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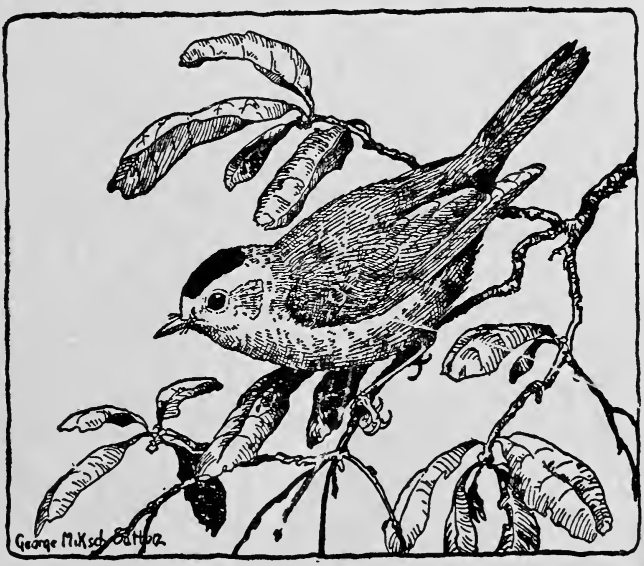

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LINEATED WOODPECKER

(Dryocopus lineatus)

Adult female, life-size. Painted in the field from a specimen collected February 17, 1938, along the Río Corona, near the village of Güemes, Tamaulipas, México, by George Miksch Sutton. This is the seventh of a series of color plates honoring the memory of Dr. David Clark Hilton.

THE LINEATED WOODPECKER

BY RICHARD R. GRABER

ESSENTIALLY a bird of tropical lowlands, the Lineated Woodpecker (*Dryocopus lineatus*) also occurs as high as 5000 feet in Mexico and 3600 feet in El Salvador. In Tamaulipas and San Luis Potosi, I have seen it in scrubby growth, but fairly mature forest seems to be the favored habitat. It will be interesting to see how this species survives increasing deforestation in Mexico. Fortunately it has a broad range, from southeastern Sonora and southern Tamaulipas, Mexico, to northern Argentina.

Over this range it varies considerably in size, plumage, and color of soft parts. Bill and eye color also vary with age. Dickey and van Rossem (1938. *Zool. Ser. Field Mus. Nat. Hist.*, 28:311) noted the bill of a juvenile from El Salvador as "bluish-horn color, tip paler," and of adults as "ivory-white becoming bluish at the base of the maxilla and on basal third of mandible." The iris of the juvenile was "dark brown," and of adults "bluish white." A similar change in eye-color with age occurs in the Pileated Woodpecker (*Dryocopus pileatus*). In northern Argentina, Wetmore (1926. *U.S. Natl. Mus. Bull.*, 133: 216) found the bill of an adult male Lineated Woodpecker to be "pale smoke gray" and the iris "dull white." Sexual dimorphism in this species also resembles that in the Pileated Woodpecker, males having the 'mustache' marks and entire crown red.

The loud, high pitched cries of Lineated Woodpeckers in Mexico are reminiscent of the Pileated. However the birds must be versatile vocally, since Wetmore (1943. *Proc. U.S. Natl. Mus.*, 93:272) "heard them uttering a chattering call that was not unlike that of a *Centurus*, while the drum was a loudly resounding, rapid roll, slowing slightly toward the end."

Dickey and van Rossem (*op. cit.*, 309) stated that pairs of the Lineated Woodpecker stay together throughout the year, and showed that the species bred in mid-winter in El Salvador. To the north, breeding occurs in, or at least extends to, April and May (see Sutton, Lea, and Edwards, 1950. *Bird-Banding*, 21:48–49; and Wetmore, 1943. *Proc. U.S. Natl. Mus.*, 93:272). This is further indicated by a Veracruz specimen in the Sutton Collection which was in postjuvenal molt on July 20. Dickey and van Rossem (*op. cit.*, 310–311) wrote, however, that the annual and postjuvenal molts may occupy three months or more. Juveniles are similar to adults. In the Veracruz specimen at hand, the outermost primary is conspicuously larger than in several adults, and the character may be good for aging specimens if it proves to correlate with dark eye and bill-color and buffy-tipped primaries. This reaffirms the point that collectors should be *especially* conscientious in noting colors of the fleshy parts.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF OKLAHOMA, NORMAN, OKLAHOMA, APRIL 21, 1954

THE OIL GLAND OF BIRDS

BY WILLIAM H. ELDER[1]

THE uropygial gland of birds, otherwise known as the oil gland, preen gland or rump gland has been the subject of much discussion and investigation for more than 100 years. The literature dealing with this subject is widely scattered in many journals and in many languages. The best review was written by Hou (1928b) in *The Chinese Journal of Physiology*—a journal available in few libraries in this country. Recent papers indicate that many authors are unaware of this diverse literature. This paper was prepared to draw together the early work, review Hou's papers, summarize the work that has appeared since, and present the results of recent experiments at the Delta Waterfowl Research Station.

EARLY OBSERVATIONS

Emperor Frederick II, in his monumental thirteenth century treatise on falconry (Wood and Fyfe, 1943:71), was seemingly the first to discuss the function of the oil gland of birds. He believed that its product not only oiled the plumage but also provided a poison which was introduced by the claws of hawks and owls thus bringing quicker death to their prey. In 1678 Willughby studied the question of the toxic nature of the oil gland secretion but found no evidence to support Frederick's contention.

The next mention of this gland was by Tyson in 1683. In his "Anatomy of the Mexico Musk-Hog" he pointed out the similar position of the scent gland in the musk-hog (=collared peccary, *Pecari angulatus*) and the uropygial gland in the partridge, and suggested that they were perhaps analogous. The possibility that this gland may serve a function in providing scent remains a moot question even today.

The chief reference to this gland during the next century seems to have been by the famed anatomist Cuvier in 1799 (Dallas, 1867:38–42), who provided the first description of the internal structure of the gland. He believed that it was a closed secreting vesicle but perhaps he examined a dove in which the gland is undeveloped and ductless for later workers have been able to trace and describe the ducts and, hence, it usually has not been considered an endocrine gland. From his study of the Gray Linnet (*Carduelis cannabina*), Monterosso (1915) believed it to function alternately as an endocrine gland and as a gland of external secretion; but details of his morphological studies alone seem to have reached publication.

1. Contribution from the Delta Waterfowl Research Station, Delta, Manitoba, and the Missouri Cooperative Wildlife Research Unit: U.S. Fish and Wildlife Service, Wildlife Management Institute, Missouri Conservation Commission, Edward K. Love Foundation, and University of Missouri cooperating.

Anatomy

During the nineteenth century and early in the twentieth there appeared a considerable number of thorough papers dealing with the anatomy of the oil gland, both gross and microscopic. Outstanding among those treating of the gross anatomy were Nitzsch (translation by Dallas, 1867), Owen (1866:230), Kossmann (1871), Paris (1910–13), and Granvik (1913).

The work of these men has shown that the uropygial glands are embedded beneath the skin in a mass of fatty tissue just dorsal to the levator muscle of the tail. The shape varies greatly among species and has considerable taxonomic significance (Coues, 1903:89). In various species the glands have from one to five openings (2–8, according to Grassé, 1950:285–289), to the outside through a nipple-like structure which is often covered by a tuft of specialized feathers. This tuft serves as a brush, functionally elongating the nipple and aiding in anointing the bill (Schumacher, 1919). At one time it was thought (Dallas, 1867) that the arrangement of these feather tufts was the best criterion for distinguishing some natural groups of birds both at the family and generic levels. The glands are best developed in aquatic birds. However, Burton (1822) pointed out that the oil gland is very small in Man-o'-war birds (*Fregata aquila*); when birds of this species were shot their plumage soaked quickly when they dropped into the sea. Gurney (1913:538–539) stated that the gland of the Gannet (*Sula bassana*) is the largest proportionally of all birds but is not used for lubrication of the feathers. Among parrots and doves are found all degrees of development of the gland from species with none to those with fully functional glands (Garrod, 1874a and b). It is absent in struthioniform, rheiform, and casuariiform birds and in some species of several other orders (Galliformes, Gruiformes, Caprimulgiformes, Apodiformes).

The gland is surrounded by a connective tissue capsule apparently devoid of muscle fibers (although Gadow, 1891:488, believed it to have a layer of smooth muscle) and receives its blood supply from the caudal artery; it is drained by the caudal vein which runs between the caudo-spinal muscle and the levator muscle. The nerve supply is from the first pair of caudo-spinal nerves plus additional sympathetic fibers. Kossmann (1871) electrically stimulated the nerve to one lobe of the gland and caused unilateral vasodilation of the artery to that lobe and a simultaneous flow of secretion from that lobe. Ligation of this artery stopped the flow. Paris (1906–13) confirmed these findings and added that the sympathetic nerve fibers must cause relaxation of the sphincter muscle around the external opening of the duct of the gland. This suggests many similarities to the sebaceous glands of mammals.

Histology and Embryology

The outstanding papers dealing with this aspect of the subject are those in

German (Kossmann, 1871; Granvik, 1913; Esther, 1938), French (Pilliet, 1889; Paris, 1912a and b), and Italian (Orlandi, 1902; Lunghetti, 1902–07; Monterosso, 1915). It is mainly from their works that the following summary has been drawn.

In the chick the gland appears first on the 9th to 10th days of incubation as a hollow invagination of the cutaneous epithelium in the rump region. Each lobe of the gland comes to have a stratified epithelium continuous with that of the duct of that lobe. Fat first appears in the gland cells on the 17th day of incubation (Ida, 1931).

The highly developed trabeculae of the inside of the gland resemble those of the heart of mammals and are packed with tiny parallel secretory tubules which produce their product by the gradual breakdown and sloughing of entire cells (a holocrine secretion, Biedermann, 1930; Grassé, 1950). The cell walls soon break down but leave the golgi apparatus intact in the secretion as revealed by special golgi stains (Bowen, 1926). Other cytological details and a discussion of the role of the mitochondria, golgi, and nucleus may be found in the work of de Jonge (1879), Röhmann (1902-04), Bowen (1926), and Hsu (1935, 1936). The weak reaction of the gland's secretion to osmic stains shows that there is little fat present in the product. This conclusion fits well with the histo-chemical work performed by Stern (1905a, 1905b). She concluded that the secretory, scarlet-red staining granules were present in the periphery of the tubules along with mitotic figures but increased in size toward the lumen while lipoid granules with osmic acid affinity were scarcer toward the lumen and the fine fat granules were found throughout.

Smooth muscle fibers are found around each trabecula of the gland and also form a sphincter at the nipple of the excretory duct. It is probable that these muscles relax under the stimulus of the sympathetic nerve fibers, thus causing the gland to empty. Relaxation seems to be induced by contact of the bird's bill with the nipple of the gland, where the receptors of pressure sensation, the Corpuscles of Herbst, are clustered (Paris, 1912b; Schmidt, 1924).

Phylogeny and Homology

Students of comparative histology have been concerned with the probable homologies of the uropygial glands and have likened them to lizard skin or scent glands (Paris, 1913; Van Eggeling, 1931; Schmidt, 1924; Esther, 1938; to crocodile cloacal glands (Esther, 1938); to turtle tear glands and snake poison glands (Orlandi, 1902; Pilliet, 1889). However, Maurer (1895) saw no relationship to reptilian glands.

Many investigators have noted the similarity in structure of the uropygial glands of birds and the sebaceous glands of mammals (Kossmann, 1871; Furbringer, 1888; Joseph, 1891; Pilliet, 1889; Orlandi, 1902; Wigger, 1906; Paris, 1913; Biedermann, 1930). Kossmann (1871), Paris (1913), Pycraft

1910:15) believed that they serve the same function—that of true scent glands. In the sporting literature of that time it was frequently claimed that retrievers were able to find diving, crippled ducks by following the odor of the oil they left behind, and Herter (1929) maintained that leeches find their duck hosts in the same manner. It was suggested (Dallas, 1867) that the glands may serve as a repellent organ in such species as the Hoopoe (*Upupa epops*), for, in the incubating female, the secretion collects, turns black and gives off a powerful odor which persists as long as the young are in the nest. Ghidini (1906) and Coupin (1914) claim that the defense function of the gland in the nestlings of this species is extremely effective for the young store up the secretion until the nest is visited by some rodent or weasel whereupon they discharge the fetid fluid onto the intruder. A similar function is described by Hingston (1933) in the Great Hornbill (*Buceros bicornis*) where the yellow threat sites—the bill casque, neck, crown, rump and wing angles—receive their color from the oil of the uropygial gland.

The absence of uropygial glands in ratite birds led Beddard (1898:18–19) to conclude that glandlessness was a primitive character but Pycraft (1910:15) pointed out that anlagen of the glands were present in the embryo of some ratites and that the loss of the glands in the adult could be considered a secondary specialization rather than a primitive character.

Genetics

The inheritance of glandlessness in doves was investigated by Johansson (1927) who found the condition to be recessive and frequent in the Fantail breed; it was not correlated with the number of tail feathers. Seven of 1,360 ordinary doves lacked the gland, which undobutedly explains the disagreement between Darwin and Kossmann (Kossmann, 1871). More recently Kessel (1945) has reported on the inheritance of uropygial gland papillae in domestic fowl.

Chemistry

Hou (1928b) states that the first analysis of the excretory product was made by Chevreul in 1853, who concluded that the sebaceous substance was developed by the setting free of a volatile acid in the presence of water. (This reference I have not been able to confirm for Hou's citation is in error). But a complete chemical investigation was not made until 1879, when de Jonge, in about two grams of the oil from a goose, found the following substances present: casein, albumin, nuclein, lecithin, low and high fatty acid, and a non-saponifiable portion, which he believed to be cetyl alcohol. Potassium, sodium, calcium, magnesium, and chlorine were found in combined form along with free sebacic acid and traces of sodium and potassium soaps. Newton (1893–96:653–654) reported that analysis of the secretion showed it possessed no sugar.

Röhmann (1904a) carefully repeated the chemical analysis and concluded that the secretion had only a small portion of fat (triglyceride of fatty acids) but a larger portion of fatty acid, ester of octadecylalcohol, and a chloroform-soluble body. Ida (1931) confirmed these findings. Röhmann (1902, 1904a) further pointed out that the gland must convert fat into fatty acids and then to wax—a hydrogenation through enzymatic action. He and de Jonge (1879) agreed that in 100 parts of the solid secretion approximately 60 are soluble in ether. The ether extract is a clear oil of yellow color which separates out as a nearly neutral, solid substance upon standing. It has an index of acidity of 0.75 to 3.4. The saponification index and iodine number are much less than for ordinary fat.

Although these early workers did not find cholesterol or the ester of cholesterol in the gland secretion of geese, Hou (1928b, 1930a) reported finding cholesterol in the glands and on the feathers of chickens. Ida (1931) found cholesterol in the whole gland but not in the secretion of the 17 species he studied. An earlier Japanese worker (Yamaguchi) whom Ida cites believed the gland excreted superfluous cholesterol.

In order to determine whether the uropygial glands actually synthesize the oil they secrete or merely convert dietary fats, Plato (1902) and Röhmann (1904a) fed geese on a diet of fat-free uncooked barley plus sesame oil and tested for the presence of the oil in the secretion of the uropygial gland at frequent intervals, determining that eight to 18 days are necessary for the transfer. However, it is not surprising that such an oil would appear in various fat depots of the body when the diet was overloaded with a foreign oil. More conclusive work was performed by Paris (1913) by feeding Sudan III in olive oil to ducks for several months. On autopsy peritoneal and body fats were stained orange but the oil of the gland was not. More controlled work was performed by Stern (1905a) by means of histochemical techniques in which she demonstrated that the outer zone of cells in the stratified epithelium actually contained fat droplets that were synthesized within the gland. Ida (1931) confirmed, in general, Stern's findings concerning the distribution of fat within the gland.

Function—Anecdotes and General Observations

In 1832 there began a prolonged argument over the supposed functions of the gland. This controversy raged in the pages of the *Magazine of Natural History* and was characterized by more heat than light. With much spirit and invective Waterton (1832, 1836, 1860) contended that birds' beaks were improperly shaped for such a purpose as dressing the feathers, that the feathers of the head and neck were as shiny as those of the body although not "preened" by the beak—"proof positive that the plumage of the bird has not been lubricated with oil from the tail gland." He maintained that the sole function of the preening activities was removal of lice—which he claimed to have found in quantities in the gullets of birds he had skinned.

The Rev. Morris (1836) poked holes in Waterton's arguments and reported watching birds anoint their bills and crown feathers at the feather tuft on the oil gland. This was confirmed for ducks and pelicans by Crisp (1860), and Hussey (1860) gave a careful and cautious description of ducks' use of the bill in oiling their feathers. In the next year Matthews (1861) gave a convincing and detailed account of chickens observed at a distance of two feet immediately after a rain. The birds raised the feathers of the gland region, turned the head to one side, and squeezed the oil from the gland with their beak before wiping it off with the head and neck, which were in turn used to anoint the body plumage. This opinion was followed by Coues in the first and subsequent editions of his "Key to North American Birds" (1903:89).

Although Newton in his famous "A Dictionary of Birds" (1893:654) followed Coues' opinion, Pycraft (1910:15) sharply disagreed and suggested that, as in mammals, this gland served as a scent gland.

In 1910 Stubbs coined the term "feather-film" to describe the pile of cilia and barbules which keeps the surface film unbroken around the bird's plumage. He believed that the oil from the preen gland must play but a minor part for duck feathers which he washed in warm soda water and benzine retained their buoyant properties.

Here the sleeping dog lay until rudely awakened in 1929 by Eugene Law, who, upon reading the old controversy and little of the research of the intervening 70 years, made a valiant appeal for Waterton's case. Based on kitchen-table-type experiments he (1929) concluded that feathers carry no oil and that the sole function of the gland is to lubricate the beak (which is then polished on the feathers!).

The cudgels were again taken up by Madsen (1941), seemingly also unaware of the literature, who reiterated Law's contentions and cited his own simple experiments to show that ducks' feathers are waterproof strictly because their physical structure provides a hydrofuge mechanism. He believed that the tips of the belly feathers actually became wet so as to reduce friction in swimming!

Fabricius (1945) favors the opinion that the ability of the duck to keep its plumage dry is, at least in part, dependent upon the uropygial gland and that for normal functioning the diet of the downy young must include some substance provided by insects and crustaceans. However, thousands of normal ducklings have been reared at the Delta Research Station without these animals in their diet.

A similar role for the secretion of the oil gland and for powder down of birds has been suggested by Schüz (1927) and Esther (1938). Esther thought that powder in doves and other birds with powder down serves, in part, the same function as oil. Percy (1951:36–39) has provided photographic evidence of the concurrent use of powder and oil by the Bittern (*Botaurus stellaris*) and Heron (*Ardea cinerea*) after their plumage was contaminated by eel slime.

The early suggestion by Schauer (1877) that the gland had electrical properties was obviously a case of static electricity, discharged as his fingers touched the oil gland nipple in the dark of his laboratory.

Occlusions and Ablations

Stoppage, both naturally and experimentally, and surgical removal of the oil gland provide some insight into its function.

A seven-inch "horn" protruding from the side of the uropygial gland of a Lapwing (*Vanellus vanellus*) was reported by Ticehurst (1910). This showed that stoppage and continued formation of the secretion resulted in rupture of the capsule and continuous oozing of the secretion, which came to solidify and harden. Similar excrescences were induced by Hou (1928b) by experimental occlusion of the gland.

Stoppage in chickens, resulting in enlargement, was found by Bechstein in 1791 (Hou, 1928b) and Crisp (1860). The former reported that it caused a disease known in France as "darre" while Coupin (1914) refers to it as "bouton." This seemed to be an old wives' tale until 1939 when Mohey reported a similar disease in cage birds and urban-dwelling chickens in India. He describes native as well as his own veterinary procedures for treating the disease.

Total removal of the gland by surgical procedure was first performed in Germany by Kossmann (1871), who saw no change in his pigeons following this treatment. The following year (1872) Philipeaux removed the uropygial gland from a duck and reported that the plumage remained normal, but the plumage of Hou's ducks (1928b) became dry and disorderly. Although these conflicting results perhaps are attributable to the small samples or poor operative technique, Philipeaux believed that when the ablation was performed on young ducks the gland was replaced by supplementary secretion in other skin glands in the region. But no one has found these "other skin glands." Joseph (1891) removed the glands from a few ducks and, after healing was complete, submerged them in water along with normal ducks. After a fifteen minute drying-off period the glandless birds retained in their plumage twice as much water by weight as did the normal birds.

The Italian histologist Lunghetti (1906) next performed ablations on a few 3-month-old chicks without apparent change.

Paris (1913) reported on the detailed structure of the uropygial glands of 350 different species of birds. His morphological work was accompanied by a few exploratory experiments. He ablated the glands in 10 birds (of 5 species) and saw no plumage changes. However, his birds were shunned by the controls. Coupin (1914) suggested that this might be due to their loss of normal body odor but a more convincing suggestion is that they might have been stealing some oil from the normal birds. This was actually seen by Hou (1928a, 1928b) when he ablated the glands in 16 pigeons, four chickens, four ducks and one goose. He then isolated the glandless birds from the controls and noted the following results:

1. By the fourth week, dulling and roughening of the plumage was seen with considerable soiling and very slow drying after bathing (ducks only?).
2. Heat loss, as shown by rectal temperatures before and after swimming in cold water, was greater in glandless birds than in controls.
3. Microscopic oil droplets normally present in great numbers on the barbs, barbules, and barbicels were progressively lost and completely disappeared by the third month, indicating that a bird normally removes oil as well as spreads it during preening and that in the absence of a new supply it eventually is entirely lost.
4. A slow, progressive decrease in body weight was noted, starting between 40 and 100 days after ablation of the oil glands.

Ida (1931) ablated the glands of ducks, chickens, and geese, finding no general changes in the plumage or appearance even when four months had elapsed. However, egg laying ceased.

Esther (1938) agrees with Paris and Ida in finding no general changes following gland ablation in his birds, which paired, bred, and reared several broods successfully when both sexes were made glandless. At the Delta Station one of the mallard hens, glandless for nearly a year. reared a brood successfully.

Feather Studies

Although Law (1929) made crude attempts to show that there was no oil on bird feathers and Madsen (1941) showed that feathers were wettable with colored dyes, the only thorough work reported has been that of Hou (1928b). He took small bundles of feathers from control birds and birds from which the glands had been removed and, after drying these for 24 hours in a calcium chloride desiccator, subjected them to continuous fat extraction in an alcohol-chloroform mixture in a Soxlet's apparatus for 24 hours. The bundles were then removed, air dried, then desiccator dried and weighed. Those from control birds lost approximately 5 per cent in weight, while the feathers from glandless birds gained approximately 2 per cent. Although the weight gain remains unexplained, the substance removed from the feathers of control birds was, at least in part, cholesterol as shown by the Liebermann Burchard test. Cholesterol both from the feathers and the oil glands was further identified by spectrographic analysis.

Desiccator-dried feathers suspended in a saturated atmosphere gained moisture for 48 hours, and feathers from a saturated atmosphere lost weight in a dry atmosphere for 48 hours. This indicated that feathers are permeable to water. It was further shown that normal feathers subjected to an aqueous solution of methylene blue for an hour and then washed for two hours showed dye in the interior of the barbules.

Microscopic examination of feathers removed from birds several months after their glands had been ablated indicated that their loss of color and gloss was due to actual physical breakdown, undoubtedly in part the result of the preening activity itself. Seemingly, loss of the oil predisposed the feather to physical degeneration, making its wear more rapid, until it was possible to see, by microscopic examination, that there were actual holes in the feather due to breaking off of bits of the barbs.

It is of interest to note Hou's (1928b) observation that, after the feather is drawn through the blades of the beak, an act of swallowing invariably follows, indicating 1) that there is an automatic, instinctive behavior pattern, or 2) that something has actually been ingested. This might well be dirt, dandruff, lice, and oil. R. C. Murphy (1936:473–474) suggests that the stomach oil of procellariiform birds may be the secretion of the preen gland subsequently swallowed to be later regurgitated and used as a feather dressing. Fisher (1952:390–391) states that stomach oil is used in preening but clearly shows that this oil is produced in the proventriculus and not in the uropygial glands.

Nutrition Studies

Hou (1928b) cites evidence that carnivores in zoos frequently develop rickets and may succumb on a diet of horse meat alone, while addition of intact birds or rabbits plus liver, fat, and flat bones prevents this. Rowan noted (1928) that his Merlins (*Falco columbarius*) needed feathers in their diet in order to remain healthy and that the mother forcibly fed these to her young every few days. Rowan suggested that the feathers might contain vitamin D resulting from irradiation by sunlight of oil spread on them from the preen gland.

A thorough study of the nutritional function of the preen gland product was reported in a series of papers by Hou (1928a, 1928b, 1929, 1930a, 1930b, 1931). A weak, rachitic pigeon in which the oil gland had been ablated was restored to health upon eating an irradiated gland from another bird. A second rachitic pigeon fed on a gland removed in the dark showed no improvement. Eight chicks (four of which were glandless) were placed on a rachitogenic diet until two died and all showed decalcification and swollen joints. Ultraviolet-light treatments which were then begun cured the controls of their rickets but not the glandless birds. The same results were obtained when the glands were removed in a group of four chicks after the rickets had developed —the controls again recovered under ultraviolet exposures but operated birds did not.

Adult pigeons, mallards, and chickens (kept in the sunshine after ablation of the glands) did not develop rickets but the plumage degeneration was severe. (The degenerative changes are never as severe in pigeons as they are in chickens and ducks.)

Guareschi's note (1934) suggesting a relationship between rickets, abnormal growth, and a keratinized uropygial gland in one chick and one pigeon added little to our knowledge.

Clark (1934) and Knowles, Hart, and Halpin (1935) removed the oil glands from three groups of Leghorn chicks at ten days of age. With nine birds in each group the first group was given a cod-liver oil supplement, the second ultraviolet treatments, and the third left on the rachitogenic base ration alone. Up to four weeks of age all gained weight like the normal unoperated controls but from this time on the third group developed rickets. Although they saw these results as a complete contradiction to Hou's work, it seems the conclusion should have been that rickets is easily prevented in the absence of the oil gland if therapy is started early, but, as Hou showed, once rickets has set in it is not readily cured by ultraviolet light. In brief, it is easier to prevent than to cure.

The last work of this sort reported was by E. F. Murphy (1936), who removed the oil glands and the combs from 50 Rhode Island Red chicks at the age of two weeks. One week later, along with an equal number of controls, they were put on a rachitogenic ration. The birds were treated as five groups, with ten glandless and ten intact birds in each group. There was a slight difference in the growth rates of the glandless and intact birds in the control group on basic ration alone, but apparently no significant difference in (1) the group receiving cod-liver oil supplement from the start, (2) the group given cod-liver oil starting with the fifth week, and (3) the group given 20 minutes daily irradiation after rachitic symptoms were apparent in the fifth week. But among the remaining group—those that received only five minutes of ultraviolet irradiation from the start—the glandless birds were greatly retarded as compared with the intact birds. Analysis of the bones showed that in four of the five groups the intact birds had a slightly greater total ash content than did the glandless birds. Unaided by statistical analysis, Murphy concluded that there was no real difference in the responses of glandless and intact birds, but her data suggest to me that there may have been a real difference and that the thrift of glandless birds was much less than that of intact birds on a subminimal dose of ultraviolet light, although when given 20 minutes of treatment per day the thrift of glandless birds equalled that of intact birds.

This was shown earlier by Hou in his 1931 paper (again with too few birds) where he concluded that ultraviolet light cured rickets in chicks with or without oil glands when the legs and feet were exposed, quite regardless of whether the feathers were exposed or not. This later work was not in complete agreement with his first paper, and it seems clear that the threshold for ultraviolet therapy varies so much among species, and among breeds of one species, that consistent results cannot be expected when the irradiation is not measured and expressed in terms of actual dosage, as in the work of Maughan and Dye (1929).

Although we are forced to conclude that, at least in chickens, the presence of the preen gland is not essential for the prevention of rickets, it has not been shown that the gland does not play an important role. In another paper Hou (1930a) demonstrated that feathers contain vitamin D, that it can be extracted with fat solvents, and that the cholesterol content is twice as great in the feathers of intact birds as it is in feathers of glandless birds.

Hou tested thoroughly, by means of published roentgenograms taken at the start and at the end of the experiment, the effects of feeding feathers, feather extracts, and other parts of birds both normal and rachitic, to rats kept on a rachitogenic diet. The results are shown in Table 1.

TABLE 1

EFFECT OF FEEDING CHICKEN TISSUES TO RATS WITH RICKETS

Rachitogenic diet supplement	Per cent healing of rickets in rats fed on tissues from chickens *Normal*	*Glandless*
Chicken feathers	70%	10%
Ether soluble extract of feathers	93%	0%
Skin	96%	38%
Body fat and muscle	90%	0%

This seems to be conclusive evidence that the oil on feathers of normal chickens contains an appreciable amount of vitamin D which could serve as a dietary supplement if accidentally ingested during preening. However, Ida (1931) found no cholesterol in the preen gland secretion, and Koch and Koch (1941) found no pro-vitamin D in alcohol-ether extracts of preen glands or feathers of ten-week old pullets when assayed on rats. The same procedures demonstrated that extracts from skin and legs of the pullets did cure rickets in rats.

Some of the seeming contradictions in these experimental results may be due to the difference in age of the birds from which feathers were clipped for chemical extraction and tests for vitamin D. Hou (1930a) pointed out the significant difference in the ability of young and adult chickens to store anti-rachitic factor. Adult birds kept in the dark on a rachitic diet for four months after the oil glands were removed retained in their skin and fat appreciable amounts of anti-rachitic factor, while young kept in the sunlight for four months following ablation of their glands completely lost this factor.

Relationship of Oil Gland to Endocrine Glands

Ida (1931) found that not only were no more eggs layed by the ducks, geese, and chickens from which he had removed the uropygial glands but that from 146 to 204 days after operation there was complete atrophy of the gonads in both sexes. This has not been found by any of the later workers.

Esther (1938) suggested that the uropygial glands of doves had some endocrine relationship for he found that the inner epithelial lining of the gland developed rapidly in nestlings after hatching but atrophied as soon as the young no longer received pigeon milk. A much earlier suggestion was made by MacGillivray (1837:44–45) that the function of the gland was related to the molting process for he found it highly developed during molt and greatly diminished after the molt was complete. This lead seems never to have been investigated further. Grassé (1950:285–289) states that the gland seems better developed in the male than in the female and that in the goose it reaches maximum size in January and February.

That the size and amount of secretion of the uropygial glands is under the influence of sex hormones was first suggested by Selye (1943) when he stated categorically: "It is known that during the mating season it [the uropygial gland] produces an increased amount of secretion at least in certain species." He injected Leghorn chicks, starting on the second day of life, with various steroid hormones, and found that testoid hormones depressed the uropygial glands between the 20th and 45th days but that the glands then resumed normal size and histology in spite of continued hormone treatment.

Kar (1947) found that the uropygial glands of Leghorn cockerels atrophied as a result of castration in 86 days from an average weight of 604 mg. to that of 345 mg. This atrophy was prevented by injections of the male hormone, testosterone. The same male hormone depressed the weights of uropygial glands in normal chicks but female hormone (diethylstilbesterol) did not. In old capons (age 156 days) the gland had returned to normal size without hormone injections, probably due to male hormone supplied by hypertrophy of adrenal cortical tissue.

These findings all suggest that the amount of uropygial gland secretion is under the influence of male sex hormone.

Experiments at Delta, Manitoba

Preliminary experiments concerning the function of the uropygial glands of ducks were made at the Delta Waterfowl Research Station at Delta, Manitoba, in the summer of 1947. Glands were surgically removed from 5 Redhead (*Aythya americana*) and 5 Shoveller (*Spatula clypeata*) ducklings less than ten days of age. All were kept in the hatchery where healing was observed to be prompt. The ducklings were normal in appearance and behavior until the juvenal plumage was assumed in August. The rough and dull look of the feathers was apparent at the time the birds were released on a large outdoor pond. They seemed to swim and dive normally but quickly became wet and bedraggled. Survivors were kept over winter in the hatchery but did not do well—their soiled, dry, roughened plumage was definitely inferior to that of normal ducks kept with them.

Early in July, 1951, glands were removed from 9 Mallards (*Anas platyrhynchos*) and 23 Redheads in order to study growth and survival in comparison with controls of the same age. Observations were also made of behavior and plumage changes induced by ablation of the glands. Because Hou (1928a, 1928b) saw evidence of glandless birds attempting to steal oil from normal birds, our controls were kept in separate pens from the operated birds without glands.

Preening Behavior. In the Redhead ducklings the preening behavior pattern was observed repeatedly both in glandless and intact birds. No alteration in the act either in sequence or frequency of occurrence could be detected in the birds deprived of their oil glands. They were seemingly unaware of the futility of their movements; the whole behavior pattern is probably innate, although it becomes more elaborate as the number of feathers to be preened increases with age.

Although the details are difficult to observe, the sequence of events is usually as follows: The tip of the bill is touched to the area of the gland's nipple. Slight nuzzling movements suggest that the tactile-sensitive Corpuscles of Herbst are being stimulated. It is possible that the nipple is actually squeezed between the mandibles but this could not be observed for certain. (Manual manipulation by the observer did not elicit flow of the gland's secretion.) Apparently the stimulation from the duck's bill induces flow of the gland's secretion and immediately afterward the lower mandible, chin, sides of head, and occasionally the top of the head are wiped across the nipple. The lower mandible is then rubbed over the breast and belly feathers. Some feather arrangement may be accomplished at the same time. Use of the bill in preening feathers in other regions seems to be primarily a matter of feather arrangement and is usually accomplished without prior application to the oil gland.

The remainder of the body plumage, namely the flanks, back, and scapulars, is treated by being rubbed with the sides of the head and chin. The flight feathers are rarely touched with the bill but may receive oil when the sides of the head are rubbed along the sides of the body.

The pattern of the preening behavior is usually as described above although the sequence of events may vary. Frequent preening was observed during which, and prior to which, no use was made of the oil gland. Such feather arranging is probably much more frequent than is preening following use of the oil gland. The complete preening pattern, including the movements attributed to anointing the head and bill in the normal birds, was observed in both intact and glandless ducklings up to the age of seven weeks, when the summer's study period ended. The preening pattern is seemingly innate for it persisted in these glandless ducks and was repeatedly seen during the following summer after the birds were fully adult.

Most of the same preening behavior described for the Redhead was also seen in Mallards although the condition of their housing made them difficult to observe.

At the age of five weeks one of the groups of glandless Redheads was placed in the same pen with a group of normal ducklings in order to watch their reactions to each other. At no time during the ensuing two weeks were glandless birds seen to attempt to steal oil from their intact companions as was described by Hou (1928b), nor was stealing seen the following summer when the ducks were adult.

Plumage Comparison and Behavior toward Water. The difference in appearance between glandless and normal ducks, especially in the Redheads, was striking. The feathers of normal birds were glossy and kept well arranged while those of glandless birds were dry, lusterless, and matted (see Figs. 1 and 2). The difference was even more apparent when the birds emerged from water; feathers of the normal ducks remained dry, glossy and in place, while those of the glandless ducks became completely water soaked, matted, and disarranged.

Although there was some variation in the behavior of different pens of Redheads under observation so far as their use of water was concerned, it was obvious that glandless birds avoided water even to the extent of being cautious

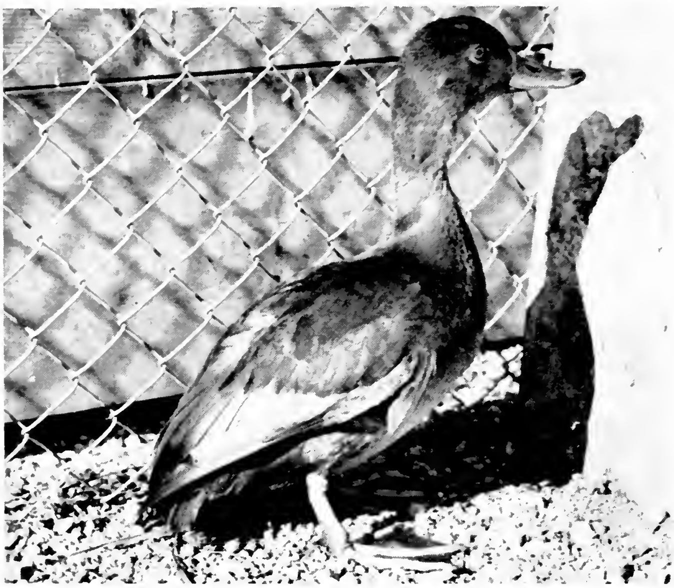

Fig. 1. Normal, hatchery-reared Redhead, age approximately 15 weeks.

about slipping down the incline of the pens during feeding. In contrast, the normal Redheads, by seven weeks of age, spent much of their time on the water—feeding, playing, and preening—and even rested on the water at night. The difference in the condition of the plumage in normal and glandless birds seems to be an obvious explanation for the disparity in amount of use made of water by the two groups.

Differences in plumage of intact and glandless birds disappeared with the completion of the molt the following summer. The glandless birds were not only restored in appearance but also in behavior for they no longer avoided the water but swam and bathed with other ducks on the pond. The glandless ducks had to be caught and the leg band numbers read in order to distinguish them from normal birds. However, their plumage again showed deterioration during the ensuing winter and was again fully restored to normal by molt in the next summer (their third year of life). Madsen (1941) reports that one adult duck from which the gland was removed just prior to molt was normal in appearance and behavior after the molt was completed. Heinroth (1928, 1:32–33) mentioned that sea ducks which have lost their water-proofness as a result of being shipped in a basket are restored to normal at the next molt, if they survive that long.

Fig. 2. Hatchery-reared Redhead, 15 weeks of age, from which oil gland was removed during first week of life.

Skin and Bill Condition. In the glandless ducks the surface of the bills, legs, and feet became dry; the bill peeled, the skin of the legs and feet thickened and cracked. This condition, especially of the legs and feet, was extreme by the following summer, after the glandless birds were more than one year old. It persisted after the birds were turned out on the enclosure pond and lived under natural conditions. Although the glandless birds' plumage was restored to normal after the eclipse molt, the skin condition did not improve. This reminds one of the suggestion first made by Trouessart (1906) that the oil gland was essential for oiling the skin as well as the feathers. In their third summer the glandless ducks at the Delta Station had completely normal plumage, bills, and legs after the molt.

Growth and Survival. In order to determine what effect removal of the oil glands might have on the growth of ducklings, both glandless and normal birds were weighed at frequent intervals. The average weights for each group

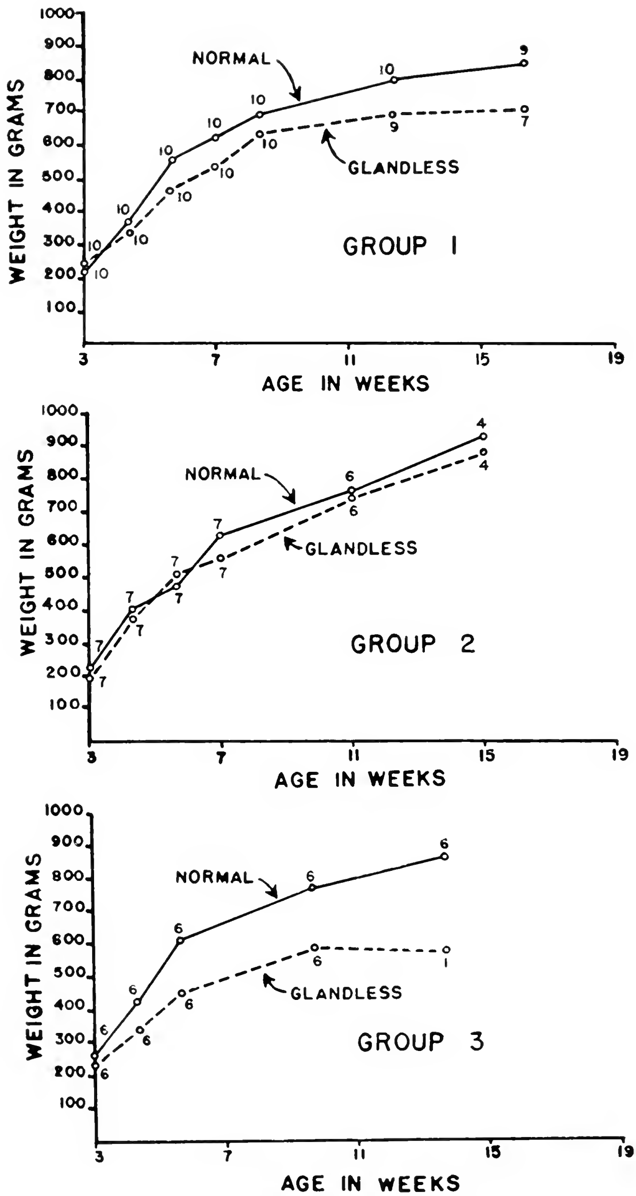

FIG. 3. Growth rates of 3 groups of Redheads in the Delta hatchery. The numbers of birds alive at each weighing are shown by the figure adjacent to each point on the curves.

of Redheads and Mallards throughout the summer growth period are shown in Figs. 3 and 4. It may be seen from examination of these figures that in

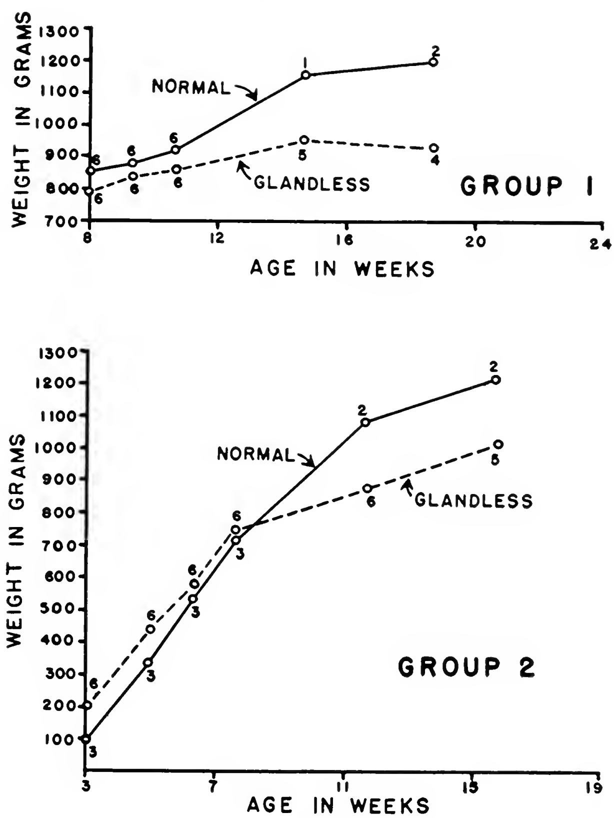

FIG. 4. Growth rates of 2 groups of Mallards in the Delta hatchery. The numbers of birds alive at each weighing are shown by the figure adjacent to each point on the curves.

each of the five groups of ducks the normal, intact birds showed a more rapid gain in body weight than did the corresponding group of birds from which the oil glands had been removed.

It seems certain that the oil gland is essential for maintenance of maximum thrift in ducks and that the differential growth rates shown by intact birds in captivity would be even greater in the wild. Although it is possible that the intact birds gained faster because of vitamin D supplement received through preening, it seems more likely that the difference in the two groups may be mainly attributed to the more efficient insulating layer provided by the feathers of the normal bird. The heat loss suffered by the glandless birds with matted plumage must be a constant drain depriving the birds of energy otherwise used for growth. It is doubtful that glandless ducks could long survive in the wild. Among the Mallards held in captivity, three of the 12 glandless birds died by February but all of the normal birds were still alive. Among the Redheads 13 of the 23 normal birds died by February and 17 of the 22 glandless birds succumbed during the same period.

Species Differences in Size of Oil Gland in Proportion to Body Weight. Crisp in 1860 was first to show interest in the general relationship of preen gland weight to body weight and gave examples from several species. Because the size of the oil glands of water birds has frequently been pointed out as exceeding that of land birds, it might be anticipated that the glands of diving ducks would be larger in proportion to the body weight than would be those of dabbling ducks. As one test of this, all glands removed from young ducklings were weighed and compared with the weights of the birds from which the glands had come. The results were as follows:

Species	Number of birds	Per cent of body weight made up by oil glands
Redhead	24	0.54
Mallard	12	0.31
Shoveller	5	0.40

Glands from more species and from older birds would be required before correlations should be made.

Buoyancy and Wetting Time in Incubator-Hatched Ducklings Compared with Wild-Hatched Ducklings. Madsen (1941) claimed that in Eider duck nestlings (*Somateria mollissima*) the oil glands do not become functional until several days after hatching, but that these young have no difficulty remaining dry while swimming. It may be possible that young ducks are copiously anointed by their mother before leaving the nest (Heinroth, 1911) or that the downy young get enough oil from contact with their mother's feathers (Heinroth and Heinroth, 1928, 3:211–212) to make them water-repellent until their own glands become functional.

As one test of this hypothesis, four downy young of approximately three days of age were taken from a hen Redhead that chanced to pass the Delta Station with her brood. The behavior of these birds was studied in comparison with four downy young Redheads of the same size that had been hatched in the incubator. The birds were tested singly and as a group by placing them in washtubs half filled with ordinary water for 15-minute observation periods.

Wild-hatched ducklings seemed to float a little higher in the water, were more at ease, less active, never jumped in attempts to escape, and did not get wet. Incubator-hatched young began jumping to escape within 8 to 10 minutes and showed more wetting of the outer belly down. The basic question remains unanswered: Did these ducklings jump to escape because they were getting wet or did they get wet because they were jumping?

A further test of the two groups of young was made the following day by placing each bird alone in a tub containing 25 liters of water to which had been added 50 grams of the wetting agent "Alconax." With wild-hatched Redheads jumping now began in ½ to 1 minute and within 3½ minutes all sank until only the head remained above the surface. Each was then quickly rescued, dried and later used for another trial on a later day. There was no progressive decrease in wetting time during the four trials as might have been expected had an oil film been removed by the concentrated solution of "Alconax." With the four incubator-hatched Redheads jumping began earlier and sinking to the level of the head occurred in half the time required by wild-hatched young. Again the cause of the earlier jumping could not be ascertained.

Application of a cigarette paper to the feather tuft on the oil gland of newly hatched ducklings from the incubator at the Delta Research Station always produced a greasy spot, indicating that the gland was functional in the first day of life in the Redhead, Canvasback (*Aythya valisineria*), and Mallard. This is in agreement with Esther (1938) who found the gland functional in the first day in domestic ducks and the Coot (*Fulica atra*). However, neither Madsen (1941) working with the Eider duck nor Veselovsky (1951) working with the Tufted Duck (*Aythya fuligula*) believed the gland to be functional in the first few days of life.

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Conclusions Concerning Function of the Oil Gland

From the welter of opinions, inconclusive observations, and contradictory experimental evidence reported in the literature, plus observations made at the Delta Waterfowl Research Station, the following general conclusions concerning the functions of the uropygial glands of birds seem justified.

1. The oil gland of birds secretes a substance containing much fatty acid plus some fat and wax. The act of preening induces, through a nervous re-

flex, flow of the secretion onto the nipple or feathers occurring at its opening. This substance is transferred to the body plumage and probably also to the wing plumage by the bill and head plumage.

2. In waterfowl the secretion of the oil gland maintains the water-repellent quality of feathers either directly or by preserving their physical structure.

3. In waterfowl the secretion is essential for maintenance of feather structure from one molt to the next. Without this secretion the feathers lose much of their normal function both as a flight mechanism and as a heat-insulating medium. It seems unlikely that a bird rendered glandless could survive in the wild.

4. Degenerative plumage changes following removal of the glands are more pronounced in waterfowl than in chickens and more pronounced in chickens than in pigeons. This seems reasonable in view of the general relationship of gland size and probable need for "waterproofing."

5. The degenerated plumage of Mallards and Redheads caused by removal of the glands when the birds were in the downy young stage is lost through normal molt during the following summer and the new plumage is normal in appearance, at least at first.

6. The secretion is used to anoint the bill and maintains its surface structure and glossy appearance; without the secretion the bill becomes dry and shows some sloughing. Neither the bill condition nor the dryness and cracking of the skin of the legs of glandless birds improves during the molt in the second summer of life but in the third summer their appearance is normal in every respect after the molt.

7. The rôle of the uropygial gland as a scent gland remains a complete enigma.

8. The uropygial gland is not essential for growth and development but in its absence growth is impaired in Mallard and Redhead ducks.

9. Hou's papers (1928–1931) seemed to show that the feathers of normal intact chickens (probably adult) contain vitamin D which is lacking in the feathers of glandless chickens and that these feathers have twice the cholesterol content of feathers from chickens having had their glands previously removed. These findings could not be confirmed by later workers (Koch and Koch, 1941) using pullets.

10. Although growth of glandless birds was slower than growth of intact Mallards and Redheads, the secretion of the gland can not be considered essential in the diet; however, if it is ingested in even small amounts following the act of preening, the vitamin D it is said to contain may significantly augment in the growing bird the usual dietary supply of that vitamin.

11. The preen gland is not essential for the maintenance of life in the laboratory; it certainly is essential for survival in the wild.

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A NESTING STUDY OF RED CROSSBILLS

BY DOROTHY E. SNYDER

During the winter of 1951–52, Red Crossbills (*Loxia curvirostra*) were seen at Eastern Point, Cape Ann, Essex County, Massachusetts, on numerous occasions. On March 2, Ludlow Griscom saw a female carrying nesting material at an estate called Shoal Waters; on March 4, I found the partially built nest.

Nests and eggs of this species have been previously seen and taken in New England; in Maine the most recent reports are those of Allan D. Cruickshank from the Muscongus Bay region, where a nest was found on August 22, 1949, and a nest with young on August 14, 1952 (letter). There is an old Massachusetts record of Maynard's (1882:520): "Nest and eggs collected in Tyngsboro a few years ago" (in August about 1875). An incubating female was flushed from a nest in Marblehead, Essex County, on April 22, 1917; the empty nest was brought a month later to William Brewster (1918). Red Crossbills were seen building a nest at Andrews Point, Cape Ann, in March, 1949 (Snyder, 1951). The female was incubating when the nest was blown down in a gale on April 6; the nest and egg fragments were recovered.

With the exception of Lawrence's observations (1949), I have found no complete record of the nesting of the species in North America; in most cases nests were deserted or broken up shortly after discovery. Therefore I decided to watch the Eastern Point nest from a distance unlikely to interfere with its success. Observations were usually made with a telescope from a car parked across the road. While this procedure prevented the gathering of precise data concerning egg laying, incubation, and number of days young were in the nest (facts previously determined for this species by Lawrence, 1949, and the Rosses, 1950), it did result in a series of observations during the entire period of a successful nesting. Except on week ends, observations were made before and after school classes in Gloucester; 25 visits to the nest were made on 20 days. The periods of observations totalled 41 hours and 15 minutes.

Habitat

Wilderness is apparently not a nesting requirement of the Red Crossbill. The Andrews Point nest was located in a pitch pine (*Pinus rigida*) within a few feet of a summer cottage. At Shoal Waters the nest was only 8 feet from a stone wall enclosing the property, and not more than 15 feet from the road. It was at the edge of a grove of 93 Japanese black pines (*Pinus thunbergii*) which were fruiting abundantly and formed a convenient food supply for the nesting pair. Across the road were sumac (*Rhus typhina*), privet (*Ligustrum vulgare*), and a small cherry (*Prunus* sp.) often used as a singing perch.

Weather Conditions

A complete weather chart for March 1 to April 18, furnished by the U.S. Coast Guard station at Eastern Point, shows a low temperature of 17 degrees, a high of 51, below freezing temperatures on 9 nights and an average temperature of 38 degrees. The wind velocity averaged about 15 mph; the highest recorded was force 8 (48 mph) on April 5. During the nesting period there was sun or broken clouds on 11 days in March and fog, rain, and snow on 15. In April there were only 3 days with sunshine or light clouds in contrast with 11 days of fog and /or rain.

Courtship

Since the nest was partly built when located, little courtship behavior was observed. On my first visit the male was singing brilliantly. This was probably a courtship song as it was never heard again. On March 14, while the female was building, the male sang from a tall elm in the adjoining property. Here the female joined him and both birds flew high around the grove in large circles, calling continuously, with the male in the lead. This (courtship?) flight ended with the pair dropping to the top of the elm, where the female still called loudly.

Nest Building

On my arrival at Shoal Waters on March 4, a male Red Crossbill (M) was singing from a cherry limb overhanging the road; 20 minutes later a female (F) flew into a small pine across the road. Carrying a twig in her bill, she went directly to a half-built nest, thus revealing its location. F then made five trips to the nest in three-quarters of an hour; on one trip she brought a six-inch privet twig on which she had been tugging vigorously. During this time M, a bird with mottled green and red plumage either accompanied F or sang near the nest tree. Once F fluttered her wings like a hungry juvenile and was fed by M.

Two days later, March 6, during a northeast drizzle, there were no signs of crossbills in the vicinity and the nest was no nearer completion.

Between 10 and 10:30 a.m. on March 9, F came to the nest tree three times with material, once staying on the nest and molding the interior by turning around vigorously. At noon on March 13 there was much crossbill activity in the grove; the nesting pair seemed to be courting and were feeding on the pine cones. M was singing often and both birds were calling. F made 5 trips to the nest, once bringing a white feather two inches long. During this hour F spent a total of 7 minutes at the nest.

By the next visit, on March 18, the nest was completed. Measurements taken later showed it to be 16 feet 2 inches from the ground and 24 inches from the top of a small pine. It was saddled on a branch ½ inch in diameter and (contrary to descriptions of most other nests) only 2½ inches from the trunk, in a thick tuft of needles and cones. The outside was of loosely woven spruce twigs (*Picea* sp.), many of them from 90 to 160 mm. long. Inside were grass and weed stems, together with a few feathers and some felted material of vegetable origin. Measurements were: outside diameter, 120 × 140 mm.; inside diameter, 70 × 85 mm.; shape somewhat oval; inside depth, 35 mm.; outside depth, 60 mm.

Incubation

At noon on March 18 F was first seen on the nest, where her olive-green feathers blended perfectly with the surrounding pine needles. She was fed there three times by M, who signalled his arrival by calling. F kept up a soft *cheep*ing much of the time. Returning at 3 p.m., I did not see F until 3:13 when she returned to the nest. The first egg was probably laid on this date. During the noon hour on March 20 the actions of both birds were similar and I judged that the third egg was laid. On this date, the female again left the nest after being on it more than an hour although the weather was inclement. On the 23rd and 25th I noted little activity—in the poor light F could not be detected on the nest until she moved. M was not seen at all between the 20th and 27th. On the latter date, when incubation must have been well advanced, it seemed safe to approach the nest tree. From a step-ladder placed under the tree, I raised a hand mirror wired to a 12-foot pole and saw three pale-bluish eggs, lightly spotted with reddish-brown. As reported by other authors, the female was a very close sitter. On my few inspections of the nest it was necessary to poke her off gently with some object. Squawking loudly, she would jump to the nearest twig, to return to the nest as soon as the mirror was removed. On April 1 F was still sitting closely. I saw her scratch and dress her feathers vigorously and, with opened bill, thrust her tongue in and out a number of times. During the entire incubation period F was only seen off the nest once; for the most part she sat quietly and moved little although her black and beady eyes seemed always alert.

Care of Young

The young probably hatched on April 2 (no visit) or April 3, when feedings were observed. For the next four days F brooded constantly during my visits. She was fed on the nest by M, and fed the young herself several minutes later. During this period the food regurgitated appeared thin and watery. On the 4th, after poking F gently off the nest, the naked appearing young were seen huddled in the bottom of the nest. By April 5 they showed a covering of gray down and were able to hold up their heads. On the 8th both parents were bringing food. M always fed first but F regurgitated for longer periods, and sometimes brooded after feeding. Excreta was swallowed by both parents but more often by F. During the last week of occupancy, however, the rim and outside of the nest was whitened with excreta of the young. On April 12 inspection of the nest from an extension ladder showed three young, covered with dark bluish-gray down and with pin feathers now visible.

On this date and later, photographs were taken from a ladder 8 feet from the nest. This disturbance resulted in only a slight delay in feedings. On April 17, the nestlings' heads showed high above the rim of the well-filled nest. The young were never observed exercising their wings nor climbing about the nest. They were last seen at 5:30 that night. At noon on the following day nothing could be seen in the nest. M and F were calling and flying about in back of the nest tree but never came to it. At 3:30 p.m. I climbed the tree and found the nest empty. The young could not be located until 5 p.m. when one was seen in the driveway. M and F came within two or three feet as I picked it up, M being bolder and calling continuously. As this fledgling could barely fly it seemed doubtful that it would survive a night with numerous cats and dogs in the neighborhood. Consequently, it was taken for the Peabody Museum collection.

I left for a trip on April 18. On this date Jeffrey Thomas searched the grove thoroughly and found a pair of adult crossbills in a large, thickly needled pine, where he suspected they might be feeding young. On the two succeeding days no crossbills could be found anywhere in the vicinity.

A description of the fledgling follows: length 103 mm., tail 21, wing 51, culmen 12, depth of bill at base 8, tarsus 26, middle toe 16. Mandibles just starting to cross. Head and body striped with dark Grayish Olive to Olivaceous Black on pale Olive-Buff; tail and wings solid Chaetura Drab to Chaetura Black; some Old Gold on back, most noticeable on rump; bill dark Mouse Gray with a Cinnamon-Drab base; tarsus and toes Light Drab (Capitalized color terms from Ridgway's *Color Standards and Nomenclature*).

Songs and Calls

A rich warble suggesting the song of a Brown Thrasher (*Toxostoma rufum*) was heard for twenty minutes on the first visit; this musical song agreed with Pough's (1946:235) description of "an ascending series of double notes," though it lacked the final trill. This song was never heard again. During the first weeks, M's usual song was *z-z-zt, z-z-zt, z-z-zt,* all on the same note, in twos, threes, or fours. On March 17 he sang *whit-whit, zzzzt,zzzzt, zzzzt;* the last notes low and rasping. On the same date, when a courting flight (?) was seen, he also sang *pit-pit, tor-r-ree, tor-r-ree.* On April 16 M sang a new song: *whit-wheet* and *wheet, wheet, wheet,* changing pitch frequently and using doublets and triplets, with single notes interspersed. On the following day, when the young left the nest, the male sang many of the songs noted above, and called in a new and more rasping manner. The arrival of either bird in the vicinity was always signalled by *pip-pip*; there was much formless twittering or cheeping by both sexes. Calls were sometimes recorded as *pit-pit, whit-whit-whit, wheet-wheet*, or *whit-wheet.* F's lower and deeper tones could be distinguished from M's somewhat higher and softer calls.

Territory

No actions relating to territorial defense were noted. Cats crossed the yard below, dogs were always in the vicinity, a gray squirrel (*Sciurus carolinensis*) ran along the wall near the nest. A small flock of Black-capped Chickadees, (*Parus atricapillus*), Red-breasted Nuthatches (*Sitta canadensis*), and Golden-crowned Kinglets (*Regulus satrapa*) fed in neighboring trees. The crossbills ignored all this activity. Flickers (*Colaptes auratus*), a Phoebe (*Sayornis phoebe*), and Robins (*Turdus migratorius*) were nesting nearby, while Brown Creepers (*Certhia familiaris*), Ruby-crowned Kinglets (*Regulus calendula*), Cowbirds (*Molothrus ater*), Slate-colored Juncos (*Junco hyemalis*), and Song Sparrows (*Melospiza melodia*) fed in the grove or on the ground below. Other species were seen flying over the grove. At least two other pairs of Red Crossbills fed in the grove, both of the males with mottled plumage. These other crossbills were observed on March 23 and 25 and on April 3 and 8. Except for one occasion late in the nesting period when she came off the nest, F incubated or brooded quietly with no response to their calls and movements.

Summary

The activities of a pair of Red Crossbills were watched from the time a half-built nest was found until the young left the nest 45 days later. Observation periods totalled 41 hours. The female built the nest with the male in close attendance.

The nest was 16 feet 2 inches high in a small black pine on an estate bordering Gloucester Harbor, Massachusetts; there was abundant food in this grove of trees.

During the nesting period temperature averaged 38°F., wind velocity averaged 15 mph; the weather was cloudy or stormy 67 per cent of the time.

The female alone incubated the eggs; she was fed on the nest by the male.

For the first 4 to 5 days after hatching, the young were fed by the female after the male had fed her. Subsequently the pair returned to the nest together, the male always feeding the young first, and more briefly. Food regurgitated, whether to female or young, was a whitish "pap." In early stages this was thin and watery; when the young were half-grown it changed to a

thicker substance transferred in soft balls. Usually it was the female who removed the excreta and swallowed it but the nest became fouled by excreta in the later stages of nestling life.

Young left the nest at the age of 15 or 16 days.

Various types of songs and calls are described.

The young were not seen after the day they left the nest. One fledgling was collected and its plumage is herein described.

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Peabody Museum, Salem, Massachusetts, November 29, 1953

BIRDS AND BIOGEOGRAPHY OF THE SIERRA DE TAMAULIPAS, AN ISOLATED PINE-OAK HABITAT

BY PAUL S. MARTIN, C. RICHARD ROBINS, AND WILLIAM B. HEED

Numerous distributional accounts of Mexican animals have appeared in recent years, amplifying our understanding of a rich, complex, and highly diverse fauna. Few studies, however, have related local faunas to climatic and vegetation types as outlined by Leopold (1950). By the focusing of study on a single plant formation or vegetation type, rather than on a political or other nonenvironmental unit, certain zoogeographic problems, such as Pleistocene influences on distribution patterns, are opened to investigation. The following account illustrates an application of this viewpoint.

In northeastern Mexico two small ranges, the Sierra San Carlos and Sierra de Tamaulipas, rise from the Tamaulipan Coastal Plain, completely isolated from the abrupt escarpment of the Sierra Madre Oriental. The higher parts of these ranges are covered by belts of open pine-oak woods, similar in structure and presumably in climate, to extensive forests of this nature in the adjacent Sierra Madre. They are isolated from the latter and from each other by the arid tropical thorn forest and thorn scrub of the intervening coastal plain (map 1), and thus constitute environmental islands for species inhabiting the pine-oak formation.

The coastal plain Sierras have been visited by comparatively few collectors and no faunal reports have appeared beyond that of Dice (1937) and others on the Sierra San Carlos. The pine-oak avifauna of the Sierra Madre Oriental in northeastern Mexico is somewhat better known and appears fairly homogeneous, judging from published accounts (Burleigh and Lowery, 1942; Harrell, MS; Phillips, 1911; Robins and Heed, 1951; Sutton and Burleigh, 1939; Sutton and Pettingill, 1943; Sutton, Pettingill, and Lea, 1942). Our preliminary faunal survey of the Sierra de Tamaulipas has been compared with these in viewing the relationships between the pine-oak areas of northeastern Mexico.

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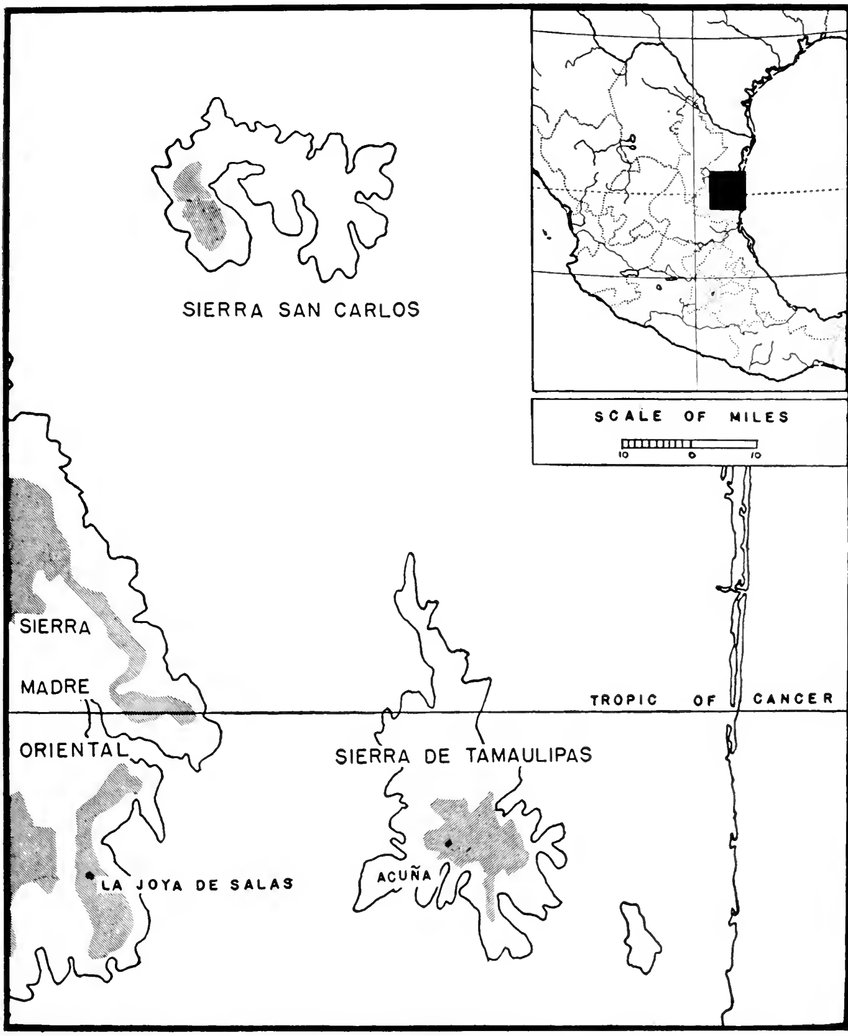

Map 1. Distribution of the pine-oak belt (shaded) within the 2000 foot contour (outlined) in southern Tamaulipas. Contour interval from World Aeronautical Chart 522 and 589.

Reed at the Hacienda Acuña, by Sr. and Sra. Raul Sanchez of Santa María and by Mr. and Mrs. Irby Davis. For certain plant identifications we thank Robert T. Clausen. The following individuals have examined part or all of the manuscript and offered valuable suggestions: R. T. Clausen, P. Dansereau, L. R. Dice, E. P. Edwards, B. E. Harrell, K. C. Parkes, R. W. Storer, and C.

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Itinerary

We entered the Sierra de Tamaulipas on April 9, 1949, traveling from the lowlands near Gonzales north to the Hacienda Acuña (elev. 962 meters; for this and other localities mentioned see the American Geographical Society millionth map N.F. 14, San Luis Potosí). About four miles northwest of Acuña at a slightly higher elevation we camped along a small stream in the pine-oak woods, collecting there until April 25. We did not return to the Sierra de Tamaulipas until June 2 when we remained until June 11, completing observations on nesting birds. In 1950, Marian and Paul Martin spent August 5 to 12 collecting mammals and reptiles at the village of Santa María (870 meters), a few miles east of Acuña. At least two other field parties including Starker Leopold and Helmuth O. Wagner in one and Chester Lamb in the other visited Acuña prior to our trip; we have no detailed information on their discoveries.

Geology

Rising from the Gulf Coastal Plain north of the Tampico Embayment, the Sierra de Tamaulipas extends along a north-south axis for approximately 100 kilometers. It is roughly spatulate in shape, reaching a maximum width of about 60 kilometers in the south. Most of the higher parts of the range, those above 600 meters, lie in this wider southern portion just below the Tropic of Cancer and north of 23° N Lat. The highest peaks apparently do not reach 1400 meters. The topography of this area is rolling and dissected, comprising a series of sharp ridges and narrow valleys with some hilly plateaus near Acuña and Santa María. Coastal plain and low mesas to the north and west separate the Sierra de Tamaulipas from the Sierra San Carlos and the Sierra Madre Oriental. On the east the coastal plain extends to the Gulf of Mexico, interrupted only by a low range of hills, the Sierra San José de las Rusias.

The Sierra de Tamaulipas is considered the southernmost of a series of low anticlinal mountains which, isolated from the main mass of the Sierra Madre and from each other, lie east of the Sierra Madre and extend north to the Sierra del Burro of northern Coahuila (Muir, 1936). The Tertiary history of these mountains is especially significant. During this period the mountains of the coastal plain are thought to have formed low islands, slowly emerging from the Eocene Sea; by Middle Eocene time, and later, they composed the eastern margin of the Mexican continent (Muir, 1936). Thus their history indicates complete geological isolation from the front ranges of the Sierra Madre Oriental.

Weather

During mid-April we recorded morning temperatures of 54° to 58° F, rising to an early afternoon maximum of 75° to 80° and falling again to 60° by nightfall. Early morning clouds which often gathered around a pine-covered ridge near our camp usually were dissipated by 10:00 a.m. On the afternoon of April 15, rising winds and falling temperatures heralded the arrival of a mild "norte" or norther which brought very heavy winds by sundown. The following morning was dark, cold, and windy with a low of 45°.

During early June we found the weather much warmer than in April, though never oppressively hot. In August, maximum-minimum readings taken at Santa María from the 6th through the 10th were as follows: high, 85° to 88°; low, 55° to 64°.

In the Sierra de Tamaulipas, as in most of northeastern Mexico, the rainy season lasts throughout the summer and autumn with the dry season beginning in early winter. At this time the trees of the tropical deciduous forest shed their leaves and remain leafless until late spring. In 1949 an unusually severe dry season resulted in a water shortage so that by early June the pools near our camp were almost the only source of drinking water for both the residents and the cattle of the Hacienda Acuña. According to Howard Reed, supervisor of the Hacienda, precipitation is heaviest during the months of August and September when torrential rains are frequent and travel is difficult. However, little rain fell during the time the Martins visited Santa María.

Vegetation

We recognize the following four major animal habitats in the Sierra de Tamaulipas:

1. Tropical Thorn Forest. Characteristic of the driest parts of the Tamaulipan Coastal Plain is a low scrub, averaging 2 to 3 meters in height. Locally it may be almost impenetrable; however, many areas are more open, grading into a savanna formation when not overgrazed. Little time was devoted to faunal studies in this habitat.

2. Tropical Deciduous Forest. This formation, analogous to Carr's Monsoon Forest (plates 25 and 26, Carr, 1950), is well developed in local areas with greater available moisture than that required by the low thorn forest. The ravines and slopes of the Sierra de Tamaulipas between 300 and 700 meters are covered by this type of dense growth in which the tallest trees attain 20 meters and a continuous canopy averages 8 meters in height. Here are found a number of Neotropical bird genera, such as *Crypturellus, Momotus, Piaya, Xiphorhynchus,* and *Nannorchilus,* which seldom enter other habitats in this region.

3. Montane Scrub. In certain dry areas between 600 and 900 meters, above the tropical deciduous forest, are various combinations of low thickets or savannas composed of huisache (*Acacia farnesiana*), oaks, and some trees of the tropical deciduous forest. This habitat is usually lower in height than either the tropical deciduous forest or the pine-oak woods. Near the Acuña landing strip (900 meters) thickets of this type were inhabited by *Basileuterus*

Fig. 1. Open pine woods with discontinuous crown cover. Photographed at about 1000 meters near Acuña, Tamaulipas, by William B. Heed.

rufifrons and *Toxostoma longirostre* while the more open huisache savannas were favored by *Chamaethlypis poliocephala* and *Aimophila botterii.*

4. Pine-Oak Formation. Pine and oak forests interspersed with grassland are characteristic of the Sierra above 800 meters. Our field studies were devoted mainly to this habitat. Dominant trees include *Pinus teocote, Quercus arizonica* (reported by Leopold, 1950), other species of *Quercus*, and hard shell hickory (*Carya* sp.). On a few slopes oak thickets and scattered live oak trees are found as low as 300 meters (near Misión), but they are infrequent at such low elevation. Within the Pine-Oak Formation there is considerable variation in development and distribution of the forest and grassland areas; many ridges and high meadows are entirely covered with short grass, others grade into either pine or oak savannas and these into woods with complete crown closure. Less than 50 per cent of the area is actually covered by woods. In only a very few wooded areas is crown cover sufficiently dense to prevent dessication of the thin ground litter. One of these excep-

tional areas was a narrow sheltered ravine near a cliff south of Acuña where moisture was conserved; here we found several species of orchids, large tank bromeliads, and jack-in-the-pulpit (*Arisaema*). The entire area of this small pocket was barely 200 square meters. Along a few ravines and stream courses vegetation was also luxuriant, maidenhair ferns were present, and here we found the Black-headed Nightingale Thrush, *Catharus mexicanus.*

Fig. 2. Pine savanna and exposed ridge at about 1100 meters near Acuña, Tamaulipas. Note low palmettos and agaves in foreground. Photographed in April, 1949, by C. Richard Robins.

Among the generally scarce shrubs, we noted a scrub palmetto and a small cycad (*Dioon* sp.). On barren ridges grow a low chamaephytic oak and a small *Agave.* In addition to bunch grass we found considerable bracken (*Pteridium aquilinum*) under the pines. As epiphytes on the oaks grew abundant Spanish moss (*Tillandsia* sp.), a member of the Crassulaceae (*Echeveria* sp.) a few orchids, and a few tank bromeliads.

Near the village of Santa María some selective pine lumbering is presently in progress.

Faunal Notes

Our mammal and bird collections are now part of the George M. Sutton Collection and the herpetological collection is at the University of Michigan. A few plants were presented to the Wiegand Herbarium of Cornell University. The majority of our collections were made in the pine-oak habitat above

800 meters and except where noted, the following faunal discussion is confined to species inhabiting the Pine-Oak Formation.

Fishes of the families Cichlidae and Characinidae were abundant in a tiny stream at Santa María and in deeper pools downstream above a 20-meter falls at Las Pilas. None were present in the pools near our camp site which contained newts (*Diemictylus*). Below these pools there was no surface drainage. About 1000 meters downstream from them was an abrupt cliff and, presumably, a waterfall in the rainy season.

Taxonomic analysis of the reptile and amphibian collections is presently in progress; most of the mammals have been discussed by Hooper (1947, 1952, 1953).

Amphibia.—*Diemictylus* sp., *Bufo horribilis*, *B. valliceps*, *Syrrhophus campi*, *Eleutherodactylus latrans*, *Hyla baudinii*, *Hyla* sp., *Rana pipiens*.

Lizards.—*Lepidophyma* sp. (two collected at Santa María), *Sceloporus variabilis*, *S. cyanogenys*, *S. grammicus*, *S. olivaceus*, *Cnemidolphorsu sackii*, *Ameiva undulata*, *Eumeces dicei*, *E. tetragrammus*.

Snakes.—*Leptotyphlops myopicus*, *Coniophanes imperialis*, *Drymarchon corais*, *Drymobius margaritiferus*, *Leptodeira annulata*, *Thamnophis sauritus*, *Micrurus fulvius*.

Turtles.—*Kinosternon herrerai* (collected from a pool near camp: identified by Norman E. Hartweg).

Mammals.—Among the mammals that we saw but did not collect were many white-tailed deer (*Odocoileus*), rabbits (*Sylvilagus*), and one peccary (*Pecari angulatus*). Coatis (*Nasua narica*) were common in remote areas away from the villages; one specimen was taken in the pine-oak woods. Tree squirrels of two species (*Sciurus aureogaster aureogaster* and *S. deppei negligens*) were common, the former in the *Tillandsia* of the oaks and hickories, the latter in the pine woods and the tropical deciduous forest. Several specimens of both were collected, including melanistic individuals of *S. aureogaster*. Small mammals trapped near Acuña included *Liomys irroratus texensis*, *Reithrodontomys fulvescens intermedius*, *Peromyscus leucopus texanus*, *P. pectoralis collinus*, *P. boylii levipes* and *Sigmodon hispidus toltecus* (Hooper 1947, 1952 and 1953).

Birds.—The following account of 72 species includes only the resident birds of the pine-oak belt: an asterisk indicates that we are uncertain whether the species so marked actually breeds in the pine-oak belt. Weights listed are in grams; fat classification follows the system of McCabe (1943). With few exceptions nomenclature follows that used in the following works: Cory, Hellmayr, and Conover, "Catalogue of Birds of the Americas"; Friedmann, Griscom, and Moore (1950): and the A.O.U. Check-list, fourth edition with supplements.

Coragyps atratus, Black Vulture. We found several large gatherings of vultures feeding on dead cattle; twenty to thirty Black Vultures came to devour a drought-killed heifer near camp.

Cathartes aura, Turkey Vulture. Seen daily, but never in as large numbers as the Black Vulture.

Buteo jamaicensis, Red-tailed Hawk. Seen occasionally in April, June, and August, indicating that they probably breed in this part of Tamaulipas.

Buteo albonotatus, Zone-tailed Hawk. Several pairs of Zone-tailed Hawks inhabited the Acuña area. One pair frequented cliffs along a ridge west of camp. On April 21, Heed and Robins discovered the nest of another pair in a pine at the foot of an escarpment overlooking a broad panorama of ridges three miles south of Acuña. This nest, constructed of twigs and oak branches and lined with fresh oak leaves, was about 40 feet above the ground and contained two whitish eggs. Friedmann, Griscom, and Moore (1950) do not list this species from Tamaulipas.

Buteo nitidus maximus, Gray Hawk. One or two noted daily, usually in the oak woods at 900 meters. On April 12, Robins secured a female with enlarged ovary (largest oocyte 6 mm.). The stomach contained three lizards, two *Cnemidophorus sackii* and a *Sceloporus*. Weight 655 grams; fat classification moderate; wing 275 mm.; tail 196 mm.

Hypomorphnus urubitinga ridgwayi, Urubitinga. Common. A nest Heed discovered April 14 in pine-oak woods was located about 40 feet above the ground in the central crotch of a tall pine. A copulating pair was observed by Robins in June. Martin saw four (a family group) at Santa María in August. A male weighing 1010 grams with testes measuring 15 $\times$ 8 mm. was taken April 12. The "flags" of this specimen are tipped with less white than those of five other Mexican *ridgwayi* examined.

**Herpetotheres cachinnans*, Laughing Falcon. Robins noted a pair near camp April 18 and 23.

**Caracara cheriway*, Caracara. Uncommon. Single birds encountered April 15 and 24; two were seen June 8.

**Falco albigularis*, Bat Falcon. Martin watched a Bat Falcon pursue several Red-crowned Parrots (*Amazona viridigenalis*) on April 13. One was seen April 18 near high rocky bluffs west of camp.

Colinus virginianus, Bob-white. Two were seen April 17 and 22; an immature female was shot from a covey of six near Santa María on August 5. In the Sierra, quail were much less abundant than in the lowlands near Gonzales and Misión. A singing male (testes enlarged) collected June 6 was identified by Dr. Aldrich of the U. S. Fish and Wildlife Service as *aridus* approaching *maculatus*.

Cyrtonyx montezumae, Harlequin Quail. Robins flushed a pair April 22 about 5 miles south of Acuña and collected the male. A pair was noted June 10 along the road to Santa María (elevation about 800 meters).

Meleagris gallopavo, Wild Turkey. Common locally on wooded hillsides about Acuña.

Columba flavirostris, Red-billed Pigeon. Noted daily in flocks of five to ten at all elevations.

Zenaida asiatica, White-winged Dove. First seen April 19 when a flock of 15 passed overhead. On April 22 Heed noted flocks of 15 to 40 doves flying low through the mountain valleys. Small groups of breeding birds present in June.

Scardafella inca, Inca Dove. A common dove in the villages of Acuña, Santa María, and in the vicinity of our camp.

Columbigallina passerina pallescens, Ground Dove. Rather common both in April and June but in small numbers, usually pairs. Measurements of two males taken in April (testes enlarging): wing, 85 and 81 mm.; weight, 37 and 35 grams.

Leptotila verreauxi angelica, White-fronted Dove. Fairly common in the thickly wooded canyon bottoms below 800 meters where they called daily. Seen less often in ravines of the dry open oak woods at higher elevations.

The ovary and oviduct of a female collected June 6 were enlarged with several oocytes measuring 6 mm.

Amazona viridigenalis, Red-crowned Parrot. Common over the high pine ridges as well as in the tropical deciduous forest of the canyons. Large flocks often flew over our camp in the evening screaming *kee-yaw, graw, graw, graw.* In mid-April we witnessed small groups engaged in erratic courtship flights accompanied by much noisy squawking. The testes of a male taken April 12 measured 14 × 7 mm.: it weighed 294 grams. We were surprised to find that this parrot is not confined to the arid tropical Tamaulipan lowlands, but ranges over the dry open pine-oak ridges with such typically temperate species as Ravens, Olive Warblers, and Red Crossbills. The crop and stomach of our single specimen contained pine seeds. At Santa María farmers shoot many parrots raiding the milpas for corn.

Coccyzus americanus americanus, Yellow-billed Cuckoo. First heard on June 5 in an oak thicket near Acuña. Three females taken June 7 and 8 were in the process of egg laying with large ruptured ovarian follicles and exposed brood patches. The oviducts of two birds each contained an ovum. Measurements resemble those of the nominate race: wing 142, 142, 148; tail, 138, 145, 149 mm. Evidently both *C. americanus* and *C. minor* breed in the Sierra de Tamaulipas although they appear to favor different habitats, *americanus* the oak thickets above 800 meters, *minor* occurring more frequently in the tropical deciduous forest below 600 meters.

Ciccaba virgata tamaulipensis, Wood Owl. Heed collected a female April 15 in a small cave in the pine-oak woods. Others called infrequently in April and nightly in early June. Largest oocyte in the ovary of our specimen measured 3 mm.; weight was 333 grams. The stomach contained beetles and the tarsus and feathers of a trogon (*Trogon elegans*).

Chordeiles minor, Nighthawk. Several observed in late April. In June six to ten hunted over our camp valley every evening and on moonlight nights we heard their booming dives at every hour from dusk to sunrise. A nest with one egg found by Heed on June 7 was located on an old path in the oak woods.

Nyctidromus albicollis yucatanensis, Pauraque. Several were calling April 9 and 12 near camp. Martin shot a female in worn plumage June 7 south of Acuña (ovary, 9 mm.; largest oocyte, 4.5 mm.; wing 163 mm.; tail 139 mm.).

**Caprimulgus salvini salvini*, Salvin's Whip-poor-will. A female collected by Robins on April 13 had enlarged ovary and little fat; it measured as follows: wing, 163 mm.; tail, 123 mm.; weight, 56 grams. In early May near Zamorina we often heard their calls; only on the night of June 3 did we hear one near camp in the Sierra.

Cynanthus latirostris latirostris, Broad-billed Hummingbird. A male was seen June 4 in open oak woods south of Acuña. Measurements of a female with unenlarged ovary taken June 7 are: wing, 53 mm.; tail, 32 mm.; culmen, 22 mm.

Amazilia cyanocephala cyanocephala, Red-billed Azure-crown. Common throughout the pine-oak and oak woods. Five females were secured; one of these, taken April 21, contained an egg (shell unformed) in the oviduct. Measurements are: wing, 59, 59, 58, 57.5, 57; tail, 34, 33, 34, 32.5, 33; culmen, 22, 21.5 (3), 21; weights of three April birds were 6.5, 6.5, and 6 grams.

Amazilia yucatanensis chalconota, Yucatan Hummingbird. Noted infrequently April 10 to 24 in the canyon bottoms. Fairly common in June in brushy thickets and in the open oaks. Our three specimens are slightly more rufous below than *chalconota* from Texas, but are much paler than *cerviniventris* of Veracruz. Weight of an April female was 4.5 grams.

Trogon elegans ambiguus, Coppery-tailed Trogon. Fairly common in the tropical deciduous forest of the canyon bottoms; less numerous in the high pine-oak woods, but breeding in both habitats. In June Robins found a nest ten feet high in an oak. The cavity was 16 inches deep. Weights of three males collected in April were 60, 61, and 70 grams.

**Chloroceryle americana*, Green Kingfisher. One seen June 6 at a spring in a wooded ravine, elevation 1000 meters.

Piculus aeruginosus, Bronzed Woodpecker. Fairly common in the canyon bottoms below 600 meters, noted less frequently in the open pine-oak woods above 900 meters. Weight of a female with enlarged ovary taken April 12, 78 grams.

Melanerpes formicivorus formicivorus, Acorn Woodpecker. Very common in open pine-oak woods. On June 6, Martin watched an adult feeding young at a nest 25 feet high in a dead pine. The following day Robins found another nest at which at least four adults were participating in the feeding of young. Measurements of two males and two females: wing, 133.5, 130, 132, and 128 mm.; tail 77, 79, and 76 mm.; culmen 29, 27.5, 27.5, and 28 mm. Wing measurements of this series are smaller than those of three males and four females from the Sierra Madre of western Tamaulipas which range from 135 to 142 (mean 138.5 mm). Further study may justify nomenclatorial recognition of Sierra de Tamaulipas birds.

Melanerpes aurifrons aurifrons, Golden-fronted Woodpecker. On April 22 Heed collected a female, weight 73 grams, in open pine-oak woods near camp. This species is much more common in the lowlands.

Dendrocopos scalaris symplectus, Ladder-backed Woodpecker. Common through the open pine-oak hills. Several family groups noted on June 8. Wing lengths of two males and a female, 99, 102.5, and 100 mm., are characteristic of this larger subspecies rather than of the nominate form.

**Phloeoceastes guatemalensis*, Flint-billed Woodpecker. The rolling call of this large woodpecker was heard infrequently in tropical deciduous forest below 600 meters. A pair, apparently in courtship, were observed June 5. At Santa María in August several were seen on oaks (elevation 800 meters).

Lepidocolaptes affinis lignicida, Allied Woodhewer. Fairly common both in the oak parklands and in the pine-oak woods above 800 meters. On June 5, Martin discovered a nest in an open oak woods near Cerro Marquita (1000 meters), north of Acuña. The nest cavity was about ten feet above the ground in the dead vertical branch of an oak. The three white eggs present were nearly spherical and slightly smaller than those of *Trogon elegans*.

The breeding range of *L. a. lignicida* has long been cited erroneously. In southern Tamaulipas we have found this species only in cool montane forests, including both oak-sweet gum cloud forest and pine-oak forest, between 800 and 2000 meters. Sutton has collected wintering individuals along the Rio Sabinas near Gómez Farías (100 meters) in February, but *Xiphorhynchus flavigaster* is the only woodhewer known to breed in the Tamaulipan tropical lowlands. Therefore we questioned the assertion (Griscom, 1932, 1950) that the occurrence of *lignicida* ". . . in the arid hills of Tamaulipas, is one of the few cases where a Subtropical Zone bird reaches sea level in northern Mexico." In subsequent correspondence with Griscom (letter of March, 1952) we learned that this concept originated with Bangs and Penard (1919) who state that a series of eleven *lignicida* were collected by Armstrong in ". . . the very arid tropical hills of the region north and west of Ciudad Victoria." We both have examined the gazetteer of localities from which the type series was taken (Phillips, 1911) and find no positive evidence of any records below 1000 meters. The elevation given for one of the localities, Realito, is 8000 feet. The description of this area, copied from Armstrong's field notes, clearly suggests montane humid forest. Thus the Allied Woodhewer may be considered a reasonably good indicator of cool montane forest in the northern, as well as the southern, part of its range.

A male and three females were collected. Measurements: wing 107, 105, 109, and 108 mm.; tail 93, 92, 95, and 89 mm.; weights of two females, 31 and 30 grams. Tentatively we assign our specimens to the subspecies *lignicida* although they are decidedly paler than two topotypes of that form that we have seen.

Pachyramphus major major, Black-capped Becard. Not noted until June 3 when three specimens were collected in the pine and oak woods. On June 7 a singing male was noted in oak-hickory woods near Acuña.

Tyrannus melancholicus couchii, Olive-backed Kingbird. Robins heard one April 22 and collected a male June 4 in breeding condition. Seen frequently in June and August.

Myiarchus tuberculifer lawrencei, Dusky-capped Flycatcher. Fairly common in the oak and pine-oak woods. On June 7 Robins found a nest with four or five young in a cavity 15 feet high in an oak (elevation 1000 meters). Two males taken in April weighed 21 and 22 grams.

Contopus pertinax pertinax, Jose Maria. This conspicuous flycatcher, one of the most common birds above 800 meters, inhabits pine and pine-oak woods. In mid-April they began singing before sunrise, called vigorously through the day, and often continued until long after sundown. In June and in August they sang less; more often we heard their sharp note, *bink-bink*. Although we found no nests, gonad size and courtship displays indicated that the breeding was in progress.

Four Acuña specimens are somewhat darker above than eight *C. p. pallidiventris* of Arizona and resemble more closely a series of eight specimens of *C. p. pertinax* from Chiapas in the Michigan collection. Two males and a female weighed 27 (medium fat), 20 (little fat), and 30 grams (fat).

Camptostoma imberbe imberbe, Beardless Flycatcher. Singing near Acuña in June and at Santa María in August. Measurements of a male in breeding condition taken June 7 are as follows: wing 54 mm., culmen 8.5 mm.

Corvus corax, Raven. Noted throughout the Sierra. Several pairs were in the Acuña region in April and June; others seen at Santa María in August. *Corvus ossifragus imparatus*, common throughout the Tamaulipan Coastal Plain, apparently does not enter the mountains.

Parus atricristatus atricristatus, Black-crested Titmouse. Fairly common in the Sierra as well as in the lowlands. Wing of a male measures 71 mm.; weight 15 grams.

Thryothorus ludovicianus, Carolina Wren. This Wren is fairly common locally along ravines of the oak and pine-oak woods. Dr. George Lowery in a letter to Dr. G. M. Sutton (November, 1949) identified our eight specimens as *tropicalis*$>$*berlandieri* with the following comment: "For several reasons their closest relationships appear to be with *tropicalis* rather than *berlandieri*. One example looks just like typical *tropicalis;* the lighter-backed specimens lack the rufescence of intermediates from around Victoria; and the barring of the flanks is more or less dusky in all except one bird. We might call them *tropicalis*$>$*berlandieri*, though material in fresh plumage might show that they are typical *tropicalis* rather than intermediates."

Weights of three males (April 14, 15) are as follows: 19, 19, and 17 grams; of two females (April 14), 16 and 18 grams.

**Salpinctes obsoletus*, Rock Wren. Robins recorded several April 18 on a rocky hillside west of camp.

Catherpes mexicanus mexicanus. Canyon Wren. Recorded on four days in April and twice in June, usually along cliff faces or rocky outcroppings. A pair collected April 14 weighed 18 and 17 grams.

Toxostoma longirostre, Long-billed Thrasher. One was seen near camp April 13. Martin found a nest June 7 in a brushy thicket near Acuña. The nest was four feet from the ground and contained three blue eggs marked with small russet spots. Measurements of an immature male collected at Santa María on August 6 are: wing 98, tail 128, culmen 27 mm. In size this bird matches typical *T. l. sennetti* of Texas; however, more material is needed to demonstrate whether or not intergradation in color occurs with *T. l. longirostre.*

Turdus grayi tamaulipensis, Gray's Robin. Common in small flocks in April. A nest examined June 6 was 35 feet high in a hickory at camp. A female, moderate fat, taken April 16 weighed 69 grams; a male, no fat, weighed 74 grams (April 22). Testes of this specimen were blue gray as were those of another male shot March 1 near Gómez Farías.

