimus sociabilis,* new subspecies.)

Moore, Robert T. The status of *Dendroica auduboni nigrifrons* in the United States. *Auk* 63 (2), *April* 1946:241–242.

Niedrach, Robert J. Duck Hawk nesting in Colorado. *Auk* 63 (2), April 1946: 253.

Pitelka, Frank A. A New Race of *Aphelocoma unicolor* from Southern Mexico. *Condor* 48 (1), Jan. 1946:44–45. (*A. u. oaxacae,* new subspecies from Oaxaca.)

Sheppard, R. W. Water birds of the Niagara. *Canad. Field-Nat.* 59 (5), Sept.-Oct. 1945:151–169, map.

Sutton, George Miksch, and Rowland S. Wilson. Notes on the Winter Birds of Attu. *Condor* 48 (2), March 1946:83–91, figs. 18–20.

van Rossem, A. J. The Composite Nature of the Name *Cissilopha yucatanica* (Dubois). *Condor* 48 (1), Jan. 1946:40–41.

van Rossem, A. J. Two New Races of Birds from the Lower Colorado River Valley. *Condor* 48 (2), March 1946:80–82. (*Toxostoma dorsale coloradense* and *Pipilo aberti dumeticolus,* new subspecies.)

Van Tyne, Josselyn, and Milton B. Trautman. The Red-winged Blackbird of Yucatan. *Univ. Mich. Mus. Zool. Occ. Papers No.* 496, April 18, 1946:1–3. (*Agelaius phoeniceus pallidulus,* new subspecies.)

See also *Migration and Flight:* Cooke; *Population:* Fisher and Baldwin; *History . . . and Institutions:* McAtee, Schorger.

Evolution and Speciation

Ripley, S. Dillon. Suggested terms for the interpretation of speciation phenomena. *Jour. Wash. Acad. Sci.* 35 (11), November 1945:337–341.

See also *Distribution and Taxonomy:* Mayr.

Migration and Flight

Abbott, Jackson Miles. The White-faced Storm Petrel off Cape Cod. *Auk* 63 (2), April 1946:251.

Behrend, Fred W., and Mary Fern Behrend. Evening Grosbeaks in Northeast Tennessee. *Migrant* 16 (4), Dec. 1945:53–55.

Berry, Arthur L. Golden Plover at Sea. *Condor* 48 (1), Jan. 1946:45.

Cooke, May Thacher. The winter range of the Great Blue Heron. *Auk* 63 (2), April 1946:254.

Lowery, George H. Jr. Evidence of Trans-Gulf Migration. *Auk* 63 (2), April 1946:175–211, 1 fig.

Mackenzie, Locke L. Migration of the Sooty Shearwater off the Washington coast. *Auk* 63 (2), April 1946:257–258.

Packard, Fred Mallery. Midsummer Wandering of Certain Rocky Mountain Birds. *Auk* 63 (2), April 1946:152–158.

Patterson, Robert L. Burrowing Owl at sea. *Wils. Bull.* 58 (1), March 1946:53.

Riney, Thane A. Birds Aboard ship. *Auk* 63 (2), April 1946:250.

Schorger, A. W. Jaçana taken at sea. *Auk* 63 (2), April 1946:255.

Skutch, Alexander F. The Migration of Swainson's and Broad-winged Hawks through Costa Rica. *Northwest Sci.* 19 (4), Nov. 1945:80–89.

Woodbury, Angus M. Huge Migratory Flock of Purple Martins in Utah. *Condor* 48 (1), Jan. 1946:42.

See also *Techniques:* Cooke (Titles 2, 3, and 4), Géroudet, Thomas.

Ecology

McAtee, W. L. The Economic Status of Flocking Birds. *Condor* 48 (1), Jan. 1946:29–31.

Marshall, William H. Cover Preferences, Seasonal Movements, and Food Habits of Richardson's Grouse and Ruffed Grouse in Southern Idaho. *Wils. Bull.* 58 (1), March 1946:42–52, figs 1–6.

Rice, Lucile A. Studies on Deciduous Forest Animal Populations During a Two-Year Period with Differences in Rainfall. *Amer. Midl. Nat.* 35 (1), Jan. 1946:153–171.

Shelford, V. E., and Lenore Martin. Reactions of Young Birds to Atmospheric Humidity. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:66–68, figs. 1–2.

See also *Food and Feeding Habits:* Brown; *Population:* Sooter.

Life History and Behavior

Breckenridge, W. J. Wood Ducks at the Brackens. *Flicker* 18 (1), March 1946: 1–2. (Minnesota).

Bryens, Oscar McKinley. Trap Behavior of Bronzed Grackles. *Bird-Banding* 17 (2), April 1946: 76–78.

Chamberlain, Nell M. A Cardinal Family. *Flicker* 18 (1), March 1946:12–13.

Clotfelter, J. W. Some Episodes in the Lives of Robins. *Kentucky Warbler* 22 (2), Spring 1946:20–22.

Conway, Albert E. Unusual nesting of the Prothonotary Warbler. *Auk* 63 (2), April 1946: 250.

Davis, David E. A seasonal analysis of mixed flocks of birds in Brazil. *Ecol.* 27 (2), April 1946:168–181.

EISENMANN, EUGENE. Acorn storing by *Balanosphyra formicivora* in Panamá. *Auk* 63 (2), April 1946:250.

FLEETWOOD, RAYMOND J. Unusual Matings of a Brown-headed Nuthatch. *Bird-Banding* 17 (2), April 1946:75–76.

FOWLE, C. DAVID. Notes on the Development of the Nighthawk. *Auk* 63 (2), April 1946:159–162, pl. 6, 1 fig.

GROFF, MARY EMMA, and HERVEY BRACKBILL. Purple Grackles 'anting' with walnut juice. *Auk* 63 (2), April 1946:246–247.

HARE, MONTGOMERY. Avian leukosis and the Great Black-backed Gull. *Auk* 63 (2), April 1946: 245–246.

HAVERSCHMIDT, FR. De broedduur van de Zwarte Stern, *Chlidonias niger* (L.). *Ardea* 33 (3–4), Dec. 1945:237–240. (Egg-laying and incubation period.)

HAVERSCHMIDT, FR. Notes on the Breeding of the Little Gull. *Brit. Birds* 39 (1), Jan. 1946:14–18, pl. 1–6. (*Larus minutus.*)

HUSSONG, CLARA. The Clay-colored Sparrow. *Passenger Pigeon* 8 (1), Jan. 1946: 3–7, 2 photos.

LASKEY, AMELIA R. Notes on Mourning Dove Nests. *Migrant* 16 (4), Dec. 1945:65–66.

LOVELL, HARVEY B., and C. M. KIRKPATRICK. A Winter Roost. *Kentucky Warbler* 22 (2), Spring 1946:17–19. (A roost of *Turdus migratorius, Sturnus vulgaris, Molothrus ater,* and *Quiscalus quiscula* in Kentucky.)

MAYFIELD, G. R. A Remarkable Robin Roost at Nashville. *Migrant* 16 (4), Dec. 1945:62.

MUSGROVE, JACK W. The Eastern Goshawk in Iowa. *Iowa Bird Life,* 16 (1), March 1946:2–4.

MUSSELMAN, T. E. Some Interesting Nest Habits of the Eastern Bluebird *(Sialia sialis sialis). Bird-Banding* 17 (2), April 1946:60–63, photo.

NEFF, JOHNSON A., and R. J. NIEDRACH. Nesting of the Band-tailed Pigeon in Colorado. *Condor* 48 (2), March 1946:72–74, fig. 16.

NICHOLS, J. T. Chipping Sparrow's nest without hair lining. *Auk* 63 (2), April 1946:247–248.

OLSON, ROSS. Nesting Birds of Prey. *Flicker* 18 (1), March 1946:16–17.

PARKS, G. HAPGOOD. Notes on the Behavior of a Nesting Nighthawk. *Bird-Banding* 17 (2), April 1946:55–60.

SCHREIBER, EDWIN D. Immense Bird Roost near Martha, Tenn. *Migrant* 16 (4), Dec. 1945: 62–63.

SKUTCH, ALEXANDER F. Life Histories of Two Panamanian Antbirds. *Condor* 48 (1), Jan. 1946:16–28. *(Hylophylax naevioides* and *Myrmotherula axillaris.)*

SKUTCH, ALEXANDER F. The Parental Devotion of Birds. *Sci. Monthly* 62 (4), April 1946:364–374.

SPOFFORD, WALTER R. Peregrine Falcons in a West Tennessee Swamp. *Migrant* 16 (4), Dec. 1945:56–58.

STABLER, ROBERT M. Eastern Kingbird Uses Rose Petals As Nest Material. *Bird-Banding* 17 (2), April 1946:74–75.

TAYLOR, WALTER P. Scissor-tailed Flycatcher and Red-tailed Hawk Nest in the Same Tree. *Condor* 48 (2), March 1946:94.

THACHER, MRS. S. CHARLES. Wood Thrush Parasitized by Cowbird. *Kentucky Warbler* 22 (2), Spring 1946:22.

VAURIE, CHARLES. Early Morning Song During Middle and Late Summer. *Auk* 63 (2), April 1946:163–171.

See also *Distribution and Taxonomy:* Niedrach; *Food and Feeding Habits:* Gunn, Sprunt.

Food and Feeding Habits

Baldwin, W. P., Jr., and C. O. Handley. Winter Food of Bobwhite Quail in Virginia. *Jour. Wildl. Manag.* 10 (2), April 1946:142–149.

Brown, Charles P. Food of Maine Ruffed Grouse by Seasons and Cover Types. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:17–28.

Culbertson, A. E. Lawrence Goldfinches Feed on Jumping Galls. *Condor* 48 (1), Jan. 1946:40.

Gunn, W. W. H. Pigeon Hawk vs. Sandpiper. *Jack-Pine Warbler* 24 (1), Jan. 1946:15–18.

Nestler, Ralph B. Mechanical Value of Grit for Bobwhite Quail. *Jour. Wildl. Manag.* 10 (2), April 1946:137–142, pl. 11.

Norris-Elye, L. T. S. Symbiotic Tendencies Among Birds. *Canad. Field-Nat.* 59 (5), Sept.-Oct. 1946:174. (Ring-billed Gulls catching fish scared to the surface by Murres; Sanderlings stealing food from Turnstones.)

Sprunt, Alexander Jr. Predation on living prey by the Black Vulture. *Auk* 63 (2), April 1946:260–261.

Stevens, O. A. Sociable Ruffed Grouse Eats Baneberry Fruits. *Kentucky Warbler* 22 (2), Spring 1946:20. (In Minnesota.)

Treichler, Ray, Richard W. Stow, and A. L. Nelson. Nutrient Content of Some Winter Foods of Ruffed Grouse. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:12–17.

See also *Ecology:* McAtee, Marshall; *Techniques:* Martin *et al.*

Population *(including age, and mortality rates)*

Craven, Earl. The Status of the Whooping Crane on the Aransas Refuge, Texas. *Condor* 48 (1), Jan. 1946:37–39.

Fisher, Harvey I., and Paul H. Baldwin. War and the Birds of Midway Atoll. *Condor* 48 (1), Jan. 1946:3–15, figs. 1–2.

Lack, David. Clutch and Brood Size in the Robin. *Brit. Birds* 39 (4, 5), April, May 1946:98–109, 130–135.

Sooter, Clarence A. Habits of Coyotes in Destroying Nests and Eggs of Waterfowl. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:33–38, pls. 1–2.

See also *Physiology:* Elder; *Techniques:* Lehmann (2 titles).

Techniques *(including banding)*

Cooke, May Thacher. Returns of Banded Birds: Some Recent Records of Interest. *Bird-Banding* 17 (2), April 1946:63–71.

Cooke, May Thacher. Bobwhites that Traveled. *Bird-Banding* 17 (2), April 1946:74.

Cooke, May Thacher. Wanderings of the Mockingbird. *Bird-Banding* 17 (2), April 1946:78.

Cooke, May Thacher. Cardinal not always Sedentary. *Bird-Banding* 17 (2), April 1946:78–79.

Géroudet, P. Le tambourinage des Pics. *Nos Oiseaux No.* 185, April 1946:145–150, illus.

Lehmann, Valgene W. Bobwhite Quail Reproduction in Southwestern Texas. *Jour. Wildl. Manag.* 10 (2), April 1946:111–123, pls. 8, 9.

Lehmann, Valgene W. Mobility of Bobwhite Quail in Southwestern Texas. *Jour. Wildl. Manag.* 10 (2), April 1946:124–136, pl. 10.

Martin, A. C., R. H. Gensch, and C. P. Brown. Alternative Methods in Upland Gamebird Food Analysis. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:8–12.

Ryves, B. H. Some Criticisms on the recording of Incubation-Periods of Birds. *Brit. Birds* 39 (2), Feb. 1946:49–51.

Thomas, Ruth Harris. Returns of winter-resident Mockingbirds in Arkansas. *Wils. Bull.* 58 (1), March 1946:53–54.

WEAVER, RICHARD LEE. What Can a Bird-Bander Contribute to Ornithology Today? *Bird-Banding* 17 (2), April 1946:53–55.

WIEBE, A. H. Improving Conditions for Migratory Waterfowl on TVA [Tennessee Valley Authority] Impoundments. *Jour. Wildl. Manag.* 10 (1), Jan. 1946:4–8.

See also *Physiology:* Elder; *Distribution and Taxonomy:* Aldrich; *Life History and Behavior:* Bryens; *Food and Feeding Habits:* Nestler.

HISTORY, BIOGRAPHY, BIBLIOGRAPHY, AND INSTITUTIONS

HOWARD, HILDEGARDE. George Willett: May 28, 1879—August 2, 1945. *Condor* 48 (2), March 1946:49–71, figs. 5–15, 1 pl. (With full bibliography.)

MCATEE, W. L. Georgian Records in John Latham's "General History of Birds," 1821–1824. *Oriole* 11 (1), Jan. 1946:1–11.

SCHORGER, A. W. The Quail in Early Wisconsin. *Trans. Wis. Acad. Sci., Arts and Letters* 36 (for 1944), 1946:77–103.

SCHORGER, A. W. Thure Kumlien. *Passenger Pigeon* 8 (1), Jan. 1946:10–16, photo. (To be concluded.)

TAYLOR, MRS. H. J. Iowa Ornithologists of Other Days: Ira Noel Gabrielson. *Iowa Bird Life* 16 (1), March 1946:9–11, photo.

VAN ROSSEM, A. J. Dates for Volume 1 of Bonaparte's 'Conspectus Generum Avium.' *Auk* 63 (2), 1946:243.

PALEONTOLOGY

MILLER, LOYE. The Lucas Auk Appears Again. *Condor* 48 (1), Jan. 1946:32–36, fig. 3.

See also *Distribution and Taxonomy:* Mayr.

To the Editor of The Wilson Bulletin:

It may interest some of your readers to know that I have a contract with Dodd, Mead and Company, 432 Fourth Ave., New York 16, N.Y., to publish a reprint of my Bulletin 107, Life Histories of North American Diving Birds. It will probably appear some time next fall or winter.

The price and the format will be announced by the publishers in due course. As the edition will be limited by the probable demand, it might be wise for those who lack this number to notify the publishers that they would like to have an opportunity to purchase a copy.

If the demand seems to warrant it, some of the other rare numbers may be reproduced.

Taunton, Massachusetts. A. C. BENT
May 6, 1946

WILSON ORNITHOLOGICAL CLUB LIBRARY

The following gifts have been recently received. From:

William C. Baker—1 book (typed transcription)
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Margaret M. Nice—13 reprints, 6 journals
W. H. Phelps—1 reprint
Frank A. Pitelka—2 books, 44 journals 1 reprint
Thomas L. Quay—2 books
A. W. Schorger—1 reprint
Carl Stromgren—14 pamphlets and reprints
R. M. Strong—2 reprints
Gordon Wilson—4 reprints

WILDLIFE CONSERVATION

The Ring-Necked Pheasant and Its Management in North America *

This book, published in November 1945 by the American Wildlife Institute, Washington, D. C., presents the findings of a series of researches on pheasants conducted by seven land-grant colleges with the help of the respective state conservation departments and the supervision of the U. S. Fish and Wildlife Service. Michigan contributes an additional research conducted independently. In addition, there are chapters on classification and artificial propagation of pheasants.

The eight regional chapters differ greatly in viewpoint and technique. Some are casual surveys; others are based on ecological research of a high order. W. L. McAtee undertook the difficult editorial task of welding these diverse materials into a book. The result is better than might be expected of so heterogeneous a mixture of authorships and auspices.

The critically reasoned chapter on the pheasant in Ohio, by Daniel L. Leedy and Lawrence E. Hicks, excels the work from other states in both quality and volume. Every page, bristling with quantitative measurements in pheasant ecology, is a compressed summary of material that would ordinarily be reported as a separate paper. In fact, the main defect of the Ohio work is that its findings are so abundant that many of the detailed data and methods of analysis are omitted for lack of space.

The concept of game research in the agricultural colleges dates from the 1920's, when it first became clear that farm-game populations are controlled mainly by soil, farming practices, and farmers, rather than by game laws, game farms, and sportsmen. The Ohio pheasant study is a monumental elaboration of this concept. Not only are pheasant population levels shown to reflect the general pattern of soils and crops, but also to reflect such seemingly unimportant details as the speed of mowing machines, the selection of hay species, the date of last cultivation, the maintenance of fences and ditches, and the social organization of neighborhoods. We recall no equally thorough integration of wildlife ecology and land-use. Those readers who are not particularly interested in pheasants should be reminded that an equally intimate soil-farmer-animal relationship probably exists among numerous other birds and mammals, but remains to be explored.

With all its merits, this book presents certain defects which, if now clearly defined, may perhaps be avoided in the monographs on other game species now "in the mill" for future Wildlife Institute publication.

The most important is that none of the seven agricultural colleges looked further inside the pheasant than its crop or gizzard for explanations of its success or failure as a game bird. Their work was done during a decade when biochemistry and endocrinology were making spectacular advances in helping animal husbandry, poultry science, and medicine explain hitherto insoluble problems. Why did wildlife managers, quartered on the same campus, fail to seek similar help? In our opinion, the answer lies at least in part in an ill-advised mandate to be "practical," i.e. to choose lines of research whose results could be applied quickly to management problems. By and large the researches here reported are good to the extent that this mandate was disregarded or circumvented. (Ironically enough, the Fish and Wildlife Service is now justly proud of its very recent work on the vitamin nutrition of quail.† Encouragement of similar work in pheasants might have greatly enriched this volume.)

A second weakness is that the book is not up to date. The bibliography contains only one title later than 1942, and the argument shows unawareness of important recent publications, some comparable in quality with the Ohio study.

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* American Wildlife Institute, Washington, D.C., 1945: 6 × 8⅝ in., 320 pp., 31 pls. (2 col.), 12 figs. $3.50.

† Nestler, Ralph B. Vitamin A, Vital Factor in the Survival of Bobwhite. Unpubl. MS read at Eleventh North American Wildlife Conference, New York, March 11, 1946.

Parts of the Michigan chapters were written a decade ago, and show it in outmoded and unsupported assertions.

A third weakness is the authors' apparent unawareness of recent advances in the study of bird behavior. For example, it is now widely known that pheasants reared in captivity show a low survival rate where they are in competition with wild pheasants. Might this not arise from the imprinting of abnormal behavior patterns on juveniles while in confinement? Such a possibility is not mentioned, nor can we detect the idea anywhere in the book.

Again, what are we to think about the widely-alleged damaging competition offered to native game birds by pheasants? Errington (p. 198) is the only author who even suspects dominance phenomena. Several others dismiss the question with the remark that no fights have been observed.

We, as readers, would have liked this book better if it offered a chapter summarizing the several regional studies. We would have liked the book better if more of its arguments ended with a flat "I don't know." We would have liked it better if somebody, a decade ago, had started pheasant research in the Dakotas—it does not speak well for "planning" that all pheasant research, until very recently, has been confined to habitats which, in comparison with Dakota, are more or less marginal.

As a piece of technical writing, the book is a monument to its editor. Its style is simple, direct, and uncluttered by "scientific jargon." Except for two color plates, the illustrations (31 plates and 12 figures) are good. It is too bad that the outlay for the color plates was not applied to Walter Weber's handsome painting, which is reproduced as an uncolored frontispiece.—Aldo Leopold and Robert A. McCabe.

Conservation News

The Wildlife Society Award for 1945 was made to the authors and editor of "The Ring-Necked Pheasant and Its Management in North America".

Ira N. Gabrielson, who retired this year as director of the U. S. Fish and Wildlife Service, has accepted the presidency of the Wildlife Restoration Institute, which is replacing the American Wildlife Institute. The new organization will carry on the former activities of the Wildlife Institute, including the sponsorship of the annual North American Wildlife Conference. In addition, it is establishing "a complete service and research organization better to correlate and advance the activities of cooperating agencies in the field of wildlife restoration and conservation."

Duck Hunting Unlimited. "During the fall season of 1943, 1,169,352 [duck stamps] were sold. In 1944, the number jumped to 1,487,029, an increase of about 27%. During the first six months of this fiscal year, which included the last hunting season, more stamps were sold than during all of the year before. In fact, on last December 31st, the duck stamp sales had reached the highest point in history, 1,540,468."—Albert M. Day, in an address to the Eleventh North American Wildlife Conference, March 12, 1946. Day thus presented what he called the "cold facts": "We have overshot our annual increase during the past two hunting seasons.—The population has declined in those two years.—The annual regulations provide the only quick means of adjusting hunting pressure to supply.—Marsh restoration and protection are highly important.—Mother Nature is the prime factor in production. . . . We can do much to improve wintering conditions.—Better public understanding is essential."

The Directors of the National Audubon Society recommended the following changes for the 1946–47 waterfowl hunting season:

1. Reduce the length of open season from 80 to 30 days.
2. Reduce the bag limit from 10 to 5 birds per day, with possession limit the same as the bag limit.

WILDLIFE CONSERVATION COMMITTEE
Frederick N. Hamerstrom, Jr., *Chairman*

CONSTITUTION AND BY-LAWS OF THE WILSON ORNITHOLOGICAL CLUB *

As adopted December 29, 1930, and amended by the Executive Council on August 11, 1944, and October 13, 1945. The Constitution and By-laws as published here will be voted on by the Members of the Club at the next Annual Meeting.

CONSTITUTION

Article I

Name and Object

Section 1. The organization shall be known as "The Wilson Ornithological Club."

Section 2. The object of The Wilson Ornithological Club shall be to advance the science of ornithology, particularly field ornithology as related to the birds of North America, and to secure cooperation in measures tending to this end by uniting in a group such persons as are interested therein, facilitating personal intercourse among them, and providing for the publication of the information that they secure.

Article II

Membership

Section 1. The membership of this club shall consist of six classes: Associate Members, Active Members, Sustaining Members, Life Members, Patrons, and Honorary Members.

Section 2. Any person who is of good moral character and in sympathy with the object of this club may be nominated for membership. Nominations and applications for membership shall be made through the Secretary. Applications for membership shall be endorsed by at least one member. Members shall be elected at the annual meeting by a majority of the members present. Nominations presented in the interim between annual meetings shall be received and confirmed by the Secretary, subject to ratification at the next annual meeting.

Section 3. The annual dues of Associate Members shall be two dollars ($2.00); of Active Members, three dollars ($3.00); of Sustaining Members, five dollars ($5.00). Any member may become a Life Member, exempt from further dues, by making a payment into the endowment fund of the Club of one hundred dollars ($100.00). Any member may become a Patron, exempt from further dues, by making a payment into the endowment fund of the Club of five hundred dollars ($500.00) or more. Upon the unanimous recommendation of the Executive Council, honorary membership may be conferred by the Club by a three-fourths vote at any annual meeting.

Section 4. All members shall be entitled to vote, and all except Associate Members shall be entitled to hold office.

Section 5. All annual dues for the ensuing year shall be due on January 1. Any member in arrears for dues for one year shall be dropped from the roll of members, provided that two notices of delinquency, with an interval of two months between them, shall have been sent to such member.

Article III

Officers

Section 1. The officers of this club shall be a President, two Vice-Presidents, a Secretary, a Treasurer, and an Editor. The duties of these officers shall be those usually pertaining to their respective offices.

Section 2. All officers except the Editor shall be elected at the annual meeting by ballot of the members. The Editor shall be elected annually by the Executive Council.

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* Incorporated under the laws of the State of Illinois on October 16, 1944.

Section 3. Officers shall hold office for one year, or until their successors are elected, and shall be eligible for re-election. Their term of office shall begin at the close of the meeting at which they are elected.

Section 4. The officers of the Club, all past Presidents of the Club, and three additional members who shall be elected by ballot of the Club, shall constitute an Executive Council. The Executive Council shall also constitute the Board of Directors of the Corporation. The business of the Club not otherwise provided for shall be in the hands of the Executive Council, which shall pass upon any urgent matters that cannot be deferred until the next annual meeting. Five members of the Council shall constitute a quorum.

Section 5. Vacancies in the staff of officers, occurring by death, resignation, or otherwise, shall be filled by appointment of the Executive Council, but the person so appointed shall hold office only until the close of the next annual meeting of the Club, except in the event of his election to that office by the members of the Club.

Article IV

Meetings

Section 1. The Executive Council shall determine the time and place of meetings of the Club.

Section 2. Twenty-five (25) members shall constitute a quorum for the transaction of business.

Article V

Accounts

Section 1. A committee of two shall be appointed annually by the President to audit the accounts of the Treasurer.

Section 2. The proper care of an Endowment Fund shall be provided for by a Board of Trustees. This Board shall consist of three members appointed by the President, one member for one year, one for two years, and one for three years. At the expiration of each respective term, a member shall be appointed for three years. Any vacancy on the Board, occurring by death, resignation, or otherwise, shall be filled for the unexpired term.

Article VI

Amendments

Section 1. This constitution may be amended at any annual meeting by a two-thirds vote of the members present, provided that the amendment has been proposed at the preceding annual meeting or has been recommended by a two-thirds vote of the Executive Council, and a copy has been sent to every voting member of the Club at least one month prior to the date of action.

Article VII

By-laws

Section 1. By-laws may be adopted or repealed at any annual meeting by a majority vote of the members present.

BY-LAWS

1. Notice of all meetings of the Club shall be sent to all members at least one month in advance of the date of the meeting.
2. The time and place of the business session shall be published prior to the opening session of the annual meeting.
3. A program committee, of which the Secretary shall be chairman, and a local committee on arrangements for the annual meeting shall be appointed by the President at least ninety days in advance of the meeting.
4. Election of officers, except the Editor, shall be by ballot, but by the unanimous consent of the members, the Secretary may cast one ballot, representing

the unanimous vote of the members present. A nominating committee shall be appointed by the President at the beginning or in advance of the annual meeting, which shall offer nominations of officers to serve the Club during the ensuing year. Nominations may also be made by any member in good standing from the floor.

5. A committee on resolutions, consisting of three members, shall be appointed by the President at the beginning or in advance of the annual meeting.
6. The accumulation and care of one or more Wilson Ornithological Club Libraries shall be provided for. A library committee of three or more members shall be appointed annually by the President.
7. The Executive Council shall have power to expel any person found unworthy of membership in the Club.
8. The official organ of the Club shall be *The Wilson Bulletin.* It shall be sent to all members not in arrears for dues.
9. Any member three months in arrears for dues shall be ineligible to vote or to hold elective office in the Club.
10. The fiscal year of this Club shall be the calendar year.
11. The order of business at regular annual meetings shall be as follows:
    1. Calling of meeting to order by the President.
    2. Reading and approval of minutes of the previous meeting.
    3. Reports of officers.
    4. Appointment of temporary committees.
    5. Election of members.
    6. Business.
    7. Reports of committees.
    8. Election of officers.
    9. Adjournment.

    The program may be interpolated in the order of business according to convenience.
12. The rules contained in Roberts' Rules of Order shall govern the Club in all cases to which they are applicable and in which they are consistent with the Constitution and By-laws of the Club.
13. If no annual meeting can be held, election of officers may be conducted by a mail ballot.
14. This constitution may be amended by mail ballot provided that the amendment has been recommended by a two-thirds vote of the Executive Council, and a copy has been sent to every voting member of the Club at least two months prior to the date of action.

REPORT OF THE TREASURER FOR 1945

Balance as shown by last report, dated Dec. 31, 1944	$ 522.00	
Receipts, Jan. 1 to Dec. 31, 1945		
Dues:		
Associate	1414.25	
Active	1194.05	
Sustaining	355.50	
Subscriptions to *The Wilson Bulletin*	167.00	
Sale of back issues of *The Wilson Bulletin* and of reprints	145.32	
Interest from Endowment Fund	82.00	
Contributions for printing of colored and insert plates	287.80	
Gifts: miscellaneous receipts	9.40	
Total receipts		$4177.32

Disbursements

The Wilson Bulletin: printing, engraving, mailing	2588.98		
President's expense: printing, postage	2.56		
Editor's expense: reprints, postage, secretarial aid	163.99		
Secretary's expense: stationary, postage	44.23		
Treasurer's expense: stationary, postage, clerical aid	58.28		
Membership Committee expense: postage, printing	45.00		
Bank charges; foreign exchange; corporation papers	27.54		
Bad checks	15.00		
Transferred to Endowment Fund savings account	690.14		
Total disbursements		$3635.72	
Balance transferred to new Treasurer, Burt L. Monroe		541.60	
			$4177.32

Endowment Fund

Cash balance in savings account, Dec. 31, 1944	$ 45.24		
Received during year:			
Interest on U. S. bonds and on savings account	82.00		
Sale of U. S. Savings Bonds	900.00		
Life Membership payments	1020.00		
Gifts	35.00		
Transferred from checking account	690.14		
Total		$2772.38	
Transferred to checking account (interest)	82.00		
Purchase of U.S. Savings Bonds, Series G, July 17 ($900.00) and Oct. 19, 1945 ($1400.00)	2300.00		
Total		2382.00	
Balance			$ 390.38
Bonds:			
U. S. Postal Savings Coupon Bonds, dated July 1, 1935			780.00
U. S. Savings Bonds (maturity value Aug. 31, 1948: $1075.00) purchase value			806.25
U. S. Savings Bonds, Series G, dated Sept. 1, 1943			1000.00
U. S. Savings Bonds, Series G, dated Dec. 20, 1944			1500.00
U. S. Savings Bonds, Series G, dated July 1, 1945			900.00
U. S. Savings Bonds, Series G, dated Oct. 1, 1945			1400.00
Total Endowment Fund, transfered to new Treasurer, Burt L. Monroe, Dec. 31, 1945			6776.63

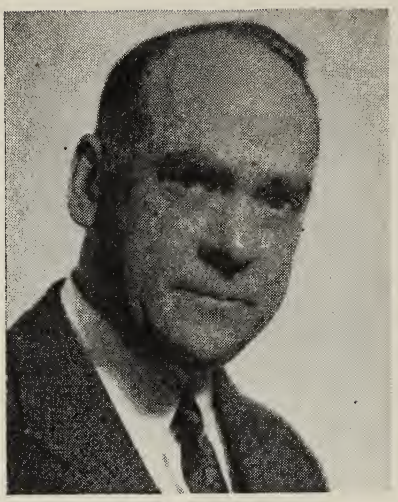
Respectfully submitted,

MILTON B. TRAUTMAN, *retiring Treasurer*

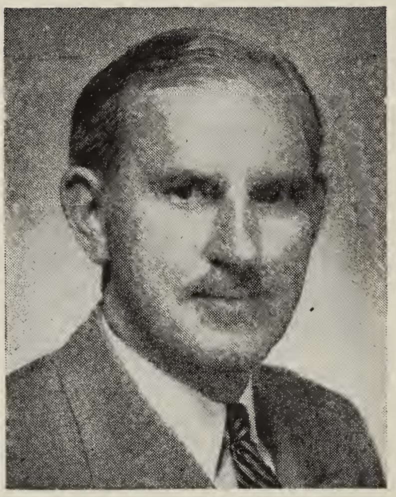
December 31, 1945

Approved by Auditing Committee
James B. Young
Leonard C. Brecher

NEW LIFE MEMBERS



Cecil Billington has long been associated with the Evening News Association and with Booth Newspapers, Inc. of Detroit. His important contributions to horticulture and to systematic botany have been recognized by his appointment as Honorary Curator of Phanerogams in the University of Michigan Herbarium and by the award of the Esther Longyear Murphy Medal "for distinguished service to horticulture." He is a Trustee of The Cranbrook Foundation and of Cranbrook Institute of Science. His publications include several papers on Michigan flowering plants and ferns and a book (1943) on the shrubs of Michigan.



Dr. Alexander W. Blain, a founder of the American College of Surgeons and of the American Board of Surgeons, is now Professor of Surgery at Wayne University and Chief of Staff of the Alexander Blain Hospital and Clinic, Detroit. He serves on the editorial board of several surgical journals and is the author of numerous papers on surgery. But in addition, he takes an active and enthusiastic interest in the fields of botany, mammalogy, and ornithology. He has been a member of the Wilson Ornithological Club since 1902. In 1903 he issued the call which led to the reorganization of the Michigan Ornithological Club. He edited its "Bulletin" through 1903 and 1904 and was Secretary of the Club in 1905. With Jefferson Butler he organized the Michigan Audubon Society in 1904. He was a member of the Michigan State Conservation Commission from 1939 to 1945.

TO OUR CONTRIBUTORS

Our members are asked to submit articles for publication in the *Bulletin*. Manuscripts will be accepted only with the understanding that they have not previously been published or accepted for publication elsewhere.

Manuscript. Manuscripts should be typed, with double-spacing and wide margins, on one side of white paper of good quality and of standard size (8½ x 11). The title should be brief and should indicate the subject clearly. Ordinarily the scientific names of the birds treated should be given and should appear early in the article. Most articles should conclude with a brief summary.

Bibliography. Literature referred to in the text should be cited by author's name, year of publication, and exact page of the particular reference. Such literature should ordinarily be listed in full at the end of the paper.

Illustrations. Photographic prints, to reproduce well as half-tones, should have good contrast and detail. Please send prints unmounted, and attach to each print a brief but adequate legend. Do not write heavily on the backs of photographs.

Proof. Authors are requested to return proof promptly. Expensive alterations in copy after the type has been set must be charged to the author.

Reprints. Orders for reprints, which are furnished to authors at cost, should accompany the returned galley proof.

1946
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SEPTEMBER ISSUE

Number 3
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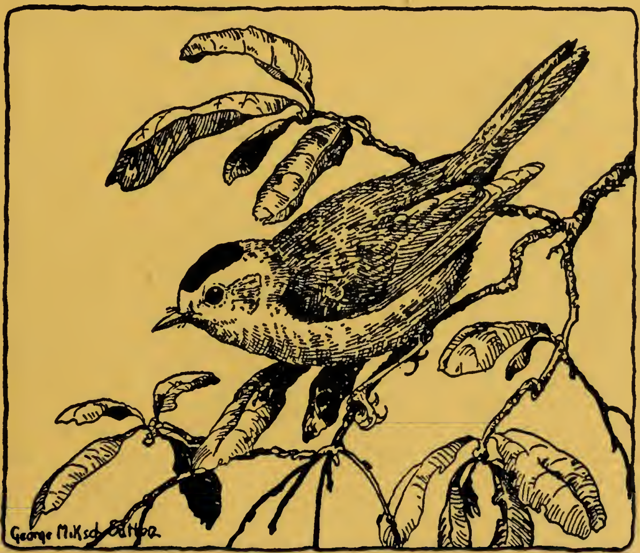
The Wilson Bulletin



Published by the

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THE WILSON BULLETIN

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All articles and communications for publication, books and publications for review, exchanges, and claims for lost or undelivered copies of the magazine, should be addressed to the Editor.

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THE WILSON ORNITHOLOGICAL CLUB

Founded December 3, 1888

Named after ALEXANDER WILSON, the first American ornithologist.

Membership dues per calendar year are: Sustaining, $5.00; Active, $3.00; Associate, $2.00. *The Wilson Bulletin* is sent to all members not in arrears for dues.

WEST INDIAN RED-BELLIED WOODPECKER

Centurus superciliaris murceus

Photographed at Santa Barbara, Isle of Pines, Cuba, March 21, 1945, by Lawrence H. Walkinshaw.

THE WILSON BULLETIN

A QUARTERLY MAGAZINE OF ORNITHOLOGY

Published by the Wilson Ornithological Club

1946		Number 3
Vol. 58	SEPTEMBER ISSUE	Pages 133–195

NOTES ON THE BIRDS OF THE ISLE OF PINES, CUBA

BY LAWRENCE H. WALKINSHAW AND BERNARD W. BAKER

WHILE making a study of Sandhill Cranes, we found there was a dearth of material on the Cuban Sandhill Crane (*Grus canadensis nesiotes*) and decided to spend a short time studying the species on the Isle of Pines during late March, 1945, hoping to be there during the nesting season.

The Walkinshaws landed at Nueva Gerona March 13, 1945, leaving on March 24; the Bakers landed March 17 and left March 26. The Walkinshaws spent March 13 to 15 at Nueva Gerona; March 15, 16, 18, 21, 23, and 24 at Santa Barbara; March 17 and 19 at 'Sabana Grande' (March 19 with Bernard Baker); March 20 and 22 at Los Indios. Late during the day of March 24 they left Santa Barbara for Nueva Gerona and the 'Black Sands' area in the northeastern portion of the island. The Bakers spent March 17 at Nueva Gerona; March 17 (evening) to March 24 at Santa Barbara (except March 19); March 24 to 26 at Nueva Gerona, with a trip to the 'Black Sands' on March 24.

The Isle of Pines belongs to the Republic of Cuba and is located in the Caribbean Sea, the northern end of the island lying about 81 miles by air south from Habana, Cuba. It extends north and south about 35 miles and slightly less across, except along the 'South Shore' where it is nearly 40 miles across. The 'South Shore' is cut off by a large swampy area, the 'Gran Cienega de Lanier,' so that travel from the northern end of the island to the southern portion is not possible except by boat.

The soil is rather rocky, sparingly covered on the northwestern portion, where we did most of our work, with grasses, shrubs, some other plants, and scattered groups of pines and palms—tropical pine (*Pinus tropicalis* Morelet), often associated with bottle palm (*Colpothrinax Wrightii* Griseb. and Wendl.) and in places with such palms as *Acoelorraphe Wrightii* (var. *novo-geronensis*) and *Coccothrinax Miraguama;* grasses: *Paspalum conjugatum* Bergius, and *Imperata brasiliensis* Trin.; sedges: *Rhynchospora;* Rubiaceae: *Rondeletia correifolia*

Griseb.; Bignoniaceae: *Tabebuia lepidophylla* (Griseb.) Rich.; Mimosaceae: *Pithecellobium arboreum* (L.) Urb.; Caesalpinaceae: *Cassia hispidula* Vahl.; Fabaceae: *Aeschynomene tenuis* Griseb., *Centrosema virginiana* (L.) Benth., *Clitoria guianensis* (Aubl.) Benth., *Brya ebenus* (L.) D.C., some species of *Galactia.* Samples of all of these except the palms and palmettos were collected and were identified by Brother Léon of the Colegio de La Salle, Habana, Cuba.

The plant associations have been described by Brother Marie-Victorin and Brother Léon (1942:261–304; 1944:143–166). They also gave some very good descriptions of the island.

The island is mostly one large savanna, slightly rolling in places, with small, rocky mountain ranges. There are two ranges at Nueva Gerona, one to the east and a small one to the west. The Sierra de la Canada is a more extensive range in the region of Los Indios and eastward. The northwestern portion of the island, several thousand acres, is a great, almost treeless savanna, most of it belonging to an American, Ed Pearcy. This area has been fenced and is pastured to a large herd of cattle.

Jean Gundlach did ornithological work on the Isle of Pines, published as follows: Cabanis, 1854–57; Thienemann, 1857; Gundlach, 1862, 1875, 1873–76. Outram Bangs and W. R. Zappey (1905) published considerable material on the birds of the island. W. E. Clyde Todd (1916) published on the extensive work that Gustav A. Link did there. Thomas Barbour (1923, 1943) and James Bond (1936, 1945) have also worked on the island.

Although we did not have access to weather reports, we made records of temperature, of sunrise and sunset, wind direction, and weather. Temperatures were consistently warm, with daytime ranges of 68° to 82° at 6:30 a.m., 84° to 88° at noon, 77° to 82° at 6:30 p.m. Except for a semi-cloudy day on March 20, the weather was clear, with the wind in the southeast until March 22 and 23, when it veered to the north.

The following bird observations were made:

Cormorant. *Phalacrocorax auritus* subsp.

One observed along the Caribbean Sea in the 'Black Sands' area March 24.

Great Blue Heron. *Ardea herodias* subsp.

One observed along a small creek near 'Sabana Grande' March 17.

American Egret. *Casmerodius albus egretta* (Gmelin)

Four observed near 'Sabana Grande' March 19.

Green Heron. *Butorides virescens* subsp.

One was observed at Rancho Rockyford, March 18, flying from tree to tree along the arroyo.

Turkey Vulture. *Cathartes aura aura* (Linnaeus)

The most conspicuous bird on the Isle of Pines.

Marsh Hawk. *Circus cyaneus hudsonius* (Linnaeus)

Three were observed coursing over the open country, two on March 22, and one March 23.

Cuban Sparrow Hawk. *Falco sparverius dominicensis* Gmelin

This hawk was found sparingly on the open pine plains. Baker found a nest in a post along the highway on March 18; it contained three eggs. A Sparrow Hawk was observed chasing a Turkey Vulture March 14 at Nueva Gerona, the vulture finally alighting in a tree. Sparrow Hawks were observed at Nueva Gerona, Santa Barbara, Los Indios, and on 'Sabana Grande.'

Cuban Bob-white. *Colinus virginianus cubanensis* (G. R. Gray)

A flock of nine was observed between Rancho Rockyford and Santa Barbara March 15, resting during the heat of the afternoon in a mass of low growth on the pine plains. On March 16, at Rancho Rockyford, Colonel E. C. Morton observed two flocks whose calls were also heard. A covey was seen often near Santa Barbara March 18, and a covey was heard calling at daylight near Los Indios, March 20.

Cuban Sandhill Crane. *Grus canadensis nesiotes* Bangs and Zappey

Evidently this species was much more common during the time of Gundlach (1875:293) than it is now. Barbour (1943:48–49) stated that cranes were becoming rarer in Cuba but were not uncommon on the Isle of Pines. There cannot be many cranes left. All the natives remarked how rare they were becoming.

For two days we rode horseback across 'Sabana Grande,' hoping to see a flock of 10 observed March 14 by Ed Pearcy. No trace of them was found except tracks along a water hole in one of the arroyos on March 17. On March 20, Walkinshaw rode horseback down to Los Indios across the Sierra de la Canada and stopped at the Hedin residence. Lawrence Hedin said that the cranes used new burns for feeding, evidently picking up dead insects and lizards. Hedin had burned part of his pasture field two days earlier (a custom all over the island), and cranes had already used it as a feeding spot. We immediately walked across the pine- and palm-covered pasture; on an open dry flat, near a small arroyo with some water, we found three cranes feeding in typical crane fashion, always one or more "on guard." After some time we approached them carefully, and soon they flushed, flying just over the tree tops to the southwest, landing about half a mile away. They gave the loud sharp alarm note *garoooo-oo--garoooo-oo--garoooo-oo* exactly like that of the Greater Sandhill Crane (*Grus canadensis tabida*), both on the ground and in the air. We searched carefully for them, and they did not fly but apparently slunk away amongst the pines, for we did not see them again. Hedin reported them on the burn again March 22. These cranes were much browner than the captive bird we saw at Santa Barbara (see below).

Walkinshaw returned alone through the mountains that same afternoon. While crossing a small arroyo with some water, surrounded by foothills covered sparingly with pines, bottle palms, and trees resembling saw-palmettos, he discovered two cranes only 150 feet in front of his horse. They were walking along the bank of the stream and flew across, landing only 100 yards away, giving the trumpeting alarm call in unison while he searched the spot for a possible nest. Soon they slunk quietly across the plain and disappeared. From their behavior he judged that they had their territory selected—though our party could find no trace of them at daylight the following morning. The Walkinshaws found a pair feeding shortly after sunrise March 22 along the same mountain slope. When approached, the cranes flew over the more westerly foothills. Both Lawrence Hedin and Peter Smellie (a Scot living about eight miles east of Los Indios at the base of a high mountain) heard cranes the morning of March 22.

Thus during 63 hours in the field on March 15, 17, 19, 20, 21, and 22, while searching specifically for cranes, Walkinshaw saw only seven cranes. During this time, at least 19 miles were covered on foot, 24 by car, and 62 by horseback. During an equal amount of time spent in any part of the United States or Canada where cranes occur, many more cranes will be observed—even in areas such as Mississippi and southern Michigan.

One Cuban found nests in shallow water at 'Sabana Grande' about three feet from shore, but all of the other natives who had found nests said they were on dry land. Peter Smellie told of finding a nest in late April about 1932 situated on a pine- and palm-dotted savanna along the Sierra de la Canada, east of Los Indios. The two eggs were laid on dry ground beside a small tree far from water. He took the eggs and placed them under a hen, but they did not hatch. Hedin captured a young Sandhill Crane, standing about nine inches high, during the 1930's and tried to raise it, but it was caught and eaten by a large snake. A downy crane was captured about 10 miles west of Santa Barbara during late May, 1943, and brought to the ranch of Silbio Gargiulo, where we saw it in March, 1945 (Plate 4). Except for a drooping wing caused by wing-clipping, it appeared healthy. Like other Cuban Sandhill Cranes it very much resembled the Lesser Sandhill Crane (*Grus canadensis canadensis*), having much shorter tarsi than the Greater Sandhill Crane and the Florida Sandhill Crane (*Grus canadensis pratensis*). The bird was giving the adult call, and he fed around the yard, eating grasshoppers and other insects, earthworms, and lizards, as well as corn which was fed to him. He was heard calling

Captive Sandhill Crane (age 2 years, 10 months) at Santa Barbara, Isle of Pines.

on March 19 at 6:35 a.m. just before sunrise, as other cranes often do. This call was much less shrill than the alarm cry. No one was disturbing him, and it was evidently a natural call. Most of the time he was allowed his freedom, and he fed for a mile or more along the stream. We heard that several cranes had been shot over him as a decoy during the summer of 1944. These were eaten by the natives who shot them. Many of the natives remarked how good cranes were to eat, and many of them had tried to raise young at some time or other.

We had hoped to find the nest of the Cuban Sandhill Crane, but we learned from the natives that the cranes nested in late April and May, the rainy period on the island. This is several months later than the nesting season in Florida.

Purple Gallinule. *Porphyrula martinica* (Linnaeus)

Walkinshaw observed one March 18 and Baker one March 23 at Rancho Rockyford. On both occasions the bird was climbing around among the horizontal or nearly horizontal branches of trees along the stream.

Killdeer. *Charadrius vociferus* subsp.

Two were observed over the river March 15 at Nueva Gerona and two at Nueva Gerona March 24. In both cases they were calling.

Lesser Yellow-legs. *Totanus flavipes* (Gmelin)

Two were observed along the 'Black Sands' in the northeastern portion of the island March 24.

Mourning Dove. *Zenaidura macroura* subsp.

Very common in the grapefruit orchard at Rancho Rockyford and near by.

Cuban Ground Dove. *Columbigallina passerina insularis* Ridgway

Observed at 'Sabana Grande' in the pine areas March 17, first a lone bird, then two. Three more were observed there March 19 and two near Los Indios March 20.

Cuban Parrot. *Amazona leucocephala leucocephala* (Linnaeus)

A fairly common species, several times observed in small flocks of from 2 to 25 in grapefruit orchards, where they often sat twisting the stems of the unripe grapefruit until the fruit dropped to the ground. Flocks were observed at Rancho Rockyford, Santa Barbara, and at Los Indios. The parrots were very noisy while flying and often while feeding.

Isle of Pines Lizard Cuckoo. *Saurothera merlini decolor* Bangs and Zappey

Observed almost daily in tangles of trees and shrubs, often gracefully hopping from branch to branch, their long tails swinging from side to side or up and down and at times bent forward over the back. Their loud raucous call, *Ca-ca-ca-ca-ca-ca-ca-ca,* was one of the earliest heard in the morning and one of the latest in the evening. It rose sharply on the second and third syllables, dropped on the fourth.

