University of Kansas Publications

Museum of Natural History

VOLUME 3 · 1951

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Museum of Natural History
UNIVERSITY OF KANSAS
LAWRENCE
1951

Museum of Natural History

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LAWRENCE

PRINTED BY
FERD VOILAND, JR., STATE PRINTER
TOPEKA, KANSAS
1951

24-1811

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BY

ROLLIN H. BAKER

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Volume 3, No. 1, pp. 1-359, 16 figures in text
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One of fifty copies printed
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University of Kansas
LAWRENCE
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MUSEUM OF NATURAL HISTORY.—E. Raymond Hall, Chairman, Editorial Committee.

This series contains contributions from the Museum of Natural History.

Cited as Univ. Kans. Publ., Mus. Nat. Hist.

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University of Kansas Publications, Museum of Natural History

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University of Kansas
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PRINTED BY
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22-8131

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CONTENTS

FIGURES IN TEXT

INTRODUCTION

Birds in Micronesia comprise the most outstanding animal life of the islands, as far as vertebrates are concerned. No fewer than 206 kinds, belonging to 37 families and 91 genera have been found there. Although this number upon first consideration may seem large, actually any large land mass in the same latitude has many more kinds of birds than does Micronesia. In this connection it is pertinent to recall that the islands of Micronesia are oceanic and have apparently been formed independently of any continental land mass. Thus, animal life found on these islands has reached them by overseas migration, either by some passive means or by individual effort. Zoogeographers have had some difficulty in explaining the presence of snails and other nonflying animals on isolated oceanic islands. Crampton, in his studies of the land snails of the genus *Partula* at Guam and Saipan (1925:10), writes, "Despite the geological difficulties, the biological findings strongly support the view that the dominant process in this part of Oceania has been one of subsidence and of insular dissection." Although there exists today some question as to how certain forms of life have reached these remote dots of land, the ornithologist has not been much in doubt as to the actual *means* of arrival of birds. With the exception of six kinds of birds which are definitely known to have been introduced by man, the birds have apparently reached these islands by flying there from somewhere else. The ornithologist is, therefore, concerned with learning *from where, by what route, when,* and *why* the various species of birds came and *how* they have become established on these islands of Micronesia. These birds exist in small populations; often less than 100 individuals of one kind may be found on a small island. How have such small numbers had the ability to survive and what environmental adaptations have occurred, are two additional questions which confront the student of Micronesian birds.

DESCRIPTION OF MICRONESIA

The vast expanse of the Pacific Ocean is dotted with numerous islands, most of which are concentrated in the central and western part and are known collectively as Oceania. Within Oceania three divisions are popularly recognized: Melanesia, Polynesia, and Micronesia. According to Krieger (1943:6), the Micronesia islands include the Mariana, Palau, Caroline, Marshall, and Gilbert islands; they may take in also the Volcano, Bonin, and Ellice islands (from the standpoint of anthropology). Zoogeographically, according to Wallace (1876), Micronesia is to be included in the Polynesian Subregion of the Australian Region. Mayr (1941a:193), on the basis of the distribution of birds, ranks Micronesia as one of the four subdivisions of the Polynesian Subregion, and includes within Micronesia the Palau, Caroline, Mariana, Marshall, and Gilbert islands. Except in the discussion of distribution, this report does not treat of the avifauna of the Gilbert Islands, which straddle the equator south of the Marshall Islands. This report is concerned only with the birds in the Mariana, Palau, Caroline, and Marshall islands formerly mandated to Japan, and with the birds of the island of Guam, which is a possession of the United States.

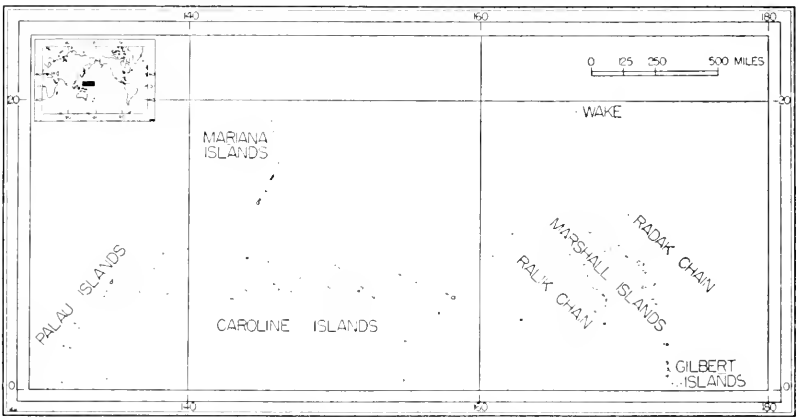

FIG. 1. The Islands of Micronesia

The word Micronesia is, of course, derived from the Greek words *mikros* meaning small and *nesos* meaning island, and, as shown in figure 1, this term is appropriate, for the islands of this area are small. For the most part they are too small even for inclusion on standard-sized maps of the world. There are thousands of these islands in an area some 2,400 miles long from east to west and some 1,200 miles broad from north to south. All of the islands of Micronesia are oceanic islands; that is to say, they have never been connected to the Asiatic continent or to other land masses by means of land bridges.

Geologists and oceanographers have shown (see descriptions by Hobbs, 1945), that islands of Micronesia are of two general types: arcuate and strewn. The Pacific Ocean is surrounded by rising mountain ranges which are arranged in elongated, near-circular arcs, which form an extended series of scallops. In the western Pacific these sweeping arcs extend into the ocean, where the mountain ranges project upward from the bottom of the sea with only the crests showing above the waves to point out, in dotted outline, the position of the mountains. The easternmost of these arcs is marked by the islands of the Aleutians, Kuriles, Japan, Izo, Bonins, Volcanoes, Marianas, Yap, Palaus, and others continuing southward into Melanesia. These are characterized by igneous rocks of andesitic nature.

To the eastward of the arcuate islands in Micronesia, are numerous and irregularly distributed islands, making up all of the central and eastern Carolines and the Marshalls, which are known as strewn islands. Strewn islands mark the places of former volcanoes or volcanic peaks. If these volcanic peaks have been completely drowned and are now marked by a series of low islands edged by a protecting reef formed by coral growth enclosing a lagoon and with all exposures consisting of coral rock, the island is known as a coral atoll (example, Ulithi Atoll). Some of the coral exposures lack lagoons; they are known merely as coral islands (example, East Fayu). Some atolls become elevated by geologic activity and the lagoons may dry out or drain. The accumulation of guano of oceanic birds and the residue of fish and other organisms in the area of the lagoon remains as a rich phosphate deposit; these raised atolls have been called phosphate islands (example, Fais). Other strewn islands consist of igneous rocks which are exposed above the surface of the ocean. These are known as "high" or volcanic islands and may occur as a single mountain rising out of the ocean (example, Kusaie), or be partly drowned and surrounded by a coral reef (example, Truk). The igneous rocks found on these strewn islands are basaltic in nature.

The Mariana Islands consist of a chain of volcanic islands approximately 450 miles long. As shown in figure 2, there are 14 single islands and one group of three islands (Maug), from Uracas in the north to Guam in the south. The Palau Islands which are situated in the easternmost part of Micronesia have often been considered from a political standpoint as part of the Caroline Islands. As shown in figure 3, the Palau Islands are a chain of islands approximately 120 miles long from north to south. Sonsorol, Tobi, Merir, Pulo Anna, and Helen Island occur to the southward of the Palaus and may be considered as part of the Carolines or as part of the Palaus. The Palaus together with the Carolines, to the eastward, extend in an east-west direction for approximately 1,700 miles. The Palaus and Carolines include (as shown in figures 3 and 4) 37 atolls, 34 banks, 11 coral islands without lagoons, 2 uplifted phosphate islands, 4 volcanic islands, and the Palau chain. The Marshall Islands to the extreme eastward extend approximately 700 miles from north to south and, as shown in figure 5, contain 29 atolls and five coral islands without lagoons. No volcanic exposures occur in the Marshall Islands.

There is a total land surface of approximately 846 square miles in the islands of Micronesia. The Palaus and Carolines have 525 square miles, the Marianas 247 square miles, and the Marshalls 74 square miles of land surface. Guam has the largest land surface of any of the islands of Micronesia with 225 square miles, Ponapé has 145 square miles, and Babelthuap has 143 square miles. Asuncion, in the northern Marianas, has the highest elevation, rising as an almost perfect cone to a height of 2,923 feet; Ponapé reaches a height of 2,579 feet above the sea level. The volcanic islands are known as "high" islands, and the coral atolls are known as "low" islands. The coral islands usually rise but a few feet above sea level.

Climate

In Micronesia there are two seasons: a wet summer and a dryer winter. Temperatures rarely go above 90° F. and rarely below 70° F. Rainfall in the Marianas averages approximately 85 inches per year, in the Palaus approximately 150 inches, in the Carolines it ranges from 129 to 185 inches, and in the Marshalls it goes up to 160 inches. The humidity is excessive, the average annual mean of relative humidity for selected islands in Micronesia being between 82 and 86 percent. The relative humidity is lower in the western Carolines and the Palaus, than in other parts of Micronesia.

The Mariana Islands lie between the area of the Asiatic monsoon and the belt of the northeast trade winds. At Saipan from November until March or April, winds usually are easterly or northeasterly and are strong and steady since the northeast trades and the winter monsoon reinforce each other. In April and May the directions of the winds shift toward the southeast, and they become weaker and more variable. In this period there may be some easterly winds in addition to the predominating southeasterly winds. Detailed information is not available on the winds which occur in the Marianas north of Saipan, but at Pagan easterly winds probably prevail from May to July and westerly winds prevail in the remainder of the year. The Carolines lie in the belt of alternating northeast trade winds and southwest monsoons. The northeast trades begin in October and prevail until May or June. The southwest monsoon occurs from May to October and may be felt as far east as Truk. To the eastward, the winds of the summer are usually light and variable. In the Marshall Islands, the northeast trade winds predominate from about December to April, especially in the northern part of the Marshalls. In summer, winds are variable and weak; periods of calm may occur. Typhoons and squalls occur most frequently in the spring and summer in Micronesia. Some of the severe typhoons are known to engulf entire islands, as did the one at Woleai in 1907.

SOILS

The soils of the islands of Micronesia have been derived from volcanic materials or from depositions of coralline limestone. Volcanic soils occur on the "high" islands of Micronesia. In many places, especially on the islands of the northern Marianas there is little soil; there are large areas of bare igneous rock, because the islands are geologically of relatively recent origin and little erosion has occurred. On islands where volcanic rocks have decomposed, the resulting soil may have a top layer of humus. The richest soils of the islands are along drainage areas and in alluvial deposits.

Coralline soils result from the decomposition of limestone, coral fragments, shells, and sand, and are overlain by some humus. Where the layer of humus is deep, the fertility is greatest. Coralline-volcanic soils occur on some "high" islands where coral rock and volcanic rock have become mixed in the decomposition process which forms soil. In parts of the Marianas and elsewhere, unwise practices of burning and overgrazing have allowed extensive erosion to occur, resulting in reduced fertility of the soil. On the island of Yap certain sedimentary rocks are exposed which are thought to have been elevated from the ocean bottom. Soils at Yap which have developed from this rock are considered more fertile than soils of coralline origin, although the fertility there also is dependent on the depth of the layer of humus.

SURFACE WATER

There is little fresh water on the coral atolls, but brackish marshes are present on some islands, and many of these marshes are used for the cultivation of taro by the natives. Some volcanic islands, on the other hand, possess small streams and fresh water lakes, producing suitable habitat for certain rails, gallinules and ducks. On the "low" islands in the Marshalls, natural surface pools are rare.

VEGETATION

The "high" islands of Micronesia support a heavy cover of vegetation. Typically the lowlands and stream courses are covered with dense jungle vegetation, and the slopes and higher hills are covered with grasses and brush. The vegetation of the "low" coral atolls and islands is, by comparison, much less dense. Many shorelines are covered with scant grasses and shrubs and the interior in many places is dominated by coconut, betel palms, breadfruit, papaya, and pandanus. References to papers dealing with plants in the islands of the Pacific may be obtained in Merrill (1945), who (1945: 207) writes, "Botanically, the low islands are very uninteresting and monotonous. The flora of one is usually quite the same as that of another, although these islands and islets may be separated by many hundred and in some cases several thousand miles. The native vegetation may be scanty or reasonably well developed, depending on the size of the island, the quality of its soil, and whether or not it is permanently inhabitated." Of the vegetation on the "high" islands of the Pacific area, Merrill (1945:209) comments that the vegetation "is well developed, particularly within the forested areas, but for these high islands within the Pacific basin as a whole, the number of endemic genera is relatively small and most of them have definite relationships with those of Malaysia." Concerning the "high" islands of Micronesia, Merrill (1945:210) remarks that these islands are smaller and more isolated than some of the others in Oceania and have fewer individual species "as compared with what one finds on islands of a similar size located within limits of the Malay Archipelago. Thus with all of the islands under Japanese mandate, and including a number of high, but at the same time relatively small islands, less than 1,300 different species are known, of which 230 manifestly represent purposely or accidentally introduced ones. This relatively small flora includes representatives of approximately 620 genera in 192 families. . . . Specific endemism is relatively high, for approximately 460 species are confined to the islands within the area under consideration. The generic endemism is very low; about seven endemic genera only are involved for the whole group." The figures for endemism of plants are comparable to those for birds. Of endemic birds there are 5 genera, 35 species, and 73 subspecies. The total number of species of birds known from Micronesia is only 206 as compared with 1,300 plants. Yamada (1926:966) writes that the number of species of plants that Micronesia has in common with Japan may be due to the influence of the "Japan Stream."

Many land birds in Micronesia depend directly on the plant life for food. Possibly the soil (including its mineral content), upon which the plants themselves depend for development of fruits and other edible parts, may offer a limiting factor to the distribution of birds in Micronesia. Possibly the fruits and other edible parts of plants do not provide the necessary amounts of proteins, carbohydrates, minerals, vitamins, and other essential food items for species of plant-eating birds, which have not become established in Micronesia. Possibly some species of plant-eating birds have reached Micronesia but have failed to establish themselves because of some dietary deficiency caused by poverty of the soils on which the plants grow. If a comparison were made of soils and of the food values of fruits of plants in both the islands of Micronesia and similarly sized islands in the Malay region, a difference might be revealed which would partly explain why some plant-eating birds have not become established in Micronesia.

GAZETTEER OF ISLANDS OF MICRONESIA

In the following list the name in current usage for each island or island group in Micronesia is followed by other names which have been used. There is no attempt made to list the names of the small islands of each atoll or those of the myriads of small islets that lie offshore from the larger volcanic islands. Collections have not been made on most of the smaller islands. For the few on which a species has been collected, the islet is adequately described in the account of the particular species concerned. The reader may refer to Brigham (1900) for a listing of the islands of the Pacific Ocean. Most of the islands included in the following list may be located on the map of Micronesia as shown in figures 2, 3, 4, and 5. These listings follow in order of arrangement those in the Civil Affairs Handbooks, published by the United States Navy Department (1943, 1944a, 1944b, and 1944c).

MARIANA ISLANDS

The Mariana Islands (also called Ladrone, Marianne, Marian) consist of 14 single islands and one group of three islands. The Marianas are all "high" or volcanic islands. The islands, shown in figure 2, are listed as follows:

Agrihan (also called Agrigan, Arijan, Francisco Xavier, Granger, Gregus, Grigan, San Francisco Javier).

Agiguan (also called Agaigan, Agiigan, Agiguan, Agigwan, Aguigan, Aguijan, Aguyan, Guigan, Saint Ange, Santa Angel).

Alamagan (also called Almagan, Aramagan, Concepcion).

Anatahan (also called Anatagen, Anatajen, Anataxan, San Joaquin).

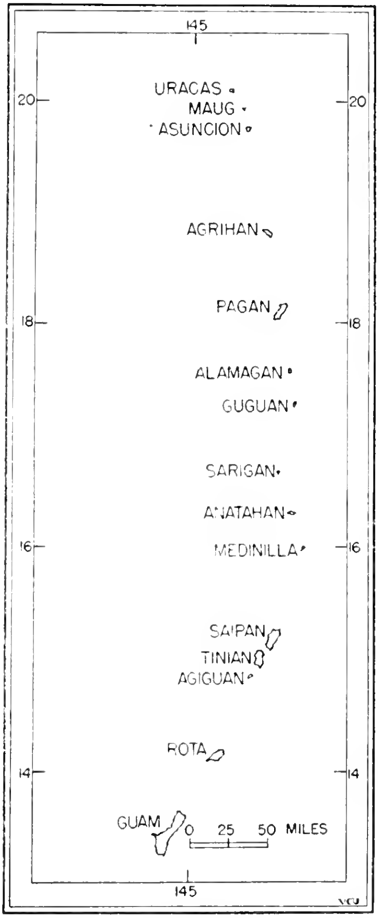

FIG. 2. The Mariana Islands.

Asuncion (also called Asonson, Assongsong, Assumption).

Guam (also called Guaham, Guahan).

Guguan (also called Guguwan, Guugwan, Piedras, San Felipe, St. Philippe).

Maug (also called Mang, Mangs, Mauga, Monjas, Mougu, Saint Laurent, San Lorenzo, Tunas).

Medinilla (also called Bade, Bird, Farallon de Medinilla, Rocher).

Pagan (also called Pagon, Paygan, St. Ignace, San Ignacio).

Rota (also called Luta, St. Anne, Santa Ana, Sarpan, Satpana, Suta, Zarpane).

Saipan (also called (Saepan, St. Joseph, San José, Saypan, Siepan, Serpan, Seypan).

Sarigan (also called St. Charles, San Carlos, Sariguan, Sarigwan).

Tinian (also called Bona Vista, Buenavista, Temean, Tenian, Tiniamou).

Uracas (also called Guy Rock, Farallon de Pájaros, Pájaros, Urakasu).