Myadestes obscurus, Brown-backed Solitaire. Uncommon, several birds were heard frequently in ravines near camp.

Catharus mexicanus mexicanus, Black-headed Nightingale-Thrush. Although no *Catharus* were recorded in April, this birds was one of the first species we encountered upon returning to our camp site June 3. They sang daily from humid ravines among the pine-oak woods for the remainder of our stay and were in song at Santa María in August. One spotted immature was noted near Santa María on August 10. *Catharus mexicanus* is much more common in the Rancho del Cielo cloud forest near Gómez Farías. Four males with enlarged testes and a female with a large oocyte (8 $\times$ 7 mm.) were collected.

Sialia sialis, Bluebird. Fairly common, especially about the settlement of Acuña. On June 2 a bluebird was observed carrying food. Two juveniles were collected June 8 near camp. Measurements: two males, wing 99, 95; tail 67, 62; two females, wing 93, 96; tail 59, 60.

Poliopotila caerulea deppei, Blue-gray Gnatcatcher. Fairly common in April and, locally, in June south of Acuña. Three birds in breeding condition were secured. Measurements of these are: two males, wing 48.5, 46; tail 52, 47 mm.; one female, wing 47; tail 44.5 mm.

Vireo griseus micrus, White-eyed Vireo. Martin heard songs of this species south of Acuña on April 20. Wing of a male collected there on June 7 measured 58 mm.

Vireo huttoni mexicanus, Hutton's Vireo. Common in the pine-oak woods. Singing constantly in April and June. Heed watched a pair constructing a nest of Spanish moss 20 feet up in an oak. Five males, all with testes slightly enlarged, were collected. Wings measured 63, 64, 66 (3); weights of two were 11 and 12 grams.

Vireo olivaceus flavoviridis, Yellow-green Vireo. One pair noted April 23. Abundant in June both in the tropical deciduous forest and in the pine-oak woods to 1000 meters. Robins found a nest with four white eggs at camp June 9, 25 feet high in an oak. The oviduct of a female shot June 5 contained two eggs.

Vermivora superciliosa mexicana, Hartlaub's Warbler. Common. Noted daily on the open oak and pine-oak hillsides, usually in company with the equally common Pitiayumi warbler. Three birds collected April 15 and 22 were approaching breeding condition. Two of these (a male and a female) each weighed 9 grams.

Parula pitiayumi nigrilora, Pitiayumi Warbler. One of the most common birds in the Acuña region. Their wiry buzz could be heard through the pine-oak parklands as well as in the dense tropical deciduous forest of the canyon bottoms. Measurements of a male and two females are as follows: wing 54.5. 50, 49; tail 40, 38, and 36 mm.; weights 8. 7, and 7 grams.

Peucedramus taeniatus arizonae, Olive Warbler. In the pine and oak woods of the ridges we discovered this inconspicuous warbler. Robins collected what he thought was a copulating pair on April 17, but discovered upon preparing the specimens that the ovary of the female (very fat) was just enlarging. Testes of adult April males were enlarged with the seminal vesicles present; those of a one-year old male taken June 6 were only slightly enlarged. Weights of April males were 10, 12, and 12 grams; two females weighed 11 and 12 grams.

Our six Acuña birds are similar to the subspecies *arizonae*: they lack the olivaceous wash on the back and the broad yellow edging of the secondaries said to be typical of *giraudi* and are much duller on the throat and crown than *taeniatus*. Indeed the narrow lemon yellow edging of the secondaries is reduced to such an extent that we could separate our five adults from 25 *arizonae* males and 14 spring *arizonae* females on this feature alone.

Chamaethlypis poliocephala poliocephala, Thick-billed Ground-Chat. This shy bird of the scrub oak and huisache was common locally in April and June. The song, usually given from a low shrub, is a hurried *zip zip zip zip wichy wichy wichy*. Two specimens, both males, were collected.

Basileuterus rufifrons jouyi, Rufous-capped Warbler. Noted frequently in April and June; gonads of June specimens were enlarged. Brushy slopes of the montane scrub above 600 meters appeared to be their favorite habitat.

Tangavius aeneus aeneus, Red-eyed Cowbird. First recorded April 19, seen daily thereafter.

Cassidix mexicanus prosopidicola, Great-tailed Grackle. A female (weight 108 grams) was shot from a flock of five near camp April 12, elevation 1000 meters. Several were recorded April 16. This species is much more common in the lowlands. Our specimen is darker below and smaller than *C. m. mexicanus*.

Icterus graduacauda graduacauda, Black-headed Oriole. Common in the tropical deciduous forest as well as in the higher, open pine-oak woods. Measurements of three males and a female are as follows: wing 99, 94. 100, and 88; tail 95, 97, 101, and 92.5; weights 46, 48, 40, and 40 grams.

Icterus cucullatus cucullatus, Hooded Oriole. Several seen in the low scrub *Acacia* near Acuña April 19-21. Two males taken June 3 and 4 were in breeding condition. Measurements of three males: wing 87, 88, 85 mm.; tail 97, 95, 91 mm.; weight of one male (April 20), 26 grams.

Tanagra elegantissima elegantissima, Blue-hooded Euphonia. Heed shot a singing male in open pine-oak country south of camp June 4 (testes enlarged, brood patch present, no fat), but we failed to find others. *Tanagra affinis* and *T. lauta* occur in the tropical deciduous forest, but did not appear at higher elevations in the breeding season.

Piranga flava dextra, Hepatic Tanager. One of the most common birds of the Acuña region. In April groups of five to ten frequently were seen feeding on the ground along the open grassy ridges. On June 9 Robins found a nest seven feet high in a small oak on a pine-oak hillside. The nest, a loose structure of twigs placed near the end of a small branch, contained three young about ten days old. Weights of an adult male and two females are 45, 38, and 40; of an immature male, 35 grams.

Piranga bidentata sanguinolenta, Flame-colored Tanager. Fairly common in the canyons and noted infrequently in the pine-oak woods. Ovaries of two females collected April 14 and 15 were enlarging; weights were 32 and 34 grams. A singing male shot June 5 was in breeding condition.

**Rhodothraupis celaeno*, Crimson-collared Grosbeak. Found mainly in the canyons below 600 meters and in the thorny thickets of the lowlands, although a small group was seen in an open oak woods four miles south of Acuña on April 9 (elevation 900 meters).

Guiraca caerulea interfusa, Blue Grosbeak. Fairly common at Acuña in April where flocks could always be seen in the fields. In June they were scattered, singing and paired. Common about the milpas at Santa María.

Sporophila torqueola, Ringed Seedeater. Common. Three males collected are not in full adult plumage so we are uncertain of the subspecies. At Santa María in August Martin saw several adult males with what appeared to be complete dark chest-bands, typical of *S. t. morelleti*.

Spinus psaltria psaltria, Arkansas Goldfinch. Small groups fairly common in the open pine-oaks in April. They were paired and singing commonly throughout the region in June. Very common about the village of Santa María. Measurements of two males are: wing 61 and 62 mm.; tail 40 and 42; weight of one 9.5 grams.

**Loxia curvirostra stricklandi*, Red Crossbill. Fairly common above 900 meters. Flocks of four to fifteen were noted near camp every day feeding in the pines. Four immature birds were taken (April 10 and June 6) along with ten adults; however, we found no evidence of nesting and gonads of all adults were small. No crossbills appeared at Santa María in August. Although our birds are smaller in wing measurements (average of five males 95.4 mm.) than typical *stricklandi*, the depth of the bill (average 12 mm.) and brick red underparts indicate this subspecies. Weights of three males: 40, 40, and 39 grams; of three females: 35, 38, and 40 grams.

Aimophila ruficeps boucardi, Rock Sparrow. Fairly abundant throughout the pine and pine-oak woods, favoring especially fallen trees, clumps of cycads, and any brush available for cover in the open woods. Young birds seen flying June 6 to 10.

Fourteen specimens were collected in all; those taken in August are too worn to be of value for measurements. Critical examination reveals differences in size and color between our specimens and typical *boucardi* from the Sierra Madre Oriental of Nuevo Leon. However, the differences are not outstanding and further study is necessary to determine whether this population warrants subspecific status. Measurements of five males and four females are: wing of males 61–63 (62), females 56–58 (57.1); tail of males 58–65 (62.6), females 58–62 (60); weights of five adults: 19, 21, 20, 22, and 20 grams.

Aimophila botterii, Botteri's Sparrow. On April 19, Robins shot a male in a burned-over section of the Canyon de las Animas. *A. botterii* was not recorded again until June 7 when several birds in breeding condition were collected in open *Acacia* and brushy fields south of Acuña (900 meters). On June 10 Heed and Martin noted numerous Botteri's Sparrows in thorn forest and savanna near Agua Fria (100 meters). Measurements of six males and two females are as follows: wing of males, 63–68 (65), females, 61 and 63 (62); tail of males, 62–66 (64), females, 57 and 64 (60.5).

Vegetation of the Pine-Oak Formation

In the Sierra Madre Oriental of Tamaulipas two climatically and physiognomically distinct types of oak-pine forest can be recognized, as follows:

1. An arid phase with widely spaced trees, the oaks generally round-crowned with gnarled branches, the pines of medium height, seldom exceeding 25 meters. The flora is often characterized by *Agave americana, Pteridium, Juniperus, Juglans, Arbutus,* and a wealth of grasses. The western slopes of the Sierra Madre Oriental around La Joya de Salas and Carabanchel and the drier portions of the eastern side are covered by this park-like woodland which is quite similar to the pine-oak belt of the coastal plain Sierras. In Novilla Canyon west of Ciudad Victoria and along the Dulces Nombres road west of El Barretal arid pine-oak woods with associated palms (*Sabal*) and chamal (*Dioon*) descend to less than 700 meters where they contact thorny scrub forest of the lowlands. This arid pine-oak woods is probably homologous to Muller's Montane Low Forest of Nuevo Leon and Coahuila (1939, 1947), characterized by a mild and semi-arid climate.

2. Humid pine-oak forests of tall. straight, closely spaced and narrow crowned trees which often reach 30 meters are a feature of more mesic portions of the Sierra Madre east of La Joya de Salas. A wealth of large tank bromeliads and other epiphytes, numerous ferns, selaginellas, and mosses appear here. Fir (*Abies*), yew (*Taxus*), *Tilia, Cupressus, Garrya, Cornus,* and *Myrica* are some of the associates of *Pinus patula, P. montezumae,* and the various oaks which comprise the dominant species.

Apparently the coastal plain Sierras are too dry to support this mesic type forest which is confined largely to higher parts of the Sierra Madre above 1500 meters on the eastern slope and 2000 meters or more on the western side. In Nuevo Leon and Coahuila, Muller (*op. cit.*) describes a Montane Mesic Forest with a cool, sub-humid climate. This appears quite similar in physiognomy to, and only slightly different in flora from, the humid pine-oak forest of Tamaulipas.

Despite certain floristic differences, the pine-oak belt of the Sierra de Tamaulipas is clearly the climatic equivalent of the arid pine-oak woods or Montane Low Forest of the Sierra Madre Oriental. Evidently the pine-oak belt of the Sierra San Carlos is also arid. In view of this physiognomic and climatic similarity, the coastal plain Sierras may be expected to exhibit a close faunal relationship to the arid pine-oak formation found along most of the Sierra Madre.

Fauna of the Pine-Oak Formation

1. Birds. Throughout the Mexican Plateau certain characteristic species can be expected wherever pine-oak forests are found, including the following:

TABLE 1

Birds Largely Restricted to Pine-Oak Communities in Tamaulipas

A. Species found both in the Sierra Madre Oriental and Sierra de Tamaulipas.	B. Species found only in the Sierra Madre Oriental.
Buteo albonotatus	*Columba fasciata*
Cyrtonyx montezumae	*Glaucidium gnoma*
Melanerpes formicivorus[1]	*Hylocharis leucotis*
Lepidocolaptes affinis[1-2]	*Eugenes fulgens*
Pachyramphus major[1]	*Trogon mexicanus*[1]
Myiarchus tuberculifer[2]	*Dendrocopos villosus*
Contopus pertinax[2]	*Empidonax difficilis*
Corvus corax	*Mitrephanes phaeocercus*[2]
Catherpes mexicanus[1-2]	*Aphelocoma ultramarina*
Myadestes obscurus[1-2]	*Parus wollweberi*
Catharus mexicanus[1-2]	*Troglodytes brunneicollis*
Vireo huttoni	*Melanotis caerulescens*[1-2]
Vermivora superciliosa[1]	*Catharus aurantiirostris*
Peucedramus taeniatus	*Catharus occidentalis*[2]
Basileuterus rufifrons[2]	*Sialia mexicana*
Tanagra elegantissima	*Ptilogonys cinereus*
Piranga flava	*Setophaga picta*
Piranga bidentata[1-2]	*Basileuterus belli*
Aimophila ruficeps	*Pheucticus melanocephalus*
Loxia curvirostra	*Hesperiphona abeillei*[1-2]
	Atlapetes pileatus
	Aimophila rufescens

1. Also nests in oak-sweet gum cloud forest (Harrell, MS).
2. Winters below 300 meters in the tropical lowlands.

Columba fasciata, Trogon mexicanus, Dendrocopos villosus, Melanerpes formicivorus, Contopus pertinax, Aphelocoma ultramarina, Troglodytes brunneicollis, Catharus occidentalis, Sialia mexicana, Peucedramus taeniatus, Pheucticus melanocephalus, and *Atlapetes pileatus.* In the Sierra Madre Oriental of Tamaulipas we found 44 species which are largely confined to the pine-oak formation at least at its lower limit (Table 1). Some of these such as *Parus wollweberi, Setophaga picta,* and *Aimophila ruficeps* apparently favor arid pine-oak woods, while others including *Trogon mexicanus, Catharus occidentalis,* and *Hesperiphona abeillei* inhabit the humid or Montane Mesic Forest. However, it would be premature to attempt a subdivision of the pine-oak avifauna into species favoring arid or humid communities; actually many forms range throughout both.

In the Sierra de Tamaulipas 20 of the 44 Sierra Madre species were found (Table 1. List A). Most of these are typical of arid woods in the Sierra Madre, although a few, such as *Lepidocolaptes affinis* and *Catharus mexicanus*, are not. We conclude that the pine-oak avifaunal component of the Sierra de Tamaulipas exhibits a strong relationship to that of the Sierra Madre despite the relatively small area and homogeneous nature of the pine-oak habitat in the former.

2. Mammals. Obviously our knowledge of the mammal fauna is meager; however, all the species recorded thus far, with the exception of *Peromyscus boylii*, are known to occur in the foothills or lowlands below the pine-oak belt. *P. boylii* is also the only species listed by Dice (1937) which might be confined to the pine-oak belt of the Sierra San Carlos.

3. Reptiles and amphibians. In contrast to the pattern of bird distribution the herpetological affinities of the Sierra de Tamaulipas are almost entirely with the lowlands. Admittedly our faunal sample is incomplete; nevertheless of the 25 species recorded, all but *Lepidophyma* and possibly *Eumeces dicei* range below the pine-oak belt, most of them occurring throughout the arid lowland scrub of northeastern Mexico. Of the entire group only *Eumeces dicei* is definitely disjunct in its zonal distribution, having been taken at 500 meters in the Sierra San Carlos, at about 900 meters in the Sierra de Tamaulipas, between 1100 and 2000 meters in the Sierra Madre near La Joya de Salas, and at 600 meters near Ciudad Victoria. It is especially significant that the highly diverse iguanid genus *Sceloporus* is represented in the Sierra de Tamaulipas by four species which are typical inhabitants of the lowlands, while those species abundant in the Sierra Madre near La Joya de Salas such as *S. torquatus*, *S. jarrovii*, *S. parvus*, and *S. scalaris* were not collected. Thus it appears that the mammals, reptiles, and amphibians exhibit very slight relationship to the pine-oak faunal component of the Sierra Madre.

Reptiles and amphibians reported from the Sierra San Carlos (Gaige, 1937) were taken mainly below the pine-oak belt. Virtually all of the species listed also inhabit the Tamaulipan lowlands: no forms restricted to the pine-oak formation were collected.

Discussion

Pollen studies correlated with archeological horizons from the vicinity of Mexico City (Sears, 1952) have thrown new light on the problem of Pleistocene climatic fluctuations far below the continental glacial border, and remove some of the burden of proof from evidence based on relict distributions alone. Evidence for the extreme views adopted by some that during the period of maximum refrigeration the South American faunal element was virtually destroyed in Mexico (Griscom, 1950) and the Tropical Zone was driven into a narrow coastal fringe in Central America (Beecher, 1950) is largely circumstantial; but the more substantial data afforded by fossil records and relict mammal distribution patterns (Burt, 1949) suggests a definite refrigeration of climate in Mexico.

Although fossil evidence from the coastal plain of Mexico is lacking, we suspect that significant fluctuations of climate and vegetation occurred. In view of the pollen findings of Potzger and Tharp (1947) from Austin, Texas, which demonstrate major changes in the vegetation of that area, 500 miles north of the Sierra de Tamaulipas, it seems probable that northeastern Mexico was also affected. A climatic shift sufficient to lower the present arid pine-oak belt with its mild, semi-arid climate from the 700 to the 200 meter contour would establish habitat continuity between the Sierra Madre and the coastal plain ranges. At such a time faunal movement across the coastal plain would have been possible for species inhabiting the pine-oak belt.

Assuming then that faunal isolation in the Sierra de Tamaulipas is of post-Wisconsin age, we must account for the absence of a distinct pine-oak faunal component among the terrestrial vertebrates. Why are the relationships of the mammals, reptiles, and amphibians almost exclusively with the lowlands in contrast to the strong montane affinities of a third of the breeding birds? We offer the following two hypotheses:

1. Small habitat size. As previously mentioned, the pine-oak formation of the Sierra de Tamaulipas occupies a small area; it may cover less than 700 square kilometers. Optimal population conditions are not realized by animals restricted to small isolated habitats and the possibility of local extermination of species confined to this formation is much greater than for the same species inhabiting the extensive pine-oak belt of the Sierra Madre Oriental. Among the vertebrates, the birds, with their superior dispersal capacity, should be able to maintain balanced populations by occasional immigration from the Sierra Madre.

2. Post-glacial thermal maximum. In view of the xeric-mesic fluctuations dating to at least 2000 B.C. in the Valley of Mexico (Sears, 1952), and the xerothermic intervals postulated on the basis of pollen studies in eastern North America (Sears, 1948), it is probable that in recent times the pine-oak formation of the Sierra de Tamaulipas was somewhat constricted. If xerothermic conditions did prevail here, a retreat of the pine-oak woods to isolated peaks and north-facing ravines would follow, subdividing the habitat into numerous isolated pockets. Under such conditions animals confined to the pine-oak belt would be in danger both of increased competition from invading lowland species and local extirpation in an environment too small to support adequate breeding populations. As the habitat increased again under the return of favorable climatic conditions, only the birds succeeded in re-establishing part of the Sierra Madre faunal element.

Summary

Isolated from the main front of the Sierra Madre Oriental, the Sierra de Tamaulipas is surrounded by xeric thorny scrub of the Gulf Coastal Plain. A belt of arid pine-oak woods covering its higher slopes forms an environmental island of temperate forest for certain animals which reached this habitat from the Sierra Madre. Of 44 birds largely confined to pine-oak forests in the former, 20 were also found in the Sierra de Tamaulipas; however, virtually none of the amphibia, reptiles, or mammals restricted to this habitat in the Sierra Madre appeared in the Sierra de Tamaulipas.

On the assumption of Pleistocene connection between the pine-oak belts of the two Sierras, we postulate both small habitat size and a post-glacial xerothermic effect as responsible for the observed faunal composition of the Sierra de Tamaulipas.

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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN; DEPARTMENT OF CONSERVATION, CORNELL UNIVERSITY; AND DEPARTMENT OF ZOOLOGY, UNIVERSITY OF TEXAS, JULY 28, 1952

GENERAL NOTES

Baird's Sparrow in Oklahoma.—The paucity of migration records of Baird's Sparrow (*Ammodramus bairdii*) east of New Mexico and Colorado has long been a matter of interest to ornithologists of the mid-west. Nice (1924. Birds of Oklahoma:113) stated that Cooke had looked for this species at Caddo, Oklahoma, in 1883. Dr. Alexander Wetmore (1920. *Auk*, 37:457-458) made a thorough but unsuccessful search for Baird's Sparrows in eastern Kansas. Cartright, Shortt, and Harris (1937. *Trans. Royal Canadian Inst.*, 21:155) pointed out that migration records of this species are few, and that it seems largely to escape notice in migration. In their very useful paper they list migration records in sequence in order to show the passage of the birds from south to north. From this list it is clear that Baird's Sparrows pass through the region of New Mexico and Colorado in late April and early May.

In view of the above facts we considered it worthwhile to make a concerted effort to find Baird's Sparrows in central Oklahoma during the spring migration of 1953. Beginning our searches in mid-March, we regularly visited various types of habitat, but concentrated on upland grasslands and weedy fields. We made field trips from one to three times a week for the express purpose of finding this species.

Our search was rewarded on April 23 (1953) when R. Graber collected one of three Baird's Sparrows which he saw in a field three and one-half miles northeast of Norman. The field was of interest because of the variety of cover which it offered, with patches of various grasses and forbs, bare eroded areas and a few scattered clumps of wild plum (*Prunus* sp.). A short list of some of the common plants will help show the nature of the vegetation: grasses; *Aristida, Andropogon scoparius, Bromus, Festuca octoflora*: forbs; *Melilotus officinalis, Ambrosia psilostachya, Plantago virginica, Liatris*, and *Oenothera laciniata*.

In the same field were singing Grasshopper Sparrows (*Ammodramus savannarum*) and a few Savannah Sparrows (*Passerculus sandwichensis*). Like these sparrows, the Baird's Sparrows were reluctant to fly, preferring to run away through the grass, though they seemed less skillful in keeping themselves concealed than the first two species.

The specimen was a male, testes little enlarged, in somewhat worn plumage (the tail and upper tail coverts were badly worn). It weighed 18.2 grams, was moderately fat, and was molting on the head, neck, and upper breast.

Though we continued to look for Baird's Sparrows in succeeding weeks, we failed to find the species again. Cartright, Shortt, and Harris (*loc. cit.*) thought that the spring migration of this species is very rapid, and it is not unreasonable to suppose that the birds did pass through our study area in just a few days and that we encountered them only when the migration was at its peak.

Nice (*loc. cit.*) included Baird's Sparrow in a list of birds unreported but to be expected in Oklahoma. Force (1929. *Okla. Acad. Sci.*, 9:68), in a list of birds of Tulsa County, Oklahoma and vicinity included *Ammodramus bairdii*, but indicated its status there as uncertain, there being no specimen. In view of the secretive nature of Baird's Sparrows in migration and the possibility of confusing it with other migrants, Oklahoma records should generally be based on collected birds.

Our specimen is now in the University of Oklahoma Museum of Zoology (UOMZ 625). We wish to thank Dr. George J. Goodman for identifying several plant specimens.— RICHARD GRABER AND JEAN GRABER, *Museum of Zoology, University of Oklahoma, Norman, Oklahoma, May 18, 1953.*

Nest-building behavior of the Carolina Wren.—In the spring of 1953 we observed a pattern of nest-building behavior in the Carolina Wren (*Thryothorus ludovicianus*) that seems not to have been recorded previously.

The observations were made in our back yard on the border of a mesic hammock near Gainesville, Alachua County, Florida. There are about a dozen fairly large trees standing in the yard beneath which the underbrush has been cleared out but the leaf mold has been left largely undisturbed. In the area just south of the yard there is a dense thicket of underbrush under the trees.

The phenomenon observed was simply that when the wren, in gathering nesting material, picked up anything larger than a tiny leaf it did not fly directly to the nesting site but instead climbed up the trunk of a tree to a height above the nest and then flew down toward it with the load.

We first noticed this on May 10 when the wrens were collecting material from the leaf mold in the open yard. On this occasion the nest was situated close to the ground. The wrens would leave the nest, fly parallel to the ground and about a foot or two above it to the area where they were gathering the nesting material. With small items, they would take off from the ground and fly horizontally back to the nest, but with larger objects (a leaf an inch or more in diameter, a pine straw, etc.) they would hop to the nearest tree, climb straight up the trunk to an altitude above the level of the nest, then take off and fly downward to the nest. In a tree 44 feet from the nest they climbed to a maximum height of 14 feet and they climbed 16 feet up the side of a tree 49 feet from the nest. On one occasion, one of the wrens selected an item which appeared to be a piece of dead magnolia leaf about 2 inches in diameter. It hopped over some 8 or 10 feet to the nearest tree, which was 49 feet from the nest, climbed it to a height of 16 feet, but then, instead of flying downward directly toward the nest, it flew off at a tangent to another tree, landed on the trunk 8 feet from the ground, climbed to a height of 13 feet, and then flew downward toward the nest which was now only 25 feet away.

While collecting material in the shrubby area south of the nesting site the birds would also gain altitude before taking off for the nest but here they would simply hop up from twig to twig of the shrubs until they reached a sufficient altitude. Once we saw one hop from twig to twig until it reached the top of the shrub about 10 feet from the ground, then hop to a tree and ascend the trunk for another 4 feet above the level of the top of the shrubs. Both the male and the female take part in the nest building and both of them exhibited this same behavior.

While watching a pair (perhaps the same birds) building a nest in June we made a check of fifty flights and found that the birds climbed trees or shrubs to get altitude 28 times as compared to the 22 times they took off from the ground. This nest was placed under the eaves over the front step of our house and hence was about 8 feet from the ground. On several occasions the birds would pick up some item, then instead of hopping to the nearest tree they would fly close to the ground and land on the base of a live oak tree about 6 feet from the door. They would then climb up this tree to a height equal to or above the nest before concluding the final lap of the flight to the nest.

When we discussed this behavior of wrens with our friend, O. C. Van Hyning, he told us that he had seen them do the same thing when carrying food to the nestlings.—COLEMAN J. AND OLIVE B. GOIN, *Department of Biology, University of Florida, Gainesville, Florida, July 21, 1953.*

Notes on Some Birds of Yellowstone National Park.—While employed during the entire summer of 1952 in Yellowstone National Park, Wyoming, I had the opportunity to observe birds in various sections of the park. My notes contain several additions to our knowledge of the status and distribution of birds in this area.

Bufflehead (*Bucephala albeola*).—Brodrick (1952. "Birds of Yellowstone National Park," p. 12) indicates that this species has been found breeding within the park boundaries only once. Kemsies (1930. *Wilson Bull.*, 42:202) lists this duck as a migrant. On July 6, 1952, I found a female accompanied by seven downy young on a small pond separated from Yellowstone Lake by a sand-bar about one-quarter of a mile southwest of Fishing Bridge.

White-tailed Ptarmigan (*Lagopus leucurus*).—One individual was observed closely on the southeast side of Mount Washburn just above timberline on July 20, 1952. The only other record from the park is that of at least one bird seen on Quadrant Mountain in 1927 (Brodrick, *op. cit.*:18).

Sora (*Porzana carolina*).—This species has been cited by both Kemsies (*op. cit.*:203) and Brodrick (*op. cit.*:19) as being an "occasional breeder." My observations indicate that this was a common breeding species in the proper habitat throughout the park in 1952. During all of June the call of this species was obvious around Swan Lake Flats and also from a small, wet area near Madison Junction. On June 22, 1952, I heard at least seven of these birds and found a nest containing eleven eggs on the northwest side of Swan Lake. I saw five young in Upper Geyser Basin on July 7 and heard and saw others along Yellowstone Lake and River occasionally.

Wilson's Snipe (*Capella gallinago*).—Skinner (1925. *Roosevelt Wildlife Bull.*, 3:157) regarded this species as "not common." Again, both Kemsies (p. 203) and Brodrick (p. 19) regard this as only an "occasional breeder." I heard one bird every morning and evening in the Upper Geyser Basin during June and early July. I flushed two birds from Swan Lake Flats on June 22, 1952, and one adult with three or four young along Yellowstone Lake about seven miles north of Thumb on July 5. Considering all records, I think that the present species is an uncommon but regular breeding bird in the park.

Western Wood Pewee (*Contopus richardsonii*).—This species has apparently extended its range up into the lodgepole pine (*Pinus contorta*) forests of the Canadian Zone to some extent from the lower elevations. I observed and heard it commonly all summer from Upper Geyser, Black Sand and Biscuit Basins. Bailey (1930. "Animal Life of Yellowstone National Park.") and Kemsies (*op. cit.*:206) state that this species is a "common summer resident" only at the "lower altitudes."

Barn Swallow (*Hirundo rustica*).—This species is rare in summer in the park region. Barn Swallows nested about five miles north of Thumb along Yellowstone Lake in 1952. I saw two adults here five times during June and two adults and four young in the same area on July 27.

Lark Sparrow (*Chondestes grammacus*).—Termed a "rare summer visitor at the lowest levels" by Brodrick (*op. cit.*:50), I found this species to be fairly common during migration in late summer mixed in with flocks of Savannah Sparrows (*Passerculus sandwichensis*) and Chipping Sparrows (*Spizella passerina*) in the Upper Geyser Basin during late August and early September.

Brewer's Sparrow (*Spizella breweri*).—Bailey stated that this species was a common summer resident in the sagebrush valleys but Kemsies and Skinner regarded it as a rare breeder. I did not find the nest of this species but during June and most of July I heard and observed one male in the Biscuit Basin. This single bird frequented brush piles and was seen so regularly here that I suspect it had a mate and nested here.—Richard C. Rosche, *Cornell University, Ithaca, New York, April 21, 1953.*

Yellow-bellied Sapsucker on Anegada, British West Indies.—On January 24, 1950, I collected a female Yellow-bellied Sapsucker (*Sphyrapicus varius*) from a cocoanut tree on Anegada Island. My guide informed me that this bird was not uncommon and that he saw "woodpeckers" every year. Sapsuckers are ordinarily rare migrants in this part of the world. The island of Anegada, covered with the most meager xerophilous scrub and only thirty feet above sea level, hardly appeared to be the place to find one. I believe this a new record for the island. The bird is No. 26 in my collection.—George A. Seaman, *Christiansted, St. Croix, Virgin Islands.*

Injury-feigning by the Catbird.—At the 1949 annual meeting of The Wilson Ornithological Club, Mr. Frederick V. Hebard gave a paper entitled "Survey of injury-feigning birds on the A.O.U. checklist." At that time there were no published records of injury-feigning by members of the family Mimidae, and, so far as I know, there have been none since. Mr. Hebard informed me later (letter dated January 10, 1950), however, that a Catbird (*Dumetella carolinensis*) he had observed (during the first week of August, 1949) "feigned mildly for the first several days after the eggs had hatched." He added that "this was the first Catbird nest from which I had ever surprised the adult bird."

On May 30, 1949, I flushed a Catbird from a nest containing five eggs. The bird flew to a gravel road only a few feet away and gave a modified broken-wing display, *i.e.*, fluttered its wings moderately fast as it moved slowly along the road away from me and the nest. The same behavior was repeated the following day, when there were still five eggs. The nest was destroyed before my next visit.

That injury feigning is not a common behavior pattern of the Catbird is indicated by the lack of published records and by the fact that I have observed it only at one nest in a six-year period, during which I observed 118 nests of this species.

A more common type of behavior of the Catbird when surprised on its nest is an intimidation display. In this, the incubating bird moves only a short distance from the nest before advancing with outstretched wings toward the observer, giving the typical loud alarm note repeatedly. Catbirds have, on several occasions, approached to within two or three feet of me with their wings outstretched in this manner.—Andrew J. Berger, *Department of Anatomy, East Medical Building, Ann Arbor, Michigan, July 20, 1953.*

Brewer's Blackbird nesting in Indiana.—Although a number of sight records and one specimen (Mumford, 1951. *Wilson Bull.*, 63:47) of Brewer's Blackbird (*Euphagus cyanocephalus*) have previously been reported from Indiana, it was not until the spring of 1952 that the first nesting record was established. Since 1949 sight records have been obtained from Lake, St. Joseph, Newton, Porter, Pulaski, Noble, and Wayne counties. I have failed to find any earlier reports and Butler (1898. *Indiana Dept. Geol. Nat. Resources Ann. Rep.* 22:1178) carried the species on the hypothetical list.

Hubert O. Davis, W. Marvin Davis, and Richard E. Phillips observed a number of Brewer's Blackbirds of both sexes on a small, isolated remnant of prairie near Schererville, Lake County, Indiana, April 8, 1949. They also recorded the birds there in 1950 and 1951, but no search for nests was made. On May 11, 1952, Phillips found at least ten pairs of Brewer's Blackbirds on the area and was successful in locating a nest. It was on the ground in a rather dense growth of switch grass (*Panicum virgatum*) remaining from the previous year. This had fallen over and formed a tangled mat over the ground. The nest was sunken into the ground so that the rim was level with

FIG. 1 Brewer's Blackbird nest and eggs, Lake County, Indiana, May 11, 1952. Photo by Frank E. Phillips.

the surface. The nest contained five eggs (Fig. 1). Phillip's measurements of the nest are as follows: inside depth, $2\frac{1}{2}$ inches; inside diameter, $3\frac{3}{4}$ by $4\frac{1}{4}$ inches. The nest was composed of grasses and lined with fine rootlets. It was on a dry site, although the lower depressions on this tract contained water, in which were growing *Scirpus*, *Iris*, and other aquatic or semi-aquatic plants. Two cottonwood trees (*Populus deltoides*) were within 70 yards of the nest and were utilized by the males as singing perches. Two dense thickets of quaking aspen (*Populus tremuloides*) were situated within 100 yards of the nest, but the remainder of the approximately 12-acre tract surrounding the nest was relatively open, except for scattered aspen of small size.

Phillips, Mrs. Mumford, and I visited the nest on May 17, 1952. There was a light rain falling at the time and we flushed the female from the nest. It contained three small young and two eggs. Dr. C. M. Kirkpatrick, Phillips, the Davises, and I visited the nest again May 30 and found it empty; we caught two fledglings near the nest, however, and observed both adults carrying food to the young from a field one-half mile away.

During our visit on May 17, we investigated the area about the nest carefully without finding evidence of other nests. We did locate a nest with three eggs about 300 yards southeast of the first one, in a partially-barren field which has been under cultivation the previous year. The female was flushed from the nest, which was on the ground in the center of a clump of weeds. Both adults flew about over our heads scolding us while we examined the nest.

Further investigation of a similar tract of land across the highway from these two nests resulted in our finding a third nest, which contained one egg. This nest was also in a clump of vegetation in a field cultivated the year before. It was on the ground and constructed of soybean stems from the previous year's crop and lined with fine rootlets. It contained no mud. The nest and egg were collected and have been deposited in the Joseph Moore Museum, Earlham College, Richmond, Indiana. The following measurements of the nest were taken: outside diameter, 132 by 160 mm.; inside diameter, 90 by 92 mm.; inside depth, 52 mm.; and outside depth, 90 mm.

Two more nests were located in the vicinity of this one on May 30. Both were in the same type of situation as the second and third nests above and they contained young almost ready to fly. We noted that the nesting birds became very excited as we approached a nest site. By studing the intensity of their scoldings, we found one nest more easily. All five of the above nests were placed within an area roughly 300 yards wide and 880 yards long. It is quite likely that more nesting pairs were present, since we observed 18 adults on May 17, most of which were males.

Another nesting record was established on May 23, 1952, when Mr. and Mrs. Ray Grow, James B. Cope, and Robert Lewis discovered a nest containing five young and one egg in Pine Township, Porter County, Indiana. This nest was on the ground in an alfalfa field about 30 feet from the edge of a plowed field. Four males and two females were observed in the area at the time.

The nesting of this species has probably been overlooked for some years in Indiana. On areas where muck farming is practiced, it seems that the birds might be present. Brewer's Blackbirds were rather common in Newton County, Indiana, during late March, 1953. Many flocks were noted with Cowbirds (*Molothrus ater*), Red-wings (*Agelaius phoeniceus*), and Rusty Blackbirds (*Euphagus carolinus*). I made a brief visit to the Schererville area on May 11, 1953, and collected a male and a female Brewer's Blackbird; I observed 13 on the area at this time, but had no opportunity to search for nests. The specimens have been deposited in the Joseph Moore Museum.

I wish to thank Richard E. Phillips for permission to publish the above data and Frank E. Phillips for the accompanying photograph. Thanks are also extended to James B. Cope for supplying the data on the Porter County nest.—Russell E. Mumford, *Route 1, Cortland, Indiana, August 11, 1953.*

Wintering Blue and Snow geese in northern Alabama.—Blue Geese (*Chen caerulescens*) and Lesser Snow Geese (*Chen hyperborea hyperborea*) in the eastern United States normally winter in the coastal marshes of the Gulf of Mexico. There are scattered winter records in the interior, but the establishment of a small flock wintering regularly on the comparatively recent impoundments of the Tennessee River is new and interesting.

Impoundment of the Tennessee Valley Authority's reservoirs on the Tennessee River began with the completion of Wheeler Dam in 1936, followed quickly by the completion of the Guntersville, Pickwick, Kentucky, and other dams. Prior to these impoundments, Blue and Snow geese were virtually unknown to residents of the Tennessee Valley. Howell's "Birds of Alabama," last printed in 1928, lists both species as only rare and irregular migrants in the state. With Wheeler Reservoir impounded in 1936, Blue and Snow geese stopped briefly in the fall of 1937. Since then, these birds have stopped regularly on Wheeler each fall and are now noted each autumn on all the lower impoundments, including Guntersville, Wheeler, Wilson, Pickwick, and Kentucky reservoirs.

The establishment of the Wheeler National Wildlife Refuge in 1938 by the U. S. Fish and Wildlife Service on the middle third of Wheeler Reservoir provided an added incentive to the birds to stop and rest. While the stopovers have occurred regularly, numbers have varied widely. In 1939 the writer estimated that 2,000 were present on the refuge during late October and early November. In 1945, Mr. L. S. Givens, then refuge manager, estimated 5,000 present on the sanctuary during the fall flight. In other years the number present at the peak of the flight has varied from 100 to 1,000.

For both species the earliest fall arrival date for the refuge is October 2. Normally the peak of the flight occurs the last week of October and the first week of November. By the third week of November the flight is over and the migrating birds have passed on to the Gulf. Although rarely pure flocks of both species are noted, they are commonly mixed, with Snow Geese comprising from 5 to 10 per cent of each flock.

For ten years after the establishment of Wheeler Refuge the birds continued their status as fall migrants only. Occasionally single birds or small groups of 2 or 3 were noted in middle or late winter, usually in company with Canada Geese (*Branta canadensis*). These were assumed to be sick or crippled birds that failed to migrate. The first wintering in numbers occurred in 1948–49 when a flock of 20 Blues and 5 Snows remained until late March. During the winter of 1949–50, 400 Blue Geese and 30 Snows stayed over until early spring. Again, in the winter of 1950–51, 500 Blue Geese and 40 Snows were present until mid-March, although the winter was severe, with considerable snow and ice. Strangely enough, during the winter of 1951–52, characterized by mild weather, only a few stragglers were present. The winter of 1952–53 saw them present again, with an estimated 200 Blues and 15 Snows using the refuge until early spring.

The fluctuating waters of Wheeler Reservoir prevent the growth of any significant amounts of aquatic vegetation, and the waterfowl management of the refuge is based on the growing of agricultural crops on upland fields and leaving portions unharvested for wintering waterfowl.

A part of the land is also kept in small grain, alfalfa, and other green winter crops to provide grazing for geese. While Canada Geese make good usage of both browse crops and unharvested corn, the Blue and Snow geese seemed to depend entirely on natural mud flat vegetation until the winter of 1949–50. During that winter they made limited use of both browse and corn. Since then, they have fed regularly on upland fields.

While these geese are said to remain close to the Mississippi Valley on their northward migration, there have been indications, during the last few years, that there may be a limited spring flight through northern Alabama. Those birds that have spent the winter on Wheeler Refuge have left during the period between the last few days of February and mid-March. A few scattered flocks have been noted moving through this area in April. This has occurred with some regularity and as late as April 28. It is believed that these April birds have wintered elsewhere. It seems clear that the impoundment of the five lower reservoirs on the Tennessee River, aggregating over a quarter-million surface acres of water, is modifying both the winter range and the migration routes of these species to some extent.—THOMAS Z. ATKESON, *Box 1643, Decatur, Alabama, May 29, 1953.*

Courtship behavior of the Pied-billed Grebe.—Pied-billed Grebes (*Podilymbus podiceps*), of which no more than 4 were present at any one time, were watched on a small pond in Seneca, Maryland, from approximately 8 to 9 a.m. on successive week ends from March 22 to April 19, 1953. Activity suggestive of courtship was first noted on March 28 when 2 grebes swam together for a few moments with bills touching, one making a loud, rapid note *h'n, h'n* resembling a nasal laugh. On the following day 2 grebes made the same noise as they swam near each other. On April 5, one grebe (A) suddenly flew over to a second (B). Then B swam after A, remaining 2 to 6 feet behind. Grebe A kept turning its head from side to side as it swam away. The pursuit, which was not hurried, continued for about 30 feet. This same performance of one grebe flying to another, then swimming away with head turning, was observed 3 times in one hour. On April 12 a single grebe (C) remained in one spot and fairly motionless for some time. Suddenly it stood upright on the surface, beating its wings rapidly, and treading water with both feet. In spite of this vigorous and sustained activity the bird remained in one spot. Another grebe (D) was 20 feet away at the time and began to swim toward C, which soon ceased performing and swam toward D. As the 2 came together they floated side by side. Grebe D then held its wings out horizontally and beat them in a rather helpless fashion against the water. Grebe C mounted the back of D and both birds sank under the water with much splashing. After a few moments they separated and swam away. By April 25, the grebes had left the pond, on which they have not been known to nest in previous years.

On April 26 continued observations were made in a wooded swamp one mile from the pond. I waded to the middle of this small swamp until I was about 25 feet from 2 grebes which I couldn't see because of bushes. One made *cowp, cowp, cowp* noises interspersed with *ugh* notes suggestive of air being sucked into a defective pump. The other grebe joined in with the *h'n, h'n* notes described above. Suddenly both birds burst into an open stretch of water, one pursuing the other at top speed. The bird I judged to be the male grabbed the female by the nape of the neck with his bill and held on vigorously for the next few minutes. During this time there was much thrashing about, the pair being as much under the water as above and moving about irregularly the whole time. The male hung on so that he was somewhat on the side of the female. When they had separated and returned behind the bushes, I waded through and found an uncompleted nest. This consisted of old bull rush stalks on top of which was a circular layer of mud and plant matter, the whole resting on the submerged end of a log in 3 feet of water. There were no eggs. Grebe feathers floated nearby on the water. A week later the nest had not been added to, although one grebe was calling in the vicinity. No more grebes were seen in the swamp after this time.

Comment: Courtship activities and at least attempted coition may take place among Pied-billed Grebes before they reach their nesting waters. Activities associated with coition may be more abrupt and violent when eventuating in the vicinity of a nest as Glover (1953. *Wilson Bull.*, 65:32–39) has also described. Courtship behavior of Pied-billed Grebes, especially the standing upright on the water and the head turning, shows some resemblances to that described for other species of grebes.—LAWRENCE KILHAM, *8302 Garfield St., Bethesda, Maryland, May 11, 1953.*

Blue Jays feed tent caterpillar pupae to nestlings.—Although it is generally known that American cuckoos (*Coccyzus americanus* and *erythropthalmus*) and Baltimore Orioles (*Icterus galbula*) feed on tent caterpillars (*Malacosoma americana*), there are few references to the important activity of Blue Jays (*Cyanocitta cristata*) in the control of this pest (see Forbush, 1929, "Birds of Massachusetts, etc.," Part 2, p. 383). In April and May, one pair of Blue Jays will destroy hundreds of the cocoons to feed the pupae to their nestlings, thus eliminating potential thousands of eggs due to hatch on fruit trees the following spring.

I first observed Blue Jays gathering the cocoons in 1948 while watching a jay nest near my house. As the food brought to the nestlings was always carried inside the mouth instead of between the mandibles, it was necessary to watch the adults as they foraged to find out what they were bringing to the nest. With binoculars, I could see them carry a small white object to a brush pile, hold it between the toes, and pound it with the bill. Something was then tossed into the mouth as the white object was released to float off in the breeze or cling to the twigs. After two or three repetitions of this performance, the parent jay flew to the nest to feed the young. Examining the white objects, I found them to be the silky cocoons woven by the adult tent caterpillar. The birds had opened each one at the end to extract the developing pupa.

Each year since, I have noted that Blue Jays hunt these cocoons about the wild cherry trees.—Amelia R. Laskey, *1521 Graybar Lane, Nashville 12, Tennessee, July 22, 1953.*

The cause of partial albinism in a Great-tailed Grackle.—The presence of white feathers in certain areas, on a bird normally colored elsewhere, is a common and well-known phenomenon. The frequency of partial albinism (if we may really apply the term "albinism" here), usually very low, varies with the species; it is highest in the young of the Cliff Swallow (*Petrochelidon pyrrhonota*), but is also rather high in the Robin (*Turdus migratorius*), English Sparrow (*Passer domesticus*), and Brewer's Blackbird (*Euphagus cyanocephalus*). On the other hand, it is very low in such groups as the flycatchers (Tyrannidae), warblers (Parulidae), and the cardueline finches. But despite its widespread occurrence, we know little about the causes of partial albinism.

On November 26, 1952, a female Great-tailed Grackle (*Cassidix mexicanus*) was collected in some newly cleared fields between Las Varas and the Boca de Chila, on the coast of southwestern Nayarit, México. On picking it up, I found that it was white on the left side of the face in the lores, the rear of the malar area, and most of the intervening subocular region. On skinning the bird, thirty hours or more later, I found a large yellow cyst directly under the skin at the same point, in the muscular area beside the rear of the lower jaw. The bird's health was evidently unaffected, as it weighed 121.8 grams even though without fat (which condition is not unusual at this season).

The only preservative at hand was 70% alcohol. Nevertheless, the tissue was preserved and, through the kindness of Dr. Louise Micklewright of the University of Arizona, was prepared for sectioning. She found, however, that it would not slice properly because of a very hard sliver in the center. She then cut some sections by hand and stained them. Nowhere in the preparation are any cell nuclei visible. Thus it appears that the sliver had become accidentally embedded in the jaw muscles, and a very hard fibrous cyst had then developed around it.

These results fall short of what might be desired; but they do suggest that our knowledge of partial albinism might be advanced if collectors made a point of preserving the tissues lying directly under the affected areas. Some abnormalities may not be so obvious, macroscopically, as was this one. It must be admitted that I, for one, have neglected opportunities of this sort in the past.—Allan R. Phillips, *Museum of Northern Arizona, Flagstaff, Arizona, July 17, 1953 (Contribution No. 203).*

Notes on the nesting of the Cayenne Swift in Surinam.—The nest of the Cayenne Swift (*Panyptila cayennensis*) is one of the most remarkable structures built by any bird in tropical South America. Although the nest has been known for some time, I am not aware of the existence of satisfactory photographs showing a nest *in situ.* The picture published by the Penard brothers (1910. "De Vogels van Guyana," Paramaribo. Vol. 2:96–97) was long a mystery to me, until I found that it not only

FIG. 1. A nest of *Panyptila cayennensis* under the eave of a roof. Photographed in Surinam on March 9. 1947, by F. Haverschmidt.

shows a nest which is cut open but that the picture is reproduced upside down! I have no detailed observations on the bird's breeding behavior because watching an occupied nest yields no result other than seeing the bird dash out of the nest to vanish altogether. Even so, it seems worthwhile to publish the data I was able to assemble.

The best description of the nest is that by Belcher and Smooker (1936. *Ibis,* 13th Ser., 6:28): "The nest is a tubular sleeve-like structure of plant down collected on the wing, often reaching a length of 2 feet. The sleeve is open at the bottom, where the bird enters and flies up to the egg-chamber, a little saucer shaped pocket some way up at one side." I did not find corroborated by other writers the statement of these authors that each time the nest is enlarged a new nest cup is made, so that a long used nest may have as many as four cups, one above the other.

The nest is fawn colored and, when cut open and flattened, looks like a tightly woven carpet, about 8 mm. thick, of very soft, downy, plant material. Sick (1947. *Rev. Brasil Biol.*, 7:219–246) gives a detailed description of four nests from Brazil

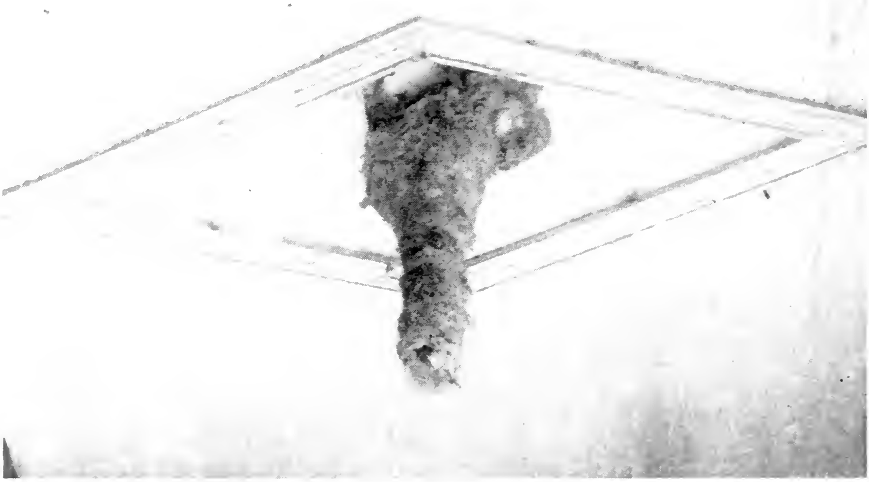

FIG. 2. A nest of *Panyptila cayennensis* hanging from the ceiling of a porch in Paramaribo, Surinam. Photographed on May 10, 1953, by F. Haverschmidt.

with measurements and a careful analysis of the plant material of which these nests were built, but he overlooked the important notes by Belcher and Smooker (*op. cit.*) and Greenway (1934. *Auk*, 51:377–379).

Sick distinguishes two general types of nests, the long, straight type and the short, kinked type.

The nests I found in Surinam were built under the eaves of the roofs of wooden buildings, on the ceiling of a porch of a building, alongside the trunk of a tree, and attached to the underside of a branch. Greenway (*op. cit.*) even mentions nests built inside buildings in the Panama Canal Zone.

Descriptions of the five nests I have found in Surinam follow:

1. March 2, 1947, nest with a very long sleeve under the eave of the roof of the hospital building at the plantation "Peperpot" along the Surinam River (fig. 1). On March 9, the bird was seen leaving the nest; it was again observed dashing out of the nest on April 11 and June 27, 1947. In 1948 the nest was enlarged and occupied

again; the bird was seen leaving the nest on May 23. In 1949 the nest was once more enlarged and inhabited; I saw a swift flying out of it on June 9. This nest was the largest of all I have seen.

2. On March 23, 1947, I found a second nest on this plantation. It was built alongside the trunk of a shade tree (*Erythrina glauca*) at a height of about 20 meters. The nest appeared old and not in use at that time.

3. On April 4, 1948, I found a nest suspended from the underside of a horizontal branch of a huge cotton tree (*Ceiba pentandra*), about midway out from the trunk, at a height of about 30 meters on the plantation "La Liberté" along the Surinam River. The bird was not seen but the nest looked new. This nest seemed remarkable to me as it was attached to the branch only at the top, while the sleeve hung free in the air.

4. On April 3, 1951, I found a nest with a long sleeve under the eave of the roof of a building on the grounds of the waterworks at Republiek. The nest was occupied at that time as the bird was seen repeatedly leaving the nest. On August 13, 1952, the nest was still there and apparently it had been used again though the bird was not seen. In this same locality on April 6, 1951, I found a different nest on the ground which had apparently been removed from its site. This nest was of the kinked type with only a short sleeve.

5. On April 9, 1953, I found a nest with a long sleeve hanging from the ceiling of a porch of a building along the Surinam River in the middle of the town of Paramaribo. It was of the same type as nest 3, as its upperside was attached to the roof and the sleeve hung freely in the air (fig. 2). Although I did not see the bird, the nest was inhabited, since on the floor under it lay some fresh excrement.

From these notes it seems clear that in Surinam the nests are occupied from March to the end of June, which is corroborated by the observations of Belcher and Smooker (1936) in Trinidad who found nests occupied usually in April. Because of the inaccessibility of the nests, I never was able to examine their contents. The nest of a near relative, *Panyptila sancti-hieronymi*, which occurs in western Guatemala and which is considered by Peters (1940. "Check-List of Birds of the World," Cambridge. Vol. 4:253-254) as a separate species but by Stresemann (1927-34, "Aves. Handbuch der Zoologie." Berlin. p. 348) as only a geographic race of *cayennensis*, is described as similar but is said to contain a "false entrance" half way up its side (Sclater 1863, quoted by Stresemann, *op. cit.*). Whether this is the rule or only an exception further observations must show.—F. Haverschmidt, *P. O. Box 644, Paramaribo, Surinam, Dutch Guiana, May 18, 1953.*

Two Mallard ducks caring for the same brood.—On July 5, 1953, a Mallard duck (*Anas platyrhynchos*) hatched a late brood of four young on Wintergreen Lake at the W. K. Kellogg Bird Sanctuary. The following day one duckling disappeared and on July 8 only two remained. However, on this date two Mallard ducks were noted for the first time to be with the young and from that time on the two ducks were seen always with the two young. Both females seemed equally concerned over the care of the young and all four birds kept in close proximity to one another. On July 10, a particularly aggressive male Mute Swan (*Cygnus olor*) was observed swimming rapidly towards the young ducklings. The two ducks were unsuccessful in their attempts to herd the ducklings away from the onrushing swan. As the swan reached out to seize one of the ducklings both of the Mallard females flew at the head of the swan. For several minutes both ducks continued their attack on the swan, beating him about the head and neck with their wings. The swan soon retreated and the Mallards returned to the two ducklings. At the present time (July 17) only one duckling is left and both ducks are caring for it.

The Mallards at the Sanctuary are wild birds that have become tame; they are full winged and free to come and go as they please. Every year a score or more Mallards nest along the shores of the Sanctuary lake and it is with one of these late broods that the above observations were made. I was unable to ascertain which Mallard was the actual parent.—ARTHUR E. STAEBLER, *W. K. Kellogg Bird Sanctuary of Michigan State College, Hickory Corners, Michigan, July 17, 1953.*

Robins eating minnows.—Robins (*Turdus migratorius*) are seldom thought of as fish eaters, although observations of Robins eating trout fry have been reported by Phillips (1927. *Bird-Lore,* 29:342–343) in Massachusetts and by Michael (1934. *Condor,* 36:33–34) in California.

I witnessed another type of this unusual feeding habit by a pair of Robins in the city of Sturgeon Bay, Door County, Wisconsin, on May 31, 1953. Scattered about a dock on the shore of Sturgeon Bay were many dead emerald shiners (*Notropis atherinoides*) discarded by fishermen. This abundant species is commonly called "lake shiner" by anglers and is much favored as a bait minnow in Lake Michigan and Green Bay waters.

Two Robins, possibly a mated pair, were seen foraging around the dock for a period of about ten minutes before being frightened off by the arrival of several fishermen. In this interval one of the birds twice picked up two dead minnows about 1½ inches long and flew off holding the fish crosswise in its bill, shortly to reappear without them. I was not able to see the destination of this bird's flight. It is possible that the minnows were being fed to nestlings.

The second Robin was observed to pick up and swallow four dead minnows, also about 1½ inches in length. Each fish was picked up crosswise and juggled in the bird's bill until it could be swallowed head first. All four fish were handled with some dexterity, as if the Robin had fed in this manner before.

The minnows eaten by these Robins had been dead long enough to be dry on the surface, but the flesh was still soft.—JAMES B. HALE, *405 Washburn Place, Madison 3, Wisconsin, July 6, 1953.*

Reddish Egret and White Pelicans in northwestern Pennsylvania.—In the afternoon of May 9, 1953, a Reddish Egret (*Dichromanassa rufescens*) in the dark phase was seen on Presque Isle, located near Erie, Pennsylvania. The bird was identified by Stanley Belfore, Mary Templin, Margaret Band, Mr. and Mrs. Charles Shontz, and John Mehner, all of Pittsburgh, Pennsylvania, Robert Sundell of Frewsburg, New York, and Mr. and Mrs. H. C. Pees of Meadville, Pennsylvania.

The egret was seen in excellent light, through a 26 power telescope. It was observed feeding for a half hour near a sand spit at the eastern tip of the peninsula, and its characteristic behavior was noted. As it fed, the egret lurched about and ran in circles. Later it flew over the spit to a stump in the water where it was once again observed with the scope. This constitutes the first record of this bird in northwestern Pennsylvania.

A few minutes after the egret was found, two White Pelicans (*Pelecanus erythrorhynchos*) were observed in flight over the sand spit. Herring Gulls (*Larus argentatus*), Ring-billed Gulls (*Larus delawarensis*), and Caspian Terns (*Hydroprogne caspia*), which were perched on the spit, immediately flew into the air, giving call notes. The gulls and terns circled the area for approximately fifteen minutes, the majority coming back to the water instead of the sand. Later the pelicans alighted on the sandspit, and when they were last observed the gulls and terns were also on the spit. On the basis of information from George B. Sennett, Warren (1890. "Report on the Birds of Pennsylvania," pp. 29–30) writes that White Pelicans were seen in the vicinity of Erie between 1870 and 1875. Todd (1940. "Birds of Western Pennsylvania," p. 44) cites four other records for this bird in western Pennsylvania.—JOHN F. MEHNER, *1003 James Street, Pittsburgh 34, Pennsylvania, May 16, 1593.*

Incubation period of the Mourning Warbler.—There are apparently few records of the incubation period of *Oporornis philadelphia.* Bent (1953. *U.S. Natl. Mus. Bull.* 203) does not give any information about the incubation period nor about the time spent in the nest by the young of this warbler. Therefore, the following notes seem worthy of record.

On June 12, 1951, I flushed a female Mourning Warbler from her nest. The nest, containing three eggs, was located in a *Populus-Alnus* swamp within the city limits of Duluth, Minnesota. It was placed on the ground in a drier portion of the swamp, and was well hidden by wild strawberry plants. On June 13 a fourth egg was added. On June 23 the female was still incubating the four eggs. I was unable to visit the nest again until June 28 at which time I found the four eggs had hatched. I estimated the age of the young to be about four days, based on a comparison of their development with that of the Yellow-throat (*Geothlypis trichas*). The young left this nest on July 2.

The second nest was found on July 1, 1953, in a windfall clearing on the grounds of the University of Minnesota Forestry and Biological Station at Itasca State Park. The nest was placed 14 inches above the ground, and was supported mainly by a swamp thistle (*Cirsium muticum*). At the time the nest was found it was empty. On the morning of July 3 the nest contained two eggs, and by 9:00 a.m. on July 4 a third egg was added. The nest was visited daily, and on July 16 all three eggs had hatched. I left Itasca Park on July 18, but Dr. William H. Marshall, of the University of Minnesota, provided me with further information on this nest. He visited the nest on July 23 and again on July 26. On July 23 the nest contained three well-developed young, but on July 26 the nest was empty. It was Dr. Marshall's opinion that the young had successfully left the nest, probably before July 26.

The observed incubation period for the second nest and the estimated period for the first nest indicate an incubation period of 12 days. The young apparently leave the nest at an age of eight or nine days.—P. B. HOFSLUND, *Biology Department, University of Minnesota, Duluth Branch, Duluth, Minnesota, August 12, 1953.*

An unusually high nest of the Yellow Warbler.—On June 6, 1953, Geza Hufnagel, Harold Mahan, Walter P. Nickell, and I made observations on the nesting birds at Rondeau Park, Kent County, Ontario. The habitat in the area studied is an extensive climax forest of beech (*Fagus grandifolia*) and sugar maple (*Acer accharum*) with an admixture of red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), red oak (*Quercus rubra*), and other deciduous trees. The predominant undershrubs are American hornbeam (*Ostra virginiana*), spicebush (*Lindera benzoin*), sassafras (*Sassafras albidum*), and raspberry (*Rubus*). These and other shrubs together with wild grape (*Vitis* sp.) and an abundant growth of beech and maple saplings form a dense understory.

The Yellow Warbler (*Dendroica petechia*) nests abundantly in this understory association. Of 25 nests of the Yellow Warbler found on June 6, all but one were in this type of habitat, and were located at heights of from 21 inches to 12 feet. The exception was in an upright fork, almost at the top of an American beech. The female warbler flew from the nest when we tapped the trunk of the tree. The nest contained 5 eggs. A weighted line dropped from the rim of the nest to the ground measured 39 feet with a steel tape.

A. C. Bent (1953. *U. S. Natl. Mus. Bull.* 203, p. 163) gives the usual heights for nests of this species as from 3 to 8 feet, rarely to 30 or 40 feet. However, he cites (p. 164) nests recorded by T. S. Roberts at heights of 40 to 60 feet in cottonwoods in the prairie region of Minnesota, where shrubbery is scarce. The highest nest that Bent mentions from eastern North America (p. 167) was 30 feet up in an elm, recorded by T. E. McMullen in either Pennsylvania or New Jersey (no date).—DOUGLAS S. MIDDLETON, *7443 Buhr, Detroit 12, Michigan, August 15, 1953.*

Cannibalism by a Burrowing Owl.—While visiting a large prairie dog "town" situated 4½ miles north and 2 miles east of Sharon, Barber County, Kansas, on the afternoon of May 6, 1953, I observed four Burrowing Owls (*Speotyto cunicularia*). Three were perched on mounds of earth thrown up by prairie dogs at the entrances to their burrows. The fourth owl was observed feeding between two of these mounds. I approached the feeding owl and flushed it from a dead Burrowing Owl. Feathers from the breast and belly of the dead owl were scattered about in the short grass. The head had been torn from the body and could not be found. There remained the skin of the body with the wings and legs attached. The kill seemed to be no more than a day old; the exposed edges of the skin were dry and friable, and there were dried drops of blood on the feathers. Another instance of cannibalism by a Burrowing Owl has been reported by Bent (1938. *U. S. Natl. Mus. Bull.*, 170:390).—THANE S. ROBINSON, *Museum of Natural History, University of Kansas, Lawrence, May 19, 1953.*

Western records of *Chaetura vauxi tamaulipensis*.—As recently as 1939 it was generally supposed that the distribution of the swifts of the genus *Chaetura* in North America, north of Tamaulipas, was very simple: *vauxi* in the western part of the continent, *pelagica* in the eastern, and casually west over the Atlantic drainage as far as New Mexico. The only problem thought worthy of study was the winter range of the latter, then unknown. Swifts being in most places notoriously difficult to collect, the "sight record," based on geographic "reasoning." held happy and unchallenged sway.

The first shock to this complacency came when Lowery (1939. *Wilson Bull.*, 51: 199–201) discovered that a few swifts occasionally winter in Louisiana, and that they are *vauxi* rather than *pelagica*! We still, however, lack records of *vauxi* in any other region near Baton Rouge, so perhaps the shock failed to open closed minds. Soon afterward, Sutton (1941. *Wilson Bull.*, 53:231–233) demonstrated the intermediate characters of the birds of northeastern Mexico, which he named *C. v. tamaulipensis*, and showed that they are at least partially migratory. The only record between October and March, apparently, was one from San Lucas in the mountain of southern Guatemala. With the announcement by Barnes (1946. *Auk*, 63:258) of the capture of *C. pelagica* in Utah, and the discovery of its winter home, it seemed likely that the next important discoveries would be in the northern or western parts of the Mexican mainland or the adjacent Southwest of the United States. Here, west of Tamaulipas and San Luis Potosí, *Chaetura* was generally an uncommon transient, a status not conducive to procuring specimens of such masters of the air!

The past few years seemed unfavorable for *Chaetura* in southeastern Arizona; few were seen, and no *C. v. vauxi* were taken. On May 14, 1950, however, I was fortunate enough to secure a lone male swift feeding with about fifty Violet-green Swallows (*Tachycineta thalassina*) rather low over the grassland at the mouth of Garden Canyon on the Fort Huachuca Reservation, Cochise County, Arizona. Subsequent examination by several ornithologists showed this to represent some Mexican race. Only Dr. Sutton, however, had enough material to actually compare it with *tamaulipensis.* He has kindly written me, under date of January 15, 1953. that it is "very similar" to the type and three topotypes (two males, one female) of *tamaulipensis*, "but rump feathers and upper tail-coverts . . . somewhat more conspicuously edged with buffy gray; and lower belly and under tail-coverts very slightly darker. General effect of the crown and back very similar to that of male topotypes—*i.e.*, less blackish than in *richmondi.*" Summarizing, he writes: "I see no reason why the bird should not be called *tamaulipensis.* . . . I cannot believe that the nominate race is ever this dark on the crown, back, lower belly, and under tail-coverts."

Meanwhile, I was very much interested to find a number of *Chaetura* apparently settled for the winter in the foothills east of Las Varas, southwestern Nayarit, in mid-November 1952. They never came within range more than momentarily at my camp at the foot of the mountains; but in returning up to Compostela on November 29, I found them hawking low over the cornfields along the road just above Mazatán. In fact, a Rough-winged Swallow (*Stelgidopteryx ruficollis*) that pursued one too hotly was killed instantly in full flight by striking telephone wires. Climbing a little ridge in the sloping fields in this narrow valley, I obtained a single female just finishing the annual molt. Though a trifle paler, this closely resembles the Arizona male, and it doubtless represents the same race. Both are definitely distinct from *C. v. vauxi*, according to the studies of Allan J. Duvall and Dr. Alexander Wetmore. I wish to thank all of those who have helped in the identification of these swifts.

Thus it appears that any of the three northern forms of *Chaetura* may turn up almost anywhere on the Mexican mainland or in the adjacent parts of the United States. *Chaetura* thus joins the large and growing list of genera in which, to have any scientific value whatever, records in this large region must be based on critically determined specimens. Further, the north Mexican race may now be added to the American Ornithologists' Union Check-List of North American Birds as having been recorded from southeastern Arizona.—ALLAN R. PHILLIPS, *Museum of Northern Arizona, Flagstaff, Arizona, August 21, 1953.*

SEVENTY-FIRST MEETING OF A.O.U.

At the meeting of the American Ornithologists' Union in Los Angeles in October, the following officers were elected for 1953–1954: *President*, Alden H. Miller; *Vice-Presidents*, Ludlow Griscom and Ernst Mayr; *Secretary*, Harold Mayfield; *Treasurer*, Charles G. Sibley. *Elective Members of the Council*: John T. Emlen, Jr., A. W. Schorger, Albert Wolfson.

The Council re-elected Robert W. Storer, *Editor* of 'The Auk'; Frederick V. Hebard (Chairman), G. Ruhland Rebmann, Jr., and Phillips B. Street, *Investing Trustees.*

The 1953 Brewster Medal was awarded by action of the Council to Dr. Hildegarde Howard for her research on fossil birds.

The following were elected to the class indicated: Fellows: W. Lee Chambers, John Roy Pemberton, Francis Marion Weston. Honorary Fellow: Ernst Schuz. Corresponding Fellows: Edward M. Nicholson, Ludwig Schuster. Members: Paul Herbert Baldwin, Frederick Milton Baumgartner, Alexander William Blain, John Davis, Miguel Alvarez del Toro, Keith Lee Dixon, Henry Sheldon Fitch, Gordon W. Gullion, Thomas Raymond Howell, Carl Buckingham Koford, Robert Allen Norris, Kenneth Carroll Parkes, Kenneth E. Stager.

Albert Wolfson

LETTER TO THE EDITOR

So many requests for information as to the status of Peters' "Check-List of Birds of the World" have come to the Museum of Comparative Zoology that we think your readers would be interested in the matter.

We have been appointed joint editors to see that the work is completed. Probably seven volumes will be required to contain the families not treated by Mr. Peters. A volume has almost been finished by Dr. Zimmer of the American Museum in New York. Sixteen collaborators have most kindly agreed to contribute the families that remain to be done and each one will be the responsible author of his contribution. We hope by this means to assure that the work will be completed in as short a time as possible.

Ernst Mayr
James C. Greenway, Jr.
Museum of Comparative Zoology at Harvard College

DISTRIBUTION OF MEMBERSHIP

A study of the membership roll as published in the December, 1952, *Wilson Bulletin*, produced some interesting data regarding the distribution of our membership. While our roots are in the midwest, the present composition of the membership shows that we are today much more national in scope than one familiar only with the early days of the organization might realize. The membership includes persons from every state, most Canadian provinces, and many foreign countries. New York showed the greatest membership, 174, followed by Michigan, 143, Ohio, 131, Illinois, 82, California, 78, Pennsylvania, 73, Wisconsin, 70, Minnesota, 67, Massachusetts, 55, and Iowa, tenth with 45. The second ten showed New Jersey and Texas tied with 43, Indiana, 41, Maryland, 39, Kentucky and Missouri tied with 43, Kansas, 31, West Virginia, 30, and the District of Columbia and Ontario tied with 29. A line drawn through Columbus, Ohio, to the Gulf of Mexico east of Tallahassee, Florida, approximates the actual dividing line of the eastern and western halves of our membership.

ORNITHOLOGICAL LITERATURE

The California Condor. By Carl B. Koford. National Audubon Society, New York, 1953: $7\frac{7}{8} \times 10\frac{1}{2}$ in., xiii + 154 pp., 31 pls., 15 text-figs. $3.00.

This is a most thorough report upon the history, distribution, population, mechanics of flight, and behavior of the magnificent bird based upon experience gained in nearly 500 days spent by the author watching condors. His work in the rugged terrain occupied by condors was facilitated by his ruggedness as a mountaineer. His sponsors in the National Audubon Society and the Museum of Vertebrate Zoology of the University of California, realized the necessity for so detailed a life history study as a basis for understanding how best to assist the condor in maintaining its numbers. For the condor is affected deeply by the activities of man, consequently it is up to man to regulate these activities appropriately—assuming of course that we all want the condor with us. It is a surprise to learn that some do not; an article has actually appeared entitled "What price condor?" and there have been various attempts to sacrifice the bird's welfare to exploitation of minerals in its roosting and nesting areas.

A model of tactful writing, the book avoids caustic comments upon human foibles and so may win more to the condor's side. The author's heaviest sarcasm (regarding oil development) is mild indeed: "most of the interest has been in buying and selling leases rather than in drilling and production." Reading between the lines we find as profound a study of man as is ever likely to come out in an ornithological publication. By his own example Dr. Koford has demonstrated the feasibility of his suggested program of conservation by education, through personal contact, of those persons who meet the condor in their daily lives.

The reader must appreciate that variability in the condor's behavior necessitates the detail presented by Dr. Koford; many aspects of its activity do not resolve themselves into the clear-cut patterns we find in studies of more stereotyped species. The reviewer has watched the growth of this condor project over the years in seminars, a visit to the condors with Dr. Koford, informal discussions, and in the author's papers presented at scientific meetings. As the study matured, as the facts piled up (3500 pages of field notes!), generalities had to be abandoned. With 10 days of observations upon the condor a neat simple picture of its behavior could easily be portrayed. With 500 days the exceptions literally become the rule. It is purely the personal opinion of the reviewer that we see emerging from this wealth of information the one constant trait of the condor which is precisely its *inconstancy*; it is erratic, cautious, unpredictable and capricious. The condors roost a few days or weeks at one place. Then they move. A pair nests and years go by before the site is again used. The birds feed at a carcass one day and may never return; some carcasses are consumed, others in favorable locations are ignored. This constant shift, feint, and deployment, though occurring within one general mountainous area, might insure that the population as a whole will not suffer from a local catastrophe.

The approximately stable, total population of condors is about 60 individuals; therefore the prevention of the death of a single condor or of the failure of a single nest may mean that the population will show an increase rather than a decrease for a given year. Artificial provision of carcasses is impractical because the condor is so erratic in its selection of food. Rather, it is best to facilitate utilization of available carcasses (should they be free of disease) by not destroying them and where possible by dragging them to openings. The protection of former nest sites is justified because of the tendency of the birds to use them again after many years. Extreme alarm, rather than tameness, prompts the condor to come near a human at the nest. "One man can keep a pair of condors from the egg all night or prevent the feeding of a chick for an entire day merely by exposing himself within 500 yards of a nest for a few minutes at one or two critical times of the day. Loud noises can alarm condors at distances of over one mile." The apparent success of a nest near a logging road in Tulare County was due to a fortunate series of coincidences which kept disturbance at a minimum and does not constitute evidence that nests would ordinarily succeed in such circumstances. Practically every phase of condor activity has been adequately photographed in color, both in motion pictures and stills, and since it is impossible to photograph the nesting birds without disturbing them there is no justification for further photography in any portion of the nest-roost-water area.

Sensational and false information about the condor frequently appears in the popular press. This prompts curious folk to seek out and disturb the bird. It is not enough to make available reliable information—it must be watched for distortions clear through the stages of publication.

Condors are especially cautious at their chosen nesting sites, roosts, and drinking and bathing places. Since they require very limited conditions of terrain for flight and feeding, and because of the enormously long fledging period, year-round freedom from disturbance in the limited area meeting their requirements is necessary. Fortunately this area is relatively inaccessible to man. As long as no more roads and trails are constructed near roosts and nests the outlook for the condor is good.

By far the most effective means of conservation is through education by personal contact, for the condors will not stay in a sanctuary. One man truly interested in condors can secure the cooperation of ranchers upon whose property the birds feed, of fire lookouts, trappers, forest rangers, game wardens, etc.,—a select group of persons who naturally come in contact with the birds and who have the opportunity to pass on the information. "The interest and cooperation of these people can best be gained by helping them to understand something of the relation of the condor to its environment rather than by giving them a list of 'don'ts.' . . . If eventually it is possible to employ permanently a man to guard the interests of condors in the field, this man should spend much more time visiting persons throughout the condor range and securing their cooperation than in patrolling nesting areas against intruders. With education and cooperation, little, if any, patrolling probably would be necessary."

The condor is *not doomed to extinction.* Ever since 1890 writers have portrayed it as a relic of the Pleistocene with "one wing in the grave," in spite of which the great bird has persisted to this day and has even extended its breeding range into Tulare County. True enough, its breeding range has receded in historic times from San Diego County and along the coast from Monterey to San Luis Obispo counties: but this is far less severe than the impression of wholesale decimation one gets from incorrectly considering the former range as extending from the Columbia River to the San Pedro Martir Mountains of Baja California. There is no evidence that the birds at these far-flung outposts were breeding. Evidently they had gone there for particular food supplies, possibly salmon in the case of the Columbia River. "Inasmuch as the condor has persisted in spite of apathy and predictions of its early extinction, let us be optimistic and assume that the species will persist indefinitely if we give it aid." It seems to the reviewer that it is the duty of every ornithologist not only to read Dr. Koford's book but to insure that his recommendations for aid are actually carried out.—Joe T. Marshall, Jr.

THE FULMAR. By James Fisher. Collins, St. James's Place, London, 1952: 5¾ × 8½ in., xv + 496 pp., frontis. (painting by Peter Scott), 82 photos (4 colored), 70 maps, diagrams, and line-drawings. Distributed in the U.S.A. by John De Graff, Inc., N.Y. $8.00.

Examples of species which are expanding their ranges are not numerous, and studies of the dynamics of such range expansions are rarer still. We have James Fisher to thank for what is probably the most thorough such account prepared to date. In many ways Fisher's choice of a subject was fortunate: Fulmars were an important source of food to the inhabitants of islands where they nest, arctic explorers have contributed many observations on the species, and the Fulmar has been the subject of special cooperative studies by the British Trust for Ornithology. The scope of the research which went into the preparation of this book is perhaps best expressed by stating that 2,378 works were consulted, and unpublished material was obtained from 575 persons. (A copy of this bibliography has been filed with the Society for the Bibliography of Natural History.)

Following two chapters introducing the Fulmar and its relatives, the Antarctic and Pacific fulmars, are eight chapters which take up nearly half of the book and recount the history and spread of the Fulmar in the Arctic, Iceland, Faeroe Islands, Norway, St. Kilda, and Britain. Two chapters are devoted to the populations of the Fulmar and the geographic distribution of its color phases. Next are a series of chapters on the life history of the Fulmar, including accounts of the Fulmar at sea, its voice and display, yearly cycle, parasites and enemies, and food. The final chapters treat the possible causes of the Fulmar's spread and the question of how often the Fulmar breeds. A very short bibliography, an appendix, and an index complete the work.

The numerous illustrations are both attractive and well integrated with the text. They include a handsome frontispiece by Peter Scott; over eighty photographs, including many striking pictures of the cliffs on which the Fulmars nest and of the birds themselves; and a wealth of maps, graphs, and line drawings. Of particular value are several photographs showing some of the displays of the Fulmar.

One of Fisher's major contributions is in pointing out numerous problems which merit further study. A comprehensive study of the relationship between colony size and nesting success, in particular, would be valuable. Many of the calls and displays of the Fulmar have been described, but much remains to be learned about their significance. What determines the distribution of the dark and light phases of the bird is not clear. A close check on future changes in population size should be kept and, finally, an attempt to find out the reasons for the bird's spread should be made. Indeed, the groundwork has been laid for what could be a magnificent life history study.

A few parts of the book are not up to the standards of excellence of most of it. The measurements of Fulmars (Appendix III) were compiled from some fifteen references: it is always unwise to average measurements made by different workers. This is particularly true when, as seems to be the case here, wing lengths taken by Europeans, who measure the arc, and those taken by Americans, who usually measure the chord, are combined. The index contains two parts: a list of the vertebrates mentioned (in a systematic order) and a list of selected places. The lack of a more complete subject index hampers the reader who wants to look up an aspect of the Fulmar's life history. Finally, while it is understandable that the complete bibliography could not have been included, it is annoying to find works cited merely as "W. Stone (1892)" with no further clue as to where to find them without writing to the Society for the Bibliography of Natural History, the address of which, incidentally, is omitted from the book.

These defects, however, detract little from the great value of the work; the author and the other editors of the New Naturalist Series are to be congratulated on having produced an excellent book.—ROBERT W. STORER.

THE BIRDS OF NEW BRUNSWICK. By W. Austin Squires. Publ. New Brunswick Museum. Monographic Series No. 4. Saint John, 1952: 6 × 9¼ in., title + 164 pp., index, 12 photos., map (folding).

Ornithologists are still few and far between in New Brunswick. Nevertheless, there has been a handful of avid observers in various parts of the Province and a steady stream of visitors to fascinating and ornithologically fruitful Grand Manan Island at the mouth of the Bay of Fundy. There has been no systematic general collecting in the Province. As a consequence of these factors, the list of casuals and accidentals is formidable, but subspecific determinations for common species are few.

In this list much new material has been added and a widely scattered literature has been brought together. The old lists have been sifted, and many dubious records have been rejected. However, many species admitted to the present list on the strength of sight records should probably be relegated to a hypothetical status.

New Brunswick birdlife presents a full quota of oddities. Both Richardson's Boreal Owl and the Brown Thrasher are breeding birds in the Province. Turkey and Black vultures, both casual, are equally numerous. Purple and Florida gallinules have been recorded with equal frequency as accidentals. Although Bald Eagles are numerous in summer, nests are rare. Banding has proved that most of the summer population is made up of post-breeding wanderers of the southern race (*H. l. leucocephalus*) from as far south as Florida, while eagles nesting in New Brunswick are of the northern race (*H. l. washingtonii*). The climate at the mouth of the Bay of Fundy is much colder in summer than that of the Gulf of St. Lawrence coast to the northeast. Thus, many of the most typically northern birds are found breeding in the southern portion of the Province rather than in the north.

As the first modern annotated list of the birds of New Brunswick this publication will find a welcome place on many ornithological bookshelves.—C. O. HANDLEY, JR.

This number of *The Wilson Bulletin* was published on June 3, 1954.

SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A. O. U. Check-List (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

NOTICE OF CHANGE OF ADDRESS

If your address changes, notify the Club immediately. Send your complete new address to the Treasurer, Leonard C. Brecher, 1900 Spring Drive, Louisville 5, Kentucky. He in turn will notify the publisher and editor.

THIRTY-FIFTH ANNUAL MEETING

of the

WILSON ORNITHOLOGICAL CLUB

CAPE MAY, NEW JERSEY

FRIDAY, JUNE 11, TO MONDAY, JUNE 14

Sponsored by

Delaware Valley Ornithological Club

Urner Ornithological Club

New Jersey Audubon Society

Plan now to attend this eastern seaboard meeting to be held in an area as widely known ornithologically as any in the United States.

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The Wilson Bulletin

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The Wilson Ornithological Club

Founded December 3, 1888

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

Wilson Ornithological Club Library

The Wilson Ornithological Club Library, housed in the University of Michigan Museum of Zoology, was established in concurrence with the University of Michigan in 1930. Until 1947 the Library was maintained entirely by gifts and bequests of books, pamphlets, reprints, and ornithological magazines from members and friends of The Wilson Ornithological Club. Now two members have generously established a fund for the purchase of new books; members and friends are invited to maintain the fund by regular contributions, thus making available to all Club members the more important new books on ornithology and related subjects. The fund will be administered by the Library Committee, which will be glad for suggestions from members on the choice of new books to be added to the Library. George J. Wallace, Michigan State College, East Lansing, Michigan, is Chairman of the Committee. The Library currently receives 65 periodicals as gifts and in exchange for *The Wilson Bulletin.* With the usual exception of rare books, 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. Inquiries and requests by borrowers, as well as gifts of books, pamphlets, reprints, and magazines, should be addressed to "The Wilson Ornithological Club Library, University of Michigan Museum of Zoology, Ann Arbor, Michigan." Contributions to the New Book Fund should be sent to the Treasurer, Leonard C. Brecher, 1900 Spring Dr., Louisville 5, Ky. (small sums in stamps are acceptable). A complete index of the Library's holdings was printed in the September 1952 issue of *The Wilson Bulletin,* and each September number lists the book titles in the accessions of the current year. A brief report on recent gifts to the Library is published in every issue of the *Bulletin.*

The Wilson Bulletin

The official organ of The Wilson Ornithological Club, published quarterly, in March, June, September, and December, at Lawrence, Kansas. In the United States the subscription price is $3.00 a year, effective in 1951. Single copies, 75 cents. Outside of the United States the rate is $3.25. Single copies, 85 cents. Subscriptions, changes of address and claims for undelivered copies should be sent to the Treasurer. Most back issues of the *Bulletin* are available (at 50 cents each for 1950 and earlier years, 75 cents each for 1951 and subsequent years) and may be ordered from the Treasurer.

All articles and communications for publication, books and publications for review should be addressed to the Editor. Exchanges should be addressed to The Wilson Ornithological Club Library, Museum of Zoology, Ann Arbor, Michigan.

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CONTENTS

HELP YOURSELF—AND THE WILSON CLUB

The mails these days are filled with appeals for contributions to innumerable philanthropic, educational and scientific institutions. We do not decry this necessary part of modern life—most of the institutions are worthy and there is undeniable satisfaction in helping a worthy cause and in so giving pleasure and benefit to others.

However, we would like to mention an opportunity to contribute to the conservation of our birdlife by supporting an organization active in sustaining interest in and concern for this birdlife, while at the same time benefiting yourself.

We refer to Life Membership in the Wilson Ornithological Club. Life membership contributions are placed in the Endowment Fund. If you are a member of the Wilson Club and especially if you have been a member for some years, it is probable that you derive some, perhaps much, pleasure and benefit from your membership and that you deem the Club worthy of your support. If you belong on an annual basis, you and the Club benefit from your dues as long as you pay them, but when you pass on to study the birds of paradise, your benefit to the Club ceases. Or if, because of adversity of some sort, you can no longer pay dues, both you and the Club cease to benefit. A Life Member, however, not only is spared the annual bother of sending in his dues, but he has also made a financial investment which will pay interest annually and is free from income tax throughout his life. He knows that he will reap the benefits and pleasures of membership as long as he lives. Furthermore, he is aware that the Club has invested the sum he paid and so should continue to receive interest from it long after he is gone. What better example of *mutual* benefit can you find than this?

If the Chairman may be pardoned for twanging a personal string, he will say that long ago when he was young, singularly blessed, and moneyed more than sufficiently for his needs, he showed more wisdom than he has sometimes since by joining for life the W.O.C., the A.O.U., and sundry other organizations, and now that he is *pater familias* and the dollar is not what it used to be, he is very glad he did so. No dues to pay, but still *The Wilson Bulletin* and *The Auk* and the others keep coming! He would like you to be glad, too, so pick up your pen and battered checkbook and assure for yourself and for your Club a bit of that "security" which has become such a shibboleth.

While Life Membership is of *greatest* benefit to younger members, it helps your Club at whatever age you take it out. Besides, don't forget that people are living a lot longer than they used to and life is fun—especially to a Life Member of the W.O.C. with no more worries about paying dues. Try it and see.

The Endowment Committee
Charles H. Rogers, *Chairman*

FIG. 1. Nest and eggs of anhinga at Swan Lake, Arkansas, photographed May 3, 1952. This nest was appropriated from a pair of American Egrets.

FIG. 2. Young anhinga in nest, photographed at Swan Lake, Arkansas, July 4, 1953. Nests constructed by anhingas are usually more compact and of greater depth than those of herons or egrets.

NESTING OF THE WATER-TURKEY IN EASTERN ARKANSAS

BY BROOKE MEANLEY

During the nesting seasons of 1951, 1952, and 1953 I had opportunity to obtain certain information relative to the nesting of the Water-Turkey (*Anhinga anhinga leucogaster*), or anhinga, in eastern Arkansas. This was made possible at a nesting colony located on April 10, 1951 while I was driving along the base of the Arkansas River levee at Swan Lake with Robert E. Stewart who spotted several anhingas circling over the brushy end of a small lake. The village of Swan Lake is about fifteen airline miles east of Pine Bluff and is surrounded by the cotton fields of Jefferson County.

I am indebted to Anna Gilkeson Meanley for assistance in several phases of the field work, to Neil Hotchkiss of the U.S. Fish and Wildlife Service for the identification of certain plants mentioned in this paper, and to E. R. Kalmbach of the U. S. Fish and Wildlife Service for reviewing the manuscript.

Status as a Breeding Bird in Arkansas

The breeding range of the anhinga in Arkansas lies largely in the eastern third of the State. Favorite nesting places are about the margins of old river-bed or ox-bow lakes along the lower Arkansas River, lower White River and Mississippi River. Arthur H. Howell (1911:15) has written the following about the occurrence of the anhinga in Arkansas in the early 1900s: "The water turkey or 'snake bird' is fairly common locally in the swamps of eastern Arkansas. It breeds at Helena [on the Mississippi River], Wilmot [southeastern part of state near Louisiana line], and Walker Lake [an ox-bow of the Mississippi in northeastern Arkansas] and has been recorded from Osceola and Newport (northeastern Arkansas) . . ." Baerg (1951:28) lists additional breeding localities as Grassy Lake, Hempstead County, and the White River Heronry, Arkansas County. Nesting localities observed by the writer, in addition to Swan Lake, are Cypress Bayou near Tichnor, and in several rice field reservoirs near Stuttgart.

The Swan Lake Colony

The Swan Lake colony is located at the south end of an old river-bed lake in a large heronry. This lake was a section of the main channel of the Arkansas River over one hundred years ago, and the river in its ever changing course is now three miles away. The heronry is only about 200 yards from the center of the village of Swan Lake. It occupies an area of about 20 acres of buttonbush (*Cephalanthus occidentalis*) and swamp privet (*Forestiera acuminata*).

The several species of herons and egrets nesting in this heronry and their estimated numbers (pairs) in 1952 were as follows: Little Blue Heron (*Flori-*

da caerulea) 200, Snowy Egret (*Leucophoyx thula*) 100, American Egret (*Casmerodius albus*) 70, Green Heron (*Butorides virescens*) 15. Passerine birds nesting in the heronry, in order of abundance, were Bronzed Grackle (*Quiscalus quiscula*), Red-winged Blackbird (*Agelaius phoeniceus*), Prothonotary Warbler (*Protonotaria citrea*), and Baltimore Oriole (*Icterus galbula*). During the latter part of May, 1953 a flock of 40 White Ibises (*Guara alba*) came to the heronry at about 5:30 p.m. each evening to roost.

The number of nesting pairs of anhingas ranged between 20 and 25 during the three years of my observations.

Arrival of Migrants

Anhingas usually arrived at Swan Lake during the first or second week in April. Seventy-five miles south, at Wilmot, Arkansas, I have seen them as early as March 21 (1953). In 1952 the first anhinga, a male, was observed at Swan Lake on April 5. By the 15th of the month most of the females had returned and many of the anhingas were paired.

In 1953, probably because of a cold spell beginning in mid-March and lasting through early April, the first arrivals were not observed until April 19, when two pairs were seen. Two days later there were 26 birds (20 males and 6 females) at the heronry.

Herons and egrets usually arrived about two weeks ahead of the anhingas and a few pairs had eggs before the first anhinga put in an appearance.

Courtship and Pairing

In 1952 male anhingas were observed in courtship display on the first day of arrival at the nesting colony. While possibly on their territories they would lift their folded wings alternately up and down above their backs in a sort of flapping motion for several minutes and sometimes point their partly spread tails upwards, nearly vertically, usually ending the performance in a crouch as if molding a nest. As the displaying bird crouched the neck was usually curved in an "S" shape with the bill pointing downward and the feathers on the neck and head extended outward. As the climax of the performance was reached during the crouch a gutteral sound that somewhat resembled the low rolling notes of a screech owl (*Otus asio*) was uttered.

Following this exhibition the head and neck were usually extended straight out from the body and sometimes held motionless for several seconds. The outstretched neck and head were then shifted about in several directions.

When in courtship display the males were not always on their territories. I noticed one male that followed a female from one end of the heronry to the other while performing. I also observed another male displaying in various widely scattered locations throughout the heronry. On one occasion I observed two males perched about three feet apart going through courtship display at the same time and almost in unison.

It appears that in some cases pairing may have occurred before the birds reached the heronry as several pairs had started to build nests two days after arrival in 1953.

Selection of Nests and Nest Building

In the Swan Lake heronry anhingas either appropriated occupied nests of American Egrets, Snowies, and Little Blues or constructed their own. Of 20 nests under observation in 1953 at least 6 were originally nests of egrets or herons. Additional nest-lining material was added to nests taken from egrets and herons.