Smooth-billed Ani. *Crotophaga ani* Linnaeus

These ungainly birds were found daily around a bamboo thicket at Rancho Rockyford, sometimes in a flock of from 12 to 15 individuals. They were also observed in the region of 'Sabana Grande.' At times their shrill call could be heard ringing through the grapefruit orchard near our cabin, and small groups could be found there. Often in the early morning they sat near a bamboo thicket across the stream, sunning themselves, wings and tail half-spread, drooping ungracefully from their bodies.

Cuban Pygmy Owl. *Glaucidium siju* (d'Orbigny)

Observed daily (Figure 1) from March 16 to March 23 at both Rancho Rockyford and Los Indios. Its call was very shrill, similar to the syllables *tio-tio-tio-tio-tio.* The call was usually given just at the break of day or at dusk, but it was sometimes heard by day from some dense spot in the top of a palm. These owls also flew about sometimes during the day. At daylight on March 16, a pair was observed in front of our cottage in a grapefruit tree. They were heard calling, and then as the female sat on a horizontal branch the male copulated with her, his wings vibrating rapidly.

Cuban Emerald Hummingbird. *Chlorostilbon ricordii ricordii* (Gervais)

One or two seen on several days, feeding on flowers in the yards at Santa Barbara and Los Indios.

Belted Kingfisher. *Megaceryle alcyon* (Linnaeus)

One was observed along a stream at Santa Barbara March 17, and its familiar rattling call was heard.

Cuban Tody. *Todus multicolor* Gould

These dainty flycatcher-like birds (Figure 2) were found on three occasions in the grapefruit orchard near the pool at Rancho Rockyford, and one was observed about two miles from there March 21. Sometimes we could approach within three feet of them. They usually remained in deep shade. Suddenly they would dash out from their perch, capture some passing insect, and dash back to another branch, quivering their wings. Their contrasting colors and their sharp call, *ti-ti-ti-ti-ti-ti-ti,* helped locate them easily.

West Indian Red-bellied Woodpecker. *Centurus superciliaris murceus* Bangs

Observed daily at Rancho Rockyford (Plate 3), near Santa Barbara, and on March 20 at Los Indios. They were often rather noisy, feeding singly or by twos.

Cuban Green Woodpecker. *Xiphidiopicus percussus insulae-pinorum* Bangs

Figure 1. Cuban Pygmy Owl, eight miles east of Los Indios, Isle of Pines, March 22, 1945.

Figure 2. Cuban Tody, Santa Barbara, Isle of Pines, March 16, 1945.

Figure 3. Greater Antillean Pewee, Santa Barbara, Isle of Pines, March 23, 1945.

Figure 4. Western Red-legged Thrush, Santa Barbara, Isle of Pines, March 23, 1945.

Two were observed March 19, near Santa Barbara, along a semi-wooded highway border. We watched them for a few minutes as they fed only 12 feet from us. One was observed March 23.

Yellow-bellied Sapsucker. *Sphyrapicus varius varius* (Linnaeus)

A male was observed at Rancho Rockyford March 17, 18, and 23, always at the same tree along the highway just outside of the gate. He had drilled many holes in rows around the tree. We often saw him scolding a Red-bellied Woodpecker, much larger than he, that was drinking the sap from the holes which he had made.

Greater Antillean Pewee. *Contopus caribaeus caribaeus* (d'Orbigny)

These little flycatchers (Figure 3), much like our Eastern Wood Pewee, were found in the grapefruit orchards. On March 21, one scolded Walkinshaw with a sharp *wee-wee-wee* and then proceeded to chase a Prairie Warbler, a Black and White Warbler, and a Red-legged Thrush (in that order) as they approached the same area. Finally the partly constructed nest was found on a horizontal grapefruit tree branch about 10 feet from the ground. This nest was worked on during the next few days. When we left March 24 it was beginning to resemble a Wood Pewee's nest. The outside was covered with lichens.

Cuban Crow. *Corvus leucognaphalus nasicus* Temminck

Crows sat daily in the royal palms at Rancho Rockyford, working around the tops for food. We were able to approach them closely. Their wings were set farther back on the body than in our Eastern Crow (*Corvus brachyrhynchos*). Their call was a harsh *haw-haw*.

Cuban Mockingbird. *Mimus polyglottos orpheus* (Linnaeus)

Observed only on two days.

Catbird. *Dumetella carolinensis* (Linnaeus)

Several observed at Rancho Rockyford and Nueva Gerona.

Western Red-legged Thrush. *Mimocichla plumbea rubripes* (Temminck)

A robin-like bird (Figure 4) with a black throat-patch. It is about the size of the American Robin (*Turdus migratorius*), and was common about the yards and orchards. A pair was building a nest inside of the open garage at Rancho Rockyford on March 17. One of the calls was much like that of our young American Robin; another was quite harsh.

Black-whiskered Vireo. *Vireo altiloquus barbatulus* (Cabanis)

These vireos were not observed until March 17, when the grapefruit orchard around our cottage at Rancho Rockyford seemed alive with them. Their song resembled *bien-te-veo* (Barbour, 1943:105) and was given again and again. They sang from near the tops of the trees, sometimes in trees as low as 12 to 15 feet, again in trees as high as 50 or 60 feet.

Black and White Warbler. *Mniotilta varia* (Linnaeus)

A single individual was observed almost daily, working over the grapefruit branches near our cottage at Rancho Rockyford. Another was observed at Santa Barbara March 20, and one was heard singing the same day about 6 p.m., just before sunset, at Rancho Rockyford.

Myrtle Warbler. *Dendroica coronata* (Linnaeus)

Observed only on March 21 and 23.

Prairie Warbler. *Dendroica discolor* subsp.

Observed at Nueva Gerona in a tangled thicket in the mountains March 14. A single individual was observed daily at Santa Barbara in the yard and orchard, feeding along the branches, allowing us at times to approach within a few feet of it. Most of the time it fed only 6 to 15 feet from the ground.

Western Palm Warbler. *Dendroica palmarum palmarum* (Gmelin)

One of the most common birds on the island, often found in small flocks of from 5 to 18 individuals feeding in the low shrubbery and bathing in the streams.

Yellow-throat. *Geothlypis trichas* subsp.

Observed almost daily.

American Redstart. *Setophaga ruticilla* (Linnaeus)

Observed several times at Rancho Rockyford, flitting about the grapefruit orchard.

Cuban Spindalis. *Spindalis zena pretrei* (Lesson)

A male and female were observed near Rancho Rockyford in thickets bordering a stream March 21.

Greater Antillean Grackle. *Holoquiscalus niger caribaeus* Todd

A few small flocks of these grackles were seen at Santa Barbara.

Greater Antillean Oriole. *Icterus dominicensis melanopsis* (Wagler)

Two individuals (four on March 20) observed daily at Santa Barbara and Los Indios. They were usually feeding on flowers, often hibiscus, working at the base of each flower either for insects or nectar.

Cuban Meadowlark. *Sturnella magna hippocrepis* (Wagler)

Very common on the open grassy plains where there were a few tropical pines. They were quite similar to our Eastern Meadowlark (*Sturnella magna magna*) but the voice differed, resembling the words *ze-te-zwe-zwee*. The scolding note was harsher too. They usually sat near the ground while singing, but at times were found 12 feet up.

Yellow-faced Grassquit. *Tiaris olivacea olivacea* (Linnaeus)

A common bird along brushy arroyos and roadways and around farm yards. A large flock fed daily at Los Indios with Hedin's chickens, often flying right into the buildings. It is a very active bird and its rapid, sibilant *see-see-see-see-see-see* was often heard. One pair was building a nest three and a half feet from the ground, in the hedge at Rancho Rockyford, near Santa Barbara, on March 21. The female carried the nesting material and was accompanied on her trips by the male.

The list of birds observed by Walkinshaw is summarized in Table 1.

TABLE 1

Birds Observed on the Isle of Pines, Cuba, by L. H. Walkinshaw, March, 1945

MARCH	13	14	15	16	17	18	19	20	21	22	23	24
Cormorant												1
Great Blue Heron					1							
American Egret							4					
Green Heron						1						
Turkey Vulture	8	5	6	10	12	26	110	65	12	16	18	
Marsh Hawk										2	1	
Cuban Sparrow Hawk	1	1	2		5	3	11	4	1	2	4	
Cuban Bob-white			9	h		10	h	h		4		
Cuban Sandhill Crane								5		2		
Purple Gallinule						1						
Killdeer			2									2
Lesser Yellow-legs												2
Mourning Dove			4	6	25	12	125	47	18	20	25	
Cuban Ground Dove					3		3	2		1	1	
Cuban Parrot			25	25	13	2		23	2	2		
Isle of Pines Lizard Cuckoo		5		2	3	2	3	4	2	2	1	
Smooth-billed Ani				15	12	12	5	15	4	3	12	
Cuban Pygmy Owl				2	2	2	2	3	2	5	1	
Cuban Emerald Hummingbird					1	1		2	1	1		
Belted Kingfisher					1							
Cuban Tody				2		2			3		1	
West Indian Red-bellied Woodpecker				2	2	2	2	3	2	2	4	
Cuban Green Woodpecker							2				1	
Yellow-bellied Sapsucker					1	1					1	
Greater Antillean Pewee					2		1	3	2	1	3	
Cuban Crow				2	2	3	2	2	2	2	5	
Cuban Mockingbird										1	2	
Catbird		1			1		1		1		1	
Western Red-legged Thrush			6	8	8	4	4	4	3	6	8	
Black-whiskered Vireo					6	3		2	5	1	3	
Black and White Warbler					1	1	1	2	1		1	
Myrtle Warbler									1		3	
Prairie Warbler		1		1	1	1	1		1		1	
Western Palm Warbler	2	6	2	8	8	5	18	15	12	10	12	
Yellow-throat		1	1	1	2		1	1			1	
American Redstart				1	2	1	1		1			
Cuban Spindalis									2			
Greater Antillean Grackle				6	8	4	3	12				
Greater Antillean Oriole			2	2	2	2	2	4	2	2	2	
Cuban Meadowlark			2	1	12	2	6	18	20	6	8	
Yellow-faced Grassquit			2	4	8	2	5	24	4	8	12	4
Total individuals	11	20	63	99	144	105	314	261	104	99	132	9
Total species	3	7	12	19	27	25	24	23	24	22	26	4

h = Heard only (counted as one individual in totals).

Literature Cited

Bangs, Outram, and W. R. Zappey
1905 Birds of the Isle of Pines. *Amer. Nat.*, 39:179–215.

Barbour, Thomas
1923 The birds of Cuba. *Mem. Nuttall Ornith. Club No.* 6.
1943 Cuban ornithology. *Mem. Nuttall Ornith. Club No.* 9.

Bond, James
1936 Birds of the West Indies. Academy of Natural Sciences, Phila.
1945 Check-list of the birds of the West Indies. 2nd ed. Academy of Natural Sciences, Phila.

Cabanis, Jean
1854–57 Dr. Gundlach's Beiträge zur Ornithologie Cuba's. *Jour. für Ornith.*, 2–5.

Gundlach, Jean
1862 Zusätze und Berichtigungen zu den "Beiträgen zur Ornithologie Cuba's." *Jour. für Ornith.*, 10:81–96; 177–191.
1875 Neue Beiträge zur Ornithologie Cubas. *Jour. für Ornith.*, 23:293–340.
1873–76 Contribución á la ornitologia Cubana. Havana.

Marie-Victorin, Frère, and Frère Léon
1942 Itinéraires botaniques dans L'Ile de Cuba (ser. 1). *Contrib. de l'Inst. Bot. de l'Univ. de Montréal No.* 41.
1944 Itinéraires botaniques dans L'Ile de Cuba (ser. 2). *Contrib. de l'Inst. Bot. de l'Univ. de Montréal No.* 50.

Thienemann, F. A. L.
1857 Ueber die von Dr. Gundlach eingesendeten Eier und Nester Cubanischer Vogel. *Jour. für Ornith.*, 5:145–162.

Todd, W. E. Clyde
1916 The birds of the Isle of Pines. *Ann. Carnegie Mus.*, 10:146–296.

1703 Central National Tower, Battle Creek, Michigan.
Marne, Michigan.

A STUDY OF EASTERN BLUEBIRDS IN ARKANSAS

BY RUTH HARRIS THOMAS *

THE Eastern Bluebird (*Sialia sialis sialis*) is common in summer, and fairly common in winter, in the neighborhood of my home near North Little Rock, Arkansas. The country is rocky upland, with sandstone formations close to the surface. Most of the area is thin woodland, with oaks the predominating tree. Homes are isolated or in clusters along the highway. There are many open spaces, such as lawns, gardens, fields, and Bermuda pastures, while cattle ranging on unfenced areas keep grass short and undergrowth low.

This paper deals, first, with the Bluebirds that occupied three breeding territories near my home during the years I have banded birds, 1937–1945; second, with data collected from 1931 to August 1945 on the winter flock, pair formation, territory, and social behavior. The three territories lie in a row on the ridge of the hill on which our house is located (Figure 1). The middle, or Dooryard Territory, includes the tended part of the grounds, with small shallow pools and a feeding station which is maintained all year. From the Dooryard's central box, it is 75 yards to the one box in the Gate Territory to the east, and about

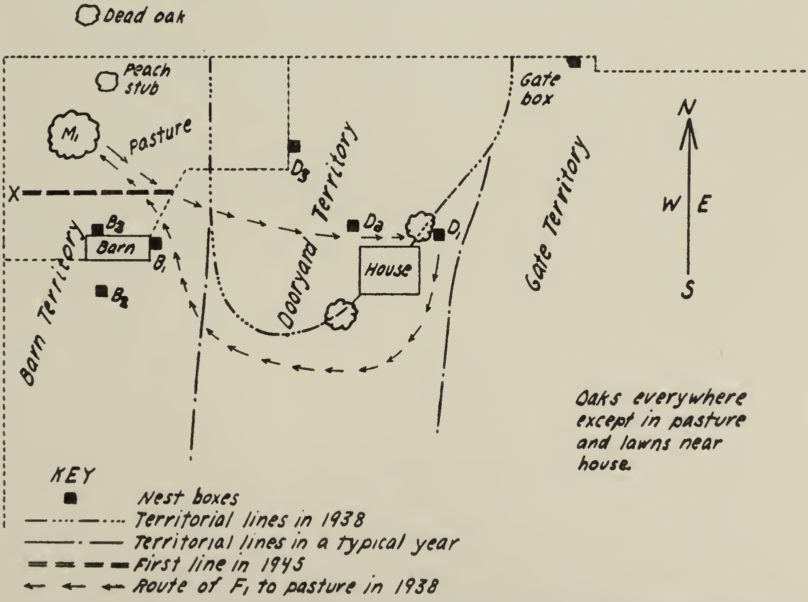


Figure 1. Map of three Bluebird territories, North Little Rock, Arkansas 1937–1945.

* I wish to express my appreciation to Mrs. Margaret M. Nice and J. Van Tyne for their assistance in preparing the text; to Prof. A. D. Moore for his careful draughting of Figure 1.

the same distance to the group of three boxes in the Barn Territory to the west. The Gate and Barn Territories are half wooded and half pasture land. Dividing lines established by the pairs, between Gate and Dooryard Territories, and between Dooryard and Barn, are perfectly clear; but the outer boundaries, i.e., the east side of the Gate Territory, west side of the Barn Territory, and north and south ends of all three territories, are not defined, since there are no near Bluebird neighbors in these directions. From the distances the pairs go for food for nestlings, I estimate that each territory comprises from two to three acres. In 1938, two pairs nested only 25 yards apart, but each territory spread away from the dividing line to the extent of two or more acres.

Technique

The Bluebirds were identified by banding and re-trapping. Many could be taken in a nest-box trap in the pre-nesting season, but since this did not indicate the ultimate owners of a territory, it was necessary to identify each pair in the course of each nesting. Females were lifted from their boxes in the latter part of incubation. This was most easily done before 6:30 a.m., when the birds were less alert than later in the day; males could usually be tempted into a trap just before or just after their young left the nest. The bait was always raw peanuts, shelled, and run through a meat chopper.

In 1937, two breeding pairs and one unmated female were banded on the left tarsus. Since their nestlings and adults of subsequent years were banded on the right tarsus, the last survivor (a female, *F*3)† of the 1937 group was recognizable at sight. In 1944 and 1945, I color-banded the breeding pairs.

Banding Data: Arrival, Residence, Returns

Table 1 summarizes the data on banding and returns. Of the nine males banded as adults and breeding in the area, the approximate date of arrival is known for seven: *M*7, October 20; *M*6, November 20; *M*9, November 22; *M*8, January 23; *M*11, February 6; *M*3, March; *M*5 (brought to the area by *F*3), May. They could have been present a week or so before they were caught. Of the 16 females banded as adults and breeding in the area, three (*F*1, *F*2, *F*3) were banded at the start of my banding in March 1937, and five (*F*4, *F*8, *F*13, *F*17, *F*18) were summer replacements for mated females that had been killed. Of the remaining eight, three (*F*5, *F*11, *F*15) were banded in April and June; five (*F*6, *F*7, *F*9, *F*10, *F*16), between November 14 and January 13. That is: at least four out of seven breeding males and five out of eight breeding females either wintered in the area in which they later held territories or came to their breeding ground in January, about two months before the start of nesting.

† Throughout this paper banded individuals that nested in the territories are designated by *F* (female) or *M* (male) followed by a number; other banded individuals are designated *F* or *M* followed by a letter indicating the color of their band (for example, *FG* = female banded green).

The seven males and seven females banded but not nesting in the study area were winter residents or January and February arrivals in search of nesting places. With some exceptions, they probably represented the number of Bluebirds above the available territories—the losers in the fights.

In addition to the four nestlings, listed in the table, that wintered at their birthplace and remained to nest, seven other young, banded as nestlings, were trapped in their first winter but were never retaken. These four breeders and seven winter residents do not represent a true percentage of the number of young remaining at the birthplace, since out of the 172 fledged in the three territories in nine breeding seasons (1937–1945) only 137 were banded. Laskey (1940:188) reported that of 521 nestlings banded in three years, 15 females were found breeding in the park in subsequent seasons, and several males, known by the band on the left tarsus to have been banded as nestlings, were seen.

Of the 10 banded breeding males (omitting from consideration *M*11, first banded in 1945), 6 (*M*1, *M*2, *M*4, *M*7, *M*8, *M*9), or 60 per cent, remained or returned to breed a second season; one (*M*2) of these for a third. Omitting from consideration the 4 banded breeding females (*F*7, *F*8, *F*10, *F*12) that were killed in their first nesting season, and *F*18, first banded in 1945, 8 out of 13 females, or 61.5 per cent, remained or returned to nest a second season; one (*F*9) of these for a third season; one (*F*3) for a third and fourth.

Four pairs (*M*1/*F*1, 1937–38; *M*2/*F*2, 1937–38; *M*7/*F*9, 1941–42; *M*8/*F*13, 1942–43) were mated in two successive seasons.

TABLE 1

BLUEBIRD BANDING DATA 1937–1945 NORTH LITTLE ROCK, ARKANSAS

Breeders in study area banded as adults (9 ♂♂, 16 ♀♀)			
Banded Oct.—Nov.	Banded Jan.—Feb.	Banded March	Banded Apr.—June
M6 ’40 [41]	M8 ’42 [42,43]	M1 ’37 [37, 38]	M5 ’40 [40]
M7 ’40 [41, 42]	M11 ’45 [45]	M2 ’37 [37, 38, 39]	
M9 ’42 [43,44]		M3 ’38 [38]	
F7 ’38 [39K]	F6 ’39 [39]	F1 ’37 [37, 38]	F4 ’38 [38]
F9 ’39 [40, 41, 42]	F16 ’43 [44,45]	F2 ’37 [37, 38K]	F5 ’39 [39, 40]
F10 ’40 [41K]		F3 ’37 [37, 38, 39, 40]	F8 ’39 [39K]
			F11 ’42 [42]
			F13 ’42 [42, 43]
			F15 ’44 [44]
			F17 ’44 [44, 45K]
			F18 ’45 [45]
Breeders in study area banded as nestlings (2 ♂♂, 2 ♀♀)			
M4 ’38 [39, 40]			
M10 ’43 [44]			F12 ’41 [42K]
			F14 ’42 [43]
Non-breeders banded as adults (Nov.—Feb.): 7 ♂♂, 7 ♀♀; as nestlings: 133			
Total banded, March 1937—June 1945: 16 ad. ♂♂; 23 ad. ♀♀; 137 nestlings			

M before a numeral designates a male; *F* a female.

Following each individual's number is the year of banding and (in square brackets) the year or years of nesting.

K following a year indicates that the bird disappeared or was killed in that nesting season.

Migratory Status

Most of the nesting pairs were permanent residents, while a few were known to migrate. This was easily observed in the first years, when the total number banded was small and the five individuals of 1937 were banded on the left tarsus and all others on the right. For the later years, data are incomplete. In order to establish a pair's permanent residence, they had to be trapped several times in November and December; failure to trap did not, of course, prove the pair had migrated.

After November 10, 1937, only one ($M1/F1$) of the pairs banded that year was seen; they were caught in every month up to March. The other pair ($M2/F2$) apparently migrated; they returned to their former territory in February 1938. The third left-banded female ($F3$) regularly migrated. The date of her return in 1938 was not noted; in 1939, it was March 1, and in 1940, February 28.

Migrating Bluebirds that stop over here (usually in groups of 6 to 12) may stimulate local birds to leave. For example, November 18, 1938, a flock estimated at 50—the only flock of that size I have ever seen—arrived on our hill and stayed for three days. On the fourth day, the transients, as well as the left-banded Bluebirds (including the pair, $M1/F1$, that had not migrated the winter before) were gone. $M1$ and $F1$ never returned; the other male, $M2$, was back on February 10, 1939.

Weather may also be a determining factor in migration. November and December in this latitude are very variable months. Some years there are a few cold spells with intervals of balmy days. Other years there is almost continuous cold from mid-November through December, with very heavy rainfall. The warmer weather may inhibit, and the colder release, the latent migratory impulse. Nice (1943:76) suggests this theory for the Song Sparrow (*Melospiza melodia*) of central Ohio.

Importance of Nest

In considering the life history of Bluebirds, one fact is outstanding: the individual's life is oriented to the nest site, a hole. As single birds, as pairs, or as flocks, they are drawn throughout the year, excepting only the period of the molt, to the vicinity of nesting places. The Bluebird's need is far more specialized than that of open nesters, even more than that of many hole-nesters. The Bluebird cannot make its own cavity, and it does not, as some wrens do, accept just any odd corner or cranny for a nest hole. The Bluebird requires a nest environment with open grassy places, spacious lawns, meadows, abandoned fields, pasture or fallow lands, or the margins of thin woods. Bluebirds can live neither in dense woods, nor in closely built residential sections of towns.

Several other species of hole-nesters are, to some degree, concerned with nest sites outside the breeding season. House Wrens (*Troglodytes aedon*) and Starlings (*Sturnus vulgaris*) occasionally visit boxes in autumn, and the latter even throw out old nest material (Nice, letter). At my home, Bewick's Wrens (*Thryomanes bewickii*) remain mated or form new pairs in autumn, and the male defends a territory through the winter. They often roost in boxes, and "scold" when other hole nesters look at the boxes. Carolina Wrens (*Thryothorus ludovicianus*), which also remain paired through the winter, show less interest in nest sites, but look at boxes and explore sheds and farm buildings. Odum (1941–42) does not mention the Black-capped Chickadees (*Parus atricapillus*) as interested in nest sites until pair separation from the flock, but in this region a Carolina Chickadee (*Parus carolinensis*) will protest in mid-winter if, for example, a Downy Woodpecker (*Dryobates pubescens*) goes to the cavity or box that the Chickadee is using as a roost, and there is some casual examination by the Chickadees of holes in trees. Tufted Titmice (*Parus bicolor*) behave in general like the Chickadees.

In central Arkansas sexual activities among the hole-nesters appear so early in the year that no sharp line can be drawn between winter behavior and mating behavior. Bluebirds differ from the species mentioned above in this respect: the interest in nest sites is competitive between pairs within the flock, and is accompanied by "breeding" behavior, such as courtship and singing, and occasionally by fighting, throughout the non-breeding season.

Pairing and Courtship

Pairs form at any time between completion of the post-nuptial and post-juvenal molts (average September 15–October 1) and the start of nesting, but banding records indicate that most pairs are formed between November and the last of January.

Courtship is inseparable from pair formation. It functions as mutual stimulation and—in weeks immediately preceding nest construction—as advertisement of ownership of a box and territory. It always takes the form of visiting a nest box but varies in intensity according to the time of year and the number of pairs present. In the fall, in the case of a lone pair, it may be no more than male and female looking into the box together and even in spring a lone pair is rather quiet, although making daily visits to their box. But if in spring a pair has close neighbors (for example, if all three territories at my home are claimed by as many pairs early in the season), the courtship is a frenzy of warbling by both sexes, of flying and fluttering around the box with continual wing-lifting and twitching. The two keep up the warbling and wing movements in trees near the box. The male often flies at the female and takes her perch as she moves away, but this is the only expression of dominance within the pair; when she flies off and he follows, there is no hint of a chase. Either at the first meeting of male and female at the box in the pre-nesting season, or in the few days just before the female begins to gather nest material, the male may hold a wisp of dry grass in his beak as he perches on the box or looks into it. He does not feed his mate in the courtship period, and I have never seen a female beg at this time, but in January 1945, I twice saw a female fly after a male as if she wanted the grub he had (see below).

For a pair's second and third nestings in a season, the courtship is usually limited to looking into the box, with slight wing lifting.

Examples of Pair Formation

In fall. In 1944, a green-banded daughter (*FG*) of the second 1944 brood of *M*10 and *F*16 was paired with a banded but unidentified juvenile male by September 18. At this time, other juveniles had disappeared, and the newly-formed pair, with *FG*'s parents, constituted a flock. The two pairs frequently visited nest boxes together. There was very little warbling or wing lifting, and no fighting except for the mild dominance of the old male over the juvenile; *M*10 would occasionally fly at the young male, forcing him to quit his perch on top of the box.

In 1938 for two days (November 12 and 13), one of the old left-banded pairs defended the central Dooryard box (D3, Figure 1) from a pair apparently newly-formed. The attacking male was right-banded; his mate, an obviously young bird, unbanded, fluttered back and forth but took no part in the fighting. The courtship excitement was up to the pitch usual in March. On the third morning, the old pair did not appear; the right-banded male and his timid mate were in possession. The female made three or four trips to the box with grass in an uncertain manner, and at that time was trapped and banded *F*7. The male evaded my attempts to capture him, which I especially regretted when on February 19, 1939, I found the male owning this box to be *M*4, a fledgling from the summer before. He then had an unbanded mate; *F*7 was found the next month paired with an unbanded male in the Gate Territory.

Within the winter flock. On December 3, 1944, the unidentified male, mate of *FG,* disappeared. At this time, the yellow-banded pair (*M*9/*F*17) had joined the flock, so that it then consisted of two pairs and *FG*. On December 13, a new male, promptly banded green (*MG*), joined the flock and paired with *FG*. There was some flock visiting of the boxes, but at times only the new male and *FG* looked at a box, and their courtship continued up to his disappearance on December 23. There was almost no excitement.

Rivalry between females. Through the disappearance of one individual after another, the winter flock had been reduced by December 27, 1944, to the two old females, *F*16 and *F*17. On January 11, 1945, a new male arrived and was banded red (*MR*). There was all-day visiting of boxes, with little excitement early in the morning, but more in the afternoon on the part of the females. It seemed to be an example of rivalry between females before full gonadal development, as well as an example of the courtship's stimulating effect.

8:30 a.m. 33° F., sunny: *MR* on fence beside box in Barn Territory. *F*16 and *F*17 in trees between barn and house. *F*16 flies at *MR,* displacing him. He gives a low warble and looks into box; *F*16 perches on top of box. *F*17, still in tree 40 yards to east, calls *tu-a-wee*. *F*16 does not answer.

8:40: *MR* and *F*16 fly to Dooryard box, with *F*17 following; all are chased by a Mockingbird (*Mimus polyglottos*). They fly to Gate Territory box. *MR* looks in, *F*16 looks and goes inside, *MR* perches on top. No warbling or wing lifting. *F*17 stays 10 yards off. All fly out of sight.

10:30: All three at Barn box, then to Gate box, *MR* now warbling almost continuously in low voice, and lifting wings. *F*16 stays close to him, and after he has clung to box and looked in, she looks in. If *MR* stays in trees for several minutes, *F*16 takes initiative, flying to the box, warbling softly, lifting wings; *MR* then flies to box. *F*17 approaches within two yards, *F*16 several times flies at her, snapping her bill. *F*17 retreats, perches with fluffed feathers.

11:40: All three in trees east of our house. Only *F*16 comes down to feeding table; *F*17 perches with fluffed feathers. *F*17 is first to fly back to Dooryard box; then *F*16, *MR* following. At 1:25, this program is repeated, *F*17 leading the way to the box after a visit to the feeding table.

1:50 p.m.: *MR* and *F*17 (who is now more confident) visit Dooryard box, with *F*16 perched in vegetable garden 10 yards off. *MR* goes to compost heap, finds large grub, flies with it to a tree, *F*16 following just one foot behind him like a nearly grown fledgling after a parent, as if about to beg, but they go out of my sight.

3:00 to 3:40: All three near Dooryard box. *MR* now indifferent most of the time, going often to ground to feed. Females not feeding at all, continually fluttering about box, rushing at each other, occasionally falling to ground but separating immediately. When *MR* perches on box, females' excitement increases; they give a low chatter, almost a warble. Again *MR* finds a large grub, and both females fly after him as if to beg. He flies to another tree to escape them, and eats the grub.

4 p.m.: *MR* on fence beside box with a short piece of grass in his beak, which he "works," then drops. Females are near by, still flying at one another. As I go by, all three are frightened off.

On January 12, as I left home at 7:30 a.m., all three Bluebirds were in the vegetable garden near the Dooryard box, the females flying at each other as on the evening before. On my return at noon, all excitement had subsided, there was no visiting of the boxes, and the three birds moved together as a flock. From later actions of the three, it appeared that *F*16 and *F*17 had come to an "understanding" on January 12 that *F*16 was paired with *MR*. At the same time, *dominance shifted* from *F*16 to *F*17. Up to that date, *F*16 had consistently pecked *F*17 at the feeding table. From then on, *F*17 became a despot, driving *F*16 from all feeding shelves.

On January 13, *MR* was caught in a nest-box trap, which indicated his interest in nest sites, yet there was no demonstration, such as warbling and fluttering, at any of the boxes. Several times that day, *MR* and *F*16 were seen together, *F*17 not present; the latter, in the course of the afternoon, came five times to the feeding table, each time alone. From January 14 to 19, the three were always together when I observed them; on January 19, at 8 a.m., *MR* and *F*16 were alone at a Barn box, first one and then the other going into it, and this removed all doubt that they were the pair.

In late winter. After the pairing of *MR* and *F*16 on January 11, 1945, no other male appeared in the study area until February 6. At 9 a.m., a new male (later banded *M*11) and *F*17 were observed visiting the Dooryard box in a courtship of highest intensity. They were apparently paired from the first meeting at the box.

Replacing a Lost Mate

When a male's mate is killed in the nesting season, he may go off for a time and return with a new mate, or remain in the territory until a female arrives.

M2 lost his mate about March 21, 1938, while she was incubating, and was not seen until March 25, when he appeared with a new mate. (Since the Barn Territory is the least observed, he may well have come back to his box at times without being seen.) The courtship with the second mate lasted only a day; on the next day she started building.

*M*9 (yellow-banded) lost his mate and young about May 1, 1944. He was seen every day thereafter, looking into the box and warbling softly, but may also have ranged beyond the territory. On May 26, at noon, he was still alone. At 9:30 a.m. the next day, a female was carrying grass into the box.

In 1936, the male of the Dooryard Territory lost mate and eggs on June 1, and remained in the territory. For the first two days, he warbled and looked into boxes. On the third, he carried grass to one box, but continued to visit other boxes. The warbling and visiting of boxes, with intermittent grass-carrying, continued for 10 days, when a female arrived and typical courtship began.

A fourth male, *M*8 of the Dooryard, lost his mate on April 24, 1942 (three days before the young left the nest). He warbled some, while continuing to feed the nestlings. On April 26 a female appeared and fluttered at Dooryard box 3 that held the young. Later, she and the male together looked at Dooryard box 2. This was the courtship. The next morning, the fledglings left the nest, and in the afternoon the new mate carried fresh grass lining into Dooryard box 3.

In 1945, *M*11's mate, *F*17, disappeared between June 10 and 24, while I was away. On my return, *M*11 and a new mate (*F*18) were in courtship at a Dooryard box, this territory having been previously unoccupied that season; *M*11 and *F*17 had had two successful nestings in the Gate box.

In every case where the female was known to have disappeared—presumably killed—the male has obtained a new mate. However, there have been four instances of a *pair* disappearing after a nest disaster, and this may indicate that the female was killed, and the male left in search of a new mate, which he failed to find. For example, when *M2* and *F*4 had their young killed in the nest about April 28, 1938, and the pair disappeared, *F*4 may have been killed. *M2* returned the following year with a new mate.

I have no record of a male being killed while the female had eggs or nestlings, but I judge, from the arrival of unmated females here in the nesting season, that a widow wanders off in search of a new mate. In the winter of 1944–45, the two old females, *F*16 and *F*17, whose mates disappeared in late December, stayed in their home territories for a large part of each day, but at times, on a walk over 10 acres, I could not find these females. On January 9, 1945, at 3:45 p.m., I saw *F*16 start from the Barn territory to the north, flying above the trees until she was a vanishing speck in the sky; she was back at the feeding table early the next morning. It seems probable that they ranged a considerable distance each day. As noted above, males (*MR* and *M*11) came to these females' home territories on January 11 and February 6.

Fighting to Obtain a Mate

The male that has lost a mate after the start of nesting does not at any time invade the territory of a mated pair to fight the male for his box and mate. All the widower males cited in the preceding section had near neighbors, yet they were not seen even to trespass. But an unmated female will invade a mated pair's territory, either just before the first nesting or in the interval between nestings, and fight the female. The mated pair's courtship at the start of the cycle appears to stimulate the unmated female, whereas the quiet behavior between nest-making and fledging of the young inhibits attack.

Many fights between females have been observed in the pre-nesting season when identities could not be ascertained. Where the birds were known, the best example is that of *F*3's defeat of *F*6. *M*4 and *F*6 were established in the Dooryard Territory by late February of 1939. On March 1, *F*3, the female who had nested in the Dooryard the year before and had migrated, returned. At first, *F*6 chased *F*3, with *M*4 following. Presently the two females fought, repeatedly meeting in the air and falling to the ground. The male was greatly excited, flying back and forth, hovering above the combatants, warbling continuously and lifting his wings. In the last struggle on the ground, one female cried like a captured fledgling. They separated, and one flew up to a tree; the other lay for a moment as if exhausted, and then flew slowly away to the woods. *F*3, the victorious female, perched on top of the box; she and *M*4 then went through the courtship ceremony; he remained in the territory with her as mate.

Another example occurred in 1935, when the Dooryard Territory was occupied by an old pair that were unbanded but had recognizable individual characteristics. On the morning of March 10 the old female was carrying grass to her box, and I saw another female take grass to a box just 10 yards off. She appeared awkward and uncertain at her work. The old female deposited her own load of grass and then drove the new female off. That afternoon there was a fierce battle in the Dooryard between two females, probably the old female and the visitor of the morning; afterwards one chased the other down hill. The old female remained in undisputed possession of the territory.

Pettingill (1936:86) reports a battle between two females soon after the start of nest-making, the attacker driving off the first mate. Nice (1931:144) mentions a fierce fight between two females on the day before the second nest of one of them was begun.

Pair Formation Among Returned Migrants

There is some indication that Bluebirds that migrate may find a mate in the wintering grounds. *M2* on his return to his old territory in 1939 had a new mate that had not been banded as a member of the local winter flock, and *F*3 on returning in 1938 had an unbanded mate; they could, however, have found these mates in the roaming population of the pre-nesting season in this neighborhood. *F*3 came back without a mate in 1939, drove *F*6 away, and thus obtained *M*4. She was again alone when she returned February 28, 1940; within the next week she left the neighborhood, coming back on May 9 with a mate (*M*5) and fought the pair *M*4/*F*9 for the territory. Without the use of colored bands, it was not possible to determine whether mates return together from the south.

Mating Behavior During Migration

On September 16, 1944, two pairs of Bluebirds, unbanded and presumed to be migrants, spent the afternoon in the Dooryard Territory, and for the 20 minutes that I watched, performed a series of acts that seemed to be a form of courtship, nest-making, and boundary settlement.

The males flew at the females, forcing them to quit their perches, and alighted in the places the females had left. Moving through the trees, continually displacing the females, the males kept up a courtship chatter that sometimes became a low warbling. Once a male flew to the ground and pulled at grass, and then the females, about two feet apart, picked at grass. Another time, the males were on the ground within a few feet of each other, teasing at grass. They came face to face, and there was a brief encounter, the two jumping like little cocks; then they hopped in opposite directions and pecked at the ground; they several times picked up and tossed away dead leaves. During this time, a female came down near them and gathered grass, dropping it before she returned to a tree. In the time that I watched, the migrants did not go to the Dooryard box, which was about 25 yards from the area of their activities.

The pecking at the ground and tossing of leaves was apparently substitute behavior for fighting at a boundary line, as I realized when on October 22, 1944, the red- and yellow-banded pairs (*M*10/*F*16 and

*M*9/*F*17) went through a similar performance on the line that had divided their breeding territories.

The Bond Between Mates

Courtship repeated in varying degrees through the winter seems to maintain the bond between mates wintering in the study area. Nevertheless, the bond between the mates of fall- and winter-formed pairs is probably very slight. Indeed, there is doubt whether every association of male and female is a pair, and the flutterings at a box may sometimes be flock behavior rather than pair behavior.

Between old mates, however, there appears to be a real bond the year around. This is not apparent from their behavior toward each other when the pair is in the flock, but is indicated by their occasional withdrawal from the flock, or even their continuous segregation, as when only one pair was present during the years when there was only one box in the area (1931–1934). It is also suggested by the dominance of one male and one female over others in the flock; in the fall of 1944, the red-banded pair (*M*10/*F*16) dominated the two other pairs, *M*10 pecking the males, and *F*16 the females.

The old unbanded pair referred to above gave a specific illustration of the bond. From some time in November 1934 up to nest-making in March 1935, the female roosted on a small shelf-like space at the top of a corner porch-column. The male never slept there. He appeared at the feeding table early each morning, and the female joined him there. Early on the morning of February 17, he attracted my attention by warbling and flying back and forth on the porch, hovering several times before the empty shelf. Apparently the female had not met him at the feeding table, and he was disturbed at not finding her either there or at her roosting place. A little later, the pair were together, and that night the female was on her roost as usual.

Colquhoun (1942:127) in his study of color-banded Blue Tits (*Parus caeruleus*) in England, found that the bond between mates was not evident while they were in the flock but was very plain at roosting time. The mates chased one another, with the male singing; the male visited his mate's roosting site, then roosted nearby.

In 1944, the Bluebird mates, *M*10 and *F*16 (red-banded), were together continuously, even during the molt, until the male's disappearance on December 25. During the fall, they often visited the box in which their last brood had been fledged. On October 13, the female was seen to gather grass and carry it to a fence post where she worried it and dropped most of it; she finally took a small amount to the box. She gathered a second load, and after some dawdling she took a little in. The box was found to contain half an inch of grass. On October 17, the male perched beside the box with grass in his beak, which he let fall; then the female gathered grass and clung to the entrance hole but did not take the grass in.

The yellow-banded mates, *M*9 and *F*17, also remained together until the male's disappearance on December 23, and on several dates in October were seen in similar grass-gathering performances. They were somewhat more excited than the other pair, the male squealing as in the mating period.

Mates remain together through the nesting season unless separated by an attacking female. Pontius (1928:75) gives an instance observed by Thomas in Ohio of a male that changed mates for the second nesting but had his first mate back for the third nesting. He gives no explanatory circumstances.

The Nesting Cycle

Tables 2 to 4 summarize the nesting data for the nine seasons of banding.

The season. My earliest record for nest-making is February 16 (1944). The average date is between March 7 and 10. Weather influences the start. Interference by another pair or by an unmated female may cause a delay. In 1937, *F*3 fought *F*1 throughout March delaying the latter's nesting until April 1. Young of the last brood are usually fledged by the middle of July, occasionally in the first week of August, rarely later.

Selection of the box. Young pairs probably find the nest site together. They have looked at boxes in the area of the winter flock, and as they ranged, watched for holes in posts and trees. When an old male or female takes a new mate, either may lead the other to a box. The males whose mates have died or disappeared have all had new mates in their old territories. The females *F*5, *F*9, *F*16, and *F*17 kept their old boxes with new mates. *F*3 brought two males, and possibly three, to her box. (It is not known whether *M*3, her mate in 1938, had been her unbanded mate of 1937).

Nest-making. Under natural conditions it is doubtful if a female ever builds more than one nest at a time. When two or three boxes are offered in a territory, the male visits them all, his mate following him, and she may build as many nests as there are boxes. Apparently she makes the final choice when ready to lay. An occasional male takes grass to the box at the start of construction, but as a rule the female does all of the building. She finds her material, always dry grass, with sometimes a few chicken feathers or a little hair, within 30 or 40 yards of the box. She works rapidly, rarely taking more than four days to construct a nest. The male does not accompany the female to and fro but frequently flies to the box as she returns to it, perching there and lifting his wings. The male with a new mate shows more excitement at this time than one long-mated; also a male's excitement when a later nest is started is greater after a loss of eggs or young than after a successful nesting.

Laying. In the first cycle, started in late February or early March, there may be a lapse of a week or more between nest completion and the laying of the first egg. With later nestings, most females have laid five days after they began the nest. Eggs are usually laid on successive

TABLE 2

DOORYARD TERRITORY

Year	Pairs	Nesting	Laid	Hatched	Fledged	
1937	M1/F1	1(4–1)	6	6	4(5–11)	2 died in nest at 12 days. 1 fledgling disappeared.
		2(5–24)	4	0	0	Eggs taken by predator.
		3(6–27)	2	2	0	Yg. killed at 10 days. Different box used for each nesting. TOTAL SUCCESSFULLY FLEDGED: 3
1938	M3/F3	1(3–8)	5(3–20)	5	2(4–21)	3 died in nest at 10 days. 1 fledgling died in rainstorm 4-22.
		2[4–28]	4	4	4(6–8)	Different box used.
		3[6–20]	3	3	3(7–30)	TOTAL SUCCESSFULLY FLEDGED: 8
1939	M4/F3	1(3–6)	5(3–26)	5	5(5–2)	F3 drove away F6, first mate of M4.
		2(5–30)	4(6–3)	4	4(7–7)	1 yg. left nest at 13 days; killed by dog. TOTAL SUCCESSFULLY FLEDGED: 8
1940	M4/F9	1(3–8)	5(3–24)	5	5(4–28)	Pair driven away by M5/F3. (Had 2nd nesting in Gate Territory.)
	M5/F3	1(5–12)	5(5–17)	5	5(6–20)	
		2(7–11)	4(7–15)	0	0	F3 incubated until 8–18. M5 had deserted by 8–10. TOTAL SUCCESSFULLY FLEDGED (from 2 pairs): 10
1941	M6/F10	1(3–5)	5(3–21)	5	5(4–24)	
		2(5–9)	4(5–18)	3	3(6–20)	1 egg infertile.
		3(6–28)	4(7–3)	1	0	3 yg. died in shell; 1 a few hrs. after hatching. M6/F10 visit nest till 8–6. TOTAL SUCCESSFULLY FLEDGED: 8
1942	M8/F12	1(3–12)	3(3–25)	3	3(4–27)	F/12 disappeared 4–23. F13 arrived 4–26.
	M8/F13	1(4–27)	5(5–2)	5	4(6–7)	1 yg. died at 14 days.
		2(6–21)	3(6–25)	2	1(7–28)	1 egg infertile. 1 yg. died at 3 days. TOTAL SUCCESSFULLY FLEDGED (from 1 ♂, 2 ♀ ♀): 8
1943	M8/F13	1(3–15)	4(3–27)	4	4(4–24)	
		2(5–5)	4(5–10)	4	4(6–11)	Yg. left prematurely.
		3(6–19)	2(6–22)	0	0	Eggs infertile. Deserted after 16 days. TOTAL SUCCESSFULLY FLEDGED: 8
1944	M10/F16	1(2–16)	5(3–2)	5	0	Yg. taken by predator at 11 days.
		2(4–3)	5(4–8)	5	5(5–13)	Different box used.
		3(5–24)	4(5–28)	4	4(6–30)	M10/F16 annex Barn Territory. TOTAL SUCCESSFULLY FLEDGED: 9
TOTALS:		23	95	80	65	TOTAL SUCCESSFULLY FLEDGED: 62 TOTAL SUCCESSFUL NESTS: 17

Dates following the number of the nesting, the number of eggs laid, and the number of young fledged represent respectively: the date of starting nest construction, the date of laying the first egg, and the date of fledging. Dates enclosed in square brackets are approximate.

mornings; I have noted only one exception—in 1945, *F*16 laid a fourth set, starting July 22; she laid the second egg July 23, skipped the next day, laid the third (and last) egg July 25. Smith (1937:26) also noted an exception; a female laid May 13, 14, and 15, skipped May 16, laid on May 17 and 18. Bluebirds lay rather late in the morning, usually around 8:30, which is about two hours after sunrise in the first week of March. On May 6, 1945, *F*17 laid the first egg of her second set at 8:55 a.m., which was nearly four hours after sunrise (5:13). I had opened the box, believing that she would have laid and left by that time; at the touch of my hand upon her back, the bird flew out to an oak tree, perching with her feathers much fluffed. In a moment she laid, the egg falling to the ground and breaking. As soon as I withdrew, she returned to the nest. She did not abandon the nest, as might have been expected, but laid four more eggs on successive days. Sets contain from three to six; a late set may contain only two. Laskey (1939:24) reported a set of seven.

Incubation and brooding. As a rule, only the female incubates and broods, but Smith (1937:26) saw a male take his mate's place on the eggs three times in three hours.

I have noted only two males that fed the female during incubation. One was the Dooryard male in 1933. In 1945, *M*11 was noticed carrying food several times a day to the box in which *F*17 was incubating; this was true during both her first and second nestings, and he also took food to his new mate, *F*18, as she incubated. Rather surprisingly, *M*11 fed *F*17 on June 1, 1945, when the young in the nest were 11 days old; he took a beakful of peanuts from the feeding table up to *F*17, who was perched in a tree, and she fluttered her wings like a begging fledgling.

Incubation starts with the laying of the last egg, or, in a set of six, with the fourth or fifth. The period is 13 to 15 days, commonly 14; Smith (1937:26) found it once extended to 16. Laskey (1940:18) reports an incubation of 21 days in the case of infertile eggs. In 1940, *F*3 in the Dooryard Territory incubated 33 days. She had started July 17, and one egg was pipped on July 31. The chick died in the shell, and the other three eggs also held dead chicks. She continued to incubate through August 18, and occasionally looked into the box until August 25. Body feathers in the nest indicated the bird had begun to molt.

The female Bluebird is not a close sitter; she usually flies out of her nest at a human's approach; apparently she can hear footsteps in grass 20 feet from her box.

Care of Young. Both parents feed the young. In the first few days after hatching, the male seems to deliver food to the brooding female. Within a week, both bring food, entering the box with it. In an intermediate stage, they perch in the entrance to the hole and lean far down to feed the young. In the last stage, the young meet the parents at the entrance.

Both parents attend to sanitation, dropping the sacs 20 to 40 yards away. In the last day or two of nestling life, this duty is somewhat neglected, and many nests become quite dirty. In extremely hot weather, parents give little attention to sanitation. For example, in 1945, the nest which the three young of *M*11 and *F*18 left on July 30 looked as if sacs had not been removed for at least a week.