PALAU ISLANDS

The Palau Islands (also called Arrecifos, Palaos, Paleu, Pally, Paloc, Pannog, Parao, Pelew) consist of 8 large islands, 18 smaller islands, and a large number of minute islets, all enclosed in a single reef system. The northern islands (Babelthuap and Koror) are of volcanic origin; the southern islands (Peleliu and others) are of coralline formation. Angaur, to the south of Peleliu,

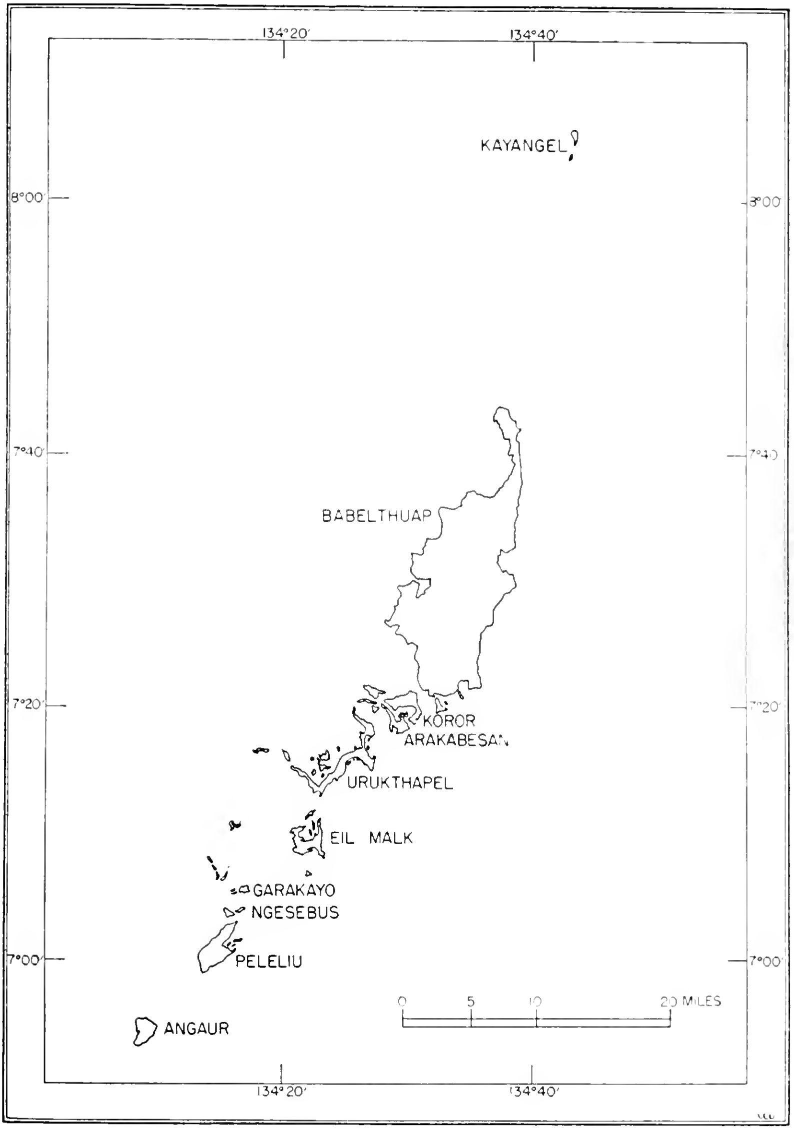

FIG. 3. The Palau Islands.

may be included with the Palau Archipelago. From the standpoint of the avian zoogeography, the coral islands or atolls of Kayangel, Merir, Pulo Anna, Sonsorol, and Tobi are also included. The principal islands, shown in figure 3, are listed below:

Arakabesan (also called Ngarekobasang).

Aurapushekaru (also called Aburashokoru, Auluptagel, Oluksakel, Oropushakaru).

Babelthuap (also called Babeldzuap, Babel Taob, Babelthouap, Baberthaob, Baberudaobu, Babldaob).

Eil Malk (also called Amototi, Cogeal, Irakong, Makarakaru).

Garakayo

Koror (also called Coror, Goreor, Kororu).

Malakal (also called Amalakell, Malaccan, Marakaru, Nanalake).

Ngabad

Ngesebus (also called Guadokusu).

Peleliu (also called Pelelew, Periryu, Pililer, Peliliu, Uler).

Urukthapel (also called Cape, Kuapasungasu, Ngurukdapel, Ulugeang, Uruktaaburu, Uruktapi).

Included with the Palau group because of proximity and relationships of the avifauna are the following:

Angaur (also called Angauru, Angyaur, Ngaur, Ngeour, N'Yaur).

Kayangel (also called Kadjangle, Kajanguru, Kazyanguru, Kianguel, Kreiangel, Moore, Ngajangel, Ngeiangel).

Merir (also called Marir, Meliel, Meriel, Meriru, Pulo Marier, Warren Hastings).

Pulo Anna (also called Anna, Bul, Bur, Current, Paola, Pul, Puru, Wull).

Sonsorol (also called St. Andrew, San Andreas, Sonesor, Songosor, Sonseron, Sonsol, Sonsoru, Tschontil).

Tobi (also called Codopuei, Johnstone, Kadogubi, Lectobis, Lord North, Nevil, Togobei, Tokobei).

CAROLINE ISLANDS

The Caroline Islands consist of 41 island clusters or isolated islands (exclusive of submerged coral reefs). These are of coral formation. They are atolls or single islands except for Yap, which is of sedimentary rock, and Kusaie, Ponapé, and Truk, which are of volcanic rock. The principal islands are shown in figure 4 and are listed as follows:

East Fayu (also called Fajo, Faliao, Lutké, Rukutee).

Eauripik (also called Aurepik, Eourpyg, Iuripik, Kama, Low, Yorupikku, Yuripik).

Fais (also called Astrolabe, Feis, Feys, Fuhaesu, Huhaesu, Tromelin, Woaje).

Faraulep (also called Faraulip, Faroilap, Fattoilap, Foroilap, Furaarappu, Gardner, Huraarappu).

Ifalik (also called Evalook, Faloc, Furukku, Hurukku, Ifalouk, Ifelug, Two Sisters, Wilson).

Kapingamarangi (also called Bakiramarang, Constantine, Greenwich, Guriinitchi, Kabeneylon, Kapenmailang, Makarama, Pikiram, Tenuv).

Kusaie (also called Arao, Armstrong, Experiment, Hope, Kusai, Kuschai, Kushai, Kuthiu, Oualan, Quollen, Strong, Teyoa, Ualan, Walang).

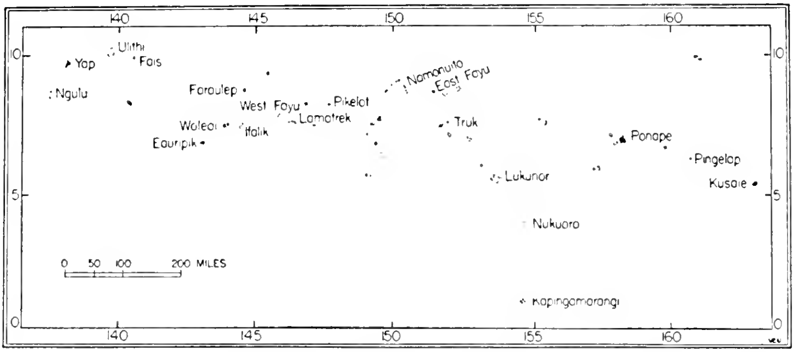

FIG. 4. The Caroline Islands.

Lamotrek (also called Lamorsu, Lamureck, Lamutrik, Low, Namotik, Namotikku, Manochikku, Namurrek, Swede).

Lukunor (also called Lemarafat, Lougoullos, Lougounor, Luganor, Lugunor, Lugunoz, Mortlock, Namonefeng, Rukunoru, Youngwilliam).

Namonuito (also called Anonyma, Baxos de San Bartolomeo, Bunkey, Las Hermanas, Livingstone, Lost Jardines, Lutké, Namenwita, Olol, Omun, Onon, Ororu, Remp, Ueito, Ulul).

Ngulu (also called Angegul, Anolul, Goulou, Kurru, Lamoliao, Lamoliork, Lamuliur, Lamuniur, Matelotas, Ngilu, Ngoli, Ngolog, Spencer Keys, Ulu).

Nukuoro (also called Dunkin, Matakema, Menteverde, Nugoru, Nukor, Nukuor).

Pikelot (also called Bigali, Biguela, Coquille, Lydia, Pigela, Pigerotto, Pigouelao, Pik, Pyghella).

Pingelap (also called Macaskill, Musgrave, Pelelap, Piigerappu, Punlap, Sailrocks, Tucks Reef).

Ponapé (also called Ascension, Bonabee, Bonybay, Faloupet, Faounoupei, Funopet, Niponpei, Painipete, Ponapi, Piunipet, Puynipet, Quirosa, Seniavin, William IV). Ponapé is the largest island of the Senyavin Islands.

Truk (also called Djuk, Hogoleu, Hogolu, Hoguleu, Lugulus, Ola, Rough, Ruck, Ruk, Torakku, Tuck, Ugulut). The Truk group includes approximately 100 islands.

Ulithi (also called Mackenzie, Mogmog, Mogumogu, Mokomok, Ouluthy, Uluthi, Uluti, Urushi).

West Fayu (also called Faiyao, Fajahu, Faliau, Huiyao, West Faiu).

Woleai (also called Anagai, Mereyon, Oleai, Ouleyai, Thirteen Islands, Uala, Ulea, Uola, Ulie, Wolea).

Yap (also called Eap, Guap, Heap, Jap, Ouap, Uap, Wuap, Yappu).

MARSHALL ISLANDS

The Marshall Islands consist of 29 atolls and 5 coral islands without lagoons arranged in two chains, the Ralik and the Radak chains, which extend in a northwesterly to southeasterly direction. No volcanic rocks are exposed in these islands. The principal islands shown in figure 5 are as follows:

Ailuk (also called Ailu, Fisher, Krusenstern, Tindall, Watts).

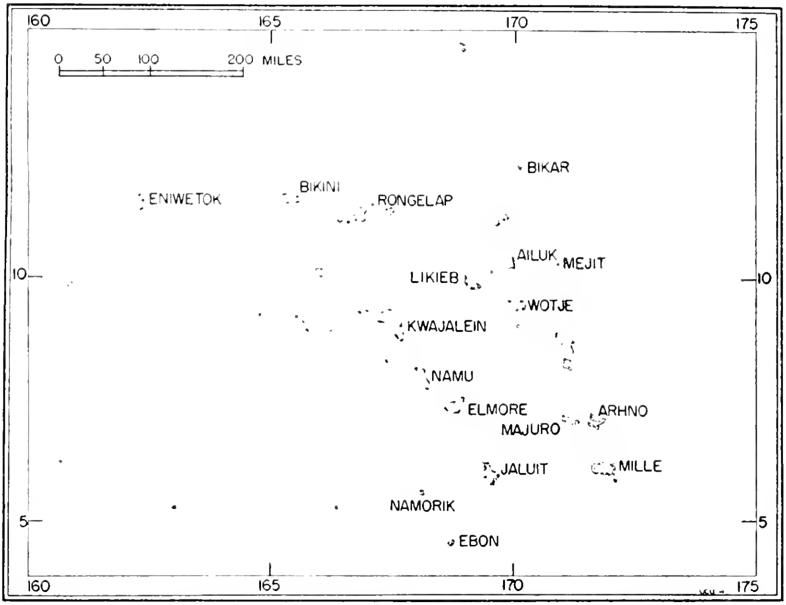

FIG. 5. The Marshall Islands.

Arhno (also called Arno, Aruno, Auru).
Bikar
Bikini
Ebon (also called Boston Atoll).
Elmore (also called Ailinglap, Ailinglapalap, Iringlob).
Eniwetok
Jaluit (also called Bonham, Taluit).
Kwajalein
Likieb (also called Likiep).
Majuro (also called Arrowsmith, Mezyuro).
Mejit
Maloelab
Mille (also called Mulgrave).
Namorik
Namu (also called Musquillo, Namo).
Rongelap
Wotje (also called Romanzov, Wotze, Wozzie).

ORNITHOLOGICAL EXPLORATION IN MICRONESIA

The Micronesian islands were first explored and colonized by a a people who came from Malaysia. It is thought that these people spread into the Palau, Caroline, Mariana, Marshall, and Gilbert islands as a single wave of migration. Following this occupation, the people apparently underwent a normal process of cultural evolution and differentiation. Remains of stone walls, dikes, fences, pillars, graves, and other structures which may be found today at various islands in Micronesia were constructed by the ancestors of the islanders of the present day. It is thought by archeologists that the Polynesians moved eastward into the Pacific islands by way of Micronesia. The date of this wave of migration is thought to have been approximately 1200 A. D. What kinds of birds may have been exterminated by this earliest of human colonization cannot be ascertained. Edible species, particularly megapodes, rails, and pigeons, probably were eliminated or reduced in numbers, as is indicated by later discussions.

The first Europeans to visit Micronesia, as far as the present writer can ascertain, left no accounts of the birds significant for the study here reported upon. Magellan, on his trip around the world, was the leader of the first party of Europeans who touched at Guam; this was on March 6, 1521. Rota, Agiguan, Saipan, and Tinian were also discovered by this Portuguese sea captain in the service of the king of Spain. Eltano, one of Magellan's lieutenants, revisited the Pacific and stopped at Rota in 1524. After the voyage of Magellan, other seafarers, mostly in the service of Spain, visited the Micronesian islands. The Caroline Islands were apparently first observed by the Portuguese captain, Diego de Rocha, in 1526. Loyasa and Saavdera, both Spaniards, visited the Marshall Islands in 1526 and 1529, respectively.

One of the first travelers to record observations on the bird life was Henry Wilson. Wilson was captain of the schooner "Antelope" which became grounded on a reef in the Palau Islands in August, 1783. He lived with the islanders while the ship was being repaired and kept a journal of his observations (Wilson, 1788). Wilson also visited several other islands in western Micronesia. Adelbert von Chamisso (1821), as naturalist with the Russian expedition in the ship "Rurick," made observations of the animal life in Micronesia in 1817 and 1818. Under the command of Otto von Kotzebue, this Russian expedition made the first detailed exploration of the Marshall Islands; visits were made also to Guam and Rota and to Yap, Fais, Ulithi, Palau, and other island groups in western Micronesia. Freycinet's famous expedition in the ships "Uranie" and "Physicienne," visited Guam, Rota, and Tinian in 1819. Quoy and Gaimard, the naturalists of the expedition, obtained birds, which were among the first to be described from Micronesia. These two naturalists revisited the Marianas in 1829 on board the ship "Astrolabe."

Scientific results of both of these expeditions (Quoy and Gaimard, 1824-'26 and 1830-'35) include texts and plates dealing with the birds obtained.

The French expedition in the corvette "La Coquille" visited Kusaie in June, 1824. Lesson (1829) wrote the zoology of this trip. Kittlitz (1836) of the expedition which sailed in the corvette "Le Seniavine" commanded by Lutké obtained birds at Kusaie in December and January, 1827-'28, at Guam in March, 1828, and at Lukunor and other islands of the Carolines. At Kusaie, Kittlitz found a rail (*Aphanolimnas monasa*) and a starling (*Aplonis corvinus*) which have not been obtained since his time. His specimens were deposited in St. Petersburg. He was one of the most competent of the early naturalists; his writings contain accounts of habits as well as descriptions and are accompanied by colored plates. The expedition which sailed on the "Astrolabe" and the "Zélée" in 1827-'40 under the command of Dumont d'Urville visited the Caroline Islands. The naturalists, Hombron and Jacquinot, obtained birds at Truk, including the interesting flycatcher, *Metabolus rugensis*, which they described (1841). The "Novara," in the course of its voyage around the world (1857-'59) visited the Caroline Islands in 1858. Birds were recorded from Ponapé, Lukunor and other islands by Pelzeln in his account of the birds of the expedition (1865).

In the years following the middle of the Nineteenth Century, Godeffroy and Sons, of Hamburg, opened branches of its trading firm in Micronesia. Representatives of the company including Heinsohn and Peters, who were ship captains, obtained collections of birds at Palau and Yap. These were deposited in the Godeffroy Museum at Hamburg and reported on by Hartlaub and Finsch (Hartlaub, 1868; Hartlaub and Finsch, 1868a and 1872). Tetens became representative of Godeffroy and Sons at Yap in 1869 and obtained birds. Perhaps the most famous collector in this period was Johann Kubary. He went to Ponapé at the age of nineteen and traveled in Micronesia for many years for Godeffroy and Sons. He obtained birds at many of the islands of the Carolines, spending fourteen months at Truk. In 1873, one of his collections of some 200 birds was lost in a shipwreck. Hartlaub and Finsch, (Hartlaub and Finsch, 1872; Finsch, 1876a) described much of his material; Nehrkorn (1879) reported on nests and eggs which he obtained. Hartlaub and Finsch (1868b) also reported on birds obtained at Palau by Doctor Semper, which were deposited in the museum at Altona. Otto Finsch (1880b, 1880d, 1881b, 1881c) traveled in Micronesia about 1880, observing birds in the eastern Carolines and in the Marshalls.

One of the largest collections from Micronesia was made by Alfred Marche in the Marianas. He arrived there on April 22, 1887, and stayed until May, 1889. He obtained approximately 732 specimens of birds, nests, and eggs at Guam, Rota, Tinian, Saipan, Pagan, and Alamagan, which were deposited in the Paris Museum and reported on by Oustalet (1895-'96). Shortly after Marche's visit, Japanese collectors in the hire of Alan Owston, a professional collector of Yokahama, obtained birds in the Marianas and at Truk in the years 1894-'97. These went to the Rothschild collection at Tring and were reported on by Hartert in 1898 and 1900.

At the turn of the Twentieth Century, several ornithologists were visiting Micronesia. Alvin Seale (1901) obtained a collection of birds at Guam in the summer of 1900 which was deposited in the Bernice P. Bishop Museum in Honolulu. The U. S. Fish Commission steamer "Albatross" visited Micronesia from August, 1899, to March, 1900; birds obtained by the expedition were reported on by Townsend and Wetmore (1919). Paul Schnee (1901) spent approximately one year, 1899-1900, at Jaluit in the Marshalls and obtained records of birds. In 1899, Brandeis, on board the German ship "Kaiserland" visited many of the islands in the Marshalls and recorded birds. William Safford (1905) resided at Guam in the early part of this century and reported on the bird life in the course of his studies of the botany and native life. Bartsch (Mearns, 1909) also obtained a small collection of birds at Guam, this is in the United States National Museum.

In the first World War when the Japanese gained a mandated control over the islands of Micronesia, the Japanese ornithologists promptly visited the area, obtained collections, and published works concerning the birds. In 1922, Momiyama and Kuroda prepared a list of the birds of Micronesia. The work was published under the auspices of the Ornithological Society of Japan. Subsequent editions appeared in 1932 and 1942.

The Whitney South Sea Expedition of the American Museum of Natural History visited Micronesia from October, 1930, to December, 1931, with William F. Coultas as collector. Although experiencing some difficulty and being restricted somewhat in his travels by the Japanese officials, he managed to obtain collections at Ponapé (October 26, 1930, to January 1, 1931), Kusaie (January 15 to June 11, 1931), Guam (June 24 to August 30, 1931), Saipan and Tinian (September 1 to 26, 1931), and Palau (October 2 to December, 1931). Many of the species which he obtained are represented by large series of fine skins. Only part of his collections have been reported on by Mayr and his associates.

Other than the work of Coultas and that of the Japanese, there was little ornithological work done in the period between the two world wars, probably, at least in part, because of the "iron curtain," which Japan had thrown about her mandate. Bryan (1936) did visit Guam in the middle 1930's and published an account of the birds in the newspaper, Guam Recorder.

When the Micronesian islands were taken by the American forces in 1944, personnel attached to various units made observations on the bird life. The first reports, published or unpublished, were from the Marshalls, which were taken at the beginning of the campaign. Gleise, Genelly, Wallace, and others made contributions. In the Marianas considerably more observing and collecting were done by service personnel including Marshall, Stott, Borror, Strophlet, Buss, Watson, Arvey, Downs, and others. Marshall (1949) obtained also a collection of birds in the Palaus in 1945. The Laboratory of Mammalogy, United States Naval Medical Research No. 2, to which I was attached, collected at Guam (January to October, 1945), at Rota (October 17 to November 2, 1945), at Ulithi (August 11 to 23, 1945), at Palau (August 24 to September 24, 1945), and at Truk (November 24 to December 18, 1945). Following the end of the war, Harvey I. Fisher visited Micronesia and obtained a collection of birds at Yap, which is to be reported on in the near future. Larry P. Richards obtained 33 birds at Ponapé and 4 at Truk in the period from August 28, 1947, to February 10, 1948.