On April 21, 1953 I saw a mated pair of anhingas perched about two feet away from an incubating American Egret. When I returned on the 23rd they had taken over the nest and the egret was then standing by. The egret and its mate attempted to retake the nest when the anhingas left to copulate several feet away; however, the male anhinga flew at the egrets and they backed off. On no occasion did I see anhingas forcibly eject an American Egret from its nest. They wait for the laying bird to leave and then move in. Also on April 21, 1953 while I was hidden in a blind about 20 feet from an American Egret's nest I noted that when the incubating or laying bird left for a few minutes an anhinga quickly moved in and stood on the rim of the nest. In three minutes the egret returned and alighted about four feet away. It did not attempt to dislodge the anhinga, although it made threatening gestures by pointing its out-stretched neck and head with bill open, emitting gutteral sounds in the direction of the anhinga. The anhinga in turn did the same. As the egret looked on, the anhinga picked up the three eggs one by one from the nest and dropped them over the side into the water.

On May 30, 1953 I observed a pair of anhingas nest hunting. They moved from one occupied Little Blue nest to the next forcing out the incubating or brooding herons as they made their inspection.

On the other side of the picture was the fact that, whenever the opportunity availed itself, egrets and Little Blue Herons removed sticks from anhinga nests for use in the construction of their own. I have seen the entire nest of an anhinga destroyed during the bird's absence by egrets and herons. In many cases as soon as the young anhingas had left their nest it was torn apart by the egrets or herons which used the sticks in constructing or mending their own.

When egret nests are taken over by anhingas, willow (*Salix*) twigs are usually added and the nest becomes a much better constructed affair. Most of the egret nests are made of buttonbush twigs. When the anhinga builds its own nest at Swan Lake, willow branches with foliage are nearly always used.

Such nests are usually smaller and more compact than those of the American Egret.

Apparently the male gathers most if not all of the nest material. On April 25, 1953 I arrived at the heronry at 3:15 p.m., and saw a male anhinga breaking off leafy twigs or small branches from a willow and carrying them to the female which was sitting on the nest platform. The female would then work the twigs into the nest. During the next hour the male made five trips, four to the same branch of the same tree and one to another tree, in both cases about one hundred feet from the nest. Throughout the time the male was gathering nest material the female remained on the nest. A nest is often started and completed in a single day.

All nests, whether built completely by the anhingas or taken from the egrets, were lined with the leaves and staminate and/or pistillate catkins of willow, a mark that distinguished them from the heron and egret nests. Other distinguishing features were the brown willow twigs, abundance of excreta during the incubation period, particularly on the rim of the nest, and as already mentioned, the compactness of the structure.

In 1952, 16 of 18 nests were in buttonbush, the other two in swamp privet. The ratio was about the same in 1953. In 1952 the average depth of water in the nesting area was three feet. The distance from the surface of the lake to the nests ranged from 3 feet, 7 inches to 10 feet, 7 inches, with an average for 12 nests of approximately 8 feet.

There were several small nesting groups within the heronry. In 1953 the group in the east side was composed of 4 nests. The largest group was in the center of the heronry where there were 11 nests. The nests were fairly close together in each group, in some cases only 6 or 8 feet apart. They were sometimes separated by a heron or egret nest.

Egg Laying and Clutch Size

In 1952 the first eggs were found on April 24, nineteen days after the first male arrived at the heronry, and nine days after arrival of the females. In 1953 egg laying began on April 25, seven days after arrival of the first migrant. In 1952 twelve pairs had complete sets of eggs by April 30.

Bent (1922:232) says that "The eggs are often laid at irregular intervals, as the young in a nest are frequently of widely different ages." In most nests at Swan Lake the young were only two or three days apart in age. In 1953, two nests under observation contained one egg each on May 21. On May 24 both contained only two eggs. On my next visit to the heronry on May 28, one of the nests contained 3 eggs. In 1952 one nest under observation during the egg-laying period contained three eggs on April 30 and five eggs on May 3. In 1953 another nest contained three eggs on May 24, three on May 30, and four on June 6.

Clutch size ranged from two to five eggs. Of 29 nests under observation in 1952 and 1953, 6 contained five eggs, 13 four eggs, 9 three eggs, and 1 two eggs.

Incubation

Both sexes incubate. On April 30, 1952 the female was incubating at a certain nest when I arrived at the colony at 2:30 p.m. When I left at 5:30 p.m. the male was incubating. On May 3 of the same year males were incubating at seven nests and females at four when I arrived at the heronry.

At a certain nest under observation throughout most of the day on three successive Saturdays the female was always incubating. The male was usually perched about eight feet away. On one occasion when the male left its territorial perch and dropped below into the water another male that had been perched 75 feet away from the nest flew over and mounted the female on the nest. The incubating female made no attempt to, or perhaps could not, leave the nest. In a matter of seconds the mated male returned and chased off the intruder.

At two nests, in 1953, the females left for good after the eggs were laid, leaving the males to incubate and care for the young.

Sprunt and Chamberlain (1950:75) give the incubation period as 25 to 28 days. My observations on length of incubation period are not complete. I found this information sometimes difficult to obtain as I could not always determine just when the birds began to incubate. At Nest no. 8 the incubation period for the first of three eggs was probably between 25 and 28 days. The first egg was laid on May 21. By May 24 there were two eggs in the nest and on May 26 there was a full set of three. The first egg hatched on June 20. Nest no. 7 contained two eggs on May 28, three eggs on May 30. There were two newly hatched young in the nest on June 24.

Care and Food of Young

Both sexes brood, feed, and otherwise care for, the young. The young feed by thrusting the bill down the throat of the parent. An interesting photograph by A. M. Bailey and F. R. Dickinson in "The Birdlife of Louisiana" (Oberholser, 1938:pl. 6) illustrates this procedure. Fish appeared to form the principal diet of the Swan Lake young. When I was standing beneath anhinga nests young birds often regurgitated whole fish which fell near me into the water. Several of these fish collected were identified at the Arkansas Game and Fish Commission Hatchery at Lonoke, Arkansas, as small sunfish (*Lepomis* spp.). Stomachs of two approximately week-old young contained mostly fish, a few aquatic beetle (*Dytiscid*) fragments, and rootlets of an aquatic plant.

The adult birds did some fishing in the water beneath the nests, but mostly in nearby bayous, river-bed lakes and in the Arkansas River.

One young bird remained in or near its nest for approximately three weeks after hatching. I arrived at Nest no. 20 at the time of hatching of the first egg on May 30 (the two remaining eggs in the nest were infertile). The young bird began wandering away from the nest after June 20. On June 24 it was observed about 60 feet from the nest climbing about the tops of buttonbushes. It would sometimes flutter several feet from a higher to a lower limb.

After about two weeks of age some of the young would jump out of their nests into the water as I walked beneath them. I observed this action closely to find out if the birds actually dived, but was disappointed to see that they made a perfect "bellyflop." Mr. P. J. Van Huisen, Manager of the White River National Wildlife Refuge, also observed this characteristic flop into the water by the young at Swan Lake when disturbed. After hitting the water the older young would usually swim beneath the surface for several yards and occasionally for a considerable distance before emerging. It seemed remarkable to me that one young bird (and no doubt others a little over two weeks old) was able to return to its nest after jumping into the water from a height of 12 feet. This young bird, one of three in a nest, jumped into the water on a Wednesday and by Saturday had returned, as there were then three birds in the nest.

Nesting Success

Of 20 nests under observation in 1952, only 8 were successful in hatching one or more young, and only 13 young were produced from these nests. The low nesting success was due partially to curious boys and bird photographers, including the writer. Whenever someone entered the heronry the anhingas, egrets, and herons usually left the immediate area of the intrusion with the anhingas the last to return. During their absence the egrets and herons pilfered some nests, carrying the sticks to their own. Many of the eggs "cooked" from the heat of the sun during the anhingas' enforced absence. I picked up several eggs that were almost too hot to handle. The fact that a well travelled farm road was less than fifty yards from several nests may have hindered success in these nests. In 1953 seven of ten nests marked to determine nesting success produced one or more young on the wing, with a total production of 14 young.

Post-Nesting Activity

In 1952 the last anhinga left the Swan Lake heronry on about July 14, but some egrets and herons were still feeding young after that date.

After nesting is concluded, the anhingas move into the bayous, river-bed lakes, "borrow" pits below the river levees, rice field reservoirs, and large ponds. At a goldfish pond near Swan Lake an anhinga was observed feeding on goldfish for about a week before it was shot. Examination of its stomach revealed six undigested goldfish measuring from three to four inches in length, and some aquatic plant fragments.

Most of the summer resident anhingas leave Arkansas by early October. The latest date of departure noted by the writer was October 17, 1950, when six anhingas were seen with a small flock of White Pelicans (*Pelecanus erythrorhynchos*) soaring and gradually drifting downstream toward the mouth of the Arkansas.

Summary

Information relative to the nesting of the anhinga in eastern Arkansas was obtained by the writer in 1951, 1952, and 1953 when nesting anhingas were studied in a large heronry of mixed species at Swan Lake, Jefferson County.

The breeding range of the anhinga lies largely in the eastern third of the state, and favorite nesting places are about the margins of old river-bed lakes along the lower Arkansas River, Lower White River, and the Mississippi River.

Anhingas arrive at Swan Lake usually during the first or second week in April, and courtship begins almost immediately.

Nests were either constructed by the anhingas or appropriated from herons and egrets, and most were placed in buttonbushes at a height averaging about eight feet from the surface of the water. The male gathered most if not all of the material and the nest was sometimes completed in a single day.

Egg laying began during the last week in April. Of 29 nests, 6 contained five eggs, 13 four eggs, 9 three eggs, and 1 two eggs. Incubation, in which both sexes participate, was probably between 25 and 28 days. The sexes also join in brooding and feeding the young.

Fish was the principal diet of the young, but aquatic plants were also found in two stomachs.

One young bird left its nest about three weeks from time of hatching, but remained nearby (within 20 yards) during the next two weeks. Two week-old young that jumped from their nests when disturbed by the writer were eventually able to return, presumably under their own power.

Nesting success was below normal largely because of interference by human beings. In 1952 eight out of twenty nests produced one or more young. In 1953 seven of ten nests produced one or more young on the wing.

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P. O. Box 270, U. S. Fish and Wildlife Service, Stuttgart, Arkansas, August 30, 1953

NEW LIFE MEMBER

E. Alexander Bergstrom is an insurance underwriter by trade and a bird-bander by avocation. His station in West Hartford, Connecticut, bands about 2000 individuals a year; special interests include trap design, plantings appropriate for a banding station, and a nearby Bank Swallow banding project (now in its tenth year). Since the fall of 1950, Bergstrom has been editor of *Bird-Banding*, succeeding the late James Lee Peters. He is a member of some two dozen groups interested in birds in particular or natural history in general, including the British Ornithologists' Union, the Hartford Bird Study Club (president), the Linnean Society of New York, the Massachusetts Audubon Society (vice-president), the Northeastern Bird-Banding Association (member of the council), and the Nuttall Ornithological Club. He was born in 1919, graduated from Harvard ('39), and (in 1943) married Elizabeth Wasson, who shares his interest in birds. They have four children.

TRAILL'S FLYCATCHER IN NEW YORK

BY KENNETH C. PARKES

A CONTROVERSY over the subspecific division of Traill's Flycatcher (*Empidonax traillii*) in the eastern portion of its range has existed since Brewster (1895) gave the name *alnorum* to the breeding form of the boreal northeast. Few authors supported Brewster in this division until Aldrich (1951) finally demonstrated that two eastern subspecies are, indeed, recognizable. Aldrich claimed that Brewster had named the wrong population and that Audubon's type specimen of *traillii* was a migrant of the boreal race. Aldrich placed *alnorum* as a synonym of *traillii* and gave the name *campestris* to what he called the "Plains Traill's Flycatcher." Snyder (1953) agreed that two subspecies should be recognized, and defined their respective ranges in greater detail than had Aldrich. Snyder, however, felt that the naming of *campestris* was unnecessary, and preferred to use *alnorum* and *traillii* as originally proposed by Brewster. Nomenclature is outside the scope of the present paper. My notes were assembled before the appearance of Snyder's paper, and use the names *traillii* and *campestris* following Aldrich. For convenience I use the latter nomenclature here; this is not to be construed as an endorsement of Aldrich's findings nor a refutation of those of Snyder.

Much of the interest in Traill's Flycatcher centers on the fact that the two eastern subspecies are barely separable morphologically but are strikingly different in song and habits. These differences have been discussed by Snyder (1953) and Aldrich (1953). McCabe (1951) discussed the question of song, but as pointed out by Allen (1952) and Snyder (1953), several of McCabe's findings are subject to reinterpretation. To summarize the differences between the subspecies, *traillii* builds a bulky, coarse nest not unlike that of a Song Sparrow (*Melospiza melodia*), prefers on the average a wetter habitat, tends to lay heavily spotted eggs, and sings a three-syllabled song accented on the second syllable; the *wee-be-o* of Peterson (1947:152) and many others. On the other hand, *campestris* builds a compact nest much resembling that of a Yellow Warbler (*Dendroica petechia*), frequently lives in drier situations, tends to lay sparsely spotted eggs, and sings a two-syllabled song accented on the first syllable; the *fitz-bew* of Peterson (*loc. cit.*). The objective distinctness of the two songs is well illustrated by the audio-spectrographs of Kellogg and Stein (1953).

Both Snyder (1953) and Aldrich (1953) have discussed these characteristics of the two races with particular emphasis on the portions of the range where only one of the two is found. Both authors have mentioned New York as one of the regions in which *both* subspecies may be found. Aldrich (1953:9) stated: "It is possible that the western prairie population of Traill's

Flycatcher was formerly more completely isolated from the eastern boreal population, but has recently come into closer contact by infiltration from the west, along the plain of the Great Lakes, since removal of the original forest cover has produced more satisfactory habitat for it." Students of bird distribution in New York will recognize this as a well-known route of penetration into the state by species of southern and western affinities. That Aldrich's theory is probably correct is indicated by the discussion of this species in Eaton's "Birds of New York" (1914). Eaton knew the bird chiefly as an inhabitant of the mountains and cold bogs. His description of the song, nest, and eggs leaves little doubt that the bird he knew in New York was the race we now call *traillii*. However, he mentioned that the bird was appearing in the "Transition Zone" of the western part of the state where it had not been previously known. We may postulate that these immigrants were *campestris* moving in from the west.

A number of austral birds have penetrated New York from two directions; from the west along the Lake Plains and from the south entering the lower Hudson valley. This is apparently true of *campestris*. The breeding form of the Adirondack Mountains, most of the Catskill Mountains, and of the "Canadian Zone" islands in central and western New York is definitely *traillii*. The breeding form of the Lake Plains as far east as Oswego is *campestris*. So much has been acknowledged by recent authors. Richard B. Fischer, who has been conducting a study of this species in southeastern New York, has shown that the breeding population of Long Island conforms most closely in song and habits to the type we are calling *campestris* (Fischer, 1950). That this race is penetrating the normal range of *traillii* is indicated by Mr. Fischer's unpublished data concerning the birds breeding in the valleys of the southwestern part of the Catskill region. Birds singing the *fitz-bew* song of *campestris* were found as far north as Lew Beach, in northern Sullivan County. Authentic breeding specimens from southeastern New York are greatly to be desired. It seems almost certain that these birds will prove to be *campestris*, judging from what we know of their song and habits.

It thus seems evident that McCabe (1951) should not have lumped together his New York records of the songs of Traill's Flycatcher. According to McCabe, a questionnaire circulated among the members of the Linnaean Society of New York produced the following interpretations of the song: *fitz-bew*, 11; *wee-be-o*, 3; *greadeal*, 2; *sweet-cheeuu*, 1. Two things are apparent from this listing. First, the members of the Linnaean Society were influenced by their reading in giving their phonetic interpretations, as all of these, letter for letter, have appeared in the literature. Second, twelve of the members learned the song from the southern race, *campestris*, and five from the northern *traillii*. This proportion would not be unexpected, since, as mentioned above, the *campestris* song is typical of the breeding birds in the New York City region where the Linnaean Society students are most active.

The situation in western and central New York is more complicated. Aldrich (1953:9–10) stated: "The relatively slight physiographic and ecological barrier which exists today between the Interior Lowlands and Appalachian Plateau physiographic provinces in western New York apparently has been sufficient to prevent complete genetic intermingling of these two populations as indicated by both specimens and field observation of song differences. . . . the correlation of their distribution with the sinuous boundary between plain and plateau results in extremely interdigitated ranges."

There is some evidence that the ecological barrier between these two forms breaks down occasionally, so that reproductive isolation is not complete. This is what we expect to find between subspecies. Snyder (1953:20, footnote) has described a nest which appeared to be of an intermediate type. Both *wee-be-o* and *fitz-bew* birds are to be found in the Finger Lakes region. The latter form, which has increased remarkably in this region in the past few decades (supporting Aldrich's theory of an eastward range extension of the prairie form *campestris*), is an inhabitant of the valley of Cayuga Lake and its tributaries, a generally warmer region than swamps such as that near Danby where the *wee-be-o* type nests. However, correlation of habits and color in this region is not complete. During the course of his revisionary study, Aldrich had at his disposal the excellent series of Traill's Flycatcher from the Cornell University collection. He placed his identifications on the labels of these specimens. Some specimens from the Ithaca region taken in definitely boreal habitats (and which showed other habits of the boreal bird) were identified by Aldrich as *campestris*. Some Ithaca austral birds were labeled *traillii*. One *mated pair* (clearly so stated on labels) was divided between *campestris* and *traillii* by Aldrich. If we assume that color is a constant in these races and color alone is used in identification, then Aldrich's determinations are correct. On this premise it would appear that interbreeding of the two subspecies in the Ithaca region has resulted in some birds with the external appearance of one form and the habits of the other. This would seem to indicate independent segregation of genes governing color, nest-building habits, egg pigmentation, and song (if we assume genetic control of the latter).

Such a recombination of characters should be expected wherever *campestris*, apparently in a dynamic period of range expansion correlated with a general change in cover type and possibly climate, has penetrated the range of *traillii*. There is evidence that this has taken place in northwestern Pennsylvania. Breeding specimens from Crawford County in Carnegie Museum are indistinguishable in color from a long series of undoubted *traillii* from Labrador. Mr. W. E. Clyde Todd tells me that he has never heard a song of this species in western Pennsylvania that differed from the song heard in the boreal forests of eastern Canada. The two most recently collected sets of eggs of this species in Carnegie Museum were taken in Crawford County in June, 1947. The eggs are heavily spotted like those of *Empidonax virescens*, a characteristic of *E. t. traillii*. They were taken in the same general area as were the skins of *traillii* coloration mentioned above. Yet set no. 4356 bears a note by the collector, R. L. Fricke, to the effect that the nest resembled that of a Yellow Warbler, a characteristic of *campestris!*

There are several other areas where the ranges of *campestris* and *traillii* interdigitate; these are shown by the vertical dashes in Snyder's map (1953: 21). Much can be learned of the interrelationships of these two forms if field students will make careful note of the song, nest construction, egg color and habitat preference of the Traill's Flycatchers in these areas, and supplement this by judicious collecting of *known* breeding birds. This should be done at intervals over as long a period as possible, since *campestris*, as noted above, is apparently in an active period of range expansion.

This paper has been critically read in manuscript by the following ornithologists, to whom I am indebted for much helpful advice as well as for information specifically credited in the body of the paper: John W. Aldrich, Arthur A. Allen, Richard B. Fischer, L. L. Snyder, and W. E. Clyde Todd.

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Carnegie Museum, Pittsburgh, Pennsylvania, August 4, 1953

EFFECTS OF WEATHER ON NOCTURNAL MIGRATION AS SEEN FROM ONE OBSERVATION POINT AT PHILADELPHIA

BY JOSEPH M. DEVLIN

Most bird students are aware that during migration many transient species can be observed in most of the small parks and "squares" scattered throughout the large eastern cities, but many of these places, however interesting, remain unstudied during migrations because of the more varied birding available outside cities. Yet, city oases afford an opportunity to study nocturnal migration in a manner which can not be accomplished in the country. Daytime observations in wooded areas can be misleading, for many night-flying species do a considerable amount of diurnal traveling through the tree tops. Such migrants, with but few exceptions, are rarely seen flying over treeless sections of large cities in the day. When they are first seen in the parks it is almost always at daybreak.

I have for the past several years kept a close vigilance over the small Botany Garden on the campus of the University of Pennsylvania in West Philadelphia. The small area of less than 500 × 500 feet, hemmed in by busy city, is a temporary haven for migrating birds. The place is particularly attractive to migrants because of the varied plantings of both deciduous and evergreen plants and the presence of a pond of approximately one thousand square feet.

When a night migrant comes to the garden, it can usually be discovered almost immediately and watched until it departs. The first appearance of a species in the garden does not necessarily mean first arrival of that species for the Philadelphia region. More often than otherwise, birds arrive in the garden a few days after the species has been reported in the suburbs. The important thing is that we can be reasonably certain that the garden bird was flying over the city in migration on the previous night. We are able to acquire direct evidence of nocturnal migration by training a telescope on the lunar disc, but such observations, as valuable as they may be, produce little data on the kinds (species) that are flying, and peak migrations do not always coincide with the full moon.

Southbound Migration

Southbound nocturnal migration has long been of special interest to me. Working on the premise just outlined, I have correlated autumnal flight with wind direction during the past three years. I found that birds are mostly on the wing on nights with light to moderate north or northwest winds. Since these conditions prevail just after a cold front passes toward the south or southeast over the eastern seaboard, major migrations throughout September and October are readily predictable. A report of the fall migration of 1952, as seen from West Philadelphia, was published earlier (Devlin, 1953).

Determination of Spring Migrants

In the spring of 1953, I made an effort to correlate northbound night migration with weather conditions. The Botany Garden was examined twice daily, once in the early morning and again in the evening, through 84 consecutive days from March 14 to June 5. I seldom found a new bird in the evening that was not seen on the first survey. Occasionally a flicker was seen flying over city rooftops in daylight, but, because of the timing of the surveys, I feel fairly certain that diurnal migration did not contribute to the counts of flickers reported here.

The second daily survey sometimes showed that some birds had left the garden. These were often birds of timid species and usually happened on balmy days when many people came into the garden. I believe that these birds were actually chased out of the garden in the daytime, so their departure was not considered migration. To avoid confusion migrants were recorded only on arrival.

Migrants were identified as such by the following criteria: 1. all first arrivals; 2. reappearance of a species after an absence; 3. increase in numbers of a species—the difference being counted migrants. Often (by sex, age, distinctive plumage, or peculiarities of song) an individual could be identified for the duration of its stay in the garden. When common species such as the Olive-backed Thrush, Red-eyed Towhee, or White-throated Sparrow were passing through in abundance it was not possible to determine migrants among them, and during such periods these species had to be ignored. Whenever I felt there was any doubt about a bird being a migrant, the bird was not recorded.

Daily meteorological notes were kept, and wind direction was found by releasing hydrogen-filled balloons. Special queries on local conditions were kindly answered by Mr. H. P. Adams of the Philadelphia Weather Bureau. Weather over the entire eastern United States was studied in retrospect from the daily government weather maps.

Birds and the Wind

Soon after this study was started it became apparent to me that the hour just before nightfall was the *critical* time in nocturnal migration. If at that hour the winds were calm or southerly, migration could be expected. It did not seem to matter if the skies were overcast as long as it was not raining. Presumably, migrants took to the sky around dusk. Moon watching showed that when these conditions prevailed throughout the night, birds were in flight all night and could be watched coming in from the sky soon after daybreak.

When unfavorable conditions for migration, such as heavy fog, rain, or cold north winds, occurred at Philadelphia and southward at the critical hour, there was no migration. If conditions became favorable (south wind, rising temperatures) during the night, there still was no migration. Seemingly, migrants do not often taken flight in the middle of the night.

There were times when weather conditions were unfavorable at Philadelphia but favorable over the region south of us at the critical hour. At such times birds in the south, apparently, were able to take flight, and, if conditions at Philadelphia changed to favorable during the night, the migration penetrated our region. On the basis of the above observations, we were able to predict migration with a high degree of accuracy. Predicting migration was as safe, at least, as forecasting the weather.

In 115 hours of careful searching, I identified 468 birds as nocturnal migrants. 310 of these arrived on southerly winds. 141 were in flight on so-called calm nights. Only 17 birds arrived on northerly winds, and it is interesting that these were early migrants, all of the family Fringillidae.

The word "southerly" as here used means that the entire air mass was moving from any point between east-southeast (clockwise around the compass) to west-southwest. There were 30 nights when the wind was southerly, and migration occurred on 25 of them. On five nights there was no migration; on four of these there were heavy rains throughout the whole region during the critical hour.

Theoretically, a calm night should be best for avian navigation. Nine nights were drawn as calms on the weather maps, and migration occurred on all nine of them. These were all personally investigated, and I found that in every case there was a "breeze" from the south 100 feet above the ground. A wind of 0.5 miles or less per hour is considered a calm. Absolute calms are rare, and if migrating birds should wait for them they might never reach the breeding grounds.

"Northerly" as used here means that the air mass was moving all night from any point between west-northwest (clockwise around the compass) to east-northeast. There were 32 such nights. Migration occurred on only two of them.

Winds were variable from west to northwest on three nights, and there was no evidence of migration.

On one night the winds were variable from east to southeast. Two migrants arrived.

Table 1 gives a list of migrants and the general direction of the winds which bore them. Migration and weather from May 4 to May 14, inclusive, are presented pictorially in Figures 1 and 2.

TABLE 1

SPRING MIGRANTS AND THE WINDS WHICH BORE THEM

Species	*Wind Direction* *Southerly*	*Calm*	*Northerly*
Yellow-billed Cuckoo. *Coccyzus americanus.*		2	
Ruby-throated Hummingbird. *Archilochus colubris.*	1		
Yellow-shafted Flicker. *Colaptes auratus.*	10	7	
Yellow-bellied Sapsucker. *Sphyrapicus varius.*	3		
Downy Woodpecker. *Dendrocopos pubescens.*	1		
Phoebe. *Sayornis phoebe.*		2	
Crested Flycatcher. *Myiarchus crinitus.*	3	3	
Traill's Flycatcher. *Empidonax traillii*	1		
Wood Pewee. *Contopus virens.*	2	2	
Brown Creeper. *Certhia familiaris.*	8		
House Wren. *Troglodytes aëdon.*	1		
Catbird. *Dumetella carolinensis.*	15	7	
Brown Thrasher. *Toxostoma rufum.*	2	2	
Wood Thrush. *Hylocichla mustelina.*	1	3	
Hermit Thrush. *Hylocichla guttata.*	5	2	
Olive-backed Thrush. *Hylocichla ustulata.*	4	3	
Gray-cheeked Thrush. *Hylocichla minima.*	1		
Veery. *Hylocichla fuscescens.*	2	1	
Blue-gray Gnatcatcher. *Polioptila caerulea.*	2		
Golden-crowned Kinglet. *Regulus satrapa.*		2	
Ruby-crowned Kinglet. *Regulus calendula.*	3	2	
Yellow-throated Vireo. *Vireo flavifrons.*	1		
Blue-headed Vireo. *Vireo solitarius.*	1	1	
Red-eyed Vireo. *Vireo olivaceus.*	4	2	
Black and White Warbler. *Mniotilta varia.*	2	3	
Blue-winged Warbler. *Vermivora pinus.*		1	
Tennessee Warbler. *Vermivora peregrina.*	1		
Parula Warbler. *Parula americana.*		3	
Yellow Warbler. *Dendroica petechia.*	2	1	
Magnolia Warbler. *Dendroica magnolia.*	6	3	
Black-throated Blue Warbler. *Dendroica caerulescens.*	1	5	
Myrtle Warbler. *Dendroica coronata.*	4	3	
Black-throated Green Warbler. *Dendroica virens.*	1	1	
Chestnut-sided Warbler. *Dendroica pensylvanica.*	3		
Bay-breasted Warbler. *Dendroica castanea.*	2		
Black-poll Warbler. *Dendroica striata.*	8	4	

TABLE 1 (Cont'd)

Prairie Warbler. *Dendroica discolor*	2		
Palm Warbler. *Dendroica palmarum.*	1		
Oven-bird. *Seiurus aurocapillus.*	4		
Northern Water-thrush. *Seiurus noveboracensis.*	1		
Louisiana Water-thrush. *Seiurus motacilla.*	1		
Yellow-throat. *Geothlypis trichas.*	8	3	
Yellow-breasted Chat. *Icteria virens.*	1		
Hooded Warbler. *Wilsonia citrina.*	1		
Wilson's Warbler. *Wilsonia pusilla.*		1	
Canada Warbler. *Wilsonia canadensis.*		2	
Redstart. *Setophaga ruticilla.*	2	7	
Baltimore Oriole. *Icterus galbula.*		2	
Scarlet Tanager. *Piranga olivacea.*	2	1	
Rose-breasted Grosbeak. *Pheucticus ludovicianus.*	1		
Indigo Bunting. *Passerina cyanea.*	1	1	
Purple Finch. *Carpodacus purpureus.*	2		
Red-eyed Towhee. *Pipilo erythrophthalmus.*	8	5	
Slate-colored Junco. *Junco hyemalis.*	86	14	4
Chipping Sparrow. *Spizella passerina.*	20		
Field Sparrow. *Spizella pusilla.*	3	1	1
White-throated Sparrow. *Zonotrichia albicollis.*	59	36	
Fox Sparrow. *Passerella iliaca.*			2
Song Sparrow. *Melospiza melodia.*	6	3	10

MIGRATION AND TEMPERATURES

Some attempt was made to find if there was any correlation between night flight and night temperatures. The problem becomes rather involved because we are dealing with variables such as vertical, linear, and time gradients in temperature. We must also *know* just how high the birds are flying. There still are not enough data, and to publish these would be premature. However. it appears that the Song Sparrow and the Golden-crowned Kinglet initiate nocturnal flight with air temperatures as low as 45°F. and may continue to fly even though the temperature may fall to almost freezing. Most birds probably prefer to fly in higher temperatures, and at Philadelphia after the first of April, winds from the south usually bring with them temperatures of 50°F. or higher. There is no doubt that low temperatures can be limiting, but in spring they seldom are, for southerly winds and mild weather go hand in hand.

South winds in late April sometimes do not bring as many migrants as might be expected. The explanation for this seems to be that by that time most of the early migrants have passed through and the long-distance migrants (mostly warblers) have not yet reached the Atlantic States. One thing

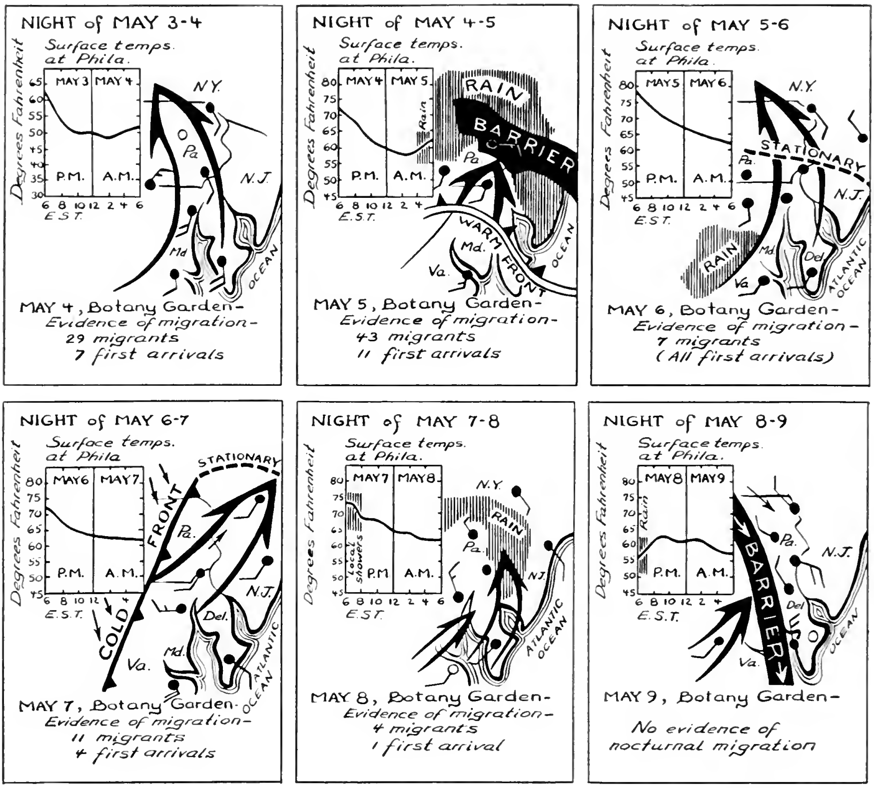

Fig. 1. Weather and nocturnal migration of birds at Philadelphia, May 3 through May 9, 1953. (Key to symbols in Fig. 2)

must be remembered—perfect weather for migration can not bring migrants if the birds have not yet acquired the urge to migrate.

Birding is commonly best during inclement weather, giving rise to the popular belief that birds migrate regardless of the weather. Usually, investigation shows that the birds began their flights before the weather turned unfavorable.

Landing at Night

Williams (1950) believes that migrants have difficulty in landing safely on dark nights. He concludes that, even though caught in a thunder storm, they are unwilling to land. This conclusion fits in well with the observations made at the Botany Garden.

On several occasions I was able to focus a telescope on the moon through a hiatus in the thunder clouds immediately after a violent storm. Birds were

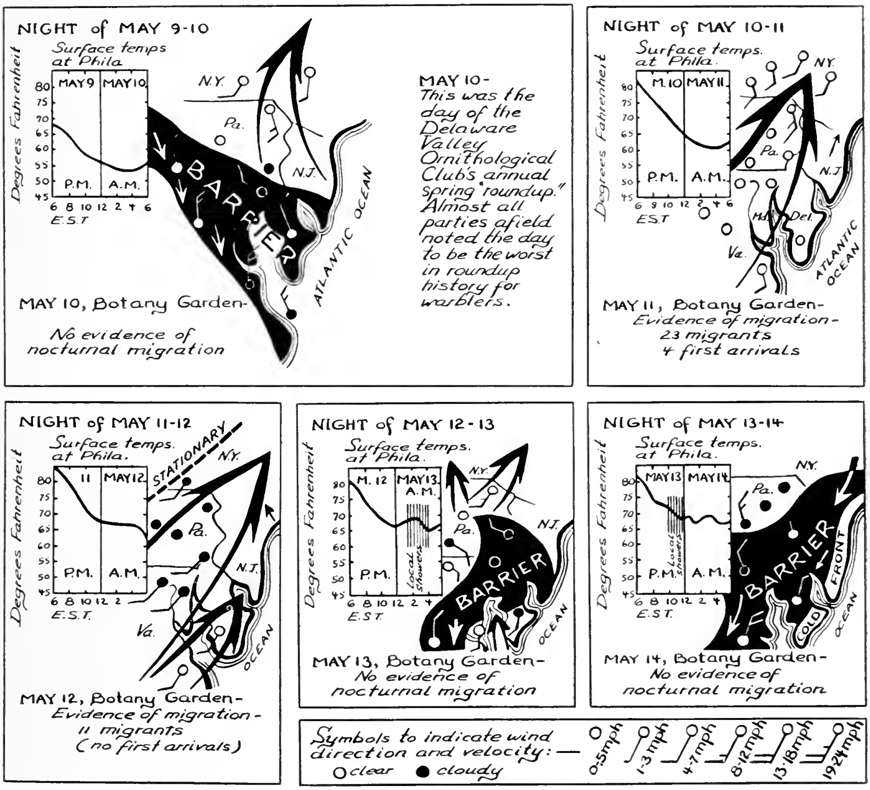

FIG. 2. Weather and nocturnal migration of birds at Philadelphia, May 10 through May 14, 1953.

still aloft. Whether or not they were flying above the storm I am not certain. Only once did I find a water-logged bird (Yellow-bellied Sapsucker) in the garden that I thought was forced to land at night.

In the evening of April 27, the wind was from the southwest and the telescope showed that migration was in full sway. A cold front bringing northwest winds passed through this area during the night, but telescopic observations indicated that the migrants continued to fly on the southerly wind high above the cold front slope. We watched the birds come in from the sky at dawn.

Essentially the same thing happened on the night of May 27-28, when again moon watching revealed that birds were aloft on southerly winds, when northerly winds prevailed at the surface.

In the fall, flying into adverse winds may end in catastrophe. Migrants on a following wind meeting a warm front with strong southerly winds may be forced to fly very low *under* the frontal slope. Apparently that is what happened on the night of September 21-22, 1953, when 300 migrants crashed to death against the Empire State Building in New York City.

Discussion

The idea that bird migrations proceed according to the weather is by no means new. Thus, the late Wells W. Cooke (1910) noted that in spring "birds prefer migrating in warm weather." However, the concept met with strong disfavor by many top-ranking ornithologists. Wetmore (1927) and others supposed that birds were driven by an irresistible migrational urge to arrive at the breeding grounds by the calendar.

Today the majority of workers believe that weather plays an important rôle in migration. The works of Lowery (1946), Williams (1950), and Imhof (1953) present convincing data which show some of the effects of weather on nocturnal bird flight.

Captain Neil T. McMillan (1938), of Eastern Air Lines, wrote "to a bird on the wing, the wind is a vehicle or means of transportation. It is the air that goes places and the birds go with it." According to Lincoln (1950) and others, the main objection to birds on the wind seems to be that the migrant becomes an object driven hither and thither, *unable to navigate.*

When a mass migration happens on an 18 miles per hour tail wind, it seems inconceivable that birds are guided across magnetic or coriolis fields, or that they can be following landmarks like mountain ranges, rivers, or coast lines. Newman (1952) wrote, "It looks as though migrants tend to travel with the wind toward low pressure areas." Studies at the Botany Garden indicate that night migrants travel with the wind regularly.

How do birds find their way? The most baffling of all questions about migration becomes even more baffling.

Summary

By keeping a close watch for migrants in some small park in a large city one is able to determine the nights of migration. When it is known on what nights birds are in flight, the appropriate correlations with weather can be made. The writer has been interested in this sort of observational research and has used the Botany Garden on the campus of the University of Pennsylvania for the field work.

In the spring of 1953 it was found that the majority of migrants arrived on southerly winds or on temperate calm nights. Relatively few birds came in on nights with northerly winds.

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218 South 43rd St., Philadelphia 4, Pennsylvania, August 7, 1953

NEW LIFE MEMBER

Dale A. Zimmerman was born at Imlay City, Michigan, on June 7, 1928. From early childhood birds have been a major interest for him and his ornithological travels have taken him to many areas from Canada to southern Mexico. He is at present studying for the Ph.D. degree at the University of Michigan, from which he has already received B.S. and M.S. degrees. Although his interests in birds are varied, he has devoted much time to field studies of birds in Michigan and Mexico and to studies of avian distribution in general. Additionally, Zimmerman actively bands, paints, and photographs birds.

METEOROLOGICAL ANALYSIS OF OCCURRENCE OF GROUNDED MIGRANTS AT SMITH POINT, TEXAS, APRIL 17 - MAY 17, 1951

BY JOHN V. DENNIS

It is not at all clear to what extent and in what manner weather controls the migratory movements of birds. Some authorities belittle the influence of weather and place far more emphasis upon such factors as amount of daylight, degree of gonadal development, and inherited migratory urge. Others suppose spring migration to be regulated by the advance of temperature isotherms. Still others disagree with a purely mechanistic approach and believe that day to day changes in the weather play an important role in shaping the progress of migration.

This latter concept is the one favored by most recent writers (Robbins, 1949; Williams, 1950; Bagg *et al.*, 1950; Gunn and Crocker, 1951). Their findings clearly confirm the fact that weather does exert an influence upon migration, and, in many instances, show that birds respond to weather variations to a very marked degree. Not enough detailed studies are available, however, to permit students to say that birds always respond in the same manner to the same meteorological phenomena. As a slight contribution to our knowledge in this field I am now undertaking to interpret daily observations of the spring migration made by myself at Smith Point, Texas, in April and May of 1951.

For their most generous help in reading and analyzing my manuscript I am indebted to W. W. H. Gunn and Aaron M. Bagg.

Study Area and Methods

Smith Point is a triangular shaped area of land which projects into Galveston Bay from the northeastern side. From the area where observations were made near the end of the point, it is 10 miles to the Gulf of Mexico while the metropolis of Galveston on the Gulf lies some 18 miles across the bay to the south. A strip of woods on the north side of the point was chosen as a suitable locality to make daily observations.

The low-lying woods, composed of hackberry, *Celtis* sp., and various xerophytic trees and shrubs, faces the bay to the north and open pasture land to the south. At the eastern end a narrow creek bordered by marshes separates the study area from another similar thicket to the northeast. Surrounded by water or grazing land, the thicket, stretching three-fourths of a mile along the bay and averaging about 50 feet in width, forms a natural haven for migratory land birds.

On April 17, 1951, I began taking census counts at the thicket. With the exception of April 20, when it was impossible to be in the area, counts were made every day through May 17, 1951. Generally counts were conducted during the morning. No set length of time was prescribed nor was the thicket always traversed in exactly the same manner. When few migrants were present the thicket could be covered in less than an hour, but on certain days when large numbers of birds were present, it took as long as six hours to make a thorough coverage. Owing to dense foliage in places, it was a time-consuming process to make reasonably sure that all species, if not all individuals, were counted. On the whole, birds were easy to approach and it was possible to view them under good conditions for making identifications.

Not included in the counts were resident species and birds not definitely associated with the thicket. Thus the following residents found in the area were not included although migrant individuals, representing several of these species, undoubtedly passed through: Mourning Dove (*Zenaidura macroura*), Scissor-tailed Flycatcher (*Muscivora forficata*), Mockingbird (*Mimus polyglottos*), Red-winged Blackbird (*Agelaius phoeniceus*), Boat-tailed Grackle (*Cassidix mexicanus*), and Cardinal (*Richmondena cardinalis*). Not closely enough associated with the census area to be included were herons, hawks, gulls, terns, shorebirds, and swallows. The Savannah Sparrow (*Passerculus sandwichensis*) and the Dickcissel (*Spiza americana*), although often present in large numbers, were not closely associated with the area and so were not included. The Sora (*Porzana carolina*) on the other hand, was included when found taking refuge within the census area. The Blue-gray Gnatcatcher (*Polioptila caerulea*), a migrant which occurred in fair numbers during the first week or two, was mistakenly omitted.

Daily weather reports were obtained from the U.S. Weather Station at Galveston, and data from these have been used in compiling Table 2. For weather developments on a wide scale, frequent reference was made to the weather maps of the U.S. Weather Bureau. Admittedly there are local variations in the weather between Smith Point and Galveston, but these were not considered to be important enough to alter the conclusions arrived at in this study. My own temperature and barometer readings at Smith Point agree closely with those of the Galveston Weather Station, and no major inconsistencies in regard to wind direction or precipitation were detected.

Census Results

Table 1 gives the names of migrants seen in the census area, their numbers, and the dates on which they occurred.

The 52 species listed are migrants closely associated with the census area. The Wood Pewee, Eastern Kingbird, and Indigo Bunting were present on at least 16 of the 30 days in the study period. The Indigo Bunting was the most abundant species recorded. (Figures of 20 and over are estimates.) Of the

TABLE 1

DAILY COUNTS IN THE CENSUS AREA, APRIL 17—MAY 17, 1951

Species	April													May																
	17	18	19	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sora rail, *Porzana carolina*								1													1									
Yellow-billed cuckoo, *Coccyzus americanus*														1							2	1			2	1				1
Black-billed cuckoo, *Coccyzus erythropthalmus*	1	1																												
Ruby-throated hummingbird, *Archilochus colubris*	1	1	1				1											1		1	6	2	2			1				
Eastern kingbird, *Tyrannus tyrannus*	8	1	1	1		1		2	2						12	3		2	2		10				1	1	2			2
Crested flycatcher, *Myiarchus crinitus*	4														2															
Unidentified empidonax, *Empidonax* sp.			1																		1				1					
Wood pewee, *Contopus virens*	1	1	1	1	1	2								3	10		2	4	2	4	6		2	3	2					
Catbird, *Dumetella carolinensis*	1					2	3							3	3			1				1								
Wood thrush, *Hylocichla mustelina*	1					5												2			2									
Olive-backed thrush, *Hylocichla ustulata*	1					1	1								1		1	2		1	8	1			4					
Gray-cheeked thrush, *Hylocichla minima*																	1	1		1	4									
Veery, *Hylocichla fuscescens*																					1									
Cedar waxwing, *Bombycilla cedrorum*																					1									
White-eyed vireo, *Vireo griseus*	3	3				1									2		1													
Bell's vireo, *Vireo bellii*																		1												
Yellow-throated vireo, *Vireo flavifrons*	1																													
Red-eyed vireo, *Vireo olivaceus*	3	5	3	3	3	3	3								1			1	1		2				2					
Philadelphia vireo, *Vireo philadelphicus*															1						1	1								
Warbling vireo, *Vireo gilvus*																		1												
Black and white warbler, *Mniotilta varia*	7	5	1	1		1									2			4			1	1								
Prothonotary warbler, *Protonotaria citrea*	1	1	1																											
Worm-eating warbler, *Helmitheros vermivorus*	1																													
Golden-winged warbler, *Vermivora chrysoptera*						1												1			1									

	17	18	19	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Tennessee warbler, *Vermivora peregrina*															1			3												
Yellow warbler, *Dendroica petechia*		2													2			2			10	3								
Magnolia warbler, *Dendroica magnolia*						1	1	1							20		1	12	1		2	1		1						
Myrtle warbler, *Dendroica coronata*										1				1	1															
Black-throated green warbler, *Dendroica virens*				1		1									1			4			2	1			1					
Cerulean warbler, *Dendroica cerulea*				1																										
Blackburnian warbler, *Dendroica fusca*															1			5	2	2	2									
Chestnut-sided warbler, *Dendroica pensylvanica*						1								2	2			4	1					1						
Bay-breasted warbler, *Dendroica castanea*										1					4			1	1		1	1								
Black-poll warbler, *Dendroica striata*																					1		1	1						
Ovenbird, *Seiurus aurocapillus*	2					2															2			1						
Northern water-thrush, *Seiurus noveboracensis*									1											1	1									
Louisiana water-thrush, *Seiurus motacilla*						1																								
Kentucky warbler, *Oporornis formosus*						1	1																							
Yellow-throat, *Geothlypis trichas*	2	2	1			3								2	6						1				1					
Yellow-breasted chat, *Icteria virens*	1		1			2											1	1								1				
Hooded warbler, *Wilsonia citrina*	6	1	1	1		4																								
Canada warbler, *Wilsonia canadensis*															1			1						1						
American redstart, *Setophaga ruticilla*	3					5	2		2	1					2		1	4	2		2	1			1					
Orchard oriole, *Icterus spurius*	6	4	5	12	1	5					1				4								2							
Baltimore oriole, *Icterus galbula*			1			2	1								2		1	2												
Scarlet tanager, *Piranga olivacea*		1					1																							
Summer tanager, *Piranga rubra*	2	1				1		1													1		1							
Blue grosbeak, *Guiraca caerulea*						1								2	2										1					
Indigo bunting, *Passerina cyanea*	60	20	17	20	20	40	20	7	7					5	20			20		8	20	4		5	3					
Painted bunting, *Passerina ciris*	1	1				1	2	1			1	1		2																
Lincoln's sparrow, *Melospiza lincolnii*					1																									
Swamp sparrow, *Melospiza georgiana*		1													1															

TABLE 2

WEATHER CONDITIONS AND NUMBERS OF MIGRANTS DURING STUDY PERIOD

Date	Average temperature	Precipitation in inches	Prevailing wind direction	Average wind speed (m.p.h.)	Barometric pressure at 6:00 a.m.	Significant changes in wind and temperature	Numbers of species	Numbers of individuals
April 16*	63	.06	NE	16.7	30.00	Light SE before dawn. 38 MPH NNE at 6:00 a.m. changing to E before dark.	23	117
17	61	0	E	15.0	30.10	Shifting from NE to E during the morning	17	51
18	66	.01	S	9.0	29.88		13	35
19	70	0	SW	12.0	29.82			
20	67	.03	SE	12.3	29.91	A change from SE to ENE at noon	9	41
21	71	0	S	11.3	29.93	A change from SE to ENE at 6:00 a.m.	5	26
22*	75	0	N	11.2	30.01	Shifting from E to NNW during the morning	25	88
23	63	0	NE	12.7	30.21	Shifting from N to ESE during the morning	11	36
24	69	0	SE	13.1	30.11		6	13
25	71	0	SE	14.0	29.97		4	12
26	71	0	SE	12.8	30.06		3	3
27	71	0	SE	12.8	30.09		2	2
28	72	0	SE	12.3	30.08		1	1
29	73	0	SE	15.4	29.88		0	0
30	74	0	SE	21.3	29.75	Wind up to 31 MPH.		
May 1*	71	.12	SE	13.0	29.85	A change from SSE to NNW at 2:00 p.m. Temp. drop from 75 to 65 degrees between 3:00 and 4:00 p.m.	9	21
2	75	0	SE	10.9	30.03		25	104
3	75	0	S	10.6	29.98	Temp. rise of 9 degrees between 5:00 a.m. & 2:00 p.m.	1	3
4	79	0	NW	11.1	29.93	Shifting from SSW to NW before dawn. Maximum temperature of 88 degrees.	8	9
5	76	0	S	11.9	29.95	Shifting from NNE to E during the morning.	24	80
6	74	0	SE	13.3	29.88	Temp. rise of 8 degrees between 5:00 a.m. & 2:00 p.m.	8	12
7*	67	.66	NE	16.5	30.02	Shifting from ESE to NNE before dawn	7	18
8	70	.02	E	17.9	30.02	Shifting from NE to E before dawn	27	92
9	75	0	SE	14.3	29.98		12	18
10	74	.21	S	10.5	30.01	A change from SE to NW at 6:00 a.m.	5	8
11*	70	.13	NE	11.0	29.95	Shifting from W to NNE before dawn Shifting from NNE to ESE in afternoon	7	13
12	72	0	E	16.5	29.94	Shifting from NNE to ENE before dawn Shifting from ENE to ESE during afternoon	11	19
13	74	0	E	18.7	29.99		4	4
14	75	0	SE	21.0	30.05	Wind up to 36 MPH.	1	2
15	76	0	SE	23.0	30.10	Wind up to 33 MPH.	0	0
16	75	0	SE	17.9	30.16		0	0
17	75	0	SE	15.8	30.01		2	3

* Cold fronts penetrated region

warblers the Magnolia occurred in largest numbers, but the American Redstart was present on more days. Warblers and vireos are well represented in the counts by total species if not number of individuals. In comparison the sparrows are rather poorly represented. Absent or poorly represented are several early migrants. The Eastern Phoebe (*Sayornis phoebe*) was not recorded while the Myrtle Warbler was seen only three times. Also a number of migrants were recorded elsewhere in the Smith Point region during the study period but were not seen in the census area; among these are the Yellow-throated Warbler (*Dendroica dominica*) and the Pine Warbler (*Dendroica pinus*).

Table 2 shows several cause and effect relationships existing between number of migrants and weather conditions.

Cold fronts penetrated the region on April 16, and 22, May 1, 7, and 11. The arrival of a cold front is associated with northerly winds, lower temperature, higher barometric pressure, and, on four out of five occasions in my study, precipitation. The only increase in number of migrants not coincident with a cold front occurred on May 4. The significant weather conditions prevailing then were above-average temperature, westerly winds, and relatively low barometric pressure.

It is to be noted that migrants were *not* present in maximum numbers until the day after unfavorable weather had halted migration. After a peak had been reached, numbers declined steadily on each succeeding day of favorable weather. During the last week in April, a period of warm weather and southeasterly winds, the number of migrants declined on each day until on the 30th none at all were recorded.

A cold front on May 11 produced fewer migrants than usual. Presumably this was due to the fact that the peak of migration had passed.

Discussion

Arrival of migrants.—Unfavorable weather conditions may halt migration and result, in the terminology of Bagg, *et al.* (1950), in the presence of an "arrested wave." The opposite of this is an "onrushing wave" which occurs when birds begin moving with a return to weather conditions favorable for migration. At Smith Point, two contrasting meteorological phenomena were seen to result in arrested waves. Of six arrested waves noted during the period of observation, five occurred with the arrival of cold fronts and the sixth seemed to have been caused by a westerly wind.

Several Gulf Coast observers (Williams, 1945; Lowery, 1946) have commented upon the sudden and immediate appearance of migrants with the arrival of a cold front. At Smith Point the arrival of a cold front did not necessarily mean an immediate influx of migrants. Birds would arrive with the first drop in temperature, but maximum numbers were not present until after the cold front had passed. Thus birds first arrive under weather conditions associated with a cold front. They continue to arrive with rising barometric pressure, warmer temperatures, and the first shift to a southerly wind.

That it takes as long as 24 hours or more for maximum numbers to appear following the arrival of a cold front seems explainable on the grounds that to the south conditions may still be favorable for migration, and thus birds flying over water or along the coast may continue northward even after a cold front has reached the vicinity of Smith Point. As they reach Smith Point, they tend to pile up in coastal thickets. As the coastline is largely devoid of habitat suitable for their needs, it seems likely that birds grounded in this inhospitable region tend to drift northward to wooded areas. Indeed, migrants at the census area, while awaiting favorable weather, restlessly made their way back and forth through the thicket, and some, usually after hesitation, crossed the creek at the eastern end of the thicket and flew to other patches of woods to the north. The creek seemed to act as a barrier, however, and tended to keep birds within the confines of the census area.

It was impossible to tell how long individuals stayed in the area, but there was evidence that some birds stayed as long as three or four days. A single Black-poll Warbler, a rarity along the Texas coast, was counted on three out of four days during the period, May 8 through 11. A Prothonotary Warbler, a species infrequently met with during the period of study, was seen on April 17, 18, and 19. A Philadelphia Vireo, perhaps the same individual, was seen on May 8 and 9.

Winds were from the northeast on four of the five occasions when cold fronts reached the Smith Point region. On May 1, a cold front brought northwesterly winds. The arrival of this cold front was of particular interest because it was in reality a quasi-stationary front which barely penetrated the Galveston Bay region. Immediately to the south a warm front was moving inland along the Texas Coast. On the morning of May 1, when a count was taken in the census area, the cold air-mass had not yet reached Smith Point. Only two migrant species were found, two Painted Buntings and one Myrtle Warbler. The temperature was 75° F., and the wind was from the southeast. At 2:00 p.m. the skies became overcast and the wind shifted to the northwest. Between 3:00 and 4:00 p.m., the Galveston Weather Station recorded a 10° drop in temperature. A fine rain accompanied these changes. I was in a wooded area some 10 miles north of the census area when the first indications of a change in weather became apparent. Migrants began to appear in the woods concurrently with overcast skies, northerly winds and falling temperature. On returning to the census area at 6:00 p.m., I found dozens of birds where in the morning there had been virtually none. Due to poor light

I had difficulty in identifying most of them, but I succeeded in adding seven species to the day's list. Late in the evening the wind shifted back to the southeast and by midnight the temperature had risen seven degrees. But as a result of this brief penetration of a cold air-mass, 25 migrant species were counted in the census area the following morning.

A Black-poll Warbler on May 8 is of interest since Williams (1950) associates the appearance of either this species or the Cape May Warbler (*Dendroica tigrina*) along the Texas coast with northeasterly winds. According to his view they are blown off course from their usual migration route through Florida. Weather conditions on the 8th seem to substantiate this explanation since on that date easterly winds prevailed all along the coast from Florida to Texas.

Arrested waves were associated not only with cold fronts but also, on one occasion (May 4-5), with a period of westerly and northwesterly winds not directly related to a cold front. It is to be noticed (see Table 2) that of six waves reaching Smith Point during the period of study, five were associated with cold fronts and the sixth, on May 5, was in no way associated with a cold front, but followed a period of westerly and northwesterly winds on May 4. The average temperature at Galveston on this date was 79° F., the highest for any day in the study period. Barometric pressure was low in the Galveston region, while the daily weather map for the 4th shows a high pressure area off the Texas coast.

In the events of May 4, we see an exception to the usual sequence of spring migration along the Gulf Coast of Texas. Instead of prevailing southeasterly winds, interrupted on the average of once every six days by the arrival of a cold front, we have westerly winds accompanied by unseasonably warm weather. That migrants should halt in the face of warm weather seems strange, but it appears in this instance that the wind was the controlling factor. With the wind striking them on their port beam, they were in danger, if they continued their flight, of being blown out over the Gulf.

Southwesterly winds on April 19, on the other hand, did not appear to bring a significant number of new migrants into the area. But in view of the fact that 13 species of migrants were counted on that date, it would seem that weather conditions were retarding departures. Ordinarily the exodus of migrants should have been all but completed three days after the passage of a cold front (on April 16). Unfortunately it was not possible for me to make a count on the 20th. If the southwesterly wind had been responsible for grounding an appreciable number of migrants, it might have been revealed by a census on that date.

Departure of migrants.—On departure, wind direction, temperature, and pressure trends are the reverse of conditions prevailing at the time of arrival.

Departures were made, as a rule, under conditions of southerly winds, rising temperature, and falling barometer. The only exceptions were (1) an occasion on May 13, when departures occurred with a rising barometer, and (2) on May 6, following an arrested wave which resulted from westerly winds when departures occurred with lower average daily temperatures.

Rising temperature seems to be the major factor in hastening departure so long as the wind is in a favorable quarter. Bagg *et al.* (1950) speak of "significant temperature-rise and a southerly wind as the meteorological key to the onrushing wave" during spring migration.

Tail winds.—It so happens that southerly winds go hand in hand with rising temperature and, therefore, birds generally leave in spring when a tail wind is blowing. This is in contrast to the behavior of resident species which almost invariably fly directly into the wind or else quarter into the wind when it is strong. When a moderately strong southeast wind was blowing on April 30, 1951, resident birds, without exception, were seen to avoid flying with the wind. On that date the Galveston weather station recorded a southeast wind with an average velocity of 21 m.p.h. A flock of White-faced Glossy Ibises, (*Plegadis mexicana*) was seen flying just above the waves out over Galveston Bay, and directly into the wind. Another flock of the same species flew parallel to the coast and at right angles to the wind.

It is probable that in cases such as the ones cited, birds near large bodies of water avoid flying with a wind which might take them out over a body of water. Similarly migrants, as seen in arrested waves in the face of westerly winds, avoid making flights when there is danger of their being blown out over water. With southeasterly winds migrants face no danger of being blown out over extensive bodies of water, and apparently obtain a distinct advantage in flying with the wind.

It is not clear, however, whether strong tail winds interfere with migration. But in view of the almost complete absence of migrants in the census area at Smith Point when southeast winds of up to 30 m.p.h. were blowing, it is safe to say that strong tail winds along the coast do not result in precipitations of migrants such as occur when a norther strikes. This is either because the birds continue on their course in spite of strong tail winds, or else because birds are simply not overhead to be grounded by adverse conditions. It does seem logical to suppose that continued strong southeasterly winds would tend to push the main current of migration inland.

Summary and Conclusions

From April 17 through May 17, 1951, daily census counts were taken in a thicket at Smith Point, Texas, with the purpose in view of determining how migrating birds respond to changes in weather conditions. During this period birds were grounded in sizable numbers on six occasions. On five of these occasions the arrival of migrants coincided with the arrival of cold fronts. In the remaining instance a westerly wind was blowing. The following correlations between weather and migration were found to exist:

1. The arrival of a cold front invariably results in an arrested wave.
2. With the arrival of a cold front, migrants temporarily terminate their migration in the face of northerly winds, falling temperature, and rising barometric pressure.
3. The influx of migrants with the advent of a cold front is not immediate. Birds are present in maximum numbers on the day following the arrival of a cold front.
4. Southerly winds, rising temperature, and falling barometric pressure generally attend the departure of migrants.
5. In one instance westerly winds, which might tend to blow migrating birds out over the Gulf, had the same effect in pinning down migrants as the arrival of cold fronts.
6. Migrating birds were not seen to terminate their flight in the presence of strong tail winds.

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Box 376, Leesburg, Virginia, May 4, 1953

BODY WEIGHT AND FAT DEPOSITION IN CAPTIVE WHITE-THROATED SPARROWS IN RELATION TO THE MECHANICS OF MIGRATION[1]

BY ALBERT WOLFSON

In 1945 a study of body weight and fat deposition in transient birds was begun at Evanston, Illinois. The data for the White-throated Sparrow (*Zonotrichia albicollis*) for the years 1945-1947 have been analyzed and are in press (Wolfson, 1954). It was found that White-throats captured in the spring at Evanston varied greatly in body weight and that these variations were correlated with the amount of fat deposition. When the birds were classified according to fat deposition there were significant differences in the mean body weights of the four fat classes (none, little, medium, and heavy). The fact that birds arrived with different amounts of fat suggested that they had had different migratory behavior patterns during the 24 hours prior to capture. Those without fat (mean weight—22.9 gms.) possibly *had undertaken* a long flight the previous night which had brought them to Evanston on the date of capture. Those with "heavy" fat (mean weight—30.3 gms.) were thought to have been feeding in or near Evanston for the past several days and perhaps were "ready" *to undertake* a long flight at night. Irrespective of the interpretations, the marked difference in the body weight and fat deposition of these two groups of birds suggested that their behavior subsequent to arrival at Evanston would be different. On the basis of previous experimental studies (Wolfson, 1942, 1945), the birds without fat would be expected to remain "stationary" and restore their fat deposits. Those with heavy deposits would be expected to undertake a long flight as soon as other conditions were suitable.

The migratory behavior of transients can be studied by noting the length of stop-over time in a given locality and the number of birds which repeat during the migratory period. Two extensive studies of this kind have been made: Stack and Harned (1944) showed that the average stop-over time at Lansing, Michigan, was 4.5 ± 1.6 days. Borror (1948) found the stop-over time at Columbus, Ohio, to be 5.3 $\pm$ .3 days. At Columbus, the average percentage of repeats was 48.5. At Lansing, it was 24.0. These data would be more meaningful if we knew the body weight and fat deposition of the birds which were trapped only once, and the entire weight history of those which repeated. Judging from our earlier studies, I would guess that repeaters are primarily birds that arrive with little or no fat. Non-repeaters are probably birds with moderate or large amounts of stored fat. To determine the facts

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entails only recording of the body weight and fat deposition in banded and free-living transients. So far this has not been done by others, and we did not do it in our study. A major weakness of this method is that one may fail to retrap the "repeats" at the proper times. This would prevent a correct evaluation of body weight and fat deposits in relation to subsequent migratory behavior. For example, one may have several weight records which show a gradual decrease in weight for a repeating individual before it disappears from an area. One has no way of knowing whether this individual is foraging a short distance away, or whether it has undertaken a long migratory flight. To overcome this weakness it was decided to retain the birds in captivity after their initial capture and weigh them regularly. In this way the *potential response* of each individual could be determined. I say potential response, because conditions in captivity are far from identical with those in nature. It will remain for studies of free-living birds to determine what actually occurs in nature, but studies of captive birds can yield important clues. I would expect the observations in nature and those in the laboratory to be in agreement conceptually. Differences in degree, if they are found, will probably be readily explicable in terms of the conditions of observation.

The purpose of our study, therefore, was to determine the "weight" and "fat" response of spring transients which arrive with different body weights and amounts of fat. It was thought that a knowledge of these responses would be useful in understanding the migratory behavior of transients. A secondary objective was to compare the data on body weight for the various fat classes in these captive birds with the same data for birds captured in nature. This would give some idea of any degree of difference which might be due to diet or continual availability of food in captivity. Data were obtained in 1946 and 1947.

Methods

The methods of trapping, weighing, and classifying the birds according to age and fat deposits have already been described (Wolfson, 1954). In captivity the birds were housed in flight cages (24 × 15 × 19 inches, or 18 × 18 × 16 inches) which were kept in a large, unheated room. Light was provided by natural daylight. Four to six birds were housed in each cage. Food consisted of unmixed canary seed, dried insects, and dog food, and was available at all times. Water, cuttlebone, and grit were also available at all times.

Results

The first determinations which were made were the changes in mean body weight from the time of capture until the termination of the period of captivity on June 26 and 27. This was done to permit comparisons with the data of

TABLE 1
COMPARISON OF MEAN BODY WEIGHTS OF CAPTIVE BIRDS FOR SUCCESSIVE DATES, 1946–1947. NO SEGREGATION ACCORDING TO SEX, AGE, OR FAT CLASS.

	1946 Mean Body Wt.	1946 % change from preceding Wt.	1946 % change from initial Wt.	1947 Mean Body Wt.	1947 % change from preceding Wt.	1947 % change from initial Wt.
Initial Weight	27.8 (20)	—	—	26.6 (29)	—	—
May 7–10	——	—	—	26.7 (4)*	+ .4	+ .4
May 13–19	27.5 (20)	–1.1	–1.1	27.9 (10)*	+4.5	+4.9
May 23	27.3 (20)	– .9	–1.9	——	—	—
May 30	26.0 (20)	–4.7	–6.5	——	—	—
June 4	25.8 (20)	– .8	–7.3	——	—	—
June 11–13	24.8 (20)	–3.9 –9.8**	–10.9	24.7 (22)	–11.5	–7.1
June 26–27	22.3 (20)	–10.1	–17.7	22.6 (20)	–8.5	–15.1

*Data from None and Heavy fat classes only.
**Percentage from May 13–19 for comparison with similar period in 1947.

other investigators, and to test again the value of mean body weight determinations. In our first report (1954) it was shown that mean body weight determinations were of little value in themselves and tended to mask or distort important information. The data are presented in Table 1. The initial weight is the mean body weight at the time of capture for all of the individuals which were subsequently held in captivity. This is followed by the mean body weight for the periods of time or the dates given. From the time of capture, there were relatively small changes in weight until June 11–13. In June the mean body weights decreased markedly. The final mean weights and the percentage lost from the initial weight are almost identical for the two years. This pattern of weight change is what Baldwin and Kendeigh (1938) have shown to be true for many species. The weaknesses of mean body weight determination have been pointed out before and it will become evident that these same weaknesses are applicable here.

In view of the marked variations in body weight and fat deposition on arrival the changes in body weight were analyzed for each of the fat classes. The data for 1946 were more complete and suitable for this purpose, and they are summarized in Figure 1. Using the initial mean body weight as 100%, the percentage change is shown for each date of weighing for each fat class. The marked difference in response between the birds that were initially in the "heavy" and "none" fat classes is evident. By May 16 the birds in the "heavy" fat class had lost about 8% of their weight while the bird in the "none" class had gained about 15%. Unfortunately, only one bird was in the "none" class and four in the "heavy" class so that the quantitative aspects of these responses are open to question. They are also open to question because sex and age differences are not taken into account in this analysis. Nevertheless the pattern of response is consistent. Birds with "little" fat also gained weight. The birds in the "medium" class remained about the same. It is interesting to note that after the bird in the "none" class reached a maximum weight it began to lose weight just as the "heavy" birds did previously. It is also noteworthy, despite the weakness of the quantitative aspects of this analysis, that the "heavy" birds lost about 25% of their initial weight and the "none" bird lost about 22% of its *maximum* weight.

In view of the fact that "mean" figures tend to obscure the extent of response in individuals, especially in a group where the variations in time of response can occur, Table 2 was prepared. It shows the change in body weight and fat deposition for each individual of each fat class. The marked changes in certain individuals on a given date and the absence of any change in others is clearly evident. The variations in each group are also evident and emphasize the need for more data to determine the quantitative aspects with accuracy. In 1947, the dates of capture were too late and too irregular to permit comparison with the data for 1946.

To satisfy the secondary objective of the study—to compare wild and captive birds with respect to body weight and fat deposition—the mean body weights were calculated for each of the fat classes and are presented for both years in Table 3. The means and percentage change from the "none" class for each year are similar. The data for the captive birds are compared with the wild birds in Table 4. Birds in the wild are slightly heavier than those in captivity in all fat classes, but the differences are too small to be significant.

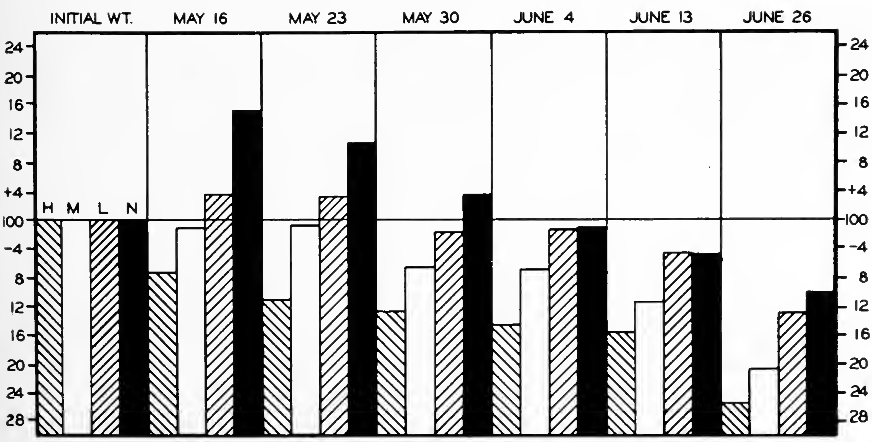

FIG. 1. Percentage change in mean body weight from initial weight for each of the fat classes in 1946. Abbreviations H, M, L, N, refer to fat classes. See text for further explanation.

TABLE 2
BODY WEIGHT AND FAT CLASS OF CAPTIVE BIRDS,
SEGREGATED ACCORDING TO FAT DETERMINATION ON DATE OF CAPTURE, 1946*

No.	Age	Cage No.	Date of Capture	May 16	May 23	May 30	June 4	June 13	June 26
					HEAVY				
83	Ad.	2	(14) 31.0–H	29.1–M	25.0–M	24.7–L	23.7–L	24.7–M	22.2–N
91	Ad.	9	(14) 31.6–H	28.4–M	27.0–M	26.6–L	27.0–L	26.3–L	24.3–N
64	Int.	10	(9) 32.2–H	30.5–H	31.0–H	29.1–H	28.5–H	27.5–M	24.0–L
80	Imm.	5	(11) 30.0–H	27.5–M	27.4–M	28.6–M	27.7–M	26.7–M	22.4–N
					MEDIUM				
73	Ad.	9	(11) 31.1–M	29.5–M	31.5–H	29.8–H	31.4–H	29.5–H	27.6–M
77	Ad.	9	(11) 26.2–M	24.7–M	24.3–M	22.9–L	23.7–L	22.4–N	21.2–N
78	Ad.	9	(11) 29.6–M	29.7–M	29.7–M	26.0–L	27.9–L	27.0–L	22.6–N
85	Ad.	6	(14) 28.2–M	27.0–L	26.5–L	25.2–N	25.4–N	26.6–L	22.5–N
88	Ad.	2	(14) 28.1–M	27.6–M	26.3–M	26.0–M	24.2–M	23.2–M	20.1–N
69	Int.	8	(9) 29.7–M	30.5–M	32.0–H	27.1–M	28.1–M	27.7–M	23.3–N
70	Int.	8	(9) 23.3–M	23.0–M	22.8–M	21.4–L	21.5–N	20.0–N	18.9–N
71	Int.	10	(9) 28.5–M	30.0–H	29.2–H	25.7–M	25.8–M	25.4–M	23.8–N
90	Int.	5	(11) 27.3–M	26.2–M	27.5–M	28.8–M	27.4–M	25.0–M	22.7–N
75	Imm.	6	(11) 26.1–M	27.0–M	28.0–H	27.8–H	25.6–M	22.3–L	20.8–N
79	Imm.	6	(11) 26.1–M	24.9–M	24.1–M	23.8–M	22.2–L	20.0–N	18.0–N
					LITTLE				
65	Ad.	10	(9) 23.5–L	24.5–M	26.0–M	25.3–M	25.1–M	24.6–M	23.2–L
74	Ad.	9	(11) 26.9–L	25.5–L	24.7–M	23.8–L	25.4–M	23.2–L	21.6–N
67	Int.	8	(9) 26.6–L	28.1–M	28.1–M	26.9–M	26.0–M	27.3–M	23.3–N
72	Imm.	8	(9) 24.6–L	27.0–M	26.0–M	23.8–L	23.7–L	21.9–L	20.1–N
					NONE				
62	Int.	10	(9) 25.8–N	29.7–M	28.5–M	26.7–L	25.5–L	24.6–L	23.2–N

(Weights on Various Dates)

*The number in the first column represents the last two digits of the band number, the complete number for the series of bands being *40–134100.* The number in parenthesis preceding the weight in the date of capture column is the exact day of capture in May. The letter following each weight indicates the fat class.

To put it another way, the mean weight of captive birds can be expected to be 95 to 97 per cent of the mean weight of wild birds for the same fat class.

DISCUSSION AND CONCLUSIONS

There is good agreement between captive birds and wild birds with respect to maximum and minimum weights. White-throats arriving in Evanston without fat have a mean weight of 22.9 grams. The lowest mean weight reached in captivity was 21.8. The maximum mean weight (on day of capture) for wild birds was 30.3 grams; for birds in captivity it was 29.5 grams. This agreement in wild and captive birds gives us a fairly good idea of the maximum range of variation which we can expect in the White-throated Sparrow. The data from the captive birds seem to strengthen the interpretation made earlier

(Wolfson: 1954) that a White-throat has a maximum of about 8 grams of "metabolizable tissue" which could be used to provide energy for sustained flights. If all of this were fat, an energy source of about 72 Calories would be available. Considering that the daily needs of a White-throat are about 18 Calories a day at 22°C and for a 15-hour photoperiod (Siebert, 1949), one gains some idea of the relative amount of energy available for a single flight at night.

The agreement in captive and wild birds of the mean weights of the fat classes substantiates our classification of birds according to their fat deposits, and confirms the existence of these "classes" in the White-throated Sparrow. It also suggests that the data obtained from captive birds are representative of what occurs in nature. The use of captive birds in ornithological studies is not only permissible, but could well be encouraged in view of the difficulty in making certain studies in the field. I do not suggest that laboratory studies replace field studies, but that they substitute for them when necessary, and

TABLE 3*

MEAN BODY WEIGHTS OF FAT CLASSES IN CAPTIVE BIRDS, 1946–1947

			Fat Class			
			Heavy	Medium	Little	None
Mean body weight	1947	M	29.23 (24)	25.81 (18)	24.85 (10)	21.26 (20)
		E	25.2 – 32.7	22.2 – 30.0	20.2 – 29.0	18.8 – 26.3
	1946	M	29.82 (25)	26.61 (85)	24.77 (53)	22.11 (42)
		E	26.4 – 32.7	22.8 – 30.5	21.4 – 27.9	18.0 – 26.9
	Both yrs.	M	29.5 (49)	26.5 (103)	24.8 (63)	21.8 (62)
Percentage increase from None class	1947		37.5	21.4	16.9	——
	1946		34.9	20.4	12.0	——
	Both yrs.		35.3	21.5	13.8	——
Percentage increase from lower preceding fat class	1947		13.3	3.9	16.9	——
	1946		12.1	7.4	12.0	——
	Both yrs.		11.3	6.8	13.8	——

TABLE 4*

COMPARISON OF MEAN BODY WEIGHTS OF FAT CLASSES IN WILD AND CAPTIVE BIRDS

		Fat Class			
		Heavy	Medium	Little	None
Mean body weight	Wild	30.3 (38)	27.2 (26)	25.7 (27)	22.9 (15)
	Capt.	29.5 (49)	26.5 (103)	24.8 (63)	21.8 (62)
Percentage increase from None class	Wild	32.5	18.8	12.1	——
	Capt.	35.3	21.5	13.8	——
Percentage increase from lower preceding class	Wild	11.5	6.0	12.1	——
	Capt.	11.3	6.8	13.8	——
Body weight of captive birds in relation to wild birds — in percentage		97.0	97.4	96.5	95.2

*In tables 3 and 4, M=mean, E=extremes, numbers in parentheses following weights indicate numbers of birds.

supplement them whenever possible.

The difference in response of the birds in the various fat classes during the first week in captivity suggests that a difference in migratory behavior might be expected in free-living birds. Birds without fat or with "little" fat may stop-over in an area for 4-5 days to replenish their "fuel" before their next major flight. Those with "heavy" and "medium" deposits of fat may be ready to undertake a major flight and will leave an area perhaps after being trapped once. The length of the average stop-over time (4–5 days) and the time it takes to deposit a "medium" or "heavy" amount of fat (4–6 days) are in close agreement. Judging from the condition on arrival, however, it is evident that a bird may not stay in a restricted area and "repeat" there until it achieves a "heavy" deposition of fat. It may move away after restoring its base weight (about 26.0 grams) or putting on some fat, and, hence, arrive at another trapping station with a "medium" or "heavy" amount of fat and without having "migrated" the night before. It would not be difficult for banders to study stop-over time, as has been done, and *add* observations on body weight and fat deposition.

Many more data are needed to determine the migratory behavior of transients, but the combination of studies of body weight and fat deposition in wild and captive birds shows promise of bringing us closer to an understanding of the mechanics of migration. In the last analysis, the problem of the mechanics of migration is a problem in ecology, behavior, and physiology, and many data from each of these fields will be needed to solve it.

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THE PTERYLOSIS OF THE NESTLING *COUA RUFICEPS*

BY ANDREW J. BERGER AND WILLIAM A. LUNK

It seems likely that differences in the pattern of the major feather tracts will be found of considerable importance in determining relationships within the order Cuculiformes. Berger (1953) recently described the pterylosis of an adult specimen of the Blue Coua (*Coua caerulea*). We are now able to describe the pterylosis of the nestling of another species. *C. ruficeps*, of this interesting genus. We are indebted to Dr. Renaud Paulian. Institut Scientifique de Madagascar at Tananarive, for his kindness in sending two sibling nestlings. These birds were taken from a nest near Ifotaka, Lower Mandrare. Madagascar.

Terminology of feather tracts follows that of Burt (1929).

Ventral tract. Marginal apteria (=submalar apteria) are present on each side of the inter-ramal tract. The *ventral cervical feather tract* is undivided anteriorly, but bifurcates about a third of the way down the neck. At the junction of neck and thorax, there is on each side a single row of feathers extending laterad to the ventral marginal coverts. Just anterior to this, another row (single at first) extends dorsad. then laterad. widening to become confluent with the anterior end of the humeral tract. (This row. being lateral in position, could not be clearly indicated in either the dorsal or the ventral view.) There is a wide lateral cervical apterium which is continuous posteriorly with the dorsally located interscapular apterium. Near the anterior end of the sternum, the ventral tract of each side bifurcates to form two *abdominal tracts.* The *inner abdominal tract* is composed of two rows of feathers throughout the sternal and anterior abdominal regions. and continues as a single row which stops short of the anus. The *outer abdominal tract.* also composed of a double row of feathers anteriorly and a single row posteriorly, does not turn inward to join the inner abdominal tract, but ends less than halfway between the posterior margin of the sternum and the anus. The lateral abdominal region is devoid of feathers. There is no anal circlet of feathers.

Capital tract. A very small median frontal apterium is present. There are small superciliary apteria; and between them there is a continuous feather tract in the frontal. coronal, and occipital regions, but the feathers are more widely spaced in the temporal and lateral occipital regions. Well developed eye-lashes are present on both eyelids, those on the upper lids being longer. There is a limited, pigmented, bare area around the eye in the superciliary, subocular, and postocular regions; in the latter the bare area extends only a short distance posterior to the bony orbital rim. The *spinal cervical feather tract,* broadest at the base of the skull, ends abruptly at about the level of the shoulder joint. The interscapular region is devoid of feathers. The bilateral *dorsal spinal feather tracts* begin at about the level of the first dorsal vertebra. These two dorsal tracts meet at the level of the hip joint to form a *median pelvic tract,* which terminates anterior to the oil gland.

There is a single *humeral* tract, composed of closely spaced feathers, raised above the level of the surrounding skin.

Alar tract. There are 10 primaries, 10 greater primary coverts, and 5 middle primary coverts. There are five alula quills. The carpal remex and its covert are present. The fifth secondary is present, *i.e.*, the wing is eutaxic (=quintocubital). According to the

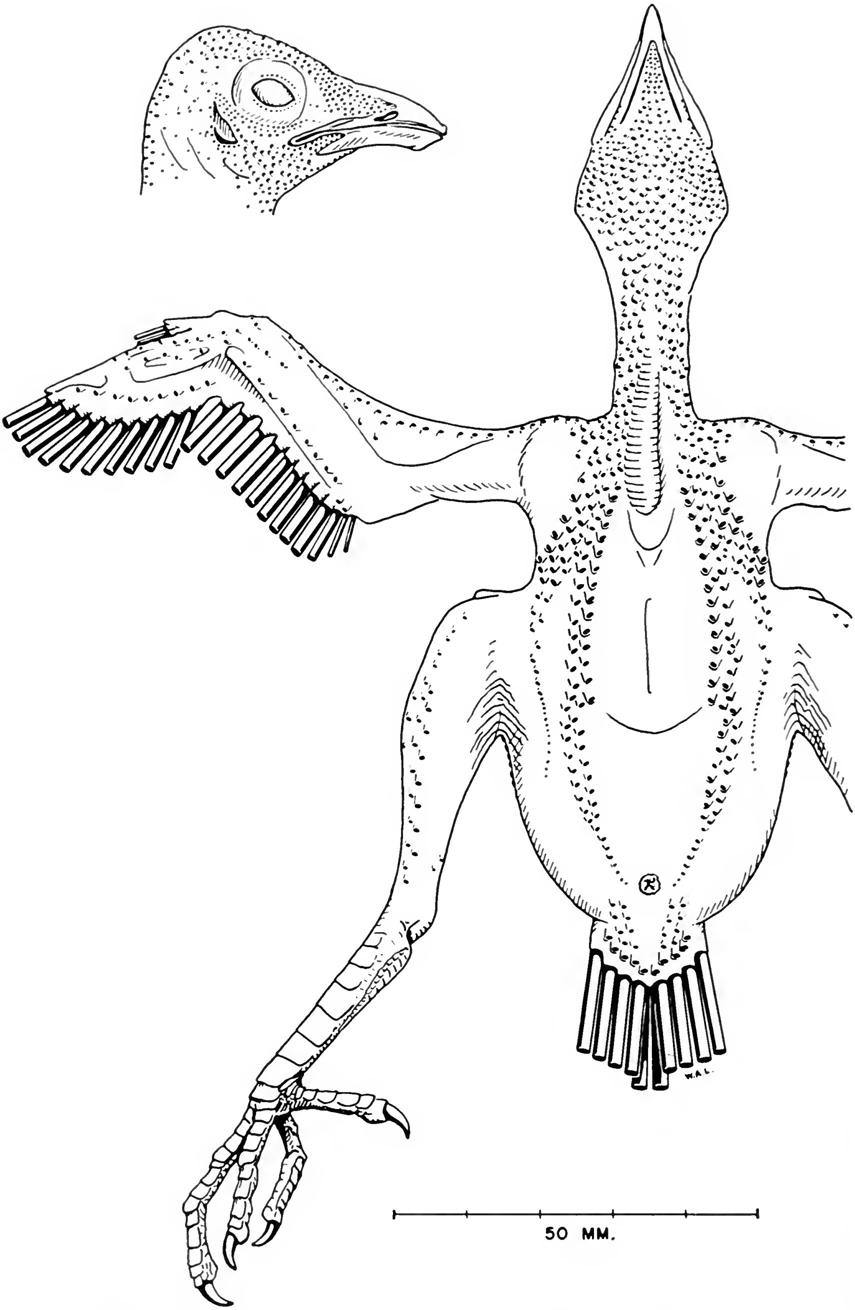

FIG. 1. Ventral view of nestling *Coua ruficeps* showing feather tracts.

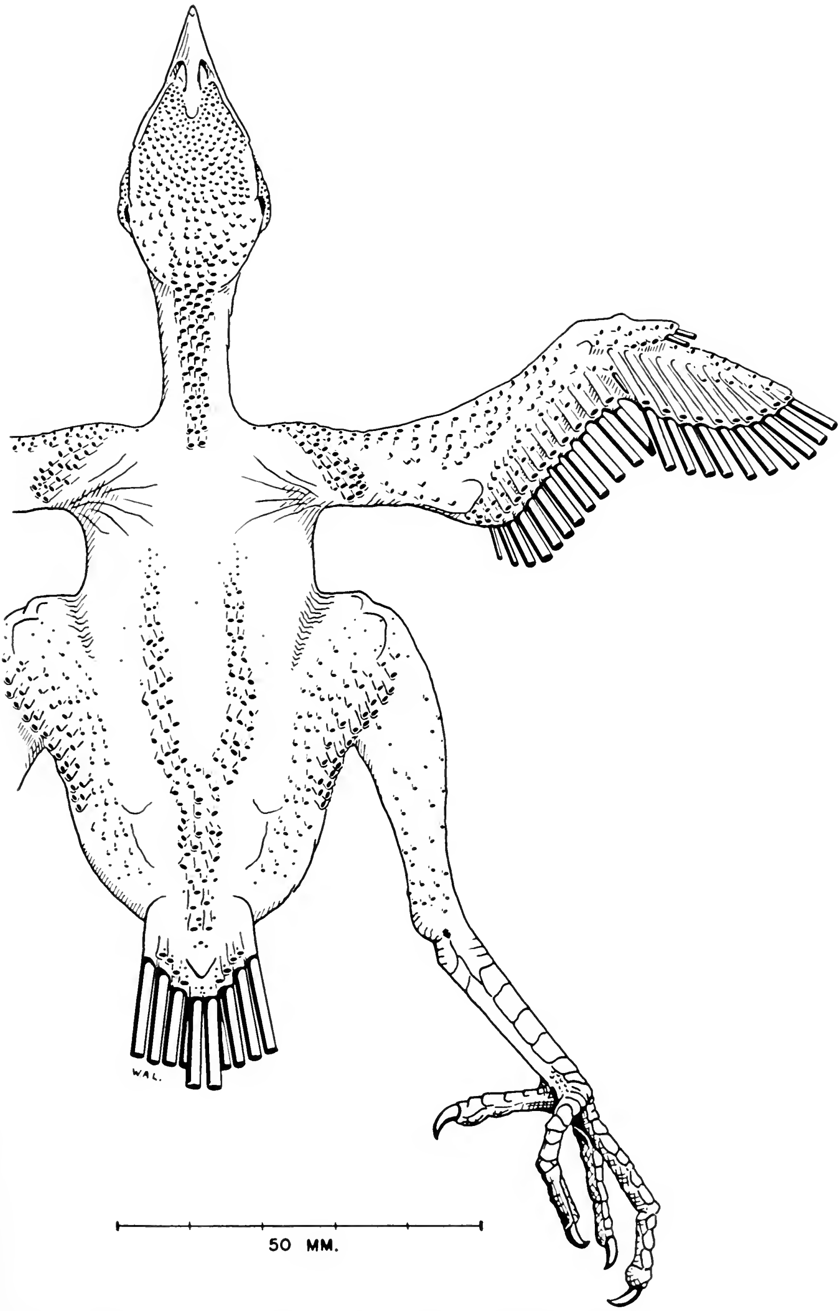

FIG. 2. Dorsal view of nestling *Coua ruficeps* showing feather tracts.

criteria we used, there are 12 secondaries, with 13 greater, 13 middle, and 15 lesser coverts. There is a distinct gap at the elbow between the secondary coverts and the tertials. (See discussion below.)

Caudal tract. There are 10 rectrices; the central pair (No. 1) is raised above the level of the others, and the second pair nearly meets beneath them. There are 8 upper and 10 lower tail coverts. The oil gland is nude. Three small feathers arising anterior to the gland send their shafts posteriorly over it.

The *femoral tract* consists of widely spaced feathers covering the outer aspect of the thigh and is bordered posteriorly by two well defined rows of very closely spaced feathers which extend onto the posteroproximal aspect of the crus.

The *crural tract* is best developed on the anterior aspect of the distal two-thirds of the crus, where it appears as a well defined, essentially double row. Laterally and posteriorly there are widely spaced feathers; the medial aspect of the crus is devoid of feathers.

Discussion

Little is known about the development of nestling plumage in cuckoos. Oberholser presented a photograph of two young *Centropus senegalensis* but made only a few general comments on the color of the plumage because many of the feathers were still sheathed and the wings and tail were "very imperfectly developed" (1899:27). Shelford (1900) described and illustrated the pterylosis of the embryo and nestling of *Centropus sinensis.* Herrick (1910: 198, 204–205) presented some data on feathers of the nestling Black-billed Cuckoo (*Coccyzus erythropthalmus*). Hartley (*in* Beebe *et al.*, 1917:309) illustrated the feather tracts in both the embryo and adult of the Smooth-billed Ani (*Crotophaga ani*).

To what extent the pattern of tracts described here for the nestling *Coua ruficeps* represents also the adult condition is not known. Nor is the feather pattern known for the nestling of any other species of this genus.

It seems probable, however, that new feathers continue to appear throughout the growth-period of the bird. Hartley's illustrations (*loc. cit.*) indicate that although the major feather tracts are visible in the embryo, additional tracts develop after hatching. In his report on the pterylosis of embryos of *Centropus sinensis*, Shelford (1900:654) spoke of the conspicuous covering of "long, white, thread-like structures" which he called "trichoptiles"; and that "dissection and microscopical examination show these threads to be enormous prolongations of the horny sheaths which envelop the developing feathers, a narrow lumen extends from the base to the tip of each, whilst the base of each lumen, again, is occupied by a feather-papilla, situated below the skin." Although Shelford found that "the arrangement of the trichoptiles is," in part, "prophetic of the adult pterylosis" (1900:666), he further stated: "The horny sheath of *all* the definitive feathers are not produced to form trichoptiles: whilst, on the other hand, certain areas occupied in the young nestling and embryo by trichoptiles are in later stages devoid of feathers" (1900:654).

In his fringillid studies, Sutton (1937) found whole new rows of feathers still coming in, particularly ventrally, after much of the juvenal plumage was complete.

There is no question that some marked change would be noted as the nestling matured. This is evidenced in the lack of symmetrical or regular alignment of feathers in the tracts, and in the great disparity in size between the "normal feathers," the much enlarged blood quills, and the minute, hairlike projections barely visible above the skin. The latter tend to be scattered, for the most part, along the periphery, and beyond the ends, of tracts. Whether they represent additional feathers that would later be as prominent as any of the others or whether they would remain rudimentary is as yet impossible to say. Some of the differences mentioned below would by inference be correlated with age, while others would represent specific characters. However, the following differences between the nestling of *ruficeps* and the adult of *caerulea* may be mentioned.

The feathers of the sterno-axillary region form a narrower and more compact tract in *ruficeps* than in *caerulea.* The inner abdominal tract extends to the anus in *caerulea,* but terminates lateral to that opening in *ruficeps.* An anal circlet of feathers is present in *caerulea;* it is lacking in *ruficeps.* In *caerulea* the outer abdominal tract turns inward to join the inner abdominal tract; in *ruficeps* the outer abdominal tract does not turn inward, and ends less than halfway between the posterior sternal margin and the anus.

In *caerulea,* the scapular region is covered by four widely separated rows of four feathers each and is connected with the spinal cervical tract by a single feather. In *ruficeps* the spinal cervical tract ends abruptly farther forward, at the level of the shoulder joint, and there is a long interscapular apterium between this tract and the two dorsal spinal tracts. In *caerulea* there is a single row of feathers down the midline in the median dorsal apterium; this character is not found in the nestling of *ruficeps.*

There is a single humeral tract in *ruficeps;* in *caerulea* there is an inner and an outer humeral tract. *Coua caerulea* has 10 secondaries; *ruficeps* 12. There is also a difference in the number of secondary coverts. In *caerulea* the secondary coverts seem to be continuous with the *distal* tertials at the elbow (see below); in *ruficeps* there is a wide diastema between the secondary coverts and the tertials.