TABLE 3

Barn Territory

Year	Pairs	Nesting	Laid	Hatched	Fledged	
1937	M2/F2	1(3–9)	4(3–20)	0	0	Eggs taken by predator.
		2[3–26]	5	5	5(5–9)	
		3[6–7]	4	1	1(7–18)	3 eggs addled.
						Different box used for each nesting.
						TOTAL SUCCESSFULLY FLEDGED: 6
1938	M2/F2	1(3–4)	5(3–13)	0	0	F2 disappeared during incubation period.
	M2/F4	1(3–26)	4(4–3)	4	0	Different box used.
						Yg. killed in nest.
1939	M2/F5	1[3–12]	4(3–23)	4	4(4–25)	
		2[5–16]	3	3	3(6–23)	
		3[6–25]	3	3	3(8–1)	Different box used for each nesting.
						TOTAL SUCCESSFULLY FLEDGED: 10
1940	Mx/F5	1(3–13)	3	2	2(4–26)	1 egg infertile.
		2[4–29]	4	0	0	Different box used.
						F5 deserted eggs (human interference).
						Pair remained in territory 10 days.
						TOTAL SUCCESSFULLY FLEDGED: 2
1941	Mx/Fx	1(6–20)	4(6–23)	4	4(7–26)	Pair arrived about 6–15.
						TOTAL SUCCESSFULLY FLEDGED: 4
1942	Mx/F11	1(3–7)	4	4	4(4–23)	
		2[4–26]	4	4	4(6–2)	
		3[6–22]	3	3	3(8–3)	
						TOTAL SUCCESSFULLY FLEDGED: 11
1943	Mx/Fx	1(3–16)	4	4	4(4–29)	
		2[5–13]	4	4	4(6–24)	
		3[7–3]	3	0	0	1 egg infertile, 2 with dead embryos.
						TOTAL SUCCESSFULLY FLEDGED: 8
1944	Mx/F15	1(3–13)	4(3–26)	0	0	Eggs taken by predator, 4–4.
		2(4–10)	4(4–16)	0	0	Different box used.
						Eggs sucked dry by predator, 4–23.
						Territory abandoned.
1945	Mx/F16	1(3–9)	0	0	0	Nest destroyed (human agency).
		2(3–16)	5(3–22)	4	1(4–25)	Changed territorial boundaries.
						1 egg infertile.
						3 yg. dead in nest.
		3(4–23)	5(4–27)	5	5(6–1)	Different box used.
		4(6–5)	5	3	3(7–16)	2 eggs addled.
		5[7–20]	3(7–22)	0	0	Pair abandoned nest and territory.
						TOTAL SUCCESSFULLY FLEDGED: 9
TOTALS:		24	91	57	50	TOTAL SUCCESSFULLY FLEDGED: 50
						TOTAL SUCCESSFUL NESTS: 15

x, instead of a number, after *M* or *F* indicates an unbanded bird.

Dates following the number of the nesting, the number of eggs laid, and the number of young fledged represent respectively: the date of starting nest construction, the date of laying the first egg, and the date of fledging. Dates enclosed in square brackets are approximate.

When all goes well, the young are fledged at 17 or 18 days. At this age, they can fly 10 to 20 yards. Usually, all leave the box within an hour, but in some cases they leave two or three hours apart, or the youngest or least developed may remain in the nest until the next day. If the nestlings are disturbed at any time after about the thirteenth day, they are almost certain to pop out suddenly. They are unable to fly, but they scramble and flutter across the ground.

TABLE 4

GATE TERRITORY

Year	Pairs	Nesting	Laid	Hatched	Fledged	
1937	Mx/F3	1(5–29)	3(6–7)	0	0	Eggs deserted when Cowbird laid in nest. Territory abandoned 7–5.
1938	M1/F1	1(3–7)	4(3–16)	4	4(4–17)	2 fledglings killed by dog.
		2(4–20)	6(4–23)	6	6(5–30)	1 yg. very weak (counted as lost).
		3(6–14)	5(6–19)	5	5(7–24)	Annexed Barn Territory; used box there. TOTAL SUCCESSFULLY FLEDGED: 12
1939	Mx/F7	1(3–17)	4(4–2)	4	0	F7 disappeared 4–25. 6-day yg. died for lack of brooding.
	Mx/F8	1(5–6)	4(5–11)	4	0	F8 disappeared 5–30. 3-day yg. found dead in nest.
1940	M4/F9	1(5–26)	3(5–31)	3	3(7–5)	Pair's 2nd nesting of season; 1st in Dooryard. TOTAL SUCCESSFULLY FLEDGED: 3
1941	M7/F9	1(3–5)	5(3–20)	5	5(4–24)	
		2(5–12)	5(5–17)	5	5(6–22)	TOTAL SUCCESSFULLY FLEDGED: 10
1942	M7/F9	1(3–16)	4	4	4(4–27)	
		2(5–14)	5(5–18)	4	4(6–21)	1 egg infertile.
		3(6–27)	4	4	4(8–4)	TOTAL SUCCESSFULLY FLEDGED: 12
1943	M9/F14	1(3–17)	4(3–30)	4	4(5–5)	
		2[5–14]	4	4	4(6–24)	TOTAL SUCCESSFULLY FLEDGED: 8
1944	M9/Fx	1(3–7)	4(3–15)	0	0	Eggs taken by predator 3–28.
		2(4–6)	4(4–11)	4	0	Fx disappeared about 5–1. Yg. found dead in nest. F17 arrived 5–27.
	M9/F17	1(5–27)	4(6–1)	4	4(7–5)	TOTAL SUCCESSFULLY FLEDGED: 4
1945	M11/F17	1(3–9)	5(3–22)	4	4(4–26)	1 egg held dead embryo.
		2(5–4)	5(5–6)	4	4(6–8)	1 egg laid on ground (human interference). F17 last seen 6–10.
	M11/F18	1(6–23)	4(6–27)	4	3(7–30) (7–31)	Used Dooryard box. 1 yg. dead in nest. TOTAL SUCCESSFULLY FLEDGED (from 1 ♂, 2 ♀♀): 11
TOTALS:		20	86	76	63	TOTAL SUCCESSFULLY FLEDGED: 60 TOTAL SUCCESSFUL NESTS: 15

x, instead of a number, after *M* or *F* indicates an unbanded bird.

Dates following the number of the nesting, the number of eggs laid, and the number of young fledged represent respectively: the date of starting nest construction, the date of laying the first egg, and the date of fledging. Dates enclosed in square brackets are approximate.

The male feeds fledglings for 18 to 21 days, and sometimes longer. If the female re-nests at once, she is soon indifferent to the young of the previous brood, but otherwise she feeds them for some two weeks, though less frequently than the male near the end of the period. In 1944, on July 25, when the last brood of the red-banded pair (*M*10/*F*16) had been out of the nest 25 days, one young begged from its mother at the feeding shelf and then from two fledglings of the first brood (three months old) but was ignored.

Interval between nestings. In 1945, *F*16 started a new nest April 23, two days before the one surviving young of the first brood left the box. One female started a new nest two days after young were fledged; two females waited three days after the fledging. At the other extreme, two females waited 28 days after the fledging of one brood before starting another nest, and several waited from 15 to 20 days. However, most females have built a new nest in from 6 to 14 days after young were fledged. In most cases, the female has built in the same box or in another in the same territory. Three pairs have moved after one nesting to a box in another territory. Although the female will build on top of an old nest, the preference seems to be for a box from which the old nest has been removed.

Number of nestings. Pairs that start late and wait three weeks before beginning the second cycle may have only two nestings, but commonly there are three attempts. An occasional pair makes four attempts, fledging three broods. In 1935 the Dooryard pair (unbanded) had the first brood of five fledged on April 18, and a second brood of four on June 10; the third brood of five was taken by a predator when it was three days old, July 5, and the fourth brood of four was fledged August 12. In 1945, *F*16 had five successive nests, with four sets of eggs, and three broods fledged. On March 11 I found her first nest, completed or nearly so, in the cavity of a dead and rotting tree north of the Barn Territory. At my touch, a slab of bark fell away, leaving the nest exposed and unsafe, and I tore it out. There were no eggs. The following day the pair claimed the Barn Territory, but fights with *M*11 and *F*17 (see below) delayed the start of the second nest until March 16. From this nest of four young, only one was fledged, on April 25; *F*16 started her third nest April 23; five young were fledged, June 1. She started the fourth nest June 5, and three young were fledged July 16. In the next week, *F*16 added fresh grass to this old nest, and laid July 22, 23, and 25. On July 26, she was seen near the nest but then disappeared; she may have abandoned the nest because of the extreme heat at that time.

Summary of Successes

In the nine-year period of banding, 26 pairs made 67 nesting attempts, with 47 successful nests, 272 eggs, 172 fledglings. This gives an average per pair of 2.6 attempts per season, 1.8 successful nests, 10.4 eggs, and 6.6 fledged young. The number of eggs per pair per season ranged from 3 to 18, and the number of young fledged, from 0 to 12. Only one female (*F*16 in 1945) in the period of banding (1937-1945) laid as many as 18 eggs; however, in 1935, the unbanded Dooryard female made four nesting attempts, laid 18 eggs, and fledged 13 young.

It should be emphasized that the 172 young that were actually fledged were in most cases 17 or 18 days old and able to fly; hence they had greater chances of survival than the fledged young of many open nesters—such as warblers and sparrows—that may leave as early as 8 days after hatching. The young Bluebirds that left the nest prematurely and were known to have been killed before the normal nest-leaving age are counted among the losses.

The percentage of successes to attempts by years was as follows:

1937	43%	1940	66%	1943	75%
1938	75%	1941	83%	1944	37%
1939	71%	1942	100%	1945	75%

There was a wide variation between years; 100 per cent of the attempts being successful in 1942, only 37 per cent in 1944.

Based on the number of eggs (272 in the 9 years), the percentage of young successfully fledged was 63.2. This agrees well with the results found for hole-nesting passerines both in this country and in Europe. Musselman (1935) in southern Illinois reports 60.4 per cent success for 1,223 eggs, with 739 fledged in three years. Laskey (1940:185) in Tennessee reports a success of 57.6 per cent for 460 eggs in 1938, and 50.3 per cent for 576 eggs in 1939, or a success of 53.8 per cent for the two years. Her lower rate may have been due to the disturbances that are inevitable in a public park area, and also to cats, English Sparrows and Starlings. In my study area, cats and English Sparrows are controlled as far as possible, and Starlings do not occur in the nesting season.

Summary of Losses

Of the 272 eggs laid, 59 were lost as eggs, 35 as nestlings, and 6 as young that left the nest prematurely, making a total loss of 100. Distribution of losses is shown in Table 5.

Predators accounted for about half the losses. If the indirect loss of eggs and young due to the killing of the mother (17), and the loss of eggs and young taken from the nest (25) are combined, the percentage is 42. Deaths in the boxes (17) could not be separated as to cause, i.e., predation, parasites, or inherent weakness of the young, but certainly part were due to predators, and these, added to the deaths of nestlings out prematurely and killed by dogs (3), would make the loss from predators well over 50 per cent. I have witnessed no robbing of a nest; the suspected predators are rats, mice, flying squirrels, cats, opossums, and snakes. Loss by predators has occurred even when the supporting post was encircled with galvanized metal.

Premature departure of nestlings is usually due to disturbance by man or predator, but in late July may be chargeable to great heat. In two cases of young killed in the nest, the flies and maggots that appeared may have caused the survivors to leave before the normal time. Parents have removed dead young from the nest only if very small; at a later stage, dead young are left in the nest.

Nestlings out only a day or two before they can fly are able to get into a tree by climbing the trunk; those out earlier can only scramble across the ground. Dogs are a special danger. My own are confined whenever it is known that young of any species are on the ground, but accidents have happened. Since dogs roam almost everywhere that Bluebirds nest, they must be counted as a common predator.

Many nests are found to be heavily infested with mites, yet entire broods have been fledged from such nests. Occasionally ants get into the boxes; parents indicate trouble by peculiar actions, such as repeatedly looking into the nest or entering without food, and then I have brought pyrethrum powder to the rescue. Laskey (1940:186) tells of three broods killed by ants at the time of hatching.

TABLE 5

Loss of Eggs and Nestlings

Eggs infertile or addled	13
Eggs with dead chicks	11
Eggs laid on ground (cause: human interference)	1
Eggs deserted (cause: parasitism by Cowbirds and human interference)	10
Eggs and nestlings lost when female killed	17
Eggs and nestlings disappeared from nest	25
Nestlings died or killed in nest	17
Nestlings prematurely out of nest (3 killed by dog, 1 in rain; 2 disappeared)	6
	100

Late spring cold snaps have not been known to affect eggs or young. An occasional fledgling is found dead after a heavy rain, but broods fledged at the normal time usually survive even violent storms. At the time of the last nesting, extreme heat may affect development of the young or even cause death. The nestlings appear not to grow as rapidly as during normal weather; they sprawl in the box as if in the greatest misery, and when older let their heads hang limply from the hole. Loss might be considerable if the boxes were not of thick lumber with ventilating holes near the top. Parents feed the young infrequently during the hours of greatest heat. In 1945, heat probably hastened the death of one of the young in the brood of *M*11 and *F*18. On July 24, when the four young were 10 days old, they showed very uneven development, the smallest being about one third the size of the largest. That day the U.S. Weather Bureau at Little Rock recorded a maximum of 99° F., with high humidity. Three of the young kept their heads lolling from the entrance hole even through the cooler evening hours, so that the parents, on resuming feeding at the end of the afternoon, were obliged to stand on the roof of the box and reach down to the young. The smallest young, inside the nest, probably received no food. On the morning of July 25, it was dead; the other three seemed listless and did not cheep when fed, but they grew livelier by noon; the day was cooler, and the parents fed them oftener.

In 1936, the deaths of two of a brood of four that hatched August 6 could almost certainly be attributed to heat. Abnormally high temperatures prevailed through most of the month, with a maximum of 110° F., on August 10; under the tin roof of the barn, where the nest was located, the temperature was much higher. When 11 days old (August 17), two nestlings died; the nest was filthy; the parents fed infrequently and spent most of their time perched near the pool in the Dooryard Territory, which the owning pair had ceased to defend when their last brood was fledged July 20. I placed the two surviving young in a Dooryard nest partly shaded by oaks, and the parents fed the young in the new location. Both young left on August 23 at 17 days, the age at which fledglings normally can fly, yet these could only scramble across the ground. Three days later, one could fly weakly; the other remained in a woodpile where I placed it for safety, and it was not seen thereafter.

Few pairs ever attempt a nesting so late. In the 9-year period, 1937–1945, the latest dates on which young left the nest were August 1, 1938, and July 31, 1945. It may be significant that the two cases of chicks pipping the shell, but dying before hatching, occurred late in the season. *F*3 in 1940 had laid July 15–17; and *F*10 in 1941, July 3–6.

Sometimes the location of a box seems to favor disaster. The Dooryard box 2, located close to a fence and overhung by dead branches of a black jack oak, had a long history of losses and was several times infested with ants. After nestlings were killed in this box in 1938, it was moved to the open (to the pasture gatepost); it then became the preferred Dooryard box (D3, Figure 1) and was not troubled by predators until 1944.

The Bluebird as Parent

Normally, both parents feed the young, with the male taking full charge as they approach independence. I have records of two males that did all the feeding for a time, and one of a female that carried the whole burden of the brood from hatching on.

On May 31, 1934, a female with six-day-old nestlings was injured. Feathers on the ground near the box indicated that she had had a narrow escape from a predator. Every day for a week she perched in a nearby tree, her feathers fluffed, and was rarely seen to find food for herself. She went to the nest only at night to brood. Throughout this time the male fed the young himself. Then the female began to help, and she was apparently fully recovered on the day the fledglings left, June 12. Three days later she was making another nest in the same box.

In 1942, *F*12 of the Dooryard pair disappeared on April 23, when her nestlings were 14 days old. The male continued to feed them despite the distraction of a new mate that arrived on April 26 and started her nest on the following day, just a few hours after the fledglings left the box. She was never seen to feed her "step-children." The father raised all three.

In 1938, *F*1, of the pair on the east fringe of the Dooryard Territory, fed her second brood without the assistance of her mate, *M*1. He had, however, performed his share of the duties with the first brood, which was out of the nest prematurely on April 17. The female laid the second set, six eggs, April 25 to 30, beginning incubation with the fourth egg. On the morning of May 3, *M*1 appeared at the box minus his tail. He went through a courtship sequence more extreme than any other I have ever watched. He warbled some, but more often gave the squealing call characteristic of sexual excitement. *F*1 was much disturbed. Many times she left her eggs to cling to the front of the box and look in—the female's normal courtship response before nest-making. For several days, *M*1 repeated his visits with the same behavior, but gradually calmed down. Thereafter he spent most of the time in the Barn Territory (abandoned shortly before by *M*2 and *F*4) with the two surviving fledglings of the first brood, and was still occasionally feeding them when they were 27 days out of the nest.

Meanwhile, the eggs had hatched. The female found good hunting in the pasture that was part of *M*1's new territory, and he often flew at her side as she returned to the box. (At this time, his new tail was about half grown out.) Once he looked into the nest, but did not feed the young. Near the end of the nestling period, he came with his mate more often. She would feed the young, give a short note, and fly swiftly away; he followed.

On May 29 and 30, the six fledglings left the nest, and *M*1 showed none of the usual concern of a male at that time, giving no alarm notes, for example, at the approach of a Blue Jay (*Cyanocitta cristata*). *F*1 appeared to toll the young over to the Barn Territory; a week later I found only three survivors. On June 14, *F*1 was building. She made two nests, one in the old box in the Dooryard, the other in the Barn Territory. She laid in the box at the barn. For this third nesting, in which five young were fledged, *M*1 was a normal father.

The only clue to an explanation of *M*1's failure to feed the second brood lies in the loss of his tail. This is not an uncommon accident, and tail-less birds have been known to carry on their nesting activities. But *M*1's terror when his tail was pulled out by hawk or owl may have been equivalent to the psychological shock of having his nest destroyed. His instinct was to start a new cycle. Bigglestone (1913) has described a somewhat similar occurrence in the case of a pair of Yellow Warblers (*Dendroica aestiva*). The male abruptly stopped feeding his nestlings after an adventure with a snake that killed one of the young. This male, however, did not try to re-nest.

In the case of the two male Bluebirds that did all the feeding for a time, it should be pointed out that in one instance (1934) the female, although sick or injured, continued to brood the young at night, while in the other (1942), the young were nearly fledged at the time of their mother's disappearance and no longer in need of brooding. Twice in 1939, and once in 1944, in the Gate Territory, the female was killed, and the young, just a few days old, died in the nest. Whether the male in any of the three cases fed the young after the mother's death was not observed; even if fed they would have perished without brooding. While it is shown that the male may increase his feeding effort in response to increased stimulus, to brood is not in his normal instinctive routine, and it is improbable that he would brood in any emergency. *M*1's continued feeding of the fledglings of the first brood may be explained by the stimulus of their begging, to which male Bluebirds are, in the normal course of events, very responsive.

In 1938, when *M*1 failed to feed his young, his mate was able to fulfill all the needs of the brood because she provided both warmth and food. Whether she would have carried on her role as parent if *M*1 had been killed is doubtful. Although they were in different stages of the nesting cycle, there was still the bond of mates, and his presence, while not relieving her labors, apparently satisfied the need for a male partner. *F*1 was almost constantly subjected to opposing stimuli, first the eggs and then the young as against the male's courtship, and the nest with its contents was the stronger. *M*1's behavior soon after she started incubation was an interruption of her cycle, just as the loss of his tail was to him, but in her case the break was only temporary—as when she left her eggs to peer into the box.

Juvenile Behavior

Fledglings give the adults' location note, *tu-a-wee,* on leaving the box and sometimes for an hour or two before their departure. Out in the trees, they usually keep apart, but one may perch within a few inches of another for a short time.

The fledgling just out of the box waits quietly, except for an occasional low *tu-a-wee,* and breaks into the hunger chatter only at the arrival of a parent with food. By the end of a week, the young bird moves from one tree to another to meet the parent. At three weeks, two or three young pursue their father, with loud clamoring, when he has found a caterpillar. He is obliged to fly to one perch after another to beat the prey to an edible state.

Broods fledged in April almost invariably leave the area on attaining independence. Mid-season broods often stay in the area, or return frequently during the parents' next cycle. This is dependent on the attitude of the male parent, who may drive them or tolerate them. Weather is also a factor; the juveniles seem less inclined to roam in dry, hot spells. In two cases of parental tolerance, only one fledgling had survived (each time, a female); these may have remained because they did not have the stimulus of brothers and sisters to cause them to wander.

Parents that tolerate fledglings permit them to look into the nest and to perch on top of the box. In 1944, the May-fledged young of *M*10 and *F*16 were greatly interested in the nestlings hatched on June 14, and took turns fluttering at the doorway. The next day, they were in trees near the box, and in the following days they were occasionally near. The father was seen to fly at them only on the evening the younger brood left the box. On July 20, the hottest day of the year, with a maximum temperature of 102° F., parents and both broods spent the afternoon together at the pool and feeding table. On September 1, one of each brood was caught in a two-cell trap. A late brood usually remains in the neighborhood with the parents through September.

I have never observed juvenile helpers at the nest, but Nice (1931: 144), Laskey (1939:28) and Wetherbee (1933:199) have reported fledglings that fed a younger brood and removed excreta. Three female juvenile Bluebirds showed a precocious instinct for picking up nest material. One at 38 days old, May 10, 1934, and another at 35 days, May 7, 1935, carried pieces of grass to the top of the box in which the mother was making a new nest. Another at 83 days, July 18, 1944, gathered several pieces of dry grass and hopped to a rock where a brother was bathing in a saucer-like depression. She dropped the grass, took a drink, gathered more grass from the ground and returned to the rock; she played with the grass a few minutes and then lost interest.

Territorial Behavior

The pair establishes territory around the nest box it claims. In this region, where there appear to be more Bluebirds than suitable nest sites, box-ownership is nearly always determined by fighting between pairs. Male fights male, and female, female. Occasionally one of a pair retires for a few moments, and then the other bears the combined attack of the opposing pair.

Two combatants meet in the air, hovering, and snapping their beaks, then fall to the ground, apparently locked together, breast to breast, but whether the feet are engaged I have not been able to see. At times, one raises its head and brings the beak down in slow blows, at other times each keeps a grip on the other's throat or breast while they roll and flop. Often when thus locked, they allow an observer to approach and all but touch them before they fly up. Each then goes to a tree, and after a brief rest, they rush together again. Victory or armistice comes when one pair flies out of the zone of fighting. Ownership may be decided in a day, but the fighting often continues for a week. I have never seen a bleeding wound or even any considerable loss of feathers.

Unmated male and territory. At the start of the season, an unmated male does not take up territory, but those males who have lost their first mates and stayed—at least, much of the time—in their territories appear to defend the territories. They sing for mates just as Song Sparrows and many other passerines do. But whether a male Bluebird without a mate could hold (or would even try to hold) his territory against a mated pair has not been conclusively shown. In no case of a widower male remaining in his territory, has a pair that apparently really wanted the box come along. In May 1945, however, in the interval between broods, the red-banded pair (*M*10/*F*16) of the Dooryard visited boxes in all three territories before taking one at the barn. On May 19, they looked at the box in the Gate Territory where the yellow-banded male (M9) was waiting for a new mate. First *M*10 and then *F*16 clung to the box. *M*9 was perched about 10 yards away, watching them, and he did not move.

Boundary settlement. Pairs claiming boxes in adjoining territories very early in the season may establish a dividing line by meeting at the line and flying at and chasing one another, with little or no fighting on the ground. (The savage fighting seen in the winter is between pairs for a box, and not for settlement of boundary.) When, however, one pair has been in its territory for some weeks, and a new pair comes to the adjacent area, fighting starts at once, the first settlers being the aggressors, and is both spectacular and long-continued. The females fight as fiercely as the males. As with other species in which a male is unable to hold the entire area that he originally claimed, the established Bluebird pair does not actually drive the newcomers off, but a boundary is established between the territories.

In 1937, there was a typical case of first settlers fighting later settlers. *M*1 and *F*1, established in the Dooryard since March 1, fought *F*3 and her unbanded mate, who came to the Gate Territory on May 26. The battle lasted three days, after which *F*3 and her mate were accepted as neighbors. In 1945, the territorial disputes of an unbanded male and *F*16 with the pair *M*11/*F*17 were much more involved and longer drawn out. The history follows:

Jan. 11. *MR* paired with *F*16 (see above under "Pairing and Courtship").

Jan. 14. *MR*/*F*16 visit hole in dead oak tree 15 yards north of the peach tree stub in the Barn territory.

Feb. 6. 9:00 a.m. New male (later banded *M*11) arrives and pairs with *F*17, the courtship taking place at Dooryard box 3. They then join another pair and an extra male in the pasture (Barn territory), and much chasing back and forth ensues.

1:00 p.m. *F*16 (red-banded) and *F*17 (yellow-banded), each accompanied by a male (unidentified), are in the pasture. The pairs are plainly establishing a dividing line (about 10 yards north of Barn box 3) where none has ever been before. *F*16 and her mate repeatedly fly north across the pasture to a peach tree stub in which there is a cavity made by chickadees; *F*17 and her mate fly to Barn box 2; then the two pairs return to the dividing line (*X* in Figure 1). Each male continues his courtship—warbling, flying at his mate and displacing her—but the birds clash as pairs, male flying at male, and female at female. A few times two opponents clash and fall together to the ground, but they quickly separate, and there is no serious fighting. In the 30 minutes of observation the two pairs many times repeat the visits to their respective nest sites and the meetings on the line.

Feb. 8. An extra male (unbanded) is still present. *MR* is last seen on this date (found dead Feb. 21 in Gate box).

Feb. 11. *F*16 is accompanied to the feeding table by an unbanded male.

Feb. 11–March 9. *F*16 and unbanded male rarely seen. (*F*16 seen at Dooryard feeding table on only 8 days.) Apparently spend most of their time in the territory established Feb. 6 around peach stub. *M*11/*F*17 claim both Gate and Dooryard and most of Barn territory. (From occasional meetings of the two pairs at the dividing line established on Feb. 6, it is plain that this remains the boundary.)

March 9. *F*17 starts nest in Gate box (where she had raised a brood in 1944). She continues to visit Barn box 2 with her mate, *M*11.

March 11. *F*16's nest (in the dead oak tree she visited with *MR* on Jan. 14) is almost completed. This nest destroyed (see above under "Number of nestings").

March 12. At 12:30 p.m., *F*16 and *F*17 are in a fierce fight near (and apparently for possession of) Barn box 2. *M*11 hovers over them and flies about in great excitement. An unbanded male keeps to the trees 20 yards distant. (Presumably *F*16's mate, perhaps already defeated by *M*11, perhaps timid and backward.) The females fight for 10 minutes. After a last flopping on the ground one (*F*17) lies motionless for a moment, then flies east to the Dooryard territory; *F*16, the winner, perches on top of the box, lifting and fluttering her wings. *M*11 stays at the scene for about five minutes. He flies at *F*16 several times and clings to the box, warbling and lifting his wings, but finally joins *F*17 in the dooryard.

March 13. In spite of *F*16's victory on March 12, *M*11/*F*17 remain in possession of the three territories, visiting both the disputed Barn box 2 and the Gate box, in which *F*17 started a nest on March 9. She does not work on the nest, however.

March 14. *F*16 claims Barn box 3. At 9:00 a.m. she is fluttering at the box, while her mate (unbanded) fights with *M*11 on the ground below. Several times *F*16 goes close to the fighting males and once pecks one of them. *F*17 keeps well out of the fighting area. After about 10 minutes, the males separate, the unbanded male the winner. *M*11 flies away to the Dooryard. At 10:00 a.m. the unbanded male and *F*16 are at Barn box 3, *M*11 and *F*17 at Barn box 2. The two pairs fly at each other at a point about half-way between the two boxes as if establishing a new line. Gradually *M*11/*F*17 grow more aggressive. Between 11:00 and 12:00 both pairs remain on the roof of the barn above Box 3. The unbanded male and *F*16 hold the position nearer the box, with *M*11/*F*17 about three feet away. All four birds keep hopping back and forth. *F*17 frequently stands very tall and erect, pointing her beak upwards (probably substitute behavior for fighting).

March 15. *F*16 and her mate only once seen at Barn box 3—early in the morning. *M*11/*F*17 visit Barn box 2, as well as the Dooryard and Gate boxes. *F*17 occasionally carries grass to the Gate box.

March 16. At 7:30 a.m., *M*11/*F*17 are at Barn box 3, keeping *F*16 and her mate away. They apparently try to keep the boundary line 20 yards north of the box. The pairs meet at this point, perching on dead weed stalks—mates within a foot or so of each other, the pairs a yard or two apart. At 8:00 a.m. they are darting at one another, *M*11/*F*17 then flying back to Box 3, *F*16 and her mate retreating to the tree in the middle of the pasture. Occasionally *M*11/*F*17 fly to Barn box 2, whereupon *F*16 and her mate fly to Barn box 3, but *M*11/*F*17 immediately return to Box 3 and drive the other pair back to their tree. *M*11/*F*17 are plainly the dominant, more aggressive pair. The performance continues until 8:45. Just then a Bluebird calls *tu-a-wee* from near the Gate box. *M*11/*F*17 fly over in great excitement, apparently to drive out the trespasser. *F*16 and her mate take possession of Barn box 3 and the whole Barn Territory. *M*11/*F*17 seem to have given up the dispute. At 9:05, *F*16 and her mate are at Barn box 3, *M*11/*F*17 fluttering at the Dooryard box. *F*16 and her mate also visit Barn boxes 1 and 2. By 10:30 everything seems settled. *F*16 and her mate come halfway to the house while *M*11/*F*17 remain around the Dooryard box. Through the afternoon both females carry grass, *F*16 to Barn box 2, *F*17 to the nest she began earlier in the Gate box. At 3:30 both nests appear to be completed.

No more fighting occurred between these pairs during the summer.

Boundary ceremony. I have seen one instance of what may have been ceremonial settlement of boundary, probably a sequel to fighting, and comparable to the territorial display of Eastern Mockingbirds and Brown Thrashers (*Toxostoma rufum*). On March 1, 1944, the Barn and Dooryard pairs flew down to the ground at about the half-way point between their boxes. First one pair, then the other, hopped forward a foot or more, the "attacked" pair moving sideways or retreating. Once the Barn pair fell back three or four feet, the Dooryard pair pressing their gain. Then the Barn pair turned and recovered the lost ground, the Dooryard pair yielding. The action ended abruptly with the pairs flying back to their respective territories.

Defense of territory. Little defense between neighbors is necessary, since both males and females respect the dividing lines. I have only a few times seen a male fly across the line and down to his neighbor's land to pick up an insect; each time the owner flew at the trespasser, who returned to his own territory without giving fight. In 1938, *F*1 showed a scrupulous regard for boundary. The year before, *M*1/*F*1 had held the Dooryard, but in 1938 they had all of the Gate Territory, as well as the east side yard, which usually belonged to the Dooryard Territory (Figure 1). Their box, D1, was a little northeast of the house, while *M*3/*F*3 had box D2, just 25 yards off. The dividing line ran through a tree close to box D1. While *F*1 was feeding the six nestlings of her second brood without any help from her mate (see above), she apparently found abundant food in the close-grazed Bermuda pasture that was part of the territory *M*1 had taken up, and she went there dozens of times a day. She could have gone directly from her box across the Dooryard Territory. Instead, she flew south on her own land about 30 yards, then cut west for 50 yards and turned north to the pasture. After about a week, she tried the short way home, and *M*3 and *F*3, with fledged young at the north end of their territory, did not bother her. Thereafter, *F*1 came home across their land, but continued to go by the roundabout route, which by that time had probably become habit.

When her young were fledged, she led them the long way, on her own territory, over to the pasture in the Barn Territory.

Homeless wandering pairs rarely trespass on a settled pair's territory in the course of a nesting, but if they do they are promptly chased out, and they do not give fight. The situation between nestings is quite different, and will be discussed in the following section.

Length of ownership. Some Dooryard pairs have seemed to hold territory continuously, from the first nesting to the last fledging. This is likely to be the case when there are only a few days between the fledging of one brood and the start of the next nest, but it has also been true when the interval was about two weeks.

Other pairs have led the fledglings to the fringe of the territory a hundred yards or more from the box. Formerly there were telephone wires (running east and west) about 75 yards north of our north boundary fence, and these wires were favorite perches for Dooryard and Barn pairs with fledged young. There are still wires above the highway about 80 yards to the east, and a Gate pair with fledged young can nearly always be found in that area. At Mrs. Nice's home (1931:144) in Oklahoma, the pairs and their young disappeared between broods, returning in from 9 to 16 days.

There is a doubt that the pairs that stay in the territory between cycles are actually holding territory. Nice (1941:441) wrote: "the owner of a territory is nearly invincible in his territory," and Tinbergen (1939:57) goes further, stating that "a male on its own territory is undefeatable." I have found that Bluebirds are invincible in their territories only in the course of a nesting, not after their young are fledged.

In 1940, *M*4 and *F*9 of the Dooryard had fledged a brood on April 29. On May 9, an unbanded male and *F*3 appeared, and in one day fought and drove out the owners. The new male (later *M*5) and *F*3 had a brood fledged June 20, and on June 23 they in their turn were attacked by an invading pair, but in this fight owners were winners. I have observed many fights between pairs in the interval between broods, but the identities were not known.

A homeless pair attacks when a box *is not in use*. In one case, the fighting took place 10 days after the young were fledged, and in the other only three days after. This suggests that use of the box and the holding of territory are inseparable, and that the pair with fledged young are in the position of all pairs at the start of the nesting season.

Even with the pair that stays near its box, there may be a temporary abandonment of the land, and then a repossession when the next nesting is started. Certainly the pairs that wander off to the extreme limits of a territory cannot consistently defend the other boundaries, or the box, from neighbors' trespassing. But from a very considerable distance, they may become aware of another pair's courtship at their box, and hurry back to fight for it.

Nice (1935:110) expressed the belief that "the purpose of territory is primarily to prevent interference in family life." The Bluebirds' territory prevents interference from the time of nest-making to the fledging of the young. When they have not been frightened out prematurely, the young fly fairly well on leaving the box, and within a few days are able to follow parents over an extensive area.

In this region, factors not associated with defense of territory may keep many pairs in or near their territories. Lawn, garden, and pasture may offer better feeding than the edge of the woods or the roadside. Our pools are their usual watering places, and in years of drouth may be the only available water in the neighborhood.

Extending territory. When a territory becomes vacant, the pair in the next territory extend their hunting and may move into the acquired land for their next cycle, yet retain their original area. This happened in 1938, when *M*1 and *F*1 had the first and second broods on the east fringe of the Dooryard and the third at the Barn; in 1944, when the red-banded pair (*M*10/*F*16) owned both Dooryard and Barn Territories; and again in 1945, when *M*11/*F*17—and *M*11 with his second mate, *F*18—owned both Gate and Dooryard Territories.

Desertion of territory. I have five records of territorial desertion during the season. In 1937, *F*3 and her unbanded mate deserted their first set of eggs in the Gate Territory because of parasitism by a Cowbird (*Molothrus ater*); there was then a three-day battle (June 28–30) with *M*1/*F*1 of the Dooryard, by which *F*3 and her mate appeared to win an extension of their land, but within the next week they left the area without having started a new nest. In 1938, *F*2 and his second mate, *F*4, disappeared after the young were killed in the nest. In 1939, an unbanded male deserted the Gate Territory after losing two mates and two broods. In 1940, *F*5 and her mate remained in the Barn Territory for about 10 days after *F*5 deserted her eggs (apparently because disturbed when lifted from the nest for identification); they then disappeared. In 1944, *F*15 and her mate abandoned the Barn Territory after two sets of eggs had been taken by predators. In each case, except the first, the desertion occurred in late April or May, when there was still time for another nesting. Some pairs may be inhibited from occupying a territory in which they have had a failure, and this may account, at least in part, for the homeless pairs that appear between cycles to fight established pairs for box and territory.

Post-nesting abandonment of territory. A few days after the fledging of the last brood, a pair becomes indifferent to the presence on its territory of neighbors, strangers, or flocks of juveniles.

Flocking

Early social bonds. Nice (1943:53) points out that nestlings of some passerines lose the first bond to one another when they leave the nest and seek separate perches. On two occasions I found fledgling

Bluebirds roosting together the first night out of the box: on April 20, 1934, the weather turned unseasonably cold, and five fledglings of a brood that had left the box that morning roosted in a row, close against each other, on a limb of an oak; on April 21, 1938, the two surviving fledglings of the brood of *M*3 and *F*3 roosted side by side their first night out of the box.

While early broods nearly always vanish soon after attaining independence, the June- and July-fledged young frequently have remained into September and later. In August, 10 to 15 juveniles, some banded and some not, form a loose flock, and come together to bathe. Three or four enter the water at once. These groups show great liveliness as compared with the apathy of the molting adults, and many chases occur. For the only time in their lives, the Bluebirds are rather noisy, breaking into frequent alarm chatters for no apparent reason. Often my walking into the garden is enough to start the flock "scolding." The juvenile flock gradually decreases in number, or all disappear at once in a spell of autumn weather. Some old pairs remain, with, occasionally, a fledgling, and are the focus of the winter flock, which is formed by mid-November. New Bluebirds arrive about the middle of January, and summer residents sometimes arrive that early.

Composition of the flock. The number of nest sites in a locality and the Bluebird population of the surrounding country determine the size of a winter flock. From 1931 to 1934, there was but one box (in the Dooryard Territory) in about 50 acres of woodland. During this period, only one pair was regularly seen in winter. Since the erection of boxes at the barn and the driveway gate, two, three, and sometimes five pairs have been present from mid-October to the taking of boxes in February. While two resident pairs may comprise the flock, they are usually joined by new arrivals in November. My wintering flock has never exceeded 12 individuals. A similar flock may be observed in any piece of roadside country that offers suitable nesting sites such as old chickadee and woodpecker holes in trees, fence posts, or poles.

It is a striking fact that the sexes in the flocks of my neighborhood are nearly always equally divided. A typical flock is composed of three males and three females. In November 1944, the first year of color-banding, the flock consisted of the red-banded (*M*10/*F*16) and yellow-banded (*M*9/*F*17) pairs that had nested in the Dooryard and Gate Territories; the first pair's fledgling daughter, *FG*, banded green; and a banded but unidentified male.

The history of the flock is as follows:

December 3, the banded, unidentified male disappeared.

December 13, a new male arrived, to be banded green (*MG*); he paired with *FG*.

December 23, *MG* and *M*9 disappeared.

December 25, *M*10 disappeared.

December 26, a new male arrived about noon.

December 27, the new male and *FG* disappeared.

December 27, 1944–January 8, 1945, the two old females were alone except for December 8, when a new male appeared and stayed for a few hours.

January 11, a new male arrived, and was banded red on the right tarsus, *MR*. He paired with *F*16.

February 6, two new males arrived; one paired with *F*17.

February 6–11, *MR* disappeared (later found dead), and the other new arrival paired with *F*16.

Losses from this flock were abnormally heavy. The first male to disappear, the new male, *MG,* and the two old males (*M*10 and *M*9) may have been killed by the Screech Owls (*Otus asio*) then known to live on the place. *FG* and the male that was here for only one afternoon may have left together to go to the male's own flock and breeding grounds. While in former years it was not possible to keep a day by day check on the individuals of the winter flock, it was apparent that fluctuations took place, and the appearance and disappearance of single birds suggested roaming and shifting from flock to flock to find mates.

The 1944–45 season was also unusual for the late arrival of the male replacements and for the fact that no new females or pairs came in January, February, or March.

Flock behavior. Throughout the winter, the flock visits the nest boxes, at times with little display of courtship or competition, at others with much flying and snapping at each other. In general, warm weather seems to stimulate the activities about the boxes, and cold to inhibit. However, when the flock is composed of an old pair and new pairs that arrived in the fall, or wholly of new pairs, there may be much singing and fighting around the boxes even at freezing temperatures, if it is not raining, snowing, or blowing hard. In the fall of 1944, when the two old pairs with a fledgling female and a third male made up the flock, there was no fighting at the boxes; this was probably due to the dominance of *M*10 and *F*16 over the others, as well as to the fact that two pairs were residents with a previously established relationship as holders of adjoining territories.

Members of the flock often separate, perching or flying 100 yards apart, but keep in contact by means of the location note, *tu-a-wee.* In long flights above the trees, the formation is open, with two or three in the lead, one or two 50 yards behind, and a last still farther to the rear. The location note is always heard as a flock goes over.

In winter, much more than in summer, the Bluebirds perch at the very tops of trees, which keeps them in sight of one another, and may account for the lack of any flock notes other than the *tu-a-wee.* The Chickadees and Tufted Titmice that almost continually utter notes of a wide variety are usually moving through the lower and middle branches of trees much of the time, and are perhaps therefore more dependent on sound for contact.

Occasionally, the Bluebirds are in a close group, as in a berried shrub or at a feeding table. Here they give an example of the social bond. When one is trapped and utters notes of fright and alarm, others in the flock break into the alarm chatter and fly about in great excitement, and may, when the trapped bird is being removed, swoop down at the bander's head.

Dominance. A peck order apparently exists. When flocks of 6 to 10 Bluebirds visit the feeding table, there is much flying back and forth, an individual or pair leaving the table as others come down to feed. Rarely, and only in the worst weather, have two pairs eaten side by side. With the color-banded flock of 1944–45, it was possible to observe the relationships of individuals. The red-banded *M*10 and *F*16 dominated all others, which suggests that dominance goes by pairs. At the feeding table this pair pecked their daughter, *FG,* but the mother pecked more often than the father. The daughter's mate (unidentified) usually waited until the others had eaten before coming down. The yellow-banded pair (*F*9/*M*17) also waited, or promptly yielded their places to the dominant pair. Males were not despotic over their mates; a male only occasionally pecked his mate when they met at the table. In the interval between December 27 and January 11, when only the two old females were present, *F*16 was noticeably dominant, but not tyrannical, over *F*17. After *F*16's pairing with *MR,* the order was suddenly reversed, and *F*17 became the tyrant, driving *F*16 from all feeding places. Nice (1943:91) reports reversals of dominance in the case of hand-raised Song Sparrows.

Inter-flock relations. Winter flocks rarely mingle in the area of their nest sites; in bitter weather, my flock has been joined by one pair or two pairs, probably attracted by the general gathering of birds at the feeding table, but with the return of mild weather the newcomers either leave of their own accord or are driven off by the resident Bluebirds. In October, November, or January, my flock may be joined by small migrating or wandering flocks for a few days; at such times there is always great excitement during the visiting of boxes.

The flock's range. Leaving the home place, the Bluebirds fly out of sight. Some flocks, in the coldest weather, have come to the feeding table only in the morning, then left, not to return to the area until afternoon. It is presumed they seek feeding places more sheltered than our wind-swept hill.

Flock roosting. As a rule, the Bluebirds roost in trees near their nest boxes. Three or four snuggle within a terminal cluster of dead leaves. Two post oaks with low hanging limbs that hold their leaves late are favorite roosting trees from year to year. Migrating flocks roost in the same way. I have found them most often in trees at the foot of the hill, 150 yards from the boxes. The flock of 50 referred to under "Migratory Status" were distributed among five or six trees. As I walked among these trees, small groups that had settled for the night would fly out with startling suddenness; from a distance I watched them returning.

In the winter of 1944–45, I did not discover the roosting place of the home flock, and from several incidents, believed they left to roost some distance away. Their choice of a roost, perhaps more exposed to predators than the two post oaks which our Bluebirds preferred for many years, may have accounted in part for the heavy losses in the flock. Probably *MR*, from the time of his arrival and pairing with *F*16 on January 11, roosted in the breeding area. On January 13, at 7 a.m., warbling was heard from the Barn Territory; there were no answering voices, and the two females did not appear until 7:40. On the evening of February 6, I found *MR* gone to roost in a rotting stump below the Barn Territory.

Only in the coldest weather have the Bluebirds slept in boxes. In January, 1940, during a week of snow with a minimum temperature of 5° F., two pairs slept in the same box, notwithstanding that on the first day of the snow they had fought each other for the box.

Relations With Other Species

With two exceptions in 15 years, Bluebirds have not interfered with other hole-nesting species. The rule is to show great curiosity. On seeing a pair of another species start to build, both male and female Bluebirds fly to the box and look in, give the squealing notes, and perhaps dart at the new tenants, but in a day or two they ignore the neighbors.

Here they have nested year after year within a few yards of Carolina Chickadees, Tufted Titmice, Bewick's and Carolina Wrens, Crested Flycatchers (*Myiarchus crinitus*), and Flickers (*Colaptes auratus*). Much cause for conflict is avoided by careful placing of the boxes. Those for Bluebirds and those for flycatchers are in the open, those for Tufted Titmice on trees. Chickadee boxes are very small, on low posts under oak trees. Wren boxes are shallow and are placed under the eaves of low buildings, inside shed or barn, or on a porch. The Flicker boxes are too deep for Bluebirds.

Both exceptions occurred in the history of a male Bluebird who was a permanent resident from 1933 through 1935. In 1934, from about February 1 he chased a pair of White-breasted Nuthatches (*Sitta carolinensis*) every time they visited a box until March 15, when they left the neighborhood. (It is, of course, not certain that they would have stayed if the Bluebird had let them alone.)

In 1935, the same male Bluebird twice threw out the nest material from a box chosen by Crested Flycatchers. There was doubt here also that the routed birds would have nested. The first time the Bluebird interfered was on May 29, when the female Flycatcher had just started to build. She waited a week, started again. Yet the nest was still incomplete two weeks later when the Bluebird's brood was fledged and he set to throwing out the Flycatcher's grass and weeds.

This particular Bluebird showed antipathy to all hole-nesting species. He carried on a perpetual feud with Downy Woodpeckers (*Dryobates pubescens*) that used our boxes as sleeping places in winter. Two years, in December, he threw out chips that a woodpecker had torn from the box walls, and then he carried in grass, warbling as in spring. On finding the Downy gone to roost early in the afternoon, he would flutter at the hole and keep up an alarm chatter for many minutes.

In this section, Bluebirds have no competition from House Wrens or Starlings, and they can usually compete successfully with English Sparrows (*Passer domesticus*). Both male and female Bluebirds fly at any bird that perches on or near their box, but do not drive other species from the territory.

Adults are not as a rule quarrelsome at feeding tables, although some fledglings go through a stage of being "bossy" to adults of other species. Bluebirds follow Chickadees and Titmice to the table, but never seem a part of the group.

Yet the Bluebirds' response to the distress of other species is strikingly like their responses within their own winter flock. A male Bluebird will hover over an English Sparrow fallen to my rifle, when no other bird takes any notice. He will join a Robin (*Turdus migratorius*) in attacking a Blue Jay near the Robin's fledgling. Many species gather at a disturbance, but usually exhibit more curiosity than flock alarm.

Mockingbirds guarding winter feeding shelves often show a marked antipathy to Bluebirds. In fall, Myrtle Warblers (*Dendroica coronata*) pursue and even nip them, and Wood Pewees (*Myiochanes virens*), Eastern Phoebes (*Sayornis phoebe*), and Summer Tanagers (*Piranga rubra*) fly into the juvenile flocks, snapping first at one and then another.

Enemy Recognition

Bluebirds' alarm signal is a short whistled note or a series of chattered notes. They sometimes initiate an alarm when the specific cause cannot be observed and keep up the chattering for several minutes or longer. Other species respond to the Bluebirds' alarms by taking flight at the whistled note and by gathering, as in curiosity, at the scene of continuous chattering. On July 30, 1945, *M*11 gave the whistled note as his young were leaving the Dooryard box, and three juvenile Bewick's Wrens that were foraging on the lawn 30 yards distant flew up with explosive suddenness. One wren flew into the screen of the window from which I was watching and clung there a moment, "frozen." When the Bluebird did not repeat the alarm, the wrens resumed their feeding.

Bluebirds ignored the Sparrow Hawks (*Falco sparverius*) that three summers nested within the territories. Occasionally, in winter, the

Bluebirds flutter at a box where a Screech Owl is known to be, and chatter, but their interest is never so sustained as is that of Carolina Chickadees and Tufted Titmice.