Descriptions of birds in Micronesia began with the naming of *Halcyon c. cinnamomina* in 1821; the most recent description is that of *Rhipidura rufifrons mariae* in 1946. In all, 131 descriptions have designated type localities in Micronesia. Table 1 lists the dates (on the basis of ten-year intervals) when names of birds (synonyms or otherwise) were proposed. In the period from 1821 to 1860, twenty-five birds were made known to science by the earliest workers, including Kittlitz, Lesson, Bonaparte, and Pelzeln. In the period from 1861 to 1880, thirty-four birds were newly named, mostly by Hartlaub and Finsch, from the collections which the Godeffroy Museum obtained through the efforts of Kubary, Tetens, Peters, and Heinsohn. Nineteen original descriptions were published from 1881 to 1900, principally by Oustalet and Hartert, who studied the material of Marche and Owston, respectively. From 1901 to 1910, only four birds were described, but from 1911 to 1940, forty-seven descriptions were published, mostly by the Japanese following World War I.

From 1931 to 1940, the number of known birds was increased by the efforts of Mayr, who studied the material of the Whitney South Sea Expedition. From 1941 to date only two original descriptions have appeared—only one was postwar. Except for possible undescribed subspecies in the northern Marianas, I think that the heyday of the taxonomist in ornithology in Micronesia is over. The field of avian ecology in Micronesia has barely been scratched.

TABLE 1. COMPILATION OF THE DATES (ON THE BASIS OF TEN-YEAR INTERVALS) WHEN ORIGINAL DESCRIPTIONS OF BIRDS OF MICRONESIA APPEARED.

YEARS	No. of descriptions	YEARS	No. of descriptions
1821-1830	8	1881-1890	9
1831 1 40	8	1891-1900	10
1841-1850	4	1901-1910	4
1851-1860	5	1911-1920	10
1861-1870	11	1921-1930	15
1871-1880	23	1931-1940	22
		1941-1949	2

CHECK-LIST OF THE BIRDS OF MICRONESIA

The 206 kinds of birds of 150 full species known to occur in Micronesia belong to 91 genera of 37 families of 13 orders. In the following list, nonresident birds are marked with an *; birds introduced by man are marked with a †.

Class AVES—birds

PAGE

Order PROCELLARIIFORMES—albatrosses, petrels, and allies

Family Diomedeidae—albatrosses

Diomedia nigripes Audubon*	Black-footed Albatross.....	63

Family Procellariidae—petrels and shearwaters

Puffinus pacificus chlororhynchus Lesson	Wedge-tailed Shearwater..	64
Puffinus pacificus cuneatus Salvin	Wedge-tailed Shearwater..	65
Puffinus tenuirostris (Temminck)*	Short tailed Shearwater....	66
Puffinus nativitatus Streets	Christmas Shearwater......	66
Puffinus lherminieri dichrous Finsch and Hartlaub	Dusky Shearwater.........	66
Pterodroma rostrata rostrata (Peale)*	Tahiti Petrel..............	69
Pterodroma hypoleuca hypoleuca Salvin	Stout-billed Gadfly Petrel..	70

Order PELECANIFORMES—tropic birds, boobies, cormorants, frigate birds and allies

Family Phaëthontidae—tropic birds

		PAGE
Phaëthon aethereus mesonauta Peters*	Red-billed Tropic Bird....	70
Phaëthon rubricauda rothschildi (Mathews)	Red-tailed Tropic Bird....	71
Phaëthon lepturus dorotheae Mathews	White-tailed Tropic Bird..	72

Family Sulidae—boobies and gannets

Sula dactylatra personata Gould	Masked Booby............	75
Sula sula rubripes Gould	Red-footed Booby.........	75
Sula leucogaster plotus (Forster)	Brown Booby.............	76

Family Phalacrocoracidae—cormorants

Phalacrocorax melanoleucus melanoleucus (Vieillot)	Little Pied Cormorant.....	78

Family Fregatidae—frigate birds or man-o'-war birds

Fregata minor minor (Gmelin)*	Pacific Man-o'-War........	79
Fregata ariel ariel (Gray)	Least Man-o'-War.........	80

Order CICONIIFORMES—herons, storks, and allies

Family Ardeidae—herons and bitterns

Butorides striatus amurensis Schrenck*	Amur Green Heron.......	81
Bubulcus ibis coromandus (Boddaert)*	Cattle Egret..............	82
Egretta intermedia intermedia (Wagler)*	Plumed Egret.............	82
Demigretta sacra sacra (Gmelin)	Reef Heron...............	84
Nycticorax nycticorax nycticorax (Linnaeus)*	Black-crowned Night Heron	87
Nycticorax caledonicus pelewensis Mathew	Rufous Night Heron......	87
Gorsachius goisagi (Temminck)*	Japanese Bittern..........	89
Gorsachius melanolophus melanolophus (Raffles)*	Malay Bittern.............	90
Ixobrychus sinensis (Gmelin)	Chinese Least Bittern.....	93
Ixobrychus eurhythmus (Swinhoe)*	Shrenck's Least Bittern...	93
Dupetor flavicollis flavicollis (Latham)*	Black Bittern	94

Order ANSERIFORMES—ducks, geese, swans, and allies

Family Anatidae—ducks, geese, and swans

Anas oustaleti Salvadori	Marianas Mallard.........	94
Anas poecilorhyncha pelewensis Hartlaub and Finsch	Australian Gray Duck....	98
Anas querquedula Linnaeus*	Garganey Teal	100
Anas crecca crecca Linnaeus*	European Teal............	100
Anas crecca carolinensis Gmelin*	Green-winged Teal........	100
Anas acuta acuta Linnaeus*	Pintail	101
Anas acuta tzitzihoa Vieillot*	Pintail	101
Anas penelope Linnaeus*	Widgeon	102
Anas clypeata Linnaeus*	Shoveller	102
Aythya fuligula (Linnaeus)*	Tufted Duck..............	103
Aythya valisineria (Wilson)*	Canvas-back..............	103

Order COLUMBIFORMES—pigeons, doves, and allies

Family Columbidae—pigeons and doves

Order PSITTACIFORMES—lories and parrots

Family Psittacidae—lories, parrots, and allies

Order CUCULIFORMES—cuckoos, plantain-eaters

Family Cuculidae—cuckoos, anis, and allies

Order STRIGIFORMES—owls

Family Strigidae—owls

Order CAPRIMULGIFORMES—goatsuckers and allies

Family Caprimulgidae—goatsuckers

Family Sylviidae—Old World warblers

Family Muscicapidae—Old World flycatchers

Family Artamidae—wood-swallows

Family Sturnidae—starlings

DISCUSSION OF THE BIRDS OF MICRONESIA

Of the 206 kinds of birds found in Micronesia, 30 kinds are classed as sea birds, 29 kinds as migratory shore birds, and 147 kinds are classed as land and fresh-water birds. For purposes of discussion these birds are arranged in these three categories, following the system used by Mayr (1945a).

OCEANIC BIRDS

Oceanic birds found in Micronesia belong to the following families: Diomedeidae, Procellariidae, Phaëthontidae, Pelecanidae, Fregatidae, and Laridae. Following Wynne-Edwards (1935:240) and Murphy (1936:326), these birds may be grouped as inshore birds (Laridae and others), offshore birds (Pelecanidae, Fregatidae and others), and pelagic birds (Diomedeidae, Procellariidae, Phaëthontidae). As shown in table 2 there are 30 kinds of oceanic birds in Micronesia, 18 kinds that are resident and 12 kinds that are regarded as visitors to the area. Records of nestings are few; field work in the future probably will yield evidence that more kinds of oceanic birds are actually resident in the Micronesian islands.

TABLE 2. LIST OF RESIDENT AND NONRESIDENT OCEANIC BIRDS OF MICRONESIA

GENERA	Resident kinds	Nonresident kinds
Diomedea	0	1
Puffinus	4	1
Pterodroma	1	1
Phaëthon	2	1
Sula	3	0
Fregata	1	1
Larus	0	1
Chlidonias	0	1
Sterna	2	4
Thalasseus	1	0
Procelsterna	0	1
Anoüs	2	0
Gygis	2	0

INSHORE OCEANIC BIRDS

The inshore zone, according to Wynne-Edwards (1935:240), "extends from high-water mark to a maximum of four or five miles out to sea, including islands and reefs within sight of shore." In Micronesia the majority of the Laridae occur in this zone including such residents as *Sterna sumatrana*, *S. anaetheta*, *Thalasseus bergii*, *Anoüs stolidus*, *A. tenuirostris*, *Gygis alba*. These birds, especially *S. anaetheta*, *Thalasseus*, and *Anoüs*, may venture into the offshore zone. Visitors to Micronesia include several terns which probably normally range in the inshore (as well as in offshore) zones, such as *Childonias leucopterus* and *Sterna hirundo*. These birds feed to a considerable extent inside the outer reefs surrounding the lagoons, coming to shore frequently in small or large groups. *Gygis alba* probably spends considerable time on shore; stomachs examined contained fish, crustaceans and insects, indicating that they obtain some of their food ashore.

OFFSHORE AND PELAGIC OCEANIC BIRDS

Wynne-Edwards (1935:241) defines the offshore zone as extending to the continental edge; however, in Micronesia where small islands rise abruptly out of the ocean's depths, there is no useful way to separate the offshore zone from the pelagic zone. Since certain species go farther from the land than others, the two zones may be combined as a single zone extending beyond the sight of land. Birds which frequent this area beyond the inshore zone but may not range extensively at sea include *Fregata, Sula, Sterna fuscata, S. hirundo, S. anaetheta,* and others. The Herring Gull (*Larus argentatus*), which has been taken in the northern Marianas, may be classed with this group although it probably ranges widely in the open sea. Birds which spend considerable time at sea and may seldom approach land include *Diomedea nigripes,* the petrels (*Puffinus* and *Pterodroma*), and possibly the tropic birds (*Phaëthon*).

In numbers of individuals the birds inhabiting the inshore zones are relatively more numerous than those preferring the offshore and pelagic zones, although 12 of the 18 resident kinds of oceanic birds apparently prefer the offshore zone, while only 6 kinds appear to be restricted primarily to the inshore areas.

FAUNAL COMPONENTS

The oceanic birds were probably among the earliest birds to reach the islands of Micronesia. The presence of phosphate deposits on islands (Fais, Angaur), denoting deposition of guano by oceanic birds (possibly boobies, noddies, sooty terns), indicates long time residence by these birds. A person is prone to think that these deposits must have been made by larger concentrations of oceanic birds than are found in these islands today. Whether there were actually more individuals present during the period of deposition of phosphate in the lagoons of these islands is not known, although the elevation of the lagoons (forming the raised islands of Fais and Angaur) with the resulting freshening of the water probably was a great attraction to oceanic birds, especially to those which prefer to drink fresh water. According to Leonard P. Schultz (*in litt.*), the abundance of fish in the areas about these Pacific islands has been approximately the same since Pleistocene times, so that there was apparently no greater concentration of fish near these islands to attract large populations of fish-eating sea birds. Probably the time element is of sufficient magnitude to account for such deposition by birds with a population similar to that found there today.

The oceanic avifauna of Micronesia contains birds which are apparently from ancestral homes in the Palearctic Region, in the North and Central Pacific, in Polynesia, in Melanesia and Malaysia, and from homes the positions of which are uncertain because of the widespread circumtropical occurrence of the birds. There are no sea birds that are endemic in Micronesia.

Oceanic birds whose range is in the Northern Hemisphere (especially Palearctica) reach the northern and western edges of Micronesia as winter visitors. These include *Larus argentatus, Chlidonias leucopterus,* and *Sterna hirundo.* Another northern gull, *Larus ridibundus,* has been reported in the Marianas.

One bird of the North and Northcentral Pacific, *Diomedea nigripes,* reaches the northern Marianas where it has been taken at Agrihan. It is not unlikely that other birds of the North Pacific reach northern Micronesia as occasional visitors.

Species of oceanic birds which are restricted in their distribution to Polynesia and some adjacent islands and which range to Micronesia, either as visitors or residents, include *Puffinus tenuirostris, P. nativitatis, Pterodroma rostrata, P. hypoleuca, Sterna lunata,* and *Procelsterna cerulea.* The islands of the vast Pacific basin offer havens for many kinds of oceanic birds. Apparently there has been considerable speciation among sea birds in Polynesia, especially in its marginal areas. Micronesia has received only a small part of this avifauna.

Two terms, *Sterna sumatrana* and *Thalasseus bergii,* have reached Micronesia, either directly or indirectly, each from a dispersion point somewhere in the Melanesian or the Malayan area. These two birds are restricted in their ranges to the western Pacific and the Indian oceans.

Many of the species of oceanic birds found in Micronesia have circumtropical ranges. These include *Puffinus pacificus, P. lherminieri, Phaëthon, Sula, Fregata, Sterna anaethetus, S. fuscata, Anoüs stolidus, A. tenuirostris,* and *Gygis alba.* Some of these kinds range along continental shores as well as in island archipelagoes. Others, like *Gygis alba,* are rarely found along the shores of continents or even at coastal islands.

MIGRATORY SHORE BIRDS

Twenty-eight species of shore birds of the families Charadriidae and Scolopacidae have been recorded from Micronesia, and one other of the family Phalaropodidae apparently occurs in the area, making a total of 29 kinds. From the entire Southwest Pacific, Mayr (1945a:28-47) lists 31 species and subspecies of shore birds and mentions six other species which may occur there. Thus, of a possible 37 kinds of shore birds in this large area (which includes Micronesia), 29 are present in the islands of Micronesia. For purposes of discussion, shore birds are here placed in one of two groups: regular visitors or uncommon visitors. A regular visitor is one which has been recorded in the literature or in unpublished field accounts as being frequently observed in Micronesia in periods of migration. An uncommon visitor is one which has been infrequently observed in Micronesia. Of the 28 kinds of shore birds recorded from Micronesia, 17 are classed as regular visitors and 11 are classed as uncommon visitors.

ORIGINAL HOMES OF THE SHORE BIRDS THAT VISIT MICRONESIA

The shore birds which are known to visit Micronesia breed in the Northern Hemisphere. Table 3 summarizes the data concerning the

TABLE 3. BREEDING AND WINTERING GROUNDS OF THE SPECIES OF MIGRATORY SHORE BIRDS IN MICRONESIA

PART A. Location of breeding grounds

CLASS	Number	Circum-polar*	Asiatic	American
Regular visitors	17	5	10	2
Uncommon visitors	11	2	8	1
Totals	28	7	18	3

PART B. Location of wintering grounds

CLASS	Number	Circum-tropical	Asiatic	American	Oceanic
Regular visitors	17	2	13	1	1
Uncommon visitors	11	1	8	2	0
Totals	28	3	21	3	1

* Denotes birds which breed on both American and Asiatic sides of the Pacific Ocean.

breeding and wintering areas of these birds. As shown in part A of table 3, 18 of the 28 species which visit Micronesia come from Asiatic breeding grounds. Seven have circumpolar breeding ranges and three (two are regular visitors) come from American breeding grounds. As shown in part B of table 3, 21 of the 28 waders have their winter ranges on the Asiatic side of the Pacific with eastern extensions to Micronesia and other parts of Oceania. Of the 7 remaining species, the winter ranges of three are circumtropical; the winter range of a fourth is restricted to Oceania; and the winter ranges of the remaining three (two classed as uncommon visitors) are American.

Bryan and Greenway (1944:109-115) record 14 species of shore birds from the Hawaiian Islands. One of these, *Himantopus himantopus knudsoni,* is a resident, probably of New World origin, according to Mayr (1943:56). The others, listed in table 7, include three species unknown in Micronesia. One of these, *Phalaropus fulicarus,* apparently winters at sea off the west coast of South America. The other two species (*Charadrius vociferus vociferus* and *Gallinago delicata*) are classified by Bryan and Greenway as "accidental" and "occasional" visitors from North America. The ten species common to both the Hawaiian Islands and Micronesia include seven whose breeding grounds are circumpolar, two whose breeding grounds are in Arctic America and one whose breeding ground is in Arctic Asia. The winter ranges of these ten species include four which are circumtropical, three which are Asiatic, one which is restricted to Oceania, and only two which are American.

The ability of the shore birds to migrate almost as well over water as over land may explain their spread into Oceania. The likelihood that shore birds, when migrating may have ventured to Micronesia and Polynesia initially from the Asiatic side of the Pacific is strongly suggested by the data given in the paragraph above. Also, on the Asiatic side of the Pacific there are large numbers of islands, which form several archipelagoes extending from Kamchatka south to Malaysia. Once accustomed to migrating along these chains of islands from the Arctic to Australia, birds would probably have to make only minor adjustments to extend the breadth of their migratory routes eastward into the islands of the Pacific Ocean. In contrast, on the Pacific coast of North America there are few coastal or offshore islands and there is a vast area of open water separating the Hawaiian Islands from the American mainland. Probably the vastness of this area of water offers little stimulus to birds to expand their migratory ranges westward, and in part accounts for the small North American contingent in the population of shore birds of the Central Pacific. Some North American shore birds do visit the Pacific. The brisk trade winds from the northeast might be an aid to the birds in their flights from Nearctica to Hawaii.

The long flight now made by shore birds going from the Aleutians to the Hawaiian Islands may have commenced as a gradual expansion from the west, or perhaps such a route was initiated by birds flying northward through the Hawaiian Chain to the Arctic in migrating to their breeding grounds, and then later returning *via* the same route to reach their wintering grounds.

Routes of Migration

The small and isolated islands of Oceania might, upon first inspection, seem to offer but little attraction to shore birds. Hesse, Allee and Schmidt (1937:172, 173) point out that the "open southeastern Pacific" being least supplied with water from land sources, which is an important means of fertility, is known to have one of the poorest faunas found anywhere in the oceans. However, there are extensive tidal flats, especially on the leeward sides of the islands, and these

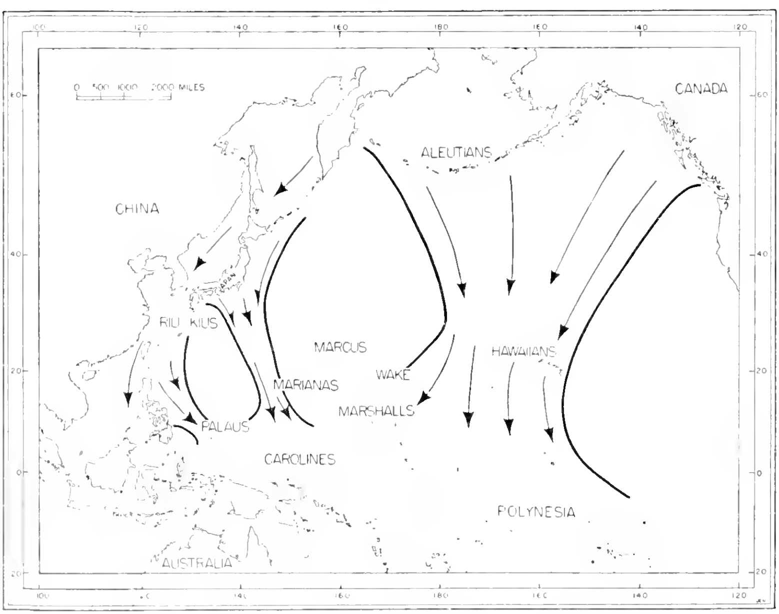

Fig. 6. Routes of migration used by shore birds in the Pacific area. From west to east these are: The Asiatic-Palauan Flyway, the Japanese-Marianan Flyway, the Nearctic-Hawaiian Flyway.

flats apparently afford extensive feeding grounds for these birds. Also, the absence of competition from resident birds as well as the virtual absence of predatory animals (native man and his domesticated animals excepted) are other factors which may help to make the islands attractive wintering grounds for shore birds.