The crowding and irregularity of feathers in the *ruficeps* nestling increase the difficulty of interpretation of certain differences between it and *caerulea*: *e.g.*, note the apparent shifting of relative positions in the region of the carpal remex and its covert. In *caerulea* the carpal remex and its covert are inserted into the dorsal surface of the basal sheath of the first primary. In *ruficeps,* however, these feathers are inserted into the skin proximal to the first primary, *i.e*, in the narrow diastema between the primaries and secondaries. Degen (1894:xxvi) believed that primitively the carpal remex had its attachment on the proximal phalanx of digit III. He believed further that a shifting of feathers from the manus to the ulna resulted from the ankylosis of certain carpal and metacarpal bones, and that the mechanical disadvantage of a flight feather located at the wrist joint resulted in the reduction in size of the carpal remex. Whether or not one accepts Degen's interpretation, the intercarpal location of the carpal remex and covert in the *ruficeps* nestling probably represents only a developmental position. It seems likely that continued ontogenetic differential growth, with an increase in size of the primary quills and a decrease in relative extent of the diastema, would "pull" the carpal remex and covert onto the surface of the basal sheath of the first primary. In this event, these feathers in the adult *ruficeps* would have similar relations to those found in the adult of *caerulea*.

Certain differences pointed out above center around the elbow region. Counts of greater, middle, and lesser secondary coverts, even the counts of secondaries themselves, and the separation or non-separation of secondaries and tertials, all seem to hinge on the correct interpretation of the small and crowded feathers near the elbow. To one who has not dissected the region in detail, or to one not thoroughly familiar with the accepted criteria of the various rows and tracts, the whole set of distinctions seems somewhat subjective. It is undeniable that to the reader who gives the drawings close study, the general pattern of feathers on the elbow and lower humeral region in the two species will look closely similar (compare with illustrations in Berger, 1953).

The secondaries (=cubitals) are by definition those flight feathers which "are seated on the fore-arm" (Coues, 1903:119). Though this seems to be a simple and clear-cut definition, it is not an easy matter to determine, in all cases, where the secondaries end and the tertials begin. There has been, in fact, considerable discussion on this matter. Wray (1887:344) stated that "the term 'tertials' or 'tertiaries' has been abandoned, 'cubitals' always including them when present, because there is no way of absolutely distinguishing any definite number of remiges as belonging to this special category." Pycraft (1889:134) felt that the feathers in question should be called "inner secondaries." Degen (1894:xxi) preferred the term "parapteron," which earlier had been used by Nitzsch. Newton (1896:780) also stated that tertials "have no separate existence," but Coues (1903:119) said that the tertiaries "are properly the remiges which grow upon the arm, *humerus*. But such feathers are not very evident in most birds, and the two or three innermost secondaries, growing upon the very elbow, and commonly different from the rest in form or color, pass under the name of 'tertiaries.' " Coues further remarked that the tertiaries "often afford good characters for description, in peculiarities of their size, shape, or color." A.A. Allen (1930:214) also said that the "innermost of the secondary group of feathers born on the 'elbow' are often elongated and spoken of as *tertiaries* or *tertials*." (For a further discussion of this problem the reader is referred to the paper by Sundevall, 1886, pp. 403–404.)

In the two specimens of *ruficeps*, all of the feathers borne on the elbow are attached either directly to the ulna or to the skin covering the olecranon process of that bone; consequently, they belong to the cubital series. It is not now possible to recheck this point on *caerulea*, but in determining the number of secondaries in that species, Berger dissected the wing so that the feathers could be traced to their bony attachments or to their position on the skin covering the ulna (the innermost secondaries are not actually attached to the bone). His statement (1953:13) that "the three rows of coverts are continuous with the tertials at the elbow," must be interpreted as meaning that in the adult *caerulea* there are small feathers located proximal to the cubital series and that they are inserted into the skin covering the distal part of the humerus and not into the skin covering the olecranon process of the ulna. The fact that the two series of feathers are in continuity increases the difficulty of deciding where one series stops and the other begins.

Probably because of this arrangement of feathers, the number of secondaries has not been used much as a diagnostic character; Ridgway (1916), for example, does not use this character. In some cuckoos, at least, the innermost two or three secondaries are progressively smaller and this fact plus the crowding of the coverts at the elbow region, makes an accurate count difficult if not impossible.

Those feathers which grow on the posterior aspect of the middle portion of the arm (=humerus) may be referred to as the tertiaries or as the parapteron. In plumage descriptions care must be taken to indicate whether a description pertains to this tract or to those sometimes elongated feathers, growing in the elbow region, which are attached to the skin overlying either the distal end of the humerus or the olecranon process of the ulna.

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ON THE SPURS ON BIRDS' WINGS

BY A. L. RAND

In handling specimens of birds bearing spurs on their wings, two points emerged which seem to be little known or new: (a) the horny covering of the wing spur, in some species, undergoes molt, and (b) the spur in some birds is a modification of a process already in existence for another purpose. In presenting these points, a summary of our knowledge regarding wing spurs is presented.

In early writings spurs and claws were confused until Jefferies (1881) pointed out that they are quite different: claws are horny sheaths on the tips of terminal phalanges (for a review of their occurrence see Fisher, 1940); spurs are projecting bony cores with an outer layer of horn, similar to the horns of cattle. Between the bone core and horn covering is a layer of tissue, the outer part of which produces new horn material. The horn must obviously increase in length from the base, the tip being the oldest (Gadow, 1891).

Well developed spurs occur on the tarsi of many gallinaceous birds, but wing spurs, all borne on the forward edge of the wing in the neighborhood of the carpal joint, are found only as follows.

Anseriformes

Anhimidae (Screamers).—All three species of this family have two conspicuous, stout, smoothly tapering, sharp spurs with a slight radial curve on each wing; the proximal spur is much the larger. They are both on the fused metacarpals; the proximal spur on the process of metacarpal I which is for the attachment of the extensor muscles; the distal spur on the distal end of metacarpal II (as figured by Sclater, 1886:150). Specimens examined show fine lines about the base of the spurs indicating growth in layers, and one specimen had three separate bands of these lines suggesting annual growth. The molt that occurs complicates this idea, however. Following are descriptions of the spurs in the three species, as seen in specimens in the Chicago Natural History Museum:

Anhima cornuta: the spur is triangular in cross section, with the side of the spur facing proximally, somewhat concave, and all the corners as well as the tip sharp; length of proximal spur, males, 58–61; females, 50–55; distal spur, males, 15, 16; females, 11–17 mm.

Chauna torquata: spur nearly oval in cross section but with a sharp-edged flange near the proximal edge, recalling the triangular, sharp-edged spur of the previous species; length of proximal spur, males, 30–47; females, 35–45; distal spur, males, 13–20; females, 15–17 mm.

Chauna chavaria (Fig. 1C): spur smoothly oval in section, sharp only at tip; length of proximal spur, male, 28; female, 30; distal spur, male, 18; female, 18 mm.

Anatidae (Ducks, Geese, etc.).—The ducks and their relatives number some 144 species. A number of genera have a projection near the carpal joint. This projection is conspicuous as a knob especially in *Sarkidiornis* and *Chloephaga* in which it projects beyond the feathering and bears a horny covering. This seems to be the process of metacarpal I. However, only two genera of the Anatidae, both monotypic, have a single well-developed spur on each wing. In the two species the spurs differ in position and some details; descriptions follow.

Plectropterus gambensis (Fig. 1D): the spur is borne on the radial carpal bone (skeleton, C.N.H.M.) as shown by Sclater (1886, p. 300). The spur is stout, strong, with a gradual taper, nearly oval in cross section, but with a tendency toward flanges giving small sharp edges. There is an area about 5 mm. from the base that suggests a growth ring in all specimens. Length of the spur in males is 20–25 mm., in females, 18–22 mm. In one specimen there is a small pad of horn on an auxiliary spur that appears to be the tip of the process of metacarpal I.

Merganetta armata (Fig. 1E): the spur is borne on the basal anterior edge of the metacarpal on the process of metacarpal I (specimen C.N.H.M.). The spurs are stout at the base, oval in section, and taper abruptly, but with an attenuated, very sharp tip. They differ from the spurs of *Plectropterus* also in that the horny sheath ends abruptly basally with an abruptly rounded edge indicating thickness of the horny covering to the base. No suggestion of growth rings is evident. Length of the spur in males is 9–17 mm.; in females, 6–13 mm. The spur of the female usually has a less attenuated and less sharp point.

Charadriiformes

Jacanidae (Jacanas).—Of the seven species in six genera in this family, only two species have well developed spurs:

Jacana spinosa (Fig. 1G) has a long conspicuous spur, borne on the process of metacarpal I (skeleton, C.N.H.M.), as figured by Sclater (1886:301). The spur is almost conical, with a slightly attenuated and very sharp tip. Faint lines suggesting growth rings are somewhat evident. The spurs of males measure 7–10; of females, 8–10 mm.

In *Hydrophasianus chirurgus* the spur is apparently similarly located and is short and very sharp; in males it measures 3–5; in females, 4–7 mm.

Another aspect of wing armature in this group is noteworthy in this connection. In *Actophilornis africana* (Fig. 1F), *A. albinucha*, *Metopidius indicus*, and *Irediparra gallinacea*, the radius is flattened and heavy, much heavier than the ulna (Forbes, 1881:646). In these species, spurs are absent, being represented only by the knob of the process of metacarpal I. *Jacana spinosa* and *H. chirurgus*, both with sharp spurs, have "normal" radii (Forbes, 1881:646–7).

Charadriidae, subfamily Vanellinae (Wattled Plovers and Lapwings).—Of the 25 species in 19 genera belonging to this subfamily I have examined 24[1] species in 18 genera and find a conspicuous spur in 10 species in 7 genera, a very small but distinct sharp spur in 4 species in 4 genera, and a condition in which a spur is represented only by the knob formed by the process of metacarpal I in 7 genera (see list below).

The following species have conspicuous, well developed spurs:

Species	*Length of Spur*	
	Male	*Female*
Belonopterus chilensis (Fig. 1H)	8–14 mm.	8–12
Xiphidiopterus albiceps	18–23	16–22
Rogibyx tricolor	15	no specimen
Lobibyx novae-hollandiae	16, 17	13–14
Lobibyx miles	15	no specimen
Afribyx senegallus	3–11	2–5
Hoplopterus spinosus	5–11	4–7
Hoplopterus armatus	9–12	7–12
Hoplopterus duvaucelii	11–13	6–15
Hoploxypterus cayanus	4–9	4–5

[1] I have not seen *Tylibyx melanocephalus* which is said to have no spur.

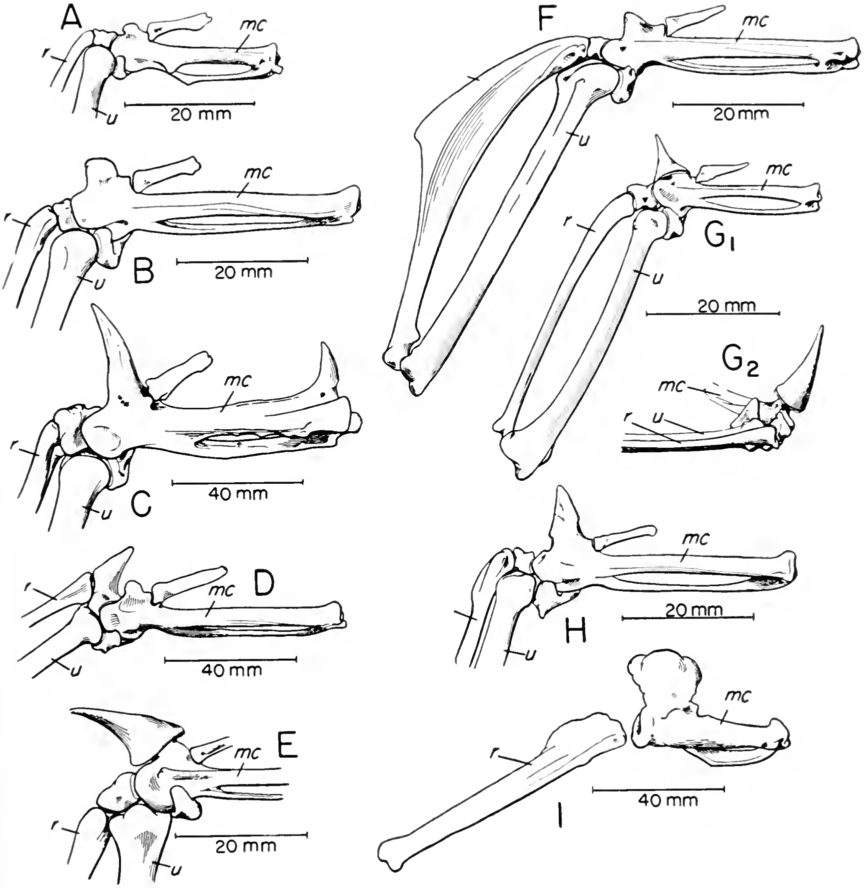

FIG. 1. Bony structures in the region of the wrist of birds. Species figured are: A, *Alectoris rufa;* B, *Haematopus ostralegus;* C, *Chauna chavaria;* D, *Plectropterus gambensis;* E, *Merganetta armata;* F, *Actophilornis africana;* G 1, *Jacana spinosa;* G 2, *Jacana spinosa*, another view, showing curve of spur; H, *Belonopterus chilensis;* I, *Pezophaps solitaria* (from Newton and Newton, 1868). A and B show "normal" process of metacarpal I; in C, E, G, and H, this process is elongated into a spur (drawn with horny sheath in E and G); C has an extra spur; D has the spur on a carpal; F has a thickened radius; I has a swollen knob on metacarpal and on radius. Abbreviations: *r*=radius; *u*=ulna; *mc*=metacarpal.

The following species, all in different genera from those listed above, have short spurs only a few millimeters long at most, but usually pointed and apparently horn covered: *Hemiparra crassirostris, Microsarcops cinereus, Lobivanellus indicus, Ptiloscelys resplendens.*

In the three species of *Stephanibyx;* the single species of *Zonifer, Lobipluvia, Sarciophorus, Anomalophrys,* and *Vanellus;* and two species of *Chettusia*, the knob formed by the process of metacarpal I can scarcely be called a spur. *Tylibyx* is said also to lack a spur.

I have examined skeletons of but two genera of the plovers with conspicuous spurs, *Hoplopterus* and *Belonopterus*, and in these the spur is on the process of metacarpal I (Fig. 1H) as in jacanas and screamers (main spur). In the other genera the spur appears to be in a similar location and presumably is also on the process of metacarpal I.

In these plovers with well developed spur, the spurs are usually more or less oval in cross section, somewhat flattened in *Lobibyx*, rather slender, sharply pointed, and more or less distinctly curved radially. Frequently there are faint, wavy lines running around the spurs which are suggestive of growth rings (see under molt), but otherwise the spurs are smooth at the base. Usually the spurs of the female are slightly smaller than those of the male.

Columbiformes

Raphidae (Dodos, Solitaires.—No pigeons have a wing spur as such, but the wing armature of the extinct solitaire, *Pezophaps solitaria* (Fig. 1 I) of Rodriguez (Newton and Newton, 1868), should be mentioned. In this species large examples, presumably males, have a considerable enlargement of the distal end of the radius, especially at the base of the fused carpometacarpus. While apparently not sharp pointed, it may well have been horn covered and certainly could have increased the wing's effectiveness as a weapon.

Other Groups.—The older literature sometimes mentions spurs on such birds as a thrush (*Turdus*), the knob-winged pigeon (*Didunculus*) of Samoa, and the moundbuilders (*Megapodius*) (Jefferies, 1881). Examination of specimens in the Chicago Natural History Museum showed no wing spurs on any of our specimens of these groups. However, the rather pronounced projection of the process of metacarpal I might be considered a rudimentary spur, as it could in most flying birds (see Fig. 1 A and B). Also, as Gadow (1891:501, 502) points out, cornification can occur sporadically on the skin of various parts of the bird's body, producing horny spurs, and to have this happen occasionally on the wings of birds which normally lack spurs is probable.

In summary, well developed wing spurs occur in: Anhimidae—2 spurs, in all 3 species; Anatidae—1 spur, in 2 of the 144 species; Jacanidae—1 spur, in 2 of the 7 species (rudimentary in all others); Charadriidae, subfamily Vanellinae—1 spur in 10 of the 25 species (present, small and sharp in a number of others).

The location of the spurs is as follows (Thomson, 1923:219), lists spurs as occurring on digits but none of his examples show this condition):

A. On radial carpal: *Plectropterus.*

B. On carpometacarpus: all others

- a. on process of metacarpal I: all except the distal spur of screamers.
- b. on distal end of metacarpal II near articulation of digit II: distal spur of screamers.

Functionally related structures are the enlarged radii of jacanas of the genera *Actophilornis*, *Metopidius* and *Irediparra* and the enlargement of the distal end of the radius and also of the proximal end of the carpometacarpus of a solitaire, *Pezophaps*.

Uses of Wing Armature

Spurs probably have their use in fighting. In many gallinaceous birds the tarsal spurs, worn only by the male, are definitely secondary sexual characters used in intraspecific fighting at mating time. Wing-spurs are well developed in both sexes of species in which they occur but those of the female are usually slightly smaller. This might imply they were not used primarily in courtship and mating. However, the jacana (*J. spinosa*) is said to have displays at mating time when with spread wings the birds act as though they were attempting to strike each other with their sharp spurs.

Some birds use their wings in fighting off enemies or intruders of other species. The swans (*Cygnus*), without spurs, make such effective use of their wings as weapons that they can be dangerous to children. The spur-winged goose (*Plectropterus*), with its formidable spurs, is said to be extremely aggressive and sometimes to injure other waterfowl with its spurs (Delacour and Mayr, 1945:28). Both male and female screamer (*Chauna torquata*) defend their nest with strong wing blows in which the spur is brought into play (Stoner, 1939:48).

One can assume that the bony enlargement of the carpal area of the solitaire and the thickened radius of certain jacanas serve to render blows more effective.

Origin of Wing Armature

Well developed wing spurs occur in only two families of each of two orders, Anseriformes and Charadriiformes. In one small family (Anhimidae) all the species have wing spurs, while in the related large family (Anatidae) about two per cent have spurs.

The diversity of the armature of birds' wings is apparent from the preceding summary. Two main effects are achieved: a club effect in two ways; a knife effect in one main and two less frequent ways.

It is interesting to note here that both club and knife or spear motive are present in one group, the jacanas, but no species has both. Those species with spurs do not have thickened radii.

Though wing armature is varied, the spur is the most common and in all but one species the spur (only the proximal spur in screamers) appears to be a continuation and modification of the process of metacarpal I, a process that in birds serves for the attachment of the extensor muscles. This process is easily felt through the skin of specimens of many, perhaps most, flying birds as a distinct point or knob. It gives the impression of a rudimentary spur. The size, shape, and position of this process apparently varies with the type of flight of the bird, as Fisher (1946:559) has demonstrated for some hawks and their relatives. Almost surely this process arose in connection with the attachment of extensor muscles. But once present, it made the wing more effective as a weapon when dealing a blow, as do some birds without spurs. Already useful as a weapon, a new set of selection factors, connected with fighting ability, could have operated to elongate the process and give it a horny coating to add to its effectiveness as a weapon. Presumably the process can maintain its first function as a point of muscle attachment and take over its new function as a weapon. This seems to be a good example of a structure arising for one purpose through the action of one set of selective factors becoming useful in quite another way when a certain point of development was reached. At this point the structure comes under the influence of another set of selective factors, and the direction of its evolution is changed. The present-day structure is the result of two sets of selective processes acting at different times.

Assuming that the process of metacarpal I is a ready made knob capable of being turned into a spur, it seems strange that this knob has been ignored, so to speak, in some species in which wing armature was achieved in other ways, as, for example, the spur on the radial carpal of the spur-winged goose (*Plectropterus*). It seems just as strange that in the jacanas certain species developed spurs while in certain other species a heavy radius was developed suitable for use as a club. No species has both.

It seems that wing armature originated separately a number of times; in the majority of cases a bony process already in existence was modified into a spur, but in some cases this process was not used and a weapon evolved along other lines.

Spur Molt

Molt of feathers usually occurs at least once a year. Molt of other epidermal structures is well known, but its occurrence is less general. Molt has been recorded for such structures as: the nails of the red grouse, *Lagopus scoticus* (Witherby, et al, 1941:227); the pectinations on each side of the toes that serve for "snowshoes" for the ruffed grouse, *Bonasa umbellus* (figured, Forbush, 1927:27); the outer sheath of the puffin's (*Fratercula arctica*) bill that serves as a nuptial adornment (Witherby, et al, 1941:172); and the "knob" on the bill of the white pelican, *Pelecanus erythrorhynchos*, that is worn during the breeding season (Baird, 1869). Apparently the spurs of domestic fowl at least do not molt, and I find only one mention of wing spur molt. Chapin (1939:86), writing of the plover *Xiphidiopterus albiceps*, says of a pair that were molting their remiges and rectrices, "Their wing-spurs were likewise about to shed the outer sheath, which could be lifted off, leaving a perfect new horny point beneath."

I have found further evidence of molt of wing spurs in three species:

(a) Screamer. *Chauna chavaria*.—In screamers there is characteristically a series of fine lines near the base of the spur which I assume are growth lines due to horn being laid down in layers. In one specimen there were three such series of lines separated by intervals. These lines I assumed to be annual growth lines. Hence it came as a surprise in handling a specimen of *C. chavaria* that an outer layer of one spur separated at the "growth ring" and slipped off as a cap, leaving the spur about 3 mm. shorter but in appearance much as it was before. This bird showed molt of flight feathers.

(b) Jacana. *Jacana spinosa.*—A specimen had long, pointed spurs (13 mm.) that showed irregular growth lines and a scaly appearance about the base. A gentle pull on each spur caused an outer layer of the horn of the spurs to slip off like a cap, leaving a pair of clean, pointed, shorter spurs (9 mm.) with less attenuated points. This specimen was also molting its remiges.

(c) Spur-winged Plover. *Hoplopterus armatus.*—A specimen had clean, fresh looking spurs 12 mm. long. A gentle tug on each spur caused the outer layer to slip off like a cap, leaving a pair of spurs similar to the old ones but about two mm. shorter. This specimen also showed molt of its remiges.

The data are scanty for generalization. The similarity of the spur before and after shedding makes it necessary to see the shed cap to realize what has happened. But from the three examples described above it appears that molt of the outer layer of the horn covering of spurs takes place in at least one species of screamer, one jacana, and two species of plovers. The correlation of this spur cover molt with wing molt indicates the former may be a regular part of the annual molt.

The structure of the spurs of birds has been compared to that of horns of cattle by Gadow. It is interesting to compare the molt of the covering of the spurs on wings of birds with the annual molt of the covering of the bony core of the horns of the Pronghorn, *Antilocapra,* which is similar.

Summary

The occurrence of wing spurs is noted for all species of screamers, some plovers, two jacanas, and two ducks. Additionally, knob or club-like wing armature is listed for several jacanas and a pigeon. These specialized structures occur on different parts of the wing and involve the radius, the radial carpal, or the fused metacarpals depending on the species. The structures are apparently used in fighting.

The process of metacarpal I (for the attachment of the extensor muscles) has been modified into the spur in a great majority of cases. This process presumably arose in connection with the insertion of muscles, and its size and location are influenced by the type of flight. But another result was that this knob made the wing more effective as a striking organ. This knob was then acted on by a new set of selective factors, those involved in providing the bird with better weapons, and a spur was produced. However, in a few cases wing armature developed independently from other parts of the wing.

Molt of an outer cap-like layer of the horny covering of the spur in a single piece is recorded in four species. In each case this molt was correlated with wing molt. It is possible that the annual molt may regularly include the outer covering of the spur.

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Chicago Natural History Museum, Roosevelt Road and Lake Shore Drive, Chicago 5, Illinois, March 26, 1953

GENERAL NOTES

Predation on bats by hawks and owls.—In the course of a year's investigation of the cave bats of the gypsum caves of south-central Kansas and northwestern Oklahoma, I made several observations on bat predation by hawks and owls which may be of interest.

On October 2, 1952, I saw a Barn Owl (*Tyto alba*) preying on Mexican free-tailed bats (*Tadarida mexicana*) while the evening flight of the latter was emerging from the entrance of Merrihew Cave (¾ mile south and ⅛ mile west of the Barber and Comanche, Kansas, county lines in Woods County, Oklahoma). The Mexican free-tails, which occur in this cave in great numbers from April until the middle of October, begin their evening flight shortly after sunset at this time of year. When flying from the cave interior to the outside, they form a steady stream consisting of numerous bats per cubic yard. It seems that they do not utilize echo-location while flying in such a dense flock. At 7:00 p.m., when visibility was still fairly good, a Barn Owl soared into this stream of bats at a height of about 20 feet above the ground and approximately the height of the top of the cave entrance. The bats made no apparent effort to dodge the owl. Approximately 10 feet in front of the cave entrance, the owl threw its head up and feet down and went into a kind of a stall. It was my impression that several bats hit the owl on its wings and breast and that one was picked off the breast with one foot. The owl then wheeled sharply and flew to a knob on the prairie some 75 feet away to devour its prey. Several minutes later the process was repeated. A third soaring attack into the flying stream of bats was unsuccessful and the owl immediately flew into the stream a fourth time, this time catching a bat and carrying it to an elm tree on top of the cave entrance. The owl seemed to use the same technique on each subsequent attack as described for the first. Macy and Macy (1939. *Jour. Mamm.*, 20:252) record two Red-tailed Hawks (*Buteo jamaicensis*) feeding on Free-tails at this same cave in August, 1934.

On the afternoon of December 7, 1952, while making homing experiments, I released 20 cave myotis (*Myotis velifer incautus*) at a wheat field on the state line ¼ mile east of the Comanche County line in Barber County, Kansas. The bats upon being released made two or three wide circles several hundred yards in diameter and then flew off ¼ to ½ mile and alit on trees or farm buildings. The following events were watched with binoculars. The fifth bat released circled once, then flew south, east and then north at a height of about 50 feet. At this time, a buteonine hawk soared from the north slightly above the bat, turned and struck at the bat from behind with its feet. The bat, however, darted about and began to climb. Although I did not collect this hawk, I tentatively identified it as a Rough-legged Hawk (*Buteo lagopus*) as a large white patch at the base of the tail was conspicuous. The hawk again attacked, the bat dipping to the side at the last moment. The bat continued to climb and the hawk missed twice more. At this point, a Sparrow Hawk (*Falco sparverius*) flew in from the north; this bird made two quick attacks upon the bat, both unsuccessful. The fifth attack by the buteo failed but on the sixth it appeared to throw itself downward, striking the bat with the right wing. The hawk immediately seized the bat with the left foot and flew back in the direction from which it came. The Sparrow Hawk also flew off to the north to a tree approximately ½ mile away.

I released another myotis and within less than a minute the Sparrow Hawk attacked it making four quick strikes the last of which was successful. The bird again flew off to the north. After a few minutes, another bat was released. The Sparrow Hawk again flew quickly after the bat, knocked it to the ground, and dived and captured it.

On February 27, 1953, at 5:00 p.m. while I was releasing bats 200 yards north of the mouth of Merrihew Cave, a Sparrow Hawk dived at a cave myotis as it flew into the cave entrance. The falcon missed and turned sharply aside, not following the bat into the cave. Several minutes later after the falcon had returned to its perch on a cedar tree approximately 100 yards southeast of the cave entrance, I released a second myotis. This time the falcon flew quickly towards the bat and dived at it from five feet above and missed it; the bird immediately flew over the bat again and neatly picked it out of the air with its claws. The Sparrow Hawk then carried its prey to the same cedar tree and there ate it.

On July 17, 1953, at Lost Colony Cave (4 miles south and 3½ miles west of Aetna, Barber County, Kansas) as I was observing the morning flight of cave myotis into the cave I saw a Sparrow Hawk dive on one of the many bats milling above the cave and catch it on the first attempt. This occurred at 4:58 a.m. when the illumination from the sky was less than one foot-candle. At 5:12 a.m. (illumination 13 foot-candles), an unidentified buteonine hawk was seen to make a sally at one of the many myotis returning from the east at this time, but I could not see whether or not a bat had been captured.

In addition to the above observations, I collected owl pellets from wood rat (*Neotoma*) houses near the entrances of caves. Three pellets, tentatively identified by size and shape as of Barn Owl origin, from Merrihew Cave contained remains of four, three, and two Mexican free-tailed bats each; three others contained one bat each of this species. A pellet identified as that of the Great Horned Owl (*Bubo virginianus*) contained six Mexican free-tails. All of these pellets contained only bats.

I have frightened Barn Owls from May's Cave (4 miles south and ½ mile west of Aetna, Barber County, Kansas) at all seasons of the year. This cave is occasionally occupied by the cave myotis and the Bunker bat (*Antrozous bunkeri*). A Barn Owl pellet from this cave yielded the remains of a Bunker bat and parts of a cottontail rabbit (*Sylvilagus*). I found a pile of bones 54 feet within this cave in a shallow concavity of a rock three feet above the cave floor. From the good condition of skulls and jaws, I judged these bones to be remains from owl pellets. Included in these bones were an amphibian jaw, a jaw of the collared lizard (*Crotaphytus collaris*), and remains of many small mammals including 10 cave myotis, three Mexican free-tails, and one Bunker bat.

With the exception of the pellet from May's cave, the identity of the pellets was tentatively determined by either Thane S. Robinson or Harrison B. Tordoff of the University of Kansas Museum of Natural History.—JOHN W. TWENTE, JR., *Department of Zoology, University of Michigan, Ann Arbor, February 13, 1954.*

A wintering concentration of eagles in Oklahoma.—A concentration of 108 eagles was counted on the Salt Plains National Wildlife Refuge near Jet, Oklahoma, on December 26, 1953. More were undoubtedly present in areas of the refuge not censused. It is known that the majority of the adult birds were Bald Eagles (*Haliaeetus leucocephalus*), and adult Golden Eagles (*Aquila chrysaetos*) also were observed. We made no attempt to identify immatures to species; however, on the basis of identifiable adults it is probable that more than 75% of the population were Bald Eagles.

It is common for eagles to winter on the refuge in numbers around 100. In 1953, one Golden Eagle remained for the summer, while two immature Golden Eagles arrived on October 5. On December 10, there was a mass immigration of 50 individuals including both species. Normally, the population decreases in March, and by the latter part of April all eagles have departed.—JOHN B. VAN DEN AKKER, *Salt Plains National Wildlife Refuge, Jet, Oklahoma, January 1, 1954.*

Mourning Doves nest in Black-crowned Night Heron nests.— On June 14, 1952, during banding operations in a large colony of Black-crowned Night Herons (*Nycticorax nycticorax*) on Harsen's Island, St. Clair County, Michigan, I found two young Mourning Doves (*Zenaidura macroura*) about eight days old in an unoccupied nest of this heron. The colony was in a permanent marsh where the water was 40 inches deep at the time. The heron nest was only 25 inches above the water in a small willow (*Salix* sp.). The doves had added only a few scattered straws to the original nest which was composed largely of coarse willow twigs, the entire mass being 20 inches in diameter. The Mourning Dove young were in the center which was slightly depressed. They were being brooded by an adult which left the nest reluctantly. Several occupied nests of the heron were nearby. Mention was made of this nest in "Bird Survey of the Detroit Region," 1952, Detroit Audubon Society.

On July 12, 1953, in the same colony, I found a Mourning Dove sitting on two eggs in a heron's nest in the same part of the colony. This was a nest which I had tagged and numbered 17 on June 7. At this time it held two eggs and one newly hatched young of the heron. The nest was 90 inches above the water in the upright fork of a willow. No new material appeared to have been added by the Mourning Doves.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, December 14, 1952.*

Yellow-billed Cuckoo's egg in Mourning Dove's nest.—On June 10, 1952, I found one egg of the Yellow-billed Cuckoo (*Coccyzus americanus*) in the nest of a Mourning Dove (*Zenaidura macroura*). The location of this nest was on the Cranbrook Estate in Bloomfield Township, Bloomfield Hills, Michigan. The measurements of the egg were 33.6 mm. by 23.3 mm. This nest, built on a horizontal branch at its juncture with the axis 92 inches above the ground, was discovered on April 29. It held two small nestlings of the Mourning Dove on this date. The young doves were banded on May 5, and observed on May 6, 11, and 13. They flew on the latter day. The empty nest, being beside the path which I walked three times daily to and from the Cranbook Institute of Science, was observed many times between May 13 and June 10 when the cuckoo egg was deposited. A Yellow-billed Cuckoo was heard in the vicinity several times previous to the deposition of the egg. I left the egg and made daily observations through June 16 but saw no cuckoo at the nest; on June 16 the nest and its contents were collected.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, January 4, 1954.*

Red-wings hatch and raise a Yellow-billed Cuckoo.—On June 2, 1953, when revisiting a nest of the Red-wing (*Agelaius phoeniceus*), I found that it contained three eggs of the hosts and one of the Yellow-billed Cuckoo (*Coccyzus americanus*). A fourth Red-wing egg lay broken on the ground directly below the nest. The nest was in a shallow marsh in southeastern Pontiac Township, Oakland County, Michigan. I had found this nest May 17 when it was not yet lined. Its height above the wet ground was seven feet, and it was fastened to five upright branches in the forks of a shrub willow (*Salix* sp.). A durable tag, numbered 10 for this location, was tied to the nest shrub on May 17. When visiting the nest again on June 11, I found two Red-wing nestlings about six days old and a Cuckoo nestling about the same age. The cuckoo exhibited wing quivering and a buzzing noise in a characteristic fashion. All three young were banded. I watched the nest for about half an hour from a distance of 30 feet with 7 × 35 binoculars. During this time the male Red-wing fed the young once and the female fed twice;

I could not see how the cuckoo was fed as the nest was too high. On June 14, three days later, the Red-wing nestlings crouched in the bottom of the nest when I lowered it for observation. The cuckoo stood erect with beak pointed upward for a moment, then climbed over the side of the nest. Its feathers had already burst from their quills and it appeared to be ready to leave the nest. The bottom of the nest was filthy from the cuckoo droppings which had not been removed by the Red-wings. My observations of many nestling cuckoos, both Yellow-billed and Black-billed (*Coccyzus erythropthalmus*) indicate that the droppings are not encased in gelatinous envelopes. The cuckoo was replaced in the nest where it remained until I left several minutes later. On June 18 the nest was empty, and I was unable to locate the young in the vicinity. According to many observations I have made on both nestling Red-wings and Yellow-billed Cuckoos, the cuckoo would have left the nest, normally, on the 9th or 10th day after hatching which would have been June 15, the next day after my last observation of the nestling. The nestling Red-wings normally should have left a day or two later or at least a day before I found the nest empty. I did not see adult cuckoos in the vicinity at any visit to the nest, but heard one calling at a distance on May 17, the day the unfinished nest was found.

While eggs of the Yellow-billed Cuckoo have been found in nests of the Robin (*Turdus migratorius*), Catbird (*Dumetella carolinensis*), Dickcissel (*Spiza americana*), Black-throated Sparrow (*Amphispiza bilineata*), Wood Thrush (*Hylocichla mustelina*), Cedar Waxwing (*Bombycilla cedrorum*), and Cardinal (*Richmondena cardinalis*), reported from several observers by A. C. Bent (1940. *U. S. Natl. Mus. Bull.* 176:56), I have not found any record of the eggs of this species in the nest of the Red-wing. The cuckoo egg was not measured, but was distinguished by its larger size, more oval shape, and lighter color from that of its black-billed relative.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, January 4, 1954.*

Avocets nesting in Kansas.—On May 15, 1951, two nests of the Avocet (*Recurvirostra americana*) were located by the writer in Finney County, Kansas, seven miles north of Garden City. One nest contained four eggs and the other, three eggs. The nests were again visited and photographed on May 22, 1951. The nest that previously contained three eggs had been destroyed. A third nest, containing four eggs, was located and of these two remaining nests, one was destroyed by the destructive hail storm of May 30, 1951. Eggs in the other nest hatched and the young survived.

During the spring of 1952 the writer located two more Avocet nests about four miles west of the nests observed the previous year. One of the two nests was destroyed by some unknown predator; three of the four eggs in the other hatched and the young survived. The pond around which the nests were observed in 1951 was dry in 1952 because of drought in the area.

On June 26, 1953, the area that had breeding birds in 1952 was again visited. Seven nests were located: all were on islands within the lake and each contained the full clutch of four eggs.

There are few previous nesting records of the Avocet in Kansas. Mr. Ed Gebhard of Meade, Kansas, told me that he has seen nests in wheat fields and around potholes in Meade County. Also, Mr. Frank Robl of Ellinwood, Kansas, told me he has seen nests in the Cheyenne Bottoms area of Barton County. It appears that the Avocet is a rather rare, but widely scattered nesting bird in western Kansas.—MARVIN D. SCHWILLING, *Forestry, Fish, and Game Commission, Box 864, Garden City, Kansas, August 1, 1953.*

Olathe Quail in Utah.—The Olathe Quail (*Lophortyx gambelii sana* Mearns), a pale washed-out subspecies of Gambel's Quail, has been considered to be confined to western Colorado in the drainage areas of the Uncompahgre and Gunnison rivers and the portion of the Rio Grande Valley lying in Colorado. During the summer of 1953, a Peabody Museum Expedition made a natural history survey in portions of Nebraska, Colorado and Utah. Two specimens of Gambel's Quail were collected, which, on comparison with three specimens of *sana* kindly loaned to me by the United States National Museum, prove to belong to that subspecies. A female with ovaries "granular" was collected August 17 two miles southwest of Fruita on the south bank of the Colorado River some fifteen miles east of the Colorado-Utah line. A male in breeding condition was collected July 22 near the McElmo River south of the Hovenweep National Monument in southeastern Utah, an extension of range into Utah for this form.

Both birds were collected in barren grassland on the edge of badlands, on higher ground above the river bottoms.—S. DILLON RIPLEY, *Peabody Museum of Natural History, Yale University, New Haven, Connecticut, November 25, 1953.*

North American birds on the Brazilian coast.—While visiting the Cabo Frio region (State of Rio de Janeiro) of Brazil from March 16 to 19 and August 3 to 5, 1953, I made some observations on wintering or migrating species of Northern Hemisphere birds. Although I collected no specimens, the records here presented may be of some interest, particularly in the case of the Arctic-nesting shore birds.

Cabo Frio is about 100 kilometers east of the city of Rio de Janeiro at approximately 23° S. latitude. The Cape is a bold headland which projects eastward into the Atlantic and in the vicinity are many long curved beaches, characteristic of this coast line, while behind the beaches are brackish and salt lakes and ponds, some tidal, some not. There are also many salt beds in the region where salt is obtained by the evaporation process.

Along the shore, or on these various lakes and ponds with their accompanying mud flats, the following species were seen:

Osprey (*Pandion haliaetus*).—An Osprey was observed on March 16 in the immediate vicinity of the Cape, where I saw it catch a fish in the open ocean and fly with it some distance across a bay where the bird disappeared behind a rocky headland. The Osprey reappeared quickly without the fish. The same bird, or another, was observed the next day in the vicinity circling at a great height with Frigate Birds (*Fregata magnificens*) and gulls. I saw an Osprey on a beach near the city of Rio de Janeiro on May 28, 1952, which is a very late date for a migrant.

Semipalmated Plover (*Charadrius hiaticula*).—Several of these plovers were with other shore birds on two different tidal mud flats and on the grassy shore of one of the large lagoons in March. Probably a total of a dozen were seen.

Ruddy Turnstone (*Arenaria interpres*).—Two seen August 3, on salt pans, in winter plumage. According to Pinto ("Catalogo das Aves do Brasil," 1938) this region is about the southern limit for wintering turnstones.

Spotted Sandpiper (*Actitis macularia*).—Two were with a mixed group of shorebirds on a tidal flat in March. One was in summer plumage and one in winter plumage.

Greater Yellow-legs (*Tringa melanoleuca*).—Five birds, apparently of this species, were seen on August 3 on salt pans near Araruama. Three were seen on August 4 on a mudflat of a small river also near Araruama. (Junea W. Kelly, of California, saw three Greater Yellow-legs on the salt pans June 1–3, 1953, so that evidently some of the birds are non-breeders and loaf away the northern summer here. She did not see any other species of shore-birds at that time.)

Lesser Yellow-legs (*Totanus flavipes*).—One was seen in March feeding on the edge of a drained salt bed.

Sanderling (*Crocethia alba*).—Flocks of 15 to 20 Sanderlings were seen in March on both mud flats and open beaches; those on the open beaches were very restless, frequently flying long distances along the shore. Nearly all were still in pale winter plumage. Six were seen with the Yellow-legs and Turnstones on August 3. These were also in winter plumage.

Barn Swallow (*Hirundo rustica*).—This species was the only one seen in March that could be definitely said to be migrating. Throughout the morning of March 17, flocks were passing northeastward, cutting across the sandy scrubby growth area to landward of the Cape.

One wonders to what extent these various migrants follow the shoreline. If they do so around the great eastward "bulge" of Brazil it would lengthen their journey enormously. In this connection, and showing that such is not always the case, it is perhaps of interest to record that I saw a Ruddy Turnstone (*Arenaria interpres*) at sea, flying directly south, on November 18, 1952, at a point roughly 100 miles from the Brazilian coast at about 10° S. latitude, or a short distance south of the easterly tip of the "bulge."—MARGARET H. (MRS. OSBORNE) MITCHELL, *Caixa Postal 4965, Rio de Janeiro, Brazil, April 24, 1953.*

Observations of sea birds off the southeastern Florida coast.—From September, 1952 to June, 1953 I was on eight voyages of the University of Miami Marine Laboratory's research vessel, T-19. Most of these one or two day trips were for the purpose of collecting plankton in the Gulf Stream between Miami and the Bahama Islands. Since little is known of the fall, winter, and spring distributions of many sea birds, careful observations and notes were made during the voyages. The results are given below by dates.

October 11: During about four hours of observation approximately 6 miles east of Miami, no sea birds of note were seen.

October 16–17: During this two day trip the T-19 maintained a position approximately 10 to 15 miles off the coast, drifting as far north as Ft. Lauderdale by the end of the second day. About eighty per cent of the daylight hours was spent on watch. On October 16 no sea birds of note were seen, but a Burrowing Owl (*Speotyto cunicularia*) circled the ship several times during the early morning. On the second day, in the late afternoon, an adult Pomarine Jaeger (*Stercorarius pomarinus*) in light plumage flew over the ship. Shortly after this a Cory's Shearwater (*Puffinus diomedea*) or a Greater Shearwater (*P. gravis*) flew across the bow. The light underparts were easily seen, but positive identification could not be made since there is a considerable amount of color variation in these two species. For several hours of the day a Clay-colored Sparrow (*Spizella pallida*) remained aboard, apparently exhausted. This seems to be an unusual record of a species that normally winters in Mexico.

November 25: The trip on this day lasted about five hours, about 10 miles east of Miami. The seas were moderate to heavy, and the wind was about 20 m.p.h. from the east. Twelve Sooty Shearwaters (*Puffinus griseus*) and eighteen Audubon's Shearwaters (*P. lherminieri*) were counted. An adult Gannet (*Morus bassanus*) was seen at a fairly close range. Again one Pomarine Jaeger was seen at very close range. It was an immature bird and in dark plumage. I am convinced that the identification was correct, because of the large size of the bird and the robust appearance of body and bill.

December 4: The entire daylight period was spent from 10 to 25 miles east of Miami in moderate to heavy seas with a 20 m.p.h. wind. About nine hours were spent on watch. Altogether, twelve jaegers were seen. Five of these were definitely Pomarine

Jaegers. Of these, two were adult birds in light plumage, and one was an adult in dark plumage. The two immature birds were seen in company with one of the adults. One adult Long-tailed Jaeger (*Stercorarius longicaudus*) was seen near dusk. The tail was very long; the bird was in light plumage and was certainly this species. Six other jaegers were seen, but could not be identified. I also saw two Sooty Shearwaters.

December 9: Again the entire daylight period was spent about 25 miles east of Miami. The seas were heavy and the wind strong. Three jaegers were seen, two of which appeared to be Long-tailed Jaegers, but identification was not certain.

January 8: The morning daylight hours were spent about 6 miles east of Miami. The seas were heavy. No sea birds were observed.

March 25: About eight hours of daylight were spent on watch 10 miles east of Miami. The seas were moderate to heavy. I saw only a single American Coot (*Fulica americana*) on the water about 5 miles from shore.

April 23–24: Most of the first day was spent en route to a position approximately 35 to 40 miles east of Miami within sight of Bimini, Cat Cay, and Gun Cay of the Bahama Islands. This position was maintained through the daylight of the second day. The seas and wind were moderate to slight. About seventy per cent of the daylight was spent on watch. During the first day only one doubtful Parasitic Jaeger (*Stercorarius parasiticus*) turned up. The second day produced six jaegers and two Audubon's Shearwaters. One of the jaegers was dark and large and probably was a Pomarine Jaeger. Five however, were definitely Parasitic Jaegers. Two were adult birds with variations of the light plumage, and three were immatures, seen with the adults. Many Sooty Terns (*Sterna fuscata*) and at least six Bridled Terns (*S. anaethetus*) were observed. In midday a Chuck-will's-widow (*Caprimulgus carolinensis*) circled the ship for fifteen minutes, attempting to land several times. I saw it at very close range, and the size and lack of white identified it as this species.—Richard W. Castenholz, *Department of Botany, The State College of Washington, Pullman, November 16, 1953.*

King Eider in West Virginia.—On November 28, 1953, along the Ohio River about 15 miles northeast of Huntington, Cabell County, West Virginia, two boys shot an unknown duck. They brought the bird to me that night, when I identified it as a King Eider (*Somateria spectabilis*). The presence of testes along with its plumage characteristics showed it to be an immature male. George Sutton has since verified the identification, and Maurice Brooks has informed me that it is the first record of the species for West Virginia.

The general color of the bird is dark brown above and lighter brown below. Many of the contour feathers have buffy tips which give the bird an overall mottled appearance. There is no indication of adult male plumage. and the large square frontal processes of the adult male are lacking. The feathers on the forehead extend to the hinder edge of the nostrils which is characteristic of this species.

It is interesting to note the occurrence of this species in neighboring states. For Ohio, Brooks (1940. *Auk*, 57:563–564) lists four records; for western Pennsylvania, there are seven records (Todd, 1941. "Birds of Western Pennsylvania."); for Virginia, five (Murray, 1952. "A Check-list of Virginia Birds."), all in the coastal region. There are no records of the species for Kentucky. There are occasional winter records on the coast for North Carolina, South Carolina, and Georgia. This West Virginia specimen then appears to be the most southern inland record of the species for eastern United States.

The testes were 3 mm. × 9 mm. The bird was not fat. The specimen, No. 44A–1, is in the Marshall College collection.—Ralph M. Edeburn, *Marshall College, Huntington, West Virginia, February 16, 1954.*

An American Bittern with a deformed bill.—On August 6, 1953, James B. Fleugel brought to me an American Bittern *(Botaurus lentiginosus)* which had been found standing on the shoulder of a road through a marshy area in Kalamazoo County, Michigan. The bird's lower mandible was slightly twisted and somewhat recurved. Its upper mandible was sharply decurved, crossing the lower on its left side. The weight of the living bird was only 256 grams.

Several teaspoonfuls of ground horse meat plus strips of freshly caught fish were force-fed to the bird between August 6 and August 10, 1953, the date when it died. At first the food was promptly expelled from the esophagus, but later it was accepted more readily. In spite of this feeding, the loss of weight continued; the bird weighed 235.5 grams at death.

The bittern was taken to the University of Michigan Museum of Zoology where P. S. Humphrey made the following additional observations. The bird was a juvenal female and contained no fat. The oviduct was visible and about 1 mm. wide, and the ovary was 12 × 3 mm. The breast muscles were much reduced; the gall bladder was probably much enlarged (14 × 11 mm.) and very dark blue-green.

Since the bill of this bird obviously had grown into this aberrant shape over a period of at least several weeks (*i.e.*, it was not suddenly and recently wrenched into that shape), it would be interesting to know how this bird was able to live as long as it did.—H. Lewis Batts, Jr., *Biology Department, Kalamazoo College, Kalamazoo, Michigan.*

Peculiar wall-scaling tactics in the English Sparrow.—During the early autumn of 1953 an estimated 400 English Sparrows (*Passer domesticus*) established a roost on an ivy-covered wall at Bradley University, Peoria, Illinois. By October defoliation of the ivy had progressed to the extent that a number of the roosting birds became completely exposed. On October 7, I observed an interesting tactic employed in ascending the vertical walls of the building. An excerpt from my field notes follows: "5:14 p.m.—A female, located about 15 inches below a male, crawled laboriously up the wall to within 5 inches of the male. During this ascent the female braced herself on two different occasions with her widely spread tail and wings. At this point in the ascent the male threatened the female and caused her to withdraw to her original perch. A few moments later the female again began her laborious ascent until she attained a position about 8 inches below the male. At this point she suddenly lost her footing and slipped downward a few inches to a slender twig where she clung crazily for five seconds while in an inverted position."

During these ascents the female at times utilized the slender vine branches for anchorage purposes. On several occasions, however, it was apparent that no leverage was attained other than that provided by the contact of her clutching toes, stiffened and widely disposed rectrices, and the tips of her out-stretched primaries against the weathered brick wall.—Oliver S. Owen, *Bradley University, Peoria, Illinois, November 13, 1953.*

Aerial feeding by the English Sparrow.—On September 27, 1953, at 4:45 p.m., I was on the roof of Bradley Hall on the campus of Bradley University, Peoria, Illinois, inspecting the English Sparrow (*Passer domesticus*) roost in the ivy covering the south and west walls. At this time at least six sparrows were observed feeding on flying insects, considerable numbers of which were in evidence several feet directly above the roof. One female sparrow perched quietly on top of the west wall, peered upward at the insects for ten seconds, then suddenly sallied upward at a 75 degree angle to a height of at least ten feet, seized an insect in its bill, and returned to the roof. This individual repeated the feeding maneuver to heights of three and four feet. The entire performance was very reminiscent of the feeding habits of flycatchers. One sparrow, flying leisurely over the roof, suddenly sallied upward six feet from its line of flight, apparently secured an insect, and then continued in its original direction.—OLIVER S. OWEN, *Department of Biology, Bradley University, Peoria, Illinois, November 1, 1953.*

Aerial feeding by White-crowned Sparrows.—On Oct. 24, 1953, at the Impounding Reservoir near Des Moines, Iowa, I was watching a group of immature White-crowned Sparrows (*Zonotrichia leucophrys*) in several young elm trees which were overgrown by a wild grape vine. Because of the mild weather, the grapes had not become withered and dried and the birds were eating these. Suddenly I noticed that several of the sparrows in the top of the tangle of vine were occasionally springing 15 or 18 inches in the air, returning to their former positions. Upon looking more closely with my binoculars I saw a swarm of gnats or other small insects hovering over the vine; the birds were catching, or attempting to catch, these. This was a feeding procedure which I had not seen before and which I do not find described in the literature.—WOODWARD H. BROWN, *4815 Ingersoll Avenue, Des Moines, Iowa, October 28, 1953.*

A hybrid between the Chipping and Clay-colored sparrows.—Hybrids between species of emberizine finches are rare; aside from crosses within the genus *Junco*, Cockrum (1952. *Wilson Bull.*, 64:150) lists but three such hybrids from North America. Of the three, one involves the genus *Spizella*, a record by Suchetet (1897. "Des hybrides à l'état Sauvage." I. Paris, J. B. Baillière et Fils) of a hybrid between the Clay-colored and Brewer sparrows (*Spizella pallida* and *S. breweri*). I have been unable to find this book, and it is possible that the "hybrid" was a specimen of *Spizella breweri taverneri*, which was described subsequent to Suchetet's work.

The scarcity of hybrids between species of the genus *Spizella* is perhaps surprising because two or more species of the genus nest in similar or adjacent habitats over wide areas. Chipping and Field sparrows (*Spizella passerina* and *S. pusilla*) are found nesting in the same field-borders and hedgerows throughout much of the northeastern United States; and in parts of Michigan, Wisconsin, and Minnesota, the Clay-colored Sparrow may be found in the same areas as the Chipping and Field sparrows.

Lovells, Crawford County, Michigan, is in the region where the three spizellas are all found as breeding birds. Here, Almerin D. Tinker collected two sparrows on May 29, 1932. One, a Clay-colored (number 510 in Tinker's field catalogue), was skinned by Norman A. Wood, and the other, number 511, by Tinker, himself. The latter skin appears to be a hybrid between the Chipping and Clay-colored sparrows. (It is interesting to speculate on what might have happened if Wood had prepared the hybrid and Tinker, the other bird; under those circumstances, I doubt that the hybrid would have remained undetected for 21 years. It is also interesting to note that when the hybrid was catalogued as number 115,640 in the collection of the University of Michigan Museum of Zoology, it was listed as a Chipping Sparrow.)

The most striking thing about the specimen is the color of the crown. The anterior part is dark with a light median stripe. The central (and largest) part is rufous with dark shaft streaks, which are broad on the feathers near the side of the crown and narrow on the feathers of the central part and thus form indistinct dark lateral and light median crown stripes. The effect of the light median crown stripe is heightened by some pale markings on the central feathers of the crown. The posterior part of the crown is lighter than the central part, is between rufous and grayish buff, and is streaked with dusky like that of a first-year Chipping Sparrow; unlike that part of the Clay-colored, there is no pale central stripe.

The bird also shows its hybrid origin in the color of its bill: the maxilla is dark except laterally at the base, and the mandible is light except at the tip. (At this season, the bills of Chipping Sparrows are all black, and those of the Clay-colored Sparrows are light except at the tip.)

In the length of the wing and in tail/wing ratio, the hybrid is also intermediate between the two supposed parent species.

	Wing length	*Tail length*	*Tail/wing*
Chipping Sparrow[1]	70.3 mm.	59.1 mm.	0.845
Hybrid	66.8	61.9	0.925
Clay-colored Sparrow[1]	61.4	60.2	0.982

[1] Mean of eleven males from the Lower Peninsula of Michigan.

(There is little difference between the lengths of the tails of birds of the two parent species; that of the hybrid is near the maximum size for both of these species.)

In other characters, the hybrid nature of Tinker's specimen is less striking. The ground color of the back is intermediate between the average color of that part in the parental species but can be matched by individuals of both. The dark streaks on the back are like those of most Chipping Sparrows but can be matched by those of some Clay-coloreds. The sides of the face and the ear coverts are light grayish buff, like the same areas of a Clay-colored but paler. The superciliary stripe is whiter than that of the Clay-colored and more like that of a Chipping Sparrow. The dark transocular stripe resembles that of a Clay-colored in being brownish black and in not extending anterior to the eye. There is a light "moustache" stripe like that of a Clay-colored but grayer than in most individuals of that species.

Tinker's catalogue gives little information about the specimen except that it was a male with "testes only slightly developed." This comment cannot be taken as an indication of possible sterility because the same comment was made about the Clay-colored Sparrow taken on the same day.—Robert W. Storer, *University of Michigan Museum of Zoology, Ann Arbor, Michigan, February 26, 1954.*

A fossil thrasher from the Pleistocene of Mexico.—Through the kindness of Dr. Claude W. Hibbard, I have been able to examine the tarsometatarsus of a thrasher from the Valley of Tequixquiac, Mexico. The exact site from which it was taken was Locality 8 (Hibbard, *Univ. Nac. Autonoma Mex., Inst. Geol. Boletin,* in press) just below Puente de Gallo, along the north bank of the Barranca de Acatlan, in deposits of Becerra Superior (Late Pleistocene). The specimen, number 49–26A in the collection of the Instituto Geologia Mexicana is tentatively referred to *Toxostoma ocellatum* (Sclater).

In its configuration, the bone closely resembles the corresponding element of *Toxostoma curvirostre*, but it is larger (36.7 mm. in total length) than three tarsometatarsi of that species in the skeleton collection of the University of Michigan Museum of Zoology (34.1, 34.2, and 35.5 mm.). Engels (1940. *Univ. Calif. Publ. Zool.,* 42:373) gives 32.7 ± 0.15 mm. for the mean and standard error for the length of the tarsometatarsus of this species but states (*op. cit.*:366–367) that the measurements of limb elements were "taken between proximal and distal articulating surfaces in such a way that their sums would most closely approximate total limb lengths." An attempt to approximate Engels' method of measurement yields figures approximately 1 mm. shorter than the total length, or 35.8 mm. for the fossil. The standard deviation (σ) of Engels' sample of this species is 0.90, hence the fossil is outside the range of the mean $\pm\ 3\sigma$, and therefore is almost certainly not *T. curvirostre.*

According to Ridgway (1907. *Bull. U.S. Natl. Mus.* 50, No. 4:191–199), the related species, *T. longirostre* and *T. ocellatum,* have tarsometatarsi which average 2.3 and 3.8 mm., respectively, longer than those of *T. curvirostre* (measurements taken from skins). Since the latter difference more closely approximates the difference between the length of the fossil and the mean of Engels' series (3.1 mm.), the fossil is tentatively referred to *T. ocellatum,* until an adequate series of skeletons of *T. ocellatum* and *T. longirostre* can be examined.—Robert W. Storer, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan, February 26, 1954.*

A new nesting locality for the Common Tern.—On July 18, 1953, I visited a rock pile at the southern end of Cayuga Lake at Ithaca, New York. This rock pile was part of an old breakwater, running for a distance of about 75 feet at right angles to the wall at Cayuga Inlet, but disconnected from the latter by several feet. The pile, now a jumble of rocks and small boulders, rises only a few inches above water level. There are a couple of small patches of vegetation, but the pile is essentially an open "rock beach" with some debris washed up on it. The pile cannot be reached by walking since the nearest land, a couple of hundred feet away, is the mud flat of the southern end of Cayuga Lake. Thus this rock pile is surrounded by water; it is relatively isolated from dogs and rats, and is not often visited by humans.

As I moored my boat two Common Terns (*Sterna hirundo*) circled and screamed a few feet over my head, and soon one of them started diving at me. Just a few steps from my boat was a tern nest containing two warm eggs. This is the first nesting record of the Common Tern in the southern Cayuga Basin.

On July 23, I revisited the site and found another tern nest, with three warm eggs, on a second island in the same old breakwater. On July 24, Arthur A. Allen visited this little tern colony. He took pictures of the eggs and the incubating bird at the second nest and found that the two eggs of the first nest had been washed away. On July 30, a group of Cornell students found the three eggs still there and warm, but one egg, with a well-developed embryo, was badly cracked. The morning of August 4 I found an adult still incubating the two eggs.

On August 8, Arnold Wellwood visited the tern nest and found that the eggs were cold. Other students visited the spot in the next few days and also reported the eggs cold. On August 23 I went to collect the eggs but found them gone. The nest had been washed over by the waves.

Up to 1953, the nearest records for Common Tern colonies were Oneida Lake, which is on the southwest end of Henderson's Bay (Jefferson County) on Lake Ontario, and Sandy Point, near Lake Ontario. There has been strong evidence that Common Terns occasionally nest at the Montezuma Marsh, at the north end of Cayuga Lake, but as far as is known the first actual nest for the Marsh was found on June 30, 1953, by Oliver Hewitt. There has also been considerable evidence that terns have nested in recent years on an island at the north end of Cayuga Lake, but no nest has been found there.—Mary P. Sherwood, *Department of Conservation, Cornell University, Ithaca, New York, October 5, 1953.*

Vertical migration in certain fringillids.— For two summers, while employed as a ranger at Shenandoah National Park in northern Virginia, I have been able to observe birds from late June until early September. The Park embraces a stretch 75 miles long in the Blue Ridge Mountains, rising from approximately 600 feet in elevation in the Shenandoah Valley to 4049 feet at the highest point, Hawksbill Mountain. Some 200 species and subspecies of birds have been recorded in the Park (Alexander Wetmore, "The List of Birds of the Shenandoah National Park," Shenandoah Natural History Association, Bulletin 1, 26 pp., September, 1950, *and* Supplement, 2 pp., August, 1952.) The observations reported here were made mostly at Hughes River Gap, a point 3100 feet in elevation, on the ridge astride the Madison-Page county line and traversed by the well-traveled Skyline Drive.

Many birds occur at Hughes River Gap with some regularity. The Rose-breasted Grosbeak (*Pheucticus ludovicianus*), a summer resident from May 9 to October 2 (dates of residence are from Wetmore, *op. cit.*), is found chiefly above 3000 feet. The Red-eyed Towhee, (*Pipilo erythrophthalmus*), resident from March 27 to October 23, is common at the Gap. The Field Sparrow (*Spizella pusilla*) is common in summer and some winter at the lower levels. The Slate-colored Junco (*Junco hyemalis*) is a permanent resident, mostly above 2500 feet in summer although in winter it may descend to the valley. All of these species breed in the vicinity of the Gap.

Aside from certain altitudinal movements associated with the seasons, as mentioned above, a peculiar sort of movement was noticed among two species common at the Gap, the Indigo Bunting (*Passerina cyanea*) and the Eastern Goldfinch (*Spinus tristis*). The bunting is a common summer resident in the Park from May 9 to September 7, while the goldfinch is resident the year around, being common from late April to early November and irregular through the winter. At the Gap, Indigo Buntings were common in early summer; juveniles, well able to fly, were noted here on July 24. But the species was last seen at the Gap on August 2 both in 1952 and in 1953. The Indigo Buntings from the Gap seemed to retreat to deeper woods and bogs at lower levels. The goldfinch, however, was seen rarely at the Gap in the early summer (only on July 12, 23 and 31, 1953), but was observed, often in flocks of a dozen or so, almost daily throughout August in both years. On August 22, 1953, a goldfinch was singing lustily from a perch atop a white pine which had been similarly used by a bunting in late July. There seemed to be a peculiar reciprocal nature to the presence of these two species at the Gap. That they were mutually exclusive because of competition for food is difficult to believe. Perhaps the situation is traceable to the late breeding habits of the goldfinches.—RICHARD H. MANVILLE, *Department of Zoology, Michigan State College, East Lansing, Michigan, October 13, 1953.*

An observation on Redhead parasitism.—The semi-parasitic nesting habits of many ducks—and especially the Redhead (*Aythya americana*)—are well known (Friedmann, 1932. *Proc. U.S. Natl. Mus.*, 80:1–7). While normal Redhead nests may be found, the species is notorious for its "dump nests." Thus the nests of Canvas-backs (*Aythya valisineria*) and other species may be found containing 20 or more Redhead eggs. Low (1945. *Ecol. Monogr.*, 15:47) suggests that "dumping" occurs either before the Redheads have constructed their nests or after an early nesting failure.

Hochbaum (1944. "The Canvasback on a Prairie Marsh," p. 91) says: ". . . parasitic females probably drop their eggs in the nests of other species during the absences of the owner at this time" (during the egg-laying period). He also states (*op. cit.*:93) that "There is no evidence of severe friction between nesting hens, except in instances of

Top left—Redhead has pushed on to the nest and sits with closed eye while being pecked on the head by the Canvas-back. *Top right*—the Canvas-back and Redhead sit quietly on the nest side by side during a brief pause in their struggles. *Bottom left*—the Canvas-back pecking at the Redhead's head. *Bottom right*—Redhead leaves the nest, still being pecked by the owner.

parasitic intrusions . . ." The following observation provides an instance of a Redhead laying in a Canvas-back nest while the owner was present.

On May 25, 1952, the nest of a Canvas-back was found at Delta, Manitoba. This nest contained 8 eggs which subsequently hatched successfully on June 20. At the end of May, a blind was erected some distance from the nest and gradually moved closer. Although the duck was nervous at first, it soon became possible to watch her normal behavior on the nest from a distance of about 15 feet.

On the afternoon of June 18, the Canvas-back had been observed incubating normally for about 2 hours when suddenly a female Redhead appeared at the side of the nest and pushed her way on to it. The owner reacted immediately by pecking vigorously at the Redhead's head, but the latter merely eased herself further on to the eggs and did not attempt to retaliate. The two birds remained sitting side by side for a period of 4–5 minutes. The Redhead appeared rather sleepy or dazed and frequently closed her eyes. This may have been due partly to the rain of blows which the Canvas-back delivered at her head. After the birds had changed position once or twice while struggling, the Redhead rose from the eggs and moved off the nest, and the owner returned to normal incubation.

When the Canvas-back was flushed some time later, a fresh Redhead egg was found in the nest.

Although this is an isolated observation, the fact that successful egg-dumping was achieved while the owner remained on the nest suggests that this may be a normal technique adopted by Redheads.—D. F. McKinney. *Severn Wildfowl Trust, Slimbridge, Gloucestershire, England, October 14, 1953.*

Diurnal foraging by the Great Horned Owl.—Diurnal foraging by the Great Horned Owl (*Bubo virginianus*) has been noted by various workers. Bent (1938. *U.S. Natl. Mus. Bull.*, 170:312), for example, reports observations made in the middle of the day of these owls soaring like large hawks. While doing field work in August, 1953, in the Riverside Mountains of California, a desert range bordering the west side of the Colorado River approximately 35 miles north of Blythe, Riverside County, I was impressed by the diurnal activity of the Great Horned Owl. On many occasions, while hiking up canyons of the east slope of the range in late afternoon, I observed owls that seemed to be foraging. I watched one individual with binoculars for a short time, and saw it perch on several commanding outcrops of rock on the steep walls of the canyon, staying approximately a minute at each vantage point. The time was more than an hour before sundown and the rims of the canyons were in sunlight, although the canyon in which the owl was noted was in deep shadow. Indirect evidence was obtained indicating that Great Horned Owls foraged in this area even in full daylight. In a large grotto, from which an owl had repeatedly been flushed, I discovered in weathered owl pellets the nearly complete skull of a chuckwalla (*Sauromalus obesus*), a large iguanid lizard active only during the hottest part of the day. To catch this chuckwalla the horned owl probably foraged in the sunlight. The following species also were taken from the owl pellets: pallid bat (*Antrozous pallidus*), pocket mouse (*Perognathus formosus*), kangaroo rat (*Dipodomys merriami*), wood rat (*Neotoma lepida*), and cottontail (*Sylvilagus audubonii*).

Evidence from trapping small mammals suggested a possible explanation for the diurnal activity of horned owls in this area. Rodent activity was low in the Riverside Mountains area when these observations were made and the rodents foraged mostly in early morning. Consequently the horned owls may have been unable to obtain sufficent food during their usual nocturnal hunting, and of necessity may have extended their foraging into the daylight hours.—Terry A. Vaughan, *Museum of Natural History, University of Kansas, Lawrence, December 30, 1953.*

American Bittern in Virgin Islands.—One of the rewards of living on a small, isolated sea island is the thrill of discovering, now and again, a new inhabitant. On the morning of October 7, 1953, I flushed a tall, buff-colored bird in a partly overgrown cow pasture at Estate Anguilla, St. Croix, Virgin Islands. At first I thought it was a young night heron. Something about this bird, however, did not appear right so I collected it. It was an American Bittern (*Botaurus lentiginosus*). The only bittern ordinarily found in the Virgin Islands is the Least Bittern (*Ixobrychus exilis*), and this is very uncommon. The closest point from which American Bitterns have been previously recorded is the island of Puerto Rico, 80 miles to the northwest. This bird was prepared as a skin; it measured as follows: wing, 255 mm.; tail, 85 mm.; bill, 66 mm.; tarsus, 85 mm. The stomach was practically empty. The bird was very light, but appeared to be in sound condition. No ectoparasites were found.—George A. Seaman, *Wildlife Biologist, Christiansted, St. Croix, Virgin Islands, October 16, 1953.*

A second flock of Whooping Cranes.—On March 20, 1952, I was seeking to study the Lesser Prairie Chicken (*Tympanuchus pallidicinctus*) about ten miles southeast of Arnett, Ellis County, Oklahoma. It was a beautiful spring day, with clear sky and balmy temperature. From time to time another and yet another flock of Sandhill Cranes (*Grus canadensis*) would fly past, all going practically due north. About 4 p.m. a flock of at least 200 Sandhill Cranes flew directly over my head, "bugling" loudly. I glanced at the flock then, but did not notice any as being different from the others in this brief belly view.

When this flock was between a quarter and half a mile north of me, it evidently encountered a thermal, because it began an upward spiral. This maneuver is common among cranes. When the flock was at the east side of the circle, I noticed a gleam of white at one edge of the flock, and focussed my 8 × 30 binoculars on it. The sun shone on half a dozen snowy white birds, with sharply marked black primaries. My observations totalled at least a minute with good focus.

For an instant I thought there must be White Pelicans (*Pelecanus erythrorhynchos*) in the flock. But pelicans flap and coast . . . these birds flew like all the other cranes, with steady beats and a curious quick upward flip of the wings each time. Their long legs trailed behind, their long necks stretched out in front. They, too, were cranes.

Two days later I went down to the Aransas Wildlife Refuge in Texas where the Whooping Cranes (*Grus americana*) winter. One of the assistants to whom I talked did indeed think that some of theirs might have started north, and been the ones I saw. But the director, Mr. Julian Howard, wrote to me that still later counts revealed that all of their Whooping Cranes were still in Texas at that time. He also said that he had a number of other records of a possible additional small flock of Whooping Cranes, presumably wintering in Mexico, but all the other records were more questionable than mine.

Having collected birds and prepared skins, I am well aware of the lack of certainty involved in all sight records. The present record, however, is based upon birds of such conspicuous marking that it is worthy of notice.—MAX W. DELAUBENFELS, *Department of Zoology, Oregon State College, Corvallis, Oregon, April 23, 1953.*

[See Robinson, 1953, *Wilson Bull.*, 65:211, for a sight record of a Whooping Crane in south-central Kansas on March 23, 1952. It seems probable that this record might pertain to one of the birds reported by Prof. deLaubenfels.—Ed.]

Additional notes on the birds of southwestern Kansas.—In the fall of 1952, Richard R. Graber and I visited Morton County, Kansas for three days, September 2–5. Among the birds that we collected were two species not heretofore reported from Kansas and several not reported in the fall. We made most of our observations in a large grove of cottonwoods along the Cimarron River about 8 miles south of Richfield, and about 6 miles east of Kansas highway 27.

Since there are no published accounts of early fall migration in western Kansas, I have included in the following list, species of especial interest as far as distribution or migration are concerned. It is not, however, a complete list of species encountered.

I am grateful to Dr. George Attwood of the U. S. Soil Conservation Station, Elkhart, Kansas, for permission to collect in the area. I wish to thank Dr. Allan R. Phillips for identifying specimens and Dr. George M. Sutton for the use of his collection.

Stellula calliope. Calliope Hummingbird.—While I did not see a single hummingbird in four months of field work in the spring of 1950, on September 3 I saw and collected an immature female (RRG 1807) which measured: exposed culmen, 14; wing, 45; tail, 24 millimeters. The dorsum is bronze-green, and the flight feathers dark gray. The sides, belly, undertail coverts, and flanks are buffy. The feathers of the throat have a median spotting of dusky brown. The auriculars are light gray. The tail has subspatulate rectrices with a relatively large amount of terminal white on the outer three. The white on the third rectrix is equally distributed on the inner and outer webs. The median pair of rectrices are bronze-green with blackish tips. The next three pairs of lateral rectrices have narrow, but distinct, edgings of cinnamon-buff, sub-basally on both webs.

At the 1952 A.O.U. Meeting, Dr. Allan R. Phillips tentatively identified (without aid of comparative material) the specimen as *Stellula calliope*. I have subsequently compared it with similar species. On the basis of size, it is separable from the Black-chinned Hummingbird (*Archilochus alexandri*) and the Broad-tailed Hummingbird (*Selasphorus platycercus*). It differs from the Rufous Hummingbird (*Selasphorus rufus*) in that the middle pair of rectrices in the latter are broadly edged on inner and outer webs with cinnamon-buff.

My specimen is readily separable from fall female Ruby-throated Hummingbirds (*Archilochus colubris*) in that the auriculars of the latter are darker, the flight feathers narrower, the rectrices narrower at the tips, there are no cinnamon-buff edgings on the webs of any rectrices, and the white on the third rectrix is confined more or less to the inner web.

I have taken space to point out the distinguishing characters in order to emphasize the difficulty of identifying fall specimens of female and immature hummingbirds. Field identification of this group in western Kansas is completely unreliable, and until there is a better knowledge of the hummingbirds which occur there, all should be collected.

Dendrocopos scalaris symplectus. Ladder-backed Woodpecker.—This species appears to be the commonest woodpecker after the Flicker (*Colaptes* species) along the Cimarron in Morton County. I noted it daily and R. Graber collected a female which is referable to *symplectus.*

Tyrannus vociferans. Cassin's Kingbird.—I noted this species but once, a single bird on September 5. It perched on weed stalks on the prairie overlooking the Cimarron.

Empidonax difficilis. Western Flycatcher.—I saw two or three *Empidonax* daily, and collected the yellowest bird I saw on September 3. It was an immature female (RRG 1804) which measured: exposed culmen, 11; wing, 68; tail, 59 millimeters. On September 5, R. Graber collected an immature male (RRG 1817) measuring: exposed culmen, 12; wing, 70; tail 62 millimeters. In both specimens, the tenth primary is shorter than the fifth. The wing bars are distinctly buffy. Allan R. Phillips identified the female as belonging to the subspecies *hellmayri,* and the male as intermediate between *difficilis* and *hellmayri.* These are the first Kansas records of the Western Flycatcher.

Vireo solitarius. Solitary Vireo.—The species was encountered but twice. R. Graber collected an immature female referable to the race *plumbeus,* an September 3. On the same date I collected an immature female of the drab, olive-gray form *cassini.* These are the first fall records of these forms in Kansas.

Dendroica townsendi. Townsend's Warbler.—Single birds were seen September 3 and 5. I collected the latter, an immature female (RRG 1816). This is the first fall record for the species in Kansas. It may be more common as a fall than as a spring migrant, since during the entire spring of 1950 only three were seen (Graber, 1950, *Wilson Bull.,* 62:208).

Seiurus aurocapillus. Oven-bird.—Single birds seen September 4 (female collected) and 5. The specimen compares well with a series of the nominate race but has a very pale crown.

Seiurus motacilla. Louisiana Water-thrush.—I saw one on September 5. Long (1940. *Trans. Kansas Acad. Sci.*, 43:451) indicated that eastern Kansas is the western limit of this species' range. It actually occurs in small numbers in both spring (Graber, 1951. *Trans. Kansas Acad. Sci.*, 54:166) and fall in extreme southwestern Kansas.

Setophaga ruticilla. American Redstart.—A female was seen September 3.

Piranga ludoviciana. Western Tanager.—I collected an immature female (RRG 1813) on September 4. This is apparently the third specimen for Kansas.—JEAN W. GRABER, *Dept. of Zoology, University of Oklahoma, Norman, Oklahoma, February 1, 1953.*

Black-throated Sparrow in Kansas.—On the morning of November 25, 1952, three miles east and four miles north of Garden City, Kansas, I noticed a small sparrow among the rafters of my garage. I had on previous occasions noted creepers, kinglets, and English Sparrows *(Passer domesticus)* in the garage but this bird I did not recognize so I closed the door for closer observation. After tentatively identifying it as a Black-throated Sparrow *(Amphispiza bilineata)*, I decided to capture it for positive identification and the bird was killed in the process. A check of the literature revealed no known records of this bird in Kansas. The prepared skin was sent to the Museum of Natural History at the University of Kansas where H. B. Tordoff identified it as *A. b. deserticola.* The specimen is now No. 31356 in the collection at the University of Kansas, Lawrence, Kansas.—MARVIN D. SCHWILLING, *Kansas Forestry, Fish and Game Commission, Box 864, Garden City, Kansas, September 17, 1953.*

Summer records of Redheads in a Michigan inland marsh.—Wood's "Birds of Michigan" (1951. *Univ. Mich. Misc. Publ., Mus. Zool.*, No. 75) includes bird records through 1943. Nine Redhead (*Aythya americana*) nesting records are given for Michigan, only two of which occurred in the last forty years. These nests were found in Saginaw Bay by H. J. Miller on May 28, 1941, one on Lone Tree Island, Huron County, and the other at Fish Point, Tuscola County. None of the reported nesting sites are in inland marshes (away from the Great Lakes). Three records of adults in summer are given by Wood in addition to the nesting records.

Thirteen miles southwest from Saginaw Bay near the Saginaw River lies a 1200 acre marsh. It is surrounded by an artificial dike. The depth of the water in this marsh is regulated by a pumping system. This area was formed from low lying farm land about 1919 and was known as the Oneida Fur Farm. It is now a breeding and migration stopover place for many water birds and in 1953 was made a state wildlife sanctuary.

Summer month observations of this marsh during years 1948 through 1953 resulted in the following records of Redheads: June 26 and July 24, 1948, 1 female (E. E. Kenaga); June 17, 1950, 30 males and females, nest with eggs (E.E.K. and M.A. Wolf); July 23, 1950, 1 male, also 1 female with young (E.E.K.); August 5, 1950, 1 male (E.E.K.); June 10, 1951, 8 males, 8 females (E.E.K.); June 30, 1951, 6 males, 6 females (E.E.K.); July 21, 1951, 1 female (E.E.K.); Summer, 1951, 3 young (F.O. Novy, J. Fitzgerald); July 9, 1952, nest with eggs, 1 female (F.O.N.); June 22, 1953, nest with 8 eggs, 1 female (F.O.N.); July 4, 1953, 1 female and 7 young (E.E.K. and M. Pirnie); July 14, 1953, nest with 8 eggs, 1 female (F.O.N.); August 23, 1953, 6 young (F.O.N.). (Also see G. Wickstrom, 1953. *Jack-Pine Warbler*, 31:142.)

These observations are apparently the first records of inland nesting of the Redhead in Michigan and add to the number of summer records of adults of this species.—E. E. KENAGA, *1629 Isabella Road, Route 5, Midland, Michigan, January 7, 1953.*

Notes on the call of a Ferruginous Pigmy Owl.—In May and June, 1949, we recorded on magnetic sound tape a call of a Ferruginous Pigmy Owl (*Glaucidium brasilianum*). The recordings were obtained in the Santa Ana Wildlife Refuge, located some 30 miles west of Harlingen, Texas. L. Irby Davis indicated that our records furnished the first positive proof that the bird inhabited this Refuge. In our work we were aided materially by Luther Goldman, the Refuge director. The refuge tract lies between a flood dyke and the Rio Grande and, excepting some flood-filled lakes, is densely timbered; the trees are festooned with vines and Spanish moss and are almost impenetrable in many places because of the heavy undergrowth of thorny shrubs. Our recorder was located about one-half mile from the northern edge of the tract on a partially-cleared neck of land between two of the lakes. One microphone was close by, with another about 500 feet to the south in dense vegetation; at that point, the Rio Grande was about a mile and a half farther south.

Our attention was first called to the owl while reviewing an earlier recording, obtained about 4:30 a.m. The owl must have been at a considerable distance from the microphone; using the greatest play-back volume obtainable, a faint, frog-like sound was heard, a single short note repeated at a uniform rate. On our next visit, the bird called from a tree rather close to the recorder; it was still dark, and we were not able to see the bird on his perch; after calling for a minute or so, a brief glimpse was obtained against the sky as he flew south. Immediately we picked him up on the distant microphone; after calling for a minute or so near that location, there was a brief silence; then the call again, quite faint; then silence, and we heard the bird no more.

During its performance, the owl gave the call at a rate of about 150 repetitions per minute; this rate was maintained throughout our recordings. The call would be repeated a varying number of times, ranging from 10 to 45 repetitions; then the bird would pause for about 10 seconds, and again begin the call. Subsequently, through the courtesy of Dr. P. P. Kellogg of Cornell University, we were privileged to hear the call of another Ferruginous Pigmy Owl, recorded some years previously on a phonograph record by Dr. A. A. Allen in Mexico. For all practical purposes, the recordings are identical with respect to quality, pitch, and time intervals.

Published "oral" descriptions of the call differ appreciably, possibly because of a difference in individual birds, but more likely because the call sounds differently to different observers. A. C. Bent, in his "Life Histories" (*U. S. Natl. Mus. Bull.* 170:437–438) quoting others, gives brief descriptions of the call: to Bendire, it sounded like *chu*; to Euler, like *khiu*; and to Stephens, like *cuck*. Peterson (1941. "A Field Guide to Western Birds," p. 90) adds one from Sutton: *chook* or *took*.

In the recordings of our bird, we are not able to detect with certainty either the "c" "k," or "t" sounds indicated above. The quality is not shrill nor sibilant; rather, it is clear and mellow, something like *whah* (short "a" as in "ah"), with the sound originating well back in the mouth, not near the teeth. By puffing, or "whuffing" the breath across the opening of a bottle, partially filled with water, we were able to produce a note resembling the call of this owl, both in quality and in pitch. Using a pitch pipe, we estimate the tone as F sharp in the third octave above middle C on the piano, close to 1400 cycles per second.—Jerry and Norma Stillwell, *RFD #2, Fayetteville, Arkansas, January 22, 1954.*

A nest of the Yellow Warbler superimposed on a Red-eyed Vireo nest.—On June 6, 1953, while collecting nesting data in Rondeau Park, Canada, I found the nest of a Yellow Warbler (*Dendroica petechia*) superimposed on the nest of a Red-eyed

Vireo (*Vireo olivaceus*). The nests were in a horizontal fork of a beech tree (*Fagus grandifolia*) suspended between two small branchlets, 93 inches above the ground. The area in which the nests were found represented a small cut-over section of a surrounding virgin beech-maple forest. This type of habitat may be considered typical for the Red-eyed Vireo but somewhat different from the habitat in which the Yellow Warbler usually nests.

Upon discovery, the female Yellow Warbler flushed from the nest and was joined in a nearby tree by the male after she had uttered alarm notes. The nest was collected and the following data obtained: The completed vireo's nest contained two Cowbird's (*Molothrus ater*) eggs which probably had been abandoned before the warbler's nest was started. The warbler's nest was built inside the cup of the vireo's nest and firmly attached to the materials at the rim of the vireo's nest, making what appeared at first glance to be a semi-pensile nest of the warbler. The finished nest of the Yellow Warbler also contained two eggs of the Cowbird, apparently laid by different females since the markings of the two eggs were decidedly different. The Cowbird eggs were covered by a second lining on which the female Yellow Warbler was incubating two eggs of her own. The measurements of the nest were: total height, 68 mm.; height of vireo's nest, 32 mm.; height of warbler's nest, 36 mm.; inside diameter of warbler's nest, 33 mm.; outside diameter of warbler's nest, 44 mm.; inside depth of warbler's nest, 31 mm.

These observations were confirmed by Douglas S. Middleton and Walter P. Nickell at the time the nest was discovered.—Harold D. Mahan, *582 E. Drayton Avenue, Ferndale, Michigan, August 24, 1953.*

Cardinal's period of dependency.—A female Cardinal (*Richmondena cardinalis*) that hatched July 25, 1953, and was color-banded before it left the nest August 4, was next seen when it began coming to my feeding shelf with its parents on September 5. This juvenile was fed regularly through September 7, on that same day began to eat raisins and crumbs of seed kernels for itself, was still fed occasionally through September 12, first succeeded in opening its own sunflower seeds September 20, begged rarely as late as September 26, and was last seen with a parent October 2. That is partial independence at the age of 44 days, complete independence at 50 days, and severance of family ties at 70 days; these figures are even higher than those I found for two other juveniles (1944. *Wilson Bull.*, 56:173–174). This bird was a member of the third and last brood of a color-banded pair, and the only member that survived the age of three weeks. —Hervey Brackbill, *4608 Springdale Avenue, Baltimore 7, Maryland, December 10, 1953.*

The Aves section of the *Zoological Record* covering the ornithological literature of 1952 was issued in March, 1954. Again we acknowledge our indebtedness to Lt. Col. W. P. C. Tenison for so ably preparing this essential bibliography and we urge our readers to support this publication, which is available for seven shillings and sixpence from The Zoological Society of London.

ORNITHOLOGICAL LITERATURE

Annual Cycle, Environment, and Evolution in the Hawaiian Honeycreepers (Aves: Drepaniidae). By Paul H. Baldwin. University of California Publications in Zoology, Volume 52, Number 4. October 28, 1953: pp. 285–398, pls. 8–11, figs. 1–12. 6¾ × 10¼ in. $1.50.

Here is a study, complementary to that by Amadon (1950. *Bull. Amer. Mus. Nat. Hist.*, 95:151–262), which places us another step ahead in our understanding of a most fascinating group. This author has, in principle, accepted and followed Amadon's taxonomic revision of the Drepaniidae. With only passing mention of most forms, he has concentrated on a comparative ecological study of certain species which still persist in numbers.

Baldwin spent extended periods in and near the Hawaiian forests over a span of twelve years, 1937 to 1949. It is evident that prior to his final year of intensive work there was opportunity, not only to gather a great many preliminary and corroboratory data, but to plan carefully the several lines of later investigation. The resulting study impresses this reader as unusually coherent. Although acquainted with 13 forms of living drepaniids, Baldwin confined his efforts largely to 3: *Vestiaria coccinea, Himatione sanguinea sanguinea,* and *Loxops virens virens,* all of which are still numerous in the Hawaii National Forest and elsewhere. Study plots were established at various elevations on the volcano slopes, mostly within the park. Local temperature and rainfall measurements, studies of vegetation types, censuses of bird populations, checks on the bloom of flowering trees, collections of tree-inhabiting invertebrates, and special observations on the three honeycreeper species mainly concerned, were carried on more or less concurrently along the transect formed by the plots. Numerous specimens were collected at intervals during the same period, from the forests closely adjacent, for study of molt, weight changes, gonadal cycles, skull development, and stomach contents.

Some new interpretations of molt-sequence are presented (see also Baldwin, 1952. *Auk*, 69:92–98), the result of very thorough and systematic comparisons. A number of interesting ideas on adaptation and past evolution within the family are evolved from the analyses of present-day factors. The main contribution, however, is the discussion of the three species as living populations: their territorial behavior, breeding cycles, habitat preference, utilization of nectar and of animal food, seasonal movements, and adaptation to the island environment in general. This is stimulating and refreshing; it is encouraging that studies not made when the Hawaiian honeycreepers were at their peak of abundance, can yet be accomplished for at least a few species that are holding their own. The close relationship between the birds and the flowering trees *Sophora* and *Metrosideros,* though long an accepted fact, is here discussed in concrete terms. It is disturbing to note that two of the three species of birds showed a decrease in numbers during the total period of the investigations, and that it could be correlated in part with the spread of the introduced white-eye (*Zosterops*) in the area. A glance at the census figures shows at once the extent to which various exotic species have invaded even these relatively remote forests: they represent exactly half of the 22 species recorded on the plots.

Some might take issue with the suggestion that color and pattern in the drepaniids are largely nonadaptive (a point upon which the author himself seems to have rather divided feelings), while song (as a social releaser) is conceded to be, in a sense, adaptive. Momentary annoyance may be caused by such laxities as the continued use of "juvenal" as a noun, and repeated lumping of spiders and mites with "insects." But all of the factual material and analyses appear to be sound, and the inferences, in the main, well founded. The whole work is attractive and readable, the photographs good, the graphs and tables clear, and the typographical errors very few. From many points of view, the paper is well worth a reader's perusal.—WILLIAM A. LUNK.

LAND USE AND OUR AVIFAUNA

A contribution from the Wilson Ornithological Club Conservation Committee

American ornithologists have enjoyed a luxury impossible in long settled countries. We came upon a continent in which the fauna and flora were practically unaltered by man. We have had the opportunity to observe and study birds in virtually primeval conditions, and though we have lost some species by the settlement of the country, we still have available some wilderness with its original inhabitants.

It must be generally accepted now that our conservation efforts rest on land use planning. A striking problem of this kind is the future of our sage grouse. They are fairly plentiful in the western plains and are hunted as a game bird, and as you drive through the miles of sage country, it may seem that they are safe enough.

But big things are happening. There is a program of sage elimination using herbicides from airplanes. I have seen large areas treated in this way, for the purpose of encouraging grass free from competition of sage. Furthermore, the reclamation program is putting large sage areas under irrigation and hence cultivation. If the sage goes, the sage grouse go, for these birds are essentially browsers and depend on sage leaves for winter survival. Dr. Robert Patterson's exhaustive study of the stage grouse (1952. "The Sage Grouse in Wyoming," Wyoming Game and Fish Commission), clearly outlines the survival requirements of this bird and suggests an economy pattern for certain western areas that would insure the survival of the species.

Nearly 20 years ago, with several associates, I had opportunity to study the fauna of the Aleutian Islands, on behalf of the U.S. Fish and Wildlife Service. We found that some cackling geese still nested on a few of the islands, but the big migration that used to come east and south from the Aleutians was nearly ended. Part of the destruction may have been by extensive shooting in autumn in the Pacific Coast states. But another vital reason was the fact that most of the islands had been leased for blue fox farming. Foxes were simply turned loose to multiply, and were trapped occasionally for the market. We recommended that Agattu Island, especially, and several others which contained good breeding areas, should be cleared of all blue foxes, in the hope that the remnant of this goose population, and the *migration to* and *from* the Aleutians, might be saved. Then came the war, and I do not know whether the foxes were ever removed.

We need to give serious attention to the problem of land use. To survive, an animal must have a place to live. There is today a hopeful movement to preserve areas in the original state. We have a system of national parks and wilderness areas. And the Nature Conservancy is concerned with preserving the smaller natural areas. There are state parks and wildlife refuges. As was stressed at one of the discussions of the Mid-Century Conference on Resources for the Future at Washington last December, this whole system needs expansion.

But we are having great difficulty in retaining what we have. As these lines are written there is a proposal in Congress to include Echo Park dam in Dinosaur National Monument in the program for water development in Utah and Colorado, and we know that the dam builders have designs on Glacier National Park and that the lumbermen want a big slice of Olympic National Park. We are still so board-feet-minded as a nation we are having trouble keeping our wilderness areas on national forests intact.

Overshadowing all this is the present concerted move to do away with public lands in a big way. On a national scale there have been bitter fights over certain bills in Congress, and more are on the way. The operation of the present mining regulations has become a national scandal, removing, by various subterfuges, thousands of acres from government ownership. The way we are crowding the Pacific salmon into oblivion is indication of what can happen when certain financial interests invoke the sacred formula "the national economy" or "the local economy," to gain their ends.

Here, in the struggle for public land—to seize it versus to keep it—is the arena for modern conservation. Each citizen, whether a scientist or not, can serve by associating with his favorite conservation organization so as to be informed on the issues as they confront us—and then act.

We believe there are enough people who are sympathetic to conservation objectives, or would be if they knew. The problem is to reach them, and to have it understood that all must take part individually as each crisis arises.—Olaus J. Murie.