They recognized the following as enemies to eggs or young: Blue Jays, Red-bellied Woodpeckers (*Centurus carolinus*), dogs, squirrels, and snakes. The only cat that has appeared in the daytime near a nest box was discovered by Carolina Chickadees, and the Bluebirds were just joining in the alarm when I went out, and the cat fled. Rather unexpectedly, they have "chattered" and flown at cows that sometimes stand beside the box on the pasture gatepost. They ignore rabbits.

The male Bluebird, as guardian of his nest, objects to the Blue Jay's near presence at any time. Hostility increases as the day of fledging approaches; as the young are leaving, both male and female will attack like furies, even pulling feathers. For a week after fledging, they give the alarm chatter at a Jay's appearance.

Hostility to the Red-bellied Woodpecker is usually confined to the periods just before and just after the young are fledged. This woodpecker nests in the neighborhood, coming regularly for suet, and I have not known it to take eggs or young. The only other birds seen to drive the Red-bellied Woodpecker are Tufted Titmice, and they attack also the Red-headed Woodpecker (*Melanerpes erythrocephalus*) a spring straggler in this locality, and known to destroy eggs and young.

Both parents give the alarm chatter if a dog goes near a box as young are leaving. They fly back and forth, hovering for a few seconds above the animal, chattering and snapping their beaks. Excitement rises to a frenzy if the dog goes near a fledgling on the ground. During the next week, the pair chatter and fly back and forth if a dog wanders beneath the trees where the young are perched. But parents with fledglings 30 to 50 yards from the house return to the feeding table and ignore the dogs near it.

On June 18, 1944, the red-banded male (*M*10), with four-day young in the nest, chattered and flew at a red squirrel in a tree 20 yards from the box. He flew into the tree repeatedly, snapping as he passed within a foot of the squirrel, and kept up the charge until the squirrel ran from the tree.

Bluebirds have given innumerable alarms at the sight of snakes anywhere in their territories, and as a result I kill from 6 to 12 snakes a year. They have included copperheads, coachwhips, black chicken snakes, milk snakes, and king snakes. The smallest were the copperheads, about two feet long, while many of the black snakes were between four and five feet in length. On finding a large snake in the outer branches of a tree, both male and female Bluebirds chatter and fly in wide arcs, back and forth, snapping as they pass close to the snake's head, or hover near it for a few seconds. Males are usually much bolder than females. Juvenile Bluebirds still with their parents join in the general alarm, chattering and flying through the tree. When a snake is on the trunk of a tree or on the ground, the Bluebirds hover near it or above it, returning again and again, and keeping up the chatter.

On July 3, 1939, at 1 p.m., the pair with 13-day-old young in Dooryard box 3 gave the chattered alarm. Both male and female flew back and forth in front of the box, hovering to look into the entrance hole, while Field Sparrows (*Spizella pusilla*), Bewick's Wrens, Orchard Orioles (*Icterus spurius*), and Brown Thrashers, had come to the fence and near-by bushes to peer down into the tall grass. They scattered when I approached. Not finding a snake, I withdrew to watch, and in about two minutes one nestling Bluebird tumbled out of the box and scrambled off, the parents still chattering. At 3 p.m., the birds again gave the alarm and hovered above some sparse weeds 30 yards from the nest. I found a black chicken snake at the spot and killed it. The other nestlings had stayed in the box.

On June 24, 1944, just before dark, the red-banded pair (*M*10/*F*16) and their five fledglings, then 59 days old, began a loud alarm in a tree about 10 yards from the box where the 10-day-old nestlings were. I kept at a little distance until the birds could "show" me the snake, but the male did not fly at it as he had swept at the squirrel just a week before. There was excited flying through the branches of the tree, and the Bluebirds would leave, only to rush back at once. Finally a Mockingbird hovered close to the trunk, and thus gave me the clue. A huge chicken snake lay at full length through a low fork, and was easily killed.

On June 20, 1944, these fledglings, then 55 days old, and unaccompanied by their parents, had found a snake on the lawn close to the house. They gave only a few alarm notes, and it was by chance that I saw them as they hovered above the grass. They perched on the fence for a moment, looking down, and then flew away. In a moment, two fledglings were back, hovering above a spot about six feet from the place where they had first hovered. I found a long milk snake there.

The Bluebird's reaction to snakes is markedly different from that observed in Song Sparrows by Nice (1943:257). One male Song Sparrow displayed only curiosity on finding a garter snake coiled beneath his nest with young, although his mate of the next year attacked small snakes near the nest.

Since the juvenile Bluebirds that found the snake on the lawn on June 20 were then 55 days old, it is unlikely that this was the first snake they had seen, and their response may already have been conditioned by the parents' behavior. Nevertheless, the almost silent hovering above the snake may have been innate behavior corresponding to young Curve-billed Thrashers' (*Toxostoma curvirostre*) stereotyped snake display (Rand, 1941:232–235). Just four days later, with their parents, the young Bluebirds flew and chattered in excitement as described above.

Rand's observation (1941:241) that a snake of large size in motion produced the Thrasher's display in its greatest intensity offers a possible explanation for the varying types of reaction to snakes seen in adult Bluebirds. The boldest charge by the Bluebird is made upon the snake that has made its way to the smaller, outer branches of a tree and lies there in *S* loops; even if the snake is at rest, its weight and the light breezes that stir the branches are apt to create the impression of coils in motion. There is almost equal excitement, but less directed flying, at a large snake lying quietly against the trunk of a tree; there is much less excitement over a snake that is partly concealed in tall grass. Frequently, a snake killed in the morning has been left on the open lawn until evening. On a few such occasions, a Bluebird has hovered momentarily above the dead snake, but then ignored it for the rest of the day. Although Bluebirds have given the alarm chatter at finding snakes at any time in the summer, they are most excited, and boldest in the attacks, when they have young, either nestlings or dependent fledglings.

Voice

The song. The familiar warble, given by both sexes, is heard occasionally even in winter, especially when several pairs visit a box together. From about February 1 until egg-laying, the male sings regularly at the start of morning twilight. Males vary in the amount of singing they do during the day; in general, the more pairs present, the more warbling there is. The singing ceases at about the time the female begins incubation, although some males continue the early morning warbles for a few days longer. At the start of a new cycle, the male again sings in the morning twilight. When this cycle follows a successful nesting, there is apt to be little or no warbling during the day. However, any break in the normal sequence of events, such as the loss of eggs or young, the death of the female and her replacement, or fights with encroaching neighbor-pairs, stimulates singing comparable with that of the first cycle. The female's warbling is usually limited to the time she is fluttering around the box, especially in the early spring. On January 24, 1945, I heard a solitary Bluebird warbling in the Dooryard and found it to be the red-banded female, *F*16. At first the notes were given in one pitch, but gradually they assumed the typical expressive inflections. A few minutes later, *MR* came flying in from the west. Apparently the song may sometimes have the same function as the location note, and females may sing more often in the pre-nesting season than has been observed. The voices of the sexes are indistinguishable.

Courtship chatter. A low, continuous *chee-chee-chee* that often merges into a soft warbling. It is most often noticed in the pre-nesting season when two or more pairs are visiting a box.

Whining. A long whining, or squealing, cry, expressing sexual excitement, sometimes frustration or distress, accompanied by repeated wing lifting. Some Bluebirds are not heard to give the whining note. This is apt to be the case when affairs have gone evenly, and nest making has started early. Others whine in the courtship performance even in January and February, especially if several pairs take part in the visiting of boxes. After all-day fights, a victorious male sings and whines and flies after his mate in the greatest excitement. At other times, as in the mating period, there is no interference to account for the whining. Some females utter a similar crying, very low, which is often, but not always, a preliminary to coition.

The whining may be heard again when a nest of eggs or young is lost to a predator. When *M*1 lost his tail and was thrown back to the start of the cycle, he "squealed" more than he warbled.

Alarm notes. 1. A sharp, rising whistle. It implies danger to the adult rather than to the nest and is a signal for flight to safety. It also suggests that the bird giving it has been startled. I have seldom been able to discover the specific cause for this alarm note. In many instances it is perhaps the alarm for a passing hawk.

2. A loud, emphatic, long continued chatter, given for an enemy of the nest or young, or when a mate or one of the winter flock is trapped. While the whistle is for escape, the chatter is for attack on the enemy or for any general disturbance, and it is accompanied by excited flying in and out of trees.

3. A short *upp*, the mildest alarm, uttered as a Blue Jay comes near, even in winter, and usually as the Bluebird leaves its perch.

Location note. The note *tu-a-wee*, with the tone quality of the song, is used throughout the year, in the flock, and between mates and fledglings.

Food and Feeding

Forbush (1929:422) sums up the Bluebirds' food as seven-tenths from the animal kingdom (chiefly insects) and the rest from the vegetable (mainly wild fruit).

The birds procure most of the insect fare from the ground. The rule is to perch in an exposed place, and fly down on seeing prey. If it is small, it is eaten then. A caterpillar or moth of any size is carried up to a perch, worked in the mandibles and "whacked" several times before it is eaten. In early spring and on many summer evenings, Bluebirds take to fly-catching. They do not pick up the insect in passing, but hover to take the victim, and then return directly to their perch on tree or wire.

Temperament

There is much individual variation in temperament, due in part to conditioning. Some Dooryard pairs and their fledglings have become as tame as Robins or Mockingbirds. Some pairs in the Barn Territory have remained "wild" and difficult to observe, while the Gate pairs are usually between the two extremes.

As a rule, pairs that have wintered here, regularly visiting the feeding table, are more tame than spring arrivals, although some newcomers that are exceedingly shy and nervous at the start of the season grow accustomed by the middle of the summer to people, dogs, and their outdoor activities. In a summer of long drouth, the Bluebirds stay more at home in the intervals between cycles and at the close of the nesting season, and thus become tame; in a rainy season they wander away.

In the late winter and early spring of 1945, *M*11 and the unbanded male that was mate to *F*16 were interesting contrasts. *M*11 was tame from the first, eating peanuts with his mate, *F*17, from the second day of his arrival; in his first 10 days here he was trapped six times. The other male would follow his mate to the trees above the table but never came down with her. Efforts to capture him in the Barn Territory during the nesting season failed. This male seems to have influenced, or perhaps dominated, *F*16, first in the choice of the dead tree north of the Barn Territory for their earliest nesting attempt, and then in keeping her away from the Dooryard. In the previous summer, *F*16 and her mate *M*10 had had their third nesting at the barn, yet had continued to come to the Dooryard.

Males vary in aggressiveness. Some resent any tampering with the box at any time, and swoop down with the alarm chatter, barely missing the offender's head. Others watch quietly while nestlings are banded, and are stimulated to attack only if the young make a sound.

Summary

Banded Eastern Bluebirds (*Sialia sialis sialis*) of three nesting territories in central Arkansas were observed from 1937 to 1945, unbanded Bluebirds from 1931.

Most of the breeding Bluebirds had either wintered in the area in which they were nesting or had come in January.

Of the males, 60 per cent nested in the area for two (or more) successive seasons; of the females, 61.5 per cent. One female returned for four successive seasons. Four pairs were mated in two successive seasons. Four fledglings (two males, two females) remained for the winter and held territories in the area their first nesting season.

Most of the nesting pairs are permanent residents, but some individuals, of both sexes, migrate. One pair was resident one year but migrated the following year.

Bluebirds are attracted to nest sites the year around.

Resident Bluebirds pair at any time between early fall and the nesting season. Migrating Bluebirds may pair on the wintering grounds. Two pairs of migrants were observed in mating behavior in September.

Both male and female take part in the courtship, singing and fluttering at a nest box.

A male whose mate has been killed during a nesting may leave the territory for a time or remain in it until a new mate comes. An unmated female may invade the territory of a mated pair at the start of nesting, or between nestings, and fight the female.

The bond between mates in winter-formed pairs is apparently slight, but is strong between mates that have had one nesting season.

Nesting begins generally in the first or second week of March. The last brood is fledged usually in the last half of July, occasionally in August.

Either member of the pair, or the pair together, may select the nest site.

The female builds the nest, incubates, and broods.

From 3 to 6 eggs are laid, rarely only 2.

The incubation period is 13 to 15 days. One female incubated eggs (addled or infertile) 33 days.

Both parents feed the young and attend to nest sanitation.

Young are fledged at 17 or 18 days, and then are fed by the male parent for two or three weeks, by the female for a shorter period.

The interval between nestings varies from 2 to 28 days, averaging 12 to 14 days.

If there is no interference mates remain together and in the same territory throughout the season.

There are commonly three nesting attempts, occasionally four.

In the 9 years of study, 26 pairs averaged 2.6 nesting attempts, 1.8 successful nests, 10.4 eggs, and 6.6 young successfully fledged, per pair per season. From 272 eggs, 172 (63.2 per cent) young were successfully fledged. Of the 100 unsuccessful eggs, 59 were lost as eggs, 35 as nestlings, and 6 as young that left the nest prematurely.

Predators, taking eggs and young in some nests, killing the mother from others, accounted for at least 42 per cent of the losses.

Extremely hot weather may kill nestlings, or retard their growth, and may affect the hatching of late sets of eggs.

Two males took entire care of feeding the young for part of the cycle. One female raised a brood entirely without help from the male.

Early broods usually leave the area on attaining independence. Some mid-season broods remain through the next nesting cycle.

A pair establishes territory (usually by March 1) around the nest box. An unmated male does not hold territory at the beginning of the season, though a male that loses a mate during the season may retain the territory.

Box ownership is usually determined by fighting between pairs, beginning in early January. Pairs in adjoining territories fix the dividing line by fighting. One incident that appeared to be ceremonial settlement of boundary was observed. Both male and female respect territorial boundaries. Wandering pairs or single birds do not interfere with an established pair during a nesting.

Some pairs appear to hold territory throughout the season, but territorial attachment is not strong between nestings. A pair annexes adjoining territories if they become vacant. Territorial defense ceases with the fledging of the last brood. Nest disasters may cause a pair to desert a territory even early in the season.

Juveniles form loose flocks in late summer.

From two to six pairs in October or November form a winter flock (with local birds as a nucleus) near nest sites; they visit the nest holes throughout the winter, often with courtship behavior and fighting between pairs.

A mild dominance sometimes occurs between members of a pair, between pairs, and between individuals of the same sex.

Several flocks may occur in a given locality, but they do not mingle in the neighborhood of their chosen nest sites.

The winter flock ranges a considerable distance but usually returns to roost in trees near the boxes.

Bluebirds rarely interfere with other hole-nesting species. One male showed antipathy, however, to all hole-nesters.

Bluebirds recognize as enemies of their young: Blue Jays, Red-bellied Woodpeckers, dogs, squirrels, and snakes. Their reaction to snakes may be innate behavior.

The chief vocal expressions are a warbled song, a courtship chatter, a whining of sexual excitement or distress, alarm notes, and the location notes.

Bluebirds procure most of their insect food from the ground but at times capture flying insects.

Individuals vary widely in temperament.

Literature Cited

Bigglestone, Harry C.
1913 A study of the nesting behavior of the Yellow Warbler (*Dendroica aestiva aestiva*). *Wils. Bull.,* 25:49–67.

Colquhoun, M. K.
1942 Notes on the social behavior of Blue Tits. *Brit. Birds*, 35:234–240.

Forbush, E. H.
1929 Birds of Massachusetts and other New England States (vol. 3). Mass. Dept. Agric., Boston.

Laskey, Amelia R.
1939 A study of nesting Eastern Bluebirds. *Bird-Band.,* 10:23–32.
1940 The 1939 nesting season of Bluebirds at Nashville, Tennessee. *Wils. Bull.,* 52:183–190.

Musselman, T. E.
1935 Three years of Eastern Bluebird banding and study. *Bird-Band.,* 6: 117–125.

Nice, Margaret Morse
1931 The birds of Oklahoma. Revised ed. *Univ. Okla. Biol. Surv. Publ.,* 3 (No. 1).

1935 [Review of "Over de betekenis van 'Territorium' in het leven der vogels," by N. Tinbergen. 1935]. *Bird-Band.*, 6:110.
1941 The role of territory in bird life. *Amer. Midl. Nat.*, 26:441–487.
1943 Studies in the life history of the Song Sparrow. II. *Trans. Linn. Soc. N.Y.*, 6:1–328.

Odum, Eugene P.
1941–42 Annual cycle of the Black-capped Chickadee. *Auk*, 58:314–333, 518–535; 59:499–531.

Pettingill, Olin Sewall, Jr.
1936 Breeding behavior of Bluebirds. *Auk*, 53:86–87.

Pontius, F. Dale
1928 Bird banding in central Ohio. *Ohio State Mus. Sci. Bull.*, 1 (No. 1): 71–75.

Rand, A. L.
1941 Development and enemy recognition of the Curve-billed Thrasher (*Toxostoma curvirostre*). *Bull. Amer. Mus. Nat. Hist.*, 78:213–242.

Smith, Wendell P.
1937 Some Bluebird observations. *Bird-Band.*, 8:25–30.

Tinbergen, N.
1939 The behavior of the Snow Bunting in spring. *Trans. Linn. Soc. N.Y.*, 5:1–94.

Wetherbee, Mrs. Kenneth B.
1933 Eastern Bluebirds in juvenal plumage feed young of second brood. *Bird-Band.*, 4:199–200.

Box 19, Route 3, North Little Rock, Arkansas.

GENERAL NOTES

Migration of the Anhinga in Texas.—Most general reference books give the impression that the Anhinga, or Water-turkey (*Anhinga anhinga*), is a more or less permanent resident of the Gulf States. Bent (1922. *U.S. Nat. Mus. Bull. No.* 121) states that "throughout the southern portion of its range, in the Gulf States and in tropical America, the water-turkey is a resident throughout the year" and that its winter range includes most of the breeding range. However, there is a southward movement with the approach of winter, at which time "the water-turkeys withdraw from their northern breeding grounds and spend the winter in Florida and the Gulf States. At this season they become more gregarious and are often about in large flocks."

Strecker (1912. *Baylor Univ. Bull.,* 15:11), summarizing the status of the Anhinga in Texas, says it is a "rather common resident of the eastern and southern part of the State." However, the species is very definitely migratory and uncommon or absent in winter in most of the State. There are a number of records of migrant flocks of Anhingas on the Texas coast listed in the *Audubon Magazine's* "Season" reports by George G. Williams, and the *Gulf Coast Migrant,* a mimeographed bulletin issued by Williams, contains many references to migratory Anhingas observed in the past 10 years. These references indicate that there is a definite spring and fall migration, in the daytime, along the coast, parallel to the line of the Gulf. In the past 10 years, a few Anhingas have been noted in winter in the Houston–Galveston Bay region and in bottomlands at the mouth of the Guadalupe River. There are other scattered winter records for the Texas coast. In the lower Rio Grande valley, the species is a permanent resident but, according to L. Irby Davis, is never plentiful. Griscom and Crosby (1925. *Auk,* 42:520) failed to find Anhingas in the Brownsville region in winter. They found no records for the period between December 5 and March 18. Presumably the great majority of the Anhingas seen in Texas in summer or during migration periods winter in Mexico.

Most of the spring migrants pass through the coast region during the first half of April. Flocks of migrating Anhingas have been seen at Rockport as early as March 8 by Mrs. Jack Hagar and as late as May 20 at Cove (at the northern tip of Galveston Bay, Chambers County) by A. K. McKay. Autumn migrants, in sizeable flocks, have been seen by McKay at Cove as early as September 3 and as late as mid-November. Some birds have been seen near Cove in December and January, but the species is not a regular winter resident in that area.

At the Aransas National Wildlife Refuge, in Aransas and Refugio counties, several large flocks have been observed. On April 4, 1941, Everett Beaty and I observed one group, estimated at well over 1,000 birds, flying north at about 11:30 a.m. over the Refuge headquarters. The general movement of the flock was northward, following the shore line of San Antonio Bay. The group was rather compact but ranged, vertically, from about 200 to 500 feet above the ground. These birds soared a great deal, interspersing the soaring with a few wing beats. Occasionally, different sections of the flock, containing from 25 to 100 birds, would sideslip in unison, spiraling downward a hundred feet or so, finally rejoining the main body of the group. The soaring and circling movements reminded us of White Pelicans (*Pelecanus erythrorhynchos*) in maneuvers over south Texas in winter. With all these evolutions, the passage of the flock was slow. We estimated that it took the flock over 10 minutes to cover the distance from Refuge headquarters to a point two miles north.

Following this flock was a group of about 100 Broad-winged Hawks (*Buteo platypterus*) which, although soaring in circles at intervals, kept within a few hundred yards of the Anhingas. A few of the hawks were actually a part of the Anhinga flock, staying at the edge of the group, but mimicking their movements even to circling and spiralling downward with units of the main group. In the *Gulf Coast Migrant,* April 1941 issue, there is a report of 1,000 Anhingas and 100 Broad-winged Hawks observed at Dickinson, Galveston County, on the same date. Since Dickinson is about 135 miles northeast of Refuge headquarters and flock movements are slow, this was probably not the group of birds described above.

Another flock of several hundred Anhingas, accompanied by a large number of Broad-winged Hawks, was seen passing over the Refuge by Beaty on April 8, 1942. Earl W. Craven observed a migrant group of about 1,250 Anhingas over the Refuge April 2, 1945.

I watched a flock of 20 flying about 300 feet up, as it passed south over Tivoli, Refugio County, October 17, 1941. The flock did considerable circling, but the general movement of flight was southwest. The birds were moving parallel to a highway, and I kept pace with them in an auto. This flock covered one mile in about seven minutes.—James O. Stevenson, *Fish and Wildlife Service, Chicago, Illinois.*

Road-runner preys on Poor-will.—On March 9, 1943, around 1:30 p.m. as I was driving along the trail about a mile northwest of Tule Tank, on the Cabeza Prieta Game Range, Yuma County, Arizona, I noticed some feathers of a Poor-will (*Phalaenoptilus nuttalli*) lying in the road. A short distance down the trail, I saw a Road-runner (*Geococcyx californianus*) running along, carrying something in its beak. When I gave chase, it dropped its burden, which proved to be the still warm carcass of a Poor-will, intact save that most of the viscera had been removed (and probably eaten), and a number of the larger wing feathers had been torn out. I find no previous reference in the literature to Road-runners preying on birds of this family.—Gale Monson, *Fish and Wildlife Service, Parker, Arizona.*

Starling and Brown Thrasher stealing food from Robins.—The systematic theft of food from weaker or otherwise vulnerable species of birds has often been noted among aquatic birds and birds of prey, much less often among passerines. In two cases that I recently observed, the victim was an American Robin (*Turdus migratorius*), a species exceptionally skilful in obtaining food from the sod but apparently not able or not inclined to resist robbery by more aggressive species.

While crossing the University of Michigan campus shortly after noon on April 22, 1946, I noticed a Starling (*Sturnus vulgaris*) run at a Robin and drive it away from the worm it had begun to dig up. Apparently the Starling failed to get the food that time, but in the next five minutes the Starling made four more raids, all of them successful. The Robin did not attempt to fight or to defend the food; it simply moved off a foot or two and continued to forage. The Starling each time quickly devoured the stolen food and then resumed walking about rapidly and erratically in characteristic starling-fashion, but keeping within six or eight feet of the Robin. As soon as the Robin found a worm and started to pull it out, the Starling ran over quickly and crowded the Robin away from the food. The six- to eight-foot range was apparently just enough to enable the Starling to get to the spot before the Robin could swallow a newly-discovered worm. On one occasion the Starling finished the worm while about 15 inches from the Robin, then moved off to the six-foot range. After the fourth successful raid, the Starling flew 150 yards north to a big elm tree, where it apparently had a nest.

On April 28, at 9:25 a.m., I watched a female Brown Thrasher (*Toxostoma rufum*) on the lawn near my house make two similar successful raids on a Robin digging worms there. Again the Robin made no attempt to defend the food.—Josselyn Van Tyne, *University of Michigan Museum of Zoology, Ann Arbor, Michigan.*

Nest of the Magnolia Warbler at Trout Lake, Wisconsin.—On July 9, 1945, at Coon's Resort, Trout Lake, Vilas County, Wisconsin, I noticed, at the edge of the large bog near camp, the nest of a warbler about four feet from the ground in a black spruce. This tree, six feet in height, stood at the edge of a mixed clump of young spruces and balsams. The nest contained two well-feathered young. I concealed myself at a distance, but the parents entered and departed through the conifers with such stealth that I could not positively identify them as Magnolia Warblers (*Dendroica magnolia*) until I watched from within the clump. The young left the nest on July 13. I saw the adult birds again during the interval.

The only other positive nest record for the state, although the species is fairly common in the northern part of the state in summer, is that of A. J. Schoenebeck ("Birds of Oconto County." Kelly Brook, Wis. [1902], p. 45), who states: "On July 10, 1894, I found a nest of this bird in a small spruce about four feet high."

The lining of the collected nest consisted of black, hair-like filaments that I could not identify. J. T. Nichols (*Auk,* 36, 1919:226) states that a "black, hair-like, slightly crinkly substance, . . . the stem of a woodland ground-moss," is much used by warblers for lining their nests. The nest was submitted to Dr. N. C. Fassett, of the University of Wisconsin, to whom I wish to express appreciation for the identification of the materials of construction. The bulk of the nest was composed chiefly of the stems of the water smartweed (*Polygonum punctatum*), hair grass (*Agrostis scabra*), and cinquefoil (*Potentilla simplex*). The lining was very puzzling. Since from its cell structure it appeared to be of fungal origin, it was submitted to Dr. David Linder, of the Farlow Herbarium at Harvard. He identified it as the stem, or stipe, of one of the mushrooms *Marasmius;* it resembled *M. rotula.* This small fungus is common, growing on fallen leaves, twigs, and at the base of living trees.—A. W. Schorger, *168 North Prospect Avenue, Madison, Wisconsin.*

Unusual display of the Myrtle Warbler.—On the evening of July 2, 1945, at Coon's Resort, Trout Lake, Vilas County, Wisconsin, I observed a male Myrtle Warbler (*Dendroica coronata*) with its bill full of May flies (*Ephemera* sp.) fly to a nest on the lower limb of a large white pine. The nest was about 25 feet from the ground and 10 feet from the trunk. Feathers used as nesting material could be seen projecting from the inner rim. The female brought food to the nest as I watched.

The nest was very difficult of access, but the events of July 5 rendered an attempt at climbing unnecessary. My field notes read: "When I returned, a lady in the cottage adjoining ours said that a small bird fluttered along the ground in front of her and she thought that its wing was broken; then she found one of its young in a small tree. She took me to the pine tree in which the Myrtle Warblers were nesting. In a small balsam about 25 feet south of it, a young Cowbird was calling. In a few seconds the male Myrtle Warbler arrived with food, fed the Cowbird, then dashed at me with excited cries. It then dropped to the ground at a distance of 5 feet and fluttered along as though injured. When I refused to follow, it rose into the air, came within 5 or 6 feet of me and about 4 feet from the ground. With its back turned toward me and tail spread fan-wise, it fanned the air, remaining almost stationary, like a hummingbird. All this time its cries were continued with the head turned to the right at an angle of 45°. This was a gorgeous, astonishing display, and I do not recall having read of it. When I did not pursue, the bird suddenly flew into the large white pine and continued to scold. By evening the Cowbird and Myrtle Warblers had left the vicinity. I doubt if they raised any young beyond the Cowbird." Mrs. Schorger also witnessed this amazing performance of which I have found no mention in the literature.—A. W. Schorger, *168 North Prospect Avenue, Madison, Wisconsin.*

EDITORIAL

We hope that as many Members as possible are planning to attend the Annual Meeting in Omaha, our first in five years. Omaha has excellent facilities for such a convention, and the officers of the Nebraska Ornithologists' Union assure us of a cordial welcome. It is our first Nebraska meeting and is slightly farther west than we have hitherto gone, but it will not seem far to the Members who attended our earlier conventions in Kansas City and Des Moines. The meeting will be held November 29 and 30. Dr. R. Allyn Moser is Chairman of the Local Committee on Arrangements. Our Secretary, Maurice Brooks, is sending out a letter to all Members and will be glad to answer any questions about the plans.

The membership of the Nominating Committee who will prepare a slate of Officers to be voted on at the Annual Meeting has not yet been announced, but Members are invited to send in their suggestions for the slate; letters may be addressed to the Committee in care of the Editor.

There is now a greatly increased demand, especially from foreign countries, for back volumes of the *Bulletin.* Except for one issue, our stock of recent volumes is fairly adequate. The single scarce issue is that for March 1941, and we should like to purchase any copies that may be available. Members who have, or can obtain, extra copies of this issue can do the Club a valuable service by sending them to the Editor.

Recent additions to the list of exchanges being received by the Club Library include: *Bulletin de la Société Nationale d'Acclimatation de France, Der Ornithologische Beobachter, Nos Oiseaux,* and *Suomen Riista.*

OBITUARY

Franklin L. Burns, a Founder of the Wilson Ornithological Club, died February 7, 1946, in Berwyn, Pennsylvania, at the age of seventy-eight. He had served as President, as Secretary, and as Treasurer of the Club; in 1901 he edited the *Bulletin.* He was the author of a book, "Ornithology of Chester County, Pennsylvania," and of an important series of articles on Alexander Wilson. His monographs on the Flicker (1900), the Broad-winged Hawk (1911), and the incubation and nestling periods of North American birds (1915 and 1921), as well as his very early breeding-bird census (1901), were important pioneer contributions to ornithology.

Oscar Neumann, the noted German ornithologist and explorer, died in Chicago, Illinois, on May 17, 1946, at the age of seventy-eight. He was best known for his work on the taxonomy of the birds of Africa.

Ornithological News

John T. Emlen, Jr., has been appointed to the newly established professorship of ornithology and mammalogy at the University of Wisconsin.

The Arctic Institute of North America has been organized to encourage arctic research. It is serving as a center in coordinating scientific work and is offering Research Fellowships for work in the Arctic or Subarctic. Communications should be addressed to the Institute at 805 Sherbrooke Street West, Montreal, Canada.

The Barro Colorado Island Laboratory, Canal Zone, is again in full operation. Under a recent reorganization order of the President it has been assigned for administration to the Smithsonian Institution.

Henry Kritzler has received a National Research Council Fellowship to study at the Scripps Institution of Oceanography, La Jolla, California.

WILSON ORNITHOLOGICAL CLUB ART EXHIBIT

In collaboration with the Joslyn Memorial of Omaha, the Club will sponsor a bird and mammal art exhibit at the Annual Meeting, November 29 and 30. Exhibitors will be members of the armed forces of the United States (not necessarily Members of the Club) who made drawings or paintings of birds and mammals during World War II. These artists need not have done their work overseas, but it is hoped that birds and mammals representing Asiatic, European, African, Australian, and Pacific Island, as well as North and South American faunas, will be shown. Possible exhibitors, and Club Members who have friends whose work might be shown, should get in touch with the Chairman of the Illustrations Committee, Walter Breckenridge, Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.

Errata

"Bachman's Warbler [*Vermivora bachmani*] in Alabama," by Henry M. Stevenson, Jr. (*Wilson Bulletin* 50, No. 1, March 1938):

Page 37, line 37—For "At this place," *read* "At Bear Swamp in central Alabama."

Page 41, lines 26–27—For "Logan found a nest in western Kentucky," *read* "Embody found a nest in Logan County, Kentucky."

Page 41, lines 31–32—For "second rarest of the North American warblers," *read* "second rarest of the warblers of eastern North America."—Henry M. Stevenson, Jr., *Department of Zoology, Florida State College for Women, Tallahassee, Florida.*

NEW LIFE MEMBER

Thomas C. Desmond is a retired engineer who has served in the New York State Senate since 1930. He is a graduate of Harvard University and of Massachusetts Institute of Technology. He is now a Member of the Corporation of the latter institution and a Trustee of Union College, New York. He has been an Associate Member of the American Ornithologists' Union since 1929. At his home near Newburgh, New York, he has developed a large arboretum and bird sanctuary, where 499 species of native American trees and shrubs are represented.

ORNITHOLOGICAL LITERATURE

Field Book of Eastern Birds. By Leon Augustus Hausman. Illustrated by Jacob Bates Abbott. G. P. Putnam's Sons, New York, 1946: 4 × 6¾ in., xvi + 659 pp., 6 col. pls., more than 400 figs. $3.75.

With this book G. P. Putnam's add a bird identification volume for eastern United States to their well-known pocket-sized Field Book series. It treats "all birds east of the Mississippi and the majority of the birds east of the Rockies."

The text for most species is arranged under the seven subheads: Other names, Field marks, Field description, Characteristic habits, Notes, Habitat, and Range. The author follows the nomenclature of the A.O.U. Check-List (1931) but ignores its two supplements (1944 and 1945).

Nearly every species is figured in black and white, and 94 are also shown in color. Many of the drawings have already appeared in the author's "Illustrated Encyclopedia of American Birds" (1944). The color plates are good and well printed. The species to be represented were wisely selected, and these plates alone will solve quickly many identification problems. A strange exception occurs on Plate 5, where the very similar Bicknell's and Gray-cheeked Thrushes are figured and appear to be quite differently colored. Many of the pen-and-ink drawings are good, or even excellent, but a considerable number are not recognizable. Even among such distinctively marked birds as the male wood warblers, we find nine drawings that no one could possibly identify except by the legend.

In order, presumably, to assist the reader, the account of each family and of almost every species, however short, is allotted a full page, and this results in many nearly blank pages—a curious procedure in a pocket guide, where space is at a premium. The additional subspecies under each species are given separate headings following the species account (and in some cases are even figured), but the text for these is usually condensed to a mere statement of the distinctive physical characteristics (usually not observable in the field). Unfortunately, in some cases the account of one of the subspecies has been separated from the others and appears among the races of a different species.

Forty-seven pages are devoted to an illustrated key to the families of birds found in eastern North America. The families as complete units are forced into one or another of 14 "sections," the specifications for which are a curious mixture of the ecological and the anatomical. The result, in many cases, will be more confusing than helpful.

The reader will find this volume least useful when applied to certain difficult groups such as the shorebirds, gulls, and flycatchers. Here the author has not taken advantage of the comparative characters described in recent years by our leading field workers, nor has the artist figured these species in a way to show such points. For example, little is said of the wing patterns of gulls, and still less is shown in the illustrations.

This volume will help many people to identify birds, but it falls short of the standard set by the best present-day field guides.—J. Van Tyne.

A Naturalist's Scrapbook. By Thomas Barbour. Harvard University Press, Cambridge, Mass., 1946: 5½ × 8 in., x + 218 pp., 20 photos. $3.00.

This posthumous collection of essays will be of great interest to all ornithologists. The author knew well the rich ornithological history of the Museum of Comparative Zoology at Harvard that he did so much to make one of the great centers of ornithological research, and he here relates many things not touched on in his earlier volumes. These new facts have not only great human interest but also real scientific value in that they help us to trace important bird specimens and generally to explain the movements of earlier ornithologists and their collections.

Other interesting chapters tell of the recent transformations of the Boston Society of Natural History and the Peabody Museum of Salem, tasks in which Thomas Barbour had an important part. A third group of chapters concerns Barbour's travels many years ago in the East Indies and the subject of zoogeography to which Barbour made such important contributions.

This delightfully written volume—in some respects the best of all his four volumes of essays—is being welcomed enthusiastically by Thomas Barbour's many friends.—J. Van Tyne.

Birds in Kansas. By Arthur L. Goodrich, Jr. Report of the Kansas State Board of Agriculture, vol. 64, 1946: 340 pp., 6 col. pls., 169 figs.

We presume that the title, "Birds in Kansas," was deliberately chosen to express the fact that this is a book for the general public on Kansas birds—not a new State list meant to supplant W. S. Long's scientific report (1941).

The text is arranged in a curious way. The species accounts begin with a selected list of 82 "more common Kansas birds"; following that, the author begins at the beginning again and gives a fairly complete list and account of Kansas birds, merely mentioning, and citing pages for, the species already treated in the first section. There may be some advantage in breaking the text this way, but we suspect that many readers will be more confused than helped by it. Also, it is hard to see what criterion was used in selecting the birds to be treated in the text. Some species recorded in Kansas but once (such as the Man-o'-war-bird) are listed and even figured, while others that sometimes occur there in considerable numbers (such as the Bohemian Waxwing) are relegated to mere mention in footnotes.

We cannot share the publishers' enthusiasm for the six colored plates. The numerous text figures are derived mainly from two (strangely different) sources: Ridgway's "Manual of North American Birds" and the Slingerland-Comstock natural history publications illustrated by Fuertes. In fairness to Fuertes, it should have been stated that the hundred or so of his drawings reproduced here were originally intended only as outlines to be colored by students and were never meant to be presented as finished pictures.

The author is himself in error when he reproves (p. 215) the A.O.U. Check-List Committee for not using Wilson's original spelling of the specific name of the Black-billed Cuckoo, as anyone can easily check if he has access to the rare, original quarto "American Ornithology" (1811, vol. 4, p. 16). The emended spelling in later editions of Wilson has, of course, no bearing on the matter.

As frequently happens, the author's attempt to be "popular" has resulted in stilted sentences and trite expressions. The book is also marred by a good many misprints.—J. Van Tyne.

BIBLIOGRAPHY *

Anatomy (*including plumage and molt*)

Fisher, Harvey Irvin. Adaptations and Comparative Anatomy of the Locomotor Apparatus of New World Vultures. *Amer. Midl. Nat.* 35 (3), May 1946: 545–714, 13 pls., 28 figs.

Rysgaard, George N. Plumage Reversal in the Ring-necked Pheasant. *Flicker* 18 (2), May 1946:42–43.

Distribution and Taxonomy

Alcorn, J. R. The Birds of Lahontan Valley, Nevada. *Condor* 48 (3), May, 1946: 129–138.

* Titles of papers published in the last number of *The Wilson Bulletin* are included for the convenience of members who clip titles from reprints of this section for their own bibliographic files. Reprints of this section are available at a small cost.

Aldrich, John W. Speciation in the White-cheeked Geese. *Wils. Bull.* 58 (2), June 1946:94–103. (*Branta hutchinsii asiatica* and *B. canadensis moffitti,* new subspecies.)

A.O.U. Check-List Committee. Twenty-First Supplement to the American Ornithologists' Union Check-List of North American Birds. *Auk* 63 (3), July 1946: 428–432.

Baillie, James L. Jr. The Redhead as a breeding bird of Michigan and Ontario. *Wils. Bull.* 58 (2), June 1946:111–112.

Baker, Bernard W., and Lawrence H. Walkinshaw. Bird Notes from Fawcett, Alberta. *Canad. Field-Nat.* 60 (1), Jan.–Feb. 1946:5–10, 6 photos.

Bancroft, Griffing. Geographic Variation in the Eggs of Cactus Wrens in Lower California. *Condor* 48 (3), May 1946:124–128.

Barnés, Ventura Jr. The Birds of Mona Island, Puerto Rico. *Auk* 63 (3), July 1946:318–327.

Delacour, Jean, and Ernst Mayr. Supplementary Notes on the Family Anatidae. *Wils. Bull.* 58 (2), June 1946:104–110, 1 fig.

Denton, J. Fred. The Breeding Status of the Cowbird in Georgia. *Oriole* 11 (2), April 1946:24–27.

Friedmann, Herbert. The Red-spotted Bluethroats of northwestern Alaska. *Auk* 63 (3), July 1946:434.

Griffith, R. E. Nesting of Gadwall and Shoveller on the Middle Atlantic Coast. *Auk* 63 (3), July 1946: 436–438.

Grimm, William C. Bird Life of the Camp Stewart, Georgia, Region. *Oriole* 11 (2), April 1946:27–42, 4 photos, 1 map.

Keck, Warren N. The Mockingbird in Iowa. *Iowa Bird Life* 16 (2), June 1946: 23–27, 1 pl., 1 map.

Moore, Robert T. The Rufous-winged Sparrow, its Legends and Taxonomic Status. *Condor* 48 (3), May 1946:117–123, figs. 25–26. (*Aimophila carpalis cohaerens,* new subspecies from Sinaloa.)

Moore, Robert T. Two New Warblers from Mexico. *Proc. Biol. Soc. Wash.* **59,** June 19, 1946:99–102. (*Geothlypis nelsoni karlenae,* new subspecies from Oaxaca; *Basileuterus belli bateli,* new subspecies from Sinaloa.)

Moser, R. Allyn. The Genus Junco in Nebraska. *Nebr. Bird Rev.* 14 (1), Jan.–June 1946: 1–6.

Munro, J. A. Preliminary Report on the Birds and Mammals of Glacier National Park, British Columbia. *Canad. Field-Nat.* 59 (6), Nov.–Dec. 1945:175–190, 4 photos.

Odum, Eugene P., and Thomas D. Burleigh. Southward Invasion in Georgia. *Auk* 63 (3), July 1946:388–401, pl. 9, map.

Palmer, Ralph S., and Wendell Taber. Birds of the Mt. Katahdin Region of Maine. *Auk* 63 (3), July 1946:299–314, pl. 8.

Street, Phillips B. Some Notes on Trinidad Birds. *Auk* 63 (3), July 1946:369–378.

Sturgeon, Myron T. Arctic Three-toed Woodpecker on the Michigan State Normal College Campus, Ypsilanti, Michigan. *Jack-Pine Warbler* 24 (2), April 1946:50.

Wallace, George J. Seasonal Records of Michigan Birds—Winter. *Jack-Pine Warbler* 24 (2), April 1946:57–62.

Weston, Francis M. Additions to the Florida list. *Auk* 63 (3), July 1946:451–452.

See also *Population:* Bond; *Techniques:* Hagar.

Evolution and Speciation

Aldrich, John W. White eggs of the Long-billed Marsh Wren. *Auk* 63 (3), July 1946: 442–443.

Migration and Flight

Buckley, John L. Land birds at sea. *Auk* 63 (3), July 1946:440.

Grant, Chapman. "Tumbling" of Brant. *Condor* 48 (3), May 1946:143.

Manners, Edward R. Shorebirds Along the Delaware. *Cassinia* 1946 (for 1945): 23–34.

Nichols, J. T. Manner of Flight in Petrels and Albatrosses. *Marine Life Occ. Papers* 1 (6), June 15, 1946:19–22.

See also *Anatomy:* Fisher; *Distribution and Taxonomy:* Denton; *Techniques:* Fischer and Gill, Hagar.

Ecology

Kendeigh, S. Charles. Breeding birds of the beech-maple-hemlock community. *Ecol.* 27 (3), July 1946:226–245, figs. 1–3. (New York.)

See also *Life History and Behavior:* Smith.

Life History and Behavior

Allen, Francis H. Audubon and anting. *Auk* 63 (3), July 1946:443.

Anderson, A. H., and Anne Anderson. Notes on the Purple Martin Roost at Tucson, Arizona. *Condor* 48 (3), May 1946:140–141.

Baker, William C. Notes on summer resident Wilson's Snipes in Columbiana County, Ohio. *Auk* 63 (3), July 1946:446–448.

Brigham, Edward Morris Jr. Some Experiences with Great Horned Owls. *Jack-Pine Warbler* 24 (2), April 1946:43–50, 3 figs.

Dexter, Ralph W. More concerning the thundering and clapping sounds of the Chimney Swift. *Auk* 63 (3), July 1946:439–440.

Gillespie, John A. An unusual nest of the House Wren. *Auk* 63 (3), July 1946: 436.

Goodwin, Derek. Some Remarks on Sex Behavior of Doves. *Brit. Birds* 39 (5), May 1946: 146–147. (*Columba livia.*)

Hill, Raymond W. Bronzed Grackle "anting" with mothballs. *Wils. Bull.* 58 (2), June 1946: 112.

Lees, John. All the Year Breeding of the Rock-Dove. *Brit. Birds* 39 (5), May 1946:136–141.

McIver, Sam. Nesting of the Louisiana Water-Thrush. *Flicker* 18 (2), May 1946: 26–27, photo.

Price, Homer F. Mallard nesting in tree cavity. *Auk* 63 (3), July 1946:441.

Rett, E. Z. An Unusual Nest of the White-throated Swift. *Condor* 48 (3), May 1946:141, fig. 27.

Ryves, B. H. Parent Birds Probing Amongst Brood in Nest. *Brit. Birds* 39 (5), May 1946:159.

Skutch, Alexander F. Life History of the Costa Rican Tityra. *Auk* 63 (3), July 1946:327–362.

Smith, Wendell P. Predator Value. *Bird-Band.* 17 (3), July 1946: 128.

Thomas, Ruth Harris. Catbird "anting" with a leaf. *Wils. Bull.* 58 (2), June 1946:112.

Tucker, B. W. Courtship Feeding in Thrushes and Warblers. *Brit. Birds* 39 (3), March 1946:88–89. (Turdidae and Sylviidae.)

Webb, Gerald B. Robins' nests on tree branches overhanging roads. *Auk* 63 (3), July 1946: 435–436, pl. 10.

Wells, Mrs. Rollo H. Nest of the Winter Wren. *Flicker* 18 (2), May 1946: 23–25.

Williams, Arthur B. Red-eyed Vireo nesting in hemlock. *Auk* 63 (3), July 1946: 438–439.

WILLIAMS, CECIL S. Rare egg-laying date for the Canada Goose. *Auk* 63 (3), July 1946:438.

See also *Distribution and Taxonomy:* Keck; *Evolution and Speciation:* Aldrich; *Techniques:* Kimball and Nichols.

FOOD AND FEEDING HABITS

DELACOUR, J. Under-wing fishing of the Black Heron, *Melanophoyx ardesiaca. Auk* 63 (3), July 1946:441–442, pl. 11.

PRICE, HOMER F. Food of a Yellow-crowned Night Heron. *Auk* 63 (3), July 1946:441.

SCHOFFMAN, ROBERT J. A Preliminary Report on the Food of Ducks at Reelfoot Lake, Tennessee. *Jour. Tenn. Acad. Sci.* 21 (1), Jan. 1946:10–13.

WAGNER, HELMUTH O. Food and Feeding Habits of Mexican Hummingbirds. *Wils. Bull.* 58 (2), June 1946:69–93, 13 figs.

WOOD, DALE T. Eye-witness Account of Golden Eagle Killing Calf. *Condor* 48 (3), May 1946: 143.

See also *Life History and Behavior:* Tucker.

POPULATION (*including age, and mortality rates*)

BOND, RICHARD M. The Peregrine Population of Western North America. *Condor* 48 (3), May 1946:101–116, figs. 21–24. (*Falco peregrinus.*)

BUXTON, E. J. M. Fertility and Mortality in the Nest of Swallows. *Brit. Birds* 39 (3), March 1946:73–76 (*Hirundo r. rustica.*)

DENCE, WILFORD A. Tree Swallow mortality from exposure during unseasonable weather. *Auk* 63 (3), July 1946:440.

ERRINGTON, PAUL L. Predation and Vertebrate Populations. *Quart. Rev. Biol.* 21 (2), June 1946:144–177. (To be concluded.)

LACK, DAVID. Clutch and Brood Size in the Robin. *Brit. Birds* 39 (4–5), April–May 1946:98–109, 130–135; map. (*Erithacus rubecula.*)

See also *Techniques:* Fischer and Gill, Hagar.

TECHNIQUES (*including banding*)

BRYAN, PAUL. Further Use of Wood Duck Nesting Boxes in Wheeler Wildlife Refuge. *Jour. Tenn. Acad. Sci.* 21 (1), Jan. 1946:76–77.

BUSS, IRVEN O. Bird Detection by Radar. *Auk* 63 (3), July 1946:315–318.

FISCHER, RICHARD B., and GEOFFREY GILL. A Coöperative Study of the White-throated Sparrow. *Auk* 63 (3), July 1946:402–418.

HAGAR, JOSEPH A. Black Duck Bandings at the Austin Ornithological Research Station on Cape Cod, Massachusetts. *Bird-Band.* 17 (3), July 1946:97–124, map. (To be continued.)

KIMBALL, HEATHCOTE M. H., and JOHN T. NICHOLS. Eight Seasons, and Three Banded Barn Swallows. *Bird-Band.* 17 (3), July 1946: 125–127. (New York.)