Only a few birds have been banded in the Pacific, and the knowledge which comes from the recovery of banded birds gives but little aid to the student of movements of birds in the Pacific. The probable flyways for migratory shore birds there have to be deduced from sight records, data from specimens collected, known stations of breeding and wintering (summarized by Peters, 1934:234-293), and from a study of maps of the region. Analysis of information from the above-mentioned sources indicates that there are three routes taken by shore birds which migrate from Micronesia to and from their northern breeding grounds (see figure 6): (1) Asiatic-Palauan Flyway; (2) Japanese-Marianan Flyway; (3) Nearctic-Hawaiian Flyway.

1. ASIATIC-PALAUAN FLYWAY. For shore birds, there appears to be a migration route extending almost due south from the Riu Kiu and the Japanese islands to the Palau Islands. Some birds may migrate *via* the Philippines and others may pass to the east of the Philippines. This route is considered to be distinct from that used by birds which follow the Asiatic Coast and coastal islands, because the Palau Islands are situated approximately 600 miles east of the Philippines. Moreover, there are fewer species—only 20 recorded from the Palaus as compared with the number recorded from islands closer to the mainland of Asia. Delacour and Mayr (1946:68-74) list 46 species of shore birds from the Philippines; the Hand-list of Japanese Birds (Hachisuka *et al*, 1942) lists 34 species from the Riu Kiu Islands.

The information available indicates that migrant shore birds which utilize this flyway move east into the Carolines (examples, *Tringa nebularia, Charadrius leschenaultii*); however, the recording of 20 species from the Palaus as compared with only 12 species in the western Carolines (table 4) indicates that this spread eastward may not be very pronounced. Migrants in autumn probably move from the Palaus in a southerly direction toward the New Guinea area. Eight species of shore birds which reach the Palaus (and adjacent islands in the western Carolines), are not recorded from other parts of Micronesia. Species which apparently utilize the Asiatic-Palauan Flyway are listed in table 5.

2. JAPANESE-MARIANAN FLYWAY. Shore birds from Asiatic, and probably Aleutian and Alaskan, breeding grounds may follow the Asiatic Coast or the adjacent island chains southeast to the Japanese Archipelago. From there some of the birds apparently fly south through the Bonin and Volcano islands to the Marianas, from where they may spread in fanlike fashion to the southeast, south and southwest, even reaching to the Palau Islands (example, *Heteroscelus incanus*). The number of species of shore birds recorded from the Marianas (see table 4) is greater than that found in the Carolines, but it must be remembered that more intensive investigations have been made by ornithologists in the Marianas, which might account for the recording of more species (especially stragglers, such as *Gallinago gallinago*). Species which apparently use this flyway are named in table 6.

3. NEARCTIC-HAWAIIAN FLYWAY. Shore birds from breeding grounds in western Canada, Alaska, the Aleutians, the Bering Sea area, and probably northeastern Asia may fly in a southerly direction along a broad front to the Hawaiian Islands. This flyway is probably the one which supplies to central and eastern Oceania the largest wintering populations of shore birds. From the Hawaiian Islands birds may fly directly south through the scattered islands to southern Polynesia, or they may fly in a southwesterly direction and reach the Marshall Islands. The shore birds which visit the Marshall Islands apparently move south through the Gilbert, Ellice and other more southern island groups rather than west into the Carolines as exemplified by the fact that *Numenius tahitiensis*, a characteristic migrant through the Marshalls from the Hawaiian Islands, is rarely found west of the Marshall Islands in Micronesia. Species which apparently use this flyway are listed in table 7.

Flyways additional to the three suggested above may be utilized by some shore birds on their southward (and northward) migrations. Species reaching Wake and the Marcus Islands may fly directly south from the islands of the North Pacific. Bryan (1903:115, 116) lists four species of shore birds from Marcus (*Erolia acuminata*, *Heteroscelus incanus*, *Pluvialis dominica*, *Arenaria interpres*).

TABLE 4. LIST OF SPECIES OF SHORE BIRDS KNOWN FROM FIVE GEOGRAPHICAL AREAS OF MICRONESIA

	Palaus	Western Carolines	Marianas	Central Carolines	Eastern Carolines	Marshalls
Number of species............	20	12	17	11	10	10

TABLE 5. SHORE BIRDS WHICH MAY USE THE ASIATIC-PALAUAN FLYWAY

Regular Visitors	Uncommon? Visitors
Pluvialis dominica fulva	*Charadrius dubius curonicus*
Charadrius mongolus stegmanni	*Charadrius alexandrinus*
Charadrius leschenaultii	*Calidris tenuirostris*
Numenius phaeopus variegatus	*Erolia ferruginea*
Numenius madagascariensis	*Erolia subminuta*
Limosa lapponica baueri	*Limicola falcinellus sibirica*
Tringa nebularia	
Tringa glareola	
Actitis hypoleucos	
Heteroscelus brevipes	
Arenaria i. interpres	
Gallinago megala	
Erolia minuta ruficollis	
Erolia acuminata	

TABLE 6. SHORE BIRDS WHICH MAY USE THE JAPANESE-MARIANAN FLYWAY

Regular Visitors	Uncommon? Visitors
Pluvialis dominica fulva	*Squatarola squatarola*
Charadrius mongolus stegmanni	*Numenius tahitiensis*
Numenius phaeopus variegatus	*Numenius madagascariensis*
Limosa lapponica baueri	*Tringa glareola*
Actitis hypoleucos	*Gallinago gallinago gallinago*
Heteroscelus brevipes	*Erolia minuta ruficollis*
Heteroscelus incanus	
Arenaria i. interpres	
Gallinago megala	
Crocethia alba	
Erolia acuminata	

TABLE 7. SHORE BIRDS WHICH MAY USE THE NEARCTIC-HAWAIIAN FLYWAY

Regular Visitors	Uncommon? Visitors
*Pluvialis dominica fulva**	*Squatarola squatarola**
*Numenius tahitiensis**	*Charadrius hiaticula semipalmatus*†
*Heteroscelus incanus**	*Charadrius v. vociferus*
*Arenaria i. interpres**	*Limosa lapponica baueri**
*Crocethia alba**	*Tringa melanoleuca**†
Phalaropus fulicarius	*Gallinago delicata*
Phalaropus lobatus?*	*Erolia melanotos**
	*Erolia acuminata**

*Indicates species which are found in Micronesia.
†Indicates species not recorded from the Hawaiian Islands; see Bryan and Greenway (1944: 109-115).

POPULATIONS OF SHORE BIRDS IN MICRONESIA

Although shore birds have been observed in Micronesia on many occasions, actual counts of numbers of individuals of the different birds have rarely been made. Kubary, Finsch, Marche, Seale and other early collectors and observers record some data of this kind as have the Japanese investigators in later times. William Coultas of the Whitney South Sea Expedition obtained considerable information of this nature at Guam, Saipan, Kusiae, Ponapé, and the Palaus, but it is unpublished. His records were made in fall, winter and spring, when migrants were present in large numbers and these observations offer evidence that many of the migrants are comparatively numerous, especially in the Carolines, throughout the winter months. McElroy's observations made on his trip for NAMRU2 to Truk in December, 1945, offer further evidence of this.

TABLE 8. POPULATIONS OF MIGRATORY SHORE BIRDS SEEN AT GUAM IN 1945

	Pluvialis dominica	*Charadrius mongolus*	*Numenius phaeopus*	*Actitis hypoleucos*	*Heteroscelus* spp.	*Heteroscelus incanus*†	*Heteroscelus brevipes*†	*Limosa lapponica*	*Arenaria interpres*	Unidentified	Total No. of individuals	Total No. of species
March 11	x	....	....	....	....	....	....	....	....	....	x	1
March 17	10	....	1	....	2	....	....	....	....	....	13	3
March 19	x	....	x	....	x	....	....	....	x	....	x	5
April 24	x	....	....	....	....	....	....	....	....	....	x	1
April 26	....	....	....	....	....	....	....	1	....	....	1	1
May 19	....	....	....	....	3	2	....	....	....	....	5	1
May 21	....	....	....	....	4	....	....	....	....	....	4	1
May 26	....	....	....	....	x	2	....	....	....	....	x	1
June 1	....	....	1	....	....	....	....	....	....	....	1	1
June 6*	....	1	x	....	x	....	1	....	....	x	x	4
June 11	....	....	1	....	....	....	....	....	....	....	1	1
June 12	....	....	12	....	2	....	....	....	....	....	14	2
June 22	....	....	2	....	....	....	....	....	....	1	3	2
June 30	....	....	....	....	....	....	....	....	....	2	2	1
July 7	....	....	2	....	....	....	....	....	....	....	2	1
July 8	3	....	x	....	1	....	....	....	....	....	x	3
July 16*	6	....	3	3	4	....	1	....	....	....	17	4
July 19	x	....	x	....	x	....	....	....	....	....	x	3
July 24*	10	....	6	....	3	....	2	....	3	5	29	5
July 26	....	....	8	....	....	....	....	....	....	....	8	1
August 2	....	....	x	....	....	....	....	....	....	x	x	2
August 3	....	....	1	....	....	....	....	....	....	....	1	1
August 6*	....	....	6	....	12	....	....	....	....	....	18	2
September 29	x	....	x	....	....	....	....	....	x	....	x	2
October 3*	x	....	....	....	x	....	....	....	....	....	x	2
October 10	x	....	x	....	x	2	....	....	x	....	x	4
October 11	....	....	....	....	....	....	....	....	2	....	2	1
October 23*	x	....	x	....	x	1	1	....	x	....	x	5
October 24	x	....	....	....	....	....	....	....	....	....	x	1

x Observed but numbers not recorded.
* Observations made on beach at Agfayan Bay area.
† Figures based on identified skins.

None of the above workers, however, obtained very much information on comparative numbers of species.

Tables 8, 9, and 10 present the writer's findings on populations of migratory shore birds in Micronesia in 1945. At Guam, as shown in table 8, the records for March, April and early May are few, owing to a limited amount of field observation. Beginning in late May and until October 24 a greater amount of time was spent in the field and more regular records were obtained. No observations were made by the author at Guam in the period from August 11 to September 25. The dates marked with an asterisk are those on which observations were made on the extensive tidal flats at Agfayan Bay and vicinity. These flats, at low tide, present excellent feeding grounds for waders and in 1945 were undisturbed by parties of service personnel, because the area was "off-limits."

Table 8 shows that *Pluvialis dominica, Numenius phaeopus,* and *Heteroscelus* spp. were the shore birds most frequently found at Guam in this period. *Pluvialis dominica* was the most numerous of the three species. Of *Heteroscelus* there was approximately equal representation of *H. incanus* and *H. brevipes* as indicated by specimens collected. These birds were not identified to species in the field.

Although records were made only infrequently in the spring migration, such information as was obtained indicates that the populations were largest in March and early April. On April 24, *Pluvialis dominica* was the only bird observed on beaches and in upland openings. On April 26, a single *Limosa lapponica* was recorded. On May 15, no shore bird was seen on a trip along several beaches. In late May and early June, single individuals of *Heteroscelus* were found. Of this genus, those collected in May were in nuptial plumage, and those collected in June were in winter plumage and probably should be classed as non-migrants. *Numenius phaeopus* was occasionally recorded beginning in early June, but waders were totally absent from beaches at Agfayan Bay and vicinity on June 18 and 19. Few shore birds were seen in early August. In late September, birds, especially *Pluvialis dominica, Numenius phaeopus,* and *Heteroscelus* spp., were numerous. These species were numerous until October 24, when observations were discontinued.

Of the 17 species of migratory shore birds recorded from the Mariana Islands, eight were identified. Of these eight, three species, *Limosa lapponica, Actitis hypoleucos,* and *Charadrius mongolus,* were found on only one occasion. Never more than four species were identified on a single field trip. These data give an idea of the lack of variety of species that may be observed on Micronesian islands.

TABLE 9. POPULATIONS OF MIGRATORY SHORE BIRDS SEEN AT ULITHI ATOLL IN 1945

SPECIES	ISLAND AND DATE							
	Potangeras				Fas-sarai	Mange-jang	Pau	Losiep
	Aug. 14	Aug. 15	Aug. 16	Aug 17	Aug. 19	Aug. 20	Aug. 21	Aug. 22
Pluvialis dominica	......	......	6	5	4	....	10	5
Charadrius mongolus	......	......	......	......	......	....	x	2
Numenius phaeopus	1	4	......	1	......	....	1	2
Actitis hypoleucos	......	......	......	......	......	....	2	2
Heteroscelus spp	......	......	......	......	2	....	6	3
*H. incanus**	......	......	......	......	......	1	....	2
Crocethia alba	......	......	......	......	......	....	30	5
Total No. of Individuals	1	4	6	6	6	1	49	21
Total No. of Species	1	1	1	2	2	1	6	6

x Observed but numbers not recorded.
* Figures based on identified skins.

Table 9 lists the shore birds seen at Ulithi Atoll, Caroline Islands, on eight field excursions in the period from August 14 to August 22, 1945. Of seven species of shore birds known to visit the atoll, six were taken in this period. As observed at Guam, *Pluvialis dominica* and *Numenius phaeopus* were the species most frequently found. *Heteroscelus* was seen on three occasions; those collected were identified as *H. incanus*. Most of the shore birds were seen at Pau and Losiep, islands unoccupied by man. Similar tidal flats are present at most of the other small islands in the atoll, but these islands (Asor, Fallalop, Potangeras, Fassarai and Mangejang were visited) were occupied by small detachments of service personnel or by natives, which may have tended to keep many of the shore birds away. At the more populated islands of Asor and Fallalop, no shore birds were seen. Almost as many species were recorded at Ulithi on the eight field trips as were found by the author at Guam in eight months of observations.

TABLE 10. POPULATIONS OF MIGRATORY SHORE BIRDS SEEN AT THE PALAU ISLANDS IN 1945

SPECIES	Peleliu								Angaur
	August		September						Sept. 21
	24	28	1	6*	8*	9†	16*	20*	
Pluvialis dominica	x	...	x	x	25	...	20	x	x
Charadrius mongolu	...	...	...	x	25	...	5	x	x
C. leschenaultii	...	...	...	x	25	...	5	x	x
Numenius phaeopus	...	...	3	x	30	...	20	x	x
N. madagascariensis	...	...	...	...	1	1	...	15	...
Limosa lapponica	...	...	...	...	3	...	4	...	...
Tringa nebularia	...	6	...	...	...	...	3	...	...
T. glareola‡	...	...	...	...	...	...	...	...	1
Actitis hypoleucos	...	...	...	...	...	2	...	...	...
Heteroscelus sp.	...	...	x	x	75	...	x	x	x
H. brevipes‡	...	...	...	3	2	...	2	...	...
Arenaria interpres	...	...	...	...	20	...	...	...	...
Capella megala	...	...	...	...	...	...	...	...	4
Calidris tenuirostris	...	...	...	...	15	...	20	...	...
Erolia minuta	...	...	...	x	50	...	50	x	x
E. acuminata‡	...	...	...	...	...	...	...	...	3
E. ferruginea‡	...	...	...	1	...	...	...	...	...
Limicola falcinellus‡	...	...	...	...	...	...	...	...	1
Unidentified	x	...	...	x	x	...	x	x	x
Total number of individuals	x	6	x	x	271+	3	129+	x	x
Total number of species	1	1	3	7	10	2	9	7	10

* Observations made on beaches at Akarakoro Point, Peleliu.
† Observations made at fresh water ponds.
x Observed but numbers not recorded.
‡ Figures based on identified skins.

Table 10 presents field counts at the Palau Islands in the period from August 24 to September 21, 1945. Of 20 species of shore birds known from the Palaus, 17 species were collected or identified on this trip. It was apparent that the fall migration was at its height at this time. Birds were numerous at inland openings and ponds, air field strips, and on the extensive tidal flats at Akarakoro Point. The latter area is between Peleliu and the adjacent island of Ngesebus to the north. Several observations were made at this area (as indicated by the dates marked with asterisks in the table); on September 8, 271+ shore birds were counted; on September 16, 129+ were counted. Six species were observed to be abundant. The majority of the birds found at these beaches were in small flocks which consisted of several birds of one or more species.

The birds observed at Angaur on September 21 were seen at several fresh and brackish ponds. Four species (*Tringa glareola, Erolia acuminata, Limicola falcinellus, Gallinago megala*), which were not taken on the tidal flats or elsewhere at Peleliu, were found at these ponds.

The abundance, and more especially the variety, of shore birds at the Palau Islands during this period was in marked contrast to the smaller and less diversified populations of shore birds in rather similar insular environments at Ulithi and Guam. These differences offer support for the supposition that the Asiatic-Palauan Migratory Shore Bird Flyway is distinct from the Japanese-Marianan Migratory Shore Bird Flyway.

LAND AND FRESH-WATER BIRDS

The land and fresh-water avifauna of Micronesia consists of 147 kinds of birds. Of these, 37 kinds are non-residents, 104 kinds are residents, and 6 kinds have been introduced by man. The 104 resident birds include 98 kinds (94 percent) which are found only within the confines of Micronesia. Included in these 98 kinds which are restricted to Micronesia are 5 endemic genera, 31 endemic species and 76 endemic subspecies.

Gulick (1932: 407, 413) stresses that the fauna and flora of the oceanic islands may be "disharmonic" (he uses Easter Island as his example) and says, "It is evident that mature groups of islands will attain an internal harmony, from the standpoint of the systematist. But this harmony, instead of reflecting the pre-existing harmony of some continental source (as in the case of the continental islands or land-bridge remnants) will be recognizably derivable by descent from a quite limited number of original importations, at the start distinctly miscellaneous and 'disharmonic'." Analysis of the land and fresh-water avifauna of Micronesia supports Gulick's view.

As mentioned previously, the islands of Micronesia, from the zoogeographical viewpoint, have been regarded as a part of the Polynesian Subregion of the Australian Region. Mayr (1941a: 192) defines the Polynesian Subregion as comprising "all the tropical and subtropical islands of the Pacific Basin which indicate by their impoverished fauna that they have had no recent continental connection (after early Tertiary) and which derived the major part of their fauna directly or indirectly from the Papuan Region or jointly from Australia and the Papuan Region." As based on the distribution of the resident avifauna, Mayr (1941a: 193) subdivides the Polynesian Subregion into the following districts: Micronesia ("including Palau, the Marianne, Caroline, Marshall, and Gilbert islands"); Central Polynesia ("including Fiji, Tonga, Samoa, Phoenix, Ellice, Union islands, and a number of small islands, such as Rotuma, Fotuna, Keppel, Niue, Niouafu, and Uvea"); Eastern Polynesia ("all the islands east of 165°W"); and Southern Melanesia ("including the Santa Cruz group, Banks Islands, New Hebrides, Loyalty Islands, and New Caledonia"). He considers that the Hawaiian Islands, Solomon Islands, and possibly New Caledonia are bordering districts to the Polynesian Subregion. Figure 7 shows

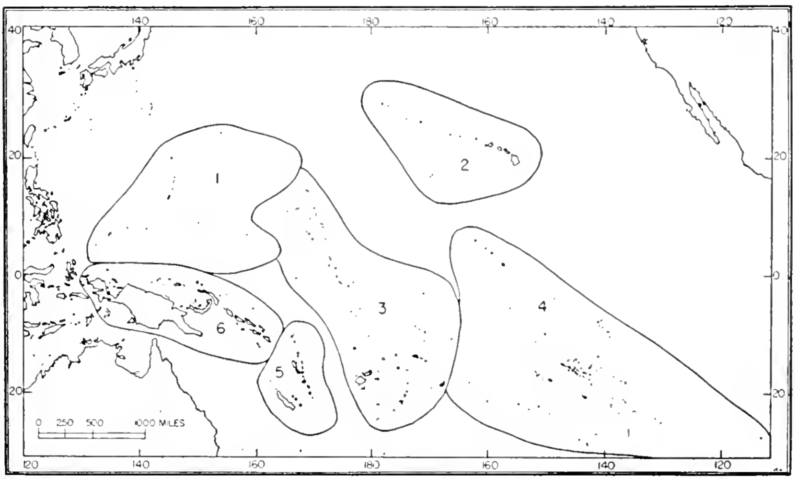

FIG. 7. Divisions of the islands of part of the Pacific Basin from the standpoint of the distribution of land birds and fresh-water birds: (1) Micronesia; (2) Hawaii; (3) Central Polynesia; (4) Eastern Polynesia; (5) Southern Melanesia; (6) Melanesia.

the divisions of the islands of the Pacific Basin from the standpoint of the distribution of the land and fresh-water birds. I have placed the Gilbert and Marshall islands in the Central Polynesian rather than in the Micronesian District. For purposes of discussion in this report, however, I am considering the Marshalls to be a part of Micronesia. The birdlife of the Bonin and Volcano islands northward of the Marianas is regarded as having its closest affinities to the Japanese avifauna. The Papuan or Melanesian Subregion of the Australian Region includes the districts of New Guinea and

Northern Melanesia, including the Bismarck Archipelago, the Admiralty Islands, and the Solomon Islands.