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This number of *The Wilson Bulletin* was published on July 14, 1954.

Suggestions to Authors

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A. O. U. Check-List (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A Word to Members

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

Notice of Change of Address

If your address changes, notify the Club immediately. Send your complete new address to the Treasurer, Leonard C. Brecher, 1900 Spring Drive, Louisville 5, Kentucky. He in turn will notify the publisher and editor.

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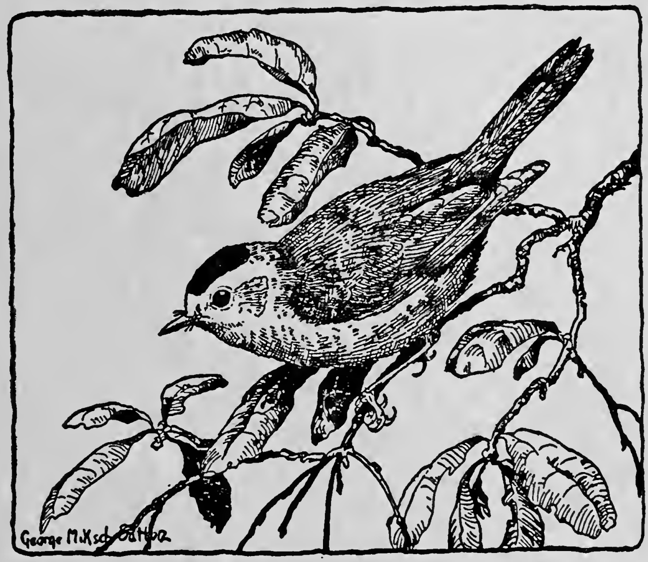

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THE WILSON BULLETIN

The official organ of The Wilson Ornithological Club, published quarterly, in March, June, September, and December, at Lawrence, Kansas. In the United States the subscription price is $3.00 a year, effective in 1951. Single copies, 75 cents. Outside of the United States the rate is $3.25. Single copies, 85 cents. Subscriptions, changes of address and claims for undelivered copies should be sent to the Treasurer. Most back issues of the *Bulletin* are available (at 50 cents each for 1950 and earlier years, 75 cents each for 1951 and subsequent years) and may be ordered from the Treasurer.

All articles and communications for publication, books and publications for review should be addressed to the Editor. Exchanges should be addressed to The Wilson Ornithological Club Library, Museum of Zoology, Ann Arbor, Michigan.

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FIG. 1. Nest and seven eggs of Snow Bunting. Mainland near head of Frobisher Bay, Baffin Island, June 26, 1953. The photograph was taken at the nest-entrance without removing a rock there. A rock to the right of and above the nest was removed, however, to allow more light to fall on the eggs.

NESTING OF THE SNOW BUNTING ON BAFFIN ISLAND

BY GEORGE M. SUTTON AND DAVID F. PARMELEE

FINANCED by a generous grant-in-aid from the Arctic Institute of North America, we spent part of the summer of 1953 (June 14 to August 22) studying the birdlife of southern Baffin Island. Our headquarters were at a United States Air Force Base near the head of Frobisher Bay, just south of the Arctic Circle. We walked considerable distances daily, covering regularly and fairly often an area about 18 square miles in extent. This area was bounded on the west by the Sylvia Grinnell River and Davidson Point, on the east by the high eastern shore of Tarr Inlet. Twice we journeyed by boat to the mouth of the Jordan River and the famous Silliman's Fossil Mount, about 16 miles west of the Base. By courtesy of the Royal Canadian Air Force we flew to three other parts of the island: the southeastern corner of Lake Amadjuak at Lat. 64° 38′ N., Long. 70° 28′ W.; a lake just inland from Cape Dorchester, near the northwestern tip of Foxe Peninsula, at Lat. 65° 20′ N., Long. 77° 10′ W.; and a lake about 50 miles east-northeast of Wordie Bay, along the west side of the island, at Lat. 68° 31′ N., Long. 71° 22′ W.

The country we covered was rough "desert tundra" (Soper, 1940:16) for the most part. The Base at Frobisher Bay was on a grassy flat, but hills rose to the northwest, north, northeast, and east. The slopes were half-covered with snow when we started our work, though the lowland flats were bare. The weather was fairly comfortable during the latter half of June, but July was gray, raw and unpleasant, a notable meteorological phenomenon being the foul inclemency accompanying a southerly wind. The whole Bay was ice-covered, of course, and the mingling of the warm wind with the cold air above the ice produced fog. In August we had some gloriously bright, still days, but even in the warmest weather we rarely stepped outdoors without extra clothing.

Of all the birds we saw, the Snow Bunting (*Plectrophenax nivalis*) was commonest; it was also the *only* bird we recorded at all the localities mentioned above. About the Base proper it was less familiar than the Lapland Longspur (*Calcarius lapponicus*) as a dooryard bird, and it obviously did not have that species' preference for grassland, but we saw and heard it daily about the big hangar and other buildings, near the tents of the Eskimo village, and at the dump. It was sometimes noticeable along the beach just above high-tide mark, or out on the tidal flats themselves. It was the only small passerine bird that we saw at all regularly on rocky peninsulas and offshore islets. It nested almost exclusively among the rocks, but in mid-summer it often flew considerable distances out onto the grassy lowlands, sometimes crossing lakes, rivers, or stretches of salt water in reaching places at which food was readily obtainable for nestlings. We saw it repeatedly in the monotonous high interior; but it was less common there than in the rough land near the sea.

When we started our observations on June 15 we instantly perceived that most of the Snow Buntings were paired. Occasionally we noted a separate male, a separate female, or two females feeding together by themselves. But the flocks had broken up. A south-southwest wind blew steadily all that day. The sun shone brightly part of the time, however; we saw three bumblebees; and a few flowers were in bloom. The male buntings were in boldly black and white feather, but scrutiny through our binoculars revealed extensive brown edgings on the back and rump plumage of two individuals, and a dark nape-patch on three others. The bills of both males and females were black, without a trace of yellow. Males were singing everywhere, some of them volubly. We witnessed one flight-song. The most characteristic callnotes seemed to be *pit-i-tick*, *chew*, *chew-kit*, and *djjj* (a soft *g* sound, imitable through pronunciation as one syllable). Whether singing or feeding, the birds obviously disliked the wind. In sheltered areas among the rocky hills we found them, pair by pair. A favorite feeding-place was the edge of a snowbank. Walking on the snow itself, the two birds stayed close together, often only a few inches apart, almost invariably facing in the same direction. They seemed to be finding something on the snow—minute seeds or insects presumably. They were silent most of the time so long as they were together; but if one flew off, the other showed concern through calling and standing high with head held up attentively. Separations of this sort were usually the result of a male's leaving to drive off another male. All the males seemed to be established on, and defending, territories. Males who were with females sometimes lifted their wings high above their backs, or scuttled rapidly through the snow, with head lowered, as if showing off. "Scuttling" males sometimes ran swiftly in one direction, stopped, turned at a right angle, and scuttled off again. We did not see a female behaving in such a manner.

We were puzzled by our failure to find nests. We saw many female birds, but not one of them flew up from underfoot, as if from a nest; not one acted as if she were gravid and waiting to lay an egg; and pairs were so indifferent toward us that we wondered if nesting had even begun. Actually, as subsequent findings proved, many nests had been completed, and eggs laid, by June 15. Clutches were incomplete, however; steady incubation had not started; and, for reasons not clear to us either then or now, the birds voiced no objection to our presence. We must have walked close to several nests, but we did not hear a single cry which sounded to us like a note of protest or distress.

In mid-morning, on June 15, we spent about an hour watching a pair which obviously had established themselves in a long, sheltered groove on a rocky ridge about a quarter of a mile north of the building in which we lived. The ridge rose abruptly from the broad tundra flat, and was the first and lowest of a series of foothills leading up to the high interior. The birds kept to the ground most of the time. They were on the move almost constantly, but their wandering seemed to be desultory. They were inseparable. They must have been feeding, but we never saw one chew at a berry, crack a seed, or pick an insect to pieces. Jabbing at the snow or moss, they obtained minute items which they swallowed rapidly. While on the snow their walking or running gait was easily perceptible. When obliged to cross a wide stretch of snow they both ran, with lowered heads, as if eager to reach the other side. The male did not sing.

At about 11 o'clock both the male and female disappeared for a short time in a shadowy place under some boulders. When they came into full view again, the female had a piece of grass in her bill. She nibbed at this, as if testing its pliability, dropped it, then picked it up again. Carrying it, she walked rapidly about 50 feet across moss, rocks and snow, straight to a crack in a sloping rock about three feet above a big snowbank. The male, considerably to our surprise, made no attempt to copulate, though he followed her closely. The female entered the crack without the slightest hesitation and the male flew off downslope.

The female was out of sight a minute or more. When she reappeared, her bill was empty. She preened a wing briefly, gave a *djjj* cry, evidently heard a response (though we did not), and flew off to join her mate. In vain we waited for her to return with more grass, or for the male to sing. Suspecting that what we had observed had not been nest-building at all, we went to the crack to investigate. We could not reach our hand in very far, and our groping fingers failed to discover anything which felt like a nest, so we removed some loose stones. About 15 inches in from what had been the entrance, and a foot below it, lay a few pieces of dry grass. Wondering whether the true nest might be far back somewhere, well out of sight and reach, we replaced the stones. The snowbank in which we stood was four or five feet deep. A meltwater pool was at its lower end, about 40 feet south of us. The buntings themselves were nowhere to be seen.

The following day we saw many pairs of buntings, occasionally noted a separate male or female, and observed several flight-songs, but we did not flush a female from her nest. Songs seemed invariably to include a repetition of certain polysyllabic phrases. Ordinary songs (*i.e.*, songs not given in flight) sounded like (1) *sir plee si-chee whee-cher; sir plee si-chi whee-cher* and (2) *chor-i-bee-chee, chor-i-bee-chee, chip-i-deer.* Flight-songs were more complex. We decided against disturbing the moot nest-site lest we cause the birds to desert.

On June 17 we watched pair after pair, convincing ourselves that not one of the females was nest-building. We observed little wrangling amongst males. Females who were with males seemed to be spending all their time looking for food. Not once did we see a male attempt to copulate, or a female squat with fluttering wings as if inviting copulation. Separate females seemed quite content: they fed part of the time, preened their belly plumage occasionally, sometimes merely perched on the top of a rock. We witnessed several flight-songs, but no male confined his performances to flight-songs. In the afternoon we visited the moot nest-site. No bird flew out, nor was a nest visible through the cracks. We did not move the stones.

On June 18 we walked about four miles up the Sylvia Grinnell River. We saw and heard buntings virtually wherever we went. Below the eyrie of a pair of Peregrines (*Falco peregrinus*) we picked up the remains—wing and tail feathers principally—of several Snow Buntings.

On June 19 we ascertained that there was a nest at the "moot nest-site" just where the two or three pieces of grass had lain on June 15. The nest appeared to be complete except that the grass lining was wholly without any feathers, hair, or bog-cotton (*Eriophorum*). We neither saw nor heard a bunting close by. About 300 yards to the south we found another nest (No. 2), with five eggs, at the bottom of a narrow crack in a huge rock. We found this nest in an unexpected way. Happening to see a lone female bunting hurriedly feeding at the edge of a patch of gravel, we kept her in sight until, her hunger apparently satisfied, she flew east toward the high country, made straight up the slope to the big rock, and disappeared in the crack. The single flight, from feeding-spot to nest-site, was fully 300 yards. When the female left the nest at our approach, she lingered close by, chirping. Her mate did not join her.

A fight we witnessed on June 19 was probably territorial. How the fight started we did not know: suddenly, there in the snow, two female buntings were battling savagely, biting each other and rolling over and over with wings fluttering. Pausing, as if to catch breath, they faced each other with beaks open, then resumed the attack. A male bird, almost certainly the mate of one of the females, stood close by, but did not join in the fight. When another male appeared, a moment later, the two males came to grips five or six feet from the fighting females, but they did not fight very hard. We thought for a time that one female might actually kill the other: but suddenly one of them flew off, with the other in hot pursuit, and the two males flew away in the same direction. Presently a male and female returned and settled down to feeding along the edge of the snow. Tinbergen (1939:27), reporting his observations on the Snow Bunting in east Greenland, says: "Mated females do not tolerate other females in their neighborhood. Fights between two females were of common occurrence."

On June 20 we collected a pair of buntings (GMS 11714.–5), ascertaining that the testes of the male were greatly enlarged and that the oviduct of the female was much swollen. This was additional proof that egg-laying was going on.

From June 20 on we continued to find nests, most of them with full sets of eggs or broods. Kumlien (1879:76) obtained "first eggs" for the season on June 20 in Cumberland Sound. At Lake Nettilling, Soper (1946:424) found the first full sets of eggs for the 1925 season on June 20; at Camp Kungovik, near the head of Bowman Bay, in 1929, he did not find full sets until "the early days of July." At the head of Clyde Inlet, in 1950, Wynne-Edwards (1952:387) found the first nest for the season on June 25. It contained "four young two or three days old."

The appearance of the nest found by us on June 15 had changed considerably by June 20, for much white material, dog hair principally, had been added to the lining. Only Sutton visited the nest that day. When, at 5:50 a.m., he approached the nest, he was greeted not by the female but by the male, who flew up companionably, alighted in the snow only a few feet away, and preceded him to the nest-entrance. Here, showing great solicitude, the bird stood, now looking in and down at the nest, now out and up at the man so close by. The nest was empty and the female was nowhere to be seen. Sutton waited in the vicinity for 40 minutes. During this period the male never left the nest very far; flew to the entrance four times, each time looking in; was not in the least secretive; and sang repeatedly. His callnotes were varied. Frequently a *tick-i-ty* or *pit-i-ty* note was followed, after a brief pause, by *chew-kit*. Occasionally the call was *djjj*, which seemed to be an inquiry as to the female's whereabouts. Knowing full well the value of data obtained from color-banded birds, we nevertheless decided against any banding or marking of the adults at this nest before there were eggs or young. Where the female was that morning, no one could say; we believe she was alive, however. Often, during subsequent observations at this and other nests, we failed to see the female or male for surprisingly long periods.

We did not visit Nest 1 on June 21. On June 22 we visited it at 5 a.m., finding one egg in it. In the lining there were now a few white ptarmigan feathers. We remained in the vicinity for 20 minutes, seeing neither the male nor the female. We wanted to mark the egg, but failed in our attempts to take it from the nest. Each time we moved loose stones, pebbles fell and we did not want to risk breaking the egg. A hand could reach the nest, fingers could grasp the egg, but the narrowness of the crevice prevented drawing out the closed hand.

On June 23, at 5:20 a.m., we went to the nest. No bird flew out. There were two eggs. The eggs and nest were warm to the touch. Failing to see either bird, we decided to look for them. We finally found a pair, quietly feeding, about 200 yards to the southeast and well above nest-level. We were not sure that these were the owners of the nest, but they were the only buntings we saw anywhere in the vicinity. After experimenting with a pebble, we found that by turning the closed hand holding an egg, then partly opening the fingers with the palm up, an egg could be brought out successfully. We marked the two eggs, each with one red dot. We visited the nest at 9:30 p.m. (cloudy: raining slightly), finding neither bird there. There were only two eggs.

Very early (1:35 o'clock) the following morning, Parmelee went to the nest. The weather was still gray and twilight seemed to be at its deepest. While Parmelee was searching for a place from which to observe, the female bunting left the nest (1:40). Immediately she was joined by the male, who apparently had been roosting among rocks about 50 paces to the southeast. The nest held only two eggs. Parmelee concealed himself with blankets about 30 paces from the nest. The male bunting stayed close by, but neither bird seemed agitated. The female returned to the nest at 1:56. At 1:59 the male sang a full song and the female again left the nest. At 2:01 she returned and settled down. The male now stood guard on one of two favorite big rocks a few rods away. Squatting and flattening himself out, he kept an eye on Parmelee almost constantly for the next three hours. At 2:47 and again at 3:24 he sang a full song. At 3:29 he sang three full songs in quick succession. At 3:31 he sang another full song. At 3:50 he chased off a male Wheatear (*Oenanthe oenanthe*) which had flown upslope from the west and alighted within a few inches of him. (We did not know it at the time, but a pair of Wheatears had a nest just over the little ridge to the west, about 40 paces from the bunting nest.) At 4:02 the male bunting sang a full song. At 4:49 he sang three songs in quick succession. At 5:15 he flew to the nest-entrance, went in, came out with a white feather in his bill, and flew back to his favorite rock. At 5:17, of her own volition apparently, the female left the nest, flew to her mate's favorite rock, and with him disappeared downslope. The nest now held three eggs. Between 5:30 and 5:45 the male sang 12 full songs.

Tinbergen (1939:34) states that incubation "begins from one to three days after completion of the clutch." On June 24 the female spent a good deal of time incubating the three eggs. We visited the nest about 1:00 p.m., finding her on the nest and the male a few yards away. Both were remarkably confiding. Hesitant though we were to disturb the birds, we nevertheless examined the nest several times to make certain that the female was actually incubating. Each time we went to the nest the female left reluctantly, disclosing three eggs. The male behaved as if our visits were no cause for alarm. While we were at the nest, the female walked or ran about, looking at us, our equipment, and the entrance to the nest inquiringly. If we stood off a way, she ran or flew to the nest-entrance and looked in. More than once she went in, but promptly came out again. From about 3:00 to 4:30 o'clock, while we were seated on rocks 20 yards away, the female was quiet on the nest, the male equally quiet on the top of a boulder. Part of the time he squatted and flattened out, as if dozing, but his eyes stayed wide open.

We do not know just when the fourth egg was laid, but we first saw it at 4:45 a.m. on June 25. At that time the female was on the nest but the male was nowhere to be seen. The female refused, at first, to leave the nest-crevice. We spoke to her, reached our hands in toward her, even touched her several times. Finally she hunched herself into a crevice just back of the nest while we removed the eggs for marking. When the nest was empty, she came forward, looked into it quizzically, then out at us, and retreated into the crevice. When we put the eggs back, she moved forward and settled down. After warming the eggs for a minute or so, she fluttered from the nest-crevice, alighted a few feet away, and ran about the rocks. Her manner was very gentle. She made no vocal sound. Presently she went back to the nest, settled on it, and stayed there. At 5:07 the male, who had not been in evidence, appeared with a mouthful of food. He went directly to the nest. We heard odd, rather angry-sounding cries of *churr, churr.* We could not, of course, see what was going on, but when he came out again, 30 seconds later, he had nothing in his mouth. He flew off a hundred yards or more, out of sight behind some rocks. The female continued incubating until 5:16, when, for no apparent reason, she left for about 45 seconds. Returning, she settled down for more than an hour of incubation, during which period the male came several times with food. At each visit the male completely disappeared in the nest-crevice and the quarrelsome-sounding *churr, churr* accompanied the feeding (presumably at the nest proper). We discontinued our observations at 6:30 o'clock.

Thus far we had failed to ascertain at all exactly when the eggs were laid, though obviously they had arrived daily, about 24 hours apart. Convinced that the female was by this time much attached to her nest, we began taking liberties. Parmelee stayed near the nest from midnight to 3:40 a.m. on June 26, at which hour Sutton took over. At 3:40 we forced the female to leave the nest: there were four eggs. At 4:00 o'clock we again forced the female to leave: there were still four eggs. At 4:55 she left of her own accord. There were five eggs. She was away from the nest only a short time. We withdrew and allowed her to settle. Deciding that the eggs should be marked before we left, we went to the nest. The female refused to leave the nest-crevice. This time, from her hunched up position just back of the nest, she chirped several time, as if for help, but the male neither answered nor flew up. About 5:30 she fluttered from the nest, flew off a way and joined the male. Presently she returned, followed by the male. After she had settled, he too went inside, and we heard the usual "*churring*." In this case the sound probably did not accompany feeding, for the male had had no food in his mouth.

On June 27 (7:45 a.m.) and June 28 (8:00 a.m.) we visited the nest. The female was on the five eggs at each visit. From this time on work elsewhere prevented our visiting the nest very often. On July 4 (1:10 p.m.) we happened by, flushed the female, noted that the five eggs were there, and saw the male fly directly to the nest with food. He expected to find his mate on the eggs. When he emerged from the nest-crevice with mouth still crammed with food, the female flew to him promptly, and we witnessed feeding outside the nest. The female lowered her head, opened her mouth wide, gave the growling *churr*, and fluttered one wing as she received the food. As she walked into the nest the male flew off. About 10 minutes later he returned with more food (among which was a pale green insect larva) and went in to the nest. An instant after he had disappeared we heard the *churr* of feeding.

On July 6 we visited the nest, forcing the female off. There were five eggs. On July 7 we did not visit the nest. On July 8, at 4:50 a.m., the nest held four young and one egg. The natal down was mouse gray. Three of the young were noticeably larger than the fourth, which had obviously just hatched, for its down was damp. The remaining egg bore one of our red dots: it was the last egg laid. We caught and banded the female. This perturbed her, but she did not leave the vicinity. We continued our observations for some time, noting first that the young birds, though obviously eager to be fed (for they opened their mouths wide when touched), *made no vocal sound of begging*. We waited more than half an hour before either parent went to the nest with food. At 5:25 the male brought food, went in to the nest, and left without a fecal sac. At 5:35 the female (without food, so far as we could see) went to the nest. Before settling down, she walked in and out twice. We last examined the fifth egg at 1:00 p.m. It was very slightly bashed-in on one side, probably from our frequent handlings.

On July 9, at 5:10 a.m., there were five young in the nest. The damaged egg had hatched successfully. The incubation period of the fifth egg had been at least 12 days and 9 hours; at most 13 days, 1 hour, and 10 minutes. Wynne-Edwards (1952:387) reports a period of 12 days "from last egg laid to last chick hatched." The fifth young was noticeably smaller than the others, and quite dry. We arranged the five siblings in a row, noting that the two largest were of almost exactly the same size; that one was slightly smaller than these two; that one was still smaller; and that the fifth was very small in comparison with the two largest. All five opened their mouths for food, even after being taken from the nest, but if any of them made the slightest vocal sound, we failed to hear it.

On July 10, the two or three largest young produced a slight noise when begging for food, but the youngest made no noise at all, though it opened its mouth wide and seemed to be as healthy as the others. The begging cry gradually increased in volume from this date on. On July 11, when we removed

Fig. 2. Female Snow Bunting on nest. Photographed by George Miksch Sutton on Southampton Island on July 2, 1930.

the five young from the nest, only one of them, the smallest, opened its mouth for food. Some instinct may have prompted the others to keep their mouths closed. On this date we observed both the male and female parents bringing food and carrying away fecal sacs. Both parents carried food to the nest direct, *i.e.*, the male did not give food to the female, and vice versa.

On July 15 there were only four young in the nest (we did not visit the nest July 13 and 14). One was definitely smaller than the other three. We had no way of knowing, of course, whether this smallest bird had hatched from Egg 4 or Egg 5. The four young were begging noisily as we approached the nest, but they instantly became silent when we touched one of them. We looked in vain for evidence that a lemming (*Lemmus trimucronatus* or *Dicrostonyx groenlandicus*) had visited the nest or taken the young bird. Lemmings of both kinds were common in the vicinity.

On July 17 only three nestlings were alive. All three were active, and one scrambled into the crevice back of the nest and would not come out. A flattened dead one was under the others. We banded and color-banded two of the young (right leg, blue over aluminum). The young were at least 9 days old, at most 11 days old, and had not yet left the nest proper. They were not, so far as we could ascertain, troubled with mites or other nest-parasites. The parent birds were still carrying off fecal sacs. The begging of the brood we could hear fully 30 paces down-wind (prevailing wind velocity: 10 mph). Nicholson (1930:299) states that the nestlings' "chittering . . . carried quite 150 yards."

We journeyed to the Jordan River mouth on July 17, and were away from the Base for several days. The brood probably left the nest-crevice at Nest 1 about July 20. When we visited the nest on July 21 we could not find the young anywhere. The nest was empty save for a great mass of feather-sheath particles and some droppings about the rim. Success: of five eggs, all hatched. Of five young, three probably fledged. Rearing the brood required about five weeks (June 15 to about July 20). During this same period we found 21 other nests, some of which we visited regularly.

Nest 2. Found June 19. Five eggs. About 300 yards south of Nest 1, at the bottom of a deep, ten-inch-wide, almost vertical crevice in a great rounded outcropping of rock. We could just touch the contents of the nest with arm fully extended. We flushed the female from her five eggs on June 20, 21, 22, 23, 27, and 28, and on none of these visits saw the male. On July 1 we saw the male, not the female. On that date the nest held three (possibly four) young and one egg. On July 5, 6, and 7 all we could see or feel was young birds, so we supposed that the five eggs had hatched. On July 8 we visited the nest about noon, just as sunlight struck part of the rim directly. We clearly saw the heads of two young, and perceived that there was at least one more. Using a bit of netting attached to a big wire hoop, we caught the female parent and banded her. We almost caught the male too. Neither parent bird would creep directly under the net in entering the crevice, but both tried repeatedly to go straight down through it. They stood on it and walked on it, without, strangely enough, becoming entangled. When they entered the crevice they did so well to one side of, or below, the net. We caught the female with a surprise rush, forcing her to fly directly from the nest into the net. On July 10 we could see at least three young. One of these scrambled from the nest when touched with the fingers. On July 12 we could see three young, all of them "at large" in the crevice. They appeared to be strong enough to fly. Both parents were near the nest. Both carried food to the young direct (*i.e.*, the male never gave the food to the female, or vice versa), and they did not go to the nest together. Neither was carrying off fecal sacs, for the young were no longer in the nest proper. On July 16 the young were gone, but there was still an egg in the nest. Fledging period: at least 12 days, probably more. Success: of five eggs, four hatched. Of four young, at least three fledged.

Nest 3. Found June 22. Five eggs. In a shallow, eight-inch-wide crevice in a vertical rock-face on the west side of a canyonlike stretch of the "HBC River" (our name for a small river which emptied into Frobisher Bay near the Hudson's Bay Company post). Examining the nest was difficult, for it was ten feet above the only solid footing we could find. It was only a few inches back in the crevice, however, so could be reached with the hand once we had climbed to nest-level. We found it through seeing the female leave. While we were trying to photograph it, the female stayed very close. The male, less concerned or less confiding, flew up once, but quickly departed. We collected the nest and five eggs. In each egg was a small embryo.

Nest 4. Found June 21 by a workman who saw the female go to it with a white feather for the lining. It held four eggs on that date. We first saw it June 23, when it held five eggs. It was under a big rock in the rubble along a steep stretch of construction-road and was alongside the rock on damp gravel rather than closely fitted into a crevice. We could ascertain its contents only by reaching our arm, full-length, under the rock. On June 26 we flushed the female from her five eggs. On June 28 there were five eggs, and both the male and female were near the nest. On July 23 the nest was empty. A mass of feather-sheath particles indicated that several young had lived there for some time. Success: five young probably fledged.

Nest 5. Found June 23, during a snow-storm. Five eggs, slightly incubated. In high country about a mile northeast of the Base, back about a foot in a crevice under a large stone. The female entered at nest-level, but when she left she flew from a hole several inches above the nest. We collected the two adults (GMS 11719,–20), the nest, and the eggs.

Nest 6. Found June 24. Five eggs. Saw the male fly to the nest-entrance with food for the female, who was incubating. On high land about 500 yards east of the Base, in a deep vertical crevice so far down and back that we could not reach it. We visited this nest rather regularly. We first saw young in it on July 4. On that date we saw the male go to the nest-crevice with food. On July 5 we saw one egg in the nest, so assumed that there were four young. On July 10, we clearly saw three young and an egg; on July 12 two young and an egg; on July 16, three young (two inside the nest-cup; one outside it) and an egg. At least one young bird appeared to be ready to fly that day, but none of the brood actually left before July 17. Fledging period: 13 days. Success: of five eggs, four hatched; of four young, at least three fledged.

Nest 7. Found June 24 in high interior about a mile east of the Base. Five eggs. Discovered through seeing the female fly out when we struck a pebble against rock several yards away. Nest in crevice under turf and a large loose stone which rested precariously on steeply sloping rock about 10 feet above a wide stretch of marshy tundra. Entrance to crevice several inches below nest-level, but easiest way to determine contents was to stick arm down through hole in the moss from above. One of the five eggs was partly buried in the lining. On July 4 and July 6 we flushed the female from five eggs. On July 9 the nest held three small young, one hatching egg, and one egg whose translucency indicated that it held no embryo. Here the incubation period for at least one egg must have been 15 days—providing, of course, that incubation actually started on June 24. In this case the female may not have started incubation until "one to three days after completion of the clutch" (Tinbergen, *loc. cit.*). Success: of five eggs, four hatched. Of four young, four probably fledged.

Nest 8. Found June 26, when partly finished. Under a comparatively small slab of stone resting on turf and rock on a steep slope about two miles north of the Base. Could see nest without moving slab, but determination of contents required moving it. Watched female nest-building for half an hour late in the morning on June 26. In all her trips she was accompanied, back and forth, by the male, but he did not go into the nest-crevice. Much material (dry grass) she found under heaps of metal rods lying about 20 yards from the nest. We did not visit this nest again until July 11, on which date there were five eggs. On July 26 there were five young, almost ready to leave. These were obviously of different ages, three being larger than the other two, and one being definitely smaller and less active than the rest. We banded all five. Success: all of five eggs hatched. Of five young, all probably fledged.

Nest 9. June 26. Seven fresh eggs. On steep talus slope in rough country about two miles north of the Base; in crevice between loose, angular stones about ten inches back. Found through watching the female go to the nest. Nest and eggs collected.

Nest 10. Found June 26. Seven eggs. In crevice among rocks along base of steep ridge just above bed of small swift stream about two miles north of the Base. Saw female go to nest. Male also in vicinity. On July 3 the nest held four young and three eggs, the latter all highly translucent. On July 11 the nest held three young and three eggs. Both the male and female were at the nest that day. We saw the female carrying a fecal sac from it. We did not visit it again. Success: of seven eggs, four hatched. Of four young, three may have fledged.

Nest 11. Found June 27. Six young of assorted sizes, three of about the same size, but larger than the others; one conspicuously smaller than the other five. Nest in pile of loose stones near dump; in moist sand, under three big angular stones. Lifting one stone nicely exposed the nest to view. We visited the nest June 29, expecting to find some of the brood dead, for one of a nestful of young Horned Larks (*Eremophila alpestris*) we had been watching had perished, presumably as a result of the bad weather. The female flew out as we approached; the young were all in good condition. On July 1, when we lifted the stone and touched the young, five of them scampered into crevices nearby. We collected a middle-sized one (female, GMS 11737) and returned the others to the nest. They quieted down when covered by the hand. The collected specimen's bill was dull corn yellow. Its underparts were suffused with faint yellowish buff, its chest indefinitely streaked with dusky. Shaggy natal down clung to the sides of the crown and of the hind-neck. The tail measured 16 mm. On July 2 we banded the remaining five of the brood. Three of them bolted from the nest as we removed the stones. The tails of these must have been fully 20 mm. long. On July 4 an adult male bunting near this nest was caring for two stub-tailed but fairly strong-winged young while the female (only) was caring for the young still hiding among crevices. Success: of six eggs, all hatched; of six young, five fledged (the sixth probably would have fledged had we not collected it).

Nest 12. Found June 27. Four eggs visible. Near the sea, at the base of rocky outcropping on Davidson Point, in crevice between large stones about two feet back and down. Crevice much too narrow to permit reaching hand and arm in. Saw female go to nest. We re-visited this nest only once—July 12. That day we could see at least three well developed young in the nest-crevice. Success: of four (perhaps more) eggs, at least three hatched.

Nest 13. Found July 5. Four (possibly more) small young. In narrow crevice among large stones in high country about half a mile east of the Base. Flushed female as we were walking over rocky ground. Could not reach hand into crevice and could not move stones. On July 10 both the male and female were at the entrance to the nest-crevice. We could see at least three young well developed enough to scamper about when we peeked in. Fledging period: at least 11 days. Success: at least four young fledged.

Nest 14. Found July 5. We could see young birds in the nest, but could not count them. Nest 300 yards from the sea, on Davidson Point, about 20 inches down among large stones along the edge of an outcropping. Both male and female at nest. On July 12 we removed some of the stones and found four young, all well developed and able to scamper about vigorously. In the nest was also one translucent egg. We put red color-bands (only) on the four young, noting that the brood seemed to be of equal size. At least one of them could fly a little. Success: of five eggs, four hatched. Of four young, all probably fledged.

Nest 15. Found July 5 by F. Stuart Haley, who noted that there were "several" young on that date. Nest on a steep rocky slope above a lake about a quarter of a mile south-east of the Base, in a very narrow crevice about 14 inches in and down. On July 16 we visited the nest, finding five young birds in the immediate vicinity. Two flew strongly down the slope from the mouth of the nest-crevice; two were on a ledge about 24 inches from the nest, crouching among the stones; and one was about 15 feet down the slope from the nest. Success: five young left the nest, all more or less able to fly. Fledging period: at least 11 days, almost certainly more.

Nest 16. Found July 9, in high interior about five miles southeast of the Base. Under a stone, in damp ground, in open grassy tundra nowhere near a rocky out-cropping or ridge. Only nest of this sort we found the whole season. Contents: two small young and five eggs, one of which was so obviously without embryo and so nearly im-maculate that we preserved it as a specimen. The other four eggs were opaque and ap-peared to be at the point of hatching. We did not visit this nest again. Success: of seven eggs, six probably hatched. On July 9 we watched a company of fifteen or more buntings, most of them males, obtaining food for nestlings on a gentle slope just above a widening of a little river not far from this nest. The birds seemed to be catching dipterous insects of some sort, perhaps crane-flies. Many of the flies they caught on the wing. When the birds flew off with a load of food some travelled up over the hilltops hundreds of yards away. Both Tinbergen (1939:36) and Nicholson (1930:298) report the gathering of food in areas apparently outside the territory.

Nest 17. Found July 10. Four young (no indication that five eggs had been laid). In crevice among stones on steep slope about 40 paces from the west bank of the "HBC River." Could reach nest easily with hand. The four young were of assorted sizes, the two largest of about the same size, the smallest conspicuously so. Success: of four eggs, all hatched; of four young, all probably fledged.

Nest 18. July 10, in pile of stones about half a mile east of the Base. Could hear several young begging for food, but could not locate the nest itself.

Nest 19. Found July 12. Five young, all fairly well developed. Between the Base and Davidson Point, on rocky peninsula, within 20 feet of the high-tide mark, in pile of angular stones. Ascertaining contents required moving one stone. Visited nest on July 16, finding three living and one dead young in crevices near nest. The dead one looked as if it had crawled into the crevice at the time of our visit July 12 and been unable to get out. Success: of five eggs, all hatched; of five young, at least three probably fledged.

Nest 20. Found July 12. At least three young. Saw female carrying food to nest and fecal sacs away from it. About 30 inches down in crevice near top of low rocky outcrop on Davidson Point. About twenty paces from Nest 12. We did not visit this nest again; but on July 16 we saw a male (only) caring for three short-tailed young birds which probably had been reared in it. We collected two of these, a female and a male (GMS 11757,–8). Success: of three (perhaps more) young, at least three probably fledged.

Nest 21. Found July 15. At least four young, all out of nest proper and ready to leave nest-crevice. Nest out of sight and reach in deep crevice among rocks on steep slope about 300 yards east of the building in which we lived. Parent birds feeding young regularly, but not carrying off fecal sacs. Success: of four (possibly more) young, four fledged.

Nest 22. Found July 18. Several young, which we could hear begging for food. Nest in hole among crumbling limestone well up on high talus slope at north end of Silliman's Fossil Mount, near the mouth of the Jordan River, about 16 miles west of the Base. We did not even try to reach in to this nest for fear of dislodging the rocks. Below a Peregrine's eyrie, not far from the bunting nest, we found remains of several adult buntings.

TABLE 1

TWENTY-TWO BAFFIN ISLAND SNOW BUNTING NESTS

Nest No.	Date found; contents on that date	Clutch size	No. eggs known or believed to have hatched	No. eggs known or believed not to have hatched	No. young known or believed to have died in or near nest	No. young known or believed to have fledged	Approx. date of fledging
1.	June 15 (nest barely started)	5	5	0	2	3	July 20
2.	June 19 (five eggs)	5	4	1	1	3	July 12
3.	June 22 (five eggs)	5	–	–	–	–	———
4.	June 21 (four eggs)	5	5	0	0	5	July 16
5.	June 23 (five eggs)	5	–	–	–	–	———
6.	June 24 (five eggs)	5	4	1	1	3	July 16
7.	June 24 (five eggs)	5	4	1	0	4	July 19
8.	June 26 (almost ready for eggs)	5	5	0	0	5	July 27
9.	June 26 (seven eggs)	7	–	–	–	–	———
10.	June 26 (seven eggs)	7	4	3	0	3	July 12
11.	June 27 (six young)	6	6	0	0	6	July 13
12.	June 27 (at least 4 eggs)	?	?	?	?	3	July 15
13.	July 5 (at least 4 young)	?	?	?	?	4	July 16
14.	July 5 (4 young, 1 egg)	5	4	1	0	4	July 12
15.	July 5 (5 young)	5	5	0	0	5	July 16
16.	July 9 (2 young, 5 eggs)	7	6	1	0	6	July 24
17.	July 10 (4 young)	4	4	0	0	4	July 15
18.	July 10 (several young)	?	?	?	?	?	July 15
19.	July 12 (five young)	5	5	0	1	4	July 17
20.	July 12	3	?	?	?	3	July 17
21.	July 15	?	?	?	?	4	July 15
22.	July 18 (several young)	?	?	?	?	?	July 18

Concerning the above table the following statements may be made: 1. Nests 3, 5, and 7 we collected. 2. Nests 18, 21, and 22 we never saw nor "felt into" so we know nothing about them except that they contained clamorous young. 3. Nests 12, 13, and 20 may well have held more than three, four, and four eggs or young, respectively. 4. In 16 of the 22 nests the number of eggs and/or young was as follows: in three nests, seven; in one nest, six; in 11 nests, five; in one nest, four. 5. In each of five nests with five eggs, one egg failed to hatch; in one nest with seven eggs, one egg failed to hatch; in one nest with seven eggs, three eggs failed to hatch. In the only nest with clutch-size of six, all the eggs hatched and all the young fledged (we collected one of the young). 6. Only two of the five dead young mentioned in the table did we actually find in or near the nest, but the others disappeared from some cause. 7. In 16 nests (all but 3, 5, 8, 18, 21, and 22) a total of at least 80 eggs was laid. Of these, 72 hatched and 8 did not hatch. The eggs that did not hatch were intact and translucent—*i.e.*, no embryo developed in them. 8. From 15 nests (all but Nos. 3, 5, 9, 16, 18, 21, and 22) a total of 60 young probably fledged. Nests 16 and 22 we saw only once and have no idea how the broods fared. From Nests 18 and 21 the broods probably fledged, but we have no idea how large the broods were.

The latest date on which we observed a newly built nest ready for eggs was June 26 (Nest 8). The eggs in this nest all were laid later than the five eggs of Nest 1, the last of which was laid June 26. Both Nest 1 and Nest 8 were exceptionally late. The earliest date on which we actually observed a newly hatched young bunting was July 1 (Nest 2), but on that date five of the six young in Nest 11 were so well developed that they scampered in all directions when we touched one of them. Two of this brood were able to fly a little on July 2, but they obviously preferred to stay among the stones, so calling them fledged as of that date would be misleading. We did not see other young out of nests until July 12 (Nests 2 and 14). About the middle of July a great many young birds left nests all over the area we covered most intensively; some of these were, of course, from nests we had not discovered.

The latest date on which we observed young just out of the nest near the head of Frobisher Bay was July 26 (Nest 8). On that date we saw many groups of buntings, each group composed of three or four young and a male or female parent, and we saw one adult female taking food into a crevice.

On July 28 we took special note of several young birds with apparently full-grown tails. These were going about independently of their parents. One of them tugged energetically at a plant-stem, as if trying to pull or shake something edible from it. We noted, too, on that date, a molting adult female unaccompanied by young. On July 30, at Davidson Point, we saw a worn-looking female feeding three young which followed her about, giving the characteristic food-cry of the fledgling—*zhip* or *zhi-dip*. On July 31 we looked in vain for an adult bird accompanied by young. A full-tailed young bird which we watched for some time gave a *chi-ti-ty* callnote indistinguishable from that of the adult. On August 1 we heard young birds calling *chew-kit* as well as *chi-ti-ty*. On August 2 we noted the first definite flocks of young birds. They were near the dump. They were not in close-knit companies; but they flew up and about together, and there were no adult buntings with them. They were feeding on half-hardened seeds which they nibbled from various low-growing plants. Several young, and a few adult, Lapland Longspurs were feeding with them. Near a lake about 50 miles east-northeast of Wordie Bay, at Lat. 68° 31′ N., and Long. 71° 22′ W., we saw a female bunting feeding stub-tailed young as late as August 8.

In general it may be said that in the Frobisher Bay area the Snow Bunting's nesting started about June 10 and was over by July 26 in 1953. At Camp Kungovik, in the Bowman Bay district, in 1929, Soper (1946:424) did not find full sets of eggs until early July, and he noted the first young a-wing at Cape Alberta on July 27.

Certain of our observations between June 15 and July 31 merit special attention. First: we noted such striking differences in size among nestlings of most broods as to convince us that incubation usually started before completion of the clutch—as it did in the observed case of Nest 1. This is quite counter to Tinbergen's statement (1939:34) that incubation starts "one to three days" after the clutch has been laid. In mid-July, when many young birds were leaving their nests, we often saw some young of a given brood well enough developed to run from the nest-cup in various directions, while others remained in the nest: or some old enough to fly from the nest-crevice and make rapidly off, while others ran back to hide among the stones. These non-flying birds were definitely younger, *i.e.*, less well developed, than the fliers, a fact we proved to our satisfaction several times. True fledging is, in other words, *a leaving of the nest-crevice.* We believe it is customary for a young bird to remain in the nest-crevice until it can fly quite well. The two or three oldest birds of the brood leave with the male parent (observed July 3 and 16), and the female continues to feed the younger siblings, which stay a while longer in the nest-crevice. Most of our late observations of adults carrying food into nest-crevices were of females.

There was a gradual subsidence of singing by the males. On July 6 we heard several full-length ordinary songs and observed one flight-song. On July 7 we heard several ordinary songs and watched one male performing a flight-song several times. This individual we collected (GMS 11743), finding it to be black-billed and in boldly black and white plumage. Its testes were greatly enlarged, and the vas deferens was coiled into a large knot in the region of the anus. July 7 was the latest date on which we observed a flight-song. Ordinary songs we continued to hear now and then, especially in the morning, until July 13. Thereafter singing virtually stopped. We heard one full song near the dump early on the morning of July 27.

The postnuptial molt started about the time the young left the nest-crevice, the postjuvenal molt shortly thereafter. The two strong-winged young birds which we collected July 16 were in full juvenal body-feather, but their remiges and rectrices were not free of sheath at the base. They were following, and being fed by, the male parent exclusively. They were dark-billed and so was their father, who appeared to be in full breeding feather (*i.e.*, not molting). On July 24, we carefully observed several dark-billed adults, deciding that their molt had not yet started. On July 28 we observed several young birds with full-length tails, some adults which appeared still to be "in quite complete plumage," and one molting adult female. On July 29, on an island near Coffin Island and well southwest of the Base, we found feathers of adult *and young* Snow Buntings below a Peregrine's eyrie. Young birds observed at Davidson Point, July 30, were molting their body plumage extensively. On August 1 all adults we saw seemed to be molting, and they were all in rough country either close to the sea or well back from it. Their bills were black. On August 1 we collected a young female (GMS 11800) in complete juvenal body-feather but with somewhat sheathed flight feathers. The bill was yellow basally, dusky at the tip. The female we saw feeding a stub-tailed young bird on August 8 (at a lake 50 miles east-northeast of Wordie Bay) seemed to be black-billed and in full breeding plumage. A female specimen (GMS 11849) collected at the Base August 18 proved to be largely in first winter feather. Even at a distance the brown tone of the head and chest, and the yellow of the bill, were readily apparent through the binocular.

Nesting Success

Obvious from Table 1 is our belief that not one of the 22 nests was destroyed by a predator. What did away with part of the brood in Nests 1, 2, 6, and 19 we cannot say. So far as we could determine, they were not killed by any sort of nest-parasite. None of the several nests we made a point of tearing to pieces was infested with mites or fleas. The dead young one at Nest 19 looked as if it had become wedged in a narrow crevice and been unable to back out.

The success of the 19 nests we observed (*i.e.*, did not collect) strikes us as remarkable. During inclement weather whole nestfuls of young Water-Pipits (*Anthus spinoletta*) died of starvation not far from bunting nests which suffered no losses at all. Young Horned Larks perished in or near their nests from starvation or exposure or both. Two young Wheatears of a brood of seven drowned in a pool at the foot of their nest-cliff. No such accident befell any of the buntings, though we did, admittedly, find a dead stub-tailed young bunting at the edge of a lake between the Base and the Hudson's Bay Company post on July 27. We were puzzled by the disappearance of one of the brood in Nest 1. The nestling may have been carried off by a lemming but, despite the great abundance of these rodents, we saw virtually nothing which clearly proved to us that they were predatory in the usual sense of the word.

As for the weasel (*Mustela erminea*), Sutton's (1932:248) experience on Southampton Island led him to believe that any weasel which might find a nestful of young buntings would certainly destroy the whole brood. We looked in vain for weasels in the immediate vicinity of the Base. The only time we recorded the mammal was, in fact, on July 22, when we collected two males (an adult and a full-grown young one) about half a mile east of the Hudson's Bay Company post. The Arctic fox (*Alopex lagopus*) too was very rare: we failed to find even a track or dropping in the area intensively studied.

The bunting's choice of nest-site is highly important to species-success. The Raven (*Corvus corax*), a potential eater of bunting eggs and nestlings, does not eat them because it cannot reach them. We took pains to examine each bunting nest from the standpoint of predation and were struck by the fact that not one of them was easily reachable by a Raven, Snowy Owl (*Nyctea scandiaca*), Peregrine, fox, or dog. A weasel could have reached many of them, perhaps any of them, but weasels were extremely rare. The abundance of lemmings probably stood the buntings in good stead, for these mammals were so readily obtainable that the owl had no occasion to molest the buntings. We visited several owl nests regularly; at not one of them did we find evidence that an owl had killed a bunting—or, for that matter, any other bird. Ravens fed regularly at the Base's dump. Abundance of food there may have reduced to some extent the sum-total of that hardy species' foraging.

Description of Specimens

Birds.—Five adult Snow Buntings (three males, two females) collected near the Base are all worn, hence without much brown in the plumage. The females are dark gray and white, not black and white, and they are much streaked, especially on the crown, nape, and hind neck. Measurements, in millimeters, are:

GMS No.	*Sex*	*Date*	*Wing*	*Tail*	*Culmen*	*Tarsus*
11714	Male	June 20	112	71.5	12	22.5
11719	Male	June 23	108	68	12.5	22.5
11743	Male	July 7	108	68	13	22
11715	Female	June 20	105	68	10.5	21.5
11720	Female	June 23	97.5	60	10	21

Males 11714 and 11743 are more boldly black and white than 11719. The last looks like a younger bird than the other two, for all the dark parts of its plumage are brown-black rather than blue-black. It is unlike the others also in that its nape is spotted with black; its primary coverts are all tipped (9 to 12 mm.) with black; all its secondaries but the two innermost bear a black spot on the outer web at the tip; and some feathers of the rump and lower back are edged with brown. In our opinion all our specimens represent the nominate race, but 11719 has certain characters of *P. n. insulae* Salomonsen, which is believed to be resident in Iceland. Salomonsen (1951:536), discussing the differences between *nivalis* and *insulae*, says: "The typical form . . . differs by having . . . dark spots on nape lacking, primary-coverts pure white or with an apical spot of less than 10 mm., first [innermost] primary pure white or with a small black patch a few mm. large, etc." The wing, according to Salomonsen (1951:539) measures 103–115 (usually 106–113) in male *nivalis*, 103–114 in male *insulae*.

An immature female (GMS 11849) which we collected August 18 (wing, 104; tail, 67; culmen, 10.5; tarsus, 22) is in the final stages of the postjuvenal molt. The rectrices and remiges are fully unsheathed at the base. The bill is dusky at the tip, yellow basally.

Among our most interesting specimens are the two juvenal siblings (GMS 11757 and 11758, female and male respectively) taken July 16. The tail of the female is 60 mm. long, that of the male only 49 mm., clear evidence of the considerable age-discrepancy possible within one brood. The female is the browner or buffier in tone throughout, especially on the belly, and her chest is the more definitely streaked. In both specimens the bill is dusky, without a hint of yellow. Both birds were flying strongly, though their flight feathers were still sheathed at the base. No natal down whatever clings to the plumage of the head or back.

Eggs.—The single egg collected July 9 is decidedly the least marked, and therefore the palest, of the 18 eggs we collected. It is bluish white with a sprinkling of very fine pale brown dots. The dots form a vague wreath around the larger end. The egg measures 22.8 × 16.2 mm.

The set of five collected June 22 are alike in having a strongly bluish white ground-color and comparatively few markings. Most of the markings (pale purplish gray blotches and scattered dark brown dots and scrawls) are at the larger end, where they tend to form a wreath. The eggs measure: 21.1 × 15.2, 22.1 × 16.0, 21.4 × 15.6, 22.2 × 15.9, and 21.3 × 15.7 mm.

The set of five collected June 23 are wreathed at the larger end with brownish gray blotches and dots and there are a few scattered dark scrawls all over each egg. The eggs measure: 22.0 × 15.3, 22.3 × 15.1, 22.2 × 15.8, 22.9 × 15.8, and 22.9 × 15.7 mm.

The set of seven collected June 26 are all heavily marked, resembling, in that respect, eggs of the Lapland Longspur. In four of them the prevailing tone is a warm shade of brown; in three it is gray, and in these three the blotching is concentrated about the larger end. They measure: 21.1 × 16.1, 21.1 × 16.0, 20.8 × 16.1, 20.4 × 16.3, 20.9 × 16.2, 20.3 × 16.1, and 20.8 × 16.1 mm.

In size the 18 eggs average 21.58 × 15.84 mm.

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Summary

1. At the head of Frobisher Bay, Baffin Island, in the summer of 1953, the Snow Bunting was the commonest land bird. Twenty-two nests found by us in June and July were all under, or among, rocks. Some of them we could neither reach nor see.

2. Clutch-size or brood-size in 16 of the 22 nests was as follows: four (one nest); five (11 nests); six (one nest); seven (three nests).

3. Young from 19 of the 22 nests fledged from about July 3 (brood of six) to about July 27 (brood of five). Average approximate date of fledging: July 16. At a lake 300 miles north of the head of Frobisher Bay we saw a female bunting feeding a stub-tailed young one just out of the nest, August 8.

4. About 35 days were required for producing a brood: four days for nest-building; four to seven days for egg-laying; 12½ to 13 days for incubating; and 12–14 days for fledging. We obtained no evidence of two-broodedness.

5. Nests were built entirely by the female, but the male accompanied the female while she was gathering material. Not once did we observe copulation, but this might have taken place in the nest-crevice.

6. A nest started June 15 was ready for lining on June 19. By June 20 much dog hair had been added. By June 21 white ptarmigan feathers had been added and the first egg laid. The third egg was laid between 2:01 and 5:17 a.m., June 24; the fifth egg between 4:00 and 4:55 a.m., June 26. Incubation started just after the laying of the third egg. Hatching of the fifth egg took place at least 12 days and 9 hours, at most 13 days, one hour, and 10 minutes after it had been laid.

7. The female incubated the eggs. She was fed by the male (presumably at the nest proper) throughout the incubation period. A *churr* callnote from her accompanied feeding. This *churr* resembled the food-cry of the nestling. When the incubating female left the nest-crevice for food or exercise she was sometimes accompanied by the male.

8. Newly hatched nestlings produced no sound when opening their mouths for food. When about two days old they produced a faint food-cry. This cry gradually became stronger. When the young were about ten days old the chorus of begging was audible to the human ear several rods from the nest.

9. Young left the nest proper when about ten or eleven days old, before they could fly well. When they left the nest-crevice, a day or so later, they flew strongly. At this stage their tails were about 20 mm. long. The oldest two or three siblings left the nest-crevice in advance of the others and were fed exclusively by the male; the younger siblings, as long as they remained in the nest-crevice, and probably for several days thereafter, were fed exclusively by the female.

10. Both the male and female bunting carried food to the nest direct, and both carried away fecal sacs. We never saw one adult transfer food to another adult.

11. The food-cry of the young bunting after leaving the nest-crevice was *zhip* or *zhi-dip*. The young bird continued to use this cry for several days after leaving the nest-crevice. It began obtaining food for itself well before its remiges were full-grown. When it began obtaining its own food it flocked loosely with other young buntings.

12. Three of the 22 nests found we collected. Of 80 eggs laid in 16 nests, 72 hatched (in eight eggs which did not hatch no embryos developed). From 15 nests a total of 60 young probably fledged. All of the 19 nests not collected as specimens were more or less successful. From each of two nests one nestling mysteriously disappeared. The most likely predator: a lemming, for lemmings were common, but we obtained no proof that a lemming even visited either nest.

13. We found remain of buntings in the vicinity of three Peregrine Falcon eyries; but we found no bunting remains at any of several Snowy Owl nests which we visited regularly.

14. The inaccessibility of bunting nests to such predators as ravens, owls, foxes and dogs greatly aids the species in its survival.

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A CHACHALACA FROM THE MIOCENE OF FLORIDA

BY PIERCE BRODKORB

Only six species of Miocene birds have been described from the eastern United States while no less than 47 are known from the Great Plains and westward. All of the eastern species are water birds and with one exception all are from marine deposits. The only eastern non-marine Miocene formation which has yielded avian fossils is at the locality known as the Thomas Farm, north of Bell, Gilchrist County, Florida. Wetmore (1943) listed three bird bones from that deposit, only one of which, however, was determined beyond the family level. This was a shore-bird which he made the type of a new family, Rhegminornithidae.

Recently Dr. Albert M. Laessle, of the Department of Biology, University of Florida, collected a fourth fossil bird in the same locality. The specimen is the tibiotarsus of a chachalaca, a representative of the family Cracidae which at present has a Neotropical distribution, extending from the lower Rio Grande south to Argentina.

Three other Tertiary cracids have been described from North America. They are *Ortalis phengites* Wetmore (1923) from the Lower Pliocene of Nebraska, *Ortalis tantala* Wetmore (1933) from the Lower Miocene of Nebraska, and *Ortalis pollicaris* A. H. Miller (1944) from the Lower Miocene of South Dakota. The discovery of a cracid in the Lower Miocene of Florida is thus of considerable interest from a distributional standpoint. First, it helps to link the Miocene land fauna of Florida with that of the Great Plains area, as already indicated by White (1942) on the basis of the mammals of the Thomas Farm. Further it marks the fourth record of the family Cracidae from the Nearctic Tertiary. Although at present characteristic of the Neotropical Region, the cracids are unknown in South America before the Pleistocene (cf. Lambrecht, 1933:752). Thus the family is assumed to be of Nearctic origin and probably did not reach South America before the Pliocene or Pleistocene land connection between the two continents.

Boreortalis new genus

Type. Boreortalis laesslei new species.

Diagnosis. Agrees with the Cracidae in shape of external condyle of tibiotarsus, prominent oblique groove for branch of peroneus profundus crossing external side of base of shaft, extent and position of tendinal groove and bounding ridges along external anterior side of shaft, conformation of tibial bridge, and presence of a tubercle on lower end of tibial bridge.

Closest to *Ortalis*, but differs from it as follows: (1) distal portion of bone less compressed; (2) arc formed by anterior portion of external condyle greater, and therefore the condyle extends less abruptly forward from shaft; (3) depression on anterior internal edge of shaft opposite upper opening of tibial bridge larger and shallower; (4) tubercle on tibial bridge located more mediad, better developed, with more prominent edges, and with its external margin concave; (5) area external to tubercle flattened, forming a depression which leads from shaft to intercondylar fossa; (6) depression in upper outer part of intercondylar fossa at base of external condyle below tubercle on tibial bridge much broader and shallower and without a pit; (7) pit on side of external condyle located nearer center, less forward and distad.

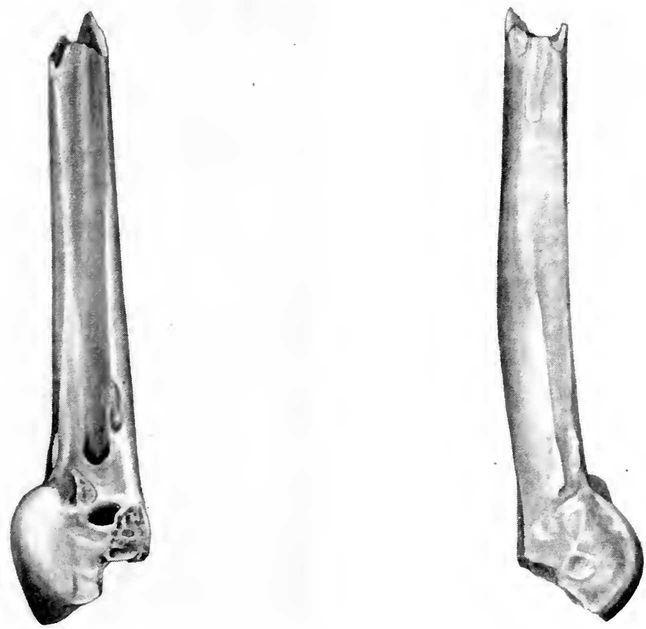

FIG. 1. Tibiotarsus of *Boreortalis laesslei*. Anterior (left) and external views. About two times natural size.

Affinities. Although in the main closest to the chachalacas of the genus *Ortalis*, the fossil resembles the Central American black chachalaca (*Penelopina*) in one respect, the large size and shallowness of the depression opposite the upper opening of the tibial bridge.

The question arises whether the other Tertiary chachalacas may belong in this genus rather than in *Ortalis*, especially since two of the three Tertiary species were referred to *Ortalis* with hesitation by the describers. The tibiotarsus is known only of *Ortalis tantala*. That species agrees with *Boreortalis* in having the distal end of the bone less compressed than in the living species of *Ortalis*. The figure, however, shows the external condyle rising abruptly from the shaft as in *Ortalis* in contrast with the condition in *Boreortalis*. Since the other generic characters of *Boreortalis* are not mentioned in the description of *O. tantala* and are not evident in the figures, I hesitate to refer it generically. Still less can be deduced about the generic position of the other two species, which are known only from wing elements.

Boreortalis laesslei new species

FIG. 1

Type. Distal portion of right tibiotarsus (with internal condyle and posterior portion of external condyle missing), No. 743, collection of Pierce Brodkorb. From Lower Miocene at Thomas Farm, eight miles north of Bell, Gilchrist County, Florida. Collected November 24, 1953, by Albert M. Laessle.

Diagnosis. Differs from the living species of cracids as detailed in the generic diagnosis. Size between the living *Ortalis vetula* (Wagler) and *Penelopina nigra* (Fraser).

Larger than other described Tertiary cracids. Of these *Ortalis pollicaris* is the largest, resembling the living *O. leucogastra* in size. *Ortalis phengites* is smaller than the living *O. vetula*, and *O. tantala* is only about half the size of the living species.

Measurements. Least width of shaft 4.4, least depth of shaft 3.8, distance from posterior end of base of shaft to anterior end of external condyle 9.4 mm.

Associated Fauna. Since the discovery of the Thomas Farm deposit in 1930 an extensive vertebrate fauna has been found there. The mammals, represented by 34 or more species, have been studied by Simpson (1932), Wood (1947), White (1940, 1941, 1942, 1947), and Lawrence (1943), and have been summarized by Romer (1948). The reptiles were described by White (1942a) and Vanzolini (1952), and the frogs were reported by Tihen (1951). The paper by Wetmore (1943) on other avian remains has already been mentioned. The ecological picture derived from these studies is of a river flowing through a dry, grass-covered plain. The presence of a cracid is in harmony with the previously studied fauna, since its closest relative, the present-day chachalaca, frequents the brush along streams in arid country.

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THE VALUE OF THE CHRISTMAS BIRD COUNTS

BY PAUL A. STEWART

At the turn of the twentieth century the late Frank M. Chapman initiated Christmas bird "censuses" as a substitute for the old time "Christmas hunt" which was an organized effort to kill hawks, crows, and other "vermin." For many years the censuses were published in *Bird-Lore.* They have since appeared in *Audubon Magazine* and are now being published annually in *Audubon Field Notes.* Similar lists are also published in *Canadian Field Naturalist* and in several state and local journals. Only 27 persons made the 25 lists of the first year. Participation in these censuses (now known as counts) has since made a spectacular growth, and the number of observers taking part each year has increased almost two hundred fold; 5,151 observers took part in 433 separate counts in 1951.

The increase of participation in Christmas bird counts bespeaks their great popularity. The desire to contribute something to science, the wish to see one's name in print, the rivalry for best lists, sport, and recreation are some of the considerations which prompt observers to go afield in all sorts of weather to make the counts. Whatever the personal motives for making them, these counts have proven to be a highly effective means of collecting raw data on early winter bird populations.

In our constant probing into animal population problems, many specialized techniques have been developed. Most methods of censusing have undergone constant revision throughout their development, and many of these revisions are increasing the accuracy of the information collected. Although this is true of numerous methods of censusing, in certain fields the techniques employed have not kept abreast of the times. It is proper to ask: of what value are the Christmas bird counts? Can we enhance their value and still hold the interest of the many who make them?

Some Opinions on the Value of the Counts

Except for the stimulus for finding unusual birds, and for charting the invasions of northern birds, many ornithologists think that about the only value of the counts comes from the recreation furnished and the popularizing of bird study through the attention focused on it by the published lists. Perhaps these are the greatest values of the counts, but others think that they hold neglected possibilities. Their present limitation has been well expressed by L. S. Putnam (personal conversation). He stated: "The great number of variables inherent in the data derived through Christmas counts render them practically useless in the furtherance of scientific knowledge." On the other side, Wing and Jenks (1939:343) stated: "Among all the activities of amateurs, none is a greater contribution to science than the taking of Christmas censuses," and Odum (1950:227) wrote: "One has the feeling that there is more gold buried in the mass of data than has yet been uncovered." Because of the large number and scattered distribution of the participants, which results in extensive sampling from a large area in a short period of time, I think that the method holds vast potentialities. However, its fullest possibilities are now being lost.

Some Attempts to Analyze the Count Data

The data at present are of limited application. Considering the large number of data amassed, relatively limited attempts have been made to analyze them. An early attempt to use the data as a basis for curves of population fluctuations in 10 species was made by Perkins (1914:14–15). The values plotted were derived by dividing the total number of individuals of a species by the total number of lists for the year. Even the important variable of extent of the total coverage was neglected. Nichols (1937:430–433) used a closely similar method of analysis.

Ganier (1938:89–93) used counts from Nashville, Tennessee, to determine the relative abundance of the "Christmas" birds in that area. Hicks and Chapman (1933:135–150) analyzed the counts made in Ohio during the first 32 years. Relative frequency of occurrence and the relative abundance of species were the principal items considered. Such attempts at determination of the relative abundance and comparative frequency of occurrence of various species, however, do not give ample consideration to the differences in coverage of various habitats and differences in conspicuousness of different species. Wing (1947:1–270) analyzed all available counts up to 1939 and presented the calculations in tabular form. No interpretation of results was attempted. With the use of Christmas count data, Wing and Jenks (1939:343–350) plotted the relative abundance of the Downy Woodpecker throughout its range. They also appraised trends in populations of the Bob-white in 26 states, the District of Columbia, and one Canadian province. Kendeigh (1944:82) plotted a curve showing yearly fluctuations of the Bob-white population in Ohio. Several additional statewide and area analyses have been made and reported in local publications. A partial list of these reports occurs in *Audubon Field Notes* (Anon., 1950b:187).

Some analysts took unjustifiable liberties with the data; in all cases they left the reader with questions which should have been answerable by analyses of counts. The simple question of whether birds have increased or decreased during the period covered cannot be conclusively answered by analyses of the counts. In an analysis (unpublished) of 48 years of Christmas counts from Youngstown, Ohio, I found that the total number of birds noted per mile of travel increased from 12 (1904) to 123 (1950). I also found a markedly lower level in the numbers of Black-capped Chickadees found per mile of travel each year since 1920 as compared with the eight-year period immediately before that date. To what extent these changes were caused by actual changes in the populations is hidden by the many variables.

Slow Trend Toward Improved Methods

While there is still much to be desired, considerable improvement has been made in the techniques employed during recent years. Modern lists include a much more complete account of weather conditions than was included in the earlier lists. Weather may have a profound influence on the results. The recent practice of reporting the extent of coverage of different habitats is also highly commendable. These two innovations indicate a trend toward improved method of the counts, but further refinement is desirable. Perhaps future improvement will be more of a qualitative than a quantitative nature.

Spread of interest has been part of the improvement achieved, and there has been a gradual increase in the number of observers. This has been paralleled by gradual extension of the routes covered. The continuous change of itineraries forestalls direct comparison of lists from successive years. There must ultimately come a time when further expansion of coverage will not increase the numbers of species found. This point may be near in some of the larger counts. If this is true, it is extremely desirable that the counts be continued without further modification of the routes covered, as successive lists are more readily comparable if the same routes are followed each year.

More Exact Information Needed On Extent of Coverage In Different Habitats

Additional precautions are desirable if lists from different areas are to be comparable. There is need for information on the extent of coverage of different habitats. Fortunately, this information has been included in many lists of recent years. Coverage in different habitats, however, has been reported as percentages of total time spent, and the figures are usually derived from guesses. If the method is to be sufficiently sensitive to give the desired indication of small changes in bird populations, all pertinent information must be given with scientific exactness.

The Mixing of Data Obtained by Different Methods of Travel

There has been improvement in certain phases of the method of making the counts but marked deterioration in other phases. Increasing use of the automobile, coupled with competition for long lists, has lowered the scientific value of the counts. Most counts incorporate data collected by use of automobiles to scout through areas to list additional species otherwise overlooked. This practice unjustifiably accentuates the apparent abundance of such conspicuous birds as hawks. In most cases the main count should include only birds listed by observers on foot. This is not to say that counting should never be done except on foot. Some counting is best done from an automobile or boat, and such counts are entirely acceptable for special conditions if a standard procedure is followed. Likewise, it is entirely fitting for the observer to use an automobile for visiting favored habitats, but a reasonable distance should be covered on foot in the habitats visited. The important thing is to segregate observations made by different methods of travel. It is clearly unscientific to compare observations made from an automobile with those made on foot, on a per mile or per hour basis. Published reports could distinguish between types of observations by enclosing in parentheses those numbers which do not properly belong in the main list made on foot.

The Need for Complete Honesty in Identifications

In addition to encouraging undesirable use of the automobile, the competitive desire for long lists sometimes induces dishonesty. I have been told of a case where an accipitrine hawk was seen but not identified. Since the list contained Cooper's Hawk, this unidentified bird was counted as a Sharp-shinned Hawk. In all fairness, however, such incidents are unusual. There is probably a high degree of accuracy in identification of the common birds. Observers should recognize that there is no particular value in long lists as such. Long lists, however, will usually result as by-products of the extensive coverage necessary to insure adequacy of the samples.

Numbers of Birds Observed per Spatial Unit More Meaningful Than Numbers per Time Unit

The raw data which appear in the published reports must be translated into common values, such as the numbers of birds found per hour or per mile, before different lists can be compared. The present practice of reporting the extent of coverage of different habitats as percentages of total time spent assumes that the analyst will be interested only in the numbers of birds found per time unit of observation. In most lists time spent has probably been reported more accurately than mileage. Accordingly, in his analysis, Wing (1939) translated the data into terms of the numbers of birds found per hour. Actually, numbers of birds found per mile of travel is much more meaningful than numbers found per hour of observation. The total number of individual birds found is more nearly a function of the distance traveled than of time spent in the field. The walking speeds of observers must vary considerably. Colquhoun (1940:67) varied his walking speed from 1 to 2.3 miles per hour and found that the slow-fast ratio for the numbers of birds noted per hour was 1 to 1.7. The rate of travel is not entirely without significance even when the observations are considered on the basis of numbers of birds found per mile but is relatively unimportant. Ideally, a reasonably uniform rate should be used on all counts even when the observations are to be considered on the basis of the numbers of birds found per mile. If a uniform rate of travel were always used the units of time and of distance would be equally satisfactory for comparative purposes. Such uniformity is obviously impossible. It is also more logical to refer to bird density in terms of space than in terms of the observer's time.

While the present practice of reporting the coverage of the different habitats in terms of percentage of total time, rather than actual time, is probably not worth quibbling about, there is a slight advantage in having the information given in units of actual time. The compiler is thus relieved of calculating a figure which must be reconverted by the analyst.

Selection of a Route and Determination of the Mileage Covered

If the count is properly planned and conducted, it is relatively easy to determine very nearly the actual distance traveled. Use of a fairly straight course will facilitate determination of mileage. In selecting a route, an itinerary which can be covered each year in spite of possible temporary shortages of observers should be chosen. This route should adequately represent the various habitats in the region. Reference should be made to aerial photographs and the route thoroughly planned in advance. The distances to be covered in the different habitats should be carefully computed from the photographs and supplementary knowledge of the region. Aerial photographs are usually available at the local offices of the Soil Conservation Service and the Production Marketing Administration. In the absence of an aerial photograph, U. S. Geological Survey topographic maps can be used. The use of a pedometer furnishes a possible alternative. The mileage need be computed only the first year, for the same route should be faithfully followed each subsequent year. Thereafter, only distances in changed habitats need to be determined. If possible, several persons should be familiar with each route so that its proper coverage is assured each year.

Variation Due to Non-Standard
Use of Special Attracting Devices

In selecting a route, care should be exercised to avoid factors which artifically influence bird movements, such as bird feeders. Some observers are now spending as much as one fifth or more of their total count time around bird feeders. Observations thus made are not comparable with those from areas where no attracting devices are used.

It is questionable, too, whether devices such as the "squeak" and the "screech" should be used to attract birds unless their use is standardized. If a chosen lure call is used at a standard frequency by all observers, it should produce reasonably uniform results. Unless their use is standardized, the various lures had best not be used. Likewise, the use of a dog in finding certain species of birds is undesirable.

Subdividing of Groups Objectionable

In many larger counts there is a rather prevalent practice of periodic subdividing and rejoining of groups of observers in making more thorough coverages of certain habitats. This adds little more than objectionable complications. Cooperative effort in spotting birds is thus varied along the route. If a group of three observers spreads out so that individuals are 500 feet apart as they cross a weed-covered field, the distance traveled by each observer would be important in considering the number of Bob-whites found per mile. If Marsh Hawks were being considered, however, the distance which one person walked would be more nearly the thing to take into account. The matter of proper spacing of observers to give uniform lateral coverage of different species in various habitats is difficult and complicated. Greater uniformity will be achieved if subdividing groups is avoided.

A possible exception is represented by a practice used by the Wheaton Club at Sugar Grove, Ohio. Many observers are available, and various habitats are traversed by a long line of observers separated by short distances and moving abreast. In many cases a complete parcel of habitat can be covered in one sweep. The size of the tract covered can then be determined with reasonable accuracy from a map or aerial photograph. A simple hatchet planimeter (Dickerson, 1942:19–22) can be conveniently used for determining the areas of habitats with irregular boundaries. Fewer of the birds occupying a given area are missed and fewer counted twice, presumably, when this method is used than when a single observer walks back and forth through the same area. The numbers of birds found per mile should not be directly compared with the numbers found by a single observer or by a group of observers following essentially the same path. The number of observers needed and the nature of the terrain to be worked limit the availability of this method for some counts, but the data yielded are much more valuable than those obtained by the standard method.

The Human Variable

There are striking differences in the proficiency in finding birds of different observers. This is related to total field experience, recent field activity, keenness of vision, and acuity of hearing. The proficiency of a single observer may vary. For instance, his hearing may be dulled by a head cold or may deteriorate with age. The influence of the human variable can be greatly reduced by several observers working together. At least one thoroughly experienced observer should be in each group.

Another important human variable is involved in personal estimates of the numbers of birds in flocks. With small flocks, reasonable accuracy is probably assured by the combined efforts of several persons in a group, and actual counts can often be made. Estimates made by different observers of large flocks frequently vary widely and the count figures for large flocks of birds must be considered as only relative.

Special Problems Imposed by Flocking Habits of Birds

The flocking of birds presents a major problem to the count analyst. Large flocks frequently include all the birds of a given species present in a considerable area. Perhaps a flock of 5,000 Black Ducks is seen on a lake from one position. If we assume that the observer moves a distance of one foot, he is seeing 5.280×5.000 birds per mile of travel. Clearly, a figure thus obtained has no meaning, and another method must be used. There is no point in translating the count observations of such species into terms of numbers per mile. Analysis of the status of a species forming large flocks is most meaningful if it is made on a range-wide basis. Perhaps the best that can be done with the data on such species is to consider the total individuals included in the various lists. Supposed population trends based on these data would be meaningless unless an extremely large sample were represented. If the comparative abundance of different species is to be determined, the relative frequency of occurrence should also be considered.

All types of winter flocking are represented in different species of birds, and calculations of percentages of the total bird population made up of various species are seriously distorted if species forming large flocks are involved in the total. Just when a flock can be considered large is difficult to decide, and the decision is necessarily arbitrary. The important consideration is whether the local distribution of the birds is affected sufficiently by flocking to distort the results of the count. Probably the local distribution of the Bob-white in Ohio is such that the number of birds found per mile of travel gives an index to its relative abundance somewhat similar to that for a nonflocking species, while the Horned Lark should certainly be treated as a flocking species. Because of flocking and peculiarities in the movement of Horned Larks, the exact number of birds found probably has little meaning. This is also true of waterfowl, doves and crows.

Differences of Conspicuousness in Different Species

It would seem that counts of two nonflocking species such as Red-tailed and Red-shouldered Hawks should be fairly comparable. There may be factors in the birds' behavior, however, which cause a differential frequency of observations. For example, perhaps one species calls more often than the other. There are many differences in conspicuousness among birds, and these differences are sometimes hard to detect and measure. Calculations of relative frequency do not give proper consideration to many differences in conspicuousness among the various species. The count analyst should make interspecific comparisons with extreme caution.

Variation in Conspicuousness of Birds at Different Times of Day

Grinnell and Storer (1924:25) listed the numbers of birds found during each hour of observation and noted that more were found in the early morning and late afternoon than at mid-day. Dice (1930:23) also pointed out that differences in bird movements at different times of day should be considered. Dice properly recommended that the numbers of individuals found during each hour or half hour should be noted. Unfortunately, it is probably impracticable to record these details in the Christmas counts, but perhaps this does not justify a serious objection, as a fairly constant average probably results when all counts represent all-day walks. It is a practical though not entirely satisfactory alternative to have coverage in the various habitats equally distributed through different hours of the day. An approximation of this probably results without special effort because of the varied habitats found in much of the country. The lists should always cover entire days as is usual for the counts. If a single habitat is worked during the entire day, approximately the average condition is shown in the results.

Variation in Results Imposed by Weather Variables

The efficiency of observers varies with different weather conditions. For instance, if the temperature is so low that the observer's ears are kept covered, acuity of hearing is probably reduced.

It is apparent, also, that the behavior and local movement of birds is influenced by weather factors. The weather on the count day is closely related to the results obtained. The details of how different species respond to given weather conditions are not now known. If information were available it might be possible to use a weather correction factor in analysis, but the problem is so highly involved that its exact details cannot be known for many years to come.

A simpler method of reducing the weather variable would be to try to make weather a constant factor. Unfortunately, most count days are selected with regard to convenience rather than weather. When many persons make a single count, a day must probably continue to be chosen for convenience. When possible, observers should allow their choice to be guided by weather forecasts. Weather should be chosen which is normal for the locality during the period. This should be reasonably pleasant if possible. If the forecast is in error it might be desirable to discontinue the count and make a second try for a day with appropriate weather. It is, of course, wholly unrealistic to expect complete standardization of the weather factor.

The weather and other factors which preceded the count day may also have an important effect on the counts of certain species. Suppose fewer birds of a species are found in an area during a given year than is usual. A range-wide analysis of the species would indicate whether the unusual scarcity is local or represents a low for the species. In migratory species, a range-wide analysis would show if scarcity in the southern part of the range of a species were caused by less southward movement than usual. The counts now contain so many variables that such an analysis is not practicable.

Use of Counts for Calculating the Absolute Density of Birds Per Unit of Area

The application of Christmas counts should be restricted to the indication of trends in populations rather than the yielding of exact data on absolute density of birds per unit of area. A reasonable estimate of the numbers of birds occurring per unit of area can be made, however, if the width of the strip covered by the observer can be determined for the individual species and the different habitats. Unfortunately this strip usually lacks a well defined boundary, and the best that can be done is to determine its average width. Kendeigh (1944:77) presented a table showing the average distances at which 24 species of birds were first observed. With this information the average width of the strip covered could be calculated, and the density of various species per unit of area approximated. But the width of the strip varies with observers, habitats, and weather conditions. Kendeigh concluded that scientific use of Christmas count data for measurement of population size is not generally practical (personal correspondence, 1953).

If the counts are to be used to estimate densities in different habitats, the need for truly random samples is accentuated. But routes are usually planned to cover the richest bird habitats in the region. This is fairly satisfactory if standardized, and if only trends in populations are to be determined. But random samples from each habitat are essential for an unbiased picture of the average densities in different habitats. Requiring these, however, would probably complicate techniques so much that participation would be seriously reduced.

Exact Measurements Needed of Effect of Different Variables on Results of the Counts

Some of the suggestions in this paper merely represent repetition of needs pointed out by earlier writers, and some are a part of the official requirements for Christmas bird counts (Anon., 1950a:183–4). There seems to be some laxity in application and enforcement of improved counting techniques, and this may be unavoidable in such a large-scale volunteer enterprise. I hope that a number of observers will review their methods and apply an improved technique which might serve as a check on the reliability of adjacent counts using the prevailing method. A more desirable check could be made if the same area were covered with both methods through a series of different conditions. A worthwhile project for an enterprising bird club would be the study of the influence of the different variables (particularly the influence of variation in observer proficiency and weather) on the results obtained in the counts. A study should be made, also, to determine the minimum size of the area required for a satisfactory sample. Lack (1937:375) has already pointed out that a relatively large area should be covered if the sample is restricted to a single day.

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Summary and Conclusion

The Christmas bird count could be a highly effective method of collecting data on early winter bird populations, but the techniques now used are in need of refinement if the data are to have the maximum, or even much, scientific usefulness. There are so many variables involved that the lists from different years and localities are seldom comparable. An increased standardization of methods is needed.

The data are best compared on the basis of the numbers of birds found per unit of distance, and the distance traveled in each habitat should be reported with scientific exactness.

Observations made from automobiles must be separable from those made on foot.

Efforts should be made to avoid bias of the data from use of artificial attracting devices such as bird feeders and the "squeak" or "screech." Likewise, dogs should not be used.

Alternate subdividing and rejoining of groups of observers should be avoided.

Proficiency in finding birds varies widely among different observers and to some extent in the same observer at different time. For the reduction of the influence of the human variable, several persons should work together on each route.

The flocking habit of birds introduces a serious problem to the count analyst, and the data for species forming large flocks should be considered as only relative. Species forming large flocks should be considered by the analyst on a range-wide basis. Percentages of the total local population which various species make up cannot be computed when large flocks of birds are involved in the total because such flocks may represent concentrations from a much larger area than that covered for nonflocking species.

Calculations of relative frequency of occurrence derived from the totals for all species do not give due recognition to the differences of conspicuousness among the various species.

Observers should attempt to make weather a constant factor. This could be done by selecting a type of weather which annually occurs during the prescribed period and by making the choice of a day with regard to forecasts of this standard condition.

If the numerous variables were properly controlled, a range-wide analysis of the status of a species during a given year would indicate the extent of a locally observed scarcity or abundance.

The Christmas counts cannot be used to determine absolute bird densities.

To provide a more exact appraisal of the value of the Christmas counts, studies are needed of the influence on the counts of the many related variables.

As a scientific method for collecting data on natural populations of wild birds, the Christmas count promises to be of vast utility, and is, indeed, the broadest available to science. The method will presumably always contain some flaws, but this should not discourage efforts toward needed improvement. The scientific value of the counts can be enhanced without serious infringement of their popular appeal.

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A LABORATORY APPROACH TO THE STUDY OF IMPRINTING[1]

BY A. OGDEN RAMSAY AND ECKHARD H. HESS

According to Lorenz (1937), imprinting differs from other forms of acquired behavior in that: (1) it occurs very rapidly; (2) it occurs only in a very limited part of the animal's life; and (3) it is irreversible, or, at least, it is difficult to extinguish. Although imprinting was for some time thought to be found exclusively in birds, it now seems that it may be a more universal type of behavior. Suggestions from the literature point to the possibility that it may exist in such diverse forms as insects, fishes, and mammals (Thorpe, 1950). The characteristics of imprinting listed above make it an extremely important subject in the study of behavior. This is emphasized by Thorpe (1950) who wrote, "It needs and would repay full and precise experimental investigation more almost than any other aspect of animal behaviour." For this reason we decided to begin a careful analysis of the problem. The experiments to be described represent attempts to develop laboratory techniques to study the following problems:

(1) What is the critical age for imprinting to occur?

(2) What characteristics are necessary in the imprinting object if it is to release the reaction of following?

(3) How long must young birds be exposed to the imprinting object, if imprinting is to be complete and irreversible?

Procedure

The Mallard ducklings (*Anas platyrhynchos*) used in these experiments were hatched from eggs incubated in a forced-air incubator. Two days before hatching, the eggs were transferred to a still-air incubator fitted with glass doors and shutters. This latter incubator was kept very humid, as the ducklings had to be removed and isolated as they hatched. Each duckling was given a number, and this number, as well as the day and hour of hatching, was noted on the cardboard box in which the duckling was placed. This information was also recorded in the permanent records. The box containing the duckling was then placed in a third incubator, used as a brooder until imprinting and testing was completed, and only then was the duckling placed in daylight and given food and water.

During school hours and during the night, it was not feasible to watch the hatching incubator constantly. At these times the incubator was examined every 1–2 hours and the age of the duckling was estimated by the degree of dryness of the duckling.

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For the experiments, papier-mâché Mallard duck decoys were secured. These models were then fitted with off-center wheels that caused them to waddle when moved. The models also contained loud-speakers that could be attached to tape-recorders. The latter were fitted with circular tapes which allowed the same pattern of sound to be presented repeatedly. Some of the models had articulated heads that moved on springs with the motion of the decoy. In addition, a male model was fitted with a heating element and a felt apron so that the duckling could go under the decoy for warmth.

The imprinting runs, as well as the test runs, were made in a 1.5 $\times$ 1.5 $\times$ 12 ft. runway. This was covered on the bottom and sides with monk's cloth and provided with a hinged cover of screen wire. It rested on legs 3 feet above the floor. Fifteen watt bulbs were present overhead at either end and in the center. The remainder of the room was kept dark whenever the eggs were hatching, or when the imprinting or testing of ducklings was in progress.

In the standard imprinting trials, the optimum male model, fitted with a heating element and a felt apron, was provided with an arbitrarily chosen series of calls, best represented as *GOCK, gock, gock, gock, gock*. Two main methods of imprinting were used. In the first series, the duckling was kept with the model 10 minutes, and although the movement of the model was accommodated to that of the individual duckling, it was kept in motion as much as possible for the entire period. The duckling usually traveled 150 to 250 feet in the time allotted. In the second series, the duckling was kept with the imprinting object for 30 minutes and the model was moved a short distance every 5 minutes for a total of 12 feet.

Five to 70 hours after imprinting, each duckling was given the following 4 tests, which we estimated to be in order of increasing difficulty. These tests are graphically presented in Figure 1. The time of response and the character of the call note (*i.e.*, whether pleasure tone or distress note) of the duckling were recorded.

In the test situation a female model was used as well as the imprinting object or male model. The male model was connected to a tape recorder upon which was recorded the standard *gock*, and the female model was connected to a tape recorder which played the sound of a female Mallard calling her young. (In order to secure the latter record, a female Mallard with young was penned up, her young removed, and her call notes were recorded from a short distance.) In each test, as much as 2 minutes was allowed for a response.

Test 1.—In this test both models were motionless at first and both were calling. The duckling in a cardboard box was placed one foot from each model in the center of the runway. The box was then removed to release the duckling. After it had made a choice, the model chosen was moved slowly to the end of the runway to test the reaction of following in the duckling. Throughout the experiments the ducklings were never touched by hand but were picked up and released by means of the cardboard box mentioned.

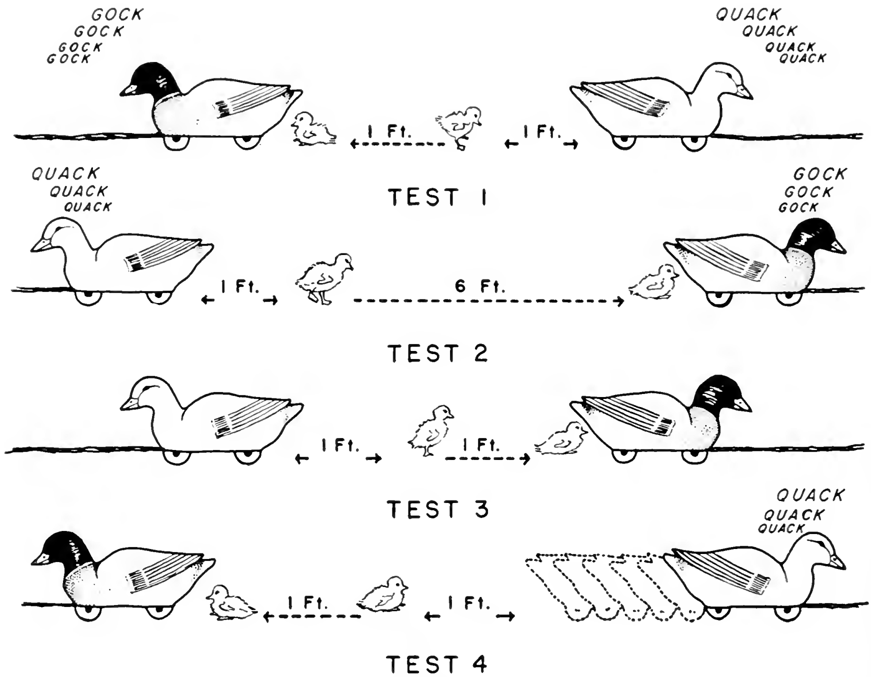


FIG. 1. Diagram of procedures used to test amount of imprinting.

Test 2.—This test was similar to Test 1 except the male model was now placed at the far end of the runway, 6 feet from the ducklings. This test was designed to determine if the duckling would respond to the imprinting object even though the female model was now closer and louder.

Test 3.—In the third test both models were kept silent and the ability of the duckling to make a response on the basis of visual cues alone was tested. The models and the ducklings were in the same starting position as in Test 1. After the duckling made a choice, the silent model was then moved to test the response of following.

Test 4.—In the last test the duckling was released from the center, as before, and the models were in the same starting position. However, in this test only the female was calling and when the duckling was released the female model was moved down the runway. Thus, to score a positive response, the duckling had to go to the male although confronted with a variety of conflicting stimuli.

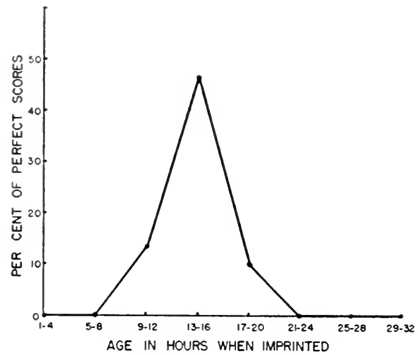
If the duckling gave a positive response to the imprinting object (the male Mallard) in all tests, imprinting was regarded as complete. Such ducklings, when released, remained apart from parent female Mallards; the imprinting may, therefore, be regarded as irreversible. Only a few ducklings were difficult to score on a quantitative basis. For these few, a response was considered partial and scored as 0.5 if the duckling went in the direction of the imprinting object before the model was moved and remained there. Other qualitative differences in response were also noted. For instance, of the 92 ducklings tested in the standard series, a total of 35 chose the male model in Test 3 and only 8 of these gave a distress note, even though no sound was used in this test. In contrast, only 16 ducklings went to the female model in this test, and 10 of these gave a distress note.

Critical Period

Ninety-two ducklings were imprinted in the standard series, 54 by 10 minutes of following (Table 1), and 38 by the 30 minute method (Table 2). In both of these series 13–16 hours proved to be the best age for imprinting. Approximately 50 per cent of the 21 ducklings imprinted in this age-group were completely imprinted. Only 3 other ducks made perfect scores, and none imprinted before 12 hours of age or after 18 hours of age made perfect scores. Beyond 28 hours no imprinting occurred. In addition, 3 ducklings were exposed to the standard *gock* call continuously for over 24 hours before and up to the time of hatching. No imprinting occurred in these ducklings. In fact, 2 of the 3 responded to the recorded call of the female Mallard in preference to the call to which they had been exposed. The other duckling did not respond to either call.

Under the conditions of the experiment, therefore, the period 13–16 hours is definitely the period for maximum imprinting in Mallards. This is made obvious by the graphs which include all of the 92 animals imprinted in the standard series. Figure 2 shows the percentage of animals in each age group that made perfect imprinting scores. Figure 3 shows the percentage of positive responses made by these same ducklings in each age group. These results will be reported elsewhere (Hess and Ramsay).

Our results contradict the findings of Fabricius (1951a) who reported that ages before 12 hours are most favorable for imprinting in several species of ducks including Mallards. It may be that the tests we used were more sensitive than those used by Fabricius. We also wonder about the condition of his young birds; he reported that normal walking and running was not established until the ducklings were 16 to 28 hours old. All of our ducklings



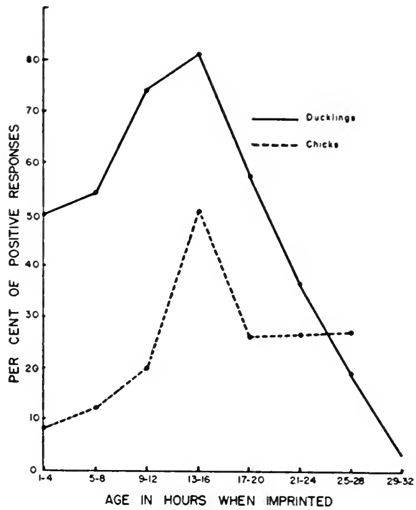


Fig. 2. Percentage of "perfect" scores for Mallards imprinted in various age groups.
Fig. 3. Percentage of positive responses made by ducklings and chicks in test series.

could walk and run many hours before that, although we recorded that 4 of the 8 ducklings imprinted before they were 2 hours old could not even crawl in a straight line at first but circled in a clockwise direction. Six ducklings, 3 to 4 hours old, imprinted by the 10 minute method, traveled an average distance of 75 feet in the time allowed. Maximum distance traveled was 250 feet, minimum 16 feet. Fabricius also reported (1951a) that fear responses first appeared in his Tufted Ducks (*Aytha fuligula*) and Eiders (*Somateria mollissima*) at 12 hours. Fear responses to the imprinting model did not appear in our Mallards until 24 hours. Eleven of the 14 ducklings imprinted in this age-group showed strong fear responses. Of over 100 other Mallard ducklings (imprinted earlier) only 3 (ages, 16, 20, and 16 hours) showed alarm. It seems significant that the only ducklings that showed any appreciable imprinting in the 21 to 24 hour group were the same individuals that showed no alarm.