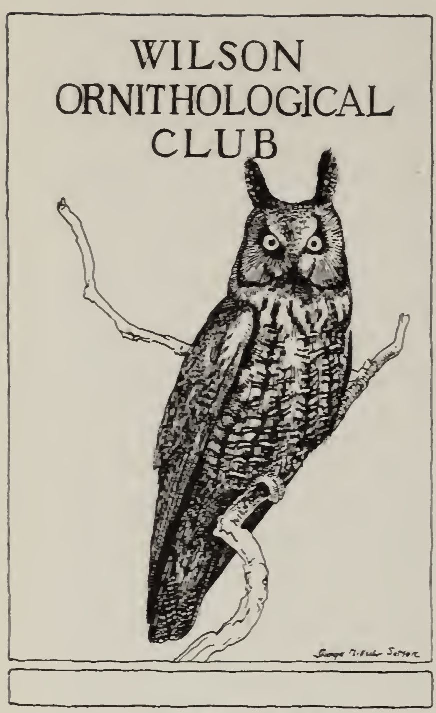
MAZZEO, ROSARIO. Binoculars and Telescopes for Bird Study. *Bull. Mass. Aud. Soc.* 30 (5), June 1946:155–162, 5 figs.

MOREAU, R. E. The Recording of Incubation and Fledging Periods. *Brit. Birds* 39 (3), March 1946:66–70.

HISTORY, BIOGRAPHY, BIBLIOGRAPHY, AND INSTITUTIONS

SCHORGER, A. W. Thure Kumlien and the early history of the Philadelphia Vireo. *Wils. Bull.* 58 (2), June 1946: 113–116.

STEVESNSON [Stevenson], JAMES O. An Old Account of the Whooping Crane in Nebraska. *Nebr. Bird Rev.* 14 (1), Jan.–June 1946:21–22.



BOOKS: List 4

Books added to the Wilson Ornithological Club Library since the publication of List 3 (*Wilson Bulletin* 57, No. 3, September 1945: 215) and books acquired by the Library before September 1945 which, for various reasons, were omitted from previous lists. Lists 1 to 3 were published in the September numbers, 1943–1945.

Baerg, W. J., Birds of Arkansas. 1931.

Beebe, C. W., Two bird-lovers in Mexico. 1905.

Bent, Arthur C., Life histories of North American wild fowl. Part 1, 1923; Part 2, 1925.

Bent, Arthur C., Life histories of North American shore birds. Part 2, 1929.

Bent, Arthur C., Life Histories of North American woodpeckers. 1939.

Craig, Wallace, The song of the Wood Pewee *Myiochanes virens* Linnaeus: A study of bird music. 1943.

Delamain, Jacques, Les jours et les nuits des oiseaux. 1932.

Dixon, Royal, The human side of birds. 1917.

Frey, Edward S., The centennial check-list of the birds of Cumberland County, Pennsylvania, and her borders. 1943.

Greene, Earle R., W. W. Griffin, E. P. Odum, H. L. Stoddard, I. R. Tomkins, E. E. Murphey, Birds of Georgia. 1945.

Haecker, F. W., R. Allyn Moser, and Jane B. Swenk, Check-list of the birds of Nebraska (revised ed.). 1945.

Hindwood, K. A., The birds of Lord Howe Island. 1940.

Howell, Arthur H., A biological survey of Alabama. 1921.

Howell, Arthur H., Birds of Alabama. (1st ed.). 1924.

Lack, David, The Galapagos finches (Geospizinae). 1945.

Lewis, Harrison F., The natural history of the Double-crested Cormorant. 1929.

McAtee, W. L. (ed.), The Ring-necked Pheasant and its management in North America. 1945.

Mailliard, Joseph, Handbook of the birds of Golden Gate Park, San Francisco. 1930.

Mendall, Howard L., and Clarence M. Aldous, The ecology and management of the American Woodcock. 1943.

Neff, Johnson A., A study of the economic status of the common woodpeckers in relation to Oregon horticulture. 1928.

Preble, Edward A., and W. L. McAtee, A biological survey of the Pribilof Islands, Alaska. 1923.

Saunders, Aretas A., A distributional list of the birds of Montana. 1921.

Saunders, Aretas A., Birds of central New York marshes. Notes on the birds of Allegany Park. 1926.

Saunders, Aretas A., Ecology of the birds of Quaker Run Valley, Allegany State Park. 1936.

Saunders, Aretas A., Studies of breeding birds in the Allegany State Park. 1938.

Saunders, Aretas A., Summer birds of the Allegany State Park. 1942.

Shufeldt, Robert W., Osteology of the Steganopodes. 1902.

Snyder, L. L., A study of the Sharp-tailed Grouse. 1935.

Soper, J. Dewey, The Blue Goose. 1930.
Spiker, Charles J., A popular account of the bird life of the Finger Lakes section of New York with main reference to the summer season. 1935.
Stevens, Ross O., Talk about wildlife. 1944.
Stoever, D. H., The life of Sir Charles Linnaeus. 1794.
van Rossem, A. J., A distributional survey of the birds of Sonora, Mexico. 1945.
Wallace, George J., Bicknell's Thrush, its taxonomy, distribution, and life history. 1939.
Weed, Clarence M., Bird life stories. 1904.
Wetmore, Alexander, Observations on the birds of Argentina, Paraguay, Uruguay, and Chile. 1926.
Wetmore, Alexander, The birds of southern Veracruz, Mexico. 1943.

The Wilson Ornithological Club Library

The Wilson Ornithological Club Library, established in 1930, is housed in the University of Michigan Museum of Zoology. It comprises some 230 books, 3,300 pamphlets and reprints, and a large collection of ornithological magazines. It currently receives 65 periodicals, as gifts, and in exchange for *The Wilson Bulletin.* The Library is maintained entirely by gifts from members and friends of the Wilson Ornithological Club. Any item in the Library may be borrowed by members of the Club and will be sent prepaid (by the University of Michigan) to any address in the United States, its possessions, or Canada. Return postage is paid by the borrower. Gifts, inquiries, and requests by borrowers should be addressed to "The Wilson Club Library, Museum of Zoology, Ann Arbor, Michigan."

The following gifts have been recently received. From:
David E. Davis—2 reprints
H. L. Kutz—40 pamphlets and reprints
Robert A. McCabe—1 book
William H. Phelps—3 pamphlets

AFFILIATED SOCIETIES

The Virginia Society for Ornithology held its first annual meeting since 1941 at Blacksburg, Virginia, on May 3 and 4, 1946. The program included a film, "German Birds" shown by C. O. Handley, Jr., and a paper on the migration of wood warblers by Rev. John H. Grey. A. O. English was re-elected President.

The Wisconsin Society for Ornithology held its sixth State convention on April 6 and 7, 1946, at Appleton. Some 400 members and friends attended the sessions. Included in the program were a talk illustrated with colored movies by W. J. Breckenridge; a series of talks on the convention theme, the Passenger Pigeon; an auction of bird paintings and wood carvings; and a field trip to Lake Winnebago. The Society reports a steady growth in membership and attendance at meetings, as well as increasingly good cooperation of members in publishing the Society's magazine, *The Passenger Pigeon.* C. S. Jung was re-elected President.

The Kentucky Ornithological Society held its first State meeting since 1942 at Mammoth Cave National Park on November 2, 3, and 4, 1945. Gordon Wilson was elected President. A. F. Ganier was the principal speaker. Dr. Wilson, who is making an intensive study of the birds of the area, led a series of field trips to typical habitats. The Society has recently instituted a life membership and now has seven life members. The fees are added to the endowment fund created by the late L. Otley Pindar.

Gordon M. Meade, M.D., *Chairman*
The Affiliated Societies Committee

260 Crittenden Boulevard
Rochester 7, New York
May 2, 1946

TO OUR CONTRIBUTORS

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Manuscript. Manuscripts should be typed, with double-spacing and wide margins, on one side of white paper of good quality and of standard size (8½ x 11). The title should be brief and should indicate the subject clearly. Ordinarily the scientific names of the birds treated should be given and should appear early in the article. Most articles should conclude with a brief summary.

Bibliography. Literature referred to in the text should be cited by author's name, year of publication, and exact page of the particular reference. Such literature should ordinarily be listed in full at the end of the paper.

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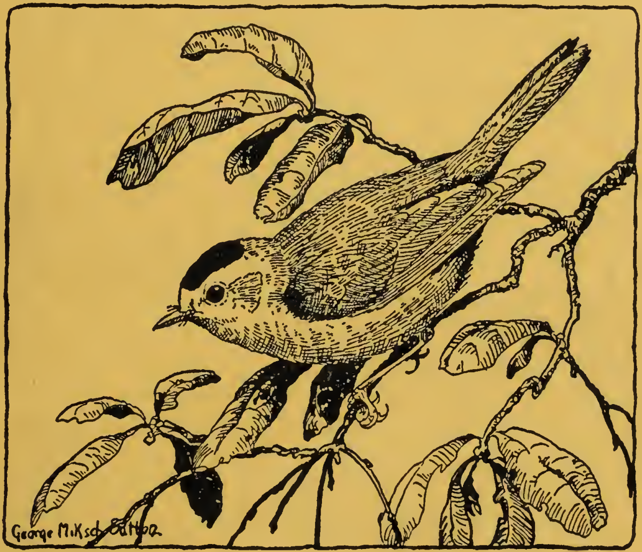

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THE WILSON BULLETIN

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Parula Warbler (Compsothlypis americana) and nest, photographed by Ralph E. Lawrence at Washington, D. C., June 7, 1946.

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NESTING SITES OF THE PARULA WARBLER IN THE POTOMAC VALLEY

BY ROGER TORY PETERSON

FRANK M. CHAPMAN once said the finding of a Parula Warbler's nest should be marked on the calendar as a red-letter day. During the summer of 1936, we had thirteen such red-letter days at the Audubon Nature Camp on Hog Island in Muscongus Bay, Maine. All thirteen nests were suspended in Usnea. Later, I also saw nests of the Parula Warbler (*Compsothlypis americana*) in Florida and the Carolinas. These were in Spanish Moss, an epiphyte not even remotely related to the lichen Usnea but superficially very like it. I thought of the Parula as a beautiful example of a bird whose distribution could not be shown to fit either the Life Zone or the Biome concepts. Rather, as with a great many other birds, its distribution seemed to be determined by the "life form" or physical appearance of certain plants that provided its proper niche.

I was puzzled when I first went to Washington, D.C., for the Parula was common along the Potomac, and neither Usnea nor Spanish Moss was present. However, I found the Parulas using approximately the same niche as those I had observed before—nesting low, in the tangled tufts of drift lodged by high water floods in the branches of riverside trees and bushes. Petrides (1942. *Wilson Bulletin,* 54:252) reported "two nests in bunches of dead leaves and debris caught, during a flood earlier that spring, in low branches of deciduous trees bordering the Potomac River," and I am told by Maurice Brooks that the Parulas of West Virginia also nest in such tufts, which furnish the same type of nest site as Spanish Moss and Usnea.

Plate 7, a photograph by Ralph E. Lawrence, of Washington, D.C., shows an example of one of these nests along the Potomac. In this case, the "niche" is a narrow strip of burlap left folded over a limb of a box elder sapling by flood waters. The female warbler was observed pulling fibers from the burlap and weaving them into the nest on April 24 (1946). She was also seen pulling slender strips from the last season's ragweed. By June 3 the pair of warblers was feeding four young in the nest. One of the young left the nest June 7, the day the photograph was taken. The others left before seven o'clock in the morning, June 9.

1206 Mt. Vernon Boulevard, Alexandria, Virginia

BEHAVIOR AND FOOD HABITS OF SENNETT'S WHITE-TAILED HAWK IN TEXAS

BY JAMES O. STEVENSON AND LOGAN H. MEITZEN *

ON the huisache- and mesquite-dotted prairies of coastal Texas, Sennett's White-tailed Hawk (*Buteo albicaudatus hypospodius*) is a rather common raptor. The species ranges from Argentina north, through Central America, to Texas; the subspecies *hypospodius* occurs from Colombia and Venezuela to southern Texas and is a permanent resident throughout most of its range in the United States. Statements in some of the more recent literature confine this hawk's range, in the United States, to the lower Rio Grande valley (e.g. Peters, 1931:228). Strecker (1912:27) pointed out that the White-tail was "not uncommon as far north as Bee and Refugio counties," and Bent (1937:221) stated that the range "extends north to southern Texas (Marfa, Boquillas, Bee County, and Calhoun County)." Other, earlier, references do not mention the occurrence of this hawk north of these limits, but, since it is a regular breeding bird in Colorado and Harris counties and the Galveston Bay region, there is reason to believe that the range of Sennett's White-tailed Hawk has been extended northeastward in fairly recent years. The birds prefer open prairie lands and use the scattered trees and bushes for nesting.

Most of the following notes were obtained by Stevenson at the Aransas National Wildlife Refuge, Aransas and Refugio counties. Meitzen added data for White-tails inhabiting the coastal region from Calhoun County north to Houston and Galveston Bay.

General behavior. On the Aransas Refuge, five pairs of adult hawks were in residence from October 1938 to October 1941, each pair occupying the same general area every spring for nesting. These territories consisted of the more open prairie rather than of prairie broken by brushlands or oak mottes.

The White-tail is generally shy and difficult to approach, at least during the nesting season. If disturbed by man, adults may abandon a nest that is under construction or even a nest that contains eggs, but visitors to a nest that contains young are tolerated. Adults usually circled 100 feet or more above a nest while we visited it. They were generally quiet, but sometimes they gave a *kil-la* call, repeating it a number of times.

This hawk, ordinarily, is unaggressive. Only once was a White-tailed Hawk seen in combat with another bird that was not potential prey. Everett Beaty, a Refuge employee, observed a pair, together with a full-grown juvenile, attack a Red-tailed Hawk (*Buteo jamaicensis*)

* Photographs, by James O. Stevenson, courtesy of the Fish and Wildlife Service.

and put it to rout. One pair of hawks nested within 30 feet of a Scissor-tailed Flycatcher's (*Muscivora forficata*) nest which contained eggs. There was no sign of antagonism between these usually pugnacious fly-catchers and the hawks. The only White-tailed Hawks which showed any positive aggressiveness toward man was a pair which nested near Salado Mill, on the Refuge, in 1941. Whenever the nest was inspected by Beaty, even before the young hatched, one bird, presumably the female, would dive at him silently from behind, swerving upward when a foot or two above him.

Hudson (1920:45–46) describes flocks of White-tailed Hawks in migration on the Argentine pampas. These flocks usually consisted of from 30 to 100 birds, but sometimes contained 1,000 to 2,000 individuals. We have never observed large flocks of White-tails in Texas but some increase—presumably birds from the northernmost breeding grounds—was noted in the normal population of the Refuge and vicinity in autumn and winter.

T. T. Waddell (letter of April 2, 1943) writes that the species comes to the prairies of Colorado County about the last of November or the first of December each year. These prairies are in part fallow rice fields crossed by small willow-bordered creeks. The birds stay until January 1 to 20, then move to the edge of the timber, where scrub live-oak borders the timber, to nest. Nesting may start by January 20, but sometimes it is as late as March before incubation begins. Two pairs come to the same locality every fall, use the same telephone poles as perches during the latter part of November, December, and part of January, and go to the same areas to nest.

Nesting. In the spring of 1940 and 1941, Beaty and Stevenson followed the progress of eight nests on the Refuge. These nests, with one exception, were placed from 8 to 12 feet above the ground in the tops of blackjack or live oaks. The only nest which was not situated in a tree on the open prairie was one located 30 feet up in the top of a live-oak within an oak grove. Meitzen found 9 nests in scrub live-oak (5–8 feet up) near Kemah, Galveston County, in March 1941. One nest which he found near Alvin, Brazoria County, in April 1946, was constructed in the topmost dead branches of a 40-foot cottonwood tree. This appears to be a record nesting height. Burrows (1917:78) collected eggs from 30 nests in south Texas between the Nueces River and the Rio Grande. He found that the average elevation of the top of the nest was about 7½ feet (extremes 1½ to 14 feet). Bendire (1892:235), quoting B. F. Goss, gives the elevation (15 nests) as "generally not higher than 6 feet," and Benners (1887:68) gives heights from 5 to 7 feet. These low elevations may be explained by the fact that the only available sites in many localities are small bushes. The "record high" for a nest is given by Bent (1937:218) as 15 feet.

Each nest at the Refuge was placed at the extreme top of a tree, generally in the center of the crown. Nests were constructed of large sticks and were lined with grasses (often with roots attached) to form a substantial, well-cupped nest. Nests were sometimes rehabilitated for use year after year. Sometimes one was usurped by Great Horned Owls (*Bubo virginianus*), in which case another nest near by was used by the hawks. Nests were sometimes visited and repaired by a pair in February or earlier, long before eggs were deposited. Nests in mesquite trees, found in Calhoun County, were sometimes occupied in February or early March, before the trees leafed out, at which time the nests were particularly conspicuous. Nests on the Refuge had very little concealment from above, but those in live-oaks or those for which grape vines offered protection were not readily visible from the sides. In June 1942, Meitzen found an occupied nest which was constructed of sticks and many pieces of barbed wire. This nest was located in the top of a 25-foot pecan tree in open country, six miles south of Alta Loma, Galveston County.

On the Refuge, egg-laying began in late March and early April 1940, and in early March 1941. Of the 8 nests examined, 6 held 2 eggs and 2 held 3 eggs. Meitzen found 5 nests in Calhoun and Galveston counties in 1941, of which 3 held 2 eggs and 2 held 3 eggs. In 1940, egg-laying began in Calhoun County in the second week of March. The eggs are dull white, generally spotted with pale brown. According to Bent (1937:218), 2 is the usual number of eggs in a set.

No information was obtained on the length of the incubation period. Young are hatched about one day apart. The nestling's eyes are open at hatching. The downy young "is an odd-looking chick, quite different from other young hawks" (Bent, 1937:218). It is covered with a dirty-gray, or brownish, down and has a black mask on the face. Colors of

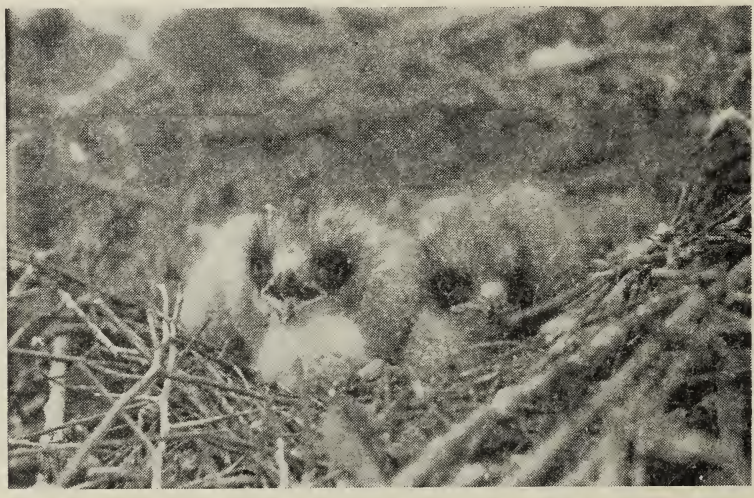

Figure 1. Sennett's White-tailed Hawks, age 14 days. Aransas Refuge, Texas April 25, 1941

soft parts of a 4-day-old bird were as follows: bill—black; cere—greenish-blue, close to cerulean; iris—dark brown; feet—lemon-yellow. Development of the young is shown in Figures 1 to 3.

At an early age (10 to 12 days or younger), the nestling begins to peer frequently at the sky and often calls. The young chick has two notes: a cat-like *mee-ow* and a sucking *tsick* note. The nests were kept clean of droppings and, nearly always, of pellets. A young bird, 12 days old, was observed several times as it moved awkwardly to the side of the nest, turned, and voided over the edge. This behavior has been described in "half grown" Eastern Red-tailed Hawks by Bent (1937:154).

Meitzen blamed Great-tailed Grackles (*Cassidix mexicanus*) for loss of eggs in one White-tail nest in Galveston County, and farmers for egg destruction at two other nests. White-tails on the Refuge had very poor success in rearing young. Of 8 nests under study, eggs were broken in one, presumably by Great-tailed Grackles. Young hatched successfully in 7 nests, but only 3 birds (2 from one nest) were reared to flight stage. Caracaras (*Polyborus cheriway*) were the cause of nestling loss in one instance and unidentified predators the cause in four others. Of the above-mentioned young, one left the nest when 47 days old, the others, somewhat prematurely, at 35 days of age, the day they were banded.

Food and feeding habits. Bent (1937:220) states on the authority of various observers that "cotton rats, quails, snakes, lizards, frogs, grasshoppers and beetles" are eaten by this hawk in the United States. Cottam and Knappen (1939:150) analyzed four stomachs and found a variety of food items—mainly insects, snakes, and frogs. One stomach

Figure 2. Sennett's White-tailed Hawk, age 30 days. Aransas Refuge, Texas May 10, 1941

Figure 3. Sennett's White-tailed Hawk, age 6 weeks. Aransas Refuge, Texas May 23, 1941

contained, among other prey, a young quail chick. Burrows (1917) found no evidence that White-tailed Hawks fed on other birds and concluded that the diet was largely confined to rabbits, although some wood rats were taken.

As is the case (Errington and Breckenridge, 1936:844) for the Marsh Hawk (*Circus cyaneus*), White-tailed Hawks feed upon whatever is found conveniently available. Immatures of various species of prey bear the brunt of White-tailed Hawk predation during the nesting season (see below). White-tails are apparently but slightly selective in preying, at least during the time they are pressed to supply food for their young.

In 1940 and 1941, notes were obtained on the food brought to nestlings in six nests on the Refuge. No quantitative study of nestling food habits was attempted because of the difficulties of obtaining pellets. No pellets were found beneath the nests, and only two or three in nests during the period of study. Errington (1930) has discussed the reasons that pellet analysis of buteonines (including nestlings) is impracticable.

The following notes give some indication of the prey taken by adult White-tailed Hawks to feed their young. On 21 visits to 6 nests, the following carcasses, or portions thereof, were noted: skink (*Eumeces septentrionalis*)—2; fence lizard (*Sceloporus undulatus*)—2; glass snake (*Ophisaurus ventralis*)—1; bull snake (*Pituophis sayi*)—1; garter snake (*Thamnophis sirtalis*)—2; Bob-white (*Colinus virginianus*), adult—5; Meadowlark (*Sturnella magna*), nestling—1;

Mockingbird (*Mimus polyglottos*), juvenile—1; cottontail (*Sylvilagus floridanus chapmani*), mainly juvenile—5; pocket gopher (*Geomys breviceps attwateri*)—2; white-footed mouse (*Peromyscus leucopus texanus*)—2.

The incidence of birds in the diet of nestling hawks is greater than the literature on *hypospodius* indicates. Meitzen found that food brought to a nest near Dickinson, Galveston County, in 1941, consisted principally of rabbits, rats, and pocket gophers. The birds brought in were King Rail (*Rallus elegans*), Meadowlark, and Dickcissel (*Spiza americana*). No remains of Bob-white were noted at the nest. On June 20, 1942, Meitzen collected evidence of the following prey at a nest containing a 3-week-old White-tail, six miles south of Alta Loma: blue racer (*Coluber constrictor flaviventris*); Clapper Rail (*Rallus longirostris*), juvenile; Meadowlark, juvenile; Seaside Sparrow (*Ammospiza maritima*), nestling; cottontail, probably an immature. We are indebted to F. M. Uhler, J. W. Aldrich, and H. H. T. Jackson, of the Fish and Wildlife Service, for the identification of material from this nest.

The stomach of a specimen (an adult female) in the Chicago Natural History Museum, collected at Rockport, Texas, February 4, 1909, contained a Meadowlark. G. H. Blanchard of Brownsville, Texas, informed Stevenson that White-tailed Hawks in Cameron County take birds to feed their nestlings whenever they are easy to obtain. He has watched hawks bring juvenile Meadowlarks to the nest and, in one instance, a Blue-winged Teal (*Anas discors*), probably a cripple. In the autumn of 1944, Refuge manager Earl W. Craven surprised a White-tailed Hawk which was grasping a Road-runner (*Geococcyx californianus*) on the ground, endeavoring to fly off with it. The hawk was unable to carry the bird and dropped it. Upon examining the Road-runner, Craven found that it had been freshly killed. W. B. Davis (letter of April 7, 1943) writes that the museum collection of Texas A. and M. College has a mole (*Scalopus aquaticus cryptus*) which was found in the stomach of an adult White-tail, collected 20 miles south of Eagle Lake, Colorado County, May 30, 1940.

At various times of the year, other than the nesting season, White-tailed Hawks were observed on the Refuge capturing one or more individuals of the following animals for food: grasshoppers (*Acrididae*), rough-green snake (*Opheodrys aestivus*), garter snake, pocket gopher, cotton rat (*Sigmodon hispidus texianus*), pocket mouse (*Perognathus h. hispidus*), and fox squirrel (*Sciurus niger limitis*). Smaller items of prey, such as lizards and mice, were usually carried in the beak; cottontails and squirrels in the talons. White-tailed Hawks were noted feeding on carrion on two occasions. Three White-tails (an adult and two full-grown immatures) were seen feeding on a dead cow near Palacios, Texas, in October 1940, and one was observed eating a dead rattlesnake (*Crotalus atrox*) in January 1939.

An interesting note on White-tailed Hawk behavior at the Refuge was obtained by Beaty, September 18, 1940. As Beaty approached a fenced 8-acre field which he was preparing for grain planting, he noticed two adult White-tails hovering over doveweeds (*Croton*) near the center of the field. The hawks evidently had spotted an animal and were trying to capture it. The hawks flew to near-by fenceposts and perched there for almost two hours while Beaty drove a tractor, with disc-harrow attachment, around the field toward its center. Finally most of the weeds were disked and flattened. A jackrabbit (*Lepus californicus merriami*) was flushed and was hit almost immediately by one of the hawks which, unable to lift the rabbit, pinned it to the ground. Both hawks then proceeded to eat the rabbit.

White-tailed Hawks invariably congregate at prairie fires on the Texas coast in search of food. As a management measure, a 150-acre tract on the Refuge was burned on January 18, 1939. The cover in this area consisted principally of sacahuiste grass (*Spartina spartinae*). This grass burns "like kerosene," making a hot fire whose smoke can be seen for miles. Refuge personnel set fire to the grass along one side of the field at 11:00 a.m. The first White-tail appeared at 11:25 a.m. and, by 1:15 p.m., some 36 raptors of 6 species had arrived. This number included 16 adult and 4 immature White-tailed Hawks. From our knowledge of White-tail distribution, it was our opinion that the fire attracted all, or nearly all, the adults present within a radius of 10 miles. The White-tails coursed back and forth parallel to the fire line and, at times, dived through the smoke for cotton rats, pocket mice, and grasshoppers which moved over the exposed, charred, ground. In October 1941, another fire in the same field attracted 8 immature White-tailed Hawks, one of which was observed to capture a cotton rat.

Literature Cited

Bendire, Charles
1892 Life histories of North American birds. *U.S. Nat. Mus. Spec. Bull. No.* 1.

Benners, G. B.
1887 A collecting trip in Texas. *Ornith. and Oöl.,* 12:65–69.

Bent, Arthur Cleveland
1937 Life histories of North American birds of prey (part 1). *U.S. Nat. Mus. Bull.* 167.

Burrows, D. B.
1917 White-tailed Hawk. *Oöl.,* 34:78–81.

Cottam, Clarence, and Phoebe Knappen
1939 Food of some uncommon North American birds. *Auk,* 56:138–169.

Errington, Paul L.
1930 The pellet analysis method of raptor food habits study. *Condor,* 32:292–296.

Errington, Paul L., and W. J. Breckenridge
1936 Food habits of Marsh Hawks in the glaciated prairie region of north-central United States. *Amer. Midl. Nat.,* 17:831–848.

Hudson, W. H.
1920 Birds of La Plata (vol. 2). E. P. Dutton and Co., N.Y.
Peters, James L.
1931 Check-list of birds of the world (vol. 1). Harvard Univ. Press, Cambridge, Mass.
Strecker, John K., Jr.
1912 The birds of Texas. *Baylor Univ. Bull.,* 15:1–70.

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WING-FLASHING IN THE MOCKINGBIRD

BY GEORGE MIKSCH SUTTON

WHILE attached to the U. S. Army Air Force's Tactical Center during the recent war, I was stationed at Orlando, Florida, for several periods during both winter and summer months of 1944 and 1945. One of the commonest birds of the military base was the Mockingbird (*Mimus polyglottos*), a species I had seen repeatedly in the southwestern United States and Mexico but had never very closely studied. What interested me chiefly about the birds was their roosting habits, concerning which I hope to report later; their 'duelling,' on which I have published a brief note (Sutton, 1945); and their wing-flashing—a puzzling and at times somewhat amusing practice of lifting and spreading the wings archangel-fashion while pausing between runs on the ground (Plate 8). So fully were the remiges spread that the white wing-patches flashed conspicuously, giving me at first the impression that some sort of courtship display was going on or that an attempt was being made to startle insects into flight. The latter concept has been discussed by Gander (1931), who says: "While watching a pair of Mockingbirds at Pensacola, Florida, in the spring of 1928, I was shown that this display may have a very practical use. These birds had a nest of young . . . and they frequently carried on the search for insects in a nearby field. As I watched I was impressed with the frequency with which the wings were opened and closed. Also, I noted that while the dull gray Mockingbird blended well with the background of earth and grass, yet when the wings were extended he became very conspicuous. The idea occurred to me that to an insect on the ground this sudden spreading of the contrastingly colored wings must be actually startling. With this in mind I watched with greater care and on several occasions noted that grasshoppers or similar insects flew from the grass as the bird made this display and that it quickly pursued them. After considerable observation I was convinced that in this instance, at least, the Mockingbird's striking wing pattern was of real assistance to it in finding insect food."

Wing flashing as a means of finding and capturing food is certainly a common practice among certain birds. My captive Road-runners (*Geococcyx californianus*) flashed their wings, or rushed about with wings spread, and thus made certain insects (especially grasshoppers) reveal themselves by moving (Sutton, 1922:15). I have reported on a Least Bittern (*Ixobrychus exilis*) which flashed its wings as it stalked its prey along the edge of a marsh in Michigan (Sutton, 1936). But with the Mockingbirds I am not sure that the flashing is part of a food-catching procedure. Whatever its purpose may be, I have this to say of it: 1. I have repeatedly seen a Mockingbird flash its wings between short runs on the ground, usually in a rather open place, often on a

Adult Mockingbird flashing its wings

Drawing by George Miksch Sutton of a specimen taken October 29, 1946, at Louisville, Kentucky, by Burt L. Monroe.

lawn, but I have never seen one flash its wings while moving about through leafage *above* the ground. 2. I have observed the phenomenon frequently in summer, only infrequently in winter. A possible explanation of this is that Mockingbirds were more conspicuous in summer than in winter or that, the days being longer, I saw more of the birds in the evening hours after work at that season. Mrs. Amelia Laskey tells me, however (*in litt.*), that she has observed the phenomenon "commonly . . . in the Nashville [Tennessee] area in summer, very rarely in winter." 3. I have seen young birds as well as old ones flashing their wings. This last phase of the subject is the one I wish to develop in the present paper.

The wing-flashing at times appears to be a modification or exaggeration of the wing-waving or wing-quivering which is so characteristic of many passerine (and some non-passerine) young birds when being fed. However, on August 19, 1945, when I was field officer of the day, hence obliged to stay at a certain desk throughout the daylight hours, I repeatedly observed a pair of Mockingbirds feeding their two 'whining' young just outside the window, and neither young bird flashed its wings at the approach of a parent bird or while being fed. The young were well fledged, their tails being 3 to 4 inches long. Most of what they ate they received directly from their parents, but between feedings they did some exploring on their own, and many times I noticed that as they ran about the shrub- and flower-bordered path they flashed their wings *at* clumps of leaves or tufts of grass, standing high and looking about expectantly after returning their wings to a folded position. Harold and Josephine R. Michener (1935:106) have reported similar behavior in three young Mockingbirds which they reared "at different times." Concerning the flashing they say: "We found with all of these babies that any new or strange object put into the cage caused this action. When released we observed one of them going about the yard lifting its wings over and over as it looked at eucalyptus caps, pebbles and all sorts of objects. This certainly was not an indication of fear because when afraid they behaved very differently."

Concerning the wing-flashing of a very young Mockingbird I have this to report. Late in the afternoon, on August 4, 1945, I heard the crying of a young Mockingbird which must have left the nest somewhat prematurely. It was standing at the base of a pine tree fully 30 yards from the nearest shrubbery. Its tail was about half an inch long. It stood uncertainly on its long legs, yet as it moved awkwardly forward through the short grass it lifted high and fully spread its stubby wings at each pause in a manner characteristic of the adult. In this case I believe it was lifting its wings, not at the grass, but at the world in general or at me. Certainly there was no strangely shaped object anywhere near it in the grass. Though obviously much too young to obtain its own food, it had, on leaving the nest, assumed a measure of adulthood—a transformation as definite as that which I observed in captive young

Cardinals (*Richmondena cardinalis*), which for the first time in their short lives lifted their crests high and gave the alarm-cry of the adult the instant they climbed from the bowl of the nest up onto the rim (Sutton, 1941:164).

Concerning wing-flashing in very young Mockingbirds, Mrs. Laskey has given me (*in litt.*) some interesting information. A young bird which she was rearing some years ago, and which was not yet feeding itself, hopped from its box, which was on a high kitchen stool in a bright part of the room, fluttered to the floor, landed in a dark spot near some cupboards and "immediately opened and closed its wings in characteristic fashion."

Another young bird which Mrs. Laskey had taken from the nest on August 1, 1939, when it was approximately 9 days old, flashed its wings at gravel and dried insects placed in its large cage on August 17 (age: 3 to 4 weeks). It approached these "new" objects warily, flashed its wings, retreated, approached them again, and finally, after thoroughly inspecting them, hopped onto its perch to preen. Two days later it flashed its wings at a pink paper napkin placed tentwise in the cage, retreated as before, eyed the unfamiliar object with obvious curiosity or suspicion, then advanced and pecked at the paper. On August 20, while still not feeding itself, it flashed its wings at a bright green dish and a piece of bread placed in its cage. Even after learning to eat by itself it flashed its wings at unfamiliar objects which it encountered in its cage, in a room in which it was allowed to fly about, or on the porch. Its attitude toward a buzzing cicada was particularly interesting. The forward thrusting of its wings (or of one wing only) was now exaggerated. Gaining courage from the failure of the cicada to respond in any special way to the flashing, it moved forward promptly and attacked the insect. It could hardly have learned this method of capturing prey during the few days of infant life it had spent with its parents.

A female bird, which Mrs. Laskey kept for a year, reacted similarly to unfamiliar objects. After this bird had learned to feed by itself, an unset mousetrap was placed in its cage. The bird approached the trap warily, flashed its wings, and grasped the trap in its bill.

On June 5, 1939, Mrs. Laskey observed an adult Brown Thrasher (*Toxostoma rufum*) opening and closing its wings while investigating something in a dark spot at the base of a yucca plant where it had been hunting food. These wing movements differed from those of the Mockingbird in that they were not given in an open area during brief pauses between runs.

From what I have reported above I believe we may safely conclude that the Mockingbird's wing-flashing is not solely, nor even primarily, a means of obtaining food. It is an instinctive gesture indicating wariness, suspicion, distrust. It is occasionally, but more or less accidentally, associated with the capture of food. Why it should be given only while the bird is on the ground I cannot say.

Literature Cited

GANDER, FRANK F.
1931 May the color pattern of the Mockingbird's wings aid in finding insect food? *Wils. Bull.,* 43:146.
MICHENER, HAROLD, and JOSEPHINE R. MICHENER
1935 Mockingbirds, their territories and individualities. *Condor,* 37:97–140.
SUTTON, GEORGE MIKSCH
1922 Notes on the Road-runner at Fort Worth, Texas. *Wils. Bull.,* 34:3–20.
1936 Food capturing tactics of the Least Bittern. *Auk,* 53:74–75.
1941 Crousty, the story of a Redbird. Part 1. *Aud. Mag.,* 43:161–168.
1945 Autumnal duelling among Mockingbirds. *Auk,* 62:301.

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SUGGESTED PRINCIPLES FOR VERNACULAR NOMENCLATURE

BY EUGENE EISENMANN AND HUSTACE H. POOR

IN North America for over 50 years both scientific and vernacular names have been fixed by the *Check-List of North American Birds* prepared by the Committee on Classification and Nomenclature of the American Ornithologists' Union. The vernacular names given in the *Check-List* superseded a disordered array of local names and in most cases proved so convenient that they are generally used in technical as well as in popular literature. However, there has been no recognized code of principles governing the formation of vernacular names of birds,* and this has resulted in certain important defects in our vernacular nomenclature.

Current vernacular nomenclature is subject to three basic criticisms:

1. The inappropriateness (misleading quality) of certain names.

2. The lack of a comprehensive name for each polytypic species as a whole.

3. The lack of system in naming subspecies.

Since many of the *Check-List* names had rather haphazard origins, it is not surprising that some are highly inappropriate and misleading. Anyone can think of many examples, such as "Palm Warbler," "Connecticut Warbler," "Tree Sparrow," "Philadelphia Vireo."

Heretofore the *Check-List* has not regularly provided an English name for a species as a whole when the species is divided into subspecies but has often given a distinct name to each race of the species. This results in inconvenience and confusion, particularly in the West, where subspecies are numerous, and where several races indistinguishable in the field, but bearing totally different vernacular names, may be found breeding a short distance apart or wintering together. It is impossible to designate an individual of these races by an established English name even though the species is identified. For example, two races of *Melospiza lincolnii* that winter in southern California are designated "Lincoln's Sparrow" and "Forbush's Sparrow," but there is no established vernacular name applicable to an individual of this species not identified as to race. The same difficulty arises when a population being studied lies in a zone of intergradation between subspecies, or when it is desired to refer to a whole polytypic species rather than to any one race.

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* There is considerable literature on the subject of vernacular names; a good bibliography is appended to an article on orthography by Cheesman and Oehser (1937. *Auk*, 54:333–340).

With the trend toward division of species into subspecies the number of bird names has been increasing. Unfortunately, no consistent system has been followed in establishing vernacular subspecies names for the *Check-List*. The names of certain subspecies have been formed by the simple and logical method of adding some descriptive prefix to a species name (e.g., the various races of Song Sparrow are called "Atlantic Song Sparrow," "Desert Song Sparrow," etc.), thus indicating the conspecific relationship. In certain other groups, some of the subspecies names have been formed in this convenient manner, while other races have been accorded names giving no clue to their specific relationship. Thus three races of *Dryobates pubescens* have "Downy Woodpecker" included in their names (Northern, Southern, and Nelson's Downy Woodpeckers) while three others do not (Batchelder's, Gairdner's, and Willow Woodpeckers). In still other species none of the names indicates the specific relationship among the races. For example, the two forms of *Vermivora ruficapilla* are known, respectively, as "Nashville Warbler" and "Calaveras Warbler," while each of the nine jays of the species *Aphelocoma coerulescens* (the Nineteenth Supplement to the *Check-List* includes the *californica* group with *coerulescens*) has a distinct name, as "Florida Jay," "California Jay," "Texas Jay," "Woodhouse's Jay." The same lack of consistency or plan is shown in the naming of new forms in the recent Supplements to the *Check-List*.

It would be helpful if the A.O.U. Committee on Nomenclature were to enunciate certain principles to be observed in the selection of vernacular names in the future, not only as a guide to the naming of our own forms but also in the coining of English names for foreign species, particularly those of the Western Hemisphere. Some day the A.O.U. will perhaps prepare a *Check-List,* not merely for the area north of Mexico, but for the entire continent of North America (See *A.O.U. Check-List,* 4th ed., p. vi). Meanwhile, in the absence of a guide, names selected in the haphazard way of the past may become established in the literature.

We do not suggest that inflexible rules, such as those that govern scientific names, should be promulgated for vernacular names, but we strongly urge that simple and logical guiding principles be recognized.

Statement of Principles

1. Every species should have a name, applicable only to that species, which can be used in a comprehensive manner for all races of the species, and which can be applied to any individual of the species without identifying it as to race. The species name should be appropriate to the species as a whole, and preferably have associative significance through referring to some conspicuous characteristic of appearance, behavior, or habitat.

2. Every subspecies name should be formed by prefixing to the species name a word or words indicating the race. The subspecific prefix

should preferably be an appropriate geographical term suggesting either the range of the race, or the type locality, if that is within the normal breeding range of the subspecies.

Discussion

Species names. To remedy the great inconvenience caused by the lack of an English group-name for each polytypic species, the present A.O.U. Committee on Nomenclature has announced (Nineteenth Supplement, 1944, *Auk,* 61:441–464) that the forthcoming Fifth Edition of the *Check-List* will provide a common name for each species. This is a major reform on which the Committee is to be congratulated.

It would seem obvious that species names should be appropriate to the species as a whole and preferably associative. An appropriate descriptive name is not only more easily learned and remembered, but it often facilitates identification, thus helping to overcome the initial hurdle to an interest in ornithology—the number of names to be memorized and associated with the proper species. A large number of the names in current use, such as "Red-headed Woodpecker," "Blue Grosbeak," "Warbling Vireo," and "Bank Swallow," exemplify this principle.

To supply the new group designations, the A.O.U. Committee will have to select, and in some instances to invent, suitable names. The usefulness of such names will be increased to the extent that they are appropriate to the entire species. With many birds, such as the Song Sparrow and Cactus Wren, there will be no problem, for the appropriate species name is already included in the present name of some or all of the races. In other instances, even though at present each race has a wholly distinct name, the current name of one subspecies is appropriate to the species as a whole. It seems preferable to apply such a familiar name to the species rather than to coin a new name. Thus, we would suggest "Black-capped Chickadee" for the species name of *Parus atricapillus,* with "Eastern Black-capped Chickadee" for the race *atricapillus.* In some instances it will, however, be necessary and desirable for the Committee to adopt a name not now in the *Check-List* because none of the subspecies bears a name appropriate for the whole species. For example, neither "Calaveras Warbler" nor "Nashville Warbler" would be appropriate for the whole species *Vermivora ruficapilla,* and neither "Florida Jay" nor "California Jay" would be suitable for the *Aphelocoma coerulescens* group. "Gray-capped Warbler" and "Scrub Jay" * are possible suggestions here. The old geographical designations could be preserved as prefixes to the species name to indicate the particular race, viz., "Calaveras Gray-capped Warbler," "California Scrub Jay." Similarly, neither "Green-backed Goldfinch" nor "Arkansas Goldfinch" is appropriate for *Spinus psaltria,* most of whose

* This is the popular name of the species in Florida and has been adopted by some ornithologists (Grimes, 1940, *Bird-Lore,* 42:431. Amadon, 1944, *Amer. Mus. Novit. No.* 1252:2. Pitelka, 1945, *Condor,* 47:23).

races have a black back and whose range extends south to Peru. Some such name as "Dark Goldfinch," indicating the contrast with the pale-backed *Spinus tristis,* might be appropriate for the entire species.

It is certainly desirable to retain many established names regardless of whether or not they are appropriate, but in those instances where a new name has to be found every effort should be made to select a name suitable to the species as a whole.

Implicit in the principle that appropriate and associative names should be selected are certain corollaries:

a) A species name should not give a false impression of taxonomic relationship. Such names as "Upland Plover" or "Mexican Goshawk" are examples of violation of this rule.

b) A species name should not be formed from the name of a geographical or political subdivision. Geographic names should be reserved for use as subspecific prefixes, since they are generally misleading when applied to the whole species. Moreover, when a species originally considered monotypic bears a geographic name and is later divided into subspecies it is extremely awkward to add another geographical prefix to form the subspecies name, e.g., "California Florida Jay." The only instance where a species name might appropriately be geographic is where the species is a truly endemic form confined to one island or locality.

c) A species name should not be formed from the name of a person. Personal names are lacking in associative value, are more difficult to remember, and are likely to be mispronounced; e.g., Holboell's Grebe, Bewick's Wren, Craveri's Murrelet.

d) In forming species names, the words "common," "least," and "great" should be used only with great care. The frequently misleading quality of these terms is well known. The Least Flycatcher is not our smallest. The Common Tern is rare or absent in many parts of the United States where other terns are abundant.

e) There should not be given to one species a name already well established in another country as the vernacular name of a different species. Of the 43 species of gulls, 7 full species are called "Black-headed Gull" by one or more of four leading authors. The possibilities of confusion, particularly with increasing travel, are obvious.

Subspecies names. In recent years it has been suggested that vernacular names for subspecies be discarded altogether since discrimination among subspecies involves such fine points that anyone sufficiently interested and qualified to make such determinations would be able to use the scientific names. It might have been better if the *Check-List* had never attempted to provide common names for all our subspecies. Certainly in naming the birds of countries whose bird distribution is even less known, it is worse than useless to invent English names for subspecies (E. Mayr, "Birds of the Southwest Pacific," 1945, p.xiv). But there are two important objections to discarding all subspecific vernacular names for North American birds at this time: (1) Valuable data indexed under those names might be overlooked if the names were abandoned. (2) A number of forms currently considered subspecies are readily distinguishable even in the field, and the amateur, at least, needs vernacular names for them.

That subspecies names should uniformly include the specific names has been frequently urged (See J. Grinnell and A. H. Miller, "The Distribution of the Birds of California," 1945). Since a subspecies is but a geographic race of a species, it would be simple and logical if in the future all subspecies names were formed by prefixing a geographic term to the species name. Even now most of our subspecies bear geographic names. Established subspecies names formed in a different manner need not be discarded, but *new* subspecies names should consistently follow this principle.

Existing subspecies names should, however, be modified to the extent necessary to include the species name; e.g., Gairdner's Woodpecker should become "Gairdner's Downy Woodpecker," and Texas Towhee "Texas Spotted Towhee." This method has been used in naming many subspecies, and should be uniformly followed. As it is, the large number of unrelated subspecies names which have to be learned has been a serious obstacle to public interest in western ornithology (R. T. Peterson, 1942, *Audubon Magazine,* 44:280). If all subspecies were named in the manner suggested, the burden of remembering numerous subspecies names would be largely eliminated. The field student would normally employ the species name, adding the subspecific prefixes only to emphasize some particular subspecific distinction. It would clarify certain relationships to include the species name in the subspecific designation. If, for example, the words "Spotted" and "Brown" were included in the respective vernacular names of the various forms of *Pipilo maculatus* and *P. fuscus,* confusion between "Texas Towhee" and "Texas Brown Towhee" (of the Nineteenth Supplement) would be reduced, the former becoming "Texas Spotted Towhee."

The chief objections raised against such changes in current names are (1) that stability is disturbed, and (2) that trinomial names are more cumbersome than binomials. So far as stability is concerned, the slight changes resulting from the insertion of the specific name are warranted by the gain in clarity. Basic stability would not be affected, since the old name would be preserved in the new designation and there would thus be no difficulty in tracing references indexed under the old names. While certain subspecies names would be lengthened, they would be no longer than a great many names now thoroughly established by the *Check-List.* Moreover, the danger of unwieldiness is more theoretical than real. As noted above, the full subspecific name would rarely be used unless some special point of distinction between subspecies of the same species were being made, in which case the full name would be useful to emphasize the point. Thus, today one never speaks of the "Eastern Song Sparrow" but simply of the "Song Sparrow," except when a discrimination between the Eastern Song Sparrow and some other race is particularly intended.

It has also been objected that if the method here advocated were followed, a change in scientific opinion as to whether a particular form is a species or subspecies would require a corresponding change in its vernacular name. This appears to us an advantage rather than a defect. When, for example, the A.O.U. Committee concluded that Nelson's Sparrow was a race of *Ammospiza caudacuta,* rather than a separate species, an alteration in name to "Nelson's Sharp-tailed Sparrow" would have been a simple way of indicating this relationship—a fact of interest to amateurs as well as to scientists. Such modifications will be infrequently required, and are certainly much less common than the numerous, and often confusing, name changes found in each successive *Check-List,* resulting from subdivision of existing forms into new subspecies or altered views as to the range of subspecies. Even this inevitable inconvenience will be minimized by adopting the method here proposed, for only the subspecific prefix need be changed.