The resident land and fresh-water birds of Micronesia have been derived from several sources. Studies of these birds and their closest relatives in adjacent areas indicate that the avifauna has been derived from five different sources: Polynesia, Melanesia, the Moluccas and Celebes, Philippines, and Palearctica.

POLYNESIAN COMPONENT

Aphanolimnas monasa (extinct ?), *Ptilinopus porphyraceus,* and *Ducula oceanica* are the only species of birds which have reached Micronesia directly from Polynesia. There are in Micronesia, as Mayr (1941b: 204) points out, eight species "which are members of typically Polynesian species or genera" and six species which are either Papuan or Polynesian. The relationships between Polynesian and Micronesian birds is evident, but insofar as the pathways of colonization are concerned the majority of these Micronesian species listed by Mayr have come from elsewhere than Polynesia and the birds of these two areas are thought to have arisen from common ancestors. *Aphanolimnas, Ptilinopus,* and *Ducula* apparently invaded Micronesia from Central Polynesia *via* the Marshall Islands through a rather continuous chain of islands and atolls. *Aphanolimnas* is known only from Kusaie in the extreme eastern part of the Carolines while *Ptilinopus* and *Ducula* are known from the Marshalls, Carolines, and Palaus.

MELANESIAN COMPONENT

The Papuan or Melanesian Region (New Guinea, Bismarck Archipelago, Solomon Islands) has supplied to Micronesia its greatest number of endemic land and fresh-water residents. Fifty kinds of birds belonging to the following species reached Micronesia from Melanesia: *Nycticorax caledonicus, Megapodius lapérouse, Ptilinopus roseicapillus, Gallicolumba xanthonura, G. canifrons, Caloenas nicobarica, Halcyon cinnamomina, Trichoglossus rubiginosus, Collocalia inquieta, Edolisoma tenuirostre, Rhipidura rufifrons, Metabolus regensis, Monarcha godeffroyi, M. takatsukasae, Colluricincla tenebrosa, Aplonis opacus, A. pelzelni, A. corvinus* (extinct ?), *Cleptornis marchei, Myzomela cardinalis* (probably by way of Southern Melanesia), *Rukia palauensis, R. oleaginea, R. ruki, R. sanfordi, Erythrura trichroa.* The colonization of Micronesia by these species has probably extended over a considerable period of time. *Megapodius, Trichoglossus,* and *Aplonis corvinus* may represent older colonizations which have become well differentiated from the ancestral forms; *Nycticorax, Myzomela,* and *Erythrura* may have become established later and have had "less time" to become modified from the ancestral forms. Birds from Melanesia have reached Micronesia probably by direct flight to the Caroline Islands. Aided by favorable winds which blow from the southwest, south and southeast during the period from May to November, birds, particularly the young of the year, might conceivably be blown in the direction of the Carolines, where 57 percent of the birds derived from Melanesia reside. The Palaus are populated with 15 percent, the Marianas with 28 percent, and the Marshalls (lacking "high" islands) with none; these may be secondary colonizations from the Carolinas excepting *Ptilinopus, Megapodius, Gallicolumba canifrons, Cleptornis,* and *Colluricincla.* The Marshall Islands have received no avian components from Melanesia. The absence of "high" islands in the Marshalls and the possible inability of birds accustomed to life on the luxuriant islands of Melanesia to become established on relatively barren atolls are logical reasons for this. Instead of New Guinea itself, the outlying islands of Melanesia (Bismarck Archipelago, Solomons, Southern Melanesia) probably have been the principal "taking-off" places for birds invading Micronesia.

MOLUCCAN AND CELEBESIAN COMPONENTS

Birds which reached Micronesia by way of the islands of Celebes and the Moluccas may have been derived originally from Melanesia. The following birds appear to have used this route: *Porphyrio porphyrio,* probably *Halcyon chloris, Rhipidura lepida, Myiagra oceanica, Zosterops conspicillata,* and *Z. cinerea.* These birds apparently became established initially in the Palaus; *Porphyrio* and *Rhipidura lepida* have not been recorded elsewhere in Micronesia, but *Myiagra* and the two species of *Zosterops* have spread to the Carolines and Marianas, although not into the Marshall Islands. Wind from the southeast in summer and fall has probably been a factor aiding these colonizations. The population of *Gallinula chloropus* resident at Palau may also have arrived by this route.

PHILIPPINE COMPONENT

Ten of the kinds of birds of Micronesia have come from or by way of the Philippine area. These are known principally from the Palaus and the Marianas and include: *Rallus philippinus, R. owstoni, Poliolimnas cinereus, Caprimulgus indicus, Corvus kubaryi, Psamathia annae, Artamus leucorhynchus,* possibly *Lonchura nigerrima,* and

Collocalia inexpectata. The Philippines may have been the actual point of dispersal of the birds (example, *Psamathia*), or may have been used as a stepping stone to Micronesia by birds coming from Melanesia (examples, *Rallus* and *Artamus*), by birds from Malaysia (example, *Collocalia*), and by birds from Asia (example, *Caprimulgus*). Two birds of this component have reached the islands of eastern Micronesia. A subspecies of *Lonchura nigerrima* is endemic at Ponapé, and a subspecies of *Poliolimnas cinereus* occurs on several islands in the Carolines and has even been recorded at Bikini in the Marshall Islands. Three species are known only from the Palaus; two are known only from the Marianas.

PALEARCTIC COMPONENT

Birds of Micronesia which have been derived directly from Palearctica are *Gallinula chloropus guami, Otus podarginus, Asio flammeus, Acrocephalus luscinia* and *Anas oustaleti*. Apparently *Gallinula, Asio,* and *Acrocephalus* arrived in Micronesia by way of the chain of islands from Japan southward to the Bonins, Volcanoes, and Marianas. *Otus* reached Palau from Asia, possibly by way of the Philippines. The smallness of the representation of this component may result partly from lesser ability of the northern birds

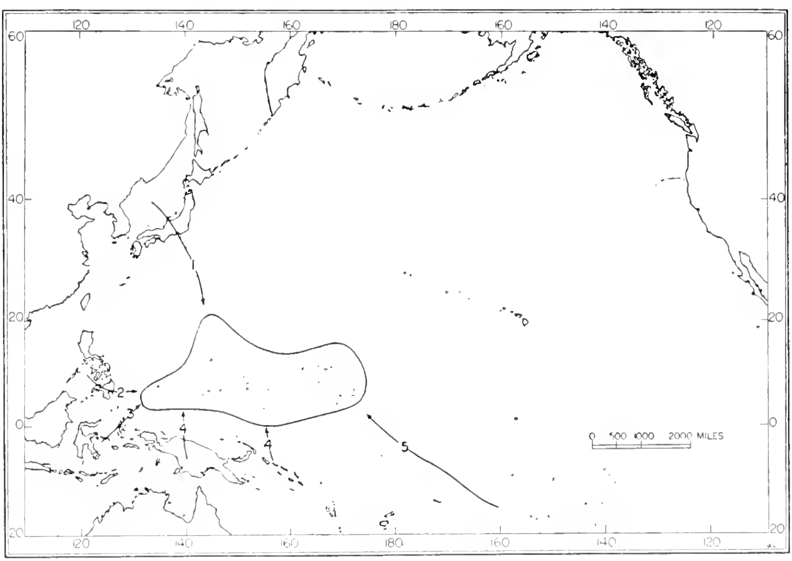

FIG. 8. Faunal areas from which the resident land birds and fresh-water birds of Micronesia have been derived. (1) Palearctica; (2) Philippines; (3) Moluccas and Celebes (Malaysia); (4) Melanesia (New Guinea and northern Melanesia); (5) Polynesia.

to adapt themselves to, and to establish themselves on, the semi-tropical and tropical islands of Micronesia as compared with birds from Melanesia where the climate and ecologic conditions resemble more closely those found in Micronesia. Evidence supporting this possibility is the large number of Palearctic residents in the Bonin and Volcano islands as compared with fewer in the Marianas; the Bonins and Volcanoes are less tropical and more temperate in climate.

Table 11 lists the birds concerned, by faunal areas from which the birds have been derived and shows the number of kinds of birds which are present as a result of these colonizations. There is some overlap in the numbers since some endemics may be found in more than one area in Micronesia. Figure 8 shows the faunal areas from which the endemic land and fresh-water birds of Micronesia have been derived. Melanesia (Papua) supplied 52 percent of this population. Birds reaching Micronesia by way of the Moluccas and Celebes include 21 percent of the total population. The Philippines have supplied 10 percent; Polynesia, 9 percent; and Palearctica, 8 percent. This population of endemic land birds and fresh-water birds has seemingly evolved from 46 colonizations, of which 27 have been derived from Melanesia, 6 from the Philippines, 5 from the Moluccan and Celebean areas, 5 from Palearctica, and 3 from Polynesia.

The Palaus have received a large part of their avifauna from the west (Moluccas, Philippines, Palearctica). Their Melanesian component is mostly the result of secondary colonization from the Carolines. The Carolines have received a greater share of their land birds and fresh-water birds from Melanesia and a smaller share from Polynesia. The Marshalls are definitely associated with the Polynesian element. The Marianas exhibit a considerable amount of secondary colonization from other Micronesian islands, as well as some unique components from the Philippines, Melanesia, and Palearctica. Thus, the number of endemics in Micronesia provides little information concerning the actual number of successful colonizations by birds from other areas. Many of the endemics probably have resulted in this way: Individuals of an endemic subspecies flew to another island and there underwent further differentiation, producing another endemic subspecies. Such secondary colonization probably is going on now.

This analysis of the avifauna shows that Micronesia, with the exception of the Marshall Islands (and the Gilbert Islands), has but little affinity to Polynesia. It has greater affinity, from the zoogeographical standpoint, with the Papuan Region (Melanesia).

TABLE 11. AVIFAUNAL COMPONENTS WHICH MAKE UP THE ENDEMIC RESIDENT LAND AND FRESH-WATER BIRD POPULATION OF MICRONESIA

FAUNAL COMPONENT	Palau	Western and central Carolines	Eastern Carolines	Marianas	Marshalls
Polynesian	2	3	5	0	3
Melanesian	11	14	16	12	0
Moluccan-Celebean	6	3	4	7	0
Philippine	6	2	2	4	1
Palearctic	2	1	2	5	0
Totals	27	23	29	28	4

SPECIATION

Of the 104 native fresh-water birds and land birds which are resident in Micronesia, only 7 kinds or 6.5 percent remain undifferentiated from populations elsewhere. These birds are *Phalacrocorax melanoleucus*, *Pandion haliaetus*, *Demigretta sacra*, *Ixobrychus sinensis*, *Anas poecilorhyncha*, and possibly *Lonchura punctulata* (may be an introduction by man). Another bird, *Gallinula chloropus*, a resident at Palau, may or may not be distinct from the gallinule of Malaysia, *G. c. orientalis*. Of the 104 resident birds, 97 kinds or 93.5 percent have become differentiated and can be separated taxonomically from populations elsewhere. Of the kinds of birds which are found only in Micronesia, there are 5 endemic genera (16 percent), 31 endemic species (32 percent) and 76 endemic subspecies (75 percent). If we consider the avifauna of Micronesia as a single element, the endemism is high as compared with that on larger and less isolated islands. For example, Mayr (1944a:174) found 137 resident birds on Timor including 22 endemic species (16 percent) and 67 endemic subspecies (47.5 percent). Stresemann (1939b:313) found 220 species including 84 endemic species (38.2 percent) on Celebes. Mayr (1944a:174) also writes that on Java, of 337 breeding species, 16 (4.8 percent) are endemic, and on New Caledonia, of 68 species 19 (27.9 percent) are endemic. Speciation in Micronesia has not progressed much farther than that at New

Caledonia and not so far as at Celebes, but subspeciation has progressed considerably more than at the island of Timor. The avifauna of the Hawaiian Islands, as recorded by Bryan and Greenway (1944), has 73 resident land birds and fresh-water birds, all of which are endemic, including one family, 23 genera and 36 species. The North American night heron, *Nycticorax n. hoactli*, may be included in this list as the only resident which is undifferentiated. The development of full specific differentiation within the resident avifauna is greater in the more isolated Hawaiian chain where 49 percent of these birds are regarded as endemic species, while in Micronesia, which is less remote from other bodies of land, the specific endemism is only 32 percent.

TABLE 12. ENDEMISM IN FAMILIES OF NATIVE LAND AND FRESH-WATER BIRDS IN MICRONESIA

FAMILY	Residents	Endemic genera	Endemic species	Endemic subspecies	Total endemic
Phalacrocoracidae	1	0	0	0	0
Ardeidae	3	0	0	1	1
Anatidae	2	0	1	0	1
Accipitridae	1	0	0	0	0
Megapodidae	2	0	1	2	2
Rallidae	7	1*	2	4	6
Columbidae	13	0	4	11	13
Psittacidae	1	0	1	0	1
Strigidae	2	0	1	1	2
Caprimulgidae	1	0	0	1	1
Apodidae	5	0	1	5	5
Alcedinidae	7	0	1	7	7
Campephagidae	3	0	0	3	3
Corvidae	1	0	1	0	1
Sylviidae	5	1	2	4	5
Muscicapidae	14	1	6	9	14
Artamidae	1	0	0	1	1
Sturnidae	9	0	3†	7	9
Meliphagidae	7	1	1	6	7
Zosteropidae	14	1	6	10	14
Ploceidae	5	0	0	4	4
Totals	104	5	31	76	97

* *Aphanolimonasa* is included but may be extinct.
† *Aplonis corvinus* is included but may be extinct.

Table 12 lists the families of land birds and fresh-water birds which have resident members as part of the avifauna of Micronesia. It can be observed from the table that only two families are represented by no endemic kinds, several families are represented by one or two endemic kinds, and others are represented by as many as 14 endemic kinds. Endemism has reached its greatest development in the families Rallidae (6), Columbidae (13), Apodidae (5), Alcedinidae (7), Sylviidae (5), Muscicapidae (14), Sturnidae (9), Meliphagidae (7), and Zosteropidae (14). Generic endemism is greatest in the Sylviidae where one endemic genus occurs among 5 endemic species and subspecies (20 percent), in Rallidae one in 6 (17 percent), in Meliphagidae one in 7 (14 percent). Specific endemism is greatest in Psittacidae and Corvidae where the single representative of each family in Micronesia is considered specifically distinct (100 percent), in Megapodidae and Strigidae one in 2 (50 percent), in Muscicapidae and Zosteropidae 6 in 14 (43 percent) in Sylviidae 2 in 5 (40 percent), in Rallidae 2 in 6 (33 percent), in Sturnidae 3 in 9 (33 percent) in Columbidae 4 in 13 (31 percent). Subspeciation within species which are endemic in Micronesia has occurred in 8 families, occurring within two species in each of the families Columbidae and Zosteropidae and once in each of the families Megapodidae, Apodidae, Alcedinidae, Sylviidae, Muscicapidae, and Sturnidae.

In summary, the families of land and fresh-water birds found in Micronesia which have the greatest number of endemic forms are Muscicapidae (14), Zosteropidae (14), Columbidae (13), and Sturnidae (9). Speciation has occurred in the single representative of the families Psittacidae (*Trichoglossus rubiginosus*) and Corvidae (*Corvus kubaryi*). Where family representation is large, speciation has occurred most frequently, as in the Muscicapidae (6 in 14 = 43 percent), in the Zosteropidae (6 in 14 = 43 percent), and in the Columbidae (4 in 13 = 31 percent). Subspeciation has occurred in 8 families, in two species in the Columbidae and Zosteropidae and in one species in each of 6 other families.

Time of Colonization

Previously (and in the accounts of the species to follow), comments are made concerning the subjects of *from where* and *by what route* the various kinds of birds have arrived at Micronesia. The problem of *when* these birds arrived is a difficult and usually unanswerable one. Although geology provides some evidence on the relative age of the islands, and although deposits of bird guano on now elevated coral islands show that oceanic birds have inhabited these islands for a long time, there is no evidence to show the time of the first colonization by land birds. No fossil remains of land birds or fresh-water birds have been found in Micronesia. The relative extent of differentiation in color and structure, which has taken place between different birds, offers one means for estimating the relative length of residence in the area, provided all other factors are equivalent. Concerning the birds of the Galapagos, Lack (1947:113) writes "That Darwin's finches are so highly differentiated suggests that they colonized the Galapagos considerably ahead of the other land birds." Evidence from this source actually is of little value, because the speed of evolution is unknown and its rate may be different in different species, even though they live under the same circumstances. Dobzhansky (1941) says that evolution is a modification of the genetic equilibrium, which, if true, may not result in similar manifestations in different kinds of birds living under the same conditions of life. Relative antiquity of the birds might be ascertained by measuring their ecologic adaptations. The Guam Rail (*Rallus owstoni*) and the Micronesian White-browed Rail (*Poliolimnas*) can be examined in this way. *R. owstoni* has the ability to live in both brackish and fresh water swamps, as well as in the scrub and grass of the uplands and in the virtually barren, rocky areas in the dense jungles. *Poliolimnas,* on the other hand, appears to be restricted to swampy areas in Micronesia. If the swampy areas were removed this rail probably would become extinct. *R. owstoni* appears to have been resident in Micronesia longer than *Poliolimnas.* However, ability to live in a variety of habitats might be acquired by *R. owstoni* in a relatively short time.