Social Facilitation in Imprinting

Two groups of 2 animals each, well past the optimum imprinting age, were partially imprinted by being placed with 2 well imprinted ducklings and the imprinting object during the imprinting period. These all made much better scores than could be expected otherwise. Each of the 2 imprinted at 28 hours made a score of 3 positive responses. Each of the 2 ducklings imprinted at 38 hours made a score of 2 positive responses in the test period.

TABLE 1

TESTS OF DUCKLINGS IMPRINTED FOR 10 MINUTES

No. of ducklings	Age in hours	Number of positive responses Test 1	Test 2	Test 3	Test 4	Average
5	1– 4	5	4	3	0	2.4
8	5– 8	8	8	3	0	2.4
8	9–12	8	8	5	2	2.9
10	13–16	10	10	8.5	4	3.3
10	17–20	9	9	3	2	2.3
6	21–24	4	3	2	0	1.5
3	25–28	1	1	0	1	1.
4	29–32	0	0.5	0	0	0.13

TABLE 2

TESTS OF DUCKLINGS IMPRINTED FOR 30 MINUTES

No. of ducklings	Age in hours	Number of positive responses Test 1	Test 2	Test 3	Test 4	Average
8	1– 4	7	7	0	1	1.9
12	5– 8	10.5	10.5	3	0	2.
7[1]	9–12	7	7	3	4.5	3.1
5	13–16	5	5	3	3	3.2
0	17–20	----	----	----	----	----
5	21–24	3	2	1	1	1.4
1	25–28	0	0	0	0	0

[1]Six of these 7 birds were 12 hours old when imprinted and very close to the age for maximum imprinting.

TABLE 3

TESTS OF CHICK IMPRINTED FOR 10 MINUTES

No. of chicks	Age in hours	Number of positive responses Test 1	Test 2	Test 3	Test 4	Test 5	Average
5	1– 4	1	0	0	0	1	0.4
5	5– 8	1	0	0	0	2	0.6
3	9–12	0.5	0	0	0	2.5	1.0
4	13–16	3	2	1	0	4	2.5
3	17–20	0.5	0	1.5	0	2	1.3
3	21–24	2.5	0.5	0	0	1	1.3
3	25–28	1	1	0	0	2	1.3

Nice (1953) observed imprinting in a 6–day old Shoveller (*Spatula clypeata*), apparently through social facilitation. We plan further study to determine the effects of maturation of fear responses, and decline in tendency to respond to the imprinting object on imprinting as the duckling grows older.

Release of the Reaction of Following

Experiments on this subject were exploratory in nature and no final conclusions can be drawn as comparatively few ducklings were used in each experiment.

Sound.—Seven ducklings of various ages were imprinted only on the recorded natural quack of a female Mallard calling her young. Of these, only 4 responded to the imprinting object at all in the test period. These 4 made fair scores in the tests (average score 2). The other 3 did not respond to either model. In contrast, of 38 Mallard ducklings similarly imprinted on the male model calling *gock*, only one failed to respond at all, and the group score averaged 2.3.

Twenty-four ducklings of various ages were carefully tested for inherent preferences. These ducklings were first tested with the models silent and then with the male model calling *gock* and the female model calling *quack*. The calls were then reversed in the models 2 or more times. At no time were the models moved and each duckling was allowed as much as 5 minutes to make a response. No talking occurred in the laboratory where the ducklings were kept until after they were tested. We could not eliminate talking outside the room.

None of the 24 ducklings made any move toward either the male or female models as long as the latter were silent. Fifteen showed no preference between the call notes. Of the 15, 10 made no move toward either sound, and 5 responded to each call once. Of the remainder of the 24, 8 chose the *gock* consistently and only one chose the *quack* repeatedly. Of 15 ducklings similarly tested for preferences between the recorded duck quack and a spoken simulated quack, 2 definitely chose the simulated quack and one the recorded quack. Thus, the ducklings showed no real preference.

Motion.—Four ducklings were kept with a motionless male model without heating element and with fixed head for 30 minutes. This model was giving the standard *gock* call. When the ducklings were tested, all gave positive scores on Tests 1, 2 and 3. However, only one was imprinted at the critical age, and again, this is the only duckling that gave a perfect score. If articulated motion, or motion within the organism, is one of the key stimuli in releasing the following reaction, as claimed by Fabricius (1951a), by the principle of heterogeneous summation, these ducklings should not have done nearly as well as they did. In our records it is recorded that 2 of these 4 ducklings followed poorly in their first following response when they were about 2 days old at the test period. It remains to be determined accurately whether any difference in this response is due to lack of exercise or practice by the duckling, or due to a lack of willingness to respond.

Three additional ducklings were imprinted by this same method on the non-moving, non-articulated male model, calling the standard gock for 30 minutes, and 3 others were imprinted by the same method on a small box fitted with a speaker. This box was approximately the same size as the male model, and the ducklings were all near the most favorable age for imprinting. When they were approximately 2 days old they were given the following tests: (1) male model and box both call the standard *gock*, (2) male model silent, box calls, and (3) male model calls, box silent.

In the test situation, those imprinted on the male model scored a total of 5.5 positive responses (and one negative). The ducklings imprinted on the box scored a total of 2.5 positive responses (and 2 negative). In other words, the ducklings imprinted on the male model were almost twice as strongly imprinted as those imprinted on the box. It also seems significant that 2 of the ducklings imprinted on the male model responded to the silent male even when the box was calling (Test 2), but none of those imprinted on the box responded to the silent box when the male model was calling (Test 3). These limited data seems to contradict Fabricius' (1951a) conclusion that ducklings have no inherent preference as to the form of the object.

Field Studies

Two groups of ducklings, kept with the male model during the entire imprinting period, remained with the male model and followed it in preference to parent female Mallards that tried to lead them away. These parent females had young of the same age as the experimental ducklings. During this experiment, as well as during the imprinting, the male model was calling *gock* intermittently. One day-old unimprinted duckling, used as a control, went by the male model calling *gock* and on to join the parent Mallard duck. One of these experimental groups that had been given less than 10 minutes practice during the imprinting runs in following a silent male model in the runway, went to a silent floating male model and followed it in spite of the female's attempt to lure them away. The second group with no practice in following a silent model went to the floating model, followed it briefly, and then left it to return to the more familiar model with wheels on nearby land.

These results are not surprising when we recall that young of various species will follow non-articulated, smoothly moving objects, such as balls and boxes drawn along a cable (Ramsay, 1951), and that Grey Lag-Geese (*Anser anser*) if caught at the critical age will follow boats (Lorenz, 1937).

A parent female Mallard duck, while resting quietly on land will sometimes spread her tail and move her folded wings slowly back and forth an inch or more from her body. In a previous experiment, 2 Mallards hatched by a Wood Duck (*Aix sponsa*) seemed to be attracted to a parent female Mallard which was displaying in this fashion but which, as far as we could observe, was not calling. This is an example of a *releaser* in the classical sense (Lorenz, 1937). It seems very likely, therefore, that Fabricius was dealing with 2 separate innate releasing mechanisms, and not with 2 key stimuli in the same releasing mechanism, when he stated that articulated motion, or motion within the organism, is one of the 2 key stimuli in the release of the reaction of following. As Tinbergen has emphasized (1951), unless the innate responses of the organism are carefully analyzed into separate components, it will appear that the animal is reacting to a complex of stimuli.

Comparative Studies

In contrast to these results with Mallard ducklings, 26 Cochin Bantam chicks, similarly treated as a group, showed comparatively little imprinting (see Table 3). None of the chicks chose the imprinting object in preference to the moving clucking female in Test 4, and only one chick responded to the male model in Tests 1, 2 and 3. In order to compare the chicks more adequately, an additional test followed Test 4. In Test 5 the female model was quiet and immobile and the male alone was calling. Even with the few animals tested, it is apparent that the critical age for imprinting in chicks corresponds closely to that for ducklings (Fig. 3).

Of 13 chicks tested for inherent preferences, all but 2 chose the recorded cluck of a mother hen in preference to the standard *gock*. It seems logical to assume, therefore, that this very strong innate preference in chicks for the cluck resulted in these low scores and that by substituting another call that was not preferred, one might find that considerable imprinting had occurred. Since chicks are readily available in large groups as experimental animals, it would be worthwhile to devise suitable testing procedures for the study of imprinting in these animals.

Summary

Ninety two Mallard ducklings were imprinted on a male Mallard decoy speaking a rhythmical *GOCK, gock, gock, gock, gock,* through a loud-speaker installed in the decoy. In order to secure maximum imprinting, this model was provided with an articulated head, an internal heating element, and off-center wheels that produced a waddling motion. For testing, a female model with loudspeaker also was used.

From 5 to 70 hours after imprinting, each duckling was given the following 4 tests, which we estimate to be in order of increasing difficulty:

(1) Both models motionless, both call; duckling 1 foot away from each.
(2) Female model louder and closer.
(3) Both models silent.
(4) Female model only calling and moving.

In the test situation the imprinting object, or male model, was used against the female model. The female was provided with the recorded call notes of a female Mallard calling her young and the male was provided with the standard *gock*.

Thirteen to 16 hours proved to be the critical age for imprinting in Mallards. Approximately half of the ducklings imprinted in this age-group were completely imprinted and went to the imprinting object in all tests. Only 3 of the remaining ducklings gave perfect scores.

Three ducklings exposed to the standard *gock* call for 24 hours before and up to the instant of hatching showed no imprinting on that sound.

Mallard ducklings were running normally in 3 to 4 hours. Fear responses did not appear until 24 hours.

Beyond 28 hours no imprinting occurred ordinarily and only one duckling showed any imprinting beyond 24 hours. Four older ducklings (28 and 38 hours) were partially imprinted by association with well-imprinted ducklings during the imprinting runs.

Twenty-four ducklings were tested for inherent preferences. None responded to either the male or female model when it was still and silent. In addition, 15 showed no preference to either call note when they were simultaneously presented. Ten of the 15 gave no response and 5 responded once to each call. Eight ducklings showed a consistent preference for the *gock* and one responded repeatedly to the *quack*.

Four ducklings were imprinted on a motionless, non-articulated male model sounding the standard call. These four all made positive scores in Test 1, 2 and 3 and one, imprinted during the critical age, made a perfect score. Three additional ducklings imprinted by this method made scores over twice as good as another group of 3 ducklings imprinted on a box of the size of the model, giving the same call through an internal loudspeaker.

Five ducklings in two different groups were imprinted for 24 hours on a male model. These ducklings stayed with this male model in preference to live parent females with ducklings of their own age. One group of these, with some experience in following a silent model, followed a silent floating model although one of the parent female ducks tried to lure them away. The other group followed the floating model briefly and then returned to the similar model with wheels on shore but did not go to the live parent duck.

All but 2 of 13 bantam chicks tested for inherent preferences chose the recorded cluck of a mother hen in preference to the *gock*. None chose the *gock* in every test. Twenty-six bantam chicks were imprinted on the male model giving the standard call. These showed considerably less imprinting than Mallard ducklings. The critical age for imprinting chicks corresponds to that for ducklings.

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McDonogh School, McDonogh, Maryland; Department of Psychology, University of Chicago, Chicago 37, Illinois, October 15, 1953

BIRD MORTALITY AT AIRPORT CEILOMETERS[1]

BY JOSEPH C. HOWELL, AMELIA R. LASKEY, AND JAMES T. TANNER

THE first reported mass mortality of migrating birds at an airport ceilometer occurred in September 1948 (Spofford, 1949a and 1949b). In October 1951 we observed the aftermaths of similar but even larger accidents, and this stimulated us to assemble all available information on the subject. Other incidents, some previously unpublished, were discovered. We now know of twelve instances at ten widely scattered localities of bird mortality at ceilometers, the number of birds killed in the different instances varying from three to about a thousand. Observations have been made by us and by others on the behavior of birds around a ceilometer. The general pattern of events in these accidents is now clear, we think, although some of the causes leading to mortality are still not known.

Behavior of Birds Around a Ceilometer Beam

A ceilometer is an instrument used at airports to measure the height of the cloud ceiling. It consists of a beam of light and a receiver. The beam is produced by a mercury-vapor lamp and parabolic reflector usually mounted from five to ten feet above the ground and placed from 500 to 1000 feet away from buildings and similar structures. The candlepower of the light is about 25 million. The light is focused into a very narrow (about two degrees wide) vertical beam. It is so brilliant that the spot of light produced on low clouds at night can often be seen from several miles away and objects passing through the beam appear shining blue-white. Around the beam is an inverted cone of dim light that spreads upward within an angle of about 45 degrees from the vertical. The receiver, located on an airport building, scans up and down, detects the light when reflected from clouds, and automatically converts the angle of reception into the height of the cloud base above the ground. The ceilometer operates continually, day and night. Ceilometers have been in operation at major airports in this country since 1946.

On cloudless nights the beam is relatively inconspicuous, depending on the amount of dust or mist in the air, and at such times few birds are seen passing through the beam. On the night of October 1–2, 1952, the sky was clear at Knoxville, Tennessee, and the moon was almost full. Tanner, watching the Knoxville ceilometer for about an hour around midnight, saw only two possible birds pass high and rapidly through the beam. At the same time observers in Knoxville, eleven miles away, were counting birds seen through a telescope pointed at the face of the moon, and during the same period when

[1]Contribution No. 93, Department of Zoology and Entomology, The University of Tennessee, Knoxville.

the ceilometer was watched, eight birds were seen against the face of the moon. In September and October, 1952, Bartlett (1952) watched at ceilometers on eight different nights when a cloud ceiling was either absent or high and saw from none to about six birds on each occasion; judging by the absence of chip notes, there was little migration on these nights.

On overcast nights the ceilometer beam produces a bright spot of light on the bottom of the clouds. Large numbers of birds have been observed in the ceilometer beam only on such nights, and only during migration seasons. The following generalized description of the behavior of birds in and about the beam on an overcast night is based upon the reports of Bartlett (1952), Mrs. J. J. Hickey (in letter), B. F. McCamey (in letter), and the authors.

Birds seen in and near the beam can be divided roughly into two groups. At the upper levels, up to the bottom of the clouds, birds pass through the beam rapidly, appearing like shooting blue-white sparks, and moving in the general direction of migration, from the north in the fall. Below these, and sometimes down almost to the ceilometer light, are more slowly flying birds, circling around in the dimly lighted area, passing quickly through the beam, or sometimes fluttering up or down in the beam. The longest that any individual bird has been observed fluttering in the beam is twelve seconds (Hickey). Sometimes a bird will fly rapidly into the dimly lighted cone and swerve sharply to avoid passing through the brilliant beam. The highest number of birds that has been reported at one time is 1200 at Albany, New York, by Bartlett (1952); on the following night he estimated a maximum of 600 at one time. An observer at Louisville, Kentucky, estimated 900 birds circling at one time (Lovell, 1952).

Bartlett (1952) made some interesting observations showing that the birds fluttering through and around the beam must have come down from higher elevations. On a night when many birds were in the light, he had the operator of the weather bureau station turn off the light for twenty minutes, during which time the number of chips and call notes decreased from a large to a relatively small and normal number. "After one minute from the time the beam was turned on there were about 30 birds high in the beam, and none had yet been seen at 300 feet or less. By then the circling flight was apparent, and the direction of entering was no longer ascertainable. Not until after the fourth minute were birds seen to enter the cone at low levels; they came in from all directions. They might have been birds that dropped from the higher level; chip notes did not indicate low migrants" (Bartlett, 1952). On the following night he began observations before darkness, and the same pattern, although building up more slowly, was seen.

Several observers have remarked on the great number of chips and calls heard from the birds in the light and from the darkness nearby. In May, Mrs.

Hickey heard the full song of Scarlet Tanager (*Piranga olivacea*), Yellowthroat (*Geothlypis trichas*), and Indigo Bunting (*Passerina cyanea*).

Records of Mortality

Table 1 summarizes the important facts about nine of the twelve known instances of bird mortality at ceilometers. The weather information included in this table came from the published accounts or letters describing each incident supplemented by U.S. Weather Bureau Daily Weather Maps. These maps detail the weather conditions at 1:30 a.m., Eastern Standard Time, for each date. We are indebted to personnel of the Craig Air Force Base, Selma, Alabama, and of the Weather Bureau Records Center for supplying additional information about the weather conditions at Selma.

At the times when mortality has occurred, there has apparently been no difference in the behavior of the birds or the pattern of movement around the light from that observed on other overcast nights. There have been few witnesses of the actual killing of birds in these accidents. After the largest, at Knoxville, Tennessee, some of the airport personnel described seeing birds fall or fly into the ground. Mrs. Laskey was at the ceilometer in Nashville during the accident of October 7–8, 1951, and although she watched around the ceilometer and along adjacent runways, she did not see any birds come down. Neither did Mrs. Hickey see any birds killed or falling at the Madison accident. Mr. McCamey is apparently the only ornithologist or careful observer who has actually made close observations during such an accident; and parts of his letter are quoted here because of their interest: "[At 11:00 p.m.] it was a damp, foggy night, with a weak warm front approaching from the south. The ceilometer was on top of the vertical side of a hangar, with the arched roof of the hangar extending up and away from it. . . . The ceiling was at about 300 feet, the visibility one-half mile or less at the time. The birds were passing through the beam at 100 to 300 feet above the ground. Most of them flew straight through without hesitation, but every once in a while one would halt in the beam, fluttering, seeming to lose his sense of direction, and gradually dropping lower and lower as he fluttered in and out of the beam. . . . A few settled on perches or projections of the building. I could see them sitting motionless in the shadows . . . . The tragedies occurred when fluttering birds struck parts of the hangar and knocked themselves out, falling to the ground. . . . Occasionally I heard one strike the glass or metal sides of the building in the half hour I watched. . . . Next morning I got back soon after daylight; the weather had cleared with a cold front passage and the temperature had dropped. I started picking up birds, collecting them from an area extending 150 feet on all sides of the light position. Most were near the side of a building where they had dropped, only two or three out on the open lawn, in the clear. I picked up sixteen good specimens, throwing

TABLE 1
BIRD MORTALITY AT CEILOMETERS

Date	Locality	WEATHER: Cloud Type	Ceiling Height (Feet)	Wind Dir. & m.p.h.	Visi-bility (miles)	Remarks	BIRDS KILLED: Species	Individuals	Authority
Sept. 1-2, 1952	Scott A. F. Base, Ill.	?	?	N 9-24	?	Cold front over area on preceding day; thunderstorms, raining ceasing at 10 p.m.	3	3	Ziegler (1952)
Sept. 9-10, 1948	Nashville, Tenn.	Stratocum.	2100 to 9700	N 4-7	6-10	Cold front over area on preceding day; temperature fell.	33	300 (approx.)	Spofford (1949a, 1949b)
Sept. 19-20, 1950	Mitchell A.F. Base, Long I.	Stratocum.	800 & higher	N 13-18	1	Cold front had moved over Long Island and New Jersey within 12 hours; temperature fell.	9+	17	Arbib (1950)
Sept. 19-20, 1950	McGuire A. F. Base, N. J.	?	?	?	?		?	?	Arbib (1950)
Fall, 1950	Westover A. F. Base, Conn.	?	?	?	?		?	500 (estim.)	McCamey (letter)
Fall, 1950 10 days later	Westover A. F. Base, Conn.	?	300	?	1/2	Foggy, weak warm front from south, cold front later that night, clearing.	8+	20+	McCamey (letter)
Oct. 7-8, 1951	Louisville, Ky.	Stratocum.	2000-3000	NW 12-18	10	A cold front had moved over the entire Kentucky-Tennessee area 12 to 24 hours before; temperatures fell.	13+	96+	Lovell (1952)
Oct. 7-8, 1951	Knoxville, Tenn.	Stratocum.	3600-4200	NNW 8-12	10		46	1044	Howell & Tanner (1951)
Oct. 7-8, 1951	Nashville, Tenn.	Stratus	2300-5000	NNW 4-7	?		10	176	Laskey (1951)
Oct. 7-8, 1951	Smyrna, Tenn.	Conditions same as at nearby Nashville					11+	1000 (estim.)	Laband (1951)
April 25-26, 1950	Selma, Ala.	Stratocum.	2000-4000	N or NW 6-12	10	Cold front from west on previous day; moderate and continuous rain.	8+	300 (approx.)	Mrs. J. P. Parrish (letter)
May 23-24, 1952	Madison, Wisc.	?	100-2500	NW-E 6-10	1/8	A stationary front south of Wisconsin; foggy or misty.	11	18	Mrs. J. J. Hickey (letter)

away a few that were too bedraggled, and undoubtedly missing more that lay on top of some of the buildings. A clean up detail appeared . . . and told me that they frequently found birds at this spot. The non-com in charge said they had half-filled a 55 gallon drum with birds ten days before, and that it was usual to pick up several handfuls, but that many times there were none . . . ." The position of the ceilometer described in Mr. McCamey's letter is unusual in being on the roof of a building, rather than near the ground and in the open; thus there were buildings near the light which the birds could and did strike.

Much of the information on mortality of birds at ceilometers has been acquired by examination of the area and of the dead birds on the morning after an accident. The dead birds have been picked up in the vicinity of the ceilometer, but not always evenly scattered about it. At Knoxville most of the dead birds were south of the ceilometer, some as far away as 470 yards. At Nashville on October 8, 1951, most of the dead birds were south or southwest and up to 300 yards from the ceilometer. At Mitchell Air Force Base the birds were found south of the light and within 75 yards, and at Scott Air Force Base the three birds lay within 25 feet of each other and 70 yards south-southeast of the light. At Madison, all of the dead birds were within a sector lying northwest of the ceilometer light and as far away as about 250 yards. In each of these cases the majority of dead birds was found in the direction from the ceilometer in which most of the migrants probably were travelling, south-southeast to southwest in fall and northwest in spring. At Nashville and Knoxville more birds were found on the concrete runways and parking areas than on the grassy areas.

Injuries to the head were found in a number of the dead birds. At Knoxville 315 Ovenbirds (*Seiurus aurocapillus*) were examined and about 80 per cent of them showed a blood clot beneath or within the skull or had a broken bill: no injury was evident on the remaining 20 per cent. Individuals of other species had broken bills. At Nashville in 1951 there were many instances of brain injuries. Mrs. Hickey observed the same kind of injury on birds that were found on the hard runways.

Not all of the birds that come down are killed. At Nashville in 1951 thirty living birds were picked up and given to Mrs. Laskey who banded and released them. Some of the airport personnel at Knoxville told of picking up birds and then letting them fly away; on the following afternoon there were still a number of birds on the ground or around buildings, some crippled and others apparently not.

The number of species of birds killed in each accident reported in Table 1 is a minimum number; five of the reports state that the list of species is incomplete for one reason or another. A total of 69 species of birds has been identified and reported as being killed at ceilometers. They are widely scattered in a taxonomic sense. Non-passerine species are Pied-billed Grebe (*Podilymbus podiceps*), American Bittern (*Botaurus lentiginosus*), Sora (*Porzana carolina*), Virginia Rail (*Rallus limicola*), Wilson's Snipe (*Capella gallinago*), Mourning Dove (*Zenaidura macroura*), Yellow-billed Cuckoo (*Coccyzus americanus*), Black-billed Cuckoo (*C. erythropthalmus*), and Whip-poor-will (*Caprimulgus vociferus*). The following families of passerine birds are represented by the indicated number of species: Tyrannidae, 4; Troglodytidae, 2; Mimidae, 2; Turdidae, 4; Sylviidae, 1; Vireonidae, 5; Parulidae, 33; Icteridae, 2; Thraupidae, 2; Fringillidae, 5. In Nashville on September 10, 1948, the largest number of individuals of one species were Red-eyed Vireos (*Vireo olivaceus*), making up 38 per cent of the total. At Knoxville on October 8, 1951, 37 per cent of the birds killed were Ovenbirds. On the same date at Nashville, Tennessee Warblers (*Vermivora peregrina*) were commonest, 21 per cent of the total. On the other hand, at the accidents where large numbers of birds were killed, many species were represented by only from one to five individuals.

The species and numbers of dead birds found are about what would be expected in the migratory flights for each place and time; they are nocturnal migrants that nest in large numbers, with few exceptions, to the north of the location of the accident and that are migrating at that time of the fall or spring. The birds killed appear to be a random sample of the migratory flight. There is no indication that any species is relatively more susceptible to ceilometer accidents than any other species present in the same migratory flight.

Some species of birds have been seen or heard around ceilometer beams but have apparently not suffered mortality there. Mrs. Hickey reported the following species heard at Madison: Green Heron (*Butorides virescens*), Spotted (*Actitis macularia*) and Solitary (*Tringa solitaria*) sandpipers, Black Tern (*Chlidonias niger*), and Kingbird (*Tyrannus tyrannus*). Bartlett (1952) reported seeing Screech Owl (*Otus asio*) and Starling (*Sturnus vulgaris*) fly through the dimly lighted cone at Albany. Tanner at Knoxville heard Killdeers (*Charadrius vociferus*) and Black-crowned Night Herons (*Nycticorax nycticorax*) and saw the latter fly through the beam.

Discussion of Possible Causes

In most cases of bird mortality at airport ceilometers in the fall, the weather conditions have been similar (see Table 1); the same general conditions have been present when medium to large numbers of birds have been observed around the light but no mortality occurred. A cold front has moved over the area within twenty-four hours or less, winds have been generally from the north, an overcast of stratocumulus or stratus clouds has been produced by the cold front pushing under warmer air, there frequently has been a trace of rain, and visibility on the ground has been between four and ten miles.

Only two of the twelve reported instances of bird mortality have occurred in the spring. In these the conditions seem to be about as follows: a large spring migration started (Mrs. Hickey stated in her letter that there was no wave of May migrants at Madison in 1952 until the night of May 23), then a cold front moved in from the north or northwest producing rain and an overcast or mist. The reason for these accidents occurring more frequently in the fall as compared with spring apparently is that the cold front which causes the low cloud ceiling also precipitates a large migration in the fall, while in spring a cold front slows or stops migration.

These weather conditions set the stage, and then somehow birds are attracted to the ceilometer light. This may be caused by any one or a combination of the following factors. An overcast, with the ceiling between 300 and 5000 feet, may push the migration to lower than usual levels. The bright spot of light on the base of the clouds may attract birds, and so may the light itself on the ground. Once birds have begun to circle and flutter through the beam, the reflection of light from their bodies may attract other birds toward the light. As the number of birds in the beam increases, the beam will become correspondingly conspicuous, and still more birds may be attracted to it, resulting in a geometric increase of the number around and in the beam.

When bird mortality at ceilometers was first reported, it was suggested that the light itself, being produced by a mercury-vapor lamp which generates a fair amount of ultraviolet, might be the cause of death. But L. J. Buttolph of the General Electric Company wrote us that, "The plate glass over the lamp would limit the ultraviolet to about the same as that from an ordinary incandescent lamp . . . ." Except for its great intensity, the light may be considered harmless. This conclusion is supported by the many observations of birds flying through the beam and continuing in level flight and of bats repeatedly flying through the beam only a few feet above its source.

All the evidence indicates that the cause of death is impact with the ground, another bird, or occasionally with a building. The problem remains of what causes the birds to lose their faculties and fly into or fall to the ground, or strike one another, or hit a building. Any satisfactory explanation of this problem will have to explain why there is mortality on some occasions and not on others, and when there is mortality why only part of the birds present around the light are killed.

The fact that most of the dead birds have been found in the direction from the ceilometer in which the migration was moving suggests that it is the birds in swift flight that are affected and not those that are circling and fluttering around the beam. The distance at which many dead birds were found from the ceilometer can only be explained by those birds having flown most of that distance: even allowing for the wind and a high flight speed. they could not have been carried to those distances by their momentum alone.

One obvious explanation is that the birds are blinded by the brilliant light, lose their equilibrium because of this. and fly into the ground. This would not explain why many birds fly through the beam apparently unaffected: that is. why the light would blind some and not others.

Another possible explanation is that birds collide with each other. and fall stunned or fly dizzily against the ground. This explanation fits most of the observed facts. Collision would be most likely to occur when there are large numbers of birds passing through the beam, and mortality would therefore be dependent upon the density of birds in the air. Occasions when birds were observed in the beam but no mortality was evident could be explained on the basis of the numbers being too low for collisions to be likely. This explanation is simple, and most of the observations agree in that on nights when mortality occurred there were more birds in and around the beam than on other nights. The observations of Bartlett (1952), however, are contradictory in that he observed very large numbers of birds in the light at one time (1200 maximum on one night and 600 on the following night) but could find no sign of birds having been killed.

Summary

Twelve instances of bird mortality at airport ceilometers have been reported. the number of birds reported killed in each varying from three to over a thousand. All instances occurred during a migration season, ten in the fall and two in the spring. Mortality has occurred only when there has been a large migration and a cloud ceiling of 5000 feet or less: weather producing this combination is more frequent in the fall.

The species of birds killed seem in each instance to be a random sample of the migrants to be expected at that time and place. In size they range from the smaller warblers up to an American Bittern. Most of the birds killed were passerines, but a number of non-passerines was represented.

The dead birds examined have almost certainly been killed by impact, either with the ground. or with another bird in mid-air. or with a building as observed at the Westover Air Base. The ceilometer beam itself is not believed to be a direct cause of death.

The following is an outline of how bird mortality at a ceilometer may occur. On a night when there is a large migration and a relatively low cloud ceiling, birds are attracted to the ceilometer light. On reaching the beam they first

fly through it, but some circle back to fly slowly or flutter in and about the beam. The brilliant light reflected from these birds may attract other migrants toward the beam. Mortality may result from birds being blinded and hitting the ground or rarely a building, or colliding with each other and then hitting the ground, or directly from mid-air collisions.

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Department of Zoology, University of Tennessee, Knoxville, Tennessee (J. C. H. and J. T. T.); 1521 Graybar Lane, Nashville 12, Tennessee (A. R. L.), September 23, 1953

GENERAL NOTES

Reactions of Chipping Sparrows to displaced nestlings.— A number of workers have set up experiments to test the reactions of young and adult birds in nesting situations. The natural occurrence described below has some elements which appear to be worthy of record in this regard.

On July 7, 1953, about 9:30 a.m., we saw a Chipping Sparrow (*Spizella passerina*) fly up from three young on the ground in the wooded edge of a baseball diamond at the University of Michigan Biological Station, Cheboygan County, Michigan. The young were huddled in a small open area of bare ground between low bushes. Their heads were together and they lay almost directly below the nest, one side of which had broken loose from its attachment to a twig near the end of an oak branch about five feet from the ground, probably in the heavy wind storm (with a little rain) the previous afternoon. Both adults gave alarm notes nearby.

As a marker to prevent our stepping on the young, two pieces of board a few inches long were placed end to end and at right angles to one another about five inches from the young birds. A few minutes later one of the adults had returned to the young and was brooding them, though unable to cover all three with its body and slightly spread wings. As the young were huddled close together, it was evident that the flat surface of the ground was a less favorable situation for brooding than the cupped depression of the nest.

The next day, we each visited the birds independently. One of us made photographs of young and brooding adult from as close as four feet. Only the youngest bird was being brooded; it had moved to the nearest board, under which its head rested while its posterior end protruded from the adult's breast feathers. The other two young had moved into the angle between the boards, where they lay largely under the raised edges, one facing outward, the other parallel to the board with its head against the tail of the first. One of these had its eyes open, and both had the entire dorsum covered with feathers; the tips of the remiges had broken from their sheaths.

The next visit was at 9 p. m., July 8. An adult flushed from the nest or a twig close to it, apparently having gone to roost there. All three young were huddled together and flattened close to the ground in the angle between the boards and mostly under the overhanging edges.

Next day, July 9, a visit at 7:45 a. m. showed that the young were not at the boards, but the adults kept low overhead and scolded. Two fecal pellets, fairly fresh, were in the angle between the boards. After a brief hunt did not disclose the young, we hid 150 feet away and watched the adults. They flew to the ground several times in the next 20 minutes, but a search there at the end of this time did not disclose any young.

Another look at the boards showed that the feces were gone—presumably taken by one or both adults on their trips to the ground. As they gave alarm notes nearby, one had a worm in its bill.

At 7:30 p.m. another search did not disclose the young. Two adult Chipping Sparrows were about 50 yards from the nest, one singing from a high perch and briefly chasing the other as it started to fly across the open ball field. No alarm notes were given. We do not know whether the young had moved some distance away or whether they had been removed by a predator, perhaps one of the *Citellus tridecemlineatus* in the area.

The most significant features of the reactions of adults and young to the abnormal situation described above may be briefly summarized as follows: the huddling of the young in the partial enclosure of the boards; brooding of the young on the ground by at least one adult; removal of feces from the ground where the young had been for more than 24 hours; and roosting of the adult at the nest rather than with the young.

The minimum temperature the night of July 8, as registered by a maximum-minimum thermometer laid on the ground near the young was 51° F. The temperature of the previous night was not measured there but was probably similar.—FREDERICK H. TEST, *Department of Zoology, University of Michigan, Ann Arbor, Michigan, and* ELIZABETH R. VANDEGRIFT, *Muskegon, Michigan, March 23, 1954.*

Bob-white eggs in pheasant nest.—The parasitic practice of the European Cuckoo (*Cuculus canorus*) and our cowbirds (*Molothrus*) in depositing their eggs in the nests of other birds is well known.

The practice is probably more common than is generally supposed in isolated cases among several species of birds. The accompanying half-tone shows a nest of the Ring-necked pheasant (*Phasianus colchichus*) filled with eggs of the Bob-white (*Colinus virginianus*). It was discovered on the property of Dr. Claire Straith on the outskirts of Detroit, Michigan. This pheasant nest was first found when there were about six pheasant eggs present. About one egg was added daily for several days and then quail eggs began to appear, so that about a week later there were thirteen pheasant eggs and eight quail eggs present in the nest, at which time the photograph was taken. The pheasant abandoned the nest and the eggs all spoiled.

The above incident was referred to D. W. Douglass of the Technical Staff of the Michigan Department of Conservation, who replied as follows: "Mr. Tucker discussed with me your letter regarding quail eggs in a pheasant nest. I have asked around the Division to see if we could get any definite records of this sort. We have not made an exhaustive effort but have so far failed to come up with any cases. However, referring to Stoddard's 'The Bobwhite Quail,' (1932, Charles Scribner's Sons, New York) we find that he mentions that so-called aggregate or dump nests, in which several female quail deposit eggs in one nest, are fairly common in the quail country.

"There have been found as many as twenty-eight eggs in one nest with reports of as many as forty or more from other areas. Also, Stoddard reports on Bob-whites laying in chicken nests. It would not be at all surprising, therefore, if occasionally a quail laid eggs in a pheasant nest. This is a rather common occurrence among many birds."—ALEXANDER W. BLAIN, *2201 Jefferson Avenue East, Detroit 7, Michigan, November 2, 1953.*

The status of cranes in Nebraska.—Since there is sound evidence that most cranes which migrate northward west of the Mississippi River cross Nebraska, their present day occurrence in the state should be accurately summarized. Reference to Haecker, Moser, and Swenk (1945. "Check-list of the birds of Nebraska." Nebr. Orn. Union, p. 11) suggests that these birds are of rare occurrence. However at the present time Sandhill Cranes in spring migration congregate in extremely large numbers in the central portion of the Platte River Valley. This note attempts to present correctly the status of the cranes (Gruidae) in Nebraska.

Whooping Crane.—At present it is difficult to evaluate the exact status of the Whooping Crane (*Grus americana*) in Nebraska because of its extreme rarity. Allen (1952. "The Whooping Crane." Natl. Aud. Soc.) in his excellent monograph on the species admirably presented all of the data for Nebraska up to 1950. Since then there have been published one or two sight records per year. In the spring of 1953 more Whooping Cranes were seen in Nebraska than were reported in the previous two years. Most of these birds which spend any time feeding in Nebraska are almost certain to be reported, because most of the residents of the Platte Valley of Nebraska have been told to be on the alert for large white cranes and to report them immediately to federal or state game officers. Thus, it is known fairly accurately when Whooping Cranes do appear in Nebraska. Haecker *et al.* (*loc. cit.*) state that the Whooping Crane is: "A rare but rather regular migrant through central Nebraska." At present we must consider the Whooping Crane an extremely rare migrant.

Sandhill Cranes.—Probably the largest annual concentration of Sandhill Cranes (*Grus canadensis tabida*) in North America occurs in the Platte Valley of Nebraska, in that portion of the valley bounded on the east by Wood River in Hall County and on the west by Sutherland in Lincoln County. The cranes start appearing there early in March and reach their maximum numbers about the first of April. They remain in large numbers for approximately one week and from the second week of April on they seem to diminish in numbers, although small flocks are occasionally seen during the first part of May. During the past five years I have seen flocks estimated at 15,000 to 20,000 in the area between Newark and Elm Creek in Buffalo County. Walkinshaw (1949. "The Sandhill Cranes." Cranbrook Inst. Sci., p. 119) quotes Kubichek who observed and photographed a concentration of more than 100,000 cranes near Hershey, Lincoln County during the spring of 1943. Breckenridge (1945. *Flicker*, 17:79–81) reported seeing a flock of 20,000 (*Grus c. canadensis*) in this same area. The identification was based on the fact that, of the ten birds he was able to collect in this area, all proved to be Little Brown Cranes. Since it is impossible to separate the Little Brown Crane from the Sandhill Crane in the field, it is impossible to say which subspecies is the most abundant. From the little collecting done it appears that the Little Brown concentrates in the western portion of the Platte River Valley roughly in the area between North Platte and Sutherland, while the Sandhill concentrates in the eastern end of the range, that is, in the Newark-Elm Creek area. However, it appears that at all times the flocks contain both subspecies. It is interesting that most of the specimens collected 20 years or more ago seem to represent the Sandhill, while most recent specimens seem to be predominantly Little Browns. Haecker *et al.* (*loc. cit.*) state that the Little Brown Crane is a common spring migrant in the central portion of the Platte River Valley of Nebraska. They say of the Sandhill Crane: "Formerly a common migrant throughout the state and a breeder in the sandhills area. Now an uncommon migrant and probably no longer nests within the state." At present this subspecies should be considered a common spring migrant in the same area as the Little Brown Crane.

Knowledge of the fall migration of all forms of cranes is very slight in Nebraska, mainly because large concentrations seldom occur in the fall and the birds fly at extreme heights. The report of the Committee on Bird Protection of the American Ornithologists' Union (1944. *Auk*, 61:632–633) states that during the 1942 fall migration 11,000 cranes were seen at Crescent Lake Migratory Bird Refuge in Garden County. This report suggests that the fall migration does not follow the same routes as the spring migration. During fall the birds seem to be widely dispersed, as there are numerous reports of individuals or small groups of three and four visiting farm ponds and other small bodies of water throughout the state.

There is very little possibility that Sandhill Cranes breed in Nebraska at present. There have been no positive breeding records since the 1880's. However, it should be pointed out that there are suitable breeding areas for these birds in the sandhill lake region and there are now extremely few bird students working in this area. As it is very evident that the Sandhill Crane is increasing in abundance, there is an excellent possibility that it will once again nest in Nebraska.—William F. Rapp, Jr., *430 Ivy Avenue, Crete, Nebraska, August 17, 1953.*

The Lark Bunting in Utah.—The occurrence of 51 (4 collected and 47 observed) new Utah records of Lark Buntings (*Calamospiza melanocorys*) for the years 1951–1953 has prompted us to compile all available information, in an effort to determine the status of this species in the state. Woodbury, *et al.* (1949. *Bull. Univ. Utah*, 39:33) give the status of the Lark Bunting in Utah as a "Sparse summer resident and migrant through the western half of the state (not known Colorado Basin), probably breeding in open plains-like desert or cultivated fields, known from May 15 to October 11." Since then, Killpack (1951. *Condor*, 53:99) has reported collecting and observing this species in the Uintah Basin. Additional records for the Uintah Basin and other parts of Utah are reported here. The earliest date is May 6, and the latest corresponds to that given by Woodbury.

Acknowledgments are made to W. H. Behle, University of Utah; R. J. Erwin, Ogden, Utah; R. W. Fautin, University of Wyoming; C. L. Hayward, Brigham Young University; M. L. Killpack, Union High School, Roosevelt, Utah; H. Knight, Weber College; C. W. Lockerbie and others, Salt Lake City, Utah; and J. S. Stanford, Utah State Agricultural College, for making available to us their unpublished observations and specimen records of Lark Buntings. Special thanks are due A. M. Woodbury for permitting us to use data from Woodbury, Cottam, and Sugden's unpublished manuscript on the birds of Utah. Records not otherwise assigned are the authors. Other persons contributing records are credited in the text.

Specimens referred to are in collections of the University of Utah Museum of Zoology (UUMZ); Brigham Young University (BYU); Utah State Agricultural College (USAC); and Weber College (WC).

The first record of a Lark Bunting in Utah was a specimen collected by J. H. Simpson (1876. "Rept. Expl. Great Basin, Territory of Utah," 1859. Gov't Print. Office, Appendix K, p. 379) from an unknown locality about 1859. Since then, records for this species have varied noticeably over the years. This variation might reflect population fluctuations, changes in migration routes, or lack of observational data. Between 1859 and 1939, Lark Buntings were reported only four times. Sixty-one buntings were recorded in the period 1940 through 1942. Only one bird was noted from 1943 to 1949, but this may have been due in part to lack of observers in the field because of the war. Sixty Lark Bunting records occurred between 1950 and 1953.

In making this compilation we found approximately 126 records (98 observations, 28 specimens) of Lark Buntings from fourteen counties of Utah of which 47 observations and 5 specimens were unrecorded in the literature. Ninety-three of these records are for the month of May: 19 for June; 2 for July; 5 for August; 5 for September; and 1 for October. Although 42 records occurred during the second week of May, they represent only 4 observations in 3 counties, while the 29 records for the third week of May represents 11 observations from 6 counties. Thus, the middle or third week of May appears to be the peak of spring migration.

A few of the records are scattered throughout the spring and summer, indicating possible nesting of this species in Utah. In addition, Woodbury, *et al.* (unpublished MS) mention a nest containing 4 eggs, near American Fork, Utah County, May 15, 1898 (UUMZ). They also state that Treganza found 2 nests, each with 4 fresh eggs, between Garfield and Saltair, Salt Lake County. No date was given. Further, Behle (1942. *Condor*, 44:231) and Behle and Selander (1952. *Wilson Bull.*, 64:31) have also suggested that this bunting nests in Utah on the basis of enlarged testes of two specimens collected during nesting season. Following is an account by counties of the known occurrences of Lark Buntings in Utah.

Box Elder County.—A specimen (USNM) was collected in greasewood opposite Hansen's Ranch near the Bear River Marshes, June 1, 1916 (Woodbury, *et al.*, unpublished MS). Records from the Bear River Marshes are: One seen by Cecil S. Williams, August, 1940, and 2 seen by Lindheimer, June, 1942 (Woodbury, *et al.*, *op. cit.*) and one collected by John B. Van Den Akker, May 25, 1946 (UUMZ). R. M. Hansen collected a male (UUMZ), May 8, 1952, 10 miles south of Grouse Creek. R. J. Erwin observed 12 near Promontory, May 16, 1952; 7, May 30, 1952; and one, May 31, 1953.

Cache County.—Three pairs were observed 2 miles south of Cache Junction, May 30, 1951.

Carbon County.—One male was seen by R. M. Hansen, 10 miles east of Price, May 17, 1952.

Duchesne County.—Two males (BYU) were collected and one female observed, May 26, 1950, 4 miles south of Roosevelt (Killpack, 1951:99). Killpack collected another male (John B. Hurley Collection, Yakima, Washington), May 18, 1952, 5 miles west of Roosevelt.

Juab County.—Knowlton (1947. *Auk*, 64:627) reported collecting one near Nephi, May 19, 1941, where he found buntings moderately abundant. Lockerbie and associates observed one male in the old Sevier River channel valley, May 17, 1952; and 2 more males in the same area, May 18, 1952. They also recorded one male 5 miles east of Topaz Mountain, May 18, 1952. A male bunting was seen July 6, 1952, about 3 miles west of Nephi.

Millard County.—Fautin took a male bunting among greasewoods near Tule Springs in White Valley, May 13, 1940; and another male in greasewoods at Desert Range Experiment Station in Pine Valley, August 8, 1940 (Woodbury, *et al.*, unpublished MS).

Salt Lake County.—Behle (1942. *Condor*, 44:231) reported a Lark Bunting shot at the Jeremy Ranch, 4,300 feet, on the Jordan River west of the Cudahy Packing Plant, May 19, 1941. H. Higgins watched a single bird of this species being chased through the trees of the University of Utah campus by House Finches (*Carpodacus mexicanus*) on October 11, 1941 (Woodbury, *et al.*, unpublished MS). Behle and Selander (1952:31) reported the collection of an adult male, June 11, 1950 from Murray.

Sanpete County.—Woodbury, *et al.*, (unpublished MS) list 4 specimens (USAC) from Manti and Manti Canyon collected on June 22, August 1, 2, and 21, 1940. These specimens could not be located. On May 21, 1941, Knowlton (1947:627) collected one of

5 birds observed 4 miles north of Fountain Green (BYU). According to Woodbury, *et al.* (*op. cit.*) Knowlton observed 2 more near Moroni on the same date.

Summit County.—Ridgway (1877. Ornithology, *in* Clarence King's report, "U.S. Geol. Expl., 40th Parallel," U.S. Army, 4:487) took a juvenile male at Parley's Park near Kimball Junction, 6,400 feet, July 30, 1952.

Tooele County.—An immature was observed in greasewood and shadscale on the east side of Camel Back Mountain, September 12, 1952. A male bunting was seen near the Iosepa Ranch, Skull Valley, September 30. 1952.

Uintah County.—Killpack (1951:99) took 2 males 2 miles south of Gusher, May 21, 1950. He collected an immature female from a group of 3 on Diamond Mountain Plateau, 30 miles north of Vernal, September 9, 1950. A male was collected by Lynn Nielson along the Green River 5,500 feet, June 10, 1952 (UUMZ). On June 12, 1953, Killpack saw 7 males and 3 females in greasewood and shadscale about 11 miles east of Jensen.

Utah County.—On May 29, 1937, Fautin observed a male bunting feeding in a pasture near Lakeview (Woodbury, *et al.*, unpublished MS).

Washington County.—Hardy and Higgins (1940. *Utah Acad., Sci., Arts and Letters*, 17:109) list 4 taken from a flock of about 40, May 10, 1940 (2 males, one female, USAC). On May 6, 1941, Behle (1942:231) reported collecting the male of a pair from a cholla cactus on the west slope of the Beaver Dam Mountains, 3,300 feet, 5 miles north of the Utah-Arizona border (UUMZ).

Weber County.—A Lark Bunting was collected at Farr West, 4,200 feet, May 28, 1951, (WC); and, June 2, 1952, 3 males were seen in the West Warren, Reese and Little Mountain section of the county. This locality is just across the Great Salt Lake from where Erwin saw 7 on May 30 of the same year.—RICHARD D. PORTER AND HAROLD J. EGOSCUE, *Department of Zoology, University of Utah, Salt Lake City, Utah, November 23, 1953.*

Pine Siskin nesting in eastern South Dakota.—The literature on the status of the Pine Siskin (*Spinus pinus*) as a breeding bird in South Dakota is meager indeed. Over and Thomas (1946. "Birds of South Dakota." Revised, *Univ. S. Dak. Mus., Nat. Hist. Studies* No. 1:161) list it as "a winter resident." Roberts (1936. "Birds of Minnesota." Vol. 2, p. 365) reports it as a common migrant in Minnesota but has only one record of a nest — from the northern part of the state. There are numerous sight records for South Dakota but only two published items which relate to breeding. Larrabee (1937. *Wilson Bull.*, 49:116) reported a nest in Yankton County and Youngworth (1936. *Wilson Bull.*, 48:311) noted a pair nesting in Yankton.

Although I have checked every available item in Stephens' "An Annotated Bibliography of South Dakota Ornithology" (1945. Privately printed, Sioux City, Iowa), I have found no published records of the hatching of young of the Pine Siskin in South Dakota. Letters from Drs. W. J. Breckenridge and O. S. Pettingill, investigators in the state, who report sight and collection records but no breeding records, seem to bear this out.

The following observation therefore is probably the first record of the Pine Siskin hatching young in the state—certainly in the eastern part of the state. I have been collecting data on this species at Sioux Falls, Minnehaha County, since 1948, and have sight records for all months of the year, excepting June, July and August.

Although I was certain in 1949 that this species nested in the area, it was not until May 19, 1951, that I discovered the first nest in Sioux Falls. Mr. and Mrs. Herman F.

Chapman corroborated my observation. Circumstances did not permit further investigation to determine whether eggs were laid or young hatched. In April, 1952, I found six nests in Woodlawn Cemetery and in McKennon Park, Sioux Falls. Two contained eggs. One nest held three eggs, the other two. Chapman and I photographed these nests and eggs. Regrettably, circumstances again made it impossible to determine whether the eggs hatched or young were reared.

On May 9, 1953, I was in Woodlawn Cemetery, listening to the call of an adult Pine Siskin, when I heard a hoarse, huskily-articulated *chay-ip*. A moment later I saw an adult Pine Siskin fly from a nearby blue spruce (*Picea pungens*), in which I found a young Pine Siskin perched on the lower bare branches, near the trunk. The young siskin continued its plaintive *chay-ip* even after I pushed the branches aside for a closer look. It was more than half grown and was completely feathered except on the sides under the wings. The bird could fly from branch to branch but not on extended flights. The yellow patch on the wing was just beginning to show, the coloring being heaviest along the shafts of the feathers. The yellow in the tail was faint but unmistakable. The breast was streaked much like the adult but tufts of down indicated its immaturity. Willard Rosine of the Biology Department, Augustana College, substantiated my observations. We photographed the bird and liberated it.

Later we saw an adult Pine Siskin fly into a neighboring spruce. Hearing more calls, we discovered a second young siskin, better able to fly. It escaped into the upper branches before we could examine or photograph it. We were unable to find a nest or nests from which the two might have come.

Unfortunately a heavy rainstorm in the night of May 9 killed what I feel sure was the individual we photographed. I found it next morning under the spruce in which I had discovered it. The specimen is now in the biology laboratory at Augustana College. I found no trace of the second individual.

Further study and observation may reveal how frequently the Pine Siskin breeds in eastern South Dakota and perhaps also something about its adaptation to an environment far removed from its usual breeding grounds in more boreal situations.—Herbert Krause, *Augustana College, Sioux Falls, South Dakota, March 8, 1954.*

First record for eastern Canada of the Black-throated Gray Warbler.—Late on the afternoon of December 7, 1952, while visiting part of the Don Valley, Toronto, Ontario, known as Glendon Hall, I identified a Black-throated Gray Warbler (*Dendroica nigrescens*). Such a rarity stirred up much local interest and many persons observed the bird prior to its disappearance on December 17.

The autumn of 1952 was mild, with little snow or cold weather. The tropical air which moderated the temperature in this region during December might have been responsible for the presence of this bird.

Previous to the winter of 1952–53, this species had been recorded about 9 times in the east. However, as reviewed by Griscom (1953. Audubon Field Notes, 7:200), a noteworthy movement of these birds took place along with a general eastern invasion of other western species in that season. The 1952 observations raised the total of Black-throated Gray Warblers seen in the East to about thirteen. It is interesting to note that nine of these were recorded in November and December.

Photographs of the warbler here reported were obtained by C. Molony and A. Van. A copy of a photograph by the former has been donated to the Royal Ontario Museum of Zoology and Palaeontology.—J. B. Foster, *136 Dawlish Avenue, Toronto 12, Ontario, March 27, 1954.*

Nesting of the Least Tern in Illinois.—Although the Least Tern (*Sterna albifrons*) has been known to nest in Illinois since late in the nineteenth century, published reports of its nesting are few. Ridgway believed that the bird nested somewhere in the state but knew of no certain breeding records (1895. "The Ornithology of Illinois," *Ill. Lab. Nat. Hist. Rep.* 1:248). Apparently the first actual record of the bird nesting in Illinois is that of Widmann (1898. *Auk*, 15:27) who found a colony on Gabaret Island in the Mississippi River near St. Louis, Missouri. Widmann noted the late nesting of the species, reporting that young were begging for food in late August, and explained it on the basis of high water in early summer.

On August 1, 1907, Bartsch (1922. *Auk*, 39:101) found adult Least Terns feeding young birds on a peninsula known as Bird Point on the north bank of the Ohio at its confluence with the Mississippi. However, Ganier (1930. *Wilson Bull.*, 42:107) has suggested that, since young birds are often fed for some time after the colony's departure from the ternery, the authenticity of this report as a breeding record is doubtful.

On July 12, 1952, Richard Anderson (personal communication) found two downy young, which he estimated to be two or three days old, on Mosenthein Island, a large island with a sand beach 50 to 100 yards wide. Anderson saw four adult birds at the island as well as the young, but saw no other immature birds, eggs, or nest hollows. Mosenthein Island is opposite north St. Louis, directly west of Gabaret Island.

Anderson found no nesting terns in this locality the summer of 1953, apparently because logging made the island unsuitable for the birds. At Horseshoe Lake, about two miles east of the river, however, Anderson and others found small groups of Least Terns feeding during July. Near the middle of August, on a grassy mudflat close to where the earlier observations had been made, young birds capable of flight were found being fed by adults. These records suggest that a colony may have been near at hand.

On July 5, 1952, investigating a report by Esther Bennett (personal communication to William Hardy) of terns, not certainly identified as to species, on a sandbar in the Ohio River, Hardy and I found a colony of Least Terns two miles north of Shawneetown, Illinois, on a sandbar about four miles long and at its widest point one mile wide. Although completely surrounded by water for a few weeks during spring, for most of the year the sandbar is at least narrowly connected with the mainland and is to be regarded as a part of Illinois. Elongated and irregular in form, the peninsula consists of elevated central portions thickly grown with sandbar willow (*Salix interior*), black willow (*Salix nigra*), and cottonwood (*Populus deltoides*) and of peripheral and interdigitated beaches of sand and pebbles. The tern colony was located on the largest beach, which makes up the downstream one-quarter of the peninsula.

Here in an area about 50 by 100 yards we found three nests. One nest contained two young and each of the others contained two young and one egg. All nests were on the pebble portions of the beach. Numerous adults which had been resting on the bar arose, some apparently with reluctance, when we came into view. Most of them remained near-by, flying about and calling for the duration of our visit. Although some birds flew low, none attempted to attack us.

The number of adults present was estimated to be about 55. Assuming that there were few or no nonbreeding birds in the group, as Palmer (1941. *Proc. Boston Soc. Nat. Hist.*, 42:106) has found to be the case with colonies of Common Terns (*Sterna hirundo*), some 25 or 30 pairs were present. A study of the colony during the 1953 nesting season revealed about thirty nests. The 1953 investigations will be described fully in a nesting study of the Interior Least Tern (*S. a. athalassos*) being prepared by William Hardy.—Richard Brewer, *1506 Edith Street, Murphysboro, Illinois, January 31, 1954.*

Winter record for the Myrtle Warbler in southeastern Michigan.—On January 25, 1954, a male Myrtle Warbler (*Dendroica coronata coronata*) was trapped in a small pine plantation in the Nichols Arboretum, Ann Arbor, Washtenaw County, Michigan. The trap was baited with sunflower seeds and suet. After a night in captivity the bird weighed 13.6 grams. It was prepared as a specimen by P. S. Humphrey and is now number 135,194 in the collection of the University of Michigan. The testes measured 1 × 1 mm. According to Wood (1951. *Misc. Publ., Mus. Zool., Univ. Mich.*, No. 75:390), there have been but 4 previous records of the Myrtle Warbler in Michigan during winter.—Evan B. Hazard, *Department of Zoology, University of Michigan, Ann Arbor, April 23, 1954.*

The hawk pass at Duluth, Minnesota.—The publication of Maurice Broun's "Hawks Aloft . . ." (1949. Dodds, Mead Co., New York) preceded the U.S. Fish and Wildlife Service's hawk migration survey, which in turn has led to the discovery of an important migration focal point for these birds-of-prey at Duluth, Minnesota. Since 1951, the author, with members of the Duluth Bird Club, has made annual counts of hawks from a lookout within the city limits of Duluth. The counts, made on the second and third weekends of September, have produced the following totals: 1951, 8,977; 1952, 13,123; 1953, 7,220. In numbers of individuals, the Duluth hawk pass seems to surpass even Hawk Mountain, Pennsylvania.

The consistency of the flight is one of the remarkable features of this pass. My observations, except for the "target days," have been limited to one to two hours at a time, yet I have never failed to see hawks. Observations by other observers confirm this consistency (Olson, 1952. *The Flicker*, 24:111–115, and Struthers, 1952. *Minn. Naturalist*, 3:1–2). Another interesting feature is that the flight is funnelled over the city, and the main lookout can be reached in five minutes from the residential districts.

The flight lasts from about the middle of August well into November, with the peak probably occurring in the second or third week of September. Fifteen species of hawks are regularly seen during the counts. Broad-winged Hawks (*Buteo platypterus*) are the most numerous and Sharp-shinned Hawks (*Accipiter striatus*) are the most consistent. Among the more spectacular hawks, Bald (*Haliaeetus leucocephalus*) and Golden (*Aquila chrysaëtos*) eagles, Peregrine (*Falco peregrinus*) and Merlin (*F. columbarius*) falcons, and Goshawks (*Accipiter gentilis*) are fairly regular, although in small numbers. Very pale Red-tailed Hawks (*Buteo jamaicensis*) as well as melanistic forms, and seemingly all gradations between, have been seen. A Gyrfalcon (*Falco rusticolus*) was recorded in 1952.

The pass presents an excellent opportunity for study of migration, plumage changes, and other problems in these birds; to advertise this opportunity is the purpose of this note.—P. B. Hofslund, *Biology Department, University of Minnesota, Duluth Branch, Duluth, Minnesota, January 21, 1954.*

NOTICE

All manuscripts for publication in *The Wilson Bulletin* should now be sent to Dr. Keith L. Dixon, Department of Wildlife Management, Texas A. and M. College, College Station, Texas. Dr. Dixon will take over as Editor beginning with Volume 67, 1955.

ORNITHOLOGICAL LITERATURE

Birds of Mexico. A Guide for Field Identification. By Emmet Reid Blake. University of Chicago Press, 1953: 5 × 7⅜ in., xxx + 644 pp., 331 drawings, one in color, by Douglas Tibbitts. $6.00.

"Birds of Mexico," the first single volume describing all of the birds of that country and its surrounding islands and waters, is a milestone of ornithological achievement. Although written in English its simple, abbreviated style will make it serviceable to those with a minimum knowledge of the language.

The introduction describes briefly topography and climate of Mexico, and explains the scope of the work, method of treatment, nomenclature, explanations of seasonal status and descriptions, remarks on distribution, subspecies and supplemental information given in the text. Facing page one is a clearly labeled diagram of a bird.

The remainder of the book treats, in nontechnical terms, the 967 full species recorded from the Mexican mainland, including Baja California, the adjacent waters and associated islands. Eighty-nine families of birds are represented. No keys to families are included. Each family section is headed by the scientific and common name of the family. There follow dichotomous keys leading to a "common name" of the species and the page number on which it is described. For families represented by many species the keys are preceded by a division into categories. Species discussion is headed by a "common name" in boldface, the generic and specific names in italics and a numeral indicating the approximate length of the bird in inches. There follow brief descriptions of the adult male, female and immature plumages if markedly different, and occasionally treatment of winter plumage. Distribution is given in general terms by regions, most often by states, and sometimes with a reference to habitat but more often in relatively meaningless terms of "altitude." Subspecies are treated and their distributions given by states and parts of states. Under "Remarks" appear comparisons with similar species, notes on general appearance, habits of some species, and all too rarely descriptions of voice. Notes on calls and song are usually vague and inadequate. Scientific nomenclature mainly follows the major standard published works and various authoritative revisions of more recent date. A comprehensive index to "common" and scientific names appears at the end of the book. The book is well bound, on good paper; print is clear and contains a minimum of mechanical errors.

The great number of illustrations portray in variety common as well as rare Mexican species, many of the latter appearing in Mexico in restricted areas for only part of the year. The illustrations range from rather ornate attempts to simple sketches from heads and foreparts of museum skins. Some show a certain ability at craftsmanship but most demonstrate a lack of familiarity with the living bird in the field. It is my opinion that illustrations of some of the common, easily identified species should have been sacrificed for others more difficult to identify by written description, or more distinctly Mexican. Space devoted to illustrating such cosmopolitan birds as *Anas crecca*, *Crocethia alba* and *Tyto alba* might well have been devoted to some of the Mexican flycatchers and warblers (*Geothlypis*, *Basileuterus*).

It is perhaps superfluous to comment on the disagreement sure to arise from certain interpretations of scientific nomenclature, species and racial relationships, and distributions included in the book; but in a country encompassing so vast an area of rich and diverse topography, climate, flora, and fauna, even the most familiar groups are still imperfectly known. Nevertheless, all ornithologists—amateur and professional—should find this an indispensable guide to the study of birds in Mexico.

Use of the book in the field during more than nine months in 21 Mexican states has shown an unfortunate number of errors, omissions and misleading or confusing statements. The Red-eyed Vireo is not the only gray-capped, green-backed vireo (p. 453); only one of the three races of *Tangavius aeneus* has a "wholly black" female (p. 508); and the Mexican breeding races of Cliff Swallow do not have "a pale forehead" (pp. 369–370).

Most notable omissions are in the keys and in aids to field identification. As stated on page xxiv the book's "primary objective is the sight identification of birds in their natural habitat." There are, however, few adequately described calls or songs, few explicit references to mannerisms, fewer pattern sketches or head pattern descriptions, and except in a few instances only vague, if any, reference to habitat. The keys, perhaps partly due to these omissions, are difficult to use—even with a bird in the hand one is not always successful. Since the book fails to include a key to families or major groups, users must recognize first nearly all of the 89 families occurring in Mexico. A key to families should have been included. The keys to the ducks and hummingbirds are incomplete; other keys are misleading. For example some White-tailed and Red-tailed Hawks cannot be keyed out; only two of the dark phases of the many buteos appear in the key; and numerous female and immature hummingbirds are not included in the keys. Only in reference to the hawks and flycatchers is the bird student warned that all species cannot be identified in the field; this might be extended to include petrels, gulls, hummingbirds, sparrows, buntings and others. Under the species description usually only one race is described; and that race is not often identified. Among the more imaginative descriptions are those of the females of *Thalurania furcata ridgwayi* and *Lophornis delattrei brachylopha*, the former known but from a single male, the latter from two males.

Distributions are given in too general terms, *i.e.* "wintering to the southward," "southward at high altitudes," "virtually country-wide," and "in suitable habitat." Few species are really country-wide in Mexico. Numerous remarks are wasted words as far as field identification is concerned. For example the description of the nest and eggs of *Tinamus major*, although of interest, helps little to identify the species. A few geographical terms are used incorrectly or loosely. For example "Caribbean slope from Coahuila and Tamaulipas southward" (p. 369) might better have been stated as the slope of the Gulf of Mexico. Reference to the Gulf of Mexico, presumably, as "the Gulf" (p. 468) fails to take into account the other gulfs in Mexican waters.

Usefulness of the book would have been considerably increased by inclusion of more Spanish or Indian names for species, at least those widely used for groups and for well known species.

Common English names for species seem to have been chosen without regard to well-established names long in use. Common names are "handles" for convenience—nothing more. What possible advantage has been gained or assistance extended to the bird watcher in Mexico by substituting "Great Kiskadee" for Derby Flycatcher, "White Tern" for Fairy Tern, "Gray-breasted Woodpecker" for Gila Woodpecker, "Bar-vented Wren" for Sinaloa Wren, "White-tipped Dove" for White-fronted Dove? There are dozens of other seemingly unnecessary changes. Other common names have been chosen as "more suitable for the species complex," a move useful perhaps to the scientist (who is likely to refer only to the scientific name anyway) but one of little help to the bird watcher who wants in a field guide a short name. The names "Scaly-throated Foliage-gleaner" and "Tawny-throated Leaf-scraper" are nearly as long as the birds. There are also complete omissions of well standardized common names; only by the scientific names can one recognize such birds as the Pacific Loon, Mexican Grebe, Audubon's Caracara, Louisiana Heron, Eastern Bluebird and Arkansas Goldfinch.

In spite of the shortcomings mentioned, "Birds of Mexico," while not completely satisfactory as a field guide, represents a major ornithological achievement and is an indispensable book to anyone interested in the avifauna of Mexico.—Dwain W. Warner.

PROCEEDINGS OF THE THIRTY-FIFTH ANNUAL MEETING

BY PHILLIPS B. STREET, SECRETARY

The Thirty-fifth Annual Meeting of the Wilson Ornithological Club was held at Cape May, New Jersey, from Friday, June 11, to Monday, June 14, 1954. It was sponsored by the Delaware Valley Ornithological Club, the New Jersey Audubon Society, and the Urner Ornithological Club.

There were four sessions devoted to papers, two evening motion pictures, "Beacons Along the Flyway," by Frank W. McLaughlin and "Machias Seal Island," by John M. Jubon, and two business meetings. A meeting of the Executive Council was held on Friday evening, June 11. The Annual Dinner was held at the Colonial Hotel on Saturday, June 12, President Walter J. Breckenridge delivering the traditional address. Following motion pictures, the host societies entertained at an informal reception.

Early morning field trips to nearby points of interest were held on Saturday and Sunday mornings. On Sunday evening, a picnic supper was held at the Stone Harbor heronry. On Monday, departure day, some eighty members took a boat trip north from Cape May through the inland waterways to Stone Harbor and return. Another group journeyed north to the Tuckerton Meadows and Beach Haven Inlet, while a third group made an extended field trip which covered the Fortescue area, on Delaware Bay, Bass River State Forest, a portion of the pine barrens, the Tuckerton Meadows, and Beach Haven Inlet.

First Business Session

President Breckenridge called to order the meeting at 10:00 a.m., Saturday, June 12. Hon. Samuel Eldridge, Mayor of Cape May, welcomed the Club, and President Breckenridge responded. The minutes of the 34th Annual Meeting were approved as published in *The Wilson Bulletin* for September, 1953.

Secretary's Report

The secretary, Phillips B. Street, summarized the principal actions of the previous evening's Executive Council meeting as follows:

1. Council accepted the invitation of Oklahoma Agricultural and Mechanical College and the Oklahoma Ornithological Society to hold the 36th Annual Meeting at Stillwater, Oklahoma, from Thursday evening, April 7, to Sunday, April 10, 1955.
2. The resignation of Harrison B. Tordoff as editor of *The Wilson Bulletin*, effective at the completion of the present volume, was reluctantly accepted.

Treasurer's Report

The treasurer, Leonard C. Brecher reported on the finances of the club. The report, already approved by an auditing committee consisting of Burt L. Monroe, chairman, Mrs. Frederick W. Stamm and Harvey B. Lovell, follows:

Report of the Treasurer for 1953

Balance as shown by last report, dated December 31, 1952			$ 2,095.99

GENERAL FUND

Receipts

Dues:			
Active	$ 4,039.00		
Sustaining	1,410.00	$ 5,449.00	
Subscriptions to *The Wilson Bulletin*			467.25
Sale of back issues and reprints of *The Wilson Bulletin*			65.90
Gifts: Color Plate Fund	$ 32.00		
Library Book Fund	87.00		
Miscellaneous	123.48	242.48	
Transferred from Endowment Fund for Research Grant (not awarded)		100.00	
Miscellaneous Income from Annual Meeting, Exchange, etc.		149.64	6,474.27
Total Receipts			$ 8,570.26

Disbursements

"The Wilson Bulletin"—printing, engraving and mailing	$ 4,988.69	
Editor's Expense—printing, postage, clerical aid, etc.	197.00	
Secretary's Expense—printing, postage, etc.	10.00	
Treasurer's Expense—printing, postage, supplies	152.96	
Committee Expense—printing, postage, supplies	21.40	
Purchase of books from Book Fund	37.90	
Bank charges, corporation papers, miscellaneous expenses	42.01	
Total Disbursements		$ 5,449.96
Balance on hand in Citizens Fidelity Bank & Trust Co. Louisville, Kentucky, December 31, 1953		$ 3,120.30

Endowment Fund

Balance in Savings Account as shown by last report, dated December 31, 1952		$ 85.29
Receipts		
Interest on Investments & Savings Account	262.99	
Life Membership payments	700.75	
Gifts to Research Fund	500.00	
		$ 1,463.74
Total Receipts		$ 1,549.03
Disbursements		
Transferred to General Account for Research Grant	$ 100.00	
State Tax on Bank Deposits	1.32	
Total Disbursements		$ 101.32
Balance in Savings Account, Citizens Fidelity Bank & Trust Co., Louisville, Kentucky, December 31, 1953		$ 1,447.71

*Securities Owned**

U.S. Postal Savings Coupon Bonds, dated July 1, 1935	$ 780.00	
U.S. Savings Bonds, Series "G", dated September 1, 1943 (maturity value $1,000.00)	979.00	
U.S. Savings Bonds, Series "G", dated September 20, 1944 (maturity value $1,500.00)	1,459.50	
U.S. Savings Bonds, Series "G", dated June 1, 1945 (maturity value $500.00)	485.00	
U.S. Savings Bonds, Series "G", dated July 1, 1945 (maturity value $900.00)	873.00	
U.S. Savings Bonds, Series "G", dated October 1, 1945 (maturity value $1400.00)	1,353.80	
U.S. Savings Bonds, Series "F", dated February 1, 1947 (maturity value $2,000.00	1,644.00	
U.S. Savings Bonds, Series "F", dated April 1, 1948 (maturity value $2,000.00)	1,618.00	
U.S. Savings Bonds, Series "F", dated October 1, 1948 (maturity value $1,450.00)	1,155.64	
U.S. Savings Bonds, Series "F", dated April 1, 1950 (maturity value $1,000.00)	767.00	
Total of Government Bonds	$11,114.94	
Massachusetts Investors Trust (116 shares at $20.75 per share)	2,407.00	
Total Securities Owned**		$13,521.94
Total Endowment Fund		14,969.65

*Bonds carried at redeemable value December 31, 1953 (appreciation during the year $149.94)

**In Reserve:

Louis Agassiz Fuertes Research Grant Fund (special gifts)	$ 525.00
S. Morris Pell Fund (special gift)	75.00

Respectfully submitted,
Leonard C. Brecher, Treasurer

Membership Committee

Ralph M. Edeburn, chairman, reported that the names of 146 prospective members enrolled since the 1953 Annual Meeting were posted for the inspection of members and election by vote at the final business session. On December 31, 1953, the Club had 87 life, 280 sustaining and 1338 active members, a total of 1705. Since January 1, 1954, 88 new members have been added. There has been an 11 per cent gain in life memberships, a 21 per cent gain in sustaining and an overall gain of 1 per cent. On December 31, 1953, there were 151 institutional subscriptions to the *Bulletin* and 73 exchanges. The membership seems to be stabilized near the 1800 mark.

Research Grant Committee

In the absence of Ernst Mayr, chairman, Dr. Breckenridge reported that William C. Dilger of Cornell University had been selected after lengthy discussion as recipient of this year's research grant of $100.00 for his work on "The Isolating Mechanisms and Relationships of the Thrush Genus *Hylocichla*."

Library Committee

George J. Wallace, chairman, reported that accessions to the library since last year's report until March this year totalled 745 items, comprised of 81 books, 465 reprints, 117 magazines, and 82 pamphlets, an appreciable gain in most departments over previous reports, particularly in books. The record donation of books was largely stimulated by the publication of the (then) complete book list in the September, 1952, *Bulletin*, which gave members a chance to know our desiderata. Two members also contributed generously to the Book Purchase Fund, enabling the purchase of special books which filled a long-needed gap. The remarkable growth of the library may be seen from the following tabulation, although the listings are not strictly comparable, since some cover four quarters and some only three.

	1950	1951	1952	1953	1954	Totals
Books	61	44	44	36	81	266
Reprints	1104	278	365	361	465	2573
Magazines	78	140	78	273	117	686
Pamphlets	6	27	34	58	82	207
Totals	1249	489	521	728	745	3732

You are again reminded to send copies of your own and other publications to the Wilson Ornithological Club Library, University of Michigan, Ann Arbor, Michigan, and advised that this is your library both to maintain and to use.

Temporary Committees

The following temporary committees were appointed:

Auditing Committee: Previously appointed.

Resolutions Committee: Seth H. Low, Chairman; Theodora Nelson; Julian K. Potter.

Nominating Committee: Fred T. Hall, Chairman; S. Charles Kendeigh; Herbert L. Stoddard.

Proposed Amendment to the Constitution

The Secretary, at the recommendation of the Executive Council, presented an Amendment to the Constitution revising Article 1, Section 1, to read: "The organization shall be known as the Wilson Ornithological Society."

Such a revision will be voted upon at the 1955 Annual Meeting. Thinking behind the suggested change was that the recommended name more truly describes our stature in the ornithological world and might facilitate the professional ornithologist in obtaining leave time for the attendance of our annual meetings.

Second Business Session

The second and final business session was called to order at 10:00 a.m. on Sunday, June 13.

The applicants for membership, whose names were posted, were elected to membership.

Report of the Resolutions Committee

WHEREAS the Wilson Ornithological Club at its Thirty-fifth Annual Meeting, held June 11–14, 1954, at Cape May, New Jersey, has had a most enjoyable and worthwhile meeting, therefore BE IT RESOLVED that the Wilson Ornithological Club express its sincere appreciation to:

1. Our hosts and sponsors of this meeting, the Delaware Valley Ornithological Club, the New Jersey Audubon Society, and the Urner Ornithological Club, and in particular to Mr. Phillips B. Street and his local committee for organizing the program, Mr. John M. Jubon, for arrangements in the auditorium, Mr. Joseph Jehl, Jr., for projection of the slides and films, and to all other members of the sponsoring groups who have so ably assisted.

2. The City of Cape May, Mayor Samuel Eldridge and its other officials, for the hospitality of the city and the use of this splendid Convention Hall.

3. The Chamber of Commerce, Mr. Rex Thomas, Secretary, for their enthusiastic assistance throughout the preparations for the meeting, and

4. Mr. Ray Fite, manager of the Colonial Hotel, and his staff for providing fine accommodations for our headquarters and delightful vocal entertainment in the person of Luther Saxon.

WHEREAS in his annual address President Breckenridge ably pointed out the need for more emphasis on the recreational and aesthetical values of birds, and WHEREAS we are meeting in an area where, in recent years, these values have already been recognized as community assets, therefore

BE IT RESOLVED that the Wilson Ornithological Club commends the local government and civic associations in Cape May for sponsoring and encouraging bird-watching and for preserving for the birds and the bird-watcher, notably at Stone Harbor's heronry, tracts which might otherwise be highly commercialized, and

FURTHER, the Wilson Ornithological Club hopes that these efforts will be continued and expanded, thereby making this area increasingly attractive to the tourist and bird-watcher alike.

Two additional resolutions called for the defeat of bills presently before Congress. One (S. 1555 and H.R. 4443) would authorize the construction of Echo Park dam in the Dinosaur National Monument and be the opening wedge towards making national park and monument lands available for power development or other purposes. The other (S. 2548 and H.R. 6787) would give special rights on national forest lands to certain present grazing permittees.

Election of Officers

Fred T. Hall, chairman, reported for the Nominating Committee and proposed the following officers for the coming year: President, Burt L. Monroe; First Vice President, Harold F. Mayfield; Second Vice President, Lawrence H. Walkinshaw; Treasurer, Leonard C. Brecher; Secretary, Phillips B. Street; Elective members of the Executive Council, Joseph C. Howell (term expires 1955), A. W. Schorger (term expires 1956), and Harvey I. Fisher, (term expires 1957).

The report of the nominating committee was accepted, and, there being no nominations from the floor, the secretary was instructed to cast a unanimous ballot for these nominees.

Papers Sessions

Saturday, June 12

Ernest A. Choate, Jenkintown, Pennsylvania, *The Ornithological History of Cape May.*

Frank W. McLaughlin, New Jersey Audubon Society, *An Introduction to Bird Areas in Southern New Jersey*, slides.

James Baird, Rutgers University, *New Additions to the Birds of New Jersey*, slides.

Edgar T. Wherry, University of Pennsylvania, *Wild Flowers of the Cape May Region*, slides.

Robert S. Arbib, Linnaean Society of New York, *Should Vernacular Subspecific Names Be Abolished?*

Kathleen Green Skelton and Richard A. Herbert, New York City, *History of a Peregrine Falcon Eyrie on the Lower Hudson.*

David E. Davis, Johns Hopkins School of Hygiene and Public Health, *Observations on Breeding Biology of Kingbirds.*

Richard B. Fischer, Cornell University, *Studies in the Breeding Biology of the Chimney Swift*, slides.

Wendell Taber, Maine Audubon Society, *The White-winged Crossbill, a Life History.*

Douglas James, University of Arkansas, *Some Factors Influencing the Temporal Pattern of Social Roosting*, slides.

Robert M. Mengel, University of Kansas, *Clinal Variation in Eastern Birds in Relation to Biotic Zonation—Some Negative Findings*, slides.

Sunday, June 13

George B. Reynard, Palmyra, New Jersey, *Bird Song Cadence Studies in Atlantic Coast States*, slides.

Aretas A. Saunders, Canaan, Connecticut, *The Songs and Calls of Non-passerine Birds.*

Milton B. Trautman, Franz Theodore Stone Institute of Hydrobiology of the Ohio State University, *Diurnal Migration of Small Land Birds Over Western Lake Erie*, slides.

Eugene Eisenmann, Linnaean Society of New York, *Why do Eastern Species Winter Farther South in Tropical America than do Western Species?* Slides.

Aaron Moore Bagg, Holyoke, Massachusetts, *Factors Involved in the Occurrence of Spring Coastal Stragglers in Northeastern U.S. and Eastern Canada*, slides.

Charles M. Weise, Fisk University, *Migratory Behavior in Captive White-throated Sparrows under Outdoor Conditions.*

Robert J. Newman, Louisiana State University, *The Hour-to-hour Pattern of Nocturnal Migration in Autumn*, slides.

Hugh C. Land, Culver Military Academy, *Winter Courtship Behavior in the Cardinal*, slides.

Walter J. Breckenridge, University of Minnesota, *Bird Life of the Back River, Northwest Territories, Canada*, slides.

Maurice Graham Brooks, West Virginia University, *The Wild Turkey in West Virginia.*

Francis Harper, Arctic Institute of North America, *Autumnal Display of the Spruce Grouse in Labrador*, motion pictures.

John M. Jubon, East Millstone, New Jersey, *The Black Rail in New Jersey*, motion pictures.

Attendance

Members and guests in attendance at the meeting, including children, approximated 250 persons. Twenty-five states, the District of Columbia, and Ontario were represented.

From **Alabama:** 1—*Birmingham*, Mrs. Blanche E. Dean.

From **Arkansas:** 2—*Fayetteville*, Mr. and Mrs. Douglas James.

From **Connecticut:** 6—*Canaan*, Aretas A. Saunders, *Danbury*, Esther E. Wagner, *New Britain*, Mr. and Mrs. Vincent C. Jones, *West Hartford*, Mr. and Mrs. E. A. Bergstrom.

From **Delaware:** 2—*Wilmington*, Mr. and Mrs. H. F. Farrand.

From **Florida:** 1—*Coconut Grove*, Wayne Short.

From **Illinois:** 2—*Blue Island*, Karl E. Bartel, *Urbana*, William E. Robertson, Jr.

From **Indiana:** 8—*Culver,* Hugh C. Land, *Indianapolis,* Mrs. S. G. Campbell, Mildred F. Campbell. Mr. and Mrs. L. N. Feenaty, Dorothy White. *Lafayette,* Mr. and Mrs. Albert G. Guy.

From **Iowa:** 4—*Davenport,* A. Lang Baily, Peter Peterson, Jr., Willie Wulf, *Lacona,* Mrs. Ora van Heeswyk.

From **Kansas:** 2—*Lawrence,* Mr. and Mrs. Robert M. Mengel.

From **Kentucky:** 6—*Anchorage,* Mr. and Mrs. Burt L. Monroe, *Louisville,* Mr. and Mrs. Leonard C. Brecher, Mr. and Mrs. Frederick W. Stamm.

From **Louisiana:** 1—*Baton Rouge,* Robert J. Newman.

From **Maine:** 2—*Wayne,* Mr. and Mrs. O. S. Pettingill, Jr.

From **Maryland:** 16—*Baltimore,* Orville W. Crowder, David E. Davis, Mr. and Mrs. Mitchell Griffith, Marjorie Griffith, Fritz Hilton, Robert E. Kaestner, Donald R. McComas, William S. McHoul, *Chevy Chase,* Elting Arnold, *Gaithersburg,* Seth H. Low, *McDonogh,* Mr. and Mrs. A. Ogden Ramsay, *Monkton,* Stephen W. Simon, *Laurel,* Mr. and Mrs. Chandler S. Robbins.

From **Massachusetts:** 11—*Cambridge,* Ludlow Griscom, Wendell Taber, *Holyoke,* Mr. and Mrs. Aaron M. Bagg, Rudolph H. Stone, *Marshfield Hills,* Joseph A. Hagar, *Northampton,* Mr. and Mrs. B. M. Shaub, *South Hadley,* Elizabeth M. Boyd, Dorothy M. Cogswell, *Woburn,* Mrs. D. H. Rice.

From **Michigan:** 8—*Alma,* Lester E. Eyer, *Ann Arbor,* Laurie C. Binford, Philip S. Humphrey, Mrs. Reuben L. Kahn, *East Lansing,* George J. Wallace, *Imlay City,* Dale A. Zimmerman, *Marquette,* Mrs. Mary Spear Ross, *Muskegon,* George M. Wickstrom.

From **Minnesota:** 3—*Minneapolis,* Mr. and Mrs. Walter J. Breckenridge, *St. Paul,* Orwin A. Rustad. ;

From **New Jersey:** 51—*Audubon,* Clarence E. Stasz, *Bergenfield,* Peggy McQueen, *Bound Brook,* Robert C. Conn, *Brooklawn,* Edward R. Manners, *Caldwell,* Mr. and Mrs. Roger Barton, Seth Barton, *Clifton,* Joseph R. Jehl, Jr., *Collingswood,* William J. Bailey, Mr. and Mrs. Julian K. Potter, *Elizabeth,* Mr. and Mrs. Albert Schnitzer, *Green Village,* Mr. and Mrs. C. B. Shaughency, *Hammonton,* Charles B. Miller, *Haworth,* Charles H. Nichols, *Millstone,* Mr. and Mrs. John M. Jubon, Jan Jubon, *Montclair* J. L. Edwards, *Moorestown,* Robert L. Haines, *Morristown,* Richard S. Thorsell, *Mount Holly,* Francis Harper, *New Brunswick,* James Baird, *Nutley,* Floyd P. Wolfarth, *Oaklyn,* Mr. and Mrs. Frank McLaughlin, *Orange,* Mrs. William A. Wachenfeld, *Palmyra,* George B. Reynard, *Plainfield,* Mr. and Mrs. Edwin I. Stearns, *Princeton,* Dorothy M. Compton, Robert M. Laughlin, Charles H. Rogers, Albert B. Schultz, Jr., *Ramsey,* Mrs. John Y. Dater, *Ridgewood,* R. H. Barth, Jr., *Stone Harbor,* Mr. and Mrs. Tom Shea, *Toms River,* Mrs. Percy Camp, *Trenton,* Mitchell Carter, Jr., *Upper Montclair,* Mr. and Mrs. Frank P. Frazier, Charles W. Lincoln, Eleanor I. Vernon, *Verona,* Mr. and Mrs. Alfred E. Eynon, Frances E. Stokey, *West Orange,* A. Todd Newberry, *no address,* Ned Boyajean.

From **New York:** 29—*Albany,* Mrs. Dayton Stoner, *Babylon,* Don R. Eckelberry, *Bronxville,* Henry H. Collins, Jr., *Brooklyn,* Robert H. Grant, Herman Goebel, *Buffalo,* Harold H. Axtell, Mr. and Mrs. Fred T. Hall, *Far Rockaway,* John L. Bull, Jr., *Flushing,* Laura M. Miner, Adele D. Potts, *Freeport,* Robert S. Arbib, Jr., *Garrison,* Richard C. Raymond, *Ithaca,* Mr. and Mrs. Lawrence I. Grinnell, Sally T. Grinnell, Richard B. Fischer, *Mount Vernon,* Catherine Pissino, Mr. and Mrs. R. J. Reichert, *New York,* Reginald Denham, Mrs. Charles Noel Edge, Eugene Eisenmann, Richard A. Herbert, Elizabeth S. Manning, Kenneth Morrison, Theodora Nelson, Kathleen Green Skelton, *Oyster Bay,* Lois Jackson Hussey.

From **Ohio:** 11—*Hiram,* M. C. Morris, *Put-in-Bay,* Mr. and Mrs. Milton B. Trautman, Beth Trautman, *Richmond,* Mr. and Mrs. C. Robert McCullough, *Steubenville,* Mr. and Mrs. Clinton S. Banks, Richard C. Banks, Earl W. Farmer, *Toledo,* Harold F. Mayfield.

From **Pennsylvania:** 24—*Allentown,* John E. Trainer, *Ardmore,* Horace Groskin, *Bryn Mawr,* Virginia Crook, *Exton,* Mr. and Mrs. Phillips B. Street, *Harrisburg,* Harold B. Wood, Adessa K. Wood, *Jenkintown,* Ernest A. Choate, *Langhorne,* John F. McIlvain, *Philadelphia,* Mr. and Mrs. Ralph Braunschweig, John H. Arnett, Jr., Richard T. Darby, Quintin Kramer, Mr. and Mrs. Norman J. McDonald, C. Chandler Ross, Charles A. Wonderly, *Pittsburgh,* Kenneth C. Parkes, *State College,* Mr. and Mrs. Merrill Wood, Emily Wood, *Wynnewood,* Robert C. Alexander, *Yardley,* Edward Carter.

From **Tennessee:** 3—*Nashville,* Amelia R. Laskey, Albert F. Ganier, Charles M. Weise.

From **Texas:** 1—*Houston,* Frank G. Watson.

From **Virginia:** 5—*Harrisonburg,* Hollen G. Helbert, Robert Sherfy, *Richmond,* Frederic R. Scott, *Vienna,* Mr. and Mrs. Ira N. Gabrielson.

From **West Virginia:** 8—*Huntington,* Ralph M. Edeburn, *Kingwood,* Larry Schwab, *Morgantown,* Bill Berthy, Mr. and Mrs. Maurice G. Brooks, Fred C. Brooks, A. J. Dadisman, Earl N. McCue.

From **Wisconsin:** 1—*West Bend,* Marvin E. Vore.

From **District of Columbia:** 2—*Washington,* Joseph D. Biggs, Wilma R. Stark.

From **Ontario, Canada:** 2—*Hamilton,* Eric Bastin, *Toronto,* William W. H. Gunn.

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Charles T. Black—1 book, 10 pamphlets
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James R. Tolman—5 magazines
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George J. Wallace—1 pamphlet

This number of *The Wilson Bulletin* was published on October 29, 1954.

Suggestions to Authors

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A. O. U. Check-List (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A Word to Members

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

Notice of Change of Address

If your address changes, notify the Club immediately. Send your complete new address to the Treasurer, Leonard C. Brecher, 1900 Spring Drive, Louisville 5, Kentucky. He in turn will notify the publisher and editor.

THIRTY-SIXTH ANNUAL MEETING

OF THE

WILSON ORNITHOLOGICAL CLUB

STILLWATER, OKLAHOMA

FRIDAY, APRIL 8, TO SUNDAY, APRIL 10, 1955

Sponsored by

Oklahoma Agricultural and Mechanical College

Oklahoma Ornithological Society

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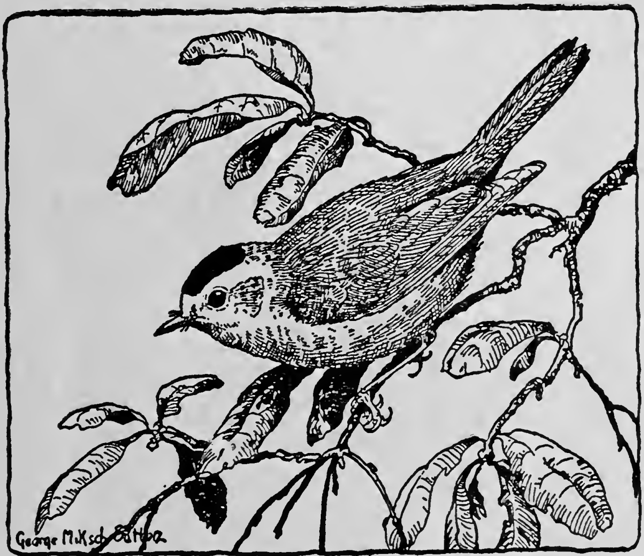
The Wilson Bulletin



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The Wilson Ornithological Club

at

Lawrence, Kansas

The Wilson Ornithological Club

Founded December 3, 1888

Named after Alexander Wilson, the first American ornithologist.

President—Burt L. Monroe, Ridge Road, Anchorage, Ky.

First Vice-President—Harold F. Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio.

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The Wilson Ornithological Club Library, housed in the University of Michigan Museum of Zoology, was established in concurrence with the University of Michigan in 1930. Until 1947 the Library was maintained entirely by gifts and bequests of books, pamphlets, reprints, and ornithological magazines from members and friends of The Wilson Ornithological Club. Now two members have generously established a fund for the purchase of new books; members and friends are invited to maintain the fund by regular contributions, thus making available to all Club members the more important new books on ornithology and related subjects. The fund will be administered by the Library Committee, which will be glad for suggestions from members on the choice of new books to be added to the Library. George J. Wallace, Michigan State College, East Lansing, Michigan, is Chairman of the Committee. The Library currently receives 65 periodicals as gifts and in exchange for *The Wilson Bulletin.* With the usual exception of rare books, 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. Inquiries and requests by borrowers, as well as gifts of books, pamphlets, reprints, and magazines, should be addressed to "The Wilson Ornithological Club Library, University of Michigan Museum of Zoology, Ann Arbor, Michigan." Contributions to the New Book Fund should be sent to the Treasurer, Leonard C. Brecher, 1900 Spring Dr., Louisville 5, Ky. (small sums in stamps are acceptable). A complete index of the Library's holdings was printed in the September 1952 issue of *The Wilson Bulletin,* and each September number lists the book titles in the accessions of the current year. A brief report on recent gifts to the Library is published in every issue of the *Bulletin.*

The Wilson Bulletin

The official organ of The Wilson Ornithological Club, published quarterly, in March, June, September, and December, at Lawrence, Kansas. In the United States the subscription price is $3.00 a year, effective in 1951. Single copies, 75 cents. Outside of the United States the rate is $3.25. Single copies, 85 cents. Subscriptions, changes of address and claims for undelivered copies should be sent to the Treasurer. Most back issues of the *Bulletin* are available (at 50 cents each for 1950 and earlier years, 75 cents each for 1951 and subsequent years) and may be ordered from the Treasurer.