In a few instances the present subspecies name may require a slight modification to prevent clumsiness when it is combined with the species name. The late Witmer Stone used to cite as a difficult example the Great-tailed and Boat-tailed Grackles, but the challenge of this and similar cases can be met with a little ingenuity. The A.O.U. Committee could preserve the best known name by calling the two races "Eastern Boat-tailed Grackle" and "Great Boat-tailed Grackle," or it could preserve both race names by naming the species "Marsh Grackle" and calling the races "Boat-tailed Marsh Grackle" and "Great-tailed Marsh Grackle." While a few cases may be difficult or controversial, there is no reason that the vast majority of simple cases should not be rectified and a consistent method of nomenclature followed in the future.

Committee on Vernacular Nomenclature, Linnaean Society of New York, American Museum of Natural History, New York 24, N. Y.

GENERAL NOTES

A second Ohio record for the Eared Grebe.—On November 24, 1945, I saw from a window of my home on South Bass Island, Ottawa County, Ohio, a small grebe fishing in the high waves of Lake Erie about 125 feet distant. The slightly upturned bill, poorly-defined dark portions of the head and neck, and small size, were quite unlike the normal appearance in autumn of the Horned Grebes (*Colymbus auritus*) that are present about the island in small numbers at this season. Hoping to obtain a better view of the grebe, I went outdoors, but the grebe dove, and I saw it no more on that day. At daylight on November 27 I saw what I believed to be the same bird, this time on the opposite side of the island, about a half mile distant from where I had made the first observation. I saw one again on the morning of November 28. Before daylight on November 29, I placed some duck decoys offshore near the place where I had seen the grebe the day before. At daylight, the bird, seeing the decoys, swam among them with typical grebe curiosity, and I succeeded in collecting it. The skin of this bird, a female Eared Grebe (*Colymbus nigricollis californicus*), is No. 7739 of the bird collection of the Ohio State Museum.

This appears to be the second record of the capture of this species in Ohio. The first record was made by W. Earl Godfrey (1943. *Auk*, 60:452) when he collected a specimen on April 22, 1941, at Corning Lake, Lake County, Ohio.—MILTON B. TRAUTMAN, *F. T. Stone Laboratory, Put-in-Bay, Ohio.*

Northern water birds summering on the Gulf Coast of Texas.—In 1945, I observed the following water birds in the vicinity of Rockport, Aransas County, Texas, between June 4 and 14, when such species are normally in the more northern States or Canada.

Anas strepera. Gadwall: 7 records, 73 individuals, of both sexes, all in apparently normal breeding plumage.

Anas americana. Baldpate: 4 records, 9 individuals.

Anas acuta. Pintail: 1 record, 3 individuals.

Aythya valisineria. Canvas-back: 2 males and 2 females observed together on June 15 by Mrs. Jack Hagar.

Aythya affinis. Lesser Scaup Duck: 5 records, 22 individuals; 10 males, none in bright plumage—white areas dull, heads lacking gloss; females without the white facial area or with only a trace of it.

Mergus serrator. Red-breasted Merganser: 1 individual, a female in exceedingly pale plumage—chalky all over except for the dull brown of the head; behavior sickly.

Squatarola squatarola. Black-bellied Plover: 6 records, 17 individuals, all in apparently normal plumage.

Arenaria interpres. Ruddy Turnstone: 5 records, 15 individual, mostly in winter plumage, but a few showing rusty-black breast patterns with white areas reduced.

Totanus melanoleucus. Greater Yellow-legs: 2 records, 6 individuals.

Totanus flavipes. Lesser Yellow-legs: 1 individual.

Erolia fuscicollis. White-rumped sandpiper: 3 records, 12 individuals.

Limnodromus griseus. Dowitcher: 2 records, 37 individuals, all in winter plumage.

Ereunetes pusillus. Semipalmated Sandpiper: 3 records, 21 individuals, all apparently in winter plumage.

Ereunetes mauri. Western Sandpiper: 4 records, 24 individuals.

Crocethia alba. Sanderling: 5 records, 13 individuals, 2 in partial breeding plumage, others in winter dress.

Sterna hirundo. Common Tern: 1 individual.

Chlidonias nigra. Black Tern: 4 records, 20 individuals, all in first winter or adult winter plumage.

All of the 17 species listed above winter in greater or lesser numbers in the Rockport area, but none of them is known to breed there. Mr. Jack Hagar tells me that this summering of non-breeding species is a regular occurrence in the Rockport area; it presents an interesting problem in the study of the migration and breeding habits of birds.—R. A. O'Reilly, Jr., *Detroit, Michigan.*

Crow killed by a Duck Hawk.—The observation by Philip Baumgras, "Crow killed by a Red-tailed Hawk" (1945, *Wils. Bull.*, 57:129), adds interest to a similar record of my own. On May 14, 1936, at North Cape, Erie Marsh, Monroe County, Michigan, my attention was attracted by the loud cawing of Crows (*Corvus brachyrhynchos*) in a near-by clump of cottonwoods; a moment later, however, an adult Duck Hawk (*Falco peregrinus anatum*) came from the trees carrying a Crow in its talons, with another Crow in wild pursuit. I assumed that the Hawk had taken a young bird from a Crow's nest.—John J. Stophlet, *2612 Maplewood Avenue, Toledo 10, Ohio.*

Snake depredations at bird nests.—During the past nine years I have recorded 12 instances of snakes discovered in the act of rifling bird nests or found coiled in the boxes after having presumably swallowed the broods. Most of the 12 instances occurred in Warner Parks, Nashville, Tennessee, a natural park situated among wooded hills, with thickets, open meadows, and tiny streams, where I have conducted a Bluebird (*Sialia sialis sialis*) nestbox project for the past decade.

In three instances, although moving too fast for capture, the predators were identified as black racers (*Coluber* sp.). On June 17, 1937, I approached a box as a racer clung there with a 10-day-old Bluebird in its mouth, which proved to be the last of the brood of five. The adults were flying excitedly from perch to perch near by. The snake made off with the screeching nestling and disappeared into a crevice before it could be overtaken. On July 26, 1940, a racer was seen inside a Bluebird box as it was swallowing the last of three large nestlings, and on June 8, 1943, a racer dropped out of a box when I arrived. The nest was found to be empty.

In nine instances, the predators were pilot snakes (*Elaphe* sp.), known locally as "chicken" snakes because they frequent chicken houses and eat chicks and eggs. Seven of these large, slow-moving reptiles were found coiled inside of Bluebird boxes which had contained nestlings—apparently remaining there to digest the meal. They measured from 48 to 60 inches in length, usually completely filling the large-size boxes. One was sent to Jesse M. Shaver, of Peabody College for Teachers, who identified it as the Southern Pilot Snake (*Elaphe obsoleta obsoleta*). The first of these was taken in 1938. On July 6, 1940, in abnormally cool weather, three were caught during the morning, two in Warner Parks and one on private grounds where several boxes had been placed. The 60-inch individual had apparently eaten four Bluebirds, at least 16 days old, due to leave the box on that or the following day. One snake, measuring 52 inches, that was opened contained three 10-day-old Bluebirds and one egg. On May 10, 1943, a 53-inch pilot snake was found resting in a box that had contained a brood of five, also 10 days old.

Two more pilot snakes were pulled out of boxes on April 21, 1944, and July 17, 1945, after having presumably consumed broods of four and five respectively. I have never found a snake occupying a box while it was vacant between nestings, and a snake found coiled and sluggish in a box that has just previously contained nestlings may presumably be assumed to have eaten them.

In Warner Parks, there are several houses that are occupied by the families of park employees, many of whom cooperated with me in banding operations by notifying me of birds nesting at their homes. Chimney Swifts (*Chaetura pelagica*) regularly used chimneys of these houses, and occasionally a nest with young dropped into the fireplace or the space behind the hearth. In 1944, at the home of Mrs. Luther Love, a brood had dropped to a ledge, accessible from the fireplace. Mrs. Love made occasional observations by means of a mirror in order to let me know when the nestlings were of proper size for banding. On July 10, instead of nestlings, she and her niece found a large pilot snake where the Chimney Swifts had been.

On the afternoon of May 29, 1945, while I was making the circuit of Bluebird boxes, I heard Catbirds (*Dumetella carolinensis*) fussing in a tangle of vegetation near a spring. Investigating, I found the Catbird pair frantically fluttering above their nest among the brambles, where a large dark-colored pilot snake was coiled, a thickened area in its body showing that it had already swallowed the contents of the nest.

In the course of the Warner Parks study, close observations have indicated that snakes rank high as natural enemies of birds in this area and are a serious problem in the management of a nest-box project. During the early years of this work, I did not ascertain the degree of snake depredation as accurately as has been possible during later years when a careful study of both Bluebirds and their predators has developed an understanding of the habits of each. An analysis of field data of the past five years shows that eggs or young from 23 to 40 per cent of the nests were probably taken each year by snakes. There is no way to determine the number of close-sitting females that may have been swallowed in addition to the contents of the nest. Because snakes rob nests without damage to the structure and leave no clues such as many mammals do, it is necessary to know the laying and hatching dates of each nesting attempt, as well as specific nest-occupancy periods, in order to estimate nesting success. With this knowledge it is possible to judge whether the young may have left the nest at the usual time or have been taken by predators before maturity. Bluebird nestlings are particularly vulnerable to predators because they do not leave the box until they are at least 16 days old. Even at that age, they do not fly out at the approach of a possible enemy but crouch low, with heads bent downward. With a predator blocking the only exit, there is no possible escape for any of the brood as there is for fledglings in open nests.

I have tried various devices in an attempt to protect nest boxes from predators. Guards of tin or other metal are effective in thwarting mammals such as cats or opossums, but nothing has proved effective against snakes, not even bands of long sharp-pointed nails covering the front of the box and the post.

The first year that boxes were placed in new territory, the success percentage was high. By the second year, snakes started to rob nests, and in the third season, only occasional broods escaped. It became obvious that after boxes are found by snakes, they are visited periodically, whereas new territories are fairly safe from depredation by snakes the first season.

Although absolute certainty is not possible, the evidence indicates that of 142 nests, 47 (33 per cent) were robbed by snakes in 1941; in 1942, of 174 nests, 40 (23 per cent); in 1943, of 151 nests, 60 (40 per cent); in 1944, of 144 nests, 53 (37 per cent); in 1945, of 136 nests, 53 (39 per cent).—Amelia R. Laskey, *Graybar Lane, Nashville, Tennessee.*

EDITORIAL

Our Annual Meeting, held recently in Omaha, was very successful and well attended. The full proceedings will be published in the March issue of *The Wilson Bulletin.*

William E. Hill has generously presented to the Wilson Club Library a number of books and magazines from the collection of his late brother, Walter P. Hill, of LaGrange, Illinois. Included are a group of very useful reference works by such authors as W. B. Alexander, A. A. Allen, W. B. Barrows, F. M. Chapman, A. H. Howell, and Florence A. Merriam.

As the *Bulletin* goes to press we have received an advance copy of the "unrevised reprint" of A. C. Bent's "Life Histories of North American Diving Birds," published by Dodd, Mead, and Company, November 11. A review will appear in the next issue of the *Bulletin.*

A number of Wilson Club members and friends have given valuable editorial assistance during 1946. Especial mention should be made of: Harley H. Bartlett, Alfred E. Brandt, Frances Hamerstrom, Burt L. Monroe, A. D. Moore, Kenneth W. Prescott, Alexander F. Skutch, George M. Sutton, Milton B. Trautman, A. J. van Rossem, and Augusta White.

We are extremely grateful to our Treasurer, Burt L. Monroe, for having undertaken the exacting task of preparing the membership roll for this issue of the *Bulletin.* In the coming weeks, dues notices will be sent to all unpaid members. Please send in your dues promptly or notify the Treasurer that you are continuing your membership and will pay your dues later. Thus much time and expense will be saved in the preparation of the mailing list for the March issue of the *Bulletin.*

OBITUARY

Ernest Thompson Seton, famous naturalist, died in Santa Fe, New Mexico, on October 23, 1946, at the age of eighty-six. He was elected an Associate of the American Ornithologists' Union at its first meeting (1883) and was made a Member in 1901. His "Birds of Manitoba" (1891 and 1909) remains a standard source book, and his use of diagrammatic duck pictures to teach the essentials needed for identification (1903) provided the inspiration for our finest modern field guides. He was a talented artist, and a number of his drawings were published in ornithological journals; in 1897 he illustrated "Bird Life" by Frank M. Chapman. His wild animal stories reached millions of people and had an important part in creating the present widespread interest in wildlife and its protection.

Edward A. Goldman, mammalogist and ornithologist, died September 2, 1946, in Washington, D.C. He was best known to ornithologists for his biological survey of Panama and for his many years of exploration in Mexico with E. W. Nelson. He had an important part in the preparation and adoption of the Migratory Bird Treaty between the United States and Mexico.

Clement S. Brimley, long an authority on the animals of North Carolina, died in Raleigh, July 23, 1946, aged eighty-two. He was an entomologist by profession but had published important papers on the reptiles, amphibians, and mammals of North Carolina as well as a great many short notes and papers on birds. With his brother, H. H. Brimley, and T. G. Pearson, he was co-author of "Birds of North Carolina" (1919 and 1942).

Ornithological News

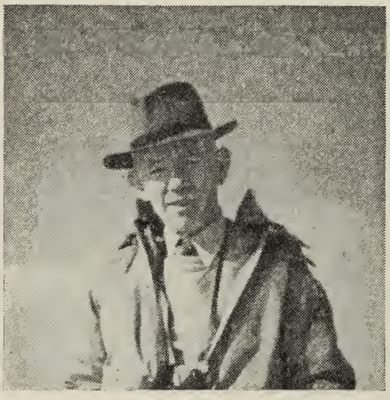
The Leidy Medal of the Academy of Natural Sciences of Philadelphia was awarded on October 2 to Ernst Mayr. The award is made once in three years for distinguished contribution to the natural sciences. Dr. Mayr is the first ornithologist to be thus honored.

At the annual meeting of the American Ornithologists' Union, held in Urbana September 2–6, President Hoyes Lloyd, Vice-Presidents Robert Cushman Murphy and Josselyn Van Tyne, and Treasurer Frederick C. Lincoln were reelected; Olin S. Pettingill, Jr., was elected Secretary. The new Council members are: George H. Lowery, Jr., S. Charles Kendeigh, and F. A. Pitelka; new Fellows: James Bond, H. G. Deignan, Jean Delacour, Hildegarde Howard, and Alexander F. Skutch; new Members: Logan J. Bennett, Victor H. Cahalane, Donald S. Farner, Harvey I. Fisher, R. A. Johnson, A. Starker Leopold, Howard L. Mendall, Allan R. Phillips, Arthur C. Twomey, and Emil Witschi. Pontus Palmgren of Finland and David Lack of England were elected Honorary Fellows. The 1947 meeting will be held in Toronto.

Olin S. Pettingill, Jr., has resigned from the Whooping Crane investigation because of the pressure of other work. The assignment has now been taken over by Robert P. Allen, who will devote full time to it.

Reuben M. Strong, one of the Founders of the Wilson Ornithological Club, has retired as Professor of Anatomy and Chairman of the Department of Anatomy of Loyola University and has moved to Chicago Natural History Museum to devote himself to ornithological research and the publication of his "Bibliography of Birds."

NEW LIFE MEMBER



John Kieran is a graduate of Fordham University. He is a Life Member of the Linnaean Society of New York, a Director of the National Audubon Society, and Contributing Editor of *Audubon Magazine*. He has published a book and many articles on natural history subjects. His great interest in natural history was evident even in the sports column which for sixteen years he wrote for the *New York Times* and in the general column he later wrote for the *Sun*. He is perhaps best known as the natural history expert on a popular national radio program.

ORNITHOLOGICAL LITERATURE

The Ducks Came Back: The Story of Ducks Unlimited. By S. Kip Farrington. Coward-McCann, New York, 1945: 7½ × 10 in., xvi + 138 pp., illustrated by Lynn Bogue Hunt. $5.00.

"The Ducks Came Back" is reviewed here because it is a book about birds, not because of its intrinsic merit. Attractively put together and plausibly written, it has potentialities for great harm: if it is widely read and accepted as truth, it will hinder the real job of waterfowl conservation more than any other single statement.

The book consists for the most part of warmed-over material from the files of the organization which it eulogizes, Ducks Unlimited, and follows faithfully that organization's "party line." It speaks glibly of "drought proof nesting grounds," of "safeguarded" and "restored" nesting grounds, and of "permanent waters"—but many of these have already gone dry. It bases a detailed mathematical analysis of waterfowl productivity on appallingly little actual evidence. It interlards staged photographs among the genuine, captioned in such a way as to be taken at face value.

Farrington adds his own personal touch. In late 1945 he urges the return of baiting and live decoys, batteries and sink boxes. He speaks of the many refuges "throughout the United States which were put in to harbor ducks that are increasing by the thousands, and which have hurt the sport of duck shooting for miles around, not to mention the farmers' crops" (p. 106). He declares that, largely because of Ducks Unlimited, ducks have increased "over 500 per cent" (p. 36). And further: "This organization will be able to take care of all the emergency contingencies that arise, such as duck sickness and other unforeseen dangers, as well as drought; and there will always be cycles of drought in the Canadian breeding grounds" (p. 127).

As a final example: "It is to me a very convincing fact which cannot be overlooked that the ducks immediately began to show an increase the minute D.U. started the job in the prairie provinces, and as they increased their efforts, the water [fowl] population has steadily increased with them. The good Lord may have supplied them with a trifle more moisture than had come from the heavens during the drought period, but rain is of little value in that country if proper preparations are not made to receive and hold it for our web-footed friends" (p. 119). It is an even more convincing fact that, at the end of the last drought, the waterfowl began to increase as the rains increased, *before* Ducks Unlimited went to work; that waterfowl continued to increase as long as the rains continued; and that with the return of drought there is now a critical decline, despite Ducks Unlimited's continued and enlarged program.—F. N. Hamerstrom, Jr.

Birds of the Philippines. By Jean Delacour and Ernst Mayr. [The Pacific World Series.] The Macmillan Company, New York, 1946: 5½ × 8 in., xv + 309 pp., with line drawings by Earl L. Poole and Alexander Seidel. Cloth. $3.75.

This is another of the handy guides of the Pacific World Series, put out under the auspices of The American Committee for International Wild Life Protection. It would have been a boon to those American servicemen interested in natural history stationed in the Philippines, and it must be regretted that a delay of more than a year in press prevented its appearance at the time when it would have found its widest use.

The treatment is succinct, but each of the 450 species now known from the Archipelago finds a place, with mention of its principal characters for field recognition; subspecies are mentioned under the species, with range and main distinguishing features. With the practical keys and the hints on distribution, habitat, and habits, it should be possible for any student to identify the birds he may see in the islands.

Remarks on habits are brief and are based almost wholly on what is known of a given species (or genus) in other countries of its range. It is a curious fact that, although Philippine ornithology has a history of almost 200 years, our knowledge of Philippine birds is almost wholly derived from the study of museum skins (sometimes a single specimen or a small series obtained by one collector); they "have been fairly completely listed," but are "in every other respect still the least known of the whole Pacific world."

The scientific names used are in accordance with the progressive taxonomic views of the two authors, with which I usually agree. An English name is given for each species, in many cases that previously used by McGregor and Hachisuka, but others apparently appear here for the first time. It is perhaps invidious to object to anything so arbitrary as a vernacular name, but exception might be taken to "Oriental Screech Owl" for a bird whose notes are "a monotonous series of high-pitched notes, as *hook, hook,*" and especially to the use of "Mannikin" for a group of weaver finches, inasmuch as "Manakin," derived from the same Dutch word, has been applied since the time of Brisson to the neotropical Pipridae.

The artists, working from study skins, have had varying success in presenting the characteristic attitudes of the several species. The portraits of the Fantail (*Rhipidura*) on page 206 and of the Bulbul (*Microscelis*) on page 174 might have been taken from life, or at least from photographs of living birds; on the other hand, the Bush Lark (*Mirafra*) on page 156 exhibits, not the squatting position of this genus at rest, but the standing position of a pipit. The figures will, nevertheless, prove of the greatest service to those making a first acquaintance with the Oriental avifauna.

Since this volume represents the only inexpensive and up-to-date work on the birds of the Philippines, it is to be highly recommended for the use of residents and travellers, both Filipino and others, who wish to add to our knowledge of the fascinating avifauna of the islands or merely to know the names of their dooryard neighbors; needless to say, its perusal will be a renewed delight to those who already have a speaking acquaintance with the birds of tropical Asia.—H. G. Deignan.

BIBLIOGRAPHY *

Parasites, Abnormalities, and Disease

Hartman, Frank A. Notes on the pathology of a loon and a pelican. *Auk* 63 (4), Oct. 1946:588–589, pl. 15.

Kursban, N. J., and Lee Foshay. Tularemia Acquired from the Pheasant. *Jour. Amer. Med. Assoc.* 131 (18), Aug. 31, 1946:1493–1494, 1 fig.

McLean, Donald D. Duck Disease at Tulare Lake, California. *Calif. Fish and Game* 32 (2), Apr. 1946:71–80. (Reference from F. A. Pitelka.)

Anatomy (*including plumage and molt*)

See *Life History and Behavior*: Stevenson and Griffith.

Distribution and Taxonomy

Aldrich, John W. The United States Races of the Bob-white. *Auk* 63 (4), Oct. 1946:493–508, map.

Aldrich, John W. New Subspecies of Birds from Western North America. *Proc. Biol. Soc. Wash.* 59, Oct. 25, 1946:129–135. (*Centrocercus urophasianus phaios,*

* Titles of papers published in the last number of *The Wilson Bulletin* are included for the convenience of members who clip titles from reprints of this section for their own bibliographic files. Reprints of this section are available at a small cost.

Certhia familiaris caurina, Telmatodytes palustris pulverius, Catherpes mexicanus griseus, Dumetella carolinensis ruficrissa, Spinus pinus vagans, new subspp.)

DUVALL, ALLEN J. An early record of the Passenger Pigeon for British Columbia. *Auk* 63 (4), Oct. 1946:598.

FARLEY, FRANK L. "Carlton House on the Saskatchewan." *Canad. Field-Nat.* 60 (2), March 1946:26–30, 2 figs. (Type locality of five Swainson species.)

GODFREY, W. EARL. A New Carolina Wren. *Auk* 63 (4), Oct. 1946:564–568. (*Thryothorus ludovicianus alamoensis,* new subsp.)

HAGAR, JOSEPH A. Black Skimmer breeding in Massachusetts. *Auk* 63 (4), Oct. 1946:594–595.

JOHANSEN, HANS. De Gule Vipstjerters (*Motacilla flava* L.) Systematik og Udbredelse. *Dansk Ornith. Foren. Tidsskr.* 40 (2), June 1946:121–142, map. ("Notes on Systematics and Distribution of the Yellow Wagtails (*Motacilla flava* L.)", summary in English.)

KUTZ, H. L. Breeding of the Ring-billed Gull in New York. *Auk* 63 (4), Oct. 1946:591, pl. 16.

KUTZ, H. L., and DAVID G. ALLEN. The American Pintail breeding in New York. *Auk* 63 (4), Oct. 1946:596.

MONSON, GALE. Notes on the Avifauna of the Rio Grande Valley, New Mexico. *Condor* 48 (5), Sept. 1946:238–241.

MOORE, ROBERT T. A New Woodpecker from Mexico. *Proc. Biol. Soc. Wash.* 59, July 31, 1946:103–105. (*Dendrocopos stricklandi aztecus,* new subsp.)

MOORE, ROBERT T., and RICHARD M. BOND. Notes on Falco sparverius in Mexico. *Condor* 48 (5), Sept. 1946:242–244.

PATTEN, JOHN A. Birds of the Berea Region—Breeding Species. *Kentucky Warbler* 22 (3), Summer 1946:29–33, 2 photos.

PEET, MAX MINOR. The Oregon Junco in Sonora, Mexico. *Condor* 48 (4), July 1946:179.

SCHORGER, A. W. Nest of the Magnolia Warbler at Trout Lake, Wisconsin. *Wils. Bull.* 58 (3), Sept. 1946:186.

VAN ROSSEM, A.J. Notes on Distribution and Color of the Mexican Turkey Vulture. *Condor* 48 (4), July 1946:180–181.

VAN ROSSEM, A. J. Two New Races of Birds from the Harquahala Mountains, Arizona. *Auk* 63 (4), Oct. 1946:560–563. (*Pipilo fuscus relictus* and *Aimophila ruficeps rupicola,* new subspp.)

WALKINSHAW, LAWRENCE H., and BERNARD W. BAKER. Notes on the Birds of the Isle of Pines, Cuba. *Wils. Bull.* 58 (3), Sept. 1946:133–142, pls. 3–6.

WETMORE, ALEXANDER. The Birds of San José and Pedro González Islands, Republic of Panamá. *Smiths. Misc. Coll.* 106 (1), Aug. 5, 1946:1–60, 4 pls.

See also *Ecology:* Larrison; *Life History and Behavior:* Jacobs, Stevenson and Griffith, Walkinshaw, Wing.

MIGRATION AND FLIGHT

LOW, JESSOP B., and DAVID M. GAUFIN. An Unusual Flight of Sharp-tailed Grouse. *Condor* 48 (4), July 1946:180.

STEVENSON, JAMES O. Migration of the Anhinga in Texas. *Wils. Bull.* 58 (3), Sept. 1946:184–185.

See also *Life History and Behavior:* Stevenson and Griffith; *Techniques:* Woodbury *et al.*

ECOLOGY

ANDERSON, ANDERS H., and ANNE ANDERSON. Notes on the Use of the Creosote Bush by Birds. *Condor* 48 (4), July 1946:179.

BALDWIN, WILLIAM P. Clam catches oyster-catcher. *Auk* 63 (4), Oct. 1946:589, pl. 15.

JONES, F. M. Double-crested Cormorants caught in fykes. *Auk* 63 (4), Oct. 1946: 592.

LARRISON, EARL J. Biotic Areas in the Pacific Northwest. *Murrelet* 27 (2), May 1946:19–24.

PETTINGILL, OLIN SEWALL, JR. King Rail impaled on barbed wire. *Auk* 63 (4), Oct. 1946:591, pl. 16.

WING, LEONARD. Species Association in Winter Groups. *Auk* 63 (4), Oct. 1946: 508–511.

See also *Life History and Behavior:* Fitch *et al.* (2 titles), Smith; *Food and Feeding Habits:* Van Tyne.

LIFE HISTORY AND BEHAVIOR

BRIGHAM, EDWARD M. III. Some Early Nesting Records of Bluebirds in 1945 and 1946. *Jack-Pine Warbler* 24 (3), July 1946:96–98, pl. 9.

CULBERTSON, A. E. Occurrences of Poor-wills in the Sierran Foothills in Winter. *Condor* 48 (4), July 1946:158–159.

FITCH, HENRY S., FREEMAN SWENSON, and DANIEL F. TILLOTSON. Behavior and Food Habits of the Red-tailed Hawk. *Condor* 48 (5), Sept. 1946:205–237, figs. 43–50.

FITCH, HENRY S., BEN GLADING, and VERL HOUSE. Observations on Cooper Hawk Nesting and Predation. *Calif. Fish and Game* 32 (3), July 1946:144–154. (Reference from C. T. Black.)

GANIER, ALBERT F. Sparrow Hawk Nests in a Cliff. *Migrant* 17 (2), June 1946:26.

GUNTHER, LLOYD F. Copulation Performed by Killdeer During Incubation Period. *Condor* 48 (4), July 1946:180.

HARRISON, JAMES M. Sun-bathing by Birds. *Brit. Birds* 39 (9), Sept. 1946:276.

HODGES, JIM. Cowbird eggs in Rose-breasted Grosbeak's nest. *Auk* 63 (4), Oct. 1946:590.

HOLSTEIN, VAGN. Duehøgen. *Astur gentilis dubius* (Sparrman). *Biol. Stud. Danske Rovfugle* 1, 1942:1–155, illus. (With English summary, pp. 129–140.)

JACOBS, DON. First Minnesota Nesting of the Philadelphia Vireo. *Flicker* 18 (3), Sept. 1946:57.

JENSEN, POUL VALENTIN. Nogle Iagttagelser over Sandternens (*Gelochelidon nitotica* [*nilotica*] (Gm.)) Biologi. *Dansk Ornith. Foren. Tidsskr.* 40 (2), June 1946:80–96, 8 figs. ("Observations on the Biology of the Gull-billed Tern," English summary.)

KEMPKES, JAY A. Arctic Three-toed Woodpecker Nesting in Washington. *Murrelet* 27 (2), May 1946:26–27, 3 photos.

LINDSEY, ALTON A. The Nesting of the New Mexican Duck. *Auk* 63 (4), Oct. 1946:483–492, pls. 12–13. ("*Anas diazi novimexicana* Huber.")

MCCABE, ROBERT A., and ARTHUR S. HAWKINS. The Hungarian Partridge in Wisconsin. *Amer. Midl. Nat.* 36 (1), July 1946:1–75, 29 figs.

MARKLE, JESS M. A Nesting Site of the Lark Sparrow. *Condor* 48 (5), Sept. 1946:245–246, figs. 51–53.

MAYNARD, VERA. Young Birds Returning to Nest. *Brit. Birds* 39 (10), Oct. 1946: 313.

MEIKLEJOHN, R. F. Some Observations on Clutch-size. *Ibis* 88, July 1946:383–386.

MONK, HARRY C. A Kingbird Roost. *Migrant* 17 (2), June 1946:17–19.

SCHORGER, A. W. Unusual display of the Myrtle Warbler. *Wils. Bull.* 58 (3), Sept. 1946:186.

STEVENSON, JAMES O., and RICHARD E. GRIFFITH. Winter Life of the Whooping Crane. *Condor* 48 (4), July 1946:160–178, figs. 38–42.

Thomas, Ruth Harris. A Study of Eastern Bluebirds in Arkansas. *Wils. Bull.* 58 (3), Sept. 1946:143–183, 1 fig.

Wagner, Helmuth. Observaciones sobre el comportamiento de *Chiroxiphia linearis* durante su propagacion. *Anales Inst. Biol. Mex.* 16 (2), Feb. 18, 1946:539–546, 1 pl., 2 figs.

Walkinshaw, Lawrence H. Some Prairie Chicken Observations in Southern Michigan. *Jack-Pine Warbler* 24 (3), July 1946:87–90, pl. 8, fig. 2.

Wing, Leonard. Drumming Flight in the Blue Grouse and Courtship Characters of the Tetraonidae. *Condor* 48 (4), July 1946:154–157, fig. 37.

See also *Distribution and Taxonomy:* Hagar, Patten, Schorger, Walkinshaw and Baker, Wetmore.

Food and Feeding Habits

Breiding, George H. Moonseed fruits as bird food. *Auk* 63 (4), Oct. 1946:589.

Knowlton, George F., and P. E. Telford. Insects eaten by Brewer's Blackbirds. *Auk* 63 (4), Oct. 1946:589.

Monson, Gale. Road-runner preys on Poor-will. *Wils. Bull.* 58 (3), Sept. 1946: 185.

Van Tyne, Josselyn. Starling and Brown Thrasher stealing food from Robins. *Wils. Bull.* 58 (3), Sept. 1946:185.

See also *Ecology:* Anderson and Anderson; *Life History and Behavior:* Fitch *et al.* (2 titles), Stevenson and Griffith.

Population (*including age, and mortality rates*)

Lack, David. Do Juvenile Birds Survive Less Well than Adults? *Brit. Birds* 39 (9), Sept. 1946:258–264. (See also a correction, *Brit. Birds* 39 (10), Oct. 1946:320.)

Techniques (*including banding*)

Haverschmidt, Fr. Capture of Adult Ground-Nesting Birds on the Nest for Ringing Purposes. *Dansk Ornith. Foren. Tidsskr.* 40 (2), June 1946:97–107, 4 figs.

Rense, William A. Astronomy and Ornithology. *Popular Astron.* 54 (2), Feb. 1946:55–73, 19 figs.

Woodbury, Angus M., William H. Behle, and John W. Sugden. Color-Banding California Gulls at Great Salt Lake, Utah. *Bull. Univ. Utah* 37 (3), June 30, 1946:1–15, 2 figs.

History, Biography, Bibliography, and Institutions

Breckenridge, W. J., and William Kilgore. Thomas Sadler Roberts (1858–1946). *Auk* 63 (4), Oct. 1946:574–583, pl. 14.

Harris, Harry. An Appreciation of Allan Brooks, Zoological Artist: 1869–1946. *Condor* 48, (4), July 1946:145–153, figs. 28–36.

Kilgore, William. A Memorial Sketch of Dr. Thomas Sadler Roberts. *Flicker* 18 (3), Sept. 1946:47–51, 3 photos.

Kilgore, William. Chronological Bibliography of Thomas Sadler Roberts', M.D., Natural History Writings. *Flicker* 18 (3), Sept. 1946:72–75.

Nice, Margaret Morse. Jan Joost ter Pelkwyk, Naturalist. *Chi. Nat.* 9 (2), 1946: 26–35, illus.

Schorger, A. W. Some Wisconsin Naturalists. Wis. Soc. Ornith., Inc., Madison, Wis. 1946: 50 pp., illus. (Eight biographies reprinted from the *Passenger Pigeon,* 1944–46. $1.00. Obtainable from N. R. Barger, 4333 Hillcrest Dr., Madison 5, Wis.)

Zimmer, John T. Frank Michler Chapman 1864–1945. *Science* 104 (No. 2694), Aug. 16, 1946:152–153.

See also *Distribution and Taxonomy:* Duvall, Farley.

WILDLIFE CONSERVATION

Where Are All the Ducks?

Waterfowl are in trouble again. The splendid upward trend of the early forties has been reversed: wildfowl are on the downgrade. Drought and overshooting appear to be the main causes.

Harsh words? They fit the situation—a situation which has been beclouded by accounts of a waterfowl "comeback," of "record crops" winging south, of "drought proof nesting grounds," and by demands for the return of baiting and live decoys. It is discussed in some detail in "Hearings before the Select Committee on Conservation of Wildlife Resources, House of Representatives, Seventy-ninth Congress, Second Session" (Govt. Printing Office, Washington, D.C., 1946: iii + 340 pp.). At these hearings the Fish and Wildlife Service pointed out that between January 1944 and January 1946 the wildlife population decreased 36 per cent, while the number of wildfowl hunters (as measured by duck stamp sales) increased 44 per cent; that we are in the second or third year of a new drought, which already extends to the Peace River district—much farther north than the last great drought; that, as a result, probably not more than 50 per cent of the breeding grounds are in normal condition; that the volume of successful nesting has been going down; and that, while a breeding stock of at least 150,000,000 waterfowl is needed to balance the present hunting demand, there were this January only about 80,000,000. And *"we have overshot our annual increase during the past two hunting seasons"* [i.e., 1944 and 1945], according to Albert M. Day (Mimeo. release, "The Problem of Increased Hunting Pressure on Waterfowl," address given at the 11th N. Amer. Wildl. Conf., N.Y., 12 March 1946).

Granted that the Fish and Wildlife Service figures are not everywhere agreed with, there is additional evidence. The National Audubon Society, in a news release dated 25 March 1946, says: "There was overwhelming testimony presented at the recent North American Wildlife Conference in New York City to the effect that the continental waterfowl supply is substantially less than it was a year ago. . . . The recent cycle of rising waterfowl population appears to have quite definitely passed and a cycle of declining waterfowl supply appears to be well underway." Carl D. Shoemaker, Washington correspondent for the National Wildlife Federation, writes (*Conservation News,* 1 June 1946): "The outlook is dismal for ducks this year. Even though the breeding season is highly favorable it is not believed that anywhere near the number of birds will start south as did last year. . . . We are up against a condition, not a theory. . . ." State game officials, in a survey conducted by *Sports Afield* (March, 1946, p. 28) reported that there were fewer ducks in 1945 than in 1944 in 26 states, more in 17, and the same number in 5. Ducks Unlimited has repeatedly headlined the idea that the poorer hunting of the past several years has been due to "freak weather," "the vagaries of migration," and the like (*D. U. Quart.,* for example, the issue for Spring, 1946, p. 1; and *The Duckological*); the organization claims that the fall population in Canada in 1945 reached "about the same number as in 1944," despite the fact that its own observers reported a markedly lessened flight through the United States in the fall of 1945 (*The Duckological,* 15 March 1946).

In short, reproduction is not keeping pace with destruction. In outline, the situation is this:

1. Given an adequate breeding stock, water is the most important single factor governing breeding success. The waterfowl population dropped to its lowest recorded level during the last major drought. From January 1935 until January 1944, during a wet period, it increased from less than 30,000,000 to about 125,-

000,000 (145,000,000 before the 1943 hunting season), according to Fish and Wildlife Service estimates. A new drought has begun. Despite the extensive water restoration program of the Canadian government and the smaller one of Ducks Unlimited, last winter the population was estimated at 80,000,000 at the close of the hunting season. And the drought has not yet been broken.

2. It is estimated that 70 to 80 per cent of the ducks and geese breed north of the United States. It follows that waterfowl management here cannot quickly improve breeding success to any marked degree. It can, and must, influence the factors causing destruction. The restoration of feeding and resting areas along the several migration routes, and of wintering grounds, are essential parts of this program. Although the northern breeding grounds offer a more spectacular problem, their complete restoration could not save a population which had no place in which to winter.

3. The hunters' kill must be governed by the size of the waterfowl population. With a reasonably large breeding stock to start with, if breeding success can be raised or migration- and wintering-losses lowered, the hunters' kill can safely be increased: such was the case between 1935 and 1944. Breeding success has been hard hit by drought. It is the *total* of all losses that determines how many will return to breed next year: of these, the hunters' kill can be lowered most quickly and surely. Hunting restrictions were increased this year.

4. When the rains come again, there must be breeding stock enough to make use of the improved circumstances. It takes ducks to produce ducks.

Some may argue that since drought has reduced the continental carrying capacity for waterfowl, there is a large surplus of doomed birds which may as well be harvested; or that, on the theory of flyway segregation, certain states should be permitted much larger kills than others. Waterfowl ecology is still too little understood to allow such proposals to be taken seriously. Local concentrations—"Plenty of ducks on my old hunting ground; what's all this talk of a shortage?"—may confuse the issue. During the next few years there will be no easy way to an understanding of the situation, and no simple remedy for it. The conservative course will be to work harder than ever on the known ways of increasing the population, to try harder than ever to find new ones, and to make certain that there will be enough breeding stock when the marshes are filled again.

These are the hard facts of the situation. If they are lost sight of, waterfowl may fall back to the low of 1934. They are about half way there already.—F.N.H.

Wildlife Conservation Committee
Frederick N. Hamerstrom, Jr., *Chairman*

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West Virginia University, Morgantown, West Virginia 1927
Broun, Maurice, Route 2, Kempton, Pennsylvania 1935
Brown, Clarence D., 222 Valley Rd., Montclair, New Jersey 1938
Brown, E. E., Davidson College, Davidson, North Carolina 1945
Brown, N. Rae, Department of Forestry, University of
New Brunswick, Fredericton, New Brunswick, Canada 1945
Brownsey, Mrs. Edgar George, 2911 San Isidro St., Tampa, Florida ...1946
Brueggemann, Miss Anna L[ouise], 584 Sheridan Ave.,
Columbus 9, Ohio 1943
*Bruns, James Henry, 724 Whitney Bldg., New Orleans 12, Louisiana ...1941
*Bryens, Oscar McKinley, % K. E. Darrow, 231 S. Main St.,
Three Rivers, Michigan 1924
Buchanan, Forest Wendell, Amsterdam, Ohio 1939
*Buchheister, Carl W., 1006 Fifth Ave., New York City 28 1943
Buckstaff, Ralph Noyes, Oshkosh Public Museum, Oshkosh, Wisconsin ..1941
Bundy, M[alcolm] F[oland], Route 2, Atlanta, Indiana 1941
**Burelbach, Maj. Martin J., 510 W. 4th St., Chattanooga 3, Tennessee ..1942
Bures, Joseph August, Riverdale Apts., Apt. 4B, Fenway S.,
Baltimore 21, Maryland 1946
Burget, Russel Lincoln, 526 Devon Place, Toledo 10, Ohio 1944
Burland, Lee J[ohnson], 138½ River St., Oneonta, New York 1939
*Burleigh, Thomas D[earborn], Fish and Wildlife Service,
316 Glenn Bldg., Atlanta, Georgia 1922
*Burlinghame, Mrs. Virginia Struble, 812 S. 8th St., Bozeman, Montana .1946
Burr, Dr. Irving Wingate, 265 Littleton St., West Lafayette, Indiana ...1945
Burroughs, Raymond Darwin, Game Division, Department of
Conservation, Lansing 13, Michigan 1937
*Burt, William Henry, Museum of Zoology, University of Michigan,
Ann Arbor, Michigan 1928
Bussewitz, Albert William, 10 Straub St., Rochester 13, New York 1943
*Butchart, G. Reeves, Museum of Zoology, University of Michigan,
Ann Arbor, Michigan 1943
Cadbury, Joseph Moore, Johnson Court 1, 16 E. Johnson St.,
Germantown, Philadelphia 44, Pennsylvania 1943
Cadman, Frederick L., 20 Exchange Place, New York City 5 1945
Cagle, Fred R., Department of Zoology, Tulane University,
New Orleans 15, Louisiana 1942
*Cahalane, Victor H[arrison], National Park Service,
Merchandise Mart, Chicago 54, Illinois 1933
Caldwell, Miss Sara Elizabeth, 220 E. Lincoln St., Findlay, Ohio 1946
Calhoun, John B[umpass], Department of Entomology and Zoology,
Ohio State University, Columbus 10, Ohio 1935
Calvert, Earl Wellington, Box 64, Haliburton, Ontario, Canada 1937

Calvert, William J[onathan] Jr., 615 N. Pelham Rd.,
Jacksonville, Alabama 1942
Campbell, Mrs. Edith Abbot, Lyme Rd., Hanover, New Hampshire ...1945
Campbell, John David, 319 Ford St., Geneva, Illinois 1944
*Campbell, Louis W[alter], 4531 Walker Ave., Toledo 12, Ohio 1926
*Campbell, Miss Mildred F[lorence], 29 N. Hawthorne Lane,
Indianapolis 1, Indiana 1938
Campbell, Thomas Hodgen, 24 15th Ave., Columbus 1, Ohio 1946
Carnes, Mrs. Herbert E., 25 Kenwood Rd., Tenafly, New Jersey 1944
*Carpenter, Floyd S., 2402 Longest Ave., Louisville 4, Kentucky 1934
Carpenter, Dr. John L., 402 Walnut St., Alexandria, Indiana 1946
Carpenter, Mrs. John L., 402 Walnut St., Alexandria, Indiana 1946
Carpenter, Mrs. Lana L., 915 Mendocino Ave., Berkeley 7, California ...1945
*Carroll, Lt. Col. Robert P., 8 Honeysuckle Hill, Lexington, Virginia 1942
***Carrothers, Miss Vera, 14704 Alder Ave., East Cleveland 12, Ohio 1938
*Carruth, Dorothy Ferrell (Mrs. Wade H.), Box 912,
Corpus Christi, Texas 1945
**Carter, Russell Webster, 126 N. MacArthur Blvd., Springfield, Illinois ..1946
*Cartwright, Bertram William, 59 Elm Park Rd.,
Winnipeg, Manitoba, Canada 1930
Case, Leslie Delos Sr., % General Delivery, Randolph Field, Texas 1938
Cassel, J[oseph] Frank[lin], Department of Zoology,
Colorado A. & M. College, Fort Collins, Colorado 1940
Castle, Eugene Spencer, 80 S. State St., Elgin, Illinois. 1936
*Cater, Milam B[rison], P.O. Box 133, Millboro, Virginia 1944
*Cavendish, Miss Virginia G., 1661 Sixth Ave., Huntington, West Virginia 1946
**Chamberlain, Charles A[biel], 119 N. Chestnut St.,
Palmyra, Pennsylvania 1945
*Chamberlain, C[harles] E[dward], Box 186, San Marcos, Texas 1944
**Chambers, W[illie] Lee, Robinson Rd., Topanga, California 1909
Chance, Edgar P[ercival], Gurdons, Witley, Godalming, Surrey, England 1941
*Chapin, James P., American Museum of Natural History,
79th St. and Central Park West, New York City 24 1945
Chapman, Floyd B[arton], 1944 Denune Ave., Columbus 3, Ohio 1932
Chapman, Lawrence B., 1 Woodridge Rd., Wellesley 81, Massachusetts .1940
Chapman, Mrs. Naomi Fran, Flossmoor, Illinois 1945
*Chase, Henry B. Jr., 517 Decatur St., New Orleans 16, Louisiana 1932
**Chatham, Comdr. Thurmond, 112 Stratford Rd., Winston-Salem,
North Carolina 1945
**Church, Charles Thomas, 70 Pine St., New York City 5 1945
Chutter, Miss Mildred C., Box 229, Athens, Ohio 1936
Clapp, G[eorge] Howard, Pabst Farms, Oconomowoc, Wisconsin 1941
Clark, James Robert, Route 3, Bucyrus, Ohio 1945
*Clarkson, Mrs. Edwin O., Wing Haven, 248 Ridgewood Ave.,
Charlotte, North Carolina 1940
Clemens, William Bryson, 40 N. Church St., Cortland, New York 1942
Clement, Roland C[harles], 49 Tremont St., Fall River, Massachusetts ..1941
*Clow, Miss Marion, Box 163, Lake Forest, Illinois 1929
Coats, Miss Ruth Emily, 702 E. 1st St., Tillamook, Oregon 1942
*Coffey, Ben Barry Jr., 672 N. Belvedere, Memphis, Tennessee 1927
Coffey, Wesley A., 544 Tabor St., Adrian, Michigan 1946
Cogswell, Howard L[yman], 2610 S. Durfee Ave., El Monte, California 1944
*Cole, Leon J[acob], Department of Genetics, University of Wisconsin,
College of Agriculture, Madison 6, Wisconsin 1921
*Coles, Victor, 2910 Grasselli Ave., Westwood, Cincinnati, Ohio 1929

Collias, Lt. Nicholas E., Address unknown 1945
*Collins, Grenold, Box 404, Anchorage, Alaska 1946
Common, Mrs. James A., 141 Flower Ave., W., Watertown, New York ..1945
Compton, Miss Dorothy M., 22 Wilton St., Princeton, New Jersey 1945
Compton, Henry Wolford Jr., 755 E. Mulberry St., San Antonio, Texas 1946
*Compton, Lawrence Verlyn, Biology Division, Soil Conservation Service, Washington 25, D.C. 1923
*Congdon, Dr. Russel T[hompson], Medical Arts Bldg., Wenatchee, Washington 1944
Conn, Dr. Robert Carland, 769 Park Ave., Bound Brook, New Jersey ..1945
**Conover, H. B[oardman], 6 Scott St., Chicago 10, Illinois 1944
Conrad, Charles L[ouis], 1206 Warwood Ave., Wheeling, West Virginia 1937
Conway, Albert E., Department of Psychology, St. Lawrence University, Canton, New York 1939
*Cooch, Graham, 685 Echo Dr., Ottawa, Ontario, Canada 1945
*Cook, Miss Fannye Addine, State Fish and Game Commission, 2550 N. State St., Jackson 44, Mississippi 1923
Cook, Frankland S., 20 Lynd Ave., Toronto, Ontario, Canada 1946
***Cooley, Miss Eleanor Graham, R.F.D., Berwyn, Maryland 1936
Coombes, Robert Armitage Hamilton, Sea Bank, Bolton-le-Sands, Carnforth, Lancashire, England 1936
Corn, Lawrence R., 329 N. 41st St., Camden, New Jersey 1945
*Cottam, Clarence, Fish and Wildlife Service, Merchandise Mart, Chicago 54, Illinois 1929
Cottrell, George William Jr., 70 Lake View Ave., Cambridge 38, Massachusetts 1941
*Court, Edward J., 1723 Newton St., N.W., Mt. Pleasant, Washington, D.C. 1944
Craighead, Frank C., Moose, Wyoming 1941
Crane, Mrs. Myrick, Wonalancet, New Hampshire 1945
Crowder, Orville W., Chase, Maryland 1946
Cross, Edmund R[ust], 1751 University Ave., San Diego 3, California ..1941
*Cruickshank, Allan Dudley, Highland Hall, Rye, New York 1939
Cruttenden, John Rudy, 2020 Maine St., Quincy, Illinois 1945
Cunningham, James W., 3009 E. 19th Terrace, Kansas City, Missouri ...1935
*Currier, Edmonde S[amuel], 8541 N. Chicago Ave., St. Johns Station, Portland, Oregon 1930
Curtis, Elizabeth L[ong], 5648 Beach Dr., Seattle, Washington 1935
*Curtis, Robert A., Route 1, Goffstown, New Hampshire 1945
*Dahlberg, Wendell O[scar], 11312 S. Michigan Ave., Chicago 28, Illinois 1939
Dambach, Charles A., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio 1934
Damon, David, Game, Forestation and Parks Commission, State Capitol, Lincoln, Nebraska 1933
Dana, Edward Fox, 57 Exchange St., Portland, Maine 1939
Danner, May S. (Mrs. John M.), 1646 Cleveland Ave., N.W., Canton, Ohio 1921
**Darden, Mrs. Colgate W[hitehead], Algonquin Park, Norfolk 8, Virginia 1943
Davey, Dr. Winthrop N[ewbury], University Hospital, Ann Arbor, Michigan 1941
*Davidson, William Mark, P.O. Box 66, Laurel, Maryland 1933
Davis, Clifford Vernon, 224 S. Church, Bozeman, Montana 1945
*Davis, Dr. David E[dward], School of Hygiene and Public Health, Johns Hopkins University, Baltimore 5, Maryland 1940