Another possibility is that the birds, which are less differentiated from their ancestral stocks, may be less differentiated because of suppression of newly evolved characters by dilutions, which result from interbreeeding with new birds, which may be arriving at irregular intervals from the ancestral home. Interbreeding of the resident population with newcomers may overshadow any modifications which might have appeared as a result of insular isolation, especially modifications which have little adaptive significance. One would suspect, from their modifications, that *Rallus owstoni, Metabolus rugensis, Corvus kubaryi,* and other endemic forms have experienced less of this "dilution," than such birds as *Rallus philippensis pelewensis, Artamus leucorhynchus pelewensis, Myzomela cardinalis,* and others. Murphy (1938) mentions this "dilution" effect in his discussion of "strong" and "weak" subspecies among warblers of the Marquesas. He writes that "strong" subspecies may develop if the birds are present on islands which are upwind from islands containing related subspecies. The wind acts to block interisland migration in these weak-flyers. On the other hand, "weak" subspecies may show the effect of "dilution," being situated on islands downwind from islands containing related subspecies. The direction of the wind acts to aid the weak flyers to move to the downwind islands and continually "dilute" the resident subspecies. Similar examples can be cited for Micronesian birds. Hesse, Allee, and Schmidt (1937:87) write, "Endemism on islands is most frequent in forms for which the difficulty of reaching the island is most extreme, so that new increments of the parent form are unlikely to follow."

Employing the criteria mentioned above, the birds of Micronesia can be tentatively divided into four groups as regards the relative time when they arrived at the islands:

1. Birds of ancient colonizations which reached certain individual islands, became modified, and dispersed no farther. Examples are *Aphanolimnas, Rallus owstoni, Aplonis corvinus, Metabolus rugensis,* and *Corvus kubaryi.*

2. Birds of ancient colonizations which reached or dispersed through a number of islands but are now restricted to relatively few islands. Examples are *Ducula oceanica, Ptilinopus porphyraceus, Megapodius lapérouse, Asio flammeus,* and *Acrocephalus luscinia.*

3. Birds of ancient, or possibly more recent, colonizations which initially reached or subsequently dispersed to many of the islands of Micronesia possessing habitat suitable for them. Examples are *Myzomela cardinalis,* the two species of *Halcyon, Aplonis opacus,* and *Zosterops conspicillata.*

4. Birds of rather recent colonizations, which may have reached only a few islands and are relatively unmodified from their parental stocks. Examples are *Artamus leucorhynchus, Caprimulgus indicus, Poliolimnas cinereus,* and *Nycticorax caledonicus.*

FACTORS CAUSING DISPERSAL

Darlington (1938:274) in discussing the origin of the fauna of the Greater Antilles uses the term "over-water dispersal" in referring to the spread of terrestrial animals across water. He is against the use of the term "accidental dispersal" since many factors besides accident are involved. He contends, as do others, that certain forms of organisms, owing to their "nature and behavior" cross water barriers more successfully than others. These observations may be applied to the "over-water dispersal" of birdlife to the islands of Micronesia. Certain groups of birds are more evident in Micronesia than others. Certain groups of birds which are found on other islands of the Pacific basin are found in Micronesia only in small numbers or may not be represented; Mayr (1945a:284) writes, "Remarkable is the almost complete absence of parrots and honey-eaters, the small number of pigeons and the absence of such wide-spread genera as *Lalage*, *Turdus*, and *Pachycephala*." The absence of some species and the presence of others produces the characteristic insular effect termed "disharmonic" by Gulick (1932:407), as compared with the continental area or island which derived its avifauna by way of a land bridge. One would think from looking at table 12 that members of the families Rallidae, Columbidae, Muscicapidae, Sturnidae, and Zosteropidae were the most successful colonizers in Micronesia on the basis of the number of successful colonizations (not necessarily on the number of endemics developed from a single colonization). Of these families, Sturnidae and Zosteropidae and possibly Columbidae contain species which often move in flocks. Furthermore, these families as well as the Muscicapidae feed on either fruits, seeds, or insects, any one of which is a type of food which might "give out" suddenly, stimulating a migratory behavior within the birds. From a flock embarking seaward in "search" of more food, a part or even all of the birds might survive in a chance flight to an isolated island in Micronesia. If a flock containing both males and females reaches an island, the species has a good chance of becoming established. Evidence that such a rapid colonization by flocks of birds can take place is found in the remarkable colonization of New Zealand by *Zosterops lateralis* from the Australian area. The bird was first seen as a winter migrant in New Zealand in 1856 and records of nestings were obtained at North Island in 1862, according to Oliver (1930:489). In the case of rails there is no evidence that they move in flocks; however, they are among the most successful colonizers and are on many of the oceanic islands in the tropical and subtropical oceans. Representatives of several species of the family Rallidae have invaded Micronesia and have successfully established 6, or possibly 7, "colonies."

Darlington (1938:274) further writes that "it is no accident that some islands, because of their nature and position, the direction of winds and currents, and the nature of the neighboring land, receive more organisms than other islands do." Semper (1881:294) writes that the distribution of flying creatures "must be in a great degree dependent on the direction and strength of atmospheric currents." These statements are applicable to the history of the avifauna of Micronesia. The Caroline Islands, for example, present a "broad front" for wanderers from the Melanesian islands. As mentioned previously, the prevailing winds in the late spring, summer, and early fall are from the south, southwest, and southeast and would favor bird flight to the northward towards the Carolines. In addition, the breeding season of many of the birds in Melanesia is from November to February, and in the spring and summer, restless young birds seeking living space might fly seaward and aided by the winds fly northward towards Micronesia. Adults, which may have well-established home territories, may be less likely to attempt such a movement.

One could conclude from the above discussion that the Micronesian islands, especially the Carolines, might be well populated with a large variety of birds from Melanesia, a scant 500 or more miles away. As it turns out, there are only a few islands in this extensive archipelago possessing proper vegetation, fresh water, and other qualities which make them capable of supporting the land and fresh-water birds of Melanesia. The few islands which have these qualities are the so-called "high" islands, including the entire Mariana chain, the Palaus, and four widely separated islands in the Carolines: Yap, Truk, Ponapé, and Kusaie. The other islands of Micronesia are "low" coral islands, which often lack fresh water and have a meager variety of fruits, insects and other foods. Thus, if birds do reach Micronesia but arrive at the atolls instead of the "high" islands, these birds may be doomed. It is noteworthy that the Micronesian islands are small compared with the Solomons, Fijis, and others. The smaller the island, the fewer the number of ecologic niches and the fewer the kinds of birds present.

Mayr (1941b:215) writes that the distance from the nearest land mass and the climatic conditions are important factors controlling dispersal. With regard to the degree of remoteness of the islands, table 13 lists the number of resident land and fresh-water birds present in the Palaus and the "high" islands of the Carolines. Also, the approximate distance from the nearest large land mass and the area in square miles are given. There is some correlation between the distance from the nearest land mass and the number of resident land birds and fresh-water birds. For example, Palau, with 32 resident birds, is only 410 miles from the nearest land mass whereas Kusaie, with only 11 resident birds, is 720 miles from the nearest land mass. The comparative size of the land mass must also be taken into account, as shown by the fact that the large island of Ponapé contains more kinds of birds but is more remote from large land masses than either Yap or Truk.

TABLE 13. CORRELATION BETWEEN NUMBER OF RESIDENT LAND AND FRESH-WATER BIRDS AND DISTANCE FROM LARGE LAND MASSES OF "HIGH" ISLANDS OF MICRONESIA

ISLAND	No. of birds	Approximate distance from nearest land mass (statute miles)	Nearest land mass	Area in square miles
Palau....	32	410	Approximately equal distance from Mindanao, Morotai, New Guinea	171
Yap.....	13	580	New Guinea	83
Truk....	17	525	New Ireland	50
Ponapé..	20	630	New Ireland	145
Kusaie...	11	720	Malaita (Solomons)	42

Climatic factors are important in the dispersal of bird life; Micronesia, where the climate is tropical to subtropical, is better suited for colonization by birds from the tropics (Melanesia) than by birds from the temperate or cold climates (Palearctica). The climatic factor may be one of the principal reasons why birds from Palearctica make up only a small part of the avifauna of Micronesia.

ANALYSIS OF SPECIATION

The process of speciation within insular populations has been discussed by many authors. Hesse, Allee, and Schmidt (1937:517) list the motives for differentiation as, "Special character of insular faunae rests on the conditions common to all islands—isolation, freedom from competition, space restriction, and special insular climates." This combination of characteristics is seldom found elsewhere in nature, and as Murphy (1938:357) points out, an island is the nearest approach to a "man-controlled laboratory." Isolation of small populations is probably the most influential factor in the process of speciation in insular organisms. Lack (1947:134) writes that "in all organisms the isolation of populations is an essential preliminary to the origin of new species." Buxton (1938: 265) also stresses this point with regard to the formation of species of insects in Samoa and emphasizes that evolution may occur more quickly in small populations. When mutations appear in such small and isolated populations, they have a greater chance to become fixed than do mutations in less restricted populations in a larger land mass, where such a mutation might be lost by the swamping effects of outbreedings. In addition, Wright (1931 and elsewhere) suggests the possibility of change by accidental elimination and recombination of hereditary characters in micropopulations. This mechanism could well be a factor in Micronesian bird populations, many of which possess no more than a few hundred individuals. Huxley (1938:256) emphasizes that "accidental" mutations may be perpetuated in small, isolated groups. It might be added that such changes might be either advantageous or disadvantageous to the organism concerned. Huxley (1938:263) states also that geographic isolation may promote nonadaptive differentiation, which may be caused by "colonization by a random sample" or by subsequent "preservation of nonadaptive mutations in numerically small isolated groups." Mayr (1942b:237) cites the importance of the "founder" principal for reduced variability in small populations. He points out that if the "founders" of the population carried with them only "a very small proportion of the variability of the parent population," one would expect to see divergence from the ancestral stock.

Freedom from competition, especially interspecific strife, is an important factor in differentiation; this is especially true in the early period of colonization. Lack (1947:113) points to the absence of food competitors, especially in the initial period of colonization, as an important influence in the evolution of Darwin's finches at the Galapagos Islands. Once a population has become established and "adjusted" to a given environment on a small island, intraspecific competition might bring about adaptative selection. Subsequent colonists might be eliminated by the competition brought about by these previously adapted organisms, especially if both organisms were adapted for life in the same ecologic niche. Space restriction may be important in such Micronesian birds as *Rhipidura* and *Myiagra*, which appear to possess recognizable territories. A new colonist entering the territory of one of these birds might be forced out. This competition might not play such an important part among birds, which live in flocks and do not range in closely guarded territories; birds in this group include some pigeons, starlings, and white-eyes.

Freedom from the pressure of predation probably exerts a direct influence on formation of species. Aside from a few migrant hawks and two kinds of resident owls, most of the avifauna feeds on vegetable and invertebrate foods. The large lizard *Varanus* may be classed as the only native predator on many of the islands. Man has been responsible for the introduction of rats, house cats, and other mammals, which may be destructive to birds. Thus, before the advent of man the factor of predation may not have been of great consequence. As mentioned previously, nonadaptive modifications may be perpetuated where the "weeding-out" process by predation is not an influence. Flightless rails have apparently developed in the absence of predation.

The absence of the pressure of predation should remove a certain amount of control on the population turn-over. As Hesse, Allee, and Schmidt (1937:521) write, a characteristic of the faunas of oceanic islands is the fact that they are distinguished by the occurrence of "disproportionately developed taxonomic groups in which one or a few basic types have undergone adaptative radiation and come to fill unduly large proportions of the population as compared with conditions that obtain on neighboring continents." Lack (1947:114) writes, "that the absence of predators may well have accelerated the adaptative radiation" in the Galapagos finches. In Micronesia, the starling (*Aplonis opacus*) dominates much of the available habitat on some of the Caroline atolls, and even on "high" islands, where other land birds are present. There appears to be no tendency towards selective adaptations occurring, or towards ecologic isolation.

Available data indicate that the life spans of individual birds in Micronesia may be short. For example, it was obvious on many of the islands visited by the NAMRU2 party that starlings (*Aplonis opacus*) in immature plumage outnumbered starlings in adult plumage, although it is possible that immature plumages are retained longer in these island birds than in others. Similar observations were made by Coultas, who noted the ratio of birds in immature plumage to birds in adult plumage at Kusaie to be 5 to 1. If the life span is shorter in these insular forms as compared with that of the ancestral stocks, the higher annual population turn-over would allow for the speed of genetic changes to be accelerated.

The origin of species by hybridization between different kinds of organisms has been a subject of frequent discussion. Lack (1947: 100) concludes that it is improbable that hybridization has played an important part in the origin of new kinds of birds. Nevertheless, the absence of sufficient mates in the confines of a small island probably stimulates the crossbreeding between two species of birds. Fertile offspring of such a cross might conceivably account for some of the populations, the origins of which are puzzles to present day taxonomists. Such Micronesian forms as *Metabolus* and *Cleptornis* could conceivably have been derived in such a manner. Yamashina (1948) has described the origin of *Anas oustaleti* as a result of hybridization between *A. platyrhynchos* and *A. poecilorhyncha.* It might be difficult to explain every case of the formation of other insular species on the basis of the effects of isolation and paucity alone. However, Mayr (1942b:236) includes the development of questionable and unusual kinds of insular forms in a general statement: "The potentiality for rapid divergent evolution in small populations explains also why we have on islands so many dwarf or giant races, or races with peculiar color characters (albinism, melanism), or with peculiar structure (long bills in birds), or other peculiar characters (loss of male plumage in birds)."

Nutrition may be also a factor influencing speciation in bird life. The types of food plants (coconut, papaya, breadfruit, pandanus, etc.) might be similar on a Micronesian island and on a continental island in the Philippine region; however, the value of these plants as foods might vary and might reflect differences in mineral content of the soils. For example, if the soils on an island lack, or by leaching out have lost, sufficient amounts of potassium and other elements, plants may store foods, not as proteins, but possibly as carbohydrates, simple sugars, or alkaloids. Whether nutritional influences might have a selective effect on the bird populations, has not been ascertained.

In summary, it may be said that genetic change altering the phenotypic expression of avian characteristics is no more apt to happen in insular populations than in continental populations but genetic change may have a greater chance of being perpetuated in small insular populatians where isolation, limited competition, freedom from the selective influences of predation, and other factors exert influences.

CONSERVATION OF THE AVIFAUNA OF MICRONESIA

The islands of Micronesia are small and their occupation by man often produces serious effects on the endemic animal life of the islands. The vulnerability of insular bird populations is well attested by the fact that the majority of birds, which have become extinct in the past two hundred years, have been insular forms. Two birds in Micronesia, the Kusaie Rail (*Aphanolimnas*) and the Kusaie Mountain Starling (*Aplonis corvinus*), are known to be either extinct or so rare that they have not been taken since the time of Kittlitz, who visited the island of Kusaie in December, 1827, and January, 1828. Other birds (*Anas oustaleti, Caloenas nicobarica, Megapodius l. lapérouse,* and *Metabolus rugensis*) have become reduced in numbers and may be threatened with extermination.

Nelson (1921:270-274) has described the following agencies destructive to island life of the Pacific: fire, volcanic eruptions, tidal waves, hurricanes, clearing of the land, introduction of domestic animals and grazing, introduction of wild animals and birds. Mayr (1945c) also presents a discussion of conservation problems in these islands.

Fire is a serious hazard to island life, especially to the land birds. It destroys both food and cover, these two habitat requirements being most essential to the birds. The firing of open lands to improve grazing conditions was a practice which persisted in the Marianas during the time of the Spanish. This practice has declined, but the resultant vegetational changes and erosion have adversely affected the avifauna. Tidal waves and hurricanes (typhoons) are occasionally of such intensity as to flood low coral atolls. Such events are damaging to, or might even exterminate populations of land birds (*Aplonis*, *Acrocephalus* and others), and prevent colonizations which might otherwise occur. Clearing of the land for agricultural use probably has affected the avifauna, especially on the island of Tinian where much of the island has been placed in cultivation. The occurrence of domestic stock, especially feral hogs and cats, has affected the birds. Hogs, apparently, have been in the islands for a long time. The English privateer, Lord Anson, visited Tinian in October, 1742, and noted a large number of hogs present at that time. At Guam, in 1945, the NAMRU2 party found both hogs and cats moving freely in all parts of the island. Stomachs of cats examined showed that they had been feeding principally on rodents.

Introduction of wild animals and plants have not been so extensive as in the Hawaiians or other islands. There have been at least five importations of land birds to Micronesia as well as several mammals, other vertebrates and invertebrates. The effect of these established colonies on the native bird life has not been studied.

The late world war has brought changes to the population of bird life in Micronesia. The author (1946b) has elsewhere described some of the effects of the bombing, invasion, and occupation of small islands. Some islands, like Peleliu, suffered severely from bombing and invasion operations. Some islands, especially smaller ones like Kwajalein and Ulithi, were partly or almostly entirely cleared of vegetation by occupation forces. Other effects were caused by "recreational" shooting of birds by garrison forces; introductions of pests in materials unloaded; and pest control by clearing, draining, and spraying with DDT and other insecticides to the detriment of inoffensive species.

It is obvious that a well-planned program of conservation should be placed in operation to insure survival of the endemic avifauna of Micronesia.

THE FUTURE OF ORNITHOLOGICAL RESEARCH IN MICRONESIA

Collections of birds have been made at most of the major islands of Micronesia, and it is thought that there are but few if any unnamed birds in the region. The distribution of several species has not been completely investigated, especially those land birds (*Ducula*, *Ptilinopus*, and *Aplonis*) which inhabit coral atolls in the Carolines and Marshalls. The bird life of the northern Marianas is also incompletely known. Continued observations in the Micronesian islands will increase our knowledge of the kinds of migratory shore birds and migratory land birds which reach the island as winter visitors. Further information is needed concerning the breeding activities of sea birds in Micronesia, especially in the Marshalls and Carolines.

The systematic status of most of the birds in Micronesia is already established. It is hoped that the present account advances our knowledge of the methods of colonization. Although these fundamental investigatons have been nearly completed in Micronesia the field of avian ecology has been relatively untouched. In the past, expeditions have visited Micronesia with the aim of obtaining within a short time collections of the animal life as large and as representative as possible. Many of the collectors made few or no field notes on the bird life; some, like Finsch, Kubary, Marche, and Coultas, made valuable observations on the habits of the birds. Intensive ecological researches may be accomplished more thoroughly by resident investigators, who can devote full time to such pursuits.

METHODS AND ACKNOWLEDGMENTS

My own opportunity to study the bird life of Micronesia came as a member of the scientific staff of the Laboratory of Mammalogy of United States Naval Medical Research Unit No. 2 (NAMRU2) in the late war. The primary duty of this laboratory was to obtain examples of the vertebrate fauna for examination for ectoparasites by the Laboratory of Acarology and to preserve specimens for identification. As a result sizeable collections of mammals, birds, and other vertebrates were obtained. In addition, ecological data were obtained (as time permitted), especially as an aid in studying the distribution of ectoparasites which affected man. In 1945, I spent

eleven months in Micronesia; for most of this time I was stationed at Guam, the headquarters of the Unit, although one month was spent in the Palau Islands, two weeks were spent at Ulithi Atoll, and short stop-overs were made at Eniwetok and Kwajalein atolls. Other members of the laboratory staff visited Rota and Truk islands.

Subsequent to the field studies in the Pacific, I was sent to Washington and spent approximately eight months at the United States National Museum studying the collections of birds and preparing several reports for publication. In this period other material was studied, both in the United States National Museum and at the American Museum of Natural History, New York, and the literature dealing with the birds of Micronesia was explored and a bibliography of Micronesian birds was prepared. At the University of Kansas, I continued the bibliographic work, borrowed and studied some specimens, and completed accounts of the avifauna of Micronesia.

Under the account of each bird, all known references in the literature, which mention the scientific name of the bird and its distribution in Micronesia, are listed. The references are arranged as follows: (1) citation to the original description, and (2) citations to names in literature in the order of their first appearance. When a name is a pure synonym, it may be recognized as such by the fact that the type locality is given immediately following the citation. In compiling these references the writer made use of the invaluable work by Wiglesworth (1891) and of Utinomi's "Bibliographica Micronesia," made available through the translation by Fisher (1947). The arrangement of the families follows that of Peters (1931-1945) and Wetmore (1940).