All articles and communications for publication, books and publications for review should be addressed to the Editor. Exchanges should be addressed to The Wilson Ornithological Club Library, Museum of Zoology, Ann Arbor, Michigan.

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THE WILSON BULLETIN

A QUARTERLY MAGAZINE OF ORNITHOLOGY

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BLACKISH CRANE-HAWK

(Geranospiza nigra)

Adult female. Painted in the field from a specimen collected February 20, 1938, along the Río Corona, near the village of Güemes, Tamaulipas, México, by George Miksch Sutton. This is the eighth of a series of color plates honoring the memory of Dr. David Clark Hilton.

BLACKISH CRANE-HAWK

BY GEORGE MIKSCH SUTTON

THE hawks of the New World genus *Geranospiza* are among the most remarkable of extant falconiform birds. They are light-weight, middle-sized hawks with small head, rather small bill, long, slender legs, fluffy plumage, rounded wings, and long, broad tail. Their leg feathering is without "flags." Their toes are short—especially the outer. The scales of the tarsi are so fused as to present an almost smooth surface in front and on the outer side. The legs are "double-jointed." In reaching down through roots or brush or into holes after prey, *Geranospiza* may flex its tibiotarsal joints either forward or backward. This adaptive character it has in common with *Gymnogenys* of Africa and Madagascar (Friedmann, 1950. *U.S. Natl. Mus. Bull.* 50, part 11, p. 516).

The only species of the genus *Geranospiza* known to me from personal field-experience is the Blackish Crane-Hawk (*G. nigra*), a bird currently believed to breed from central Tamaulipas and extreme southern Sonora southward through Middle America and South America west of the Andes to southwestern Ecuador and Puna Island (Peters, 1931. "Check-List of Birds of the World," 1:268). Presumably the species is non-migratory throughout its range.

The Blackish Crane-Hawk is about 18–20 inches long, the female being considerably larger than the male. In unworn adult plumage it is slaty black with a bluish or purplish bloom. The base of the tail is white, the very tip is grayish white, and there are two broad white bars additionally, the more distal being somewhat the less distinct because, especially on the outer webs of the feathers, the white is washed with gray. Narrow white tipping of the plumage of the under parts produces a thin barring especially noticeable on the tibial part of the legs. The nape plumage is white basally. In some specimens the chin, throat, and loral feathers are more or less white. The under-wing varies: in some individuals the remiges and coverts are spotted and barred with white; in others the white is reduced to a series of squarish spots, one on the inner web of each of the four or five outer primaries. The eyes are bright red; the cere, eyelids, and mouth-corners dull gray; the bill black with bluish cast; the tarsi and toes orange or red-orange; the claws black.

In immature birds the forehead, superciliary area, auriculars, chin, upper throat, and under parts in general are more or less streaked with buffy white; the plumage otherwise is brownish black. Dickey and van Rossem (1938. *Field Mus. Nat. Hist. Zool. Ser.* 23:130) state that the "juvenal plumage" is worn "until the second fall," and describe the eye-color of a several-months-old bird taken in El Salvador in February as reddish brown: of a "fully grown juvenile (recently from nest) in August" as orange.

My friend William J. Sheffler, of Los Angeles, has been good enough to put at my disposal a summary of his really considerable experience with this all but unknown hawk in southern Sonora. In the Sheffler Collection is a nestling female (WJS 2937) taken at a "presumed age of five weeks" and still unable to fly, at 2100 feet elevation in the Tarahumar Mountains, near Guirocoba, on June 4, 1950. Mr. Sheffler describes this specimen thus: "Forehead, supercilium, chin and throat white; crown and nape black, the white basal part of the feathers showing conspicuously; cheeks and ear coverts light gray. Upper part of body black, the wings with white markings much as in the adult. Upper tail coverts black, each with a white bar; rectrices black with white tip and a broad bar near the middle, this bar being grayish white in the middle pair and in the five other pairs buff on the inner web to gray on the outer web. The primaries, secondaries and rectrices are only about half grown. The under parts are mottled with black and cinnamon buff (Tawny Olive of Ridgway), the vent and under tail coverts being pure Tawny Olive. In the living bird the eyes were yellowish red, the bill black, the legs and feet yellowish orange, much lighter than in the adult." This last statement is entirely valid, for Sheffler collected the male parent also and was able to compare the two specimens directly.

The Blackish Crane-Hawk inhabits tropical lowlands. Sturgis (1928. "Field Book of Birds of the Panama Canal Zone," p. 131) says that it lives "near marshes and ponds in heavy forest." Dickey and van Rossem (*op. cit.*, p. 129), describe it as "primarily a bird of swamp forest and mangrove lagoons . . . seldom found away from the immediate vicinity of water" in El Salvador. M. A. del Toro (1952. "Los Animales Silvestres de Chiapas," p. 121) says that it inhabits the banks of rivers and lakes. Carriker (1910. *Ann. Carnegie Mus.*, 6:454) says that in Costa Rica it "is always found in the vicinity of water, usually a sluggish lagoon or pond." J. C. Phillips (1911. *Auk*, 28:73) has reported it from Cañon Guiaves, in the hill district near Victoria, Tamaulipas. The elevation of this locality is not known to me, but I believe it to be considerably greater than that of the Corona and Sabinas, Tamaulipan rivers along which Thomas D. Burleigh, John B. Semple and I found the species in the early spring of 1938 (Sutton and Burleigh, 1939. *Occ. Pap. Mus. Zool. Louisiana State Univ.*, 3:27). Sumichrast (1876. *U.S. Natl. Mus. Bull.* 4:40), who reports *G. nigra* from "both sides of Mexico," has this to say of its habitat and behavior: "It never leaves the woods, where, gliding with rapidity among the thickets of vines, it gives chase to the small lizards, tree-frogs, insects, etc."

In southern Sonora the species may prefer to live near streams, but its habitat there has very little water during much of the year. No mere accident is van Rossem's (1945. *Occ. Pap. Mus. Zool. Louisiana State Univ.*, 21:60) choice of words when, in discussing habitat, he writes of "Tropical zone riparian associations" rather than of lowland woods near water. Mr. Sheffler's comments on the bird's altitudinal distribution and ecology in southern Sonora merit close study. These read: "I have never seen this bird at much greater elevation than 2000 feet. On the other hand, I have never encountered it below 1500 feet, although I have in my collection an immature male taken by van Rossem at Tesia, in the lower Mayo River valley, June 19, 1937. Tesia is 16 miles east of Navojoa, and its elevation is about 200 feet.

"I have observed this bird hunting over the land like a Marsh Hawk (*Circus cyaneus*) only in the winter months. In the spring and summer I have seen it hunting quietly in the shelter of large trees along streams and cienagas. There is little water about Guirocoba, the area being for the most part arid tropical. Elevation at the Guirocoba ranch-house, from which point I have several times observed the bird, is 1540 feet."

Dickey and van Rossem (*op. cit.*, pp. 129–130) consider the Blackish Crane-Hawk "a more active bird" than either the Urubitinga (*Hypomorphnus urubitinga*) or the Mexican Black Hawk (*Buteogallus anthracinus*), "with both of which it may frequently be found . . ." Discussing its behavior, they say that it quarters a meadow in the manner of a Marsh Hawk. "A burning pasture is a sure attraction, and it often hunts through the smoke right behind the fire line."

Mr. Sheffler had an interesting experience with a Blackish Crane-Hawk near the Guirocoba ranch-house on November 17, 1944. That day, from the south front of the house, he saw a crane-hawk about a quarter of a mile away beating back and forth not far above ground, looking for prey. The principal vegetation of the hunting-ground was small, thorny, tropical plants, but there was a scattering of large mesquite-like trees, several large pitahaya cactus plants, and some grass. Some years previously the area had been planted to cotton, peanuts, and grain, but it had returned to a wild state. Here and there were rock mounds, the rocks ranging from the size of a man's head to three or four times that large, the mounds being about three feet high at the peak. Mr. Sheffler continues: "While I was attempting to stalk the bird, it lit on the side of one of these rock mounds, much out of gun-range. As I watched it through my glasses it jumped about the mound in the manner of some sort of mammal. Reaching its foot into the crevices, it finally came out with what appeared to be a large lizard. I could not stalk the bird from my position for there was no cover, but I continued to watch it. A minute or so after it had pulled its prey from the rocks, Dr. Ralph A. Woods, who had approached from the opposite side, shot the hawk from the concealment of a small wash. We found that it had caught an iguana about eleven inches long. Instead of attempting to swallow this prey, it had promptly cut through the back, just behind the front legs, to get at the soft parts. In the hawk's stomach we found parts of at least two more lizards."

An adult female specimen collected by Thomas D. Burleigh along the Río Corona, near the village of Güemes, Tamaulipas, on February 20, 1938, had eaten "a small green lizard" (Sutton, 1951. "Mexican Birds," p. 131). This crane-hawk specimen served as the model for our colored frontispiece.

Wetmore (1943. *Proc. U.S. Natl. Mus.*, 93:241) gives us this account of his meeting with this species in southern Veracruz: "On April 4, 1939, I shot a male at the Arroyo Corredor. As I moved quietly among the trees I suddenly saw its dark form clearly through the branches as it perched 15 feet from the ground in heavy, open forest. It was eating a large orthopteran."

Mr. Sheffler examined the stomach- and crop-contents of four of the five Blackish Crane-Hawk specimens (three adult, two immature) now in his collection. The stomach of an adult (WJS 2261, sex?) taken by Sheffler himself at Guirocoba ranch on May 21, 1945, contained "parts of a small snake and remains of lizards." The crop of an adult male (WJS 2934) taken by Sheffler at a nest in the Tarahumar Mountains, near Guirocoba, was "very full of lizards and parts of small snakes." This male was the parent of the well-feathered nestling described in detail above. The stomach of the nestling was empty, so the old bird must have been about to feed its progeny.

Lovie M. Whitaker, of Norman, Oklahoma, and Edna W. Miner, of Houston, Texas, observed the feeding behavior of a Blackish Crane-Hawk along the Río Corona, in Tamaulipas, not far from the spot at which T. D. Burleigh took the specimen above referred to. Camped near the place at which the Brownsville-to-Victoria highway crosses the river, the two women were looking for birds. The date was August 15, 1949. A black hawk, perched on a horizontal branch only eight or ten feet from the ground near the trunk of a giant cypress (*Taxodium distichum*) on the north side of the river, directly opposite from them and about 30 yards away, they identified as an adult *G. nigra*. The bird seemed little concerned over their presence, and they watched it for fully twenty minutes. Mrs. Whitaker has furnished me with a full account of the experience, from which I quote:

"The hawk's lax, slaty black plumage had a pronounced bloom about the foreparts. We noticed the Chinese red of the eyes; the bright orange-yellow of the long tarsi and toes; the small gray bill and gray cere; the two white bars in the long, white-tipped tail; and the lacy white tipping of the leg feathers, breast feathers, and under tail coverts. When we "squeaked," the bird turned its head and stared at us intently, but its apathetic demeanor did not change. At times it lifted the feathers of its crown and nape into a loose, thin crest. Then it depressed the median crown plumage, leaving certain feathers at either side standing as a short, slightly recurved tuft above the back of each eye. This gave it a somewhat 'horned' appearance.

"Wishing to see the manner of flight this apparently sluggish bird might have, we 'shooed' it—but it would not fly.

"When it flew of its own volition we were astonished. It sprang lightly upward two feet to an opening in the trunk where it flapped its wings, struggling to hold position. When presently it came to rest, its left wing was spread across a small branch and its toes were gripping the bark just below the opening. It now thrust its head well into the cavity. When it withdrew its head, we noticed the throat muscles working as in swallowing. The bird now returned to its original position on the branch below, again facing us. This feeding procedure was repeated four or five times. Between feedings the bird gave a low, whining, nasal *kaah* several times. When fluttering into feeding position close against the tree, it displayed the beautiful pattern of the tail and the bold barring and mottling of the under-wings.

"When the hawk had finished feeding, we threw sticks at it and called out, still hoping to watch its flight. It did not budge! Attracted by other birds, we moved up-river, expecting to keep the hawk in sight. But it slipped off without our seeing it go. We did not examine the hole in the tree and can only guess that the hawk may have been robbing a bird's nest or eating wasp or bee larvae, or possibly ants. Certainly no small bird dived at it, or scolded it, while we were watching it."

As for the Blackish Crane-Hawk's nest, eggs, and nesting habits virtually nothing has thus far been published. The following information concerning eggs and the nests from which they were collected is, therefore, of great interest. This information has been furnished me by Mr. Sheffler, who collected the eggs.

"Nest 1. June 4, 1947. Two fresh eggs, plain white, each 53 × 38 mm. Two miles west of Mirasol ranch, southeastern Sonora, at 1800 feet elevation in lowlands below ranch. In Mexican cypress tree in almost dry wash, although some water was running from the larger pools. Nest against main trunk, at highest possible point, and more than 50 feet from ground; like that of Cooper's Hawk (*Accipiter cooperii*) but of smaller sticks, vine stalks, and weeds than that species would use; a few green leaves of wild fig in lining, most of these still clinging to small branches. Very little water anywhere in this area for nine months of the year.

"Nest 2. May 12, 1949. Two eggs, incubated 7–10 days, plain white, 52 × 43 and 52 × 42 mm. At 1800 feet elevation about one mile northeast of Guirocoba ranch-house, southeastern Sonora. In very tall Mexican cypress growing in creek. Creek, running through granite wash, had many pools in

May, but in June was almost dry. These water-courses have, in spots, heavy stands of cypress, large wild fig, morning-glory trees, kapoc, mahogany, and many small Sonora palms, all growing within a few feet of the water itself. Farther back from the water grow thorny, deciduous tropical plants, the giant pitahaya cactus, and other smaller forms of cactus.

"Nest 3. June 3, 1950. One egg, almost ready to hatch, white with several small, distinct spots and four larger, distinct blotches, color Sepia (Ridgway), 50 × 40 mm. At 1650 feet elevation, one and one-fourth miles east of Guirocoba ranch-house, southeastern Sonora. More than 50 feet from ground in very tall Mexican cypress, far out on long limb. Made of rather small sticks and vine stalks lined with small pieces of vine and many green leaves, most of them adhering to small branches. Deeply cupped. Parent bird flushed but not collected.

"Nest 4. June 4, 1950. One young bird about five weeks old [see above] and one egg, the latter plain white, 51 × 41 mm., and addled. At 2100 feet elevation in Tarahumar Mountains, five or six miles southeast of Guirocoba ranch-house, southeastern Sonora. In very high Mexican cypress growing in small dry wash; at least 50 feet from ground, well out on almost horizontal branch. Nest about size of Cooper's Hawk's, but made of smaller sticks than that species would use. Lined with small twigs, grass and weed stalks, some of the twigs bearing green leaves. Remains of coral snake and two lizards along outer edge of nest. Nestling, egg, and male parent collected."

Department of Zoology, University of Oklahoma, Norman, Oklahoma, November 19, 1954

ANALYTICAL STUDIES OF HENSLOW'S SPARROW SONGS

BY DONALD J. BORROR AND CARL R. REESE[1]

THE song of the Henslow's Sparrow (*Passerherbulus henslowii*) is usually described as consisting of two short buzzy notes. Peterson (1947:231) describes it as "one of the poorest vocal efforts of any bird . . . a hiccoughing *tsi-lick*"; it has been paraphrased *tee-wick* (Jouy, 1881), *flee-sic* (Faxon, 1889), *se-lick* (Hathaway, 1913), and *teesick* (Saunders, 1935, who states that the second note is higher than the first). All these phrases fit fairly well what one hears, but the song is uttered so rapidly that the human ear cannot detect many parts of it. When one listens to a recording played at a reduced speed it is immediately evident that the song contains several notes and is not as simple as it sounds at normal speed. Audio-spectrographic analysis of the song shows that it contains many notes, and it would seem unduly belittling to call such a song the poorest vocal effort of any bird.

Our study of Henslow's Sparrow songs is based on three recordings containing a total of 73 songs: No. 412, recorded in the northern part of Franklin Co., Ohio, April 18, 1953, by Robert A. Lewis; No. 416, recorded in the northern part of Franklin Co., Ohio (about one-fourth mile from where No. 412 was recorded), April 26, 1953, by Carl R. Reese; and No. 492, recorded in the northern part of Delaware Co., Ohio (about 30 miles from the locality of Nos. 412 and 416), May 16, 1953, by the writers. These recordings, now in the writers' collection, were made with a Magnemite recorder, using a tape speed of 15 inches per second.

Vibralyzer graphs (Borror and Reese, 1953) were made of 22 of the 73 songs in our collection. Time measurements were made on graphs prepared using the wide band filter (Figs. 2, 3, 5, 6, 8, and 9); the range of error in these measurements is about 0.001 or 0.002 second (greater in the weaker notes). Frequency measurements were made on graphs prepared using the narrow band filter (Figs. 1, 4, and 7); the range of error in these measurements is about 2 per cent of the range covered by the graph. However, the frequency-wise spread of a note on the graph depends to a considerable extent on the settings on the control panel of the instrument when the graph is made; settings giving a heavy mark result in an apparently greater spread in the frequency, and settings giving a lighter mark result in what appears to

[1]This study has been aided by a grant from the Ohio State University Research Foundation. The authors wish to express their appreciation to Miss Mary Jane Boyle for her assistance in the preparation of the graphs, and to Mr. William M. Protheroe, Dr. Charles A. Shaw, Dr. Robert A. Oetjen, and Dr. Wave H. Shaffer, all of the Department of Physics and Astronomy, Ohio State University, for advice and criticisms during the course of the study.

be a more nearly pure note. In making these graphs we have used a setting which will bring out all or nearly all of the fundamental frequencies present; as a result, the frequency spread in the louder notes may be somewhat exaggerated. The lines that appear at about 2800, 7200, or 7800 cps on some of the graphs are artifacts, due to something in the graphing mechanism and not something in the songs.

Some measure of the relative intensity of different notes or frequencies in a song is given by the darkness of the mark on the graph. Some notes appear to have one frequency of greatest intensity, while in others many frequencies appear equally intense. Another measure of the relative intensity of different notes is given by the readings on the VU meter of the recorder when the song is played (at a reduced tape speed). Loudness in Tables 2–4 is indicated only in general terms, as we cannot at present assign definite decibel values to the different notes. The range from "very weak" to "loud" represents a decibel range of at least 25 db; with a gain setting on the recorder that gives a maximum reading on the VU meter for the "loud" note, the needle does not register the "very weak" note; "fairly loud" is about 5 db below "loud," and with a setting that gives a maximum reading on the VU meter for the "fairly loud" note the needle just barely registers the "very weak" note.

Data on the interval between successive songs are given in Table 1.

TABLE 1

INTERVAL BETWEEN SUCCESSIVE SONGS

Recording	Date Recorded	Time of Day	Total No. of Songs Recorded	No. of Intervals	Range of Intervals (seconds)	Average Interval (seconds)
112	4/18/53	0830	49	42	1.9–5.9	3.04
116	4/26/53	0930	14	12	0.8–1.8	1.21
192	5/16/53	0740	10	8	3.5–7.5	5.22

This interval varied from 0.8 to 7.5 seconds. The different average length of the interval in the three recordings may indicate an individual difference in different birds, or it may indicate—as Hyde (1939) has shown—that the interval later in the season is longer.

CHARACTER OF THE NOTES

A bird's note may consist of a steady output of sound, or of a series of rapid pulses that may be either isolated or connected. Since the silent interval between successive outputs of sound is variable, it is difficult to draw a line between a "note" consisting of a series of isolated pulses and a series of "notes" each consisting of an isolated pulse or group of pulses. The audiospectrograph is capable of a high degree of time resolution, and can show that what often appears to the ear as a single note actually consists of two or more well isolated sounds. In general, we have used the term "note" for a series of pulses which appear connected when graphed using the narrow band filter, and the term "note group" for a well defined group of such "notes."

A note consisting of a rapid series of connected up-and-down slurred pulses, as in most of the notes of the Henslow's Sparrow songs, is described as a *vibrato* note; a note consisting of a series of individual pulses that are nearly or quite isolated, as in **A** and **F** of Figure 2, is described as a *staccato* note.

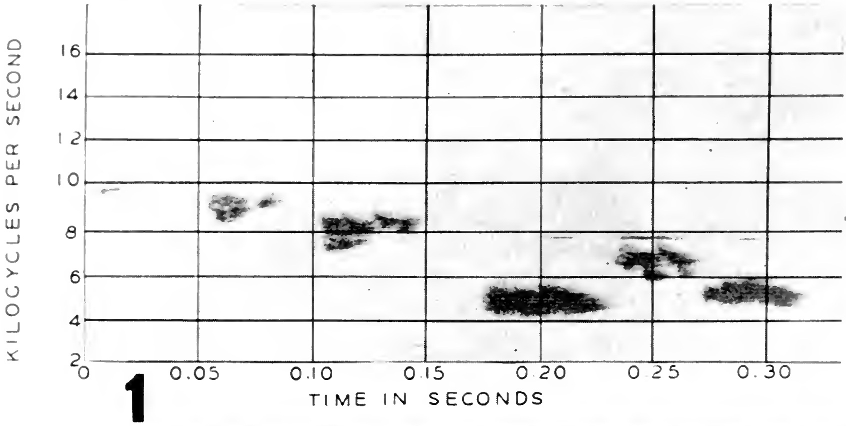
Recording No. 492 (Plate I).—Graphs were made of 8 of the 10 songs in this recording, and all are remarkably similar; graphs of two of these songs are shown in Plate I. The song consists of six note groups, which may be designated by the letters **A–F** (see Fig. 2). These songs vary in length from 0.300 to 0.305 sec. (average, 0.302 sec.). A summary of the songs graphed is given in Table 2.

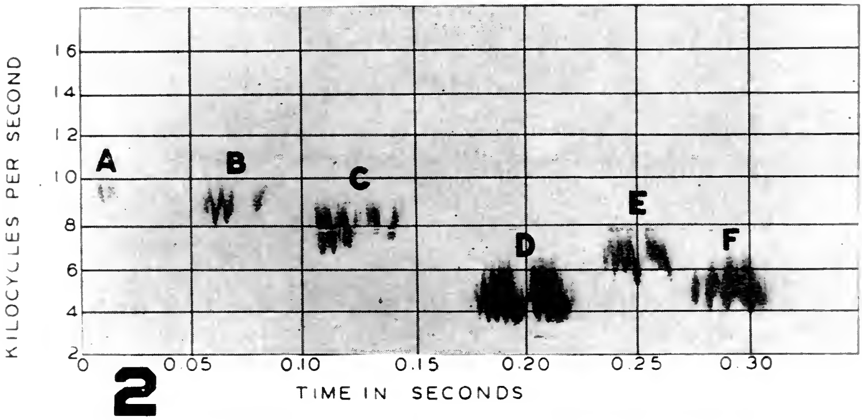
TABLE 2

SUMMARY OF SONGS IN RECORDING NO. 492

Note Group	Length (sec.)	Note	Length (sec.)	No. of Pulses	Type of Note	Frequency in cps	Loudness
A	.005–.008	1	.005–.008	2	staccato	9300–10200	very weak
B	.025–.027	1	.011–.014	5–6	vibrato or staccato	8300–9900	not very loud
		2	.004–.005	1	down-slurred	8800–10000	weak
C	.033–.039	1	.014–.019	5–6	vibrato	7000–9000	fairly loud
		2	.005–.007	1–2	staccato	8200–9000	weak
		3	.006	1	up-slurred	8000–8700	weak
D	.041–.044	1	.020–.025	5–6	vibrato	4200–5800	loud
		2	.017–.020	3–5	vibrato	4200–6000	loud
E	.029–.030	1	.014–.017	5–6	vibrato, down-slurred	6500–7800 to 5800–5900	fairly loud
		2	.010–.013	2–3	vibrato, down-slurred	7500–7800 to 5900–6200	fairly loud
F	.032–.038	1	.032–.038	4	staccato, down-slurred at end	5000–5700 to 4800–5800	almost as loud as D

A is an extremely weak note. **B** follows **A** after a silent interval of about 0.040 sec., and is lower in pitch and considerably louder than **A**; it consists of two separate notes, designated in the table as *1* and *2*. In six of the eight songs graphed *1* is a vibrato note (Fig. 2), and in the other two is a staccato note (Fig. 3). **C** follows **B** after a silent interval of about 0.002 or 0.003 sec.; it is somewhat lower in pitch and louder than **B**. It contains three notes, designated in the table as *1*, *2*, and *3*; *2* and *3* are quite weak.





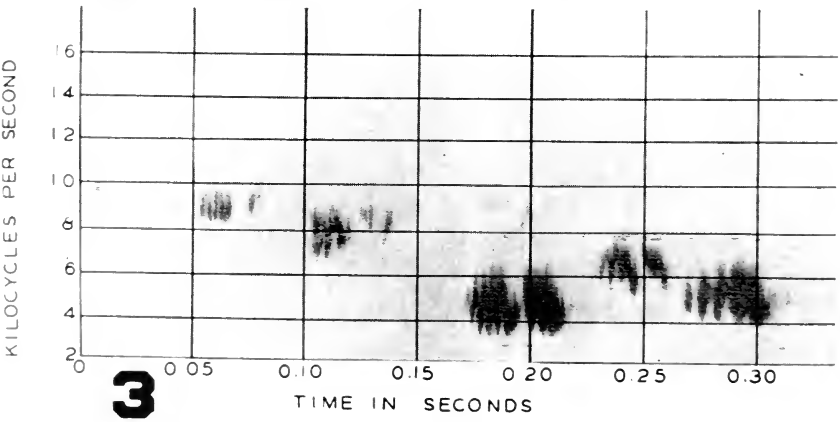


PLATE I. Songs of Henslow's Sparrow No. 192, recorded in Delaware Co., Ohio, May 16, 1953. Fig. 1, the second song in this series, graphed using the narrow band filter; Fig. 2, the same song, graphed using the wide band filter; Fig. 3, the sixth song in this series, graphed using the wide band filter. **A**–**F**, the six note groups (see text).

D, which follows **C** after a silent interval of about 0.003 sec., is the loudest and lowest in pitch of all the notes in the song; it contains two notes, the first a little longer than the second. **E**, which follows **D** after a silent interval of about 0.015 to 0.020 sec., is a little higher in pitch than **D** but not as loud; it consists of two notes, the first a little longer than the second, and each terminates in a downward slur. **F**, which follows **E** after a silent interval of about 0.010 sec., is almost as low in pitch and as loud as **D.**

By starting a recording at normal speed and gradually decreasing its speed, it is possible to determine what parts of the song the ear detects. The first three note groups (**A–C**) are heard as a faint lisp, but only if one listens very carefully. **D** is the first part of the song that is usually heard. **E** and **F**, which come in very rapid succession, are heard as a single, somewhat buzzy note, the *sic* or *lick* of most descriptions; since the frequencies in these notes are for the most part higher than those in **D**, this apparent note (**E** and **F**) appears higher in pitch than **D**, as Saunders (1935) has stated. The songs in this recording sound typical for this species.

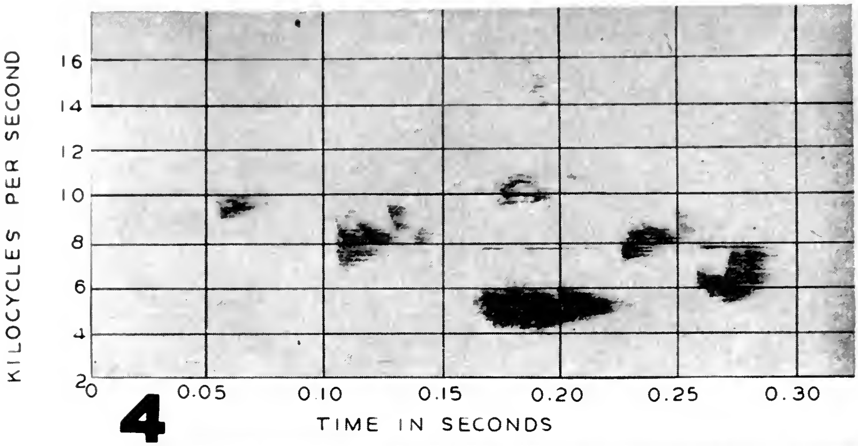
Recording No. 412 (Plate II).—Graphs were made of 8 of these songs, and they are very similar to one another and to those for No. 492. The songs in No. 412 contain only five note groups, and some of these groups differ slightly from the corresponding note groups in No. 492. The first note is very much like **A** and the remaining notes resemble **C–F** of No. 492; **B** of No. 492 is missing in these songs (Fig. 5). The songs in No. 412 vary in length from 0.223 to 0.230 sec. (average, 0.227 sec.). A summary of the songs graphed is given in Table 3.

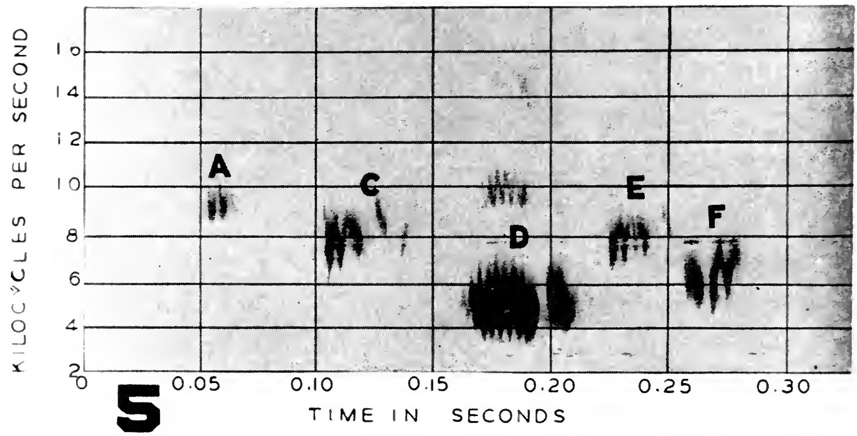
TABLE 3

SUMMARY OF SONGS IN RECORDING NO. 412

Note Group	Length (sec.)	Note	Length (sec.)	No. of Pulses	Type of Note	Frequency in cps	Loudness
A	.006–.010	1	.006–.010	2–4	staccato	9000–10000	weak
C	.034–.038	1	.014–.017	5–6	vibrato	7000–9000	fairly loud
		2	.002–.004	1	down-slurred	8600–9600	very weak
		3	.001–.003	1	up-slurred	8000–8800	very weak
D	.040–.050	1	.027–.032	13–15	vibrato	4200–6000	loud
		2	.005–.015	1	staccato	4500–6000	loud
E	.024–.027	1	.012–.017	5–7	up-slurred, vibrato	7000–9000	fairly loud
		2	.002–.004	1	down-slurred	8500–9000	very weak
F	.020–.024	1	.007–.008	1	somewhat down-slurred	5800–7000	fairly loud
		2	.010–.013	3	vibrato	5400–7800	fairly loud

A is rather weak, but is a little stronger than in No. 492. **C** follows **A** after a silent interval of about 0.040 sec., and consists of three notes (*1*, *2*, and *3* in the table); it is lower in pitch and louder than **A**. **D**, which follows **C** after a silent interval of about 0.025 sec., is the loudest in the song and the lowest in pitch; it consists of two notes, the first about twice as long as the second. In one of the eight songs graphed the second note in **D** followed the first after a silent interval of about 0.010 sec., and was only 0.005 sec. in length; in the other seven songs (Figs. 5–6) this second note was





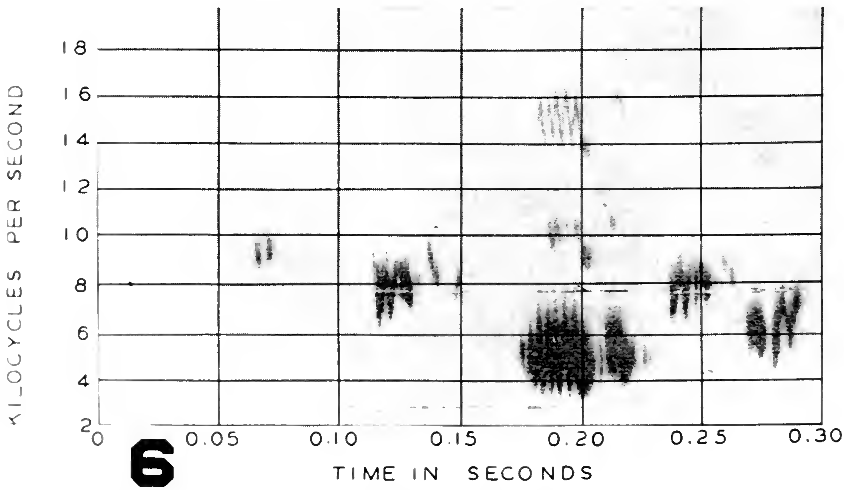


PLATE II. Songs of Henslow's Sparrow No. 112, recorded in Franklin Co., Ohio, April 18, 1953. Fig. 4, the twenty-fourth song in this series, graphed using the narrow band filter; Fig. 5, the same song, graphed using the wide band filter; Fig. 6, the twentieth song in this series, graphed using the wide band filter. **A**, **C**–**F**, the five note groups (see text).

0.010 to 0.015 sec. in length and followed the first almost immediately. **E**, which follows **D** after a silent interval of about 0.015 sec., is very similar to **C** but lacks the third very short and up-slurred note (*3* in **C**); it has about the same pitch and loudness as **C**. **F** follows **E** after a silent interval of about 0.007 to 0.008 sec., and is the second loudest and lowest in pitch in the song; it contains two short notes.

These songs sound to the ear almost exactly like those in No. 492. The first two note groups are heard as a faint lisp, but only if one listens very carefully. **D** is the first distinct note of the song, and **E** and **F** are heard as a single buzzy note slightly higher in pitch than **D**.

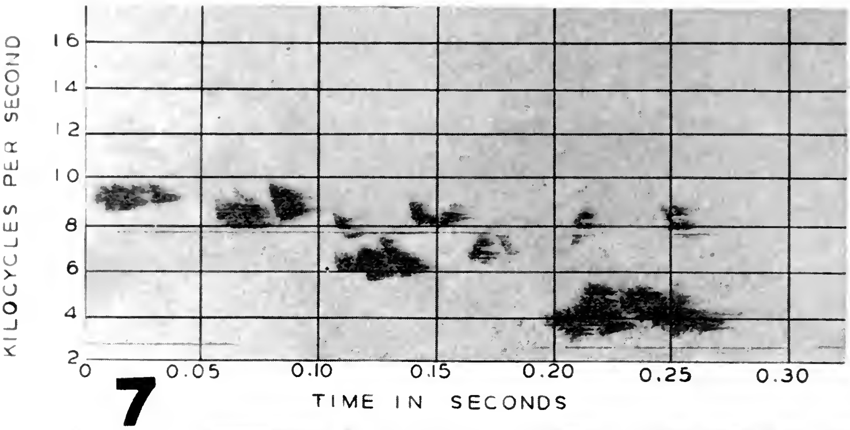
Recording No. 416 (Plate III).—These songs sound a little different to the ear than the songs of the other two birds, and when graphed differ considerably from those of Nos. 492 and 412. These songs consist of four groups of notes, which progressively increase in loudness and decrease in pitch. The first two may be designated **B** and **C**, since they are very similar to the **B** and **C** of Nos. 492 and 412; the third may be designated as **F**, as it is somewhat similar to the **F** in the other two songs; the fourth may be termed **D**, as it is similar to the **D** of the other songs. Graphs were made of six songs of this bird; these songs vary in length from 0.259 to 0.268 sec. (average. 0.262 sec.).

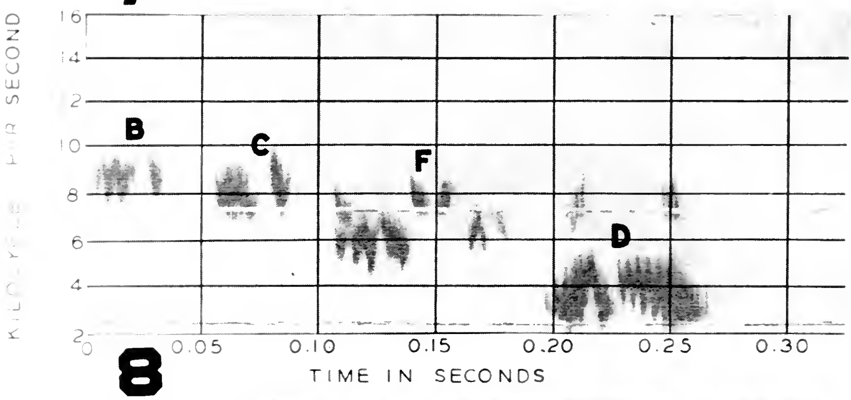
Table 4

Summary of Songs in Recording No. 416

<table>
<tr><th>Note Group</th><th>Length (sec.)</th><th>Note</th><th>Length (sec.)</th><th>No. of Pulses</th><th>Type of Note</th><th>Frequency in cps</th><th>Loudness</th></tr>
<tr><td rowspan="2">B</td><td rowspan="2">.021–.029</td><td>1</td><td>.009–.018</td><td>3–4</td><td>vibrato</td><td>8800–9800</td><td>weak</td></tr>
<tr><td>2</td><td>.005–.006</td><td>1</td><td>down-slurred</td><td>9000–9800</td><td>very weak</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">.030</td><td>1</td><td>.016–.020</td><td>3–5</td><td>vibrato (?)</td><td>8000–9500</td><td>not very loud</td></tr>
<tr><td>2</td><td>.006–.008</td><td>1</td><td>down-slurred</td><td>8400–9800</td><td>not very loud</td></tr>
<tr><td rowspan="5">F</td><td rowspan="5">.071–.072</td><td>1</td><td>.030–.032</td><td>3</td><td>vibrato and staccato</td><td>5800–8500</td><td>fairly loud</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">.015–.019</td><td rowspan="2">2</td><td rowspan="2">staccato (?)</td><td>8100–9000</td><td rowspan="2">weak</td></tr>
<tr><td>8000–8600</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">.013–.017</td><td rowspan="2">2</td><td>vibrato</td><td>6400–7600</td><td rowspan="2">weak</td></tr>
<tr><td>staccato</td><td>6900–7600</td></tr>
<tr><td rowspan="2">D</td><td rowspan="2">.066–.076</td><td>1</td><td>.027–.030</td><td>10–12</td><td>vibrato, up-slurred and down-slurred</td><td>3100 to 5800 to 3100</td><td>loud</td></tr>
<tr><td>2</td><td>.038–.042</td><td>12–15</td><td>vibrato, slightly down-slurred</td><td>4200–5500 to 3500–4600</td><td>loud</td></tr>
</table>

B is very similar in its general character to **B** in No. 492. **C**, which follows **B** after a silent interval of about 0.025 sec., is a little louder and lower in pitch than **B**, and contains two notes. **F** is a composite group of notes consisting of a fairly loud principal note (F_1) followed by two very weak notes (F_2 and F_3); **F** follows **C** after a silent interval of about 0.020 sec. F_1 contains three principal pulses; the first pulse contains two groups of frequencies, one of about 6,000–6,800 cps and the other 7,700–8.500 cps (Fig. 7); the second pulse contains frequencies between about 5.800 and 7,100 cps, and





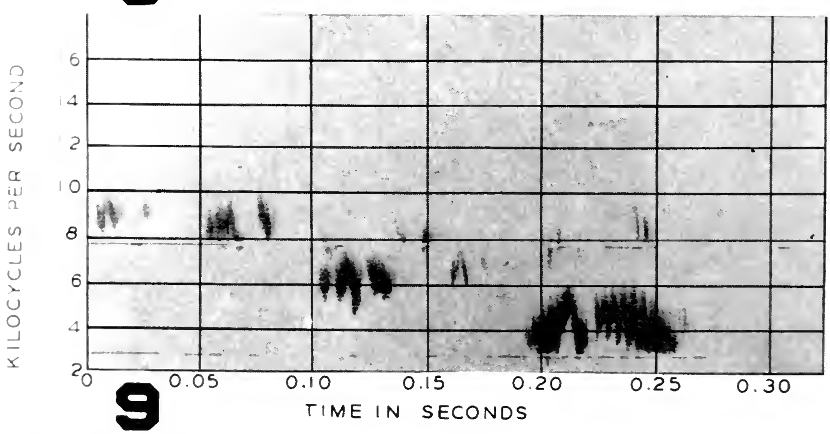


PLATE III. Songs of Henslow's Sparrow No. 416, recorded in Franklin Co., Ohio, April 26, 1953. Fig. 7, the fifth song in this series, graphed using the narrow band filter; Fig. 8, the same song, graphed using the wide band filter; Fig. 9, the second song in this series, graphed using the wide band filter. **B–D, F**, the four note groups (see text).

the third, frequencies between about 5,800 and 7,500 cps. F_2 contains two pulses, the first a little higher in pitch than the second. F_3 contains two pulses. **D** follows **F** after a silent interval of about 0.020 sec., and is the loudest in the song and the lowest in pitch; it consists of two notes, the first a little shorter than the second. The first note in **D** rises in pitch and then falls back rather abruptly; the second note is slightly down–slurred in pitch.

To the ear this song seems to consist of two notes, the first somewhat lisping and the second loud and emphatic; the first appears higher in pitch than the second. The first three note groups (**B**, **C**, and **F**) are heard as a single lisping or buzzy note; **D** is heard as the last emphatic note of the song.

Harmonics

Some of our graphs show what appear to be harmonics; others do not. We believe that all these notes would show a few harmonics if proper instrument settings were used in making the graphs, but a graph designed to show them would distort the fundamental. We have found a weak single harmonic in groups **C** and **E** (not shown in the figures) and weak double harmonics in **D** (Fig. 5) and **F** (not shown in the figures).

Summary

Audio-spectrographs of the songs of three individual Henslow's Sparrows show that the songs are much more complex than they appear to the ear. The song usually consists of a series of two or three note groups of decreasing pitch and increasing loudness, beginning with frequencies around 9,000 or 10,000 cps, and with the lowest frequencies in the lowest note about 3,100 cps. The lowest (and loudest) note in this sequence is usually followed by two fairly loud notes, the first a little higher in pitch than the second, and the second a little higher than the loud note preceding them. The ear seldom detects the first two or three note groups in the song, and the first note usually heard is the loud low note; the last two note groups appear to the ear as the "second" buzzy note of the song. Some of the graphs show what appear to be harmonics for the louder notes. The range in loudness between the weakest and the loudest note of a song represents a decibel range of at least 25 db.

The songs of a given individual are extremely similar, while those of the three individuals are different. The songs of two of the three birds here reported were fairly similar; the third bird had a somewhat different song.

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DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY, OHIO STATE UNIVERSITY, COLUMBUS 10, OHIO. JANUARY 21, 1954

NEW LIFE MEMBER

Horace H. Jeter, a native of Shreveport, Louisiana, and now a practicing Certified Public Accountant in that city, has had a life-long interest in birds and, currently, bird photography. His memberships in ornithological societies include the American Ornithologists' Union, National Audubon Society, Cooper Ornithological Club, and Louisiana Ornithological Society. He is now president of the latter organization and a regular contributor to *Aububon Field Notes*. He is now working on a checklist of the birds of the Shreveport vicinity and is gathering data on song periods of birds.

AN EXPERIMENTAL APPROACH TO THE STUDY OF BIRD POPULATIONS

BY V. E. SHELFORD

That the size of bird populations is a matter of interest to ornithologists is evidenced by the publication of *Audubon Field Notes* showing bird counts of various kinds conducted at regular intervals. It is especially praiseworthy that these counts are made of all birds regardless of their value as game or their value or detriment to agriculture. The use that has been made of the counts pays tribute to the efforts of non-professional scientists.

The size of bird (or other animal) populations is the result of the interplay of several factors, but it seems evident that an increase in the number of eggs produced and superior vigor of the young can outweigh normal predation and minor disasters. The simplest cases for testing this statement are those showing the operation of these potent factors during *critical* periods in the annual physiological cycle of the bird. One of these critical periods, which is probably related to the size of the clutch, is the late, rapid development period of the gonads.

What factor acting at this gonadal development period could influence the size of the clutch and the vigor of the young birds? In the case of an insect, a grouse locust (*Acrydium arenesum angustum*), ultraviolet light induces accelerated reproduction (*i.e.*, more offspring) with greater vigor than ordinary "white" light. Without continuous ultraviolet light stimulus over two or more months, this species would not breed in the green house where the work by Sabrosky, Larson, and Nabours (1933) was done. Under somewhat similar circumstances a pair of monkeys was induced to breed in a London zoo by the application of ultraviolet light (Stetson, 1947:181).

Marshall and Bowden (1934:418) greatly shortened the period to oestrous in a ferret by the application of carefully measured ultraviolet light. Oestrous in mammals is the equivalent of egg laying in birds, and since Bailey (1950) announced that ultraviolet light increases egg production by poultry, it seems logical that ultraviolet light may also affect the reproductive rate of other birds as well.

Other factors also may influence the size of clutch. Yeatter (personal communication) states that in the pheasant (*Phasianus colchicus*) clutch size appears to be related to temperature. In work with fish, Merriman and Schedl (1941) found that both strong light and high temperature are necessary for the development of reproductive cells of the four-spined stickleback (*Apeltes quadracus*).

Kendeigh (1944:82) utilized the Christmas bird counts for the state of Ohio to estimate the populations of quail (*Colinus virginianus*) in the entire state (1908 through 1942). This writer published a curve (Shelford, 1951: 169) showing the intensity of solar ultraviolet for the month of April, 1924–1938, as measured over that period on Mt. Wilson, California by Pettit (International Astronomical Union). When this is drawn parallel to Kendeigh's population curve from 1925 through 1938, it is evident that there is a narrow band of solar ultraviolet which appears to be an optimal range. When intensities were either above or below the apparent optimum range, populations declined. In all years in which April solar ultraviolet was within the optimal limits (102 and 117) there were increases over the quail count of the preceding year. Other studies show (Shelford, 1951:170–173) that moisture also influences quail population, though ultraviolet is most important. Usually two or more factors predominate in controlling fecundity and other physiological processes. Each of us has noted the combined action of temperature and moisture in affecting our sensations on hot, moist and hot, dry days at similar temperatures (Shelford, 1952b:155).

Considerable scientific work on fecundity control of the domestic fowl has been done. Whetham (1933:398) found there were optima of amount of light in connection with activity and suggested that the same principle applied to reproduction. She stated further that light stimulates the production of an internal secretion (anterior pituitary) which activates the ovary (1933:395). She stated that larger consumption of food in the case of birds given additional hours of light is due to the increased egg production induced by more light. Nutrition available is diverted to egg production rather than to the accumulation of fat. She did not suggest that the supply of foods plays no part in the production of eggs, but rather that factors such as deficiency of internal secretion limit the production. When a large supply of the internal secretion is present, egg production may continue for some time in the absence of adequate food supplies at the expense of body weight. A practical example of this was given by Hansson (1930:199) who showed that in one case increased illumination alone, without improvement of an unbalanced ration, resulted in an increase of egg production from 20 to 40 per cent (over controls).

In Fig. 1 the number of pheasant nests per 100 acres in northwest Ohio is shown for the year following the occurrence of the amounts of sunshine (in percentage of the total possible) and rainfall (in inches) indicated for April of the preceding year. This is because young pheasants make nests the year following hatching. Studies of paired factors have led to the drawing of this type of diagram. The drawing of the base of such a diagram is very simple. The intensities of the two factors are scaled on two sides of a rectangle such as Fig. 1. The conditions in a period such as a month, *e.g.*, April, are chosen for study here because of the general knowledge of the reproduction of birds.

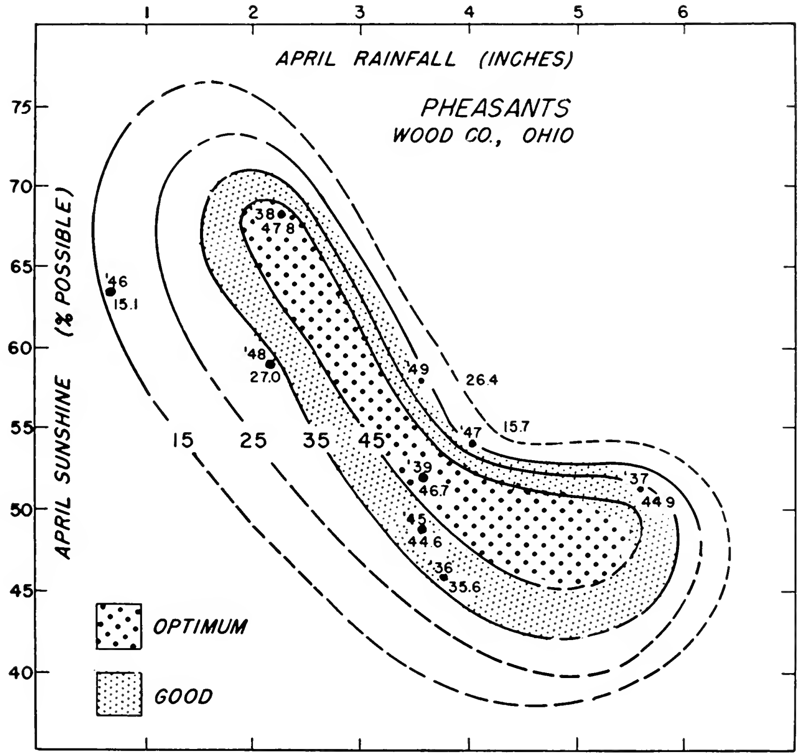

FIG. 1—A heliohydrogram, showing the number of pheasant nests per 100 acres as recorded in northwestern Ohio the year following the one plotted. The numbers are plotted at the intersections of coordinates representing the amount of sunshine in April in percentage of the total possible (recorded at Fort Wayne, Indiana) and rainfall in April (recorded at Bowling Green, Ohio). The interaction of these factors appears to have had an important influence on the size of population. Although for best results these records should have been made in the study area, it is suggested that the same approximate number of nests occurs in series of different combinations of rainfall and sunshine; for example, approximately 47 nests per 100 acres fell on approximately 68 per cent sunshine and 2.25 inches of rain and also on 53 per cent sunshine and 3.5 inches of rain; the data are too few but the ellipses shown follow the general pattern of such relationships. Optimum conditions, based on the largest number of nests, are in the center. The stippled areas indicate two zones of favorability in conditions, and the lines connect years of approximately equal population. Data are from E. Dustman's release No. 203 (1950) of the Ohio Wildlife Research Unit, Ohio State University.

The coordinate points for the two factors are located: for example the 1946 April sunshine was near 63 per cent of the total possible and the rainfall less than an inch. When the coordinated points are all located, the population data are written adjacent to them. The pattern is studied and, if possible, lines con-

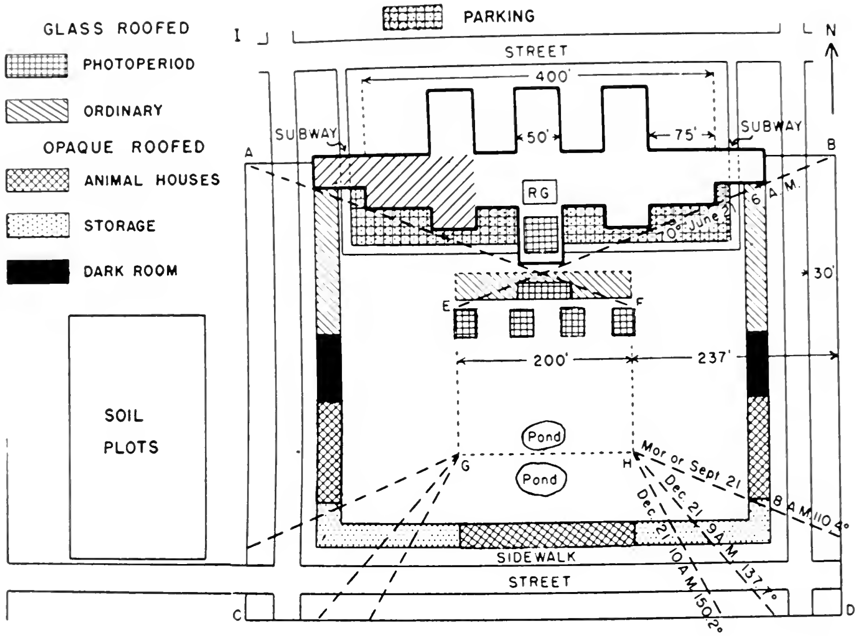

FIG. 2—"Life science" building with a yard at its south enclosed by essential one-story buildings. Area E-F-G-H, a little less than 200 feet square, at 40° N. Lat. has no shadows from 6 a.m. to 6 p.m. when objects 70 feet high are at least 237 feet from its east or west border and a lesser distance from its south border. The dark rooms are for photo-period work. The four small glass-roofed greenhouses are provided without shadow from each other to permit the use of colored glass. The heavy line surrounds the main building which is of interest only in that it casts no shadows on the well lighted area, and supports a roof garden (RG). This is an improvement over the unenclosed plan (Shelford, 1952a). The angles of the sun at various times are shown in the figure, at the right. The corresponding angles for the afternoon are at the left.

necting equal populations are drawn. In this case the figure is good and the apparent discrepancy of 1937 could easily result from a heavier *local* rainfall at the weather station used.

Birds seem to be the ideal vertebrate material for the study of relations of physical factors to fecundity and vigor of offspring. There are good series of domesticated and semi-domesticated species available for study and development of methods which may later be applied to wild species. The size of the clutch is evident in a short time while in the case of mammals there is a long period of gestation.

To be fully valid the final checking of the results of field study, diagrams, etc. should be done out of doors. This raises the question of the requirements of a suitable workshop. Experimental work which involves simulation of natural conditions and the use of variable as well as constant conditions requires the use of out-of-door facilities. Length-of-day effect can be studied by following the practice of some plant laboratories which bring plants from dark rooms into sunlight each day for any period of time desired.

On grounds adjacent to laboratories with dark rooms birds may be subjected to small additions of short or long wave radiation, semi-out-of-doors studies of metabolism may be conducted, and small birds may be trapped under permit. The area for this purpose must be completely enclosed, and essential and useful buildings may best be used to enclose the area (Fig. 2).

Experimental studies call for electrical service, and the use of delicate instruments which cannot be operated away from a laboratory. Birds have been used for considerable basic study in spite of the serious handicaps which have attended some research. With better facilities much more can be done.

The plant shown in Fig. 2 is designed for the biological work of a rather large institution. Because of the unusually favorable character of birds as material for the study of the physiology of reproduction, ornithologists can exert considerable influence toward securing better conditions for experimental work with them, or still better, interest someone in providing the funds to build suitable facilities. Most institutions are not equipped for research such as is needed.

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AN UNUSUAL MIGRATION OF BIRDS AT TOKYO, JAPAN

BY H. ELLIOTT MC CLURE

WEATHER has long been recognized as a contributing factor in bird migration. In recent years much has been written concerning bird movements and weather in North America (Lowery, 1945; Lincoln, 1950; Williams, 1950, 1952; Gunn and Crocker, 1951, Bullis and Lincoln, 1952; Imhof, 1953; and many others). That the phenomenon of bird movement before "fronts" of weather would not be confined to North America is self-evident. Undoubtedly it is variously reported in the many journals and languages of Europe. Reports of such movements in Japan would be illegible to most American students unless summarized in English. Because of this, I wish to present here observations of a movement of birds before a front that swept over Tokyo on October 31 – November 1, 1953.

Migration through Japan is of long duration, lasting from late July and early August with the appearance of Wandering Tattlers (*Heteroscelus incanus*) and other shorebirds, which have finished nesting in the Arctic, until late December when the last thrushes have come in from Siberia and Manchuria. Because of this there is a continuous flow of birds rather than a great influx. These flights include thrushes, bramblings, bulbuls, etc., reared in the vast continental areas of Siberia and Manchuria, and those more locally produced, from Sakhalin, Hokkaido, and northern Honshu. The continental populations may cross the Japan Sea (Austin, 1947) or move down the chain of islands from Sakhalin. An unknown percentage of these populations remains in Honshu, Kyushu, and Shikoku for the winter, while the remainder moves on down the Ryukyu Island chain to disperse into the Philippines, Formosa, and more southern islands. Since almost no banding has been done these routes and destinations are still poorly understood.

During October first flights of thrushes and bulbuls begin arriving along the northwest coast of Japan. They filter across the island of Honshu especially through the Fossa Magna, the great rift in the chain of mountains forming the backbone of the archipelago. As all of this takes time and is distributed over two months the appearance of migrants and winter residents in Tokyo and vicinity is usually gradual.

Whether the breeding season in Siberia and Manchuria was especially successful in 1953 or whether fall weather conditions in Japan and the land to the north were favorable to migration could not be determined, but flights through Tokyo were definitely more conspicuous than in the three previous autumns which I have observed. The flight of White-rumped Swifts (see tables for scientific names not given in text) had been greater, and that of the

Jay so conspicuous that Jays were found penetrating areas in which they had not previously been seen.

During the day of October 31, 1953, a cold front from a low hanging over the coast of Siberia, Manchuria, and inland moved quietly into Japan bringing with it a light northwest wind and rain. At 1800 hours weather reports indicated that it was raining hard at 10,000 feet and that, unless there was a wind shift, rain would reach Tokyo within an hour. The rain did not come

TABLE I
PERMANENT RESIDENT SPECIES SEEN AT HAMA PARK, TOKYO, DURING THE 1953 FLIGHT

Species[1]	*Oct. 6*	*Nov. 2*	*Nov. 9*
Common Cormorant (*Phalacrocorax carbo*)	200	41	7
Black-crowned Night Heron (*Nycticorax nycticorax*)	3	6	
Black-eared Kite (*Milvus migrans*)	3	2	4
Bamboo Partridge (*Bambusicola thoracica*)[2]	2	2	2
River Kingfisher (*Alcedo atthis*)	3	1	2
Thick-billed Crow (*Corvus levaillantii*)	1	2	2
Great Tit (*Parus major*)	4	10	17
Gray Wagtail (*Motacilla cinerea*)	2	1	1
Bull-headed Shrike (*Lanius bucephalus*)	1	8	8
Ashy Starling (*Sturnus cineraceus*)	103	43	68
Tree Sparrow (*Passer montanus*)	106	40	120
Oriental Greenfinch (*Chloris sinica*)		10	1

[1]Common and scientific names from Austin and Kuroda, 1954.
[2]Introduced in 1919 from China and now a widespread and permanent resident.

as the front veered off to the north and a high with clear skies and a light, warm, southeast wind pushed over the coast. All day November 1 the warm, clear weather held, but it became calm at sundown and by 2100 hours the wind had shifted again to the northwest and the cold weather moved in. It was raining and windy all day November 2.

There was nothing unusual about this chain of events in the weather. It happens regularly in the humid, rainy climate of Tokyo, but this time a host of birds was moving with the cold front and they were momentarily stranded by the warm weather which intercepted them.

In the light of the huge flocks of birds that may be seen in America—large both in numbers and species—those encountered in Tokyo seem insignificant. However, the weather-bird relationship was present even if on a small scale.

Within the limits of downtown Tokyo is a small, heavily wooded park of about forty acres, Hama Park. An island formed by reclaimed mudflats between canals and Tokyo Bay was established at least a hundred years ago as a private bird sanctuary and hunting ground for the Imperial Household but is now a city park. About one-third of the area is made up of ponds and landscaped lakes. The remainder is about equally divided between lawns and clumps of large trees, oaks, camphor, pines, and others, with a heavy undergrowth of bamboo and ornamental shrubs. Because of its proximity to the city, it is heavily used by pleasure seekers, and the mild weather of November 1 filled the parks with thousands of people.

Observations were made on the morning of November 2 before the bulk of the birds had moved on, and on November 9, when more normal winter populations were present. These observations are compared here with those made on October 6 (Tables 1, 2, and 3). Of the 37 species seen during these three observations, 12 were permanent residents of the park. These are listed in Table 1. There was nothing unusual about the numbers seen. The Ashy Starling, Tree Sparrow, and Cormorant numbers fluctuated because of their daily movements to and from the park. However, the sudden increase in Bull-headed Shrikes seemed to be correlated with the cold front.

TABLE 2

WINTER RESIDENT SPECIES AT TOKYO, JAPAN, APPARENTLY INFLUENCED BY THE FRONT OF OCT. 31 – NOV. 1, 1953

Species	*Oct. 6*	*Nov. 2*	*Nov. 9*
Snowy Egret (*Egretta garzetta*)	1	6	3
Spot-billed Duck (*Anas poecilorhyncha*)	2		10
Green-winged Teal (*Anas crecca*)			2
Black-tailed Gull (*Larus crassirostris*)	1	58	2
Black-headed Gull (*Larus ridibundus*)		28	42
Turtle Dove (*Streptopelia orientalis*)	1	3	4
Brown-eared Bulbul (*Ixos amaurotis*)	7	105	15
Bush Warbler (*Horeites diphone*)			13
Pied Wagtail (*Motocilla alba*)		2	2
Hawfinch (*Coccothraustes coccothraustes*)			2
Black-faced Bunting (*Emberiza spodocephala*)		4	1

Migrating flocks of winter residents (Table 2) were most evident in this population shift. The Brown-eared Bulbul is a noisy, conspicuous winter resident which arrives in October. It is the only passerine species in Japan which flocks as do blackbirds in America and can be seen sweeping like smoke above the horizon. Ordinarily, winter flocks of bulbuls are common in Kyushu but very uncommon in the Tokyo area. On November 1 and 2 a group of more than a hundred bulbuls formed a loose flock which flew restlessly above the trees of the park, diving into them every few minutes to feed. Other winter residents listed in Table 2 arrived with the front or in the weather immediately following it.

Strictly migrant species at this season were apparently brought into or moved away from the Tokyo region by this front (Table 3). The Jay went on south with the storm. Flycatcher and warbler migration was brought to a close. Thrush flights apparently just began with this front and could be ex-

TABLE 3

MIGRANT SPECIES SEEN AT HAMA PARK, TOKYO, IN THE FALL OF 1953

Species	*Oct. 6*	*Nov. 2*	*Nov. 9*
Mangrove Heron (*Butorides striatus*)	1		
Common Sandpiper (*Actitis hypoleucos*)			1
Brown Hawk-Owl (*Ninox scutulata*)	1		
White-rumped Swift (*Apus pacificus*)	6		
Jay (*Garrulus glandarius*)	5	3	
Pale Thrush (*Turdus pallidus*)			4
Red-bellied Thrush (*Turdus chrysolaus*)		4	
Blue Rock Thrush (*Monticola solitarius*)			1
Redstart (*Phoenicurus auroreus*)			1
Crowned Willow Warbler (*Phylloscopus occipitalis*)	1		
Broad-billed Flycatcher (*Musicapa latirostris*)	9	1	
Gray-spotted Flycatcher (*Musicapa griseisticta*)	3		
Narcissus Flycatcher (*Siphia narcissina*)		1	

pected to increase slightly before they moved on. All of the birds listed in Table 3 are of interest, but two species, the Common Sandpiper and the Mangrove Heron were summer stragglers that should have flown weeks before. The Redstart, a small thrush, moved in during the week but probably did not winter in the park as they usually frequent more open or brushy farmlands.

The Blue Rock Thrush, a beautiful robin-sized bird of powder blue and brick red, is a species of very limited habitat requirements. It is found most commonly along rocky coasts where it nests beneath the rocks and feeds along the water's edge. Each year of my studies a lone male has been seen on a small, unused lighthouse at Hama Park, many miles from any suitable habitat. Fall arrival dates have been October 4, 1951, October 6, 1952, and November 9, 1953. It would have been of interest to have determined the identity of this annual visitor by banding.

On November 16, another front of about the same magnitude as that of October 31 – November 1 swept over Japan, bringing another wave of birds. On the following day tallies were made at an upland farm area in the outskirts of Tokyo. This was in rolling country of open fields surrounding farmyards of large trees and bamboo thickets. Again migrant forms were much in evidence, including Bull-headed Shrikes, Brown-eared Bulbuls, Dusky Thrushes (*Turdus naumanni*), Oriental Greenfinches, Redstarts, Hawfinches, Rustic Buntings (*Emberiza rustica*), and a lone Eurasian Woodcock (*Scolopax rusticola*).

SUMMARY

A mild, cold front on October 31, 1953, stalled at Tokyo, Japan, by a warm front for twenty-four hours, brought a flight of migrants which re-

mained a few days. The most conspicuous of these was the Brown-eared Bulbul. Other species apparently arriving at this time were the Bush Warbler, Pale Thrush, Red-bellied Thrush, and Redstart. Most species moved on as the cold front overran the warm front and pushed on south. A second migratory wave appeared two weeks later with another front.

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406th Medical General Laboratory, APO 500, c/o Postmaster, San Francisco, California, December 3, 1953

GENERAL NOTES

The effect of radar on birds.—The publication of this war time observation was delayed pending the removal of security classification from the equipment used. Recently, the United States Air Force dropped this radar from the restricted list, permitting the publishing of the characteristics of the equipment, without which this report would be of little value to investigators in the field of avian orientation.

In the fall of 1943, I was in charge of a group of military personnel engaged in tracking aircraft over the ocean off the east coast of the United States. The radar set was emplaced in the dunes not far from the high tide line. During a lull in operation, a large flock of scaup (*Aythya* sp.) and scoters (species?) was seen flying parallel to the coastline a few hundred yards off shore and approaching our position. Having nothing better to do at the moment, we idly swung the parabolic antenna around and pointed it directly at the flock. The result was immediate and dramatic. The once orderly group of birds became a bewildered mass of individuals which flew in circles, missed wingbeats, and performed many unbirdlike gyrations. Some observers later insisted that a few birds accomplished loops and rolls although I never observed this. As the beam was diverted by elevating the antenna, the flock regrouped and proceeded down the coast in the original direction.

To verify this unusual behavior as being caused by radar, the experiment was repeated several times on subsequent occasions. In each case, the result was essentially the same, the response of the stimulated flock coinciding with the incidence of the beam upon the birds, the cessation of response coinciding with the diversion of the beam. The intensity of reaction appeared to vary inversely with the distance between the radar and the birds and some individuals were affected more than others. There also seemed to be some relationship between the angle of incidence and the intensity of response but this was not clear.

The electrical characteristics of this radar are quoted for those working in this field: wave length 10 centimeters (3,000 megacycles), crystal controlled; peak power 210 kilowatts; average input 540 watts; average output 280 watts; pulse recurrence frequency 586; pulse width 0.8 microseconds; beam width 1.4 degrees; maximum range 70,000 yards.

Although it is not the purpose of this report to speculate upon the nature of the mechanism involved in the detection of electromagnetic radiation by birds, one cannot help but wonder if the behavior described above does not support the theory that birds indeed perceive the earth's magnetic field. In flight, the crossing of these lines of force may result in the production of phosphenes, or perhaps the answer lies in the setting up of tiny oscillating currents somewhere in the animal's central nervous system.—O. A. Knorr, *Department of Biology, University of Colorado, Boulder, Colorado, April 20, 1954.*

Evening flights of the Southern Everglade Kite and the Blue and Yellow Macaw in Surinam.—The Southern Everglade Kite (*Rostrhamus s. sociabilis*) is, in the coastal area of Surinam, a common bird in freshwater marshes. It is often seen on poles or fences along rice fields, on the lookout for snails. This habitat it shares with the Southern Limpkin (*Aramus g. guarauna*), in Surinam called "Krau-krau," after its call note which is a characteristic sound at night or in the early morning in these places. The rice fields are only feeding areas where, owing to lack of cover, the birds are unable to breed.

The Everglade Kite is particularly numerous in the rice-growing district, Nickerie, on the right bank of the Corentyne River. I never located a breeding colony, but the breeding season must be in the long rainy season as I observed birds assembling and carrying nest material on May 29 and 30, 1953, along Huntley Creek, in the same district where both kites and limpkins were numerous in the vast, surrounding marshes. As is well known, the Everglade Kite is a very social bird which spends the night in a communal roost. In Nieuw Nickerie I observed every afternoon a number of kites crossing the Nickerie River to its right bank on their way to their roost which itself remained unknown to me. At the end of July the numbers were particularly large, so I took the opportunity to count them on July 31, 1953.

The flight started at about 5:30 p. m. They passed over at low altitude, slowly flapping their wings, alternating with short glides. Many were in immature plumage, those in adult plumage often having the primaries in molt. It was interesting that several carried single snails, either in their claws or in their bills. The flight stopped towards darkness, or at about 6:45 p. m. I counted 712 birds which certainly were not all as the birds passed over a rather broad front which I could not oversee in its entirety. It was an impressive spectacle, as at the same time a large number, running into a few thousand, of egrets passed over in the same direction. These egrets have a long-used roost in the bushes on the right bank of the Nickerie River just opposite Nieuw Nickerie.

The Blue and Yellow Macaw (*Ara ararauna*) is in Surinam a bird of the lowland forests. Here it breeds in dead Moriche palms (*Mauritia flexuosa*). Kappler (1881. "Holländisch Guiana," Stuttgart, p. 94) reports the finding of a nest with two eggs (no date given) in such a situation, along the Wana Creek in the Maroni District. A favorite food is the seeds of the possentri or poison tree (*Hura crepitans*). On December 17 and 18, 1948, in the Coronie District, I watched a number of birds feeding in these trees and the stomach of a specimen collected at that time was full of the seeds.

Through the clearance of forests it has now entirely disappeared from the neighborhood of Paramaribo, but it is still rather common wherever primitive conditions remain. I have seen it regularly when travelling by launch along the upper Nickerie and Wayombo rivers and it is always a magnificent sight when some birds, always flying in pairs, cross the forest-fringed rivers, from time to time uttering their harsh note, *rrrraaa*.

The most impressive spectacle, however, I witnessed on August 23, 1947, when travelling by launch downstream on the Coppename River. In the late afternoon, beginning at about one hour before sunset, numbers of *Ara ararauna* started crossing the river towards its left bank at the point where the Tibiti River enters the Coppename.

As so often happens in such cases I realised the opportunity to count the passing birds only after the spectacle was already well under way. The birds were, as usual, in pairs, each pair flying with slow, synchronised wing strokes, the birds close to each other. Sometimes only single pairs went over, followed again by loose flocks split up in pairs.

The total counted was 342 birds. This number was certainly not all which crossed, as I started counting when the flight had been in progress for some time and, further, I counted from a rather fast-moving boat. In reality at least twice this number must have crossed the river at that time, en route to a sleeping place in the midst of the forest.—F. Haverschmidt, *P.O. Box 644, Paramaribo, Surinam, August 26, 1953.*

Repeated territorial attacks of Pied-billed Grebe on Ring-necked Duck.— In the course of early morning observations on Pied-billed Grebes (*Podilymbus podiceps*) which began on February 27, 1954, one grebe, believed to be a male, established a territory in a marshy pond in Seneca, Maryland. By April 3, this bird had a mate, and courtship activities, similar in general to those described for the previous year (Kilham, 1954. *Wilson Bull.*, 66:65). were observed. On March 27, Coots (*Fulica americana*) were diving in open water at the center of the grebe's territory. A single female Ring-necked Duck (*Aythya collaris*) alit among the Coots and immediately began to dive. Suddenly the duck flew ten feet over the surface as the grebe emerged at the spot where she had been. The grebe then dashed at the duck which flew to the other end of the pond. Thereupon the grebe called *ka, ka, cow, cow*, etc., the sides of its neck swelling and collapsing as it did so. On March 28. the female ring-neck was again diving with the Coots while the grebe was thirty feet away. Suddenly the duck flew over the surface a short distance, then swam rapidly away, the grebe having come up where she had first been startled. Five minutes later the ring-neck had returned and was again attacked from below and pursued a short distance. A longer lull of twenty minutes followed in which the Pied-billed Grebe was lost from view in marsh vegetation and the ring-neck swam back to continue diving. As I watched (7 × 50 Zeiss binoculars), the duck suddenly started swimming, half submerging as she did so. I could not see the grebe. After swimming twenty feet the duck took flight as the grebe emerged where the former had taken wing. Ring-necked ducks were not found on subsequent visits to the pond. In the four episodes witnessed, the grebe had attacked under water from some distance away and with surprising swiftness. On April 3 a similar attack was launched against an immature Pied-billed Grebe which had no clear bill markings. I saw the male grebe sink under water and, as traced by over-lying ripple marks, head for this stranger. Meanwhile the immature bird, as if alerted, had begun to swim away at right angles. The male surfaced where the other grebe had been, then made a dash which caused the immature bird to take flight. Few other grebes were seen on the pond during the weeks it was under observation.

To test the male grebe's reactions I threw a small duck decoy, painted roughly like a female Ring-necked Duck, into his territory. Ten minutes later he swam up to within twelve feet of this lure and gave a loud *ka, ka, cow, cow*, etc. Then with head and neck stretched straight up like a periscope to see above the weeds, he approached to within six feet, looked the decoy over well, and departed. This curiosity was evoked in varying degree on subsequent occasions by a stoppered bottle thrown into the open water, a muskrat cleaning its fur on a tussock, and by any sudden commotion among the Coots or Blue-winged Teal (*Anas discors*). The grebe never showed hostility toward teal, Coots, or Wood Ducks (*Aix sponsa*) which were usually present and often passed the grebe at close range.

On April 17, a female Hooded Merganser (*Lophodytes cucullatus*) flew over and alit in open water where all previous attacks had been witnessed. I kept my binoculars on the merganser after it alit. Within seconds the duck shot eight inches straight upward with *quack, quack* of alarm as the grebe surfaced right below. To all appearances the grebe had rammed the merganser in the belly. The merganser alit 15 feet farther on and the grebe swam for it with neck arched and head low, causing the merganser to fly twenty feet still farther on. Although the duck continued to swim and dive in the grebe's territory, the latter paid no further attention to it. On this, as on other occasions, the female grebe, although nearby, was never observed to attack.

Discussion: In the above observations the so-called male was distinguished from the female grebe by a lighter back (presumably an individual variation), by being the one to establish the territory, by delivering all attacks observed, by making the only loud, prolonged calls, and, on two occasions, by performing the "courtship dance" of standing on water with rapidly treading feet, a performance which immediately preceded coition in my study previously referred to. Attacks delivered under water in an attempt to ram an adversary from below are of interest as they have been described for other species of grebes. Of special interest, however, were the repeated attacks on the female Ring-necked Duck, in explanation for which the following hypothesis is offered: When seen together it was apparent that the female ring-neck bore rough resemblances to a Pied-billed Grebe, both in color pattern and behavior. It is a small duck with a ring on its bill and a white eye ring. It is dark brown above and lighter buff below. In behavior, it dove frequently and repeatedly lifted its body at a forty-five degree angle to the surface to shake and readjust its plumage, thus exposing its white belly. The grebe, when diving, has a similar performance, but has a peculiar way of snapping back to its original position. The female Ring-necked Duck may have had sufficient "releasers" to elicit attacks which the male grebe would normally have launched only against rivals of its own species. The ring on the bill may not have been the principal "releaser" as an immature grebe and a female Hooded Merganser were also attacked. The merganser, with its distinctive reddish crest, was only attacked momentarily, possibly on account of its small size and drab color. Once the grebe had a closer look, however, no further attacks were made. In summary, the male Pied-billed Grebe was perpetually alert to activities of other birds and animals in its territory, attacking what it considered rivals, but showing well-marked curiosity toward new situations.—LAWRENCE KILHAM, *8302 Garfield Street, Bethesda, Maryland, April 25, 1954.*

Miscellaneous notes on Mexican birds.—During the past several years the California Academy of Sciences has secured several thousand study skins of birds from various parts of Mexico. Most of these were either purchased from the late Wilmot W. Brown or obtained by the senior author. Smaller accessions were received through the courtesy of Drs. Ernest P. Edwards and G. Dallas Hanna. Included in these collections are certain new state records and extensions of the ranges of a few species. In the course of studying some of this material it was necessary to examine pertinent specimens in the University of California Museum of Vertebrate Zoology and the University of Kansas Museum of Natural History. The writers are indebted to the officials of these institutions for permission to examine collections under their care and to make mention of certain specimens found therein.

Podilymbus podiceps antillarum. Pied-billed Grebe. A male taken by Webster on a pond 12 miles northeast of Durango City, Durango, June 26, 1952, was paired and apparently breeding. Its testes were enlarged. The wing length (120 mm.) is equal to the minimum listed for males of this race by Hellmayr and Conover (1948. *Field Mus. Nat. Hist., Zool. Ser.,* 13, pt. 1, no. 2:37). This species has heretofore neither been reported from Durango nor have members of this race been recorded this far north.

Falco columbarius richardsonii. Pigeon Hawk. An adult female, taken January 28, 1952, near Chilpancingo, Guerrero, and prepared by W. W. Brown, appears to be of this race. It is decidedly paler above and below than any comparable examples of either *F. c. columbarius* or *F. c. bendirei* examined. This not only constitutes a considerable southward extension of the wintering range of the race *richardsonii* but also the first record for this species from Guerrero.

Catoptrophorus semipalmatus inornatus. Willet. An adult female secured at the north end of Socorro Island on November 20, 1953, by G. Dallas Hanna, is the first record of this species from the Revillagigedo Islands.

Crocethia alba. Sanderling. A single female was seen and collected by G. Dallas Hanna at the north end of Socorro Island, Revillagigedo Islands, on November 20, 1953.

This species is not recorded from these islands by Friedmann, Griscom, and Moore (1950. *Pac. Coast Avifauna*, 29:99).

Coccyzus americanus. Yellow-billed Cuckoo. Two adult males were secured by W. W. Brown near Chilpancingo, Guerrero, one on October 1, 1950 and the other on September 1, 1952. The wing measurements (145 and 146 mm.) of these two specimens are such as to leave doubt regarding subspecific identity. Friedmann, Griscom, and Moore (*op. cit.*:132), however, do not record this species from Guerrero.

Otus scops flammeolus. Scops Owl. This species has not, heretofore, been recorded from Guerrero. A female, secured December 25, 1950, near Omilteme by W. W. Brown exhibits none of the characters assigned by Griscom (1935. *Ibis*:549) to the race *guatemalae* (=*rarus*). It is actually grayer and exhibits paler ochraceous markings than 9 specimens of *flammeolus* examined from southern Arizona.

Asio flammeus flammeus. Short-eared Owl. On February 11, 1950, W. W. Brown secured a female Short-eared Owl near Omilteme, Guerrero, which, so far as known, is the first record for that state.

Sayornis nigricans nigricans. Black Phoebe. One was seen by Webster at Arroyo Mimbres, Durango, on June 18, 1950; and on June 21, 1952 two adults and an immature were seen at a small tank near Nombre de Dios in the same state. The immature, which was collected, has the blacker crown and black shaft streaks on the under tail coverts characteristic of the more southern race, *S. n. nigricans*, rather than *S. n. semiatra*. Although Miller (1906. *Bull. Amer. Mus. Nat. Hist.*, 22:168) recorded this species from Durango under the name *S. n. nigricans* the present concept of this race is considerably different (cf. A. O. U. Check-List Supplement 20, *Auk*, 1945, 62:443) and its northern limits are not clearly known.

Contopus virens placens. Wood Pewee. An immature male was taken July 25, 1950, at 5,000 ft., 10 miles east of Mezquital, Durango, by Webster. This race has not previously been recorded from the state.

Auriparus flaviceps ornatus. Verdin. The southernmost published records for the Verdin are from Saltillo, Coahuila, by Burleigh and Lowery (1942. *Occas. Papers Mus. Zool. Louisiana State Univ.*, 12:197) and near Fresnillo, Zacatecas, by Webster and Orr (1954. *Condor*, 56:157). There are two specimens in the University of Kansas collection from Jalisco (2 miles west-northwest of Lagos de Moreno, 6,390 ft., August 12, 1949) and one specimen in the same collection from San Luis Potosi (10 miles northeast of San Luis Potosi City, 6,000 ft., July 29, 1950). We believe that the range of the species in Mexico will eventually prove to be coextensive with the ranges of the "Desert" and the "Mesquite Scrub" as mapped by Leopold (1950. *Ecology*, 31:507–518).

Sitta carolinensis umbrosa. White-breasted Nuthatch. The species has been reported from Sinaloa by Hawbecker (1948. *Condor*, 50:28), who did not, however, give a racial identification. We consider this specimen (California Academy of Sciences collection), a male from Pinos Gordo, taken September 30, 1934, to be *S. c. umbrosa*.

Certhia familiaris albescens. Brown Creeper. The species has not previously been recorded from Sinaloa. We have examined six specimens from that state: a female from El Batel, October 15, 1946, and a male from El Batel, October 14, 1946 (both in the Museum of Vertebrate Zoology): a male from Pinos Gordo, September 22, 1934, and three females from the same locality taken September 24 and 27, 1934 (California Academy of Sciences collection).

Anthus spinoletta pacificus. Water Pipit. A female secured on the north end of Socorro Island, Revillagigedo Islands, on November 20, 1953, by G. Dallas Hanna, resembles wintering specimens of *A. s. pacificus* from central California.

Vireo huttoni carolinae. Hutton Vireo. The breeding form of Durango has in the past been referred to *V. h. stephensi*, most recently by Hellmayr (1935. *Field Mus. Nat. Hist., Zool. Ser.*, 13, pt. 8:120). Two specimens taken by Webster in 1952, 15 miles west-southwest of El Salto (a female with an egg in her oviduct, June 23, and a male, June 24), as well as two specimens in the Museum of Vertebrate Zoology (a male from 4 miles southwest of El Salto, June 26, 1952, and a male from Resolana, near the Chihuahua border, June 23, 1952) we refer to the darker, less green, race of north-central Mexico.

Dendroica auduboni nigrifrons. Audubon Warbler. The most southerly breeding area reported in the literature is extreme southern Chihuahua by Moore (1946. *Auk*, 63:241–242). Actually, the species seems to breed commonly in southern Durango, and probably even farther south. Singing males were taken by Webster at Hacienda Coyotes, 8,200 ft., 7 miles northeast of El Salto, Durango, June 27, 1950, and June 24, 1952. The former specimen had testes 4 mm. long; the latter was in full breeding condition, with testes 10 and 9 mm. long and cloaca (seminal vesicles) enlarged with sperm.

Dendroica graciae graciae. Grace Warbler. On June 25, 1952, Webster observed an adult female feeding two immatures in the pines above Arroyo Mimbres, Durango, 8,000 ft. All three birds were collected. We have previously (Webster and Orr, 1952. *Condor*, 54:311) reported a sight record from the same area, but this is the first specimen to be recorded from the state.

Sporophila minuta parva. Ruddy-breasted Seedeater. An adult male was secured by Ernest P. Edwards, July 24, 1952, at Pie de la Cuesta, near Acapulco, Guerrero. The testes measured 5 and 6 mm., respectively. Edwards saw several other individuals that day, and Webster saw a single male at the same place on July 26. This species has previously been recorded in Mexico only from the states of Nayarit, Oaxaca, and Chiapas.

Loxia curvirostra stricklandi. Red Crossbill. Two red males in nonbreeding condition were taken by Webster on June 23 and 24, 1952, 15 miles west-southwest of El Salto, Durango, from several small flocks seen. There is no previous record from the state.

Aimophila ruficeps simulans. Rufous-crowned Sparrow. Since the description of this race by van Rossem (1934. *Bull. Mus. Comp. Zool.*, 77:486-487), determination of specimens from Sinaloa and southern Durango has not been reported. There are two males in the Museum of Vertebrate Zoology taken October 14 and 16, 1946, at El Batel, Sinaloa. Webster took a breeding pair on June 22, 1952, six miles west of Durango City, Durango, at 7,200 ft., in mesquite grassland; his only Durango sight records were from the same area.

Aimophila cassinii. Cassin Sparrow. On July 10, 1952, an adult male in full breeding condition (testes 7 and 6 mm. long, cloaca enlarged and full of sperm) was taken by Webster in San Luis Potosi. The bird sang a typical flight song and exhibited territorial behavior. The locality was 24 miles northeast of San Luis Potosi City, at 5,900 ft., in mesquite grassland with a good growth of new grass. We find no previous records in the literature of the Cassin Sparrow from this state.—J. Dan Webster and Robert T. Orr; *Hanover College, Hanover, Indiana; California Academy of Sciences, San Francisco, and University of San Francisco, California, March 5, 1954.*

English Sparrow seeks refuge in ground burrow.— Several large outside cages are maintained in connection with the Ornithological Laboratory at Ohio State University. Some of these cages are 16 × 10 × 8 feet in size and are covered with one inch mesh poultry netting. They are used to confine such birds as ducks and pheasants. The doors on some of the cages are slightly sprung out at the bottom, and English Sparrows (*Passer domesticus*) enter and leave through the holes thus formed. A Norway rat also entered one of the cages and dug a burrow into the ground beside the rat-proofing wire which is buried around the edge of the cage.

It was sometimes possible to enter the cages and to capture the English Sparrows with an insect net before they escaped through their entrance hole or through the mesh of the chicken wire. Normally, I entered the cages and concentrated my efforts on a chosen bird until it was captured; then effort was shifted to a second bird if one were present.

On February 18, 1954, a cage contained two English Sparrows, and I readily captured one of these birds in a net. The second was pursued from one end of the cage to the other several times before it plunged to the ground and disappeared into the rat burrow at the corner of the cage. I waited several minutes about 10 feet from the burrow for the bird to reappear, but it remained hidden. I withdrew, therefore, to a distance of some 20 feet from the burrow and waited. After about five minutes, the bird came out of the burrow. It paused a few inches from the entrance and remained there several minutes while I watched. I then disappeared from the bird's view and watched from concealment. After several minutes, the English Sparrow moved farther from the burrow and flew about the cage. I then rushed into the cage with the net only to see the bird immediately return into the burrow. This procedure was repeated two more times without my being able to capture the English Sparrow. It was only by waiting a half hour and then rushing into the cage that I was able to outwit this bird.

A second English Sparrow showed closely similar behavior. This bird escaped into the room from the small cage in which it was confined inside of the bird laboratory. When it was pursued, it soon disappeared somewhere among the equipment stored in an adjacent room. Food and water were available in the room, and this bird remained free therein through the following several weeks. Repeated unsuccessful efforts to capture it were made. Whenever I entered the laboratory, it flew directly into the small adjacent room and hid among equipment which could not conveniently be moved. After about a month it was permitted to escape through an open door.—PAUL A. STEWART, *Ohio Cooperative Wildlife Research Unit, Department of Zoology and Entomology, Ohio State University, Columbus, June 21, 1954.*

Barn Owl hunting by daylight.—At 3:00 p.m. on January 23, 1954, Francis Cormier of Hartsdale, New York, Terry Hall of Scarsdale, New York, and I observed a Barn Owl (*Tyto alba*) hunting over Tobay Beach Bird Sanctuary near Jones Beach, Long Island, New York. We watched the bird for about 15 minutes, during which time the sun was bright although the sky was slightly hazy.

The owl had a distinctive hunting pattern, which we saw it repeat four times: After flying at an altitude of 15 or 20 feet for about 50 yards over bayberry (*Myrica cerifera*) and scattered Japanese black pine (*Pinus thunbergi*) habitat, it would climb to 30 feet and hover for about half a minute. Slowly losing altitude, it would suddenly plunge to the ground. Consistently catching nothing, it would fly into a two or three acre Japanese black pine grove or perch on an 8 foot high sign post at the edge of the grove.

While hovering, the owl's long legs hung directly downward, its head was directed downward at an angle of about 35 degrees from its horizontal body, and its wingbeat was approximately one-third as rapid as that of a hovering Sparrow Hawk (*Falco sparverius*). While the owl was hunting, a light-phase American Rough-legged Hawk (*Buteo lagopus*) passed within 50 feet of it. Neither bird, however, outwardly reacted to the other.

The owl's intended prey was probably the meadow vole (*Microtus pennsylvanicus*), which occurs abundantly in the area. On February 28, 1954, 200 yards from where we had observed the owl hunting, Terry Hall and I found three Barn Owl pellets containing four skulls of meadow voles.—KEN HARTE, *45 Lawrence Road, Scarsdale, New York, April 2, 1954.*

Swimming by wild Turkey poults.—In mid-afternoon, May 14, 1954, Martin, a game management agent of the U.S. Fish and Wildlife Service, and J. H. Parsons, district supervisor of State conservation officers, were on routine patrol in Jefferson County, Alabama. They were in a light, outboard boat in the Little Shoal Creek embayment of Bankhead Lake, an impoundment of the Black Warrior River.

At this point the arm of water is at least 100 yards wide, but without current. The two officers observed a Turkey (*Meleagris gallapavo*) poult at least 30 yards from the south bank and swimming north; another was seen only a few yards from the north bank where a mature wild Turkey hen accompanied by at least two other poults was calling frantically. The poults were traveling toward the mother bird, swimming strongly and floating fairly high in the water. Maneuvering the boat alongside the first poult, the officers picked it up, examined it, carried it to near the north bank and released it. The female turkey remained in the vicinity until joined by the two poults that had been in the water.

The poult picked up was covered with down except for the wing tips, which were beginning to develop feathers. Its age was estimated to be 10 days. A probable explanation of what occurred is that the hen had flown across the embayment and then called her poults, which followed by swimming. The poults were so young that the possibility that they had attempted flight across the water and fallen in is ruled out. Both officers are thoroughly familiar with wild Turkeys. One poult was examined in the hand and the hen and remaining poults were observed at close range, leaving no doubt as to the accuracy of the observation.—Leo M. Martin and Thomas Z. Atkeson, *Box 1643, Decatur, Alabama, June 1, 1954.*

Grackle kills English Sparrow.—I saw a Bronzed Grackle (*Quiscalus quiscula*) kill an adult female English Sparrow (*Passer domesticus*) about noon on June 2, 1954.

I heard sounds of conflict in my yard and saw four birds flying rapidly about in a small area: two Robins (*Turdus migratorius*), an English Sparrow, and a Bronzed Grackle. My eye followed the Robins as they veered off in separate directions, and then I became conscious of a struggle on the ground near the wall of the house next door. Here the grackle was holding the sparrow with its foot and driving its beak forcefully and rapidly against the sparrow's head. When I stepped forward, the grackle flew up into a nearby tree, where a pair of Robins had a nest. The grackle was attacked again by the Robins but persisted in the vicinity for several minutes. I was not able to determine if the nest had been molested.