*Davis, Mrs. Edward M., 159 E. Lyman Ave., Winter Park, Florida ...1946
Davis, George, Route 5, Murfreesboro, Tennessee 1936
Davis, George W., 148 Northfield St., Montpelier, Vermont 1941
*Davis, L[ouie] Irby, Box 988, Harlingen, Texas 1933
Davis, W[illiam] B., Department of Fish and Game, College Station, Texas 1938
Dear, Lt. Col. L[ionel] S[extus], P.O. Box 127, Port Arthur, Ontario, Canada 1939
Dechen, Mrs. Lillian Orvetta, 14 Summer St., Port Dickinson, Binghamton 6, New York 1939
*Decker, C[harles] O., 6450 Kenwood Ave., Chicago 37, Illinois 1938
DeGarmo, William Russell, 306 Belvedere Apts., Charleston, West Virginia 1946
Dehner, Rev. Eugene William, 638 Stewart Ave., Ithaca, New York ...1944
Dehring, Herbert Carl, 501 Superior St., Genoa, Ohio 1946
***Delacour, Jean T., 995 Fifth Ave., New York City 25 1944
Delavan, Wayne G., Route 2, Box 61, Bronson, Kansas 1943
*DeLury, Ralph Emerson, Dominion Observatory, Ottawa, Canada 1920
Denton, J[ames] Fred Jr., 1510 Pendleton Rd., Augusta, Georgia 1945
Derdiger, Mrs. Caroline V., 3122 15th Ave., S., Minneapolis 7, Minnesota 1944
Derleth, August William, Sauk City, Wisconsin 1940
**de Schauensee, Rodolphe Meyer, Devon, Pennsylvania 1945
**DeSelm, Lt. Hal R[awie], H. & S. Co., Base Depot, Camp Elliott, San Diego 44, California 1943
***Desmond, Hon. Thomas C[harles], Box 670, Newburgh, New York ...1942
*Deusing Murl, Milwaukee Public Museum, Milwaukee, Wisconsin 1937
Devitt, Otto Edmund, 218 Eglinton Ave., E., Toronto, Ontario, Canada 1935
Dice, Lee Raymond, Laboratory of Vertebrate Biology, University of Michigan, Ann Arbor, Michigan 1943
Dickinson, J[oshua] C[lifton] Jr., Department of Biology, University of Florida, Gainesville, Florida 1939
Dickinson, Mrs. William Winston, 2006 Reid Ave., Bluefield, West Virginia 1942
Dierker, William W[ilfrid], 4186a Sacremento, St. Louis 15, Missouri ..1944
**Dilger, William Christopher, 126 Lake Ave., Hilton, New York 1946
Dille, Frederick Monroe, 822 Grand Ave., Nogales, Arizona 1912
Diller, Oliver Daniel, 1433 Beall Ave., Wooster, Ohio 1945
Dingle, Edward von Siebold, Huger, South Carolina 1921
*Dixon, J[ames] B[enjamin], Route 1, Box 688, Escondido, California ..1936
Dixon, Lt. Keith L., International House, Berkeley 4, California 1946
Dobbins, Miss Edith E., 1456 W. Clifton Blvd., Lakewood 7, Ohio 1941
*Dodge, Victor K[enney], 137 Bell Court West, Lexington 23, Kentucky .1935
*Doering, Hubert R., 2 Midland Gardens, Bronxville 8, New York 1945
Domm, Lincoln V[alentine], Whitman Laboratory of Experimental Zoology, University of Chicago, Chicago 37, Illinois 1936
Donaghho, Walter Raymond, 308 Campus Ave., Pullman, Washington ...1945
*Douglass, Donald W., Game Division, Department of Conservation, Lansing 13, Michigan 1929
*Downer, Alice Porter (Mrs. C. T.), 328 W. Evers Ave., Bowling Green, Ohio 1945
Downing, Paul E[arl], 835 Waukegan Ave., Highland Park, Illinois ...1943
Drey, Miss Minniejane, 1940 Sherman Ave., Evanston, Illinois 1945
Dreyfoos, Wallace David, 1212 Virginia Ave., N. E., Atlanta, Georgia ..1941
Drum, Miss Margaret, 217 South St., Owatonna, Minnesota 1937

*Dudley, John M[unchie], 20 Germain St., Calais, Maine 1944
Duer, Harry E., 9304 Edmunds Ave., Cleveland, Ohio 1941
Duff, C. V., 1922 Tamarind Ave., Hollywood 28, California 1946
*Duffield, Marjorie Olney (Mrs. John W.), 1180 Cragmont Ave., Berkeley 8, California 1940
***Dugan, Dr. William Dunbar, 221 Pierce Ave., Hamburg, New York ..1945
*DuMont, Philip A[tkinson], Fish and Wildlife Service, Merchandise Mart, Chicago 54, Illinois 1928
*Duncan, Donald Pendleton, 509 N. 17th St., Manhattan, Kansas 1936
Dundas, Lester Harvey, Horicon Wildlife Refuge, Waupun, Wisconsin ..1943
Dusi, Julian L[uigi], 251 Taylor Station Rd., Blacklick, Ohio 1941
*Duvall, Allen Joseph, Fish and Wildlife Service, Washington 25, D.C. ..1942
*Eagleson, Joseph P. 85 E. Gay St., Columbus 15, Ohio 1943
*Eastman, Whitney H[askins], % General Mills, Inc., Chamber of Commerce Bldg., Minneapolis, Minnesota 1941
*Eastwood, Sidney Kingman, 5110 Friendship Ave., Pittsburgh 24, Pennsylvania 1928
Eaton, Stephen W[oodman], 808 S. Main St., Geneva, New York 1942
*Edge, Mrs. Charles N[oel], 1215 Fifth Ave., New York City 29 1931
**Edwards, Robert Davis, % Stock Trend Service, 3rd National Bank Bldg., Springfield, Massachusetts 1945
***Edwards, Robert L., 81 Hamilton St., Hamilton, New York 1945
*Edwards, Sylvia P. (Mrs. Robert L.), 81 Hamilton St., Hamilton, New York 1946
*Ehringer, Mrs. Virginia S., Easton, Illinois 1946
*Eifert, Virginia Snider (Mrs. H. D.), Illinois State Museum, Springfield, Illinois 1941
*Eifrig, Charles William Gustave, Windermere, Orange Co., Florida 1907
Eisenmann, Eugene, 110 W. 86th St., New York City 1942
*Ekblaw, George Elbert, 511 W. Main St., Urbana, Illinois 1914
*Ekblaw, Walter Elmer, Clark University, Worcester, Massachusetts 1910
**Eklund, Dr. Carl Milton, 94 Bedford St., S.E., Minneapolis 14, Minnesota 1945
Elder, William H[anna], 105 Wildlife Conservation Bldg., University of Missouri, Columbia, Missouri 1938
*Elliott, Richard M., 1564 Vincent St., St. Paul 8, Minnesota 1940
Ellis, Miss Hazel R[osetta], Kenka College, Kenka Park, New York 1942
Emerson, David L[owell], 25 Everett Ave., Providence, Rhode Island ...1939
*Emerson, Guy, 16 Wall St., New York City 1938
*Emilio, S[hepard] Gilbert, Route 4, Laconia, New Hampshire 1929
Emlen, John Thompson Jr., Department of Zoology, University of Wisconsin, Madison 6, Wisconsin 1936
Empey, Miller, Freeland, Michigan 1939
*English, Pennoyer Francis, Department of Zoology, Pennsylvania State College, State College, Pennsylvania 1934
Ennis, J[ames] Harold, Cornell College, Mt. Vernon, Iowa 1942
*Erickson, Mary M[arilla], University of California Santa Barbara College, Santa Barbara, California 1930
Erickson, Ray C[harles], 1104 Washington Ave., St. Peter, Minnesota ..1939
*Errington, Paul L[ester], Iowa State College, Ames, Iowa 1932
Etz, Mrs. Elizabeth Cecelia, Thornhedge, Wheeling, West Virginia 1940
**Eustice, Mrs. Alfred L., 1138 Sheridan Rd., Evanston, Illinois 1944
*Evans, Dr. Evan Morton, 550 Park Ave., New York City 1929
Evans, Ulmont L., 3112 S. Fourth St., Shelbyville, Illinois 1945
Fahrenholz, Fred E[mery], 2912 Elmo Place, Middletown 20, Ohio 1942

Fales, John H[ouse], 1917 Elkhart St., Silver Spring, Maryland 1939
**Fargo, William G[ilbert], 506 Union St., Jackson, Michigan 1923
*Farmer, Earl Wilson, Box 1362, Steubenville, Ohio 1946
*Farner, Donald S[ankey], Museum of Natural History, University of Kansas, Lawrence, Kansas 1941
*Farrar, Merritt Calvin, 339 Park Ave., Mishawaka, Indiana 1946
Feighner, Miss Lena Veta, 298-1 S. Tremont St., Kansas City, Kansas ..1935
Feigley, Miss Margaret D[enny], 544 Chestnut St., Winnetka, Illinois ..1944
Fetherston, Miss Kathleen Elizabeth, Fernow Hall, Cornell University, Ithaca, New York 1946
*Finster, Miss Ethel B., Louisburg College, Louisburg, North Carolina ...1931
Fischer, Richard B[ernard], 140-19 Beech Ave., Flushing, New York ...1942
Fleetwood, Raymond J[udy], Piedmont Wildlife Refuge, Round Oak, Georgia 1931
Fleugel, James Bush, 1104 American National Bank Bldg., Kalamazoo, Michigan 1942
Floyd, E[arl] Pershing, Northeastern State College, Tahlequah, Oklahoma 1939
*Floyd, Judge Joseph Larke, 302 Citizens Bldg., Canton, Ohio 1903
Flynn, Michael B[urke], 282 Rider Ave., Syracuse 4, New York 1942
Folger, Miss Edith Virginia, 202 S. Campus Ave., Oxford, Ohio 1946
*Foote, Maurice E[dwin], Route 1, Mantua, Ohio 1932
Ford, Edward R[ussell], Newaygo, Michigan 1914
Forsyth, Mrs. Louise A[nn], 71 Lebanon Rd., Hanover, New Hampshire 1940
*Fox, Adrian C., Box 1451, Lincoln, Nebraska 1937
*France, H[orace] Owen, Biology Department, Clark University, Worcester, Massachusetts 1941
Freer, Marion F. (Mrs. R. Lloyd), 346 3rd Ave., E., Kalispell, Montana 1942
**French, Mrs. Elizabeth Thomas, 1801 Las Lomas, Albuquerque, New Mexico 1943
Frey, Edward Snively, 517 Hummel Ave., Lemoyne, Pennsylvania 1944
Frye, O. Earle Jr., 432 Avenue A., N.E., Winter Haven, Florida 1940
Fryman, Miss Kathyrn E[lizabeth], 114 Oak St., Wyandotte, Michigan ..1943
Funsten, R[andolph] Fairfax, 1515 Delmar Blvd., St. Louis 3, Missouri ..1944
*Furniss, Owen C[ecil], Port Alberni, Vancouver Island, British Columbia, Canada 1934
*Gabrielson, Ira N[oel], 1807 Preston Rd., Parkfairfax, Alexandria, Virginia 1913
Gaillard, Stephen Lee, 9 Lee Place, Bronxville, New York 1942
Gaines, Jack Raymond, 411 W. Koch St., Bozeman, Montana 1945
Galley, John E., 3543 E. 22nd St., Tulsa 4, Oklahoma 1945
*Gammell, Dr. Robert T[heodore], Kenmore, North Dakota 1943
**Ganier, Albert F[ranklin], 2112 Woodlawn Dr., Nashville 5, Tennessee 1915
*Gardner, Irvine M., % Hudson Bay Co., Wolstenholme Post, Eastern Arctic Patrol, Ottawa, Canada 1945
Garrett, Miss [Mary] Lois, 1709 Chestnut St., Kenova, West Virginia ...1942
Garrison, David L[loyd], Lincoln, Massachusetts 1940
Garth, Dr. John S., 515 Nebraska Ave., Long Beach 4, California 1945
Gashwiler, Jay S., Maine Wildlife Research Unit, University of Maine, Orono, Maine 1944
Gatterdam, Paul C[hristoffers], 2539 Edgewood Place, LaCrosse, Wisconsin 1940
Gavin, Angus, % Ducks Unlimited, 201 Bank of Commerce Bldg., Winnipeg, Manitoba, Canada 1942

Gensch, Robert Henry, Lake States Forest Experiment Station, University Farm, St. Paul 8, Minnesota 1939
Geren, Roy S., 123 W. High St., Columbus Grove, Ohio 1945
Gershten, Miss Blossom, 2816 Cortland St., Brooklyn 24, New York 1944
Gerstell, Richard, Pennsylvania Game Commission, Harrisburg, Pennsylvania 1939
Ghent, Percy, 425 St. Clair Ave., E., Toronto, Ontario, Canada 1946
Gibbs, Walter C., Whitehall, Michigan 1941
Gier, Herschel Thomas, Ohio University, Athens, Ohio 1937
Gifford, Harold, 3636 Burt, Omaha, Nebraska 1936
Gilbert, Gareth, 2422 Indianola Ave., Columbus, Ohio 1943
Gilbert, Miss Kathryn Helen, 714 1st Ave., W., Grand Rapids, Minnesota 1945
**Gillen, Harold W., Denslow Rd., New Canaan, Connecticut 1944
Gillette, Mrs. Darwin Clay, Box 73, Ulster, Pennsylvania 1946
Gillette, D[elbert] A[sa], Route 5, Yakima, Washington 1942
Gilligan, James P., Valentine National Wildlife Refuge, Valentine, Nebraska 1938
Giltz, Maurice L[eroy], 841 Lincoln Way, N.W., Masillon, Ohio 1939
Ginn, William Edward, 511 E. Van Buren, Columbia City, Indiana 1941
Givens, Laurence S[pessard], Box 134, Decatur, Alabama 1943
Glass, Bryan P., Department of Zoology, Oklahoma A. & M. College, Stillwater, Oklahoma 1946
Glenn, Robert W., 509 Orchard Ave., Avalon, Pittsburgh 2, Pennsylvania 1934
Gloyd, Howard K[ay], Chicago Academy of Sciences, 2001 N. Clark St., Chicago 14, Illinois 1925
Goebel, Herman John, 78-52 80th St., Brooklyn 27, New York 1946
**Goetz, Christian John, 3503 Middleton Ave., Cincinnati 20, Ohio 1930
Goldthwaite, Miss Marion, 210 Berkley Rd., Indianapolis 8, Indiana 1946
Good, Ernest E[ugene], Route 1, Van Wert, Ohio 1937
Goodman, John David, 1905 Cambridge Rd., Ann Arbor, Michigan ... 1944
*Goodridge, Edwin Tyson, Province Line Rd., Princeton, New Jersey ... 1944
*Gordon, J[esse] Halford, 139 E. Second Ave., Roselle, New Jersey 1942
*Goslin, Charles R[ussell], 726 E. King St., Lancaster, Ohio 1940
*Goslin, Robert M[artin], 316 Wilson Ave., Columbus 5, Ohio 1936
Gough, William McDonald, 28 Baby Point Rd., Toronto, Ontario, Canada 1944
*Gram, Margaret Edwards (Mrs. H. James Jr.), 207 McKinley Ave., Detroit 30, Michigan 1941
Grannis, Harriet Dudley (Mrs. J. Kidwell), Flemingsburg, Kentucky ... 1944
Granrud, Walter H[jalmer], 1910 Elm St., Lawton, Oklahoma 1941
*Grant, Cleveland P[utnam], 245 Davis St., Mineral Point, Wisconsin ... 1928
Graves, Miss Katherine [Cynthia], 1209 N. Illinois St., Apt. 28, Indianapolis 2, Indiana 1942
*Gray, William Arthur, Room 646, 224 S. Michigan Ave., Chicago 4, Illinois 1938
Grayce, Robert, 141 Main St., Rockport, Massachusetts 1946
Greeley, Fred[erick], 1121 Rutledge St., Madison, Wisconsin 1942
Green, N[orman] Bayard, Zoology Department, Marshall College, Huntington, West Virginia 1943
**Greene, Albert E., 517 Oswego St., Ann Arbor, Michigan 1939
*Greene, Earle R[osenbury], 116 S. Scott St., New Orleans 19, Louisiana 1930
Greenhalgh, Clifton M., 1230 E. 1st St., S., Salt Lake City 2, Utah 1939
*Gregory, Stephen S[trong] Jr., Box N, Winnetka, Illinois 1922
*Griffin, William Welcome, 135 Peachtree Way, N.E., Atlanta, Georgia .. 1946

Grimes, S[amuel] A[ndrew], Route 6, Box 82 G, Jacksonville 7, Florida 1924
*Grimm, William C[arey], P.O. Box 424, Linesville, Pennsylvania 1939
*Grinnell, Lawrence I[rving], 710 Triphammer Rd., Ithaca, New York ...1939
**Griscom, Ludlow, Museum of Comparative Zoology,
Cambridge 38, Massachusetts 1937
Grose, E. R., Sago, West Virginia 1939
*Groskin, Horace, 210 Glenn Rd., Ardmore, Pennsylvania 1937
*Gross, Alfred Otto, 11 Boody St., Brunswick, Maine 1927
*Grossenheider, Richard P., 5415 Gilmore Ave., St. Louis, Missouri 1941
*Guelf, George F., Brockport, New York 1944
*Guest, Mrs. Thomas K., Star Route, Rushford, New York 1946
Guller, Miss Alice Adelaide, 22 Hamilton St., Hamilton, New York ...1946
*Gunderson, Harvey Lorraine, % H. H. Gunderson, Gary, Minnesota ..1941
Hadeler, Miss Catherine Wilma, 900 Harmon Ave., Dayton 9, Ohio ...1945
*Hadley, Thomas E., 48 Wellesley Dr., Pleasant Ridge, Michigan 1944
Haecker, Fred Woods, Box 191, Kemmerer, Wyoming 1938
**Hagar, Mrs. Jack, Box 339, Rockport, Texas 1930
*Hague, Florence S., Sweet Briar College, Sweet Briar, Virginia 1931
Haight, Robert Duane, 2035 Bay Shore Blvd., Rochester 9, New York ...1945
Haines, T. P., Biology Department, Mercer University, Macon, Georgia 1941
*Hainsworth, William P[ickard], 216 Railroad Ave., North Andover,
Massachusetts 1930
*Hall, Fred T., 1215 Danville Ave., Crawfordsville, Indiana 1937
*Hall, George Arthur, Department of Chemistry,
University of Wisconsin, Madison 6, Wisconsin 1946
Haller, Frank D[enver], 125 S. Second St., Coshocton, Ohio 1940
*Hallman, Roy Cline, Box 826, Panama City, Florida 1928
*Hamerstrom, Frederick N. Jr., Edwin S. George Reserve,
Pinckney, Michigan 1934
*Hamilton, William J[ohn] Jr., Department of Zoology, Cornell
University, Ithaca, New York 1933
*Hammond, Merrill C[lyde], Upham, North Dakota 1939
Hampe, Irving E., 5559 Ashbourne Rd., Halethorpe,
Baltimore 27, Maryland 1945
Hancock, James William, Route 1, Madisonville, Kentucky 1946
*Handlan, John W[elty], 409 41st St., S.E., Charleston 4,
West Virginia 1932
*Handley, Charles Overton, Virginia Polytechnic Institute,
Blacksburg, Virginia 1925
*Handley, Charles Overton Jr., Blacksburg, Virginia 1941
*Hann, Harry W[ilbur], Department of Zoology, University of
Michigan, Ann Arbor, Michigan 1930
Hanna, Wilson Creal, 141 East F St., Colton, California 1936
Happ, George Bippus, Principia College, Elsah, Illinois 1935
Hardy, [Cecil] Ross, Department of Zoology, Weber College,
Ogden, Utah 1940
*Harford, Dr. Henry Minor, 926 Argyle Bldg., Kansas City 6, Missouri ..1946
*Harkness, Reed B., 4908 Laclede Ave., St. Louis 8, Missouri 1942
*Harper, Francis, Moylan, Pennsylvania 1930
Harrell, Byron Eugene, 1594 Stanford Ave., St. Paul, Minnesota 1943
**Harriot, Samuel C[arman], 200 W. 58th St., New York City 19 1934
Harris, Dr. Stuart Kimball, 33 Lebanon St., Winchester, Massachusetts 1946
*Harrison, Hal H., The Valley Daily News, Tarentum, Pennsylvania 1941
Hartley, Albert Thomas, Columbiana, Ohio 1944
*Hartman, Frank A[lexander], Hamilton Hall, Ohio State University,
Columbus 10, Ohio 1941

*Hartwell, Arthur M[owry], 1506 Mt. Curve, Minneapolis, Minnesota ..1940
Haskins, Mrs. Edith D., 39 Park St., Hanover, New Hampshire 1941
Hausler, Mrs. M., 7348 Paxton Ave., Chicago, Illinois 1936
**Havemeyer, Henry O[sborne], Mahwah, New Jersey 1930
Haverschmidt, Fr., 14 Waterkant, Paramaribo, Surinam, Dutch Guiana 1946
*Hawkins, Arthur S., Delta Waterfowl Experiment Station, Delta, Manitoba, Canada 1936
Hawkins, B. L., Hamline University, St. Paul 4, Minnesota 1936
Hawksley, Mrs. Janet P., 123 Lafayette Circle, Cincinnati, Ohio 1942
Hawver, Miss Marguerite N., 621 N. Grove St., Bowling Green, Ohio ..1946
*Hazard, Frank O., Wilmington College, Wilmington, Ohio 1946
**Hebard, Frederick V[anuxem], 1500 Walnut Street Bldg., Philadelphia 2, Pennsylvania 1940
Hedges, Harold [Charles], Route 2, Lake Quivira, Kansas City, Kansas 1940
*Hefley, Harold M[artin], Department of Biology, Texas Technological College, Lubbock, Texas 1942
Heft, Orvil F., 15790 Lindsay, Detroit 27, Michigan 1945
*Heidenkamp, Joseph Jr., 538 Glen Arden Dr., Pittsburgh 8, Pennsylvania 1942
Heiser, J[oseph] M[atthew], 1724 Kipling St., Houston, Texas 1939
Helfer, Miss Louise, 111 Ninth St., Watkins Glen, New York 1938
*Hendrickson, George O[scar], Department of Zoology, Iowa State College, Ames, Iowa 1933
Hendrix, Marjorie, Amsterdam, Ohio 1946
*Henry, C. J., Lower Souris Refuge, Upham, North Dakota 1933
Henwood, Mrs. Ethel May, 604 W. Main St., Urbana, Illinois 1941
Herman, Carlton M., 1060 Cragmont Ave., Berkeley 8, California 1946
*Hickey, J[oseph] J[ames], Patuxent Research Refuge, Bowie, Maryland 1940
***Hicks, Lawrence Emerson, Ohio State University, Columbus, Ohio 1925
Hiett, Lawrence D[avison], 1945 Ottawa Dr., Toledo 6, Ohio 1929
Higgins, Harold G[uymon], 455 S. 3rd St., E., Salt Lake City, Utah ...1941
Hill, Herbert Oliver, 2420 Ridge Rd., Berkeley, California 1938
Hill, Julian Werner, 1106 Greenhill Ave., Wilmington 56, Delaware 1935
Hill, Raymond W., 3316 Kenmore Rd., Shaker Heights, Cleveland 22, Ohio 1941
*Hillmer, Davis B., 8228 Woodward Ave., Detroit 2, Michigan 1926
*Hinds, Frank J., Biology Department, Western Michigan College of Education, Kalamazoo, Michigan 1935
Hindwood, K. A., Wingello House, Angel Place, Sydney, Australia 1945
Hinshaw, Thomas D[oane], 1827 San Juan Ave., Berkeley 7, California 1926
Hobson, Dorothy Madden (Mrs. L. G.), 1309 N. Pennsylvania, Apt. 39, Indianapolis 2, Indiana 1935
*Hochbaum, Hans Albert, Delta, Manitoba, Canada 1942
Hock, Raymond James, Fernow Hall, Cornell University, Ithaca, New York 1946
Hodges, Jim, 1034 Harbor Rd., Davenport, Iowa 1946
*Hoff, Clayton M., 810 Blackshire Rd., Wilmington 56, Delaware 1943
Hoffman, Paul William, 8415 Kenyon Ave., Wauwatosa 13, Wisconsin ...1940
Hoffmeister, Linus C[hristian], 504 W. Ripa Ave., Lemay 23, Missouri ..1939
Hofslund, Pershing B[enard], 511 Keech St., Ann Arbor, Michigan 1944
Hoke, Mrs. Glen A., 801 E. 21st St., Little Rock, Arkansas 1946
*Holland, Harold May, Box 615, Galesburg, Illinois 1915
Holsen, James N., 14 N. Edwards, Princeton University, Princeton, New Jersey 1944
Horton, Louise D. (Mrs. M. B.), 360 Prospect St., Fall River, Massachusetts 1941

Hostetter, D[avid] Ralph, Eastern Mennonite School,
Harrisonburg, Virginia 1937
Hotchkiss, Neil, Patuxent Research Refuge, Bowie, Maryland 1940
Hough, Mrs. Eleanor Sloan, 570 Highland Ave., Boulder, Colorado ...1941
Hough, Mrs. Mary [Yeager], 1214 W. Charles, Champaign, Illinois ...1946
Howard, William J[ohnston], 5518 Fairglen Rd., Chevy Chase 15,
Maryland 1940
Howe, [Henry] Branch Jr., 414 W. Ponce de Leon Ave.,
Decatur, Georgia 1943
Howell, Joseph C., Department of Zoology and Entomology,
University of Tennessee, Knoxville, Tennessee 1938
Hoyt, George B[rown], 2603 Habersham Rd., Atlanta, Georgia 1941
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Ithaca, New York 1936
**Hughes, Dr. W.W., Embro, Ontario, Canada 1944
Hulbert, Lloyd Clair, 529 W. Grand River Ave., East Lansing,
Michigan 1938
*Hunt, Ormond Edson, General Motors Bldg., 3044 W. Grand Blvd.,
Detroit 2, Michigan 1937
Hurley, John B[eatty], 401 S. 17th Ave., Yakima, Washington 1937
Hurst, John W. Jr., 522 S. 6th St., Bozeman, Montana 1945
Hutchinson, Arthur E., 715 Mission Canyon Rd., Santa Barbara,
California 1940
Hyde, A[rthur] Sidney, % Chapman College, 766 N. Vermont Ave.,
Los Angeles 27, California 1939
Hyder, Albert E., Department of Botany, Ohio State University,
Columbus 10, Ohio 1945
*Imler, Ralph H., Fish and Wildlife Service, 546 Custom House,
Denver 2, Colorado 1937
Ingersoll, Albert M[ills], 908 F St., San Diego 1, California 1921
**Ingersoll, Marion C[rory] (Mrs. Raymond V.), 4 E. 66th St.,
New York City 21 1942
Ivor, H. Roy, Route 1, Cooksville, Ontario, Canada 1945
*Jackson, C[icero] F[loyd], Director of Biological Institute,
University of New Hampshire, Durham, New Hampshire 1936
*Jackson, Francis Lee, 541 Hammond St., Chestnut Hill, Massachusetts 1941
James, Douglas Arthur, 25455 Dundee Ave., Huntington Woods,
Michigan 1946
Jameson, Everett Williams Jr., 179 Highland Ave., Buffalo, New York 1941
*Janvrin, Edmund R[andolph] P[easlee], 38 E. 85th St., New York City 1942
Jaques, F[rancis] L[ee], 610 W. 116th St., New York City 27 1939
Jaquith, Barbara Elizabeth (Mrs. L. E.), 72 Hudson Dr., Toronto 5,
Ontario, Canada 1943
Jenkins, James H[obart], Box 142, Twinsburg, Ohio 1939
*Jenner, William, 806 W. Davis St., Fayette, Missouri 1933
*Johnson, Clifford O., 987 14th St., Marion, Iowa 1944
*Johnson, Frank Morgan, 404 6th St., Fairmont, West Virginia 1946
Johnson, Miss Mabel Claire, 30 Westfield Rd., West Hartford,
Connecticut 1946
*Johnson, Mrs. Oscar, 38 Portland Place, St. Louis, Missouri 1931
Johnson, Perry Frank, Y.M.C.A., Michigan City, Indiana 1935
*Johnson, Robert A[nthony], 150 East St., Oneonta, New York 1930
Johnson, William M[cNutt], Route 4, Knoxville, Tennessee 1939
Johnston, Miss Verna R[uth], Stockton Junior College, Stockton,
California 1941
*Jonah, Miss Christie May, 221 Anderson St., Hackensack, New Jersey .1942

*Jones, Harold C[harles], Berry College, Mount Berry, Georgia 1929
Jones, John C[ourts], 5420 Connecticut Ave., N.W., Apt. 104, Washington 15, D.C. 1931
****Jones, Lynds, 352 W. College St., Oberlin, Ohio .... Founder
*Jones, S[olomon] Paul, 509 West Ave., N., Waukesha, Wisconsin 1921
Jones, Victor E[mmons], University of Idaho, Southern Branch, Pocatello, Idaho 1938
Jorae, Miss Irene Frances, Central Michigan College of Education, Mt. Pleasant, Michigan 1942
*Jung, Clarence [Schram], 6383 N. Port Washington Rd., Milwaukee 9, Wisconsin 1921
Jurica, E., Lisle, Illinois 1940
Kahmann, Karl W., Route 2, Hayward, Wisconsin 1941
Kahn, Dina H[ope] (Mrs. Reuben L.), 1122 Michigan Ave., Ann Arbor, Michigan 1938
*Kalmbach, Edwin Richard, Fish and Wildlife Service, 546 Custom House, Denver 2, Colorado 1926
*Kase, John C[harles], Versailles, Indiana 1937
*Keating, F[rancis] Raymond Jr., 519 5th Ave., S.W., Rochester, Minnesota 1944
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Keller, Charles Edward, 637 Eastern Ave., Indianapolis 1, Indiana 1946
Kelley, Evelyn (Mrs. George A.), 2300 North La Salle Gardens, Detroit 6, Michigan 1935
*Kelsey, Homer Stone, Box 402, Nyack, New York 1945
*Kelso, Leon H[ugh], 1370 Taylor St., N.W., Washington 11, D.C. 1930
*Kendeigh, S[amuel] Charles, Vivarium Bldg., University of Illinois, Champaign, Illinois 1923
Kendrick, Miss Muriel Sherburne, 201 Pleasant St., Laconia, New Hampshire 1945
Kerr, Mrs. Mary Helen, 1290 Delaware, Springfield, Missouri 1943
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Key, Mrs. J. Frank, Buena Vista, Virginia 1945
Kiefer, Elizabeth D[eyo] (Mrs. Francis), 243 Gratiot Blvd., Port Huron, Michigan 1941
***Kieran, John, 4506 Riverdale Ave., New York City 63 1942
Killip, Thomas III, 139 Edgeview Lane, Rochester 10, New York 1946
Kindler, Mrs. Grace E[mma], Sheridan Drive, Route 1, Lancaster, Ohio 1937
**King, Mrs. Hanley, 1103 N. 2nd St., Ames, Iowa 1944
Kirby, Edward Vincent, 5259 Union Ave., Chicago 9, Illinois 1945
Kirk, Allan D[ixon], 14 Forest Hill Rd., Wilkinsburg, Pennsylvania 1939
*Klein, Richard Paul, 24805 Emery Rd., Warrensville Heights 22, Ohio .. 1946
*Klinkerfuss, Dr. G. H., 340 Bermuda Ave., Normandy, Missouri 1941
*Klinkerfuss, Mrs. G. H., 340 Bermuda Ave., Normandy, Missouri 1941
*Klonick, Allan S., 28 Ericsson St., Rochester 10, New York 1941
Kluge, Miss Helen H[enrika], Woodtick Rd., Waterbury 63, Connecticut 1942
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Knollmeyer, Lewis Edward, Sterling Hall, University of Wisconsin, Madison, Wisconsin 1945
Knox, Miss Margaret R[ichardson], 4030 Park Ave., Indianapolis 5, Indiana 1937
Koch, Peter, Cincinnati Museum of Natural History, Cincinnati 10, Ohio 1939
Koehler, Mrs. Arthur, 109 Chestnut St., Madison, Wisconsin 1941

Koestner, E. J., Central Examining Board, U.S. Naval Air Station,
Pensacola, Florida 1938
Kolb, C[harles] Haven Jr., 5021 Midwood Ave. ,Baltimore 12, Maryland 1937
Korgen, Miss Mollie, 1919 E. 3rd St., Duluth 5, Minnesota 1944
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Canada 1943
Kossack, Charles W., 715 S. Division St., Barrington, Illinois 1945
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Pennsylvania 1943
Kramer, Theodore C[hristian], Department of Anatomy,
East Medical Bldg., Ann Arbor, Michigan 1939
Kraus, Douglas L[awrence], 92 Keene St., Providence 6, Rhode Island 1942
Kreag, Keith K., 1348 Edgewood Ave., Birmingham, Michigan 1942
Krebs, Juanita (Mrs. R. W.), 3416 North Blvd., Baton Rouge 12,
Louisiana 1946
Kritzler, Henry, The Scripps Institution of Oceanography,
La Jolla, California 1945
Krug, Howard H[enry], Chesley, Ontario, Canada 1944
*Krutzsch, Miss Barbara Ellen, 3025 Meridian St., Apt. 401,
Indianapolis, Indiana 1945
Kugel, Miss Agnes L., 330 N. Carroll St., Madison, Wisconsin 1946
Kuitert, Louis Cornelius, Entomology Department, Snow Hall,
University of Kansas, Lawrence, Kansas 1938
*Kutz, George Carl, 705 S. Holcombe St., Stillwater, Minnesota 1944
*Kutz, Harry Leon, Department of Biology, Norwich University,
Northfield, Vermont 1939
*Kyllingstad, Henry C[arrell], Mountain Village, Alaska 1940
*Lacey, George Macrae, 428 N.E. 77th St., Miami 38, Florida 1945
Lacey, Miss Mifton H., Box 614, Canton, Ohio 1939
Laffoon, Jean Luther, 1401 W. 3rd, Sioux City, Iowa 1940
Lagler, Karl F., Department of Zoology, University of Michigan,
Ann Arbor, Michigan 1941
Laitsch, John Theodore, Route 2, East Liverpool, Ohio 1946
Lake, Robert N., Woodstock, Vermont 1941
***Lambert, Bert H., 16854 Wildemere Ave., Detroit, Michigan 1936
*Lambert, Robert John Jr., 2802 Kenmore Ave., Dayton 10, Ohio 1945
Lamore, Donald Hart, 1920 Grace Church Rd., Silver Spring, Maryland 1942
Lanyon, Wesley E[dwin], 23 E. Wheelock St., Hanover,
New Hampshire 1943
*La Rivers, Ira, P.O. Box 1493, Reno, Nevada 1945
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*Larrison, Earl J[unior], 219 Packard St., Ann Arbor, Michigan 1946
Larson, Goodman Kenneth, Fish and Wildlife Service, P.O. Box 1381,
Billings, Montana 1945
*Laskey, Amelia Rudolph (Mrs. Frederick Charles), Graybar Lane,
Nashville 4, Tennessee 1928
*Lattin, Jack Daniel, 5726 W. Ohio St., Chicago, Illinois 1945
Lawrence, Miss Louise deKiriline, Rutherglen, Ontario, Canada 1946
Lawrence, William Hobart, 1410 Decatur St., N.W.,
Washington 11, D.C. 1943
Lay, Daniel Wayne, Silsbee, Texas 1939
Lea, Robert B[ashford], 24 N. Worth Ave., Elgin, Illinois 1940
*Lee, Miss Zell Charlotte, 1423 Douglas St., Sioux City 18, Iowa 1946
*Leebrick, Karl Clayton Jr., Route 3, Canastota, New York 1946

Leedy, Daniel L[ovey], Ohio Wildlife Research Station, Ohio State University, Columbus 10, Ohio 1936
Leenhouts, Miss Pearle Esther, Pease Rd., Williamson, New York 1941
Legg, William C[larence], Mt. Lookout, West Virginia 1939
*Lengemann, Miss Martha G., 360 Cedar St., Imlay City, Michigan 1946
*Leopold, Aldo, 424 University Farm Place, University of Wisconsin, Madison 6, Wisconsin 1928
Leopold, A[ldo] Starker, Museum of Vertebrate Zoology, Berkeley 4, California 1940
*Lesher, Samuel W., 303 N. 17th St., Corvallis, Oregon 1941
Levy, Alice K[lund] (Mrs. H. P.), 235 E. 22nd St., Apt. 11T, New York City 10 1941
*Lewis, Harrison Flint, Lands, Parks and Forest Branch, Department of Mines and Resources, Ottawa, Ontario, Canada 1939
Lewis, Bro. Hubert, LaSalle Institute, Glencoe, Missouri 1940
*Lewy, Alfred, 2051 E. 72nd Place, Windsor Station, Chicago, Illinois 1915
Lieftinck, John E., 1826 W. Market St., Akron 13, Ohio 1945
Lincoln, Frederick Charles, Fish and Wildlife Service, Washington 25, D.C. 1914
*Linsdale, Jean M[yron], Jamesburg Route, Monterey, California 1928
Linton, M[orris] Albert, 315 E. Oak Ave., Moorestown, New Jersey 1941
Livergood, Elmer, 271 Harvard Blvd., Steubenville, Ohio 1945
Lloyd, C[lark] K., 11 N. Elm St., Oxford, Ohio 1925
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Lodge, William R[alph], Route 3, Box 1, Cuyahoga Falls, Ohio 1935
Loetscher, Frederick William Jr., 98 Mercer St., Princeton, New Jersey 1946
Long, Chester, 39 N. Kealing Ave., Indianapolis 1, Indiana 1943
Longley, William H[oward], 334 S. Albert Ave., St. Paul 5, Minnesota 1943
Loop, George Andrew, 205 S. Keystone Ave., Sayre, Pennsylvania 1944
Lord, Frederick P[omeroy], 250½ President St., Dunedin, Florida 1939
Louchrey, Alan, 786 Wellington St., London, Ontario, Canada 1946
Lovell, Harvey B., 3011 Meade Ave., Louisville 4, Kentucky 1936
*Low, Seth Haskell, Salt Plains Wildlife Refuge, Jet, Oklahoma 1931
***Lowery, George H[ines] Jr., Museum of Zoology, Louisiana State University, University, Louisiana 1937
Lowther, Malcolm Alfred, Department of Zoology, University of Michigan, Ann Arbor, Michigan 1944
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Ludwig, Dr. Frederick Edwin, 2864 Military St., Port Huron, Michigan 1941
Lum, Miss Elizabeth C[aroline], Cincinnatus, New York 1940
*Lunk, William A., 29 Bell Run Rd., Fairmont, West Virginia 1937
Lupient, Mrs. Mary [Louise], 212 S.E. Bedford St., Minneapolis, Minnesota 1944
*Luthy, Ferd Jr., 306 N. Institute, Peoria, Illinois 1937
*Lyman, Clara Cross (Mrs. Frederick C.), 1716 Colfax Ave., S., Minneapolis, Minnesota 1944
Lyons, Mrs. Robert C., 115-44 175th St., St. Albans 12, Long Island, New York 1940
MacArthur, John Wood Jr., 200 Glencairn Ave., Toronto, Ontario, Canada 1941
MacDonald, Donald L[aurie], 72 Alexandra Blvd., Toronto, Ontario, Canada 1941
Maclean, Miss Dorothy W[illiams], 21 Ashley St., Hartford 5, Connecticut 1939

*MacLulich, D[uncan] A[lexander], 15 Bellwood Ave.,
Ottawa, Ontario, Canada 1933
*MacMillan, Comdr. Donald Baxter, Provincetown, Massachusetts 1946
*MacMullan, Maj. R[alph] Austin, 28321 Ford Rd.,
Garden City, Michigan 1940
*McAtee, Waldo Lee, Fish and Wildlife Service, Merchandise Mart,
Chicago 54, Illinois 1911
McCabe, Robert A[lbert], 424 University Farm Place,
Madison, Wisconsin 1942
McCamey, Lt. Benjamin Franklin, 1637 Netherwood Ave.,
Memphis, Tennessee 1945
*McClary, Miss Susan C., N. Main St., Windsor, Vermont 1945
McClure, H[owe] Elliott, Box 292, Station A, Bakersfield, California ...1942
*McCormack, Richard John, 815 W. Breckenridge, Ferndale 20,
Michigan 1945
*McCue, Earl Newlon, Box 104, Morgantown, West Virginia 1941
*McCullagh, E[rnest] Perry, 2020 E. 93rd St., Cleveland, Ohio 1937
McDonald, Malcolm E., P.O. Box 42, Ann Arbor, Michigan 1936
**McGaw, Mrs. G. Hampton, 18 Beech St., Woodsville, New Hampshire ..1945
McGeen, Daniel S., 144 Garfield Ave., Waukesha, Wisconsin 1944
McGraw, Harry A[rthur], 1600 5th Ave., Altoona, Pennsylvania 1936
***McIlhenny, Edward Avery, Avery Island, Louisiana 1910
McIntosh, William B[axter], 414 Oakridge Blvd., Lynchburg, Virginia ..1942
McKinley, George C., 104 North Western Parkway,
Louisville 12, Kentucky 1945
McKinney, Mrs. Walter A., 244 E. 29th St., Tulsa 5, Oklahoma 1945
*McKnight, Edwin T[hor], 5038 Park Place, Friendship Station,
Washington, D.C. 1936
McManus, William Reid, Memramcook, New Brunswick, Canada 1946
*McMath, Robert R., Route 4, Pontiac, Michigan 1934
McMurray, Arthur A., 2110 Fairfax Ave., Nashville 5, Tennessee 1939
McMurry, Frank B[ailey], Box 1032, Yuma, Arizona 1939
McNish, E[dgar] M[ann], P.O. Box 311, Waynesville, North Carolina ..1940
Mack, H[orace] G[ordon], % Gilson Mfg. Co., Ltd., Guelph,
Ontario, Canada 1937
Magath, Dr. Thomas Byrd, Mayo Clinic, Rochester, Minnesota 1935
*Magee, Michael J[arden], 603 South St., Sault Ste Marie, Michigan ...1919
Magney, Mrs. G. R., 5329 Washburn Ave., S., Minneapolis, Minnesota ...1940
Malley, Philip P., 114 Glendale Rd., Upper Darby, Pennsylvania 1935
*Mallory, Dr. Dwight Harcourt, 17 Sherwood St., Brookville,
Ontario, Canada 1946
*Manley, C. H., 649 Ridge Ave., New Kensington, Pennsylvania 1946
Manners, Edward Robert, 216 New Broadway, Brooklawn, New Jersey 1942
Manville, Richard H[yde], Museum of Zoology,
University of Michigan, Ann Arbor, Michigan 1941
*Margolin, A[braham] S[tanley], Oglebay Hall, Morgantown,
West Virginia 1944
*Markle, Jess Matthew, Route 3, Box 336A, Madera, California 1943
Marshall, [Harry] Morton, Route 1, Pamplin, Virginia 1944
*Marshall, Raymond O., Route 2, Columbiana, Ohio 1945
*Marshall, Terrell, 372 Skyline Dr., Park Hill,
North Little Rock, Arkansas 1944
Marshall, William H[ampton], Division of Entomology and
Economic Zoology, University Farm, St. Paul 8, Minnesota 1942
**Martin, John E. H., Ancaster, Ontario, Canada 1944
Martin, Paul S., Box 532, West Chester, Pennsylvania 1946

*Maslowski, Karl H[erbert], 1034 Maycliff Place, Cincinnati 30, Ohio ..1934
Mason, Miss Esther, 2523 Montgomery St., Louisville 12, Kentucky 1941
Mathiak, Harold A[lbert], Horicon, Wisconsin 1941
*Mayfield, G[eorge] R[adford], Vanderbilt University, Nashville, Tennessee 1917
*Mayfield, Harold F[ord], 2557 Portsmouth Ave., Toledo, Ohio 1940
***Mayr, Ernst, American Museum of Natural History, 79th St. & Central Park West, New York City 24 1933
*Meade, Gordon M[ontgomery], Strong Memorial Hospital, 260 Crittenden Blvd., Rochester, New York 1937
Mellinger, E[nos] O[ren], North Lima, Ohio 1939
Meltvedt, Burton W., Paullina, Iowa 1930
Mendall, Howard L[ewis], 28 Pendleton St., South Brewer, Maine 1936
Meng, Heinz Karl, 116 Miller St., Ithaca, New York 1943
*Mengel, Robert M[orrow], % Arthur D. Allen, Glenview, Kentucky 1937
*Meredith, Col. Russell Luff, 2500 2nd Ave., S., Great Falls, Montana ...1946
Meritt, James Kirkland, 99 Battle Rd., Princeton, New Jersey 1944
***Merry, Miss Katherine, 268 Auburn Ave., Pontiac, Michigan 1944
Meryman, Richard S., Groton School, Groton, Massachusetts 1945
Messner, Clarence John, 308 McKinley, Grosse Pointe 30, Michigan 1944
**Metcalf, H[omer] N[oble], % Libby, McNeill & Libby, Lake Mills, Wisconsin 1944
*Metcalf, Zeno P[ayne], State College Station, Raleigh, North Carolina 1900
*Meyer, Henry, Biology Department, Ripon College, Ripon, Wisconsin 1939
Michaud, Howard H[enry], 824 N. Main St., West Lafayette, Indiana ..1938
*Michener, Harold, 418 N. Hudson Ave., Pasadena 4, California 1926
Middleton, Douglas S., 7443 Buhr Ave., Detroit, Michigan 1946
Miles, Eleanor B. (Mrs. Philip E.), 1900 Arlington Place, Madison 5, Wisconsin 1943
*Miles, Merriam Lee, Box 709, Vicksburg, Mississippi 1941
Miller, Alden H[olmes], Museum of Vertebrate Zoology, Berkeley 4, California 1930
Miller, Mrs. Alice, 2200 Belmont, Dearborn, Michigan 1944
Miller, Mrs. Clarence Heath, 1354 Herschel Ave., Cincinnati 8, Ohio ...1941
***Miller, Douglas Scott, 122 Lawrence Ave., E., Toronto, Ontario, Canada 1939
Miller, J. Robert, 1523 E. Jefferson St., Detroit 7, Michigan 1946
Miller, Loye H[olmes], University of California, 405 Hilgard Ave., Los Angeles 24, California 1939
Miller, Raymond Foster, Baker University, Baldwin City, Kansas 1945
Miller, Richard F[ields], 2627 N. Second St., Philadelphia 33, Pennsylvania 1942
Miller, William Rosewarne, Box 22, University of Connecticut, Storrs, Connecticut 1946
Mills, Robert H[enry], 2466 Medary Ave., Columbus 2, Ohio 1941
Milnes, Miss Hattie K[ernahan], 331 Gowen Ave., Mt. Airy, Philadelphia 19, Pennsylvania 1935
*Minich, Edward C., 1047 Fairview Ave., Youngstown 2, Ohio 1923
*Mitchell, Harold Dies, 378 Crescent Ave., Buffalo, New York 1936
*Mitchell, Mrs. Osborne, Route 1, Streetsville, Ontario, Canada 1933
*Mitchell, Mrs. R. V., Four Winds Farm, Route 1, Canton, Ohio 1943
**Mitchell, Walton I[ungerich], 398 Vassar Ave., Berkeley 8, California ..1893
Mockford, Edward L., 4140 Graceland Ave., Indianapolis, Indiana 1946
Mohler, Levi L[app], 716 S. 18th St., Lincoln, Nebraska 1942
**Monk, Harry C[rawford], 406 Avoca St., Nashville 5, Tennessee 1920
Monroe, Burt L[eavelle] Jr., Ridge Road, Anchorage, Kentucky 1946
*Monroe, Burt L[eavelle] Sr., Ridge Road, Anchorage, Kentucky 1935