Specimens examined are designated as to collection in which catalogued by the following abbreviations: USNM, the United States National Museum; AMNH, the American Museum of Natural History; MCZ, the Museum of Comparative Zoölogy; and KMNH, the University of Kansas Museum of Natural History. Average and extreme measurements of specimens are usually listed in tables; unless otherwise indicated, measurements are in millimeters, and are of adult specimens. The wings have been measured by flattening them on a ruler. Weights are in grams. Unless otherwise indicated, descriptions of the birds have been written by the author. Descriptions of shore birds are not given; for these the reader may refer to Mayr (1945a:28-47) where characters useful for identification of the birds in the field also are given. The writer is especially indebted to Dr. Ernst Mayr for making available the descriptions of Micronesian birds made by Miss Cardine Bogert, especially those dealing with color of the irides, feet, and bill. Color terms in quotation marks refer to those in Ridgway (1912).

In dealing with insular forms the criterion of intergradation as indicative of subspecies cannot be applied as it can in kinds of birds on the mainland which have geographically continuous distributions. Instead, degree of difference in combination with geographic position plus other factors such as degree of variation in the geographic races of the same species or a related species on continental areas are used in deciding whether two closely related kinds are subspecies or full species. Many kinds of birds in the islands are modified but little from island to island (examples, *Rhipidura rufifrons, Aplonis opacus, Ducula oceanica,* and *Myzomela cardinalis*), and can be treated as subspecies. Others show much variability from island to island and it is uncertain whether they should be treated as subspecies or as separate species (examples, *Myiagra oceanica, Zosterops cinerea, Rukia,* and possibly *Acrocephalus luscinia*). Decisions on generic status are equally difficult to make. In many cases the experience and judgment of the taxonomist may be the only criteria by which he can decide whether a bird is different enough to be considered as a distinct genus. This "human element" has caused some disagreement. Knowing whether the bird is to be considered as a distinct genus or instead merely as a species may not be as important as knowing its correct phylogenetic relationship. The circumstance that variation in these insular birds is in general less predictable than in mainland birds adds, I think, to the pleasure inherent in the classification of the variations.

First, I thank Commodore Thomas N. Rivers (MC) USNR, then commanding officer of NAMRU2, for the opportunity to join the Unit, for his interested cooperation in seeing that the plans for field trips were successful, and for his thoughtfulness in obtaining for me the orders for duty at the United States National Museum subsequent to our field investigations. Greatly appreciated also is the help rendered by my former colleagues of NAMRU2, including Dr. David H. Johnson, Dr. George W. Wharton, Dr. Aaron B. Hardcastle, Mr. Odis A. Muennik, Mr. L. P. McElroy, Mr. Charles O. Davison, Mr. Merle H. Markley, Mr. Walter L. Necker, Dr. Wilbur G. Downs, Dr. Bernard V. Travis, and Mr. E. W. Coleman. Other personnel, then stationed in Micronesia, who contributed data used in this report include: Dr. Joe T. Marshall, Jr., (who generously loaned some of the specimens taken by him in Micronesia), Dr. C. K. Dorsey, Dr. George Hensel, Mr. Tom Murray, Dr. Irwin O. Buss, Mr. James O. Stevenson, Dr. Wilfred D. Crabb, Mr. Herbert Wallace, and Dr. M. Dale Arvey. Authorities of the United States National Museum provided generously for using the collections there, and I am especially grateful to Dr. Alexander Wetmore, Dr. Herbert Friedman, and Mr. Herbert G. Deignan for their cooperation and assistance. Doctor Wetmore kindly made available many of the birds collected at Bikini during the atomic bomb experiments. Dr. Robert Cushman Murphy, Dr. Ernst Mayr, and Dr. Dean Amadon of the American Museum of Natural History made available the collections in their charge. Doctor Murphy allowed me to examine some of the heretofore unstudied collections of sea birds of the Whitney South Sea Expedition. Doctor Mayr generously helped me with taxonomic and evolutionary problems and made available to me some of his own unpublished taxonomic notes, the unpublished field accounts of Mr. William F. Coultas and a partly completed manuscript on the birds of Micronesia by Miss Cardine Bogert. Mr. James L. Peters generously loaned specimens from the Museum of Comparative Zoölogy. The use of unpublished field notes made by Mr. Larry P. Richards at Ponapé and Truk in 1947 and 1948 is also gratefully acknowledged. I am grateful also to my colleagues at the Museum of Natural History of the University of Kansas and would single out for special mention Dr. E. Raymond Hall who gave critical assistance with the manuscript, Drs. Edward H. Taylor and Herbert B. Hungerford who made helpful suggestions, and Mrs. Virginia Cassell Unruh who drew the distributional maps.

ACCOUNTS OF THE KINDS OF BIRDS OF MICRONESIA

Diomedea nigripes Audubon

Black-footed Albatross

Diomedea nigripes Audubon, Ornith. Biog., 5, 1839, p. 327. (Type locality, Pacific Ocean, lat. 30°44'N., long. 146°W.)

Diomedea fuliginosa Oustalet, Le Nat., 1889, p. 261 (Mariannes).

Diomedea nigripes Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris (3), 8, 1896, p. 51 (Agrigan); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus. 1, 1901, p. 22 (Marianas); Safford, Osprey, 1902, p. 70 (Mariannes); *idem*, The Plant World, 7, 1904, p. 268 (Guam?); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 32 (Marriane); Peters, Check-list Birds World, 1, 1931, p. 43 (Marshalls); Hand-list Japanese Birds, rev., 1932, p. 188 (Marianas); Hand-list Japanese Birds, 3rd ed., 1942, p. 210 (Marianas); Mayr, Birds Southwest Pacific, 1945, p. 5 (Marshalls).

Geographic range.—North Pacific Ocean. Breeds on islands northwest of Hawaii. In Micronesia: Mariana Islands—Agrigan.

Characters.—A large oceanic bird with sooty-brown coloration; darker on nape, wings and tail; lighter on forehead, sides of head, and abdomen; area surrounding bill whitish; tail whitish at base; bill dark reddish-brown; feet black.

Remarks.—This albatross has been recorded from waters near the Mariana Islands. Quoy and Gaimard (1824:145) observed "albatross" between the Mariana and the Hawaiian Islands. The only actual specimens obtained from the islands were reported on by Oustalet (1896:51). These were eight Black-footed Albatrosses which were taken on the coast of Agrigan by Marche in December, 1888, and January, 1889. Oustalet gives the following measurements: total length, 680-785; wing, 485-525; tail, 180-225; tarsus, 80-90; culmen, 108-125. The specimens are apparently in the Paris Museum.

Peters (1931:43) lists the Marshall Islands as part of the range of *D. nigripes*.

In the period of the late war Gleise (1945:221) observed eight Short-tailed Albatrosses (*D. albatrus* Pallas) "off Saipan." Specimens of *D. albatrus* have not been taken in Micronesia. According to Austin (1948b:32) this albatross "is now virtually extinct," and this record may be questioned.

Puffinus pacificus chlororhynchus Lesson

Wedge-tailed Shearwater

Puffinus chlororhynchus Lesson, Traité d'Ornith., 8, 1931, p. 613. (Type is from Shark's Bay, West Australia.)

Puffinus sphenurus Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 299 (Mortlock).

Puffinus chlororhynchus Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 80 (Luganor?); Godman, Monogr. Petrels, pt. 2, 1908, p. 88 (Carolines); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 33 (Luganor or Ruk?).

Puffinus pacificus chlororhynchus Hand-list Japanese Birds, rev., 1932, p. 187 (Lukunor or Truk?, Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 209 (Lukunor or Truk?, Kusaie).

Geographic range.—Breeds at the Seychelles, Australia, Lord Howe, Norfolk, and other islands in the Australian area. Ranges throughout most of the warmer parts of the Indian and Pacific oceans. In Micronesia: Mariana Islands—Guam; Caroline Islands—Lukunor or Truk?, Kusaie.

Characters.—A large shearwater with long wedge-shaped tail; upper parts sooty-brown with crown, neck, and wings darker and forehead paler; under parts paler than upper parts; bill dark; feet flesh-colored.

Remarks.—This shearwater was taken by Kubary either at Lukunor or at Truk in the Caroline Islands. At a later date, apparently between 1922 and 1932, the Japanese recorded the bird at Kusaie. In using this subspecific name, I am following the Hand-list of Japanese Birds (Hachisuka *et al.*, 1932:187).

At Guam on August 10, 1931, Coultas obtained a male shearwater, which is tentatively placed in this subspecies. Its measurements are as follows: wing, 290; tail, 128; exposed culmen, 39; tarsus, 47. Coultas (field notes) writes that he was told by natives that petrels nest and roost on the high cliffs behind the city of Agaña on Guam. At sea south of the eastern Caroline islands, Coultas obtained five other birds which appear to be the same as the bird from Guam. All specimens are in the collections of the American Museum of Natural History.

Puffinus pacificus cuneatus Salvin

Wedge-tailed Shearwater

Puffinus cuneatus Salvin, Ibis, 1888, p. 353. (Type locality, Krusenstern Island = Ailuk, Marshall Islands, *fide* Fisher, Auk, 63, 1946, pp. 587-588.)

Puffinus cuneatus Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 80 (Krusenstern); Salvin, Cat. Birds British Mus., 25, 1896, p. 371 (Krusenstern); Godman, Monogr, Petrels, pt. 2, 1908, p. 76 (Marshalls).

Puffinus pacificus cuneatus Mathews, Birds Australia, 2, 1912, p. 84 (Marshall Group); Peters, Check-list Birds World, 1, 1931, pp. 55-56 (Krusenstern); Hand-list Japanese Birds, 3d ed., 1942, p. 209 (Krusenstern); Fisher, Auk, 63, 1946, pp. 587-588 (Ailuk).

Thyellodroma cuneata cuneata Mathews and Iredale, Ibis, 1915, p. 597 (Krusenstern); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 113 (Marshall Group).

Thyellodroma cuneata Oberholser, Auk, 34, 1917, p. 474 (Krusenstern).

Thyellodroma pacificia cuneata Mathews, Novit. Zool., 39, 1934, p. 186 (Caroline Islands).

Geographic range.—Pescadores east to the Hawaiian Islands and south to eastern Micronesia. In Micronesia: Marshall Islands—Ailuk.

Remarks.—Osbert Salvin received two specimens of this shearwater from H. J. Snow, who got them at the Krusenstern Islands in 1883. In describing them, Salvin (1888: 353) comments that the locality is seemingly in the Marshall Islands at approximately 10°17′ N. and 190° W. This locality was confusing to Seebohm (1891:191) who thought it was between the Hawaiians and the Marshalls, while Hartert (1926:352) decided it was really Krusenstern Rocks in the Hawaiian Group. To clear the matter up, Fisher (1946:587-588) writes that Salvin was correct and suggests that the name of the island should be the better established one, Ailuk, rather than the little used one, Krusenstern.

P. p. cuneatus resembles *P. p. chlororhynchus* but is whiter on the underparts, especially the breast. These two subspecies are inseparable according to the twenty-fourth supplement to the American Ornithologists' Union Check-list of North American Birds (Auk, vol. 66, 1949:281).

Puffinus tenuirostris (Temminck)

Short-tailed Shearwater

Procellaria tenuirostris Temminck, Pl. Col., livr. 99, 1835, text to pl. 587. (Type locality, Seas north of Japan and shores of Korea.)

Puffinus tenuirostris tenuirostris Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Puffinus tenuirostris Yamashina, Tori, 10, 1940, p. 677 (Kinajon, Marshall Islands); Hand-list Japanese Birds, 3d ed., 1942, p. 210 (Kinajon, Marshall Islands).

Geographic range.—Breeds in Tasmania, southeastern Australia, islands in Bass Straits, and Bounty Islands. Ranges north to the Bering Sea. In Micronesia: Mariana Islands—Guam?; Marshall Islands—Kinajon.

Character.—A rather large shearwater with short, rounded tail; upper parts sooty brown; underparts paler and more grayish than back; throat may be occasionally whitish; bill lead-gray; feet grayish, browner on outer side.

Remarks.—On migration this shearwater probably reaches most parts of Micronesia. It has been recently recorded by the Japanese at Kinajon in the Marshall Islands. Bryan (1936:15) includes this species as a "chance arrival" in his list of the birds of Guam.

Puffinus nativitatis Streets

Christmas Shearwater

Puffinus (Nectris) nativitatis Streets, Bull. U. S. Nat. Mus., 7, 1877, p. 29. (Type locality, Christmas Island, Pacific Ocean.)

Puffinus nativiatis Salvin, Cat. Birds British Mus., 25, 1896, p. 389 (Krusenstern); Lister, Proc. Zool. Soc. London, 1891, pp. 295-300 (Krusenstern); Godman, Monogr. Petrels, pt. 3, 1908, p. 153 (Marshalls).

Geographic range.—Breeds at Wake and Laysan Islands south to Christmas, Phoenix, Marquesas, Tuamotu, and Austral Islands. In Micronesia: Marshall Islands—Ailuk.

Characters.—Upper parts chocolate brown; underparts resemble upper parts but throat may be slightly grayer; bill and feet black. *P. nativitatis* resembles *P. pacificus* but is similar with black feet.

Remarks.—The only specimens of this bird known from Micronesia, are those taken in the spring of 1883 by H. J. Snow at Krusenstern (Ailuk) in the Marshall Islands. For two birds from this island in the collections of the British Museum, Godman (1908: 154) gives the following measurements: wing, 9.6 and 10.0; tail, 3.35 and 3.4; culmen, 1.15 and 1.2; tarsus, 1.7 and 1.8; middle toe and claw, 2.0 and 2.1.

Puffinus lherminieri dichrous Finsch and Hartlaub

Dusky Shearwater

Puffinus dichrous Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 244. (Type locality, McKean Island, Phoenix Group.)

Puffinus dichrous Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 108 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 44 (Palau).

Puffinus opisthomelas var. *minor* Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 832 (Type locality, Pelew); Finsch, Journ. f. Ornith., 1872, p. 57 (Pelew).

Puffinus opisthomelas Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); Finsch, Journ. f. Ornith., 1870, p. 371 (Pelew).

Puffinus tenebrosus Pelzeln, Ibis, 1873, p. 47, fig. 1 (Type locality, unknown = Pelew Islands, *ex* Mathews); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 55 (Rota); Hartert, Novit. Zool., 5, 1898, p. 69 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1. 1901, p. 23 (Marianas?); Safford, The Plant World, 7, 1904, p. 268 (Guam).

Puffinus obscurus Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 40 (Ponapé, Palau); *idem*, Proc. Zool. Soc. London, 1877, p. 786 (Palau); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 782 (Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 295, 309 (Ponapé, Kuschai); *idem*, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem*, Ibis, 1881, p. 109 (Kuschai); *idem*, Ibis, 1881, pp. 113, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Salvin, Ibis, 1888, p. 357 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 79 (Ruk, Ponapé, Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 54 (Saypan, Palaos); Salvin, Cat. Birds British Mus., 25, 1896, p. 382 (Carolines, Pelews); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 23 (Marianas?); Safford, Osprey, 1902, p. 70 (Marianas); Dubois, Syn. Avium, 2, 1904, p. 1031 (Pelew, Carolines); Godman, Monogr. Petrels, pt. 2, 1908, pp. 126, 127 (Pelew, Ruk, Ponapé).

Puffinus obscurus obscurus Hartert, Novit. Zool., 7, 1900, p. 10 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 32 (Saipan, Ruk, Ponapé, Pelew).

Puffinus lherminieri minor Mathews, Birds Australia, 2, 1912, p. 70 (Pelew, Carolines).

Puffinus assimilis minor Mathews, Syst. Avium Australasianarum, 1, 1927, p. 111 (Pelew).

Puffinus lherminieri dichrous Murphy, Amer. Mus. Novit., no. 276, 1927, p. 10 (Pelews, Carolines); Peters, Check-list Birds World, 1, 1931, p. 60 (Pelew); Yamashina, Tori, 7, 1932, p. 408 (Arakabesan); Hand-list Japanese Birds, rev., 1932, p. 188 (Saipan, Truk, Ponapé, Palaus); Hand-list Japanese Birds, 3rd ed., 1942, p. 209 (Saipan, Truk, Ponapé, Palau); Mayr, Birds Southwest Pacific, 1945, p. 10 (Carolines, Palaus); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 37 (Palau).

Alphapuffinus lherminieri minor Mathews, Novit. Zool., 39, 1934, p. 182 (Pelew Islands).

Puffinus obscura Bryan, Guam Rec., vol. 13, No. 2, 1936, p. 15 (Guam).

Geographic range.—Known from Phoenix, Nauru, Micronesia, and south to the Samoan, Society, Tuamotu, and Marquesas islands. In Micronesia: Mariana Islands—Guam, Rota, Saipan; Palau Islands—Babelthuap, Koror, Arakabesan; Caroline Islands—Truk, Ponapé, Kusaie.

Characters.—A small shearwater with upper parts sooty-black; under parts white except for sides of breast grayish and under tail-coverts blackish; bill blackish; feet yellowish, outer toe black.

Measurements.—Measurements of 17 adult birds (9 males, 7 females, 1 unsexed) from Micronesia (Palau, Truk, Ponapé, Kusaie) and 10 adult birds (6 males, 4 females) from the Phoenix Group (Enderbury, Canton) are listed in table 14.

TABLE 14. MEASUREMENTS OF *Puffinus lherminieri dichrous*

LOCALITY	Wing	Tail	Exposed culmen	Tarsus
Micronesia.......	203 (197-211)	83.6 (77-89)	27.9 (26-30)	38.5 (37.5-40)
Phoenix..........	197 (193-203)	82.2 (79-85)	26.3 (25-28)	37.2 (36-39)

Specimens examined.—Total number, 72 (44 males, 19 females, 9 unsexed), as follows: Palau Islands, AMNH—exact locality not given, 64 (Oct., Nov., Dec.); Caroline Islands, AMNH—Truk, 4 (June 15, 16)—Ponapé, 3 (undated)—Kusaie, 1 (April 25).

Nesting.—The Dusky Shearwater in Micronesia nests in holes on high, and usually isolated, coral cliffs. Owston's collectors, according to Hartert (1900:10), found a nest with one egg at Truk on June 16. The nest was in a hole four feet deep in the side of a cliff. The egg is white and measures 42 × 35. Yamashina (1932a:408) records the taking of one egg at Arakabesan, Palau Islands, on May 26. Coultas (field notes) gives an interesting account of nesting activities of this shearwater at the Palau Islands. He found the bird nesting on small islands of the group from October to December, 1931; however, he states that the natives told him that the bird nests throughout the year. Land crabs and shearwaters were often found together in the same burrow. Apparently the adult birds did not remain in the burrow with the young during the day. At Kusaie, Coultas was told by the natives that the adult birds were caught by tying the mandibles of the young together. When the parent birds approached and hovered over the young birds expecting their mouths to open, the natives had the opportunity to strike them down with clubs. Coultas collected six downy nestlings at Palau in November and December.