The sparrow crouched on the ground breathing heavily. Both eyes were closed and fluid exuded from one of them. Fifteen minutes later its condition was unchanged. But when I returned six hours later, the sparrow was dead. It had not been moved nor damaged further. Dissection revealed that all of its wounds were on the head. Its forehead was severely crushed with fractures running down into both eye sockets and there was a puncture 3 mm. in diameter in the center of the occipital region. The eyeballs were intact.

As I was examining the dead sparrow, my daughter directed my attention to a headless bird fifty feet away, under the tree where I had first noticed the conflict earlier in the day. It proved to be an immature English sparrow, short-tailed but probably old enough to fly. It had been found early in the afternoon by children and appeared to have been killed the same day. It was badly lacerated in the shoulder area as though partly eaten, but was otherwise unmarked. I am not sure what killed and mutilated it but suspect that the grackle may have been engaged in this activity when attacked by the adult sparrow.—Harold Mayfield, *2557 Portsmouth Avenue, Toledo 13, Ohio, July 23, 1954.*

Great Horned Owl attacking squirrel nests.—The Great Horned Owl, *Bubo virginianus*, occasionally preys on the fox squirrel, *Sciurus niger* (see Errington, Hamerstrom, and Hamerstrom, 1940, *Research Bull. 277, Agr. Exp. Sta., Iowa State Coll.*, p. 791). However, the manner in which the owl catches this prey has not been recorded. Several observations have been made in Douglas County, Kansas, of the Great Horned Owl apparently seeking out squirrels in the daylight hours in an unusual manner.

At 10:30 a.m., on 19 November 1953, at the University of Kansas Natural History Reservation, while in the vicinity of Hole Woods (see Fitch, 1952. *Univ. Kansas Mus. Nat. Hist., Misc. Publ.* No. 4:10), I observed a Great Horned Owl slowly circling above the trees. Suddenly this bird glided swiftly downward at approximately a forty-five degree angle toward a yellow oak, *Quercus muehlenbergii*. When the owl was within about ten feet of the upper branches, it extended its feet and legs and then struck a squirrel leaf-nest in the periphery of the tree. A fox squirrel emerged, climbed down the supporting branch to the trunk of the tree and crouched there, facing the nest. The owl twice slowly circled the tree and alighted on the branch which bore the leaf-nest, facing the squirrel approximately eight feet away. When the owl lit on the limb, the squirrel began clicking its incisor teeth and continued this noise for about two minutes until the owl flew away south over Skink Field (Fitch, *loc. cit.*). Thereupon, the squirrel descended to the ground and ran west, disappearing in understory vegetation. Immediately following the disappearance of the squirrel, I inspected the nest and thought it intact enough for further use by squirrels. Repeated observations and checks of the nest until March, 1954, however, revealed that it has deteriorated; it seemed not to have been used by squirrels after 19 November.

At 4:30 p.m., on 5 March 1954, three miles west and two miles south of Lawrence, Douglas County, Kansas, north of the Wakarusa River, I noticed a Great Horned Owl flying just above an American elm, *Ulmus americana*. The owl attacked a leaf-nest approximately forty feet above the ground in this tree, but no squirrel was flushed. The owl flew into woods to the west. Examination through binoculars showed the nest to be mutilated externally.

Cloud cover seemed not to govern the described behavior of the owls, for the sky was overcast on November 19 and cloudless on March 5.

Mr. Terry A. Vaughan, a fellow graduate student, told me that at 3:00 p.m. on 7 February 1954, two miles west of Lawrence, Douglas County, Kansas, he saw a Great Horned Owl carrying a dead fox squirrel. The owl flew out of a tree which seemingly was being used for a roost. Mr. Vaughan and I examined this area on 21 February 1954, and located five pellets, none of which contained any squirrel remains. In the immediate area, however, there were several leaf-nests damaged in a fashion similar to those described above.

In review: the Great Horned Owl catches fox squirrels in daylight, regardless of cloud cover, by searching out and striking leaf nests.—ROBERT L. PACKARD, *State Biological Survey, University of Kansas, Lawrence, Kansas, April 1, 1954.*

Pied-billed Grebe taking flight from land.—On April 26, 1954, a live, healthy Pied-billed Grebe (*Podilymbus podiceps*) was brought to my home in Mount Pleasant, Michigan. It had been found stranded on a wet highway which it presumably had mistaken for water. When placed on the lawn in my back yard, it sat quietly for several minutes while three people stood by it. Little or no wind was blowing. Suddenly the bird arose and beating its wings rapidly ran with pattering feet through the two-inch-high grass and white clover (*Trifolium repens*) for about 20 feet and took flight. Gradually gaining altitude, it flew between two houses, turned down the street, and at an altitude of about 40 feet disappeared among some trees approximately 500 feet from the starting point. Bent (1919. *U.S. Natl. Mus. Bull.*, 107:44) states that the Pied-billed Grebe " . . . seems to be incapable of rising from the ground [to fly]." In the exceptional case I observed, the short grass and clover, like water, gave proper resistance to the rapidly moving feet for impetus to aid the wings in successfully taking flight.—NICHOLAS L. CUTHBERT, *Biology Department, Central Michigan College of Education, Mount Pleasant, Michigan, June 30, 1954.*

Hudsonian Curlew and Knot in Colorado.—During the spring migration of 1953 I made almost daily observation trips around Union Reservoir, a natural lake covering approximately 600 acres in Weld County, Colorado, three miles east of Longmont. On May 15 I saw six small curlews feeding along the south shore of the lake. Careful scrutiny revealed the characteristic markings of the Hudsonian Curlew (*Numenius phaeopus*), a species that, during more than twenty years of bird study, I had never before seen in either Colorado or Nebraska. One bird, a female, was collected and is in the skin collection of the Denver Museum of Natural History (No. 26738). Dr. A. M. Bailey, Director of the museum, confirmed my opinion as to the rarity of the species in Colorado, there being only one or two other records in the literature I have examined.

On May 18, 1953, a Knot (*Calidris canutus*) was collected at almost the same spot on the shore of Union Reservoir. Upon receipt of the specimen, a male, Dr. Bailey wrote, "So far as I can find, this is the first record of the Knot for Colorado." There is no record for Nebraska, but the species has been reported in Kansas. The skin (No. 26737) is now in the Denver Museum.—MRS. CARL N. COLLISTER, *Hover Road, Longmont, Colorado, April 14, 1954.*

Fish Crows "de-lousing" cattle.—Bent (1946. *U.S. Natl. Mus. Bull.* 191:279) in his account of the Fish Crow (*Corvus ossifragus*), citing N. B. Moore's notes, made many years ago, says that "these crows alight on the backs of cattle, to pick up the ticks that are burrowing into the skin and sucking the life blood from, as well as annoying, these animals; this may be an ancient habit, as it does not seem to have been recently observed."

Payne's Prairie, a 13,000 acre wet prairie south of Gainesville, Alachua County, Florida, supports many large herds of cattle. Fish Crows are common in this area. On the morning of 21 March 1954 we observed a Fish Crow perched on a cow's back; it was repeatedly pecking about the cow's pelvic region, near the base of the tail. Another crow, which was on the ground behind the cow, flew to the cow's back. After threats from both birds, the first bird left, and the second bird began pecking at the cow. It soon flew off, whereupon the first bird returned and continued pecking. The cow ignored the birds, except for once nuzzling its back, causing one of the crows to flutter up momentarily.

The crows were obviously picking ectoparasites from the cow; whether they were ticks, lice, or bots, we cannot say, since it was impracticable to examine the cow. A number of other species of birds, including the closely related Rook (*Corvus frugilegus*), have been observed "de-lousing" hoofed mammals (Rothschild and Clay, 1952. "Fleas, Flukes and Cuckoos").—DALE W. RICE AND EDWARD L. MOCKFORD, *Department of Biology, University of Florida, Gainesville, Florida, March 25, 1954.*

EDITORIAL

No editor's job is an unrelieved bed of roses and few authors feel that it should be. Nevertheless, there are some very real compensations for the occasional periods of quiet frenzy. One such compensation is the bliss with which I use the antithetical "quiet frenzy" without fear of an alien red pencil. A more important compensation is the intense satisfaction one gets from the generous cooperation of others. So there may be no doubt that this help is appreciated. I take the occasion of my last issue as editor of *The Wilson Bulletin* to acknowledge gratefully the willing assistance over the past three years of my associate editors and many members of the Wilson Ornithological Club. We turn the editorship over to Dr. Keith L. Dixon with best wishes and the earnest hope that members of the Wilson Club will give him the fine cooperation I have received.—H.B.T.

1955 ANNUAL MEETING

Official announcement of the meeting, which will be held at Stillwater, Oklahoma, over Easter weekend, April 7-10, and call for papers will be mailed to the membership early in the year. A brief outline of the plans of Dr. Fred Baumgartner's Local Committee on Arrangements, however, is given here to encourage early planning to attend. Stillwater is located in the interesting zone where eastern forest and western plains birds meet and where there is also considerable overlap of species found characteristically in the midwestern and southeastern sections of the country. The Oklahoma Ornithological Society will be hosts at an informal gathering at the Student Union on Friday evening, and the Annual Dinner will be held Saturday evening. Early morning field trips may be arranged to Lake Carl Blackwell, 10 miles west of Stillwater, and to the Prairie Chicken dancing grounds on the Osage ranches. The Sunday field trip to the Salt Plains National Wildlife Refuge will feature a typical western style barbecue lunch. A meeting in Oklahoma should be a memorable experience for our northern and eastern members and provides an opportunity for our western members to join actively in a Wilson Club annual meeting.

LOUIS AGASSIZ FUERTES RESEARCH GRANT

Application blanks for this annual award of $100 can be obtained from the Chairman of the Research Grant Committee, Dr. Kenneth C. Parkes, Carnegie Museum, Pittsburgh 13, Pennsylvania. Completed applications should be returned to Dr. Parkes by March 1, 1955. We urge all interested persons to apply for this grant, the purpose of which is to promote worthwhile ornithological research.

We present here a second annual supplement to the complete list of books in the Club Library published in 1952 (*Wilson Bulletin*, 64, No. 3:176–185). Members who lack the *Bulletins* in which the main list and the first supplement (1953) appeared may procure reprints of both by writing to the Wilson Ornithological Club Library, Museum of Zoology, Ann Arbor, Michigan. Other facts about the Library and the procedure for borrowing books may be found on the inner front cover of this *Bulletin.*

A number of important new books have been purchased from funds contributed by interested members. Other funds for this purpose were received from the sale of duplicate books and pamphlets at the Cape May meeting in June.

Gifts of books have again come from many members and friends, as recorded in the quarterly notices published in the *Bulletin.* Special mention should be made of the very generous gifts from Karl W. Haller, Rosario Mazzeo, Margaret Morse Nice, A. A. Saunders, and Harriet B. Woolfenden. Wendell Taber established an admirable precedent when he gave a number of volumes in memory of his old friend, Dr. Winsor M. Tyler, distinguished ornithologist and a member of the Club for forty years.

BOOKS: List B–2

Books added to the Wilson Ornithological Club Library since the publication of List B–1 (*Wilson Bulletin*, 65, No. 3, September 1953:223–224).

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Robertson, A. W. P., Birds: Wild and Free. 1950.
Rogers, Cyril H., Care and Breeding of Budgies (Shell Parrakeets). 1953.
Saunders, Howard, An Illustrated Manual of British Birds. (2nd ed.) 1899.
Skutch, Alexander F., Life Histories of Central American Birds. 1954.
Smith, Stuart, The Yellow Wagtail. 1950.
Taverner, P. A., Les Oiseaux de l'Est du Canada. 1922.
Tinbergen, N., Social Behaviour in Animals, with Special Reference to Vertebrates. 1953.
Tinbergen, N., The Study of Instinct. 1951.
Townsend, Charles Wendell, Supplement to The Birds of Essex County, Massachusetts. 1920.
Uchida, S., [Students' Colored Handbook of Animals.] 1954.
Yarrell, William, A History of British Birds. (2nd ed., 3 vols.) 1845.

THE CONTINUING NEED FOR FOOD HABITS RESEARCH

A contribution from the Wilson Ornithological Club Conservation Committee

Twenty years ago the writer called attention to certain limitations of stomach analysis in determining the economic status of birds (1934. *Wilson Bull.*, 46:73–90). The deficiencies mentioned pertained to (1) the difficulty in placing economic interpretations on some of the important food items disclosed, and (2) the impossibility of mathematically converting abstract food percentages into terms of human economics.

In the same article pains were taken to emphasize the everlasting importance of stomach analysis as a technique in disclosing information sorely needed in solving other problems in wildlife management. "Aside from the legitimate demands of pure research in food habits to which stomach examination has and will continue to contribute bountifully, certain of the practical problems of economic ornithology lend themselves to direct solution solely or largely through this method of approach, . . . those in which the identification of food items constitute the major objective. . . . Whenever we are seeking the *identity* of food items, irrespective of the economic significance of the bird's having fed on them, or whenever we aim to determine merely the presence or absence of particular items of diet, analysis of stomach contents is the only direct and reliable method of approach."

To illustrate my point I cited the case of the night herons, erroneously accused of being a hazard to the "frogging" industry of Louisiana. In the stomachs of more than a hundred, collected in the critical area, not one frog was discovered. Reference also was made to alleged damage to timber by birds when, as a matter of fact, actual injury was inflicted by insects more or less concealed, which served as a lure and in that manner incriminated the more conspicuous birds. Numerous other cases might have been cited at that time, and, since that article was written, even more convincing testimony could be invoked to demonstrate the importance of stomach analysis in solving certain aspects of modern wildlife- and farm-management problems.

How little this was appreciated even by those whose information should be reasonably accurate and how tragic ignorance may be under those circumstances, was revealed by what took place in the legislative halls of our National Capitol about a decade ago. At that time an appropriation for the continuation of food habits studies of birds and mammals by the Fish and Wildlife Service was being discussed. A trite comment that "every small boy knows what a robin eats; it eats angleworms" was advanced as a reason for the termination of formal studies of the food of birds and mammals by the Fish and Wildlife Service. The project that had served as the basis of much of what we know in this field was thus ended.

Whereas it is true that, both at the Patuxent Wildlife Research Refuge in Maryland and at the Wildlife Research Laboratory at the Denver (Colorado) Federal Center, limited stomach analyses are still being conducted with finances and under authority provided from other sources, the activities are restricted largely to the solving of local or limited problems. The work often is carried out with finances and personnel coming from the Cooperative Wildlife Research Units or from Pittman-Robertson sources. At best it is an intermittent program with an uncertain future.

These facts are not generally known by those who long have looked to the Fish and Wildlife Service and its predecessor, the Biological Survey, as a source of factual information on the food and economics of wildlife. The lessened output of substantial contributions of such nature during recent years has been attributed by uninformed individuals to a variety of causes—to a change of interests by administrative personnel, to a feeling that there is nothing more of value to be done or learned, to a departure of those who, through the years, have contributed to the subject, or to some other surmise. Actually, the activity was terminated by a legislative and budgetary restriction from which there is no appeal or possibility of change except through those same channels. That there is an impelling need for well-equipped and competently staffed laboratories for wildlife food analyses is admitted by all who have attempted to do the same thing with inadequate means.

In the meantime reference collections and laboratory facilities and files, though maintained to the limits possible, have not been used to their fullest capacity and technical personnel, experienced in the field of stomach examination, has devoted its time largely to other matters. With such lapses associated values tend to deteriorate if not disappear from the scene. Without continued use, reference collections and their related files have suffered for lack of sympathetic attention; new and much needed additions have not been made; personnel involved has been handicapped through lack of "practice"; and, most important in a long-time appraisal of the situation, newcomers have not been trained to take the places of those, who for one reason or another, will step out of the picture.

Whereas the objectives of modern wildlife research are different from those of a generation ago, stomach examination as a means of investigation has lost none of its significance. It has even become of greater import through new applications. What wild creatures do or do not eat has a definite bearing on problems of nutrition and the contraction of disease. There is a growing conviction that the periodic mortality of Canada Geese at Pea Island, North Carolina may have its origin in a food habits or nutritional factor leading to excessive parasitism and ultimate emaciation and death of the birds.

Entomologists are still vitally concerned regarding the role of vertebrate enemies in the control of insect pests. Requests have been made in Colorado for an appraisal of woodpeckers in relation to the spruce bark beetles, and elsewhere with regard to the destructive spruce bud worm and the white pine weevil. In each case stomach examination of potential enemies would reveal from what source greatest aid might be expected. The extent to which birds avail themselves of proffered foods set out for their express use is readily disclosed by the examined stomach. Consequently there is a continuing need of food habit studies to determine the usefulness of specific management practices on refuges, public shooting grounds and on other areas.

The knowledge of the experienced food analyst also has application in other directions. He may aid law enforcement in the identification of evidence, be it feathers, fur, bone, or even flesh or fats. Such testimony is seldom challenged and never effectively refuted. Knowledge now being used to assure correctness of labels in the fur industry had some of its beginnings in the laboratory where the stomachs of coyotes and bobcats and the regurgitated food pellets of birds of prey were being examined.

That the end products of wildlife food analysis may go far beyond the province of the wildlife technician is brought out by the Martin, Zim, Nelson volume on "American Wildlife and Plants" (McGraw-Hill Book Company, Inc., New York, 1951). Therein the condensed information gleaned from the thousands of stomachs of birds and mammals, fish, reptiles and amphibians examined during a period of over 60 years, is made available for foresters, landscape-gardeners, and botanists. Even the morphology of seeds and the phylogeny of the plants which bear them have been given a significant stimulus through studies based on the food habits collections at the Patuxent Laboratory of the Fish and Wildlife Service (Martin, A. C., 1946. *American Midl. Naturalist*, 36:513–660).

From the very nature of the case food habits research laboratories have to be adequate. Their reference collections must be well supplied with bird and mammal skins and skeletons, alcoholic specimens of reptiles, amphibians, fishes, crustacea, and various fleshy invertebrates, pinned specimens of insects, microscopic slides of hair and fur samples, an herbarium of wildlife food plants, a comprehensive collection of seeds and other fruits of plants likely to be eaten and, above all else an adequate reference library to aid in the identification of specimens. There must also be working facilities, microscopes, collection cases, fume hoods to remove objectionable odors, and the ordinary tools, reagents and other materials that permit it to function effectively.

Then, of course, there is the all-important element of a competent staff with which to operate. In the field of stomach analysis of wildlife there is no substitute for experience. Without that even the most complete of collections and the best of technical equipment will avail little.

The foregoing all points to the fact that, if research in wildlife is to avail itself of food analysis as a working tool, the facilities needed are destined to be extensive and costly; to create these on short notice would be impossible and to duplicate them locally throughout the country would be highly uneconomical.

A score of years ago one of America's leading ecologists sounded a warning against the perennial impoverishment of research in food habits of birds and mammals (Errington, 1935. *Science*, 81, (2103):378–379). "It seems more than a little ironical that this division [of the Biological Survey] with its highly trained personnel, its unmatched reference collections and its strategic possibilities as an ecological clearing house be the perennial target of crippling economies, with occasionally its very existence threatened.

"In short, from the standpoint of one interested in wildlife management and foreseeing the great development that will surely occur, it is apparent that the necessary supporting researches into the food habits of organisms are barely entering the tremendous field of significant endeavor that awaits."

If such apprehension was justified at a time when modest funds were still available for the study of the food of wildlife by a Federal agency, what form of expression can adequately portray the present situation?—E. R. Kalmbach.

THE WILSON ORNITHOLOGICAL CLUB

MEMBERS

***Founder **Life Member *Sustaining Member Others—Active Members

Abbott, Major Jackson Miles, 814 13th St., New Alexandria, Virginia 1948
Adams, Arthur K(inney), California Dept. of Fish & Game, 132 Fifth St., Eureka, California 1951
Adams, Mrs. Lillias D., 1500 Fairidge Drive, Kingsport, Tennessee 1952
Addy, Charles Edward, Star Rt. #1, Box 402, Montgomery Road Laurel, Maryland 1941
*Adelson, Richard Henry, 34 Wensley Drive, Great Neck, L.I., New York 1938
*Afsprung, Arthur E., 3308 Bishop St., Cincinnati 20, Ohio 1948
*Aldrich, John Warren, Fish and Wildlife Service, Washington 25, D.C. 1930
*Alexander, Donald C(hild), 16 Pleasant St., Nahant, Massachusetts 1937
*Alexander, Gordon, Dept. of Biology, Univ. of Colorado, Boulder, Colorado 1936
Alexander, Maurice M(yron), Dept. of Forest Zoology, New York State College of Forestry, Syracuse 10, New York 1945
Alexander, R.C., 19207 Charleston Ave., Detroit 3, Michigan 1949
Allen, A(rthur) A(ugustus), Fernow Hall, Cornell University, Ithaca, New York 1914
Allen, Robert P(orter), Box 205, Tavernier, Florida 1947
Allin, Dr. A(lbert) E(llis), Provincial Laboratory, Fort William, Ontario, Canada 1943
Allyn, Dr. (Paul) Richard, 709 Myers Bldg., Springfield, Illinois 1944
*Alperin, Irwin M., 2845 Ocean Ave., Brooklyn 35, New York 1939
Altemus, Edward Lee, Lafayette Ave., Fort Washington, Pennsylvania 1954
Amadon, Dean, American Museum of Natural History, Central Park West, at 79th St., New York 24, New York 1935
Ammann, George Andrew, Game Division, Dept. of Conservation, Lansing 13, Michigan 1935
Anderson, Anders H(arold), 3221 E. Kleindale Road, Tucson, Arizona 1937
Anderson, Frank G., Dept. of Sociology, Univ. of Maryland, College Park, Maryland 1951
Anderson, John M., R.D. #3, Winous Point Club, Port Clinton, Ohio 1938
Anderson, Milton R(obert), 131 Park Drive, Point Pleasant, West Virginia 1954
Anderson, Paul Knight, 126 W. River St., Orange, Massachusetts 1947
Anderson, R(udolph) M(artin), 58 Driveway, Ottawa, Ontario, Canada 1937
Anderson, T(homas) J(ohn), 3 Niven, Box 856, New Liskeard, Ontario, Canada 1953
Anderson, William Deans, 3100 Beverly Road, Austin 3, Texas 1950
Andrews, Mrs. J. Clinton, Three Stone Alley, Nantucket, Massachusetts 1946
Andrews, James Clinton, Three Stone Alley, Nantucket, Massachusetts 1947
Anthes, Clarence A(lvin), 707 No. Moreland Blvd., Waukesha, Wisconsin 1939
Anthony, Jesse D., 722 1st Ave., East, Grand Rapids, Minnesota 1944
*Appel, Thomas G., 63 Sunnyside Ave., Pleasantville 2, New York 1950
*Arbib, Robert S(imeon), Jr., 231 W. Lena Ave., Freeport, New York 1947
Armington, Sven, Blanchegatan 18, Stockholm, Sweden 1948
*Armstrong, Miss Virginia, Old Concord Road, South Lincoln, Massachusetts 1939
Arnett, Dr. John Hancock, Jr., 6200 Ardleigh St., Philadelphia 38, Pennsylvania 1944
Arnold, Elting, 4914 Dorset Ave., Chevy Chase 15, Maryland 1941
Arny, Samuel A., 6515 Willston Drive, Apt. 2, Falls Church, Virginia 1947
Aronoff, Dr. Arthur Edward, University Hospital, Ann Arbor, Michigan 1948
*Ashton, Randolph, 800 Crown St., Morrisville, Pennsylvania 1941
Atkeson, Thomas Zephaniah, P. O. Box 1643, Decatur, Alabama 1953
Austin, Mrs. Harold C. (Enid K.), 1116 Mandana Road, Oakland 10, California 1950
Austin, John Brander, 2510 Nashville Ave., New Orleans, Louisiana 1947
Austin, Dr. Oliver L(uther), 28 Fairview Ave., Tuckahoe, New York 1930
*Avery, John A(rthur), 3411 So. Westnedge, Kalamazoo, Michigan 1952
Axtell, Harold H., Buffalo Museum of Science, Humboldt Park, Buffalo 11, New York 1950
Axtell, Richard C(harles), 465 State St., Albany, New York 1954

Bacon, Brasher Collins, Sr., Spring Lake Wildlife Sanctuary, Chickadee Hill, Madisonville, Kentucky 1948
Baer, Miss Myrtle W., 1237 No. Jefferson St., Milwaukee 2, Wisconsin 1941
**Bagg, Aaron Moore, 72 Fairfield Ave., Holyoke, Massachusetts 1948
Baier, Mrs. John (Carol), 111 "C" St., Martinez, California 1949
Bailey, Alfred Marshall, Denver Museum of Natural History, City Park, Denver 6, Colorado 1928
*Bailey, Harold H(arris), Rockbridge Alum Springs Biological Laboratory, R.D. #2, Goshen, Virginia 1908
Bailey, Mrs. H. M., 1020 Jones St., Apt. 4, Sioux City 18, Iowa 1918
*Baily, A(lbert) Lang, Davenport Public Museum, 704 Brady St., Davenport, Iowa 1953
Baird, James, 83 Payson Lane, University Heights, New Brunswick, New Jersey 1954
**Baker, B(ernard) W(illiam), R.D.#1, Judson Road, Spring Lake, Michigan 1938
Baker, John H(opkinson), 1165 Fifth Ave., New York, New York 1930
Baker, Maurice F(rank), Southwestern College, Winfield, Kansas 1947
*Baker, Paul S(eaman), 19 Heckscher Drive, Huntington, L.I., New York 1946
Baker, Rollin Harold, Museum of Natural History, Univ. of Kansas, Lawrence, Kansas 1938
Baker, William C(alvin), 559 Euclid St., Salem, Ohio 1931
Baldwin, Mrs. Amy G., 6335 Kimbark Ave., Apt. B., Chicago 37, Illinois 1943
Ball, Miss Henrietta S(ophia), 1213 So. Third St., Lafayette, Indiana 1951
Ball, Kathleen E., 8704 112th St., Edmonton, Alberta, Canada 1946
*Balsom, Mrs. Amos Parker, 2209 E. Stratford Court, Milwaukee 11 Wisconsin 1949
*Bamman, Miss Barbara Cleghorn, 16 Rollingmead, Princeton, New Jersey 1954
Banks, Clinton S(eeger), 202 Wilma Ave., Steubenville, Ohio 1945
Banta, Miss Edna, Mary Gray Bird Sanctuary, R.D. #6, Connersville, Indiana 1945
*Barber, Mrs. Harold A., 23863 Fordson Drive, Dearborn, Michigan 1952
Barber, Miss Lucy, Box 6092, Station A., Charleston 2, West Virginia 1950
Barber, Miss Sarah C., Box 6092, Station A., Charleston 2, West Virginia 1950
Barbour, Llewellyn P(helps), 4780 Wood St., Willoughby, Ohio 1948
Bard, Fred George, Curator, Provincial Museum, Normal School, Regina, Saskatchewan, Canada 1946
Barnes, Charles K(napp), 5006 So. Michigan Road, South Bend, Indiana 1949
Barnes, William Bryan, 311 W. Washington St., Indianapolis 9, Indiana 1941
Barrett, Lewis LeRoy, 2737 Ulysses St., N. E., Minneapolis 18, Minnesota 1949
Bartel, Karl E(mil) Edgar, 2528 W. Collins St., Blue Island, Illinois 1934
Bartleson, Fred D(urant), Jr., Dept. of Biology, University of Florida, Gainesville, Florida 1952
Bartlett, Guy, 1053 Parkwood Blvd., Schenectady 8, New York 1938
Bartlett, Wesley H., 122 So. Ridgley, Algona, Iowa 1936
Bartsch, Paul, "Lebanon", Gunston Hall Rd., Lorton, Virginia 1894
Bastin, Eric W(alter), 43 Inglewood Drive, Apt. 2, Hamilton, Ontario, Canada 1951
Batchelder, Charles Foster, 7 Kirkland St., Cambridge, Massachusetts 1927
Batchelder, Edgar M(arden), 56 Orchard St., Marblehead, Massachusetts 1941
**Batts, H(enry) Lewis, Jr., 1211 Glenwood Ave., Kalamazoo, Michigan 1946
Baumel, Julian J., Dept of Anatomy, Creighton School of Medicine, Creighton Univ., Omaha, Nebraska 1951
Baumgartner, Milton D(aniel), 1822 W. Sunset Drive, Stillwater, Oklahoma 1944
*Baxter, William, Jr., R.D. #2, Middletown, Delaware 1945
Baylor, L(eslie) M(ilton), 1912 Tyler Road, Boulder, Colorado 1954
Beals, Everett K(err), 1310 No. 11th St., Manhattan, Kansas 1953
Beardslee, Clark Smith, 132 McKinley Ave., Kenmore 17, New York 1942
Beardsley, Miss M(argaret) Hortense, 330 No. Chestnut St., Ravenna, Ohio 1941
Beebe, William, 33 W. 67th St., New York, New York 1944
Beecher, William J(ohn), Chicago Natural History Museum, Chicago 5, Illinois 1948
Behle, William H(arroun), Dept. of Biology, Univ. of Utah, Salt Lake City, Utah 1935
Behrens, Harry Carl, Box 1055, Rapid City, South Dakota 1950
*Belcher, Paul Eugene, 988 Jefferson Ave., Apt. 3, Akron, Ohio 1938
Belfore, Stanley Alexander, 3452 Harrisburg St., Pittsburgh 4, Pennsylvania 1953

Bell, Henry, III, 246 W. Evergreen Ave., Chestnut Hill, Philadelphia 18, Pennsylvania 1946
Bell, Mrs. William F., 210 Carden Ave., Nashville 5, Tennessee 1954
Bellrose, Frank, Jr., Illinois Natural History Survey, Havana, Illinois 1935
Bemont, Leslie E(dward), R.D. #3, Binghamton, New York 1954
*Benchley, Mrs. Belle J(ennings), Box 551, Zoological Garden, San Diego 12, California 1951
Bennett, Miss Esther (Vorena), 406 W. Oak St., Carbondale, Illinois 1954
Bennett, Holly Reed, 2457 Orchard St., Chicago 14, Illinois 1949
Bennett, Miss Mary A(llison), 623 E. Carroll St., Macomb, Illinois 1933
Benson, Seth Bertram, 645 Coventry Rd., Berkeley 7, California 1930
Bent, Arthur C(leveland), 140 High St., Taunton, Massachusetts 1893
Benton, Allen H(aydon), New York State College for Teachers, Dept. of Biology, Albany, New York 1953
**Berger, Andrew J(ohn), Dept. of Anatomy, University of Michigan, Ann Arbor, Michigan 1940
Berger, Daniel D(avid), 510 E. MacArthur Road, Milwaukee 17, Wisconsin 1953
**Bergstrom, E(dward) Alexander, 37 Old Brook Road, West Hartford 7, Connecticut 1943
*Berkey, Glenn L., 22 So. State St., Rittman, Ohio 1951
*Berkowitz, Albert Clarence, 1912 Grand Ave., Tension Envelope Corporation, Des Moines 14, Iowa 1946
Betts, Miss Amelia J(eannette), Baldwin City, Kansas 1953
Biaggi, Virgilio, Jr., College of Agriculture, Mayaguez, Puerto Rico 1945
*Biggs, Joseph Daniel, 6624 First St., N. W., Washington 12, D.C. 1949
Binford, L(aurie) C(harles), Museum of Zoology, Bird Division, Univ. of Michigan, Ann Arbor, Michigan 1954
Birch, Robert Lee, Dept of Biology, West Virginia Univ., Morgantown, West Virginia 1950
Bird, Dick, 2721 Assinibaine Ave., Regina, Saskatchewan, Canada 1949
Birkeland, Henry, Roland, Iowa 1934
Black, Charles T(heodore), R.D. #1, Box 480, East Lansing, Michigan 1935
**Blain, Dr. Alexander W(illis), 2201 Jefferson Ave., East, Detroit 7, Michigan 1902
Blake, Charles H(enry), Woodland Way, Lincoln, Massachusetts 1950
Blake, Emmet R(eid), Chicago Natural History Museum, Chicago 5, Illinois 1939
Blake, Mrs. Grace R. (Mrs. Henry Seavey) 1933 Westwood Drive, Topeka, Kansas 1950
Blanchard, Miss Dorothy, 2014 Geddes Ave., Ann Arbor, Michigan 1952
Blanchard, Harold H(ooper), 32 Calumet Rd., Winchester, Massachusetts 1946
*Blanchet, Miss Helen, 1406 Southfield Rd., Lincoln Park, Michigan 1954
Blazer, Warren G., P.O. Box 107, Los Angeles 28, California 1949
**Bleitz, Donald Lewis, 1001 No. McCadden Place, Los Angeles 38, California 1948
Bliese, John C(arl) W(illiam), Biology Dept., Nebraska State Teachers College, Kearney, Nebraska 1951
Blinco, Ben(edict) Joseph, 8766 No. Main St., Dayton 5, Ohio 1919
Bloor, Edwin David, Jr., 3 Grandview Ave., Lawrenceville, New Jersey 1954
*Blossom, Philip M(oss), 10969 Rochester Ave., West Wood Hills, Los Angeles 24, California 1949
Blowey, William, Mafeking, Manitoba, Canada 1951
Bock, Walter (Joseph), 7630 85th Drive, Woodhaven 21, New York 1953
Bodmer, Mrs. Herbert A. (Olive A.), Box 14, Kenmare, North Dakota 1950
*Boggs, I(ra) Brooks, Oglebay Hall, Morgantown, West Virginia 1938
Boldt, Wilbur, Box 293, Jamestown, North Dakota 1949
Bolen, Homer R., S.E. Missouri State College, Cape Girardeau, Missouri 1953
Bonar, John S(tanley), West Liberty, West Virgina 1954
**Bond, James, 1900 Race St., Philadelphia 3, Pennsylvania 1945
Bond, Richard M(arshall), King's Hill, St. Croix, U.S. Virgin Islands 1936
*Booth, Mrs. Robert V. D., 1085 Bank St., Painesville, Ohio 1949
Borell, Adrey Edwin, P.O. Box 1377, Oklahoma City, Oklahoma 1936
Borror, Donald J(oyce), Dept. of Zoology & Entomology, Ohio State Univ., Columbus, 10, Ohio 1927

*Boulton, Rudyerd, 3234 Reservoir Road, N.W., Washington 7, D.C. 1942
Bourdo, Eric Albert, Jr., 204 Vivian St., Houghton, Michigan 1951
Bowdish, Beecher S(coville), Demarest, New Jersey 1921
Bowen, Robert Marvin, 5009 Leeds Ave., Baltimore 27, Maryland 1947
Bower, Winifred F. (Mrs. F. L.), R.D. #1, Lee's Hill Road, Basking Ridge New Jersey 1954
Bowers, J. Basil, 975 Juanita, Campbell, California 1942
Boyd, Miss Elizabeth M(argaret), Mount Holyoke College, South Hadley, Massachusetts 1941
Boyd, Hugh J., Severn Wildfowl Trust, Slimbridge, Gloucestershire, England 1946
Boyd, Ivan L., Dept. of Biology, Baker Univ., Baldwin, Kansas 1951
Boyer, George Frederick, R.D. #1, West Sackville, New Brunswick, Canada 1949
Boyer, Miss G(ertrude) Paula, 420 E. Second Ave., Roselle, New Jersey 1953
*Brackbill, Hervey (Groff), 4608 Springdale Ave., Baltimore 4, Maryland 1942
Bradburn, Donald Muir, 461 Pine St., New Orleans 18, Louisiana 1950
Braden, Miss Paula Lou, 3857 Kings Highway, Brooklyn 34, New York 1953
*Bradley, Homer L., Long Lake National Wildlife Refuge, Moffitt, North Dakota 1939
Branch, Mrs. Margaret G(amble), 1324 Wells St., Ann Arbor, Michigan 1952
**Brandt, Herbert W., 2425 No. Park Blvd., Cleveland 6, Ohio 1945
Branum, Miss Florence (Pauline), 117 No. Ewing St., Lancaster, Ohio 1946
Brauner, Joseph, 11233 Van Buren Ave., Los Angeles 44, California 1942
Braunschweig, Mrs. Lee W(elsh), 5758 No. Fifth St., Philadelphia 20, Pennsylvania 1953
**Brecher, Leonard C(harles), 1900 Spring Drive, Louisville 5, Kentucky 1939
Brecht, Miss Grace Elizabeth, 1328 Clinton Ave., Irvington 11, New Jersey 1949
*Breckenridge, Walter J(ohn), Museum of Natural History, Univ. of Minnesota Minneapolis 14, Minnesota 1929
Breiding, George H(erbert), Naturalist, Oglebay Institute, Wheeling, West Virginia 1942
*Brewer, Richard Dean, 1506 Edith St., Murphysboro, Illinois 1949
Brigham, Edward M(orris), Jr., Kingman Memorial Museum, Battle Creek, Michigan 1931
Brigham, Edward M(orris), III, R.D. #5, Box 19, Battle Creek, Michigan 1950
Brinckerhof, Remsen, 156 Sherwood Place, Englewood, New Jersey 1953
Bristow, Harry Sherman, Jr., 210 Washington Ave., Cedars, Wilmington, Delaware 1942
Broadbooks, Harold E(ugene), 14333 Corliss Ave., Seattle 33, Washington 1948
Brockschlager, Miss Mary Elizabeth, 518 E. Fourth St., Cincinnati 2, Ohio 1948
Brodkorb, Pierce, Dept. of Biology, Univ. of Florida, Gainesville, Florida 1951
*Brody, Dr. Gerald L(ee), University Hospital, Ann Arbor, Michigan 1954
*Broley, Charles L(avelle), Delta, Ontario, Canada 1946
Brooks, Mrs. Chester K., P.O. Box 168, Bennington, Vermont 1952
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Broun, Maurice, R.D. #2, Kempton, Pennsylvania 1935
Brown, Clarence D., 222 Valley Road, Montclair, New Jersey 1938
Brown, Miss Doranne, 8 Charlton St., Princeton, New Jersey 1954
Brown, E(lmer) E(vans), Davidson College, Davidson, North Carolina 1945
Brown, Jerram L., 19 Hitchcock Road, Amherst, Massachusetts 1950
Brown, N(orman) Rae, Faculty of Forestry, Univ. of New Brunswick, Fredericton, New Brunswick, Canada 1945
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Browning, Miss Helen G., 206 W. Oak St., Louisville 3, Kentucky 1952
Bruce, James A(ddison), 565 E. Spring St., Wooster, Ohio 1952
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Bryan, Dr. Burton Donald, 162 French St., Fall River, Massachusetts 1949
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Buchanan, Forest Wendell, Amsterdam, Ohio 1939

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Buckland, George (Henry) (Edward), R.D. #1, Batavia, New York 1949
Bucknell, Donald N(eedham), 134 Wonham, Ingersoll, Ontario, Canada 1953
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Bures, Joseph August, 148 No. 3rd St., West Newton, Pennsylvania 1946
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Burner, Miss Florence H(elen), 5350 Reisterstown Road, Baltimore 15, Maryland 1948
Burnett, Frances L., Proctor St., Manchester, Massachusetts 1950
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Burr, Irving W(ingate), 265 Littleton St., West Lafayette, Indiana 1945
Burr, Miss Margaret, 943 Summit Ave., St. Paul 5, Minnesota 1952
Burt, William Henry, Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan 1928
Burton, Donald E(rnest), 171 Strathearn Road, Toronto 10, Ontario, Canada 1953
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Butchart, Mrs. G. Reeves, Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan 1943
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Bytzko, Miss Anne, 13563 Arlington, Detroit 12, Michigan 1948

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Cagle, Fred R., Dept. of Zoology, Univ. of Tulane, New Orleans 15, Louisiana 1942
Cahalane, Victor H(arrison), National Park Service, Washington 25, D.C. 1933
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Calhoun, John B(umpass), National Institute of Mental Health, Bldg. 10, Bethesda 14, Maryland 1949
Calvert, Earl Wellington, R.D. #2, County Home, Lindsay, Ontario, Canada 1937
Calvert, William J(onathan), Jr., 615 No. Pelham Road, Jacksonville, Alabama 1942
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Campbell, Louis W(alter), 4531 Walker Ave., Toledo 12, Ohio 1926
Campbell, Miss Mildred F(lorence), 29 No. Hawthorne Lane, Indianapolis 19, Indiana 1938
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Carroll, Col. Robert P., 213 Maiden Lane, Lexington, Virginia 1942
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Carter, Dennis (Lee), 715 Ohio St., Webster City, Iowa 1947
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Cassel, J(oseph) Frank(lin), Dept. of Zoology, North Dakota Agricultural College, Fargo, North Dakota 1940
Castenholz, Richard William, Botany Dept., Washington State University, Pullman, Washington 1949
Cater, Milam B(rison), P.O. Box 15, Clifton Forge, Virginia 1944
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Chapman, Floyd B(arton), 392 Walhalla Road, Columbus 2, Ohio 1932
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Chase, Henry B., Jr., 517 Decatur St., New Orleans 16, Louisiana 1932
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Darby, Richard T(horn), 5236 Cedar Ave., Philadelphia 43, Pennsylvania 1948
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Davis, Lt. Paul A(nthony), 829 Grant St., Gary, Indiana 1953
Davis, Russell S., Clayton, Illinois 1947
Davis, Wayne Harry, Museum of Natural History, University of Illinois, Urbana, Illinois 1953
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Dehner, Reverend Eugene W(illiam), St. Benedict's College, Atchison, Kansas 1944
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Delavan, Wayne G., R.D. #2, Box 61, Bronson, Kansas 1943
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Denham, Reginald (Francis), 100 Central Park, So., New York 19, New York 1948
Denton, J(ames) Fred, 1510 Pendleton Road, Augusta, Georgia 1935
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Devitt, Otto Edmund, Richmond Hill, Ontario, Canada 1935
Devlin, Joseph M(ark), 218 So. 43rd St., Philadelphia 4, Pennsylvania 1953
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Dickinson, J(oshua) C(lifton), Jr., Dept. of Biology, Univ. of Florida, Gainesville, Florida 1939
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Diesselhorst, G(erd) (Felix), Emmering Hauptstrasse 32, Fürstenfeldbruck bei München, Bayern, Germany (American Zone) 1949
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Disler, Walter C(larence), R.D. #1, LaGrange, Ohio 1954
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Durango, Sigfrid, Täby, Sweden 1952
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Dusi, Julian L(uigi), Dept. of Zoology & Entomology, Alabama Polytechnic Institute, Auburn, Alabama 1941
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Dyer, William A., 402 John St., Union City, Michigan 1947

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Ligon, J(ames) Stokley, P.O. Box 950, Carlsbad, New Mexico 1948
Lincoln, Charles W., 392 Highland Ave., Upper Montclair, New Jersey 1953
Lincoln, Frederick Charles, Fish & Wildlife Service, Washington 25, D.C. 1914
Lindauer, Millard R., 130 Home St., Valley Stream, L.I., New York 1949
Linsdale, Jean M(yron), Jamesburg Route, Carmel Valley, California 1928
*Linton, M(orris) Albert, 315 E. Oak Ave., Moorestown, New Jersey 1941
Livingston, Philip A(tlee), 620 Manor Road, Narberth, Pennsylvania 1953
Lloyd, C(lark) K., 11 No. Elm St., Oxford, Ohio 1925
Lloyd, Hoyes, 582 Mariposa Ave., Rockcliffe Park, Ottawa, Ontario, Canada 1922
*Lockwood, Dr. Robert Minturn, Veterans Administration Hospital, McKinney, Texas 1949
Loetscher, Frederick W(illiam), Jr., 507 W. Main St., Danville, Kentucky 1946
Longley, William H(oward), P.O. Box 362, Kasson, Minnesota 1943
Loomis, Mrs. Lester R. (Hazel R. Ellis), R.D. #2, Hammond, Louisiana 1942
Loring, George G(ardner), Bridge 57, Manchester, Massachusetts 1949
Lord, Dr. Frederic P(omeroy), 960 Broadway, Dunedin, Florida 1939
**Lory, Mrs. William T. (Hazel L. Bradley), 3538 Wenonah Ave., Berwyn, Illinois 1944
Lovell, Harvey B., 2346 Dundee Road, Louisville 5, Kentucky 1936
**Low, Seth Haskell, R.D. #2, Gaithersburg, Maryland 1931
**Lowery, George H(ines), Museum of Zoology, Louisiana State University, University, Louisiana 1937
Lowther, Malcolm Alfred, 22599 Kane Ave., Detroit 23, Michigan 1944

Ludwig, Claud C(ecil), 279 Durand St., East Lansing, Michigan 1938
**Ludwig, Dr. Frederick Edwin, 2864 Military St., Port Huron, Michigan 1941
Lueshen, Mrs. John (Willetta), Wisner, Nebraska 1952
Lukens, William Weaver, Jr., Upper Gulph Road, Radnor, Pennsylvania 1947
*Lunk, William A., 2849 Whitewood, Pittsfield Village, Ann Arbor, Michigan 1937
Lupient, Mrs. Mary (Louise), 212 S.E. Bedford St., Minneapolis 14, Minnesota 1944
Luther, Mrs. Dorothy (Hobson), 4515 Marcy Lane, Apt. 239, Indianapolis 5, Indiana 1935
Luthy, Ferd, Jr., 306 N. Institute, Peoria, Illinois 1937
*Lyman, Mrs. Clara Cross (Mrs. Frederick C.), Topside, R.D. #5, Box 590, Wayzata, Minnesota 1944

MacKenzie, Mrs. Charles (Clara Lyga), 425 Tatepaha Blvd., Faribault, Minn. 1951
MacLeod, Charles Franklyn, Dept. of Entomology & Zoology, Univ. of Minnesota St. Paul, Minnesota 1949
MacLulich, D(uncan) A(lexander), 342 Marshall Court, Ottawa, Ontario, Canada 1933
*MacMullan, R(alph) Austin, Box 44, Houghton Lake Wildlife Experiment Station, The Heights, Michigan 1940
MacQueen, Mrs. Peggy Muirhead, 48 New Jersey Ave., Bergenfield, New Jersey 1940
McAlister, (James) Don, 1723 Cardiff Road, Columbus 12, Ohio 1949
McAtee, Waldo Lee, 3 Davie Circle, Chapel Hill, North Carolina 1911
**McCabe, Robert A(lbert), 424 University Farm Place, Madison, Wisconsin 1942
McClure, John Francis, 7050 No. Oatman Ave., Portland 17, Oregon 1949
McClure, H(owe) Elliott, 406 Medical Gen. Lab., A.P.O. 500, San Francisco, California 1942
*McConoughey, Frank Perry, 1547 Northland Ave., Lakewood 7, Ohio 1951
McCormick, John M., 2356 Cheltenham Road, Toledo 6, Ohio 1951
*McCue, Dr. Earl Newlon, Box 104, Morgantown, West Virginia 1941
McCullagh, Dr. E(rnest) Perry, 2020 E. 93rd St., Cleveland, Ohio 1937
McCullough, C(lyde) Robert, Richmond, Ohio 1953
McDonald, Malcolm E., 60 Dutchman's Village, Schenectady 8, New York 1936
McDonald, Norman J., 2016 Locust St., Philadelphia 3, Pennsylvania 1954
McEntee, Mrs. Howard G. (Elinor G.), 490 Fairfield Ave., Ridgewood, New Jersey 1948
*McGaw, Mrs. G. Hampton (Elizabeth T.), 18 Beech St., Woodsville, New Hampshire 1945
McGeen, Daniel S., 707 Community National Bank Bldg., Pontiac, Michigan 1944
McKay, Arlie K(yle), R.D. #2, Box 252, Baytown, Texas 1949
McKeever, Christopher Killian, Box 63, Water Mill, New York 1948
McKinley, Daniel L(awson), Stephens Hall, University of Missouri, Columbia, Missouri 1948
McKinley, Dr. George G(ael), 104 N. Western Pkwy, Louisville 12 Kentucky 1945
McKinney, Robert G(erhard), 86 Hurstbourne Road, Rochester 9, New York 1948
*McKinney, Mrs. Walter A., 2932 So. Woodward Blvd., Tulsa 5, Oklahoma 1945
McKnight, Edwin T(hor), 5038 Park Place, Friendship Station, Washington 16, D.C. 1936
McLaughlin, Frank W., 923 White Horse Pike, Apt. B., Oaklyn, Audubon 6, New Jersey 1953
*McLeod, John Allen, Jr., 113 E. Hendrix St., Greensboro, North Carolina 1951
*McMath, Robert R., McMath-Hulbert Observatory of the Univ. of Michigan, Lake Angelus Road, North, R.D. #4, Pontiac 4, Michigan 1934
McNabb, Miss Mary Katherine, 619 No. Washington St., Baltimore 5, Maryland 1954
McQuarrie, Harold James, Gore Bay, Manitoulin Island, Ontario, Canada 1950
McQuate, Miss Nelda Jean, 374 Riverside Drive, Tiffin, Ohio 1953
Mack, H(orace) G(ordon), c/o Gilson Mfg. Co., Ltd., Guelph, Ontario, Canada 1937
*Mackenzie, Dr. Locke Litton, 829 Park Ave., New York 21, New York 1947
*Madtes, George R(ummel), 337 E. Ravenwood Ave., Youngstown 5, Ohio 1949
Magath, Dr. Thomas Byrd, Mayo Clinic, Rochester, Minnesota 1935
Magner, J(ohn) Marshall, 516 Bacon Ave., Webster Groves 19, Missouri 1948
Mahan, Harold D., 582 E. Drayton, Ferndale 20, Michigan 1953

Maher, William Joseph, 1831 E. 15th St., Brooklyn 29, New York 1951
Mahlburg, Milton William, 1109 Grant Ave., Rockford, Illinois 1949
*Mainster, Raymond Waite, 3716 Croydon Road, Baltimore 7, Maryland 1949
*Mallory, Dr. Dwight H(arcourt), 17 Sherwood St., Brockville, Ontario, Canada 1946
Mandigo, Gordon C., 600 So. Bowen St., Jackson, Michigan 1954
Manners, Edward Robert, 216 New Broadway, Brooklawn, New Jersey 1942
Manning, Miss Margaret B(iddle), Manning Lane, Lawrenceville, New Jersey 1954
Manning, T. H., 37 Linden Terrace, Ottawa, Ontario, Canada 1950
*Mannix, Mrs. Lucille Marie (Mrs. J.R.) 11424 Cedar Road, Apt. E.-2, Cleveland, Ohio 1947
Manville, Richard H(yde), Dept. of Zoology, Michigan State College, East Lansing, Michigan 1941
*Mara, Robert M(ichael), The Dearborn Inn, Dearborn, Michigan 1949
Marfield, George R(owland), 1820 So. Olive Ave., Alhambra, California 1948
Margolin, A(braham) S(tanley), Phoenix College, Phoenix, Arizona 1944
Markle, Millard S., Biology Dept. Earlham College, Richmond, Indiana 1948
Marks, Jack Loran, 115 City Hall, Director of Zoo, Portland 4, Oregon 1949
Marshall, Dr. A. J., Dept. of Zoology and Comparative Anatomy, St. Bartholomew's Hospital Medical College, Charterhouse Square, London E.C.1, England 1950
Marshall, Raymond O(scar), 256 Ridge St., Leetonia, Ohio 1945
*Marshall, Terrell, 372 Skyline Drive, Park Hill, North Little Rock, Arkansas 1944
*Marshall, William H(ampton), Division of Entomology & Economic Zoology, University Farm, St. Paul 3, Minnesota 1942
Martin, Dr. Donald B(eckwith), 2948 Oakford Road, Ardmore, Pennsylvania 1954
Martin, Paul S(chultz), Museum of Zoology, Division of Herpetology, Ann Arbor, Michigan 1946
*Marvel, Carl S(chipp), 404 W. Pennsylvania Ave., Urbana, Illinois 1949
*Maslowski, Karl H(erbert), 1034 Maycliff Place, Cincinnati 30, Ohio 1934
Mason, C(harles) N(athan), Sr., 6432 31st St., N.W., Washington 15, D.C. 1947
Mason, Miss Esther, 2523 Montgomery St., Louisville 12, Kentucky 1941
Maxwell, Miss Florence Helen, R.D. #3, Mt. Pleasant, Michigan 1952
Mayer, Mrs. Winnifred (Smith), Winghaven, R.D. #1, Two Rivers, Wisconsin 1946
Mayfield, G(eorge) R(adford), Vanderbilt University, Nashville, Tennessee 1917
*Mayfield, Harold F(ord), 2557 Portsmouth Ave., Toledo 12, Ohio 1940
**Mayr, Ernst, Museum of Comparative Zoology, Harvard University, Cambridge 38, Massachusetts 1933
Mazzeo, Rosario, 114 The Fenway, Boston, Massachusetts 1947
Meacham, Frank B., State Museum, Raleigh, North Carolina 1945
Mead, Frank Waldreth, 2035 N.E.—6 Terrace, Gainesville, Florida 1948
*Meade, Dr. Gordon M(ontgomery), Trudeau Sanatorium, Trudeau, New York 1938
Meanley, Brooke, 4710 Keswick Road, Baltimore 10, Maryland 1950
Meara, Joseph Fisher, 440 So., Harding Road, Columbus 9, Ohio 1953
Mehner, John F., 1003 James St., Pittsburgh 34, Pennsylvania 1949
*Meitzen, Logan H(erman), Box 1022, Angleton, Texas 1947
Mellinger, E(nos) O(ren), Chincoteague National Wildlife Refuge, Box 62, Chincoteague, Virginia 1939
**Melone, Miss Theodora G(ardner), Geology Library, Pillsbury Hall, Univ. of Minnesota, Minneapolis 14, Minnesota 1947
Meltvedt, Burton W., Paullina, Iowa 1930
**Meng, Heinz Karl, 116 Miller St., Ithaca, New York 1943
*Mengel, Jane S(trahan), (Mrs. Robert M.), 15 Countryside Lane, Lawrence, Kansas 1948
*Mengel, Robert M(orrow), Museum of Natural History, Univ. of Kansas, Lawrence, Kansas 1937
*Menninger, Phil B., 1724 Collins Ave., Topeka, Kansas 1949
Meredith, Col. Russell Luff, c/o Gen. Deliv., Augusta, Montana 1946
Meritt, James Kirkland, 901 State St., Schenectady, New York 1944
*Mers, W(illiam) H(enry), 1659 Marlowe Ave., Cincinnati 2, Ohio 1949
Messing, Mrs. Pauline, 383 Central Park West, New York 25, New York 1954
Messner, Clarence John, 308 McKinley, Grosse Pointe 30, Michigan 1944

*Metcalf, H(omer) N(oble), Dept of Horticulture, Montana State College, Bozeman, Montana 1944
Metcalf, Zeno P(ayne), State College Station, Raleigh, North Carolina 1900
Mewaldt, L(eonard) R(ichard), Dept. of Natural Sciences, San Jose State College, San Jose 14, California 1947
Meyer, Henry, Biology Dept., Ripon College, Ripon, Wisconsin 1939
*Meyerriecks, Andrew J(oseph), Biological Laboratories, Harvard Univ., Cambridge 38, Massachusetts 1948
Meyers, Dr. Kenneth Lewis, 2601 Far Hills Ave., Dayton 9, Ohio 1949
Michaud, Howard H(enry), 824 No. Chauncey St., West Lafayette, Indiana 1938
Michaux, Mrs. Frank W. (Joy H. Houston), 1607 Bluff St., Wichita Falls, Texas 1947
Michener, Mrs. Harold, 418 No. Hudson Ave., Pasadena 4, California 1950
Mickey, Arthur B(ayard), 1516 Rainbow Ave., Laramie, Wyoming 1935
Middleton, William R(obert), 106 No. Lincoln Ave., Wenonah, New Jersey 1953
Mikkelson, Mrs. Herbert G. (Edyth A.), Box 142, Minnetonka Beach, Minnesota 1948
Miles, Mrs. Eleanor (Burgess), (Mrs. Phillip E.), 2134 Kendall Ave., Madison 5, Wisconsin 1943
Miller, Alden H(olmes), Museum of Vertebrate Zoology, Berkeley 4, California 1930
Miller, Mrs. Alice, 1150 Brewer Road, Leonard, Michigan 1944
Miller, Mrs. Clarence Heath, 1354 Herschel Ave., Cincinnati 8, Ohio 1941
*Miller, Clark, Inwood, West Virginia 1953
Miller, Clinton F(ranklin) A(mmon), 324 So. 22nd St., Allentown, Pennsylvania 1953
**Miller, Douglas Scott, 122 Lawrence Ave., E., Toronto, Ontario, Canada 1939
*Miller, Loye H(olmes), Museum of Vertebrate Zoology, Univ. of California Berkeley 4, California 1939
Miller, Lyle (DeVerne), 5795 Mill Creek Blvd., Youngstown 12, Ohio 1947
Miller, Richard F(ields), 2637 No. 2nd St., Philadelphia 33, Pennsylvania 1952
Miller, Robert R(aymond), 1424 Liberty St., Allentown, Pennsylvania 1954
*Mills, Herbert H., Arrowhead Farms, R.D. #3, Bridgeton, New Jersey 1951
Minich, Edward C., 1047 Fairview Ave., Youngstown 2, Ohio 1923
Miskimen, Miss Mildred, Dept. of Physiology, Miami Univ., Oxford, Ohio 1950
**Mitchell, Harold Dies, 378 Crescent Ave., Buffalo 14, New York 1936
*Mitchell, Mrs. Osborne, c/o Brazilian Traction, Light & Power Co., Ltd., 25 King St., West, Toronto 1, Ontario, Canada 1933
*Mitchell, Mrs. R. V., East Drive, Congress Lake, Hartville, Ohio 1943
Mitchell, Miss Verna E., 1900 "F" St., N.W., Apt. 623, Washington 6, D.C. 1949
*Mitchell, Dr. Walton I(ungerich), 398 Vassar Ave., Berkeley 8, California 1893
Mockford, Pvt. Edward (Lee), U.S. 53220543, 9766 TSU,Camp Detrick, Frederick, Maryland 1946
*Moe, Owen A(rnold), 3651 Glenhurst Ave., Minneapolis 16, Minnesota 1951
Mohler, Levi L(app), 1000 So. 35th St., Lincoln, Nebraska 1942
Mohr, Charles E(dward), Audubon Nature Center, Greenwich, Connecticut 1947
Monk, Harry C(rawford), 406 Avoca St., Nashville 5, Tennessee 1920
Monly, Thomas L., 1919 Semple Ave., St. Louis 12, Missouri 1952
**Monroe, Burt L(eavelle), Sr., Ridge Road, Anchorage, Kentucky 1935
Monroe, Burt L(eavelle), Jr., (ENS.), USNR., Recruit Training Command, Naval Training Center, San Diego, California 1946
Monroe, Mrs. Robert A(nsley), 1424 Tugaloo Drive, S.W., Knoxville 16, Tennessee 1952
Monson, Gale, 1021 9th Ave., Yuma, Arizona 1933
Moore, Mrs. McBrayer, (Margaret Rodes), 335 W. Lexington St., Danville, Kentucky 1950
Moore, Milton C(yril), 1410 Spruce St., Berkeley, California 1954
*Moore, Robert B(yron), 1332 Alfred St., Baton Rouge 6, Louisiana 1947
**Moore, Robert Thomas, Meadow Grove Place, Flintridge, Pasadena 2, California 1939
*Moran, James Vincent, HMI, USN, Nav. Med. School (Chemistry), NNMC, Bethesda, Maryland 1943

Moreno, Abelardo, Museo Poey, Catedra "U", Escuela de Ciencias, Univ. of Havana, Havana, Cuba ... 1949
Morony, John J., Jr., Box 1114, Alamo, Texas ... 1951
Morrissey, Thomas J(ustin), 325 McClellan Blvd., Davenport, Iowa ... 1946
Morrison, Kenneth Douglas, R.D. #1, Armonk, New York ... 1937
*Morrow, Mrs. Dessie Powers (Mrs. John, Jr.), 1320 No. State St., Chicago 10, Illinois ... 1949
*Morse, Margarette Elthea, 122 W. South St., Viroqua, Wisconsin ... 1921
Morsello, Gerald P(aul), Chelten Hills Drive, Wyncote, Pennsylvania ... 1954
Mosby, Henry Sackett, Box 838, Blacksburg, Virginia ... 1951
Mossman, H(arland) W(infield), 2902 Columbia Road, Madison 5, Wisconsin ... 1948
Moule, John W(illiam), 68 No. Oval St., Hamilton, Ontario, Canada ... 1948
*Muckley, Mrs. R. L. (Marion), 1335 Astor St., Apt. 9-A, Chicago 10, Illinois ... 1950
*Mudge, Edmund W., Jr., 5926 Averill Way, Dallas, Texas ... 1939
*Mueller, Mrs. Florence N., 4408 Pine St., Omaha 5, Nebraska ... 1951
Muhlbach, W(alt) L(auritz) 3821 So. Dakota Ave., N.E., Washington 18, D.C. ... 1951
Muir, Reverend James August, Kit Carson, Colorado ... 1953
Mumford, Russell E(ugene), 712 16th St., Bedford, Indiana ... 1949
*Munford, Dr. S(amuel A(rcher), 2 Highland Place, Clifton Springs, New York ... 1953
Munter, Rr. Adm. W(illiam) H(enry), 4518 52nd Ave., N.E., Seattle 5, Washington ... 1933
Murie, Adolph, Moose, Wyoming ... 1932
Murie, O(laus) J(ohan), Moose, Wyoming ... 1934
Murphy, Paul C(harles), 935 Goodrich Ave., Apt. 10, St. Paul 5, Minnesota ... 1944
Murray, Bertram George, Jr., 807 Mountain Ave., Bound Brook, New Jersey ... 1954
Murray, Reverend J(oseph) J(ames), 6 White St., Lexington, Virginia ... 1931
*Musselman, T(homas) E(dgar), 124 So. 24th St., Quincy, Illinois ... 1940
Myers, Buford M(acMartin), Jr., 45 Oakland St., New Orleans 23, Louisiana ... 1948
Myers, Richard F., Med. Detach., U.S. Army Hospital, Fort Leonard Wood, Mo. 1952

Neal, Mrs. Charles (Dorothy Phillips), Box 133, Demorest, Georgia ... 1946
Neff, Johnson Andrew, Bldg. 45, Denver Federal Center, Denver 2, Colorado ... 1920
*Nelson, Charles E(llsworth), Jr., 124 Oxford Road, Waukesha, Wisconsin ... 1937
Nelson, Gid E(dmund), Jr., Alabama College, Montevallo, Alabama ... 1953
Nelson, L(ewis) Wayne, 76 E. Main St., Columbus, New Jersey ... 1954
**Nelson, Theodora, 315 E. 68th St., New York 21, New York ... 1928
Nero, Robert William, Dept. of Zoology, Univ. of Wisconsin, Madison 5, Wisc. 1947
*Ness, Robert David, 17 Five Points Road, Rush, New York ... 1951
Nessle, James P., R.D. #1, Waterville, Ohio ... 1936
*Netting, M(orris) Graham, Carnegie Museum, Pittsburgh, 13, Pennsylvania ... 1941
Nevius, Mrs. Richard, R.D. #1, Greeneville, Tennessee ... 1940
New, John G., Conservation Dept., Fernow Hall, Cornell Univ., Ithaca, New York ... 1946
*Newberry, A(ndrew) Todd, 70 Rock Spring Road, West Orange, New Jersey ... 1952
Newman, Robert J(ames), Museum of Zoology, Louisiana State University, Baton Rouge, Louisiana ... 1950
Nice, Dr. 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 Road, Ridgewood, New Jersey ... 1933
*Nichols, John Treadwell, American Museum of Natural History, 79th St., & Central Park W., New York 24, New York ... 1941
*Nicholson, Donald John, 1224 Palmer St., Orlando, Florida ... 1945
Nickell, Walter Prine, Cranbrook Institute of Science, Bloomfield Hills, Mich. ... 1943
Nields, James F(ulton), Jr., Hardwick, Massachusetts ... 1949
*Nielsen, Mrs. B(eatrice) W(ise), R.D. #1, Box 808, Kauffman Ave., Nielsen Reservation, Red Bluff, California ... 1945
Nielsen, Joseph A(ustin), 253 Warren St., Brooklyn 31, New York ... 1954
Nighswonger, Paul F., R.D. #9, Alva, Oklahoma ... 1950
Nolan, James R., 14 Edgewood Road, Peekskill, New York ... 1954
Nolan, Val, Jr., 806 So. Henderson St., Bloomington, Indiana ... 1953
Nordgren, Robert, 79 Seymour Ave., S.E., Minneapolis 14, Minnesota ... 1951

Nordquist, Theodore C., 2701 York Ave., No., Robbinsdale 22, Minnesota 1941
Nork, Theodore J., 451 Wrightwood Ave., Chicago 14, Illinois 1947
Norman, Edward d'Aubigny, Box 221, Deerfield, Massachusetts 1951
Norman, James L(ee), c/o Bebb Floral Co., Muskogee, Oklahoma 1948
Norris, Robert Allen, Dept. of Zoology, Rutgers Univ., New Brunswick, New Jersey 1941
Norse, William J(ohn), 531 W. 211th St., New York 34, New York 1939
North, George W(ebster), 249 Charlton Ave., W., Hamilton, Ontario, Canada 1941
Northrop, Mrs. Harson A., 358 E. Main St., Owatonna, Minnesota 1952
Northrop, Myron, 9304 Sylvan Hills Road, North Little Rock, Arkansas 1945
Novaes, Fernando (da) C(osta), Rua Toneleiros 186, Apt. 303, Copacabana, Rio de Janerio, D.F., Brazil 1953
**Nowland, Paul J., 700 Equitable Bldg., Wilmington, Delaware 1950
Nyc, Fred F., Jr., General Delivery, McAllen, Texas 1943

Oberholser, Harry Church, 2933 Berkshire Road, Cleveland Heights, Cleveland 18, Ohio 1894
O'Callaghan, Terence C., Maromala R.D., Bay of Islands, Northland, New Zealand 1954
*Odum, Eugene P(leasants), Dept. of Zoology, Univ. of Georgia, Athens, Georgia 1930
Odum, Howard Thomas, Biology Dept., Univ. of Florida, Gainesville, Florida 1946
*Olsen, Dr. Richard E., 3325 Franklin Road, R.D. #3, Pontiac, Michigan 1938
*Olson. Mrs. Gladys Elizabeth (Mrs. Simon), 33 Harvard Drive, Lake Worth, Florida 1942
Olson, Mrs. Monrad J., Watford City, North Dakota 1946
O'Neil, Norah Selby (Mrs. Mike), 1311 Bonham St., Commerce, Texas 1949
*O'Reilly, Ralph A., Box 132, Davisburg, Michigan 1936
Orians, Reverend Howard L(ester), 1611 16th Ave., Monroe, Wisconsin 1947
Ott, Frederick L(ouis), 1358 No. 63rd St., Wauwatosa 13, Wisconsin 1941
Overing, Robert, R.D. #4, Raleigh, North Carolina 1930
Owen, Oliver S., Dept. of Biology, Bradley Univ., Peoria, Illinois 1953
Owre, Oscar T., Dept. of Zoology, Univ. of Miami, Coral Gables, Florida 1935

Packard, Christopher M., Portland Museum of Natural History, 22 Elm St., Portland, Maine 1951
Packard, Fred Mallory, 24 Elizabeth Lane, R.D. #2, Fairfax, Virginia 1949
Packard, Robert Lewis, 704 Maine St., Lawrence, Kansas 1954
Paine, Robert T(reat), III, 2 Hubbard Park, Cambridge 38, Massachusetts 1951
Palmer, Ralph S(imon), New York State Museum, State Education Bldg., Albany 1, New York 1934
Palmer, T(heodore) S(herman), 1939 Biltmore St., N.W., Washington, D.C. 1914
*Palmquist, Clarence O(scar), 834 Windsor Road, Glenview, Illinois 1945
Pangborn, Mark W(hite), 25 E. 56th St., Indianapolis, Indiana 1948
*Parkes, Kenneth Carroll, Carnegie Museum, Pittsburgh 13, Pennsylvania 1946
Parks, Richard Anthony, 2303 Pembrook Place, N.E., Atlanta, Georgia 1942
Parmelee, David F(reeland), 533 Harding, Iron Moutain, Michigan 1949
Partridge, William H., Belgrano 363, Caseros F.C.S.M., Buenos Aires, Argentina, South America 1953
Patton, Bradley M., 2126 Highland Road, Ann Arbor, Michigan 1953
Patton, Mrs. Bradley M., 2126 Highland Road, Ann Arbor, Michigan 1953
Paynter, R(aymond) A(ndrew), Jr., Museum of Comparative Zoology, Harvard University, Cambridge 38, Massachusetts 1946
Peelle, Miles L., 1039 College St., Adrian, Michigan 1940
Pearson, Mrs. Carl E. (Louise C[olter]), 632 No. Stone Ave., LaGrange Park, Illinois 1954
Peffer, Mrs. Thomas A., 49 W. Depot St., Hellertown, Pennsylvania 1954
Penner, Lawrence R., Dept. of Zoology & Entomology, Univ. of Connecticut, Storrs, Connecticut 1940
Perkins, Mrs. Mary Loomis, 1305 So. 52nd St., Omaha 6, Nebraska 1946
Peter, Julius C(hristian), 307 Ridgemont, Grosse Pointe Farms 36, Michigan 1953
Peterle, Tony J., Dept. of Natural History, Morischal College, Univ. of Aberdeen, Aberdeen, Scotland 1951

Peters, Arthur L(illibridge), R.D. #1, Ewen, Michigan ... 1954
Peters, Harold S(eymour), 968 Cumberland Road, N.E., Atlanta 6, Georgia ... 1924
Peters, Stuart S., c/o Paul Griffin, R.D. #2, Freeville, New York ... 1952
*Petersen, Arnold J(erome), 712 W. Third St., Northfield, Minnesota ... 1949
Petersen, Paula R. (Mrs. Pete C.), 620 E. 30th St., Davenport, Iowa ... 1952
Petersen, Peter C., Jr., 620 E. 30th St., Davenport, Iowa ... 1951
Peterson, Alfred, Box 201, Brandt, South Dakota ... 1931
Peterson, Mrs. C(harles) E(mil), Madison, Minnesota ... 1936
**Peterson, Roger Tory, Neck Road, Old Lyme, Connecticut ... 1942
Petrides, George A., Division of Conservation, Michigan State College, East Lansing, Michigan ... 1942
Petroskey, Miss Helen Martha, Box 7, Hiram, Ohio ... 1949
**Pettingill, Olin Sewell, Jr., Wayne, Maine ... 1930
Pettit, Lincoln C(oles), Box 217, Hiram, Ohio ... 1948
Peugh, Miss Marguerite M(ary), Apartado 16, Mantemorelos, N.L., Mexico ... 1951
**Phelps, William H(enry), Apartado 2009, Caracas, Venezuela, South America ... 1940
**Phillips, Allan Robert, 113 Olive Road, Tucson, Arizona ... 1934
*Phillips, Cyrus Eastman, II, 255 Polk St., Warsaw, Illinois ... 1944
*Phillips, Homer Wayne, 2110 Morse St., Houston 19, Texas ... 1947
Phillips, Richard S(tuart), 834 Liberty St., Findlay, Ohio ... 1944
Phillips, William B(utterworth), 137 W. 81st St., New York 24, New York ... 1951
Pielou, William P(ercival), 1549 Ann St., East Lansing, Michigan ... 1954
*Pieratt, J(ames) F(rancis), 809 W. Otoe, Ponca City, Oklahoma ... 1953
Pierce, Fred J(ohn), Winthrop, Iowa ... 1947
*Pierce, Robert Allen, Dept. of Fish & Wildlife Resources, Division of Game, Frankfort, Kentucky ... 1941
*Pirnie, Miles David, Conservation Bldg., Michigan State College. East Lansing, Michigan ... 1928
Pistorius, Alan P(hil), 820 Ironwood St., Burlington, Iowa ... 1954
*Pittman, James Allen, Jr., 1138 Overbrook Drive, Orlando, Florida ... 1945
Plaisted, Walter William, 95 Newcomb Road, Tenafly, New Jersey ... 1949
Plath, Karl, 110 So. Wesley Ave., Oak Park, Illinois ... 1942
Pomeroy, Lawrence R., New Jersey Oyster Research Laboratories, Bivalve, New Jersey ... 1948
Ponshair, Jim F(rancis), White Way Farm, R.D. #1, Hudsonville, Michigan ... 1954
*Poole, Cecil A(very), 1764 Topeka Ave., San Jose 26, California ... 1942
*Poor, Hustace Hubbard, 7 Colonial Court, New Canaan, Connecticut ... 1935
*Porter, Dr. Eliot F(urness), R.D. #1, Box 33, Santa Fe, New Mexico ... 1947
Porter, Richard Dee, Ecological Research Bldg., 4050-D Area, Dugway, Utah ... 1950
Porter, T(homas) Wayne, Dept. of Zoology, Michigan State College, East Lansing, Michigan ... 1938
Potter, David M., 1557 Timothy Dwight College, Yale Univ., New Haven 11, Connecticut ... 1946
*Potter, Mrs. George C. (Beatrice B[rown]), 2111 Malvern Road, Charlotte 7, North Carolina ... 1948
Potter, Julian K(ent), 437 Park Ave., Collingswood 7, New Jersey ... 1915
Potter, Louis Henry, R.D. #1, West Rutland, Vermont ... 1941
**Pough, Richard H(ooper), 33 Highbrook Ave., Pelham 65, New York ... 1938
*Prather, Millard F(illmore), P.O. Box 599, Fairfield, Alabama ... 1940
Prescott, Kenneth Wade, Kansas City Museum, 3218 Gladstone Blvd., Kansas City, Missouri ... 1946
Preston, Frank W(illiam), Box 149, Butler, Pennsylvania ... 1948
*Prucha, Miss Alma H., 1716 No. Prospect Ave., Milwaukee 2, Wisconsin ... 1942
Pruitt, Mrs. William O., Jr., (Erna Nauert), Arctic Aeromedical Laboratory, Ladd Air Force Base, Fairbanks, Alaska ... 1948
Puett, Miss May Wilson, P.O. Box 2183, Greenville, South Carolina ... 1950
Pusey, Miss Catherine, 921 No. Anthony Blvd., Fort Wayne 3, Indiana ... 1953
Putman, William L(loyd), Dominion Entomological Laboratory, Vineland Station, Ontario, Canada ... 1945
Putnam, Mrs. Evelyn J., 1407 Woodland Ave., Duluth 3, Minnesota ... 1951
Putnam, Loren Smith, Dept. of Zoology, Ohio State Univ., Columbus 10, Ohio ... 1942

Quam, Mrs. Mary Battell, Box 716, Paoli, Pennsylvania 1944
Quay, Thomas L., Zoology Dept., North Carolina State College, Raleigh, North Carolina 1939
Quay, W(ilbur) B(rooks), Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan 1949
Quilliam, Mrs. H(elen) R(ose), 86 Brock St., Kingston, Ontario, Canada 1953
Quimby, Don C., Dept. of Zoology & Entomology, Montana State College, Bozeman, Montana 1942

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Rahe, Carl W., 9005 Tioga Ave., Cleveland 5, Ohio 1931
Ramey, Ralph E(merson), Jr., 2213 Century Drive, Columbus 11, Ohio 1948
Ramisch, Miss Marjorie (Viola), 1835 Noble Road, East Cleveland 12, Ohio 1943
Ramsay, A(lfred) Ogden, McDonogh School, McDonogh, Maryland 1949
Rand, Austin L., Chicago Natural History Museum, Roosevelt Road & Lake Shore Drive, Chicago 5, Illinois 1950
*Randall, Clarence B(elden), 38 So. Dearborn St., Chicago, Illinois 1949
Randall, Robert Neal, 928 16th St., Bismarck, North Dakota 1939
Randle, Worth S., Box 63, Cincinnati 20, Ohio 1949
Rapp, William F(rederick), Jr., 430 Ivy Ave., Crete, Nebraska 1941
*Rausch, Dr. Robert (Lloyd), U.S. Public Health Service, Box 960, Anchorage, Alaska 1947
Raymond, Richard C., R.D. #9, Garrison, New York 1953
Rea, Gene, 251 Leland Ave., Columbus 2, Ohio 1948
Read, Bayard W(hitney), Upper Dogwood Lane, Rye, New York 1949
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Reed, Parker Crosby, 27 Hayes Ave., Lexington, Massachusetts 1949
Reeder, Miss Clara Maude, 1608 College Ave., Houghton, Michigan 1938
Rees, Earl Douglas, 1504 No. Main St., Findlay, Ohio 1946
Reese, C(arl) R(ichard), 266 E. Dunedin Road, Columbus 14, Ohio 1948
*Reese, Mrs. Hans H. (Teresa S.), 3421 Circle Close, Shorewood Hills, Madison 5, Wisconsin 1941
Regan, Mrs. Frances M(aass), 113-19 Colfax St., Queen Village, New York 1948
*Rehfisch, Miss Carol, 335 Delgado, Santa Fe, New Mexico 1949
*Reichert, Miss Elsa, Mirakel Repair Co., 14 W. First St., Mt. Vernon, New York 1950
*Reilly, E(dgar) M(ilton), Jr., P.O. Box 34, Old Chatham, New York 1946
Rett, Egmont Z(achary), Museum of Natural History, Santa Barbara, Calif. 1940
Reuss, Alfred Henry, 2908 Edison St., Blue Island, Illinois 1936
Reynard, George B., 728 Parry Ave., Palmyra, New Jersey 1950
Reynolds, William Pius, 1330 Foulkrod St., Philadelphia 24, Pennsylvania 1948
Rice, Dale (Warren), Biology Dept., Univ. of Florida, Gainesville, Florida 1946
Rice, Mrs. Donald (Mary J.), 31 Warren Ave., Woburn, Massachusetts 1954
Rice, Orville O(wen), 708 Lindenwood, Topeka, Kansas 1953
Rich, Mrs. Eva, 150 W. 80th St., New York 24, New York 1952
Richards, Tudor, "Hurricane Farm," Keene, New Hampshire 1951
Richardson, E(dgar) P(reston), 734 Glynn Court, Detroit 2, Michigan 1954
Richdale, Lancelot Eric, 23 Skibo St., Kew, Dunedin, S.W. 1, New Zealand 1945
Richter, Carl H., 703 Main St., Oconto, Wisconsin 1947
Richter, Dr. G(eorge) William, 231 E. Main St., Canfield, Ohio 1954
Ricker, W(illiam) E(dwin), Pacific Biological Station, Naniamo, British Columbia, Canada 1943
Rieffenberger, Joe, Room 305, Guaranty Bldg., Parkersburg, West Virginia 1954
Riggs, Carl D(aniel), Dept. of Zoology, Univ. of Oklahoma, Norman, Oklahoma 1943
Riggs, Miss Jennie, 3313 Fairmont Drive, Nashville 5, Tennessee 1952
Rimsky-Korsakoff, V(ladimir) N(icholas), Box 735, Center Moriches, L.I., New York 1951
Ripley, S(idney) Dillon, II, Peabody Museum, New Haven 46, Connecticut 1946
Risebrough, Robert W., Box 224, Richmond Hill, Ontario, Canada 1952
Rising, Gerald R(ichard), 72 Allen's Creek Road, Rochester 18, New York 1953
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Roberts, Harold D., 610 Harrison St., Black River Falls, Wisconsin 1946
Robins, C(harles) Richard, Dept. of Conservation, Fernow Hall, Cornell Univ. Ithaca, New York 1949
Robinson, Thane S., Museum of Natural History, Univ. of Kansas, Lawrence, Kansas 1952
Rocheleau, David H., 131 Benton St., Cheboygan, Michigan 1954
Roesler, M. Stuart, June Road, Cos Cob, Connecticut 1949
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Rogers, K(ay) T(rowbridge), Dept. of Zoology, Oberlin College, Oberlin, Ohio 1952
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Rogers, Mrs. Walter E., 911 E. North St., Appleton, Wisconsin 1931
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Root, Richard Bruce, 265 Ann St., Plymouth, Michigan 1953
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Rosche, Richard Carl, 48 Dartmouth Ave., Buffalo 15, New York 1953
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Rosewall, O(scar) W(aldemar), Dept. of Zoology, Louisiana State Univ., Baton Rouge 3, Louisiana 1931
Rositzky, Simon, 1605 Ashland Blvd., St. Joseph, Missouri 1953
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Ross, James B., 2408 Westminster Way, N.E., Atlanta 6, Georgia 1949
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Schaeffer, David A(lan), 405 Pine St., West Reading, Pennsylvania 1949
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Schley, Mrs. Sue S. (Mrs. F. B.), 1352 Peacock Ave., Columbus, Georgia 1952
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Searles, Scott, Dept. of Chemistry, Kansas State College, Manhattan, Kansas 1951
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Seibert, Robert F(rederick), 17 Canoe Brook Road, Short Hills, New Jersey 1954
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Short, Lester L(eRoy), Jr., 179 John St., Ilion, New York 1953
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Sieh, James G(erald), Biology Bldg., Okoboji, Iowa 1948
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Simon, Stephen Wistar, Blue Mount Road, Monkton, Maryland 1947
Simpson, Doris Cullings (Mrs. Thomas W.), 3252 Reynolda Road, Winston-Salem, North Carolina 1953
Singleton, Albert Roland, 3968 Marburg Ave., Cincinnati 9, Ohio 1948
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Skelton, Mrs. Kathleen, 353 W. 57th St., New York 19, New York 1949
Skutch, Alexander F(rank), San Isidro del General, Costa Rica, Central America 1944
Slack, Miss Mabel, 1004 Everett Ave., Louisville 4, Kentucky 1934
Smalley, Alfred E(vans), Dept. of Biology, Univ. of Georgia, Athens, Georgia 1946
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Smith, Miss Marion L(ucille), 429 So. Willard St., Burlington, Vermont 1949
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Snyder, Dana Paul, Section of Mammals, Carnegie Museum, Pittsburgh 13, Pennsylvania 1949
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Sooter, Clarence Andrew, U.S. Public Health Service, P.O. Box 625, Greeley, Colorado 1946
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Southern, William, Clare, Michigan 1954
Spangler, Miss Iva M., 128 E. Foster Pkwy, Fort Wayne, Indiana 1939
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Speirs, Mrs. Doris Huestis, "Cobble Hill", R.D. #2, Pickering, Ontario, Canada 1936
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Sperry, Charles Carlisle, 1455 So. Franklin St., Denver 10, Colorado 1931
Spofford, Walter R(ichardson), II, Dept. of Anatomy, Syracuse Medical College, Syracuse 10, New York 1942
Stabler, Robert M(iller), Colorado College, Colorado Springs, Colorado 1939
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*Stahl, Miss Marjoretta Jean, Kimberly, West Virginia 1942
Stallcup, William B., Biology Dept., Southern Methodist Univ., Dallas, Texas 1951
Stamm, Mrs. Frederick W. (Anne L.), 2118 Lakeside Drive, Louisville 5, Kentucky 1947
Stark, Miss Wilma R(uth), 2900 Adams Mill Road, N.W., Apt. 303, Washington 9, D.C. 1939
Starrett, William C(harles), Illinois State Natural History Survey, R.D. #2, Havana, Illinois 1933
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Stauffer, James Milton, 144 So. Sawyer, Shawano, Wisconsin 1949
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Stearns, Edwin I(ra), Jr., 601 Lake Ave., Wilmette, Illinois 1945
Steel, William C., 551 Morningside Drive, Miami Springs, Florida 1952
Steffen, Earnest William, 1000 Maplewood Drive, Cedar Rapids, Iowa 1944
Steilberg, Robert H., 555 Sunset Road, Louisville 6, Kentucky 1949

Stein, Robert C., Laboratory of Ornithology, Fernow Hall, Cornell Univ., Ithaca, New York 1951
Steirly, Charles C., Waverly, Virginia 1954
Stephens, Miss Nancy Ann, Glen-Nell Hotel, McConnellsburg, Pennsylvania 1953
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Stevens, Charles E(lmo), Jr., 426 Second St., N.E., Charlottesville, Virginia 1947
Stevens, O. A., State College Station, Fargo, North Dakota 1926
Stevenson, Henry M(iller) Jr., Dept. of Zoology, Florida State Univ., Talahassee, Florida 1943
Stevenson, James O(sborne), Fish & Wildlife Service, Dept. of the Interior, Washington 25, D.C. 1933
Steward, Orville M(ilton), P.O. Box 19, Fordham Branch, Bronx 58, New York 1950
Stewart, James R(ush), Jr., 534-C Stephenson St., Shreveport, Louisiana 1954
*Stewart, Miss Mildred, 2219 Devonshire Drive, Cleveland 6, Ohio 1949
Stewart, Paul A(lva), 8640 No. State St., Westerville, Ohio 1925
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Stillwell, Jerry E., R.D. #2, Fayetteville, Arkansas 1935
*Stine, Miss Perna M., R.D. #5, Olney, Illinois 1931
**Stoddard, Herbert Lee, Sherwood Plantation, R.D. #5, Thomasville, Georgia 1916
Stoerman, Frank A., 1721½ Westport Road, Kansas City 2, Missouri 1952
Stokes, Allen W., Dept. of Wildlife Management, U.S.A.C., Logan, Utah 1950
Stone, Rudolph Heger, 171 Cabot St., Holyoke, Massachusetts 1954
Stoner, Emerson A(ustin), 285 E. "L" St., Box 444, Benicia, California 1947
**Stoner, Lillian C. (Mrs. Dayton), 399 State St., Albany 6, New York 1945
Stophlet, John J(ermain), 2612 Maplewood Ave., Toledo 10, Ohio 1934
Storer, Robert Winthrop, Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan 1938
**Storer, Tracy I(rwin), Division of Zoology, Univ. of California, Davis, California 1928
Straw, Richard M(yron), Rancho Santa Ana Botanic Garden, Claremont, California 1947
Strecker, Robert L(ouis), Zoology Dept., Miami Univ., Oxford, Ohio 1949
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Stringham, Emerson, Box 986, Kerrville, Texas 1940
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Struthers, Dana R., 4858 Fremont Ave., So., Minneapolis 9, Minnesota 1948
Stuart, Mrs. Marjorie H(offman) (Mrs. Glen), R.D. #1, Wakita, Oklahoma 1954
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Stupart, Miss Barbara, 48 Russell Hill Road, Toronto, Ontario, Canada 1952
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Summerfield, Donald, R.D. #1, Box 4, Valley Station, Kentucky 1952
Sundell, Robert A(rnold), 94 Main St., Frewsburg, New York 1951
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Suthers, Roderick A(tkins), 129 Griswold St., Delaware, Ohio 1954
Suttkus, Royal Dallas, Zoology Dept., Dinwiddie Hall, Tulane Univ., New Orleans 18, Louisiana 1947
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Swanson, Gustav A., Fernow Hall, Cornell Univ., Ithaca, New York 1927
Swedenborg, Ernie D(avid), 4905 Vincent Ave., So., Minneapolis 10, Minnesota 1929
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Talvila, Elmer, 109 Kingsmount Park Road, Toronto 8, Ontario, Canada 1954
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Tanghe, Leo J(oseph), 852 Stone Road, Rochester 16, New York 1943
Tanner, James Taylor, Dept. of Zoology, Univ. of Tennessee, Knoxville 16, Tennessee 1937
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Taylor, Mrs. Charlotte M(orley), (Mrs. William E.), 4667 Ironwood, Saginaw, Michigan 1954
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Thomas, Edward S(inclair), Ohio State Museum, Columbus 14, Ohio 1921
Thomas, Landon B(aillie), P.O. Box 141, Edgerton, Wisconsin 1947
Thomas, Lester S(t. John), Richboro Road, Churchville, Pennsylvania 1954
Thomas, Mrs. Rowland (Ruth H.), 410 E. Green St., Morrillton, Arkansas 1937
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Thoren, Rollin Karl E., 431 E. Ridge, Marquette, Michigan 1953
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**Thorp, George B(oulton), 556 Abbott Ave., Ridgefield, New Jersey 1935
Throne, Alvin L., Wisconsin State College, Milwaukee 11, Wisconsin 1949
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Tipton, Dr. Samuel R(idley), 1415 W. Adair Drive, Fountain City, Knoxville 18, Tennessee 1941
*Todd, Mrs. Elizabeth D. (Mrs. Paul H.), 918 W. Main St., Kalamazoo 48, Michigan 1939
Todd, George K(endall), 809 W. 25th St., Cheyenne, Wyoming 1943
Todd, W(alter) E(dmond) Clyde, Carnegie Museum, Pittsburgh 13, Pennsylvania 1911
Tomer, John S(haffer), 4045 E. 27th St., Tulsa, Oklahoma 1954
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Townsend, Mrs. Viola Louise, 308 Park Ave., Watseka, Illinois 1954
Trainer, John E(zra), Dept. of Biology, Muhlenberg College, Allentown, Pennsylvania 1952
**Trautman, Milton B(ernhard), Stone Laboratory, Put-in-Bay, Ohio 1932
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Troutman, (Kenneth) Roger, R.D. #1, Wooster, Ohio 1954

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Tucker, James M(itchell), Paoli, Indiana 1953
Tucker, Robert Edward, 245 No. Auburndale, Memphis, Tennessee 1942
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Wagner, Miss Esther E., 22 Golden Hill, Bethel, Connecticut 1937
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Walker, M(yrl) V(incent), Zion National Park, Springdale, Utah 1943
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*Weber, Louis M(arkus), Sherman, Missouri 1941
Webster, Clark G(ibbons), Patuxent Research Refuge, Laurel, Maryland 1948
Webster, J(ackson) Dan, Hanover College, Hanover, Indiana 1939
Webster, Miss Lois E., 314 W. Division St., Dodgeville, Wisconsin 1953
Weigele, Miss Clara Marie, 228 Erman Court, Trenton, New Jersey 1954
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Weiser, Virgil Leonard, 1106 Third St., N., Fargo, North Dakota 1946
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Welles, Mrs. George M., R.D. #1, Elmira, New York 1938
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Weston, Henry G(riggs), Jr., Dept. of Biology, Grinnell College, Grinnell, Iowa 1947
Wetherbee, David K(enneth), 11 Dallas St., Worcester, Massachusetts 1947
**Wetmore, Alexander, U.S. National Museum, Washington 25, D.C. 1903
*Weydemeyer, Winton, Fortine, Montana 1930
Weyer, Albert E., Firestone Plantations Co., Liberia, West Africa 1949
Weyl, Edward Stern, 3827 The Oak Road, Philadelphia 29, Pennsylvania 1927
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*Yeaton, H(arold) B(allard), 12908 Riverside, Van Nuys, California 1951
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Young, J. Addison, II, 60 Argyle Ave., New Rochelle, New York 1942
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BY JANE S. MENGEL

In addition to names of species and authors, this index includes references to the following topics: anatomy, albinism, behavior, display, embryology, food, fossils, hybrids, measurements, migration, nesting, physiology, predation, pterylosis, releasers, taxonomy, voice, and weights. Also included are references of biological significance to amphibians, mammals and reptiles. Names of new forms described in this volume are printed in **boldface** type.

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