*Monson, Gale, P.O. Box 1717, Parker, Arizona 1933
Moore, Miss Clara Alma, 5339 Carrollton Ave., Indianapolis 5, Indiana 1939
*Moore, Miss Dora, 18 W. Carpenter St., Athens, Ohio 1934
Moore, George A[zro], 289 Admiral Rd., Stillwater, Oklahoma 1928
Moore, George M[itchell], Nesmith Hall, University of New Hampshire, Durham, New Hampshire 1942
Moore, Miss Jeanne [Ellen], 718 Onondaga St., Ann Arbor, Michigan ..1943
Moore, Robert Thomas, Meadow Grove Place, Flintridge, Pasadena 2, California 1939
Moorman, Robert B., 815 Roland Ave., Chariton, Iowa 1941
Moran, James Vincent, 1 Alfred St., Jamaica Plain, Boston 30, Massachusetts 1943
Morgan, Allen Hungerford, Cochituate Rd., Wayland, Massachusetts ...1943
Morrell, Charles K., 119 E. Maxwell St., Lexington, Kentucky 1943
*Morrell, Miss Elsie, 1311 White Ave., Knoxville 16, Tennessee 1942
Morris, Hubert Ferguson, 28 Glengowan Rd., Toronto, Ontario, Canada 1946
Morrissey, Thomas J., 921 Mississippi Ave., Davenport, Iowa 1946
*Morse, Margarette Elthea, 11501 Mayfield Rd., Cleveland 6, Ohio 1921
*Moseley, Edwin Lincoln, University Museum, Bowling Green, Ohio ...1925
*Moser, Randolph, Aberdeen, Idaho 1944
**Moser, Dr. R[euben] Allyn, R.F.D. 1, Benson Station, Omaha 4, Nebraska 1940
Moul, Edwin Theodore, 146 W. Lehigh Ave., Philadelphia 33, Pennsylvania 1942
*Mousley, William H[enry], 4073 Tupper St., Westmont, Montreal, Canada 1922
**Mudge, Edmund W. Jr., 5926 Averill Way, Dallas, Texas 1939
*Muirhead, Miss Peggy Porter, 2708 Virginia St., Berkeley, California ...1940
Munro, J[ames] A[lexander], Okanagan Landing, British Columbia, Canada 1935
*Munter, Rear Admiral W[illiam] H[enry], 4518 52nd Ave., N.E., Seattle 5, Washington 1933
Murdock, James Ingram, 311 Irving Ave., Glendale 1, California 1940
*Murie, Adolph, Jackson, Wyoming 1932
*Murie, O[laus] J[ohan], Moose, Wyoming 1934
*Murphey, Eugene Edmund, 432 Telfair St., Augusta, Georgia 1935
*Murphy, Paul C[harles], 935 Goodrich Ave., Apt. 10, St. Paul 5, Minnesota 1944
Murray, Rev. J[oseph] J[ames], 6 White St., Lexington, Virginia 1931
Musselman, T[homas] E[dgar], 124 S. 24th St., Quincy, Illinois 1940
**Myers, Frank M[arcel], 1507 N. East St., Broken Bow, Nebraska 1944
Nash, Lt. Nathaniel C[ushing] IV, 1 Reservoir St., Cambridge, Massachusetts 1941
Neal, Mrs. Charles, Demorest, Georgia 1946
*Neely, William W., 149 W. End St., Chester, South Carolina 1939
*Neff, Johnson Andrew, 546 Custom House, Denver, Colorado 1920
*Nelson, Arnold Lars, 3256 Van Hazen St., N.W., Washington 15, D.C. ..1932
Nelson, Charles E[llsworth] Jr., 124 Oxford Rd., Waukesha, Wisconsin ..1937
Nelson, Edwin L[ewis], 77 Adelaide Ave., New Brunswick, New Jersey 1939
Nelson, Mrs. Esther Marie, 515 E. Minnehaha Parkway, Minneapolis 9, Minnesota 1945
Nelson, Grace Sharritt (Mrs. Almer P.), Box 22, Jackson, Wyoming ...1946
***Nelson, Miss Theodora, 315 E. 68th St., New York City 21 1928
Nelson, Urban C., Box 358, Fergus Falls, Minnesota 1939

Nestel, James Dudley, 504 W. 22nd St., Wilmington 259, Delaware 1946
*Netting, M[orris] Graham, Carnegie Museum, Pittsburgh 13, Pennsylvania 1941
Nevius, Mrs. Richard, Route 1, Greeneville, Tennessee 1940
New, John, 340 W. 86th St., New York City 24 1946
Newlin, Lyman W., Deephaven Park, Route 3, Wayzata, Minnesota ...1945
Newton, Earl T[homas], 5145 Swope Parkway, Kansas City 4, Missouri 1939
*Nice, L[eonard] B., 5725 Harper Ave., Chicago 37, Illinois 1932
***Nice, Mrs. Margaret Morse, 5725 Harper Ave., Chicago 37, Illinois ...1921
*Nichols, Charles K[etcham], 212 Hamilton Rd., Ridgewood, New Jersey 1933
Nichols, John Treadwell, American Museum of Natural History, 79th St. & Central Park West, New York City 24 1941
*Nichols, L[eon] Nelson, 331 E. 71st St., New York City 1937
Nicholson, Donald Jr., 1224 Palmer St., Orlando, Florida 1945
*Nickell, Walter Prine, Cranbrook Institute of Science, Bloomfield Hills, Michigan 1943
*Nielsen, Mrs. G. W., % Mrs. J. H. Wise, 141 Belleview Dr., San Leandro, California 1945
Nordquist, Lt. Theodore C., 1423 James Ave., N., Minneapolis 11, Minnesota 1941
Noren, Oscar B., 17133 Pinehurst, Detroit 21, Michigan 1945
Norris, Robert Allen, 505 W. 8th St., Tifton, Georgia 1941
*Norris, Frank Giles, Route 3, Steubenville, Ohio 1946
Norris, Russell T[aplin], 50 Milk St., Newburyport, Massachusetts ...1939
*Norse, William J[ohn], 531 W. 211th St., New York City 34 1939
North, George W[ebster], 249 Charlton Ave., W., Hamilton, Ontario, Canada 1941
*Northrop, Myron, 7932 Delmar, University City 5, Missouri 1945
Nyc, Fred[erick] F[rancis] Jr., Box 869, Brownsville, Texas 1943
Oakes, Clifford, 13 Olympia St., Burnley, Lancashire, England 1946
*Oberholser, Harry Church, Cleveland Museum of Natural History, 2717 Euclid Ave., Cleveland 15, Ohio 1894
*O'Conner, Miss Esther [Laura], 4344 Locust Ave., Kansas City 4, Missouri 1940
*Odum, Eugene P[leasants], Department of Zoology, University of Georgia, Athens, Georgia 1930
Odum, Howard Thomas, Pittesboro Rd., Chapel Hill, North Carolina ...1946
Oliver, Miss Mary C[lara], Ganado Mission, Ganado, Arizona 1934
**Olsen, Humphrey A., Pikeville College Library, Pikeville, Kentucky ...1941
*Olsen, Dr. Richard E., 1996 Lakeland Ave., Pontiac 19, Michigan 1938
**Olson, Mrs. Gladys E[lizabeth], 17906 Lake Rd., Lakewood 7, Ohio ...1942
Olson, Mrs. Monrad A., Box 141, Sanish, North Dakota 1946
Ommanney, G. G., Post Office 14, Hudson Heights, Quebec, Canada ...1944
O'Neill, Edward J., Muleshoe, Texas 1946
*O'Reilly, Ralph A. Jr., 16554 Shaftsbury Rd., Detroit 19, Michigan 1936
**Osborn, Hon. Chase S[almon], Sault Ste Marie, Michigan 1943
**Osgood, W[ilfred] H[udson], Chicago Natural History Museum, Chicago 5, Illinois 1910
Ott, Frederick Louis, 2527 N. Wahl Ave., Milwaukee 11, Wisconsin 1941
Otto, John, Amsterdam, Ohio 1946
*Overing, Robert, R.F.D. 4, Raleigh, North Carolina 1930
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Painton, Dr. Harry R., 175 Foothill Rd., Santa Barbara, California 1939
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Paoliello, Miss Frances, 1705 18th Ave., S., Nashville 4, Tennessee 1946
*Parker, Dean Roberts, Texas Technological College, Lubbock, Texas ...1944
*Parker, Henry M[elville], 122 School St., Concord, New Hampshire ...1941
Parks, Richard Anthony, 3754 Peachtree Rd., N.E., Atlanta, Georgia ..1942
Parlee, Miss Phyllis Gertrude, Route 4, Mt. Airy, Maryland 1945
Partch, Max L[orenzo], R.F.D., Lake Mills, Wisconsin 1940
Pate, Miss Lennie Elizabeth, 1315 E. Cervantes St., Pensacola, Florida ..1944
Patterson, Robert L., 1336 Geddes Ave., Ann Arbor, Michigan 1943
Paynter, Raymond A. Jr., 208 Forest Hill Rd., Hamden 14, Connecticut 1946
Pearson, Miss Dorothy, 19 Lincoln St., North Weymouth, Massachusetts 1944
*Peartree, Edward William, 425 S. State St., Oconomowoc, Wisconsin ...1941
*Peasley, Mrs. Harold R[aymond], 2001 Nash Dr., Des Moines, Iowa ...1934
Peebles, Edward M., % Dr. Edward McCrady, University of the South,
Sewanee, Tennessee 1946
Peelle, Miles L., 329 Rice St., Adrian, Michigan 1940
***Peet, Dr. Max Minor, 2030 Hill St., Ann Arbor, Michigan 1935
Penner, Lawrence R., Department of Zoology,
University of Connecticut, Storrs, Connecticut 1940
*Perner, Miss Margaret E., 3463 Woodridge Rd.,
Cleveland Heights 21, Ohio 1943
Perry, Morton H., 401 Hollywood Blvd., Birmingham 9, Alabama 1946
Peters, Ellen, 442 5th St., Brooklyn 15, New York 1942
*Peters, Harold S[eymour], 54 Folly Rd., Charleston 50, South Carolina 1924
*Peterson, Alfred, Box 201, Brandt, South Dakota 1931
Peterson, Mrs. C[harles] E[mil], Madison, Minnesota 1936
Peterson, Liven A[dam], P.O. Box 1381, Billings, Montana 1940
Peterson, Randolph L., Division of Mammals, Royal Ontario Museum of
Zoology, Toronto, Ontario, Canada 1946
*Peterson, Roger Tory, 1206 Mt. Vernon Blvd., Alexandria, Virginia ...1942
Peterson, Stella Freeman (Mrs. Theodore), 80 Oaklawn Ave.,
Battle Creek, Michigan 1941
*Petrides, George A., Wildlife Research Unit, Ohio State University,
Columbus, Ohio 1942
***Pettingill, Olin Sewall Jr., Carleton College, Northfield, Minnesota 1930
*Pfeiffer, Robert Wheeler, 2355 W. 16th Ave., Vancouver,
British Columbia, Canada 1946
***Phelps, William H[enry], Apartado 2009, Caracas, Venezuela 1940
**Phillipp, Frederick B[ernard], 99 John St., New York City 1940
***Phillips, Allan Robert, 113 Olive Rd., Tucson, Arizona 1934
*Phillips, Cyrus Eastman, 255 Polk St., Warsaw, Illinois 1944
Phillips, Richard Stuart, 834 Liberty St., Findlay, Ohio 1944
Pieczur, Walter Henry, 1143 Rogers Ave., Brooklyn 26, New York ...1945
*Pierce, Robert Allen, Nashua, Iowa 1941
*Pirnie, Miles David, W. K. Kellogg Bird Sanctuary, Augusta, Michigan .1928
Pitelka, Frank Alois, Museum of Vertebrate Zoology, University of
California, Berkeley 4, California 1938
Pittman, James Allen, 436 S. Osceola, Orlando, Florida 1945
Plath, Karl, 305 S. Cuyler Ave., Oak Park, Illinois 1942
**Poole, Cecil A[very], 830 Chapman St., San Jose 11, California 1942
*Poor, Hustace Hubbard, 112 Park Ave., Yonkers 3, New York 1935
*Porter,T[homas] Wayne, Department of Entomology, Snow Hall,
University of Kansas, Lawrence, Kansas 1938

Potter, David M., 1554 Timothy Dwight College, Yale University, New Haven, Connecticut 1946
*Potter, Julian K[ent], 437 Park Ave., Collingswood, New Jersey 1915
Potter, Louis Henry, R.F.D. 2, West Rutland, Vermont 1941
*Pough, Richard H[ooper], 33 Highbrook Ave., Pelham 65, New York ...1938
Prather, Millard F[illmore], 1129 Brown-Marx Bldg., Birmingham 3, Alabama 1940
*Preble, Edward Alexander, 3027 Newark St., Washington, D.C. 1929
*Preble, Norman A[lexander], Department of Biology, Bowling Green State University, Bowling Green, Ohio 1941
Prescott, Kenneth Wade, University of Michigan Museum of Zoology, Ann Arbor, Michigan 1946
*Presnall, Mrs. Clifford C[harles], Lake Zurich, Illinois 1930
*Prill, Dr. Albert G., Main St., Scio, Oregon 1921
**Proctor, William, Bar Harbor, Maine 1937
*Pueschel, Paul, 520 Drexel Ave., Glencoe, Illinois 1939
Putman, William Lloyd, Dominion Entomological Laboratory, Vineland Station, Ontario, Canada 1945
Putnam, Loren Smith, Department of Zoology, Ohio State University, Columbus, Ohio 1942
*Pyle, George W[inner], South Valley Rd., Box 604, Paoli, Pennsylvania 1939
Quam, Mrs. Mary Battell, 141 Joralemon St., Brooklyn 2, New York ..1944
Quay, Thomas L., Zoology Department, North Carolina State College, Raleigh, North Carolina 1939
Quimby, Don C., 4742 Garfield Ave., S., Minneapolis, Minnesota 1942
*Ragusin, Anthony V[incent], P.O. Box 496, Biloxi, Mississippi 1937
Rahe, Carl W., 4666 Turney Rd., Cleveland 5, Ohio 1931
Ramsden, Charles Theodore, 8 & 19, Vista Alegre, Santiago, Cuba 1914
Randall, Robert Neal, Fish and Wildlife Service, Box 1381, Billings, Montana 1939
Rapp, William F[rederick] Jr., 203 E. Green St., Champaign, Illinois ..1941
*Rebmann, G. Ruhland Jr., 729 Milbrook Lane, Haverford, Pennsylvania 1941
*Reeder, Miss Clara Maude, 1608 College Ave., Houghton, Michigan 1938
Rees, Earl Douglas, Suite B-31-1, Wigglesworth Dormitory, Harvard College, Cambridge, Massachusetts 1946
*Reese, Mrs. Hans H., 3421 Circle Close, Shorewood Hills, Madison 5, Wisconsin 1941
*Reilly, Edgar M. Jr., 169 Veterans Place, Ithaca, New York 1946
Remington, Charles Lee, Biological Laboratories, Harvard University, Cambridge 38, Massachusetts 1944
Rett, Egmont Z[achary], Museum of Natural History, Santa Barbara, California 1940
Reuss, Alfred Henry Jr., 12911 S. Mozart St., Blue Island, Illinois ...1936
Rice, Dale Warren, 432 W. 42nd St., Indianapolis 8, Indiana 1946
Rice, Mrs. Harry Wilson, Lafayette Club, Minnetonka Beach, Minnesota 1940
Richardson, Mrs. C. H., 3091 3rd St., Boulder, Colorado 1946
Richdale, Lancelot Eric, 23 Skibo St., Kew, Dunedin SW1, New Zealand 1945
*Ricker, W[illiam] E[dwin], Department of Zoology, University of Indiana, Bloomington, Indiana 1943
Riggs, Austen Fox II, Lowell I-44, Cambridge 38, Massachusetts 1946
Riggs, Carl D[aniel], Department of Zoology, University of Michigan, Ann Arbor, Michigan 1943
Riner, Miss Alice, 115 S. Estelle, Wichita 7, Kansas 1939

*Ripley, Sidney Dillon II, Litchfield, Connecticut 1946
*Ritchie, Dr. R. C., 60 Chatsworth Dr., Toronto, Ontario, Canada 1942
Ritter, Rhys T[heophilus], Route 4, Bethlehem, Wheeling, West Virginia 1944
*Roads, Miss Myra Katie, 463 Vine St., Hillsboro, Ohio 1914
*Robbins, Chandler S[eymour], Patuxent Research Refuge, Bowie, Maryland 1941
Roberts, C. LaVerne, 531 Tussing Bldg., Lansing 7, Michigan 1946
Roberts, Harold D., 218 N. Sixth St., Black River Falls, Wisconsin ...1946
Robertson, Miss Bertha May, Route 4, Bowling Green, Ohio 1946
***Rogers, Charles Henry, East Guyot Hall, Princeton, New Jersey......1903
Rogers, Capt. Gerald Talbot, 32-36 83rd St., Jackson Heights, New York 1945
*Rogers, Irl, 402 Alturas Ave., Modesto, California 1937
*Rogers, Mrs. Walter E., P.O. Box 385, Appleton, Wisconsin 1931
***Root, Oscar M[itchell], Brooks School, North Andover, Massachusetts ..1940
Rorimer, Irene Tuck (Mrs. J. M.), % Empire Plow Co., 3140 E. 65th St., Cleveland 4, Ohio 1938
Rosene, Walter Jr., 1212 Jupiter, Gadsden, Alabama 1942
*Rosewall, O[scar] W[aldemar], Department of Zoology, Louisiana State University, University, Louisiana 1931
Ross, C[harles] Chandler, 7924 Lincoln Dr., Chestnut Hill, Philadelphia, Pennsylvania 1937
Ross, Hollis T., 29 S. 2nd St., Lewisburg, Pennsylvania 1945
*Rowan, William, University of Alberta, Edmonton, Alberta, Canada ...1939
*Rudd, Dr. Clayton G[lass], 315 Medical Arts Bldg., Minneapolis, Minnesota 1944
Rudd, Robert L., 225 W. Alisal St., Salinas, California 1939
Ruderman, Miss Claire, Department of Biology, University of Rochester, Rochester, New York 1944
Ruecker, Miss Emilie, Seapowet Ave., Tiverton, Rhode Island 1943
Ruhland, Miss Phyllis, 20 University Terrace, Athens, Ohio 1946
*Rysgaard, George Nielsen, Museum of Natural History, University of Minnesota, Minneapolis, Minnesota 1937
Sabin, Walton B., 828 Ackerman Ave., Syracuse 10, New York 1945
Sandve, J[oseph] Reuben, 883 23rd Ave., S.E., Minneapolis, Minnesota 1943
*Satterthwait, Mrs. Elizabeth Allen, 806 W. Ohio St., Urbana, Illinois 1925
*Saugstad, N[els] Stanley, Route 4, Minot, North Dakota 1939
*Saunders, Aretas A[ndrews], 361 Crestwood Rd., Fairfield, Connecticut 1934
*Savage, James, Buffalo Athletic Club, Buffalo, New York 1939
*Sawyer, Miss Dorothy, R.F.D. 1, Unadilla, New York 1937
Schantz-Hansen, Donald [Ernst], Forestry Station, Cloquet, Minnesota 1944
Schaub, Mary Hall (Mrs. J. B.), 1040 Isabella St., Wilmette, Illinois ...1939
Schmidt, John R., Box 86, Plymouth, Wisconsin 1945
*Schneider, Miss Evelyn J., 2207 Alta Ave., Louisville 5, Kentucky 1935
Scholes, Robert T., Bushnell, Illinois 1946
*Schorger, A[rlie] W[illiam], 168 N. Prospect Ave., Madison, Wisconsin 1927
**Schramm, Wilson Cresap, 321 Kensington Rd., Syracuse, New York ...1944
*Schuette, C[hal] H. L. III, 1446 Beaver Rd., Sewickley, Pennsylvania ..1942
Schumm, William George, 302 C St., LaPorte, Indiana 1944
*Schwall, Eugene E[dward], New Concord, Ohio 1943
Schwank, James E., 432 N. 6th St., Reading, Pennsylvania 1945
*Schwartz, Charles Walsh, % Board of Agriculture and Forestry, King and Keeaumaku Sts., Honolulu, Hawaii 1943
Scotland, Minnie B[rink], 42 Continental Ave., Cohoes, New York ...1938

*Scott, John William, 1409 Garfield St., Laramie, Wyoming 1938
Scott, Thomas G[eorge], Zoology Department, Science Bldg., Ames, Iowa 1936
Scott, W[alter] E[dwin], Mendota Beach Heights, Madison 5, Wisconsin 1938
Seaberg, John A[rthur], Veterans Administration, Minneapolis 6, Minnesota 1944
Seeber, Edward L[incoln], 186 Wabash Ave., Kenmore 17, New York ..1944
Seeley, George Mervil, 461 High St., Long Branch, New Jersey 1945
Seibert, Henri C., 202 Vivarium Bldg., University of Illinois, Champaign, Illinois 1941
Sell, Richard N., 3615 Dexter Rd., Ann Arbor, Michigan 1946
*Sener, Miss Ruth, 233 Charlotte St., Lancaster, Pennsylvania 1943
Serbousek, Miss Lillian, 1226 Second St., S.W., Cedar Rapids, Iowa ...1935
*Shaffer, Chester M[onroe], Address unknown 1934
*Shaftesbury, Archie D., Women's College, University of North Carolina, Greensboro, North Carolina 1930
Sharp, Ward M., Red Rock Lakes Refuge, Monida, Montana 1936
Shaver, Jesse M[ilton], George Peabody Teachers College, Nashville, Tennessee 1922
Shaw, Dr. Charles H[icks], Bremen, Ohio 1941
Shaw, Mrs. Elizabeth Martin, 2312 Stuart Ave., Richmond 20, Virginia ..1943
**Shearer, A[mon] R[obert], Mont Belvieu, Chambers Co., Texas 1893
*Shelar, Keller, State Teachers College, Slippery Rock, Pennsylvania.......1940
*Shelford, Victor E[rnest], Vivarium Bldg., University of Illinois, Champaign, Illinois 1931
Sheppard, Roy Watson, 1805 Mouland Ave., Niagara Falls, Ontario, Canada 1933
*Sherwood, John Willitts, 26 Smith St., Salinas, California 1936
Shields, Louise (Mrs. Alston B.), 511 B Nancy St., Charleston, West Virginia 1945
Short, Wayne, 1006 5th Ave., New York City 28 1941
*Shortt, Terence Michael, Royal Ontario Museum of Zoology, Queen's Park at Bloor St., Toronto, Ontario, Canada 1941
Shubeck, Paul P[eter], 440 Bond Street, Elizabeth 1, New Jersey 1943
Sibley, Charles G., 1637 LeRoy Ave., Berkeley 4, California 1942
Sibley, Norman Othello, Route 2, Whittemore, Michigan 1945
Simmons, Mrs. Amelia C., 2007 N. Holton St., Milwaukee 12, Wisconsin 1943
***Simmons, Edward McIlhenny, Avery Island, Louisiana 1942
*Simon, Miss Tina, 1340 W. Elmdale Ave., Chicago 40, Illinois 1945
Sims, Harold L[ee], 714 St. Philip St., Thibodaux, Louisiana 1942
*Singh, Ram S., Chicago Natural History Museum, Chicago, Illinois ...1946
Skaggs, Merit Bryan, 2066 Alton Rd., East Cleveland 12, Ohio 1934
Skutch, Alexander F., San Isidro del General, Costa Rica 1944
Slack, Miss Mabel, 1004 Everett Ave., Louisville, Kentucky 1934
Smalley, Alfred Evans, Open Hearth, Lewistown, Pennsylvania 1946
*Smith, A[rthur] F[rancis], Manning, Iowa 1934
*Smith, Bertram H., 512 Harries Bldg., Dayton, Ohio 1944
*Smith, Frank R[ush], Route 2, Box 100, Laurel, Maryland 1910
*Smith, Harry M[adison], 2007 Calumet Ave., Whiting, Indiana 1936
Smith, J. Donald, Route 2, Stillwater, Minnesota 1939
*Smith, Lewis MacCuen, 8040 St. Martins Lane, Chestnut Hill Station, Philadelphia, Pennsylvania 1931
Smith, Luther E[ly], 1554 Telephone Bldg., 1110 Pine St., St. Louis, Missouri 1941
*Smith, Oliver L[edlie], 15 York Ave., Towanda, Pennsylvania 1944

Smith, Orion O., 1539 Crosby St., Rockford, Illinois 1936
Smith, Robert Leo, Route 1, Reynoldsville, Pennsylvania 1945
*Smith, Roy Harmon, 183 N. Prospect St., Kent, Ohio 1936
Smith, Thomas [Price], Osage Ave., Anchorage, Kentucky 1941
Smith, Wendell Phillips, Wells Rivers, Vermont 1921
Smith, Winnifred (Mrs. E. R.), Route 1, Two Rivers, Wisconsin 1946
Snapp, Mrs. R. R., 310 W. Michigan, Urbana, Illinois 1940
Snyder, L[ester] L[ynne], Royal Ontario Museum of Zoology,
Queen's Park at Bloor St., Toronto 5, Ontario, Canada 1929
Snyder, Richard Craine, Department of Zoology, Cornell University,
Ithaca, New York 1940
Sooter, Clarence Andrew, 1336 N. 40th St., Lincoln, Nebraska 1940
Soper, J[oseph] Dewey, 827 Riverwood Ave., Fort Garry,
Winnipeg, Manitoba, Canada 1937
Spangler, Miss Iva M., 128 E. Foster Parkway, Fort Wayne, Indiana ...1939
Spawn, Gerald B., 1101 2nd St., Brookings, South Dakota 1941
*Speirs, Mrs. Doris Huestis, % Mrs. Hewer, Fonthill, Ontario, Canada ...1936
Speirs, J[ohn] Murray, % Mrs. Hewer, Fonthill, Ontario, Canada 1931
*Spencer, Miss O[live] Ruth, 1030-25 Avenue Court, Moline, Illinois ...1938
Sperry, Charles Carlisle, 1455 S. Franklin St., Denver 10, Colorado 1931
Spofford, Walter R. II, Vanderbilt University Medical School,
Nashville, Tennessee 1942
Springer, Paul F., 417 S. Kensington Ave., La Grange, Illinois 1946
Stabler, George Earl, Box 72, Huron, Kansas 1946
Stabler, Robert M[iller], Glen Mills, Pennsylvania 1939
Stackpole, Richard, Wayland, Massachusetts 1940
*Staebler, Arthur E[ugene], Museum of Zoology, University of
Michigan, Ann Arbor, Michigan 1937
**Stahl, Miss Marjoretta Jean, Kimberly, West Virginia 1942
Stanford, Jack A[rchibald], 1900 N. Circle Dr., Jefferson City, Missouri 1941
*Stanley, Willard Francis, State Teachers College, Fredonia, New York .1946
Starrett, William C[harles], Department of Zoology and Entomology,
Iowa State College, Ames, Iowa 1933
Stearns, Edwin I. Jr., 92 Farragut Rd., Plainfield, New Jersey 1945
*Steffen, Earnest William, 1000 Maplewood Dr., Cedar Rapids, Iowa 1944
Steggerda, Morris, Kennedy School of Missions, Hartford 5, Connecticut 1941
Stegle, Joseph James, 220 Pondfield Rd., W., Bronxville, New York 1944
Stephens, Mrs. Charles N., 1122 S. 19th St., Fort Smith, Arkansas 1946
Stephens, T[homas] C[alderwood], Morningside College,
Sioux City, Iowa 1911
*Stevens, O. A., State College Station, Fargo, North Dakota 1926
Stevenson, Henry M[illis], Department of Zoology,
Florida State College for Women, Tallahassee, Florida 1943
Stevenson, James O[sborne], Fish and Wildlife Service,
Merchandise Mart, Chicago 54, Illinois 1943
*Stewart, Paul A[lva], Leetonia, Ohio 1925
Stewart, Robert Earl, Patuxent Research Refuge, Bowie, Maryland 1939
Stidolph, Robert H. D., 114 Cole St., Masterton, New Zealand 1945
*Stillwell, Jerry E., 8160 San Benito Way, Dallas 18, Texas 1935
**Stine, Miss Perna M., Route 5, Olney, Illinois 1931
***Stoddard, Herbert Lee, Sherwood Plantation, Route 5, Thomasville,
Georgia 1916
Stokes, Allen W., 1102 S. Park St., Madison 5, Wisconsin...............1945
Stone, Harry H[erbert] Jr., Box 101, Sturbridge, Massachusetts 1941

***Stoner, Lillian C. (Mrs. Dayton), New York State Museum, Albany, New York 1945
*Stophlet, John J[ermain], Route 1, Bellevue, Michigan 1934
Storer, Robert Winthrop, Museum of Vertebrate Zoology, Berkeley 4, California 1938
*Storer, Tracy I[rwin], Division of Zoology, University of California, Davis, California 1928
Stratton, Miss Nellie Mary, 209 Cutler St., Allegan, Michigan 1945
Street, Phillips B., 520 Packard Bldg., Philadelphia 2, Pennsylvania 1946
Street, Thomas M., Bottineau, North Dakota 1940
***Strehlow, Elmer William, 721 W. Mason St., Green Bay, Wisconsin 1941
Stringham, Emerson, Box 94, Madison, Wisconsin 1940
Stromgren, Carl, General Delivery, Iowa City, Iowa 1944
****Strong, R[euben] M[yron], 5840 Stony Island Ave., Chicago, Illinois ....Founder
Struck, Kuno H[erbert], 1003 First National Bank Bldg., Davenport, Iowa 1942
Strunk, William Franklin, 700 Madison Ave., Morgantown, West Virginia 1944
*Studer, Floyd Victor, 636 Amarillo Bldg., Amarillo, Texas 1946
*Stultz, Mrs. Alma J., 2223 Sunset Blvd., Los Angeles 26, California 1946
Stupka, Arthur, Great Smoky Mountains National Park, Gatlinburg, Tennessee 1935
***Sturgeon, Myron T., Department of Geography and Geology, Ohio University, Athens, Ohio 1934
Sturgis, S[ullivan] Warren, 66 Marlboro St., Boston, Massachusetts 1941
*Sturm, [William] Louis, Sheffield Rd., Glendale, Ohio 1943
*Suthard, James G[regory], 1881 Raymond Ave., Long Beach 6, California 1936
***Sutton, George Miksch, Museum of Zoology, University of Michigan, Ann Arbor, Michigan 1920
*Swanson, Miss Doris Mae, Box 83, Fillmore, New York 1946
*Swanson, Gustav [Adolph], 5245 N. Sawyer, Chicago 25, Illinois 1927
*Swedenborg, Ernie D[avid], 4905 Vincent Ave., S., Minneapolis 10, Minnesota 1929
Swoger, Arthur [Glenn], 212 Oliver Ave., Pittsburgh 22, Pennsylvania 1943
*Taber, Wendell, 3 Mercer Circle, Cambridge, Massachusetts 1936
Tabor, Miss Ava Rogers, 305 Canal Blvd., Thibodaux, Louisiana....1940
*Taintor, Mrs. Elizabeth Taber, 11 Story St., Cambridge, Massachusetts ..1945
Tallman, William S[weet] Jr., 4 Linden Place, Sewickley, Pennsylvania ..1940
*Tanger, Mrs. C. Y., 318 N. President Ave., Lancaster, Pennsylvania 1943
Tanghe, Leo J[oseph], 852 Stone Rd., Rochester 13, New York 1943
Tanner, James Taylor, 16½ N. Church St., Cortland, New York 1937
Tatum, Miss Bernice, 1105 Lowell, Kansas City 2, Kansas 1943
*Taverner, P[ercy] A[lgernon], 45 Leonard Ave., Ottawa, Ontario, Canada 1905
*Taylor, Aravilla M[eek], Lake Erie College, Painesville, Ohio 1936
***Taylor, Arthur Chandler, 309 N. Drew St., Appleton, Wisconsin 1929
***Taylor, Mrs. H. J., 900 Santa Barbara Rd., Berkeley, California 1916
Taylor, Miss Joanne, 1176 Shattuck, Berkeley, California 1941
*Taylor, Joseph William, 439 Allen's Creek Rd., Rochester 10, New York..1946
*Taylor, Walter P[enn], 254 Faculty Exchange, College Station, Texas 1937
*Taylor, William Ralph, Museum of Natural History, University of Kansas, Lawrence, Kansas 1940
*Teachenor, Dix, 1020 W. 61st St., Kansas City, Missouri 1923

*Templeman, Wilfred, Government Laboratory, Water St., East, St. John's, Newfoundland 1943
Terres, John K[enneth], 251 East 48th St., New York City 17 1939
Thacher, S. Charles, 2918 Brownsboro Rd., Louisville 6, Kentucky 1942
*Thomas, Edward S[inclair], 319 Acton Rd., Columbus, Ohio 1921
*Thomas, Mrs. Rowland, R.F.D. 3, North Little Rock, Arkansas 1937
Thompson, Daniel Q., 521 E. Mifflin St., Madison 3, Wisconsin 1945
**Thompson, John Bernard, 6027 Gwynn Oak Ave., Baltimore 7, Maryland 1946
Thomsen, Mrs. Hans Peter, Route 3, Box 406, Beloit, Wisconsin 1946
*Thorley, Robert F., 3 Midland Gardens, Bronxville 8, New York 1946
*Thornton, William James, Box 1011, Birmingham, Alabama 1940
***Thorp, George B[oulton], Carnegie Museum, Pittsburgh, Pennsylvania 1935
Thorpe, James David, 9 Elmdale Ave., Akron, Ohio 1945
Tiffany, John, 136 Seaman Ave., New York City 1946
*Tift, Richard, The Oaks, Newton, Route 1, Albany, Georgia 1937
*Tilley, Francis Thomas, 26 Mohican Ave., Buffalo 8, New York 1944
*Tinker, A[lmerin] D[avid], R.F.D. 1, Chelsea, Michigan 1909
*Tipton, Dr. Samuel R[idley], 828 S. 20th St., Birmingham 5, Alabama ...1941
Todd, Mrs. Elizabeth D., 918 W. Main St., Kalamazoo 48, Michigan ...1939
Todd, George K[endall], 1079 E. 33rd South, Salt Lake City 5, Utah ...1943
Todd, Henry O[liver] Jr., Woodberry Rd., Murfreesboro, Tennessee 1938
Todd, Mabel Sellers (Mrs. A.P.), 706 Park Place, Austin, Texas 1940
**Todd, W[alter] E[dmond] Clyde, Carnegie Museum, Pittsburgh 13, Pennsylvania 1911
*Tomkins, Ivan Rexford, 1231 E. 50th St., Savannah, Georgia 1931
*Towle, Miss Helen Jessie, 5148 29th Ave., S., Minneapolis 6, Minnesota ..1944
**Townsend, Miss Elsie White, Wayne University, Detroit 1, Michigan ...1938
***Trautman, Milton B[ernard], Stone Laboratory, Put-in-Bay, Ohio 1932
Trimm, Wayne, Address unknown 1943
*Trussell, Miss Malvina, 10 W. Kennedy Ave., Statesboro, Georgia 1946
Tryon, C[larence] A[rcher] Jr., Zoology Department, Montana State College, Bozeman, Montana 1942
*Tubbs, Farley F., Game Division, Department of Conservation, Lansing 13, Michigan 1935
***Tucker, Mrs. Carll, Penwood, Mount Kisco, New York 1928
Tucker, Robert Edward, 245 N. Auburndale, Memphis, Tennessee 1942
Tuttle, George Mott Jr., Main St., Youngstown, New York 1941
Tvedt, Lt. Harold B[loom], 1911 Grand Ave., St. Paul, Minnesota 1941
*Twomey, Arthur C[ornelius], Carnegie Museum, Pittsburgh 13, Pennsylvania 1936
*Tyler, Dr. Winsor M[arrett], 1482 Commonwealth Ave., Brighton 35, Massachusetts 1914
*Uhler, Francis Morey, Patuxent Research Refuge, Bowie, Maryland 1931
**Uhrig, Mrs. A. B., Box 28, Oconomowoc, Wisconsin 1926
Umbach, Miss Margaret, 2526 East Dr., Fort Wayne 3, Indiana 1941
*Vaiden, M[eredith] G[ordon], Rosedale, Mississippi 1937
Van Arsdall, C. A., 1024 Beaumont Ave., Harrodsburg, Kentucky 1946
Van Camp, Laurel F[rederick], Genoa, Ohio 1943
Van Coevering, Jack, 9816 Ingram, Rosedale Gardens, Plymouth, Michigan 1939
Vandervoort, Millard, 909 Security Bank Bldg., Battle Creek, Michigan ..1945
Vandervort, Charles C[hampion], Laceyville, Pennsylvania 1937
Vane, Dr. Robert F., 600 Dows Bldg., Cedar Rapids, Iowa 1946
Van Laar, Henry, 1924 Indiana Ave., Kalamazoo 39, Michigan 1944

*Van Pelt, Raymond Drake, 2687 Waverly Dr., Los Angeles 26, California 1946
***van Rossem, A[driaan] J[oseph], 2205 W. Adams St., Los Angeles 7, California 1939
**Van Tyne, Mrs. C[laude] H., 405 Awixa Rd., Ann Arbor, Michigan 1922
***Van Tyne, Josselyn, Museum of Zoology, University of Michigan, Ann Arbor, Michigan 1922
*Vaughan, William C[oleman], 115 Fairbanks Ave., Kenmore 17, New York 1938
Vaurie, Charles, American Museum of Natural History, 79th St. & Central Park West, New York City 24 1946
*Visscher, Paul, Biology Laboratory, Western Reserve University, Cleveland, Ohio 1924
*Voak, Mrs. Floyd S., 909 S. Custer Ave., Miles City, Montana 1945
*Vogt, William, % Annette L. Flugger, Conservation Section, Pan American Union, Washington 6, D. C. 1935
*Vollmar, Mrs. Joseph E., 6138 Simpson Ave., St. Louis, Missouri 1941
*Wade, Douglas E., Office of the Naturalist, Dartmouth College, Hanover, New Hampshire 1936
*Wade, Katherine White (Mrs. Sydney J.), 531 Mary Ave., Collinsville, Illinois 1940
*Waggoner, John Sheaffer, 889 Storer Ave., Akron, Ohio 1945
Wagner, Miss Esther E., 13 Locust Ave., Danbury, Connecticut 1937
Wagner, Helmuth O., Apartado 7901, Sucursal 3, Mexico, D.F. 1945
Wagner, Julia E. (Mrs. H. J.), 818 E. Boulder St., Colorado Springs, Colorado 1945
**Walcott, Hon. Frederick C., Investment Bldg., Washington, D.C. 1945
*Walker, Charles F[rederic], Stone Laboratory, Put-in-Bay, Ohio 1939
Walker, M[yrl] V[incent], Yosemite National Park, California 1943
*Walker, William M. Jr., 107 N. Park Circle, Nashville 5, Tennessee 1945
***Walkinshaw, Lawrence Harvey, 1703 Central Tower, Battle Creek, Michigan 1928
*Wallace, Miss Edith Adell, 421 W. 8th Ave., Gary, Indiana 1945
*Wallace, George J[ohn], Zoology Department, Michigan State College, East Lansing, Michigan 1937
*Wallam, Miss Mary Kathryn, Mendon, Ohio 1946
Wallner, Dr. Alfred, 13924 Weddington St., Van Nuys, California 1941
Walters, Miss Kathleen, 312 Crane, Royal Oak, Michigan 1944
Wampole, John Henry, Box 447, Grant, Nebraska 1944
Wandell, Willet N[orbert], Natural History Survey, Urbana, Illinois 1944
Wangnild, Miss Lillian M[arie], 2818 Gaylord St., Denver 5, Colorado ..1943
Wanless, Harold R[ollin], 704 S. McCullough St., Urbana, Illinois 1940
Warner, Dwain Willard, Laboratory of Ornithology, Cornell University, Ithaca, New York 1946
*Watson, Clarence W., Box 833, Atlanta, Georgia 1943
Watson, Frank Graham, 5423 Leopold Dr., Houston 4, Texas 1937
Watson, James Dewey Jr., 7922 Luella Ave., Chicago, Illinois 1945
*Watson, Robert J[ames], Box 75, Blacksburg, Virginia 1943
*Weaver, Richard L[ee], Audubon Nature Center, R.F.D. 4, Greenwich, Connecticut 1936
Webb, Miss Vera Hart, 1535 Ambler Ave., Abilene, Texas 1946
Weber, Edmund P[eter], 95 Ingram Ave., Pgh. 5, Ingram, Pennsylvania 1942
Webster, Lt. J[ackson] Dan, Wrangell, Alaska 1939
Webster, Victor S[tuart], College Station, Brookings, South Dakota 1944

Weiser, Virgil Leonard, 507 2nd Ave., E., Dickinson, North Dakota 1946
Welch, Mrs. Lola Harriet, Box 245, South Wayne, Wisconsin 1943
Welles, Mary Pyke (Mrs. George M.), R.F.D. 1, Elmira, New York 1938
**Wernicke, Maleta M. (Mrs. J. F.), Gull Point, Escambia Co., Florida ...1944
**Weston, Robert, Salmon Pool Farm, Brewer, Maine 1944
*Wetmore, Alexander, U. S. National Museum, Washington 25, D.C. 1903
*Weydemeyer, Winton, Fortine, Montana 1930
*Weyl, Edward Stern, 6909 Henley St., Philadelphia 19, Pennsylvania ...1927
**Wheatland, Miss Sarah B[igelow], Shoremeade, Sorrento, Maine 1942
White, Courtland Y., Box 31, Bennett Hall, University of Pennsylvania, Philadelphia, Pennsylvania 1942
*White, Francis Beach, Silk Farm Rd., Route 2, Concord, New Hampshire 1926
White, Miss Marcia R., 5626 Dorchester Ave., Chicago 37, Illinois 1944
*Whitney, Nathaniel Ruggles Jr., 975 Willow Ave., Glendale, Ohio 1942
Whittemore, Miss Margaret Evelyn, 1615 College Ave., Topeka, Kansas ..1946
*Whittier, Mrs Lida, 2830 E. 130th St., Cleveland 20, Ohio 1943
Widdicombe, Harry T., 439 Fulton St., S.E., Grand Rapids 3, Michigan 1943
Widmann, Berthold, 4621 Wesley Ave., Los Angeles 37, California 1936
*Wiggin, Henry T[aylor], 151 Tappan St., Brookline, Massachusetts 1941
Wilcox, Harry Hammond Jr., 1236 Isabella St., Williamsport 33, Pennsylvania 1938
Wilcox, LeRoy, Speonk, Long Island, New York 1944
Wiles, Harold O[liver], 407 Winston Ave., Wilmington 175, Delaware ...1936
Wilkowski, William [Walter], 119 Bronson Court, Kalamazoo 12, Michigan 1943
*Williams, George G., The Rice Institute, Houston, Texas 1945
*Williams, Laidlaw O[nderdonk], Route 1, Box 138, Carmel, California ..1930
Williams, Miss Mary Jane, Department of Conservation, Roscommon, Michigan 1946
Willis, Franklin Elling, Marietta, Minnesota 1946
**Wilson, Archie F[rancis], 1322 Braeburn Rd., Flossmoor, Illinois 1937
Wilson, Bruce Vernon, Box 2, Okemos, Michigan 1943
*Wilson, Gordon, 1434 Chestnut St., Bowling Green, Kentucky 1920
Wilson, Harold Charles, Ephraim, Wisconsin 1938
Wilson, Myrtha M. (Mrs. Henry E.), Route 3, Box 118, Raleigh, North Carolina 1942
Wilson, Rowland S[teele], % Otto Heaton, Apt. 1854, Deshler-Wallick Hotel, Columbus, Ohio 1941
Wilson, Ruth (Mrs. Carl), 11285 Lakepointe, Detroit 24, Michigan 1941
Wiltshire, Mrs. Grace T., Randolph-Macon Woman's College, Lynchburg, Virginia 1941
***Wineman, Andrew, 150 Michigan Ave., Detroit, Michigan 1934
***Wing, Harold F[rancis], Route 3, Jackson, Michigan 1941
*Wing, Leonard [William], Washington State College, Pullman, Washington 1924
Wistey, Lorene S., South English, Iowa 1944
Wolfson, Albert, Department of Zoology, Northwestern University, Evanston, Illinois 1944
*Wood, Dr. Harold B[acon], 3016 N. Second St., Harrisburg, Pennsylvania 1932
*Wood, Merrill, 811 N. Allen St., State College, Pennsylvania 1945
**Woodward, Miss Barbara, 24 W. Main St., Le Roy, New York 1943
*Worley, John G[raves], 237 Charleston St., Cadiz, Ohio 1936

Wright, Miss Audrey Adele, 1312 Hepburn Ave., Louisville, Kentucky ...1941
Wright, Lt. Col. Dana [Monroe], State Game Farm, St. John, North Dakota 1943
Wright, Ernest B[icknell], Aberdovey Farm, St. Michaels, Maryland 1941
*Wright, J[ohn] T[homas], Route 5, Box 618, Tucson, Arizona 1941
Wright, Philip L[incoln], Montana State University, Missoula, Montana 1940
Wright, Thomas J. Jr., 17 Mechanic St., Wakefield, Rhode Island 1939
Wyatt, Miss Grace, College Station, Murray, Kentucky 1946
*Yeager, Lee E[mmett], Fish and Wildlife Service, Merchandise Mart, Chicago 54, Illinois 1939
*Yeatter, R[alph] E[merson], Illinois Natural History Survey, Urbana, Illinois 1932
Yergason, Robert Moseley, 50 Farmington Ave., Hartford 5, Connecticut 1946
Young, J. Addison II, 93 Argyle Ave., New Rochelle, New York 1942
**Young, James B[oswell], 514 Dover Rd., Louisville 6, Kentucky 1937
Zahare, Miss Margaret Gilliam, Route 7, Box 353, Salem, Oregon 1946
Zander, Mrs. Verna M[arie], Department of Physiology, Veterinary Bldg., Colorado State College, Fort Collins, Colorado 1943
Zempel, Arnold, 3851 N. Upland St., Arlington, Virginia 1941
*Zimmerman, Dale, 480 N. Almont St., Imlay City, Michigan 1943
*Zimmerman, Fred R[obert], 4110 Birch Ave., Madison 5, Wisconsin ...1935
Zimmerman, Mrs. Janet H., 1211 Michigan Ave., Evanston, Illinois ...1945
*Zirrer, Francis, Route 1, Birchwood, Wisconsin 1943

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NEW NAMES PROPOSED IN VOLUME 58: Branta canadensis **moffitti,** 96, and Branta hutchinsii **asiatica,** 95.

Erratum, volume 58: page 106, lines 5 and 6, for *Branta bernicla,* read *Branta leucopsis.*

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