Remarks.—The first published account of this shearwater in Micronesia was apparently by Kittlitz (1858, pt. 1:358) when he recorded his "Schwärzlicher Sturmvogel" at Kusaie, according to Wiglesworth (1891a:79). Finsch (1875:44 and 1881b:113, 115) studied specimens taken by Tetens, Heinsohn, and Kubary at the Palau Islands and those taken by Kubary at Ponapé. Earlier, Hartlaub (1868:832) used some of these specimens from the Palau Islands to describe his *Puffinus opisthomelas* var. *minor,* which was destined to be placed in synonymy (Murphy, 1927:10). Oustalet (1896:54, 55) recorded specimens taken by Marche at Saipan in May, 1887, and at Rota in July, 1888. Oustalet referred to them as *P. obscuras* and *P. tenebrosus*, respectively. T. W. Gulick obtained undated skins at Ponapé. Hartert (1900:10) reported on specimens taken by Owston's collectors at Truk. In 1931, Coultas with the Whitney South Sea Expedition took one shearwater at Kusaie and a series of 64 skins at the Palau Islands. He failed to find birds at Ponapé and wrote that their scarcity there may have been due to persistent hunting of them by the inhabitants of the island. The NAMRU2 party obtained no information concerning the birds at Guam, Rota, or Truk, but at the Palau Islands observed shearwaters at sea approximately 6 miles east of Babelthuap Island on September 2, 1945.

Murphy (1927:6-15) revised the shearwaters of the *Puffinus lherminieri* group, and recognized several subspecies. *P. l. dichrous* was assigned a range consisting of Micronesia, the Phoenix Islands, and Nauru Island. The breeding range of *P. l. polynesiae* was given as the Samoan, Society, Tuamotu and Marquesas islands. Color differences between the two subspecies are very slight, and he separated them on the basis of the length of the exposed culmen as follows: *P. l. dichrous* 22.6-27 (26) in *P. l. polynesiae* 25.5-30 (28.9). In other measurements they closely resembled one another. At the time of his study, Murphy did not have the shearwaters from Micronesia collected by Coultas and actually did not have a large series from these islands. On studying this new material, I find the length of the exposed culmen of 17 adult birds from Micronesia (including 12 from the Palaus) to be 26-30 (27.9). In comparison with Murphy's findings, my measurements of Micronesian birds fall almost midway between the measurements which he recorded as characteristic of *P. l. dichrous* (from the Phoenix Islands) and *P. l. polynesiae.* The intermediate position of the measurements of the Micronesian birds, together with the absence of other distinguishing characters, suggests that these shearwaters belong to only one subspecies which consists of a group of isolated and variable populations. Unless the old specific name, *obscuras* of Gmelin, is revived, the name for the entire group in Micronesia and Polynesia would be *P. l. dichrous.* I agree with Murphy that the Bonin form, *P. l. bannermani,* is a well-defined subspecies.

Pterodroma rostrata rostrata (Peale)

Tahiti Petrel

Procellaria rostrata Peale, U. S. Expl. Exp., 8, 1848, p. 296. (Type locality, Mountains about 6,000 feet on Tahiti, Society Islands.)

Procellaria desolata Pucheran, Voy. Pôle Sud, 3, 1853, p. 138 (des îles Carolines); Hartlaub, Journ. f. Ornith., 1854, p. 168 (Carolinen).

Procellaria (Aestrelata) desolata Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 55 (Caroline Islands).

Oestrelata rostrata Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 82 (Caroline Is.); Godman, Monogr. Petrels, pt. 3, 1908, p. 190 (Caroline Is.).

Pterodroma rostrata Kuroda, in Momiyama, Birds Micronesia, 1922, p. 33 (Carolines).

Pterodroma rostrata subsp. (?) Hand-list Japanese Birds, rev., 1932, p. 188 (Carolines); Hand-list Japanese Birds, 3d ed., 1942, p. 210 (Carolines).

Geographic range.—Known to breed on the Society and Marquesas Islands. In Micronesia: Caroline Islands—exact locality unknown.

Characters.—A large petrel with blackish-brown plumage except for belly and under tail-coverts white and throat, upper breast and flanks pale brown; bill black; legs yellowish; feet black. This oceanic bird differs from other petrels and shearwaters of Micronesia by the presence of a white abdomen in contrast with dark plumage on upper parts, throat, and breast.

Remarks.—A petrel which is referred to this subspecies has been taken once in Micronesia, by Hombron and Jacquinot in the Caroline Islands. It may be pointed out that the subspecies *P. r. becki*

Murphy is known from the sea east of the Bismarck Archipelago and might range into Micronesian waters.

Pterodroma hypoleuca hypoleuca Salvin

Stout-billed Gadfly Petrel

Oestrelata hypoleuca Salvin, Ibis, 1888, p. 359. (Type locality, Krusenstern Island = Ailuk, Marshall Islands, *fide* Fisher, Auk. 63, 1946, pp. 587-588).

Oestrelata hypoleuca Salvin, Cat. Birds British Mus., 25, 1896, p. 409 (Krusenstern); Godman, Monogr. Petrels, pt. 3, 1908, p. 212 (Krusenstern).

Cookilaria hypoleuca hypoleuca Mathews, Syst. Avium Australasianarum, 1, 1927, p. 122, (Marshall Group).

Pterodroma leucoptera hypoleuca Hand-list Japanese Birds, rev., 1932, p. 188 (Marshalls); Hand-list Japanese Birds, 3d ed., 1942, p. 210 (Krusenstern); Fisher, Auk, 63, 1946, pp. 387-388 (Ailuk).

Pterodroma hypoleuca hypoleuca Mayr, Birds Southwest Pacific, 1945, p. 11 (Micronesia).

Geographic range.—Ranges from the Bonins east to the Hawaiians and south to Micronesia. In Micronesia: Marshall Islands—Ailuk.

Characters.—Upper parts grayish except for forehead whitish, crown and nape sooty-black; underparts whitish except for sides of breast sooty-black; legs and feet flesh color except for tips of toes and webs which are black.

Remarks.—In Micronesia, this petrel is known only from the type locality, Krusenstern or Ailuk, Marshall Islands. Fisher (1946: 587-588) has corrected the confusion regarding the exact position of this type locality.

Phaëthon aethereus mesonauta Peters

Red-billed Tropic-bird

Phaëthon aethereus mesonauta Peters, Occ. Papers Boston Soc. Nat. Hist., 5, 1930, p. 261. (Type locality, Swan Key, Almirante Bay, Panama.)

Phaeton aethereus Finsch, Ibis, 1880, pp. 329, 333, (Ratak Chain, Marshalls); *idem,* Journ. f. Ornith., 1880, p. 310 (Kuschai); *idem,* Ibis, 1881, p. 109 (Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 73 (Kushai, Marshalls); Ogilvie-Grant, Cat. Birds British Mus. 26, 1898, p. 457 (Kushai, Marshalls); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 34 (Kusaie, Marshall Islands).

Phaethon aethereus [*?mesonauta*] Hand-list Japanese Birds, rev., 1932, p. 187 (Kusaie, Marshalls); Hand-list Japanese Birds, 3d ed., 1942, p. 208 (Kusaie, Marshall Islands).

Geographic range.—Tropical parts of Atlantic and eastern Pacific from Cape Verde Islands west to Panama and Galapagos Islands. In Micronesia: Caroline Islands—Kusaie; Marshall Islands—Ratak Chain.

Characters.—Adult: A large, white sea bird with a long white tail; dorsal surface marked with blackish, transverse vermiculations; bill red; tarsus and foot flesh-colored with a yellowish hue, with plantar surface grayish. Immature: Resembles adults but dark transverse bars are broader; crown blacker; bill yellow.

Remarks.—No specimens have been examined. The Red-billed Tropic-bird is placed in the list of birds known from Micronesia on the basis of two observations by the German ornithologist, Otto Finsch. It has not been reported since his time, and may be considered as an unusual record for the area. I am following the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:208) in assigning the bird to the subspecies, *P. a. mesonauta.*

Phaëthon rubricauda rothschildi (Mathews)

Red-tailed Tropic Bird

Scaeophaethon rubricauda rothschildi Mathews, Birds Australia, 4, 1915, p. 303. (Type locality, Laysan and Niihau.)

Phaeton rubricaudus Finsch, Journ. f. Ornith., 1880, p. 296 (Carolines); *idem*, Ibis, 1881, p. 115 (Ponapé).

Phaeton rubricauda Finsch, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 73 (Ruk, Ponapé, Marshalls).

Phaeton rubricauda Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 451 (Caroline Islands); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 187 (Pagan, Truk, Ponapé, Marshalls).

Scaeophaethon rubricauda Kuroda, in Momiyama, Birds Micronesia, 1922, p. 34 (Mariannes, Ruk, Ponapé, Marshalls).

Phaethon rubricauda rothschildi Yamashina, Tori, 7, 1932, p. 406 (Pagan); *idem*, Tori, 10, 1940, p. 676 (Maug).

Phaethon rubricaudus rothschildi Hand-list Japanese Birds, 3d ed., 1942, p. 209 (Maug, Pagan, Truk, Ponapé, Marshalls).

Geographic range.—Bonin and Hawaiian islands south to Micronesia. In Micronesia: Mariana Islands—Maug, Pagan; Caroline Islands—Truk, Ponapé; Marshall Islands—exact locality unknown.

Characters.—Adult: Long-tailed sea bird white with pinkish tint except for black lores and eye streak; black shafts on feathers of secondaries, flanks, and tail coverts; black bases on feathers of head; central tail feathers elongate with black shafts and bright red webs; bill orange-red with black nasal streak; tarsus and foot bluish-yellow, distal part blackish. Immature: Resembles adult but barred with black above; bill blackish.

Measurements.—Yamashina (1940:676) lists the measurements for seven adult birds from Maug in the northern Marianas as wing 304-319 and exposed culmen 55-62.

Nesting.—Yamashina (1932a:406) reports the taking of one egg at Pagan in the Marianas on February 15, 1931.

Remarks.—The Red-tailed Tropic Bird has been recorded from the Mariana, Caroline, and Marshall Islands. On the basis of our present knowledge it appears to be uncommon in most of Micronesia and may be established as a resident bird only in the northern Marianas, as shown by Yamashina (1932a:406 and 1940:676), Coultas obtained an immature male at 3° N and 158° E, which is at a point in the ocean south of the eastern Carolines. Possibly this bird and others obtained in the Carolines are representatives of the subspecies, *P. r. melanorhynchos* Gmelin, which is known from the Palmerston, Society and Turtle islands.

Phaëthon lepturus dorotheae Mathews

White-tailed Tropic Bird

Phoethon lepturus dorotheae Mathews, Austr. Avium. Rec., 2, 1913, p. 7. (Type locality, Queensland.)

Phaeton candidus Kittlitiz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 382 (Ualan); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); Finsch, Journ. f. Ornith., 1872, p. 57 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 114 (Pelew, Ualan); Finsch, Journ. Mus. Godeffroy, 1875, pp. 6, 47 (Palau); *idem,* Proc. Zool. Soc. London, 1877 (1878), p. 782 (Ponapé); *idem,* Journ. f. Ornith., 1880, pp. 296, 309 (Ponapé, Kuschai); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Schmeltz and Krause, Ethnogr. Abth. Mus., Godeffroy, 1881, pp. 281, 299, 330, 353 (Ponapé, Mortlock, Nukuor, Ruk); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 52 (Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 73 (Pelew, Ruk, Luganor, Nukuor, Ponapé, Ualan, Marshalls); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 62 (Agrigan, Palaos, Ruk, Kushai, Marshalls); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne).

Phaeton flavirostris Finsch, Ibis, 1880, pp. 329, 333 (Ratak Chain); *idem,* Ibis, 1881, pp. 105, 109, 115 (Kuschai, Ponapé).

Phaethon candidus Salvadori, Ornith. Papuasia, 3, 1882, p. 426 (Pelews, Carolines, Marshalls); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 23 (Agrigan); Safford, Osprey, 1902, p. 70 (Mariannes); Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Pelew, Ponapé); Uchida, Annot. Zool. Japon., 9, 1918, pp. 489, 492 (Palau).

Phaëthon lepturus Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 453 (Pelew, Carolines, Marshalls); Hartert, Novit. Zool., 7, 1900, p. 10 (Ruk); Safford, The Plant World, 7, 1904, p. 268 (near Guam); *idem,* Contr. U. S. Nat. Herb., 9 1905, p. 80 (northern Marianas); Mayr, Birds Southwest Pacific, 1945, p. 17 (Palau); Strophlet, Auk, 63, 1946, p. 535 (Guam); Borror, Auk, 64, 1947, p. 416 (Agrihan); Stott, Auk, 64, 1947, p. 524 (Saipan).

Phaeton lepturus Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln).

Leptophaethon lepturus dorothea Mathews, Birds Australia, 4, 1915, p. 309 (Pelew).

Phaethan lepturus Cox, Island of Guam, 1917, p. 22 (northern Marianas).

Leptophaethon lepturus lepturus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 33 (Agrigan, Saipan, Pelew, Ruk, Luganor, Nukuor, Ponapé, Kusaie, Marshalls).

Phaethon lepturus dorotheae Yamashina, Tori, 7, 1932, p. 407 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 187 (Agrigan, Pagan, Saipan, Agiguan, Palaus, Truk, Luganor, Nukuor, Ponapé, Kusaie, Marshalls); Hand-list Japanese Birds, 3d ed., 1942, p. 209 (Agrigan, Pagan, Saipan, Agiguan, Babelthuap, Koror, Urukthapel, Angaur, Unusuto, Truk, Luganor, Nukuor, Ponapé, Kusaie, Namorik); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 38 (Guam, Peleliu, Ulithi, Truk).

Geographic range.—Islands in the southwestern Pacific area. In Micronesia: Mariana Islands—Agrigan, Pagan, Saipan, Agiguan, Rota, Guam; Palau Islands—Babelthuap, Koror, Urukthapel, Peleliu, Anguar, Unusuto; Caroline Islands Truk, Ulithi, Luganor, Nukuor, Ponapé, Kusaie; Marshall Islands—Namorik.

Characters.—Adult: White often with pinkish shade but lores and eye streak black; feathers of head, flanks and under tail-coverts with bases black; black on outer and subterminal part of inner webbing of primaries; black, subterminal coloring on scapulars and secondaries; black on shafts of elongated tail plumes; bill horn yellow, dark basally; tarsus dark yellow; feet blackish.

Immature: Resembles adult but upper parts barred with black, bill black on terminal part.

Measurements.—Measurements of adult birds from Micronesia are given in table 15.

Weights.—The NAMRU2 party recorded weights of five adult males from Guam as 294 (267-321) grams.

TABLE 15. MEASUREMENTS OF *Phaëthon lepturus* FROM MICRONESIA

	No.	Wing	Tail	Exposed culmen	Tarsus
Marianas: Asuncion, Guam....	6	264 256-287	107 97-117	47 44-50	21 20-21
Palaus: Peleliu...............	11	257 242-270	108 98-122	45 40-49	21 19-21
Carolines: Ponapé, Kusaie.....	11	261 252-271	105 97-114	47 44-49	21 21-22
Total: Micronesia........	28	260 242-287	107 97-122	46 40-50	21 19-22

Specimens examined.—Total number, 37 (22 males, 10 females, 5 unsexed), as follows: Mariana Islands, USNM—Guam, 5 (June 11, July 21); AMNH—Asuncion, 1 (June ?); Palau Islands, USNM—Peleliu, 5 (Aug. 29, 31, Sept. 5, 6); AMNH—exact locality not given, 7 (Oct. 13, 26, Nov. 15, 23, Dec. 18); Caroline Islands, AMNH—Ponapé, 9 (Dec. 8, 9, undated)—Kusaie, 10 (March 1-8, April).

Nesting.—The NAMRU2 party observed nests of the White-tailed Tropic Bird at Peleliu in August and September, 1945. Several nests were seen in hollows of the Australian pine (*Casuarina equisetifolia*) between 20 and 30 feet above the ground. Birds could be seen in the nest hollows because the plumes of their long tail usually extended well out of the entrance. One nest was found in a dead tree in a battle-cleared area; others were observed in jungle habitat. Coultas observed nesting at Ponapé between November 1 and December 30, 1930, and found nests in the tops of trees and in hollow trees; a few were observed in holes in cliffs. Yamashina (1932a:407) records the taking of one egg at Ponapé on August 18, 1931. At Guam the NAMRU2 party found birds along the high cliffs which edge the beach. There was no evidence that they were nesting from May to July; nevertheless males taken in June had enlarged gonads. The bird is known to breed at Namorik in the Marshall Islands, according to the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942: 209).

Food habits.—The NAMRU2 party found small fish in the stomachs of these birds taken at Peleliu.

Parasites.—Uchida (1918:489, 492) records the bird lice (Mallophaga), *Colpocephalum epiphanes* and *Menopon culasius*, from the White-tailed Tropic Bird from Palau.

Remarks.—Birds taken in Micronesia differ only slightly from those from other areas in Oceania. Within Micronesia (see table 15) the birds from the Palaus have the shortest wing and shortest exposed culmen.

The White-tailed Tropic Bird appears more numerously in western and northern Micronesia than in the Marshall Islands. This distribution may be correlated with a preference for the "high" islands; especially those which have rocky cliffs, including Guam, Rota, Peleliu, Angaur, and Truk. Reports were received in 1945 that the birds were only infrequently seen at Ulithi, a low atoll. Stott (1947:524) observed birds flying into rocky crevices at Saipan on December 18. Gleise (1945:221) also recorded the bird in the vicinity of Saipan. Borror (1947:416) reports seeing birds at Agrigan on July 29, August 5 and 6, 1945. Coultas (field notes) found tropic birds common at Ponapé in November and December, 1930, in forested regions and along the cliffs. He made similar observations at Kusaie and Palau. At Ponapé and Palau, Coultas noted the use of the eggs, young and adults as food by the natives. At Palau the plumes are used in headdresses worn by the natives, the birds being taken with the blowgun.

Murphy (1936:807) states that the principal enemy of the White-tailed Tropic Bird at Bermuda is the introduced rat (*Rattus rattus*). Introduced rats, particularly *Rattus mindanensis* on Guam, may prey on the nesting birds. Baker (1946c:404) writes that this rat is a good climber and may spend considerable time in trees. The rat was trapped also in rough coral jungle at the edge of the cliffs, where tropic birds, Micronesian Starlings and other species, may have been nesting.

Little has been recorded concerning the post-breeding season wanderings of these tropic birds in Micronesia. They seemingly spend considerable time at sea, but whether they move as far from their breeding areas as do birds in the Atlantic, as reported by Murphy (1936:803), Baker (1947a:253) and others, is not known.

Murphy (1936:796) notes that the northward distribution of the tropic birds in the Atlantic is dependent on the warm currents of water. In the western Atlantic, the poleward-flowing, warm currents of the Gulf Stream allow for the northern extension of the range of these birds to Bermuda. In the eastern Atlantic, cool currents flowing toward the equator restrict the northern range. The same condition prevails in the eastern Pacific where warm current flowing toward the pole enable the birds to range north to the Bonins and other islands.

The three species of tropic birds known from Micronesia overlap very little in their ranges in this area. The White-tailed Tropic Bird has become firmly established in the western part of Micronesia, but there are only a few records from the extreme eastern part. The Red-tailed Tropic Bird appears to be resident only in the northern Marianas although it has been recorded in the Carolines and Marshalls. Interspecific competition may prevent considerable intermingling of breeding populations in Micronesia, or it may be that each species requires different ecologic conditions.

Sula dactylatra personata Gould

Masked Booby

Sula personata Gould, Proc. Zool. Soc. London, 1846, p. 21. (Type locality, North and northeast coasts of Australia = Raine Island.)

Sula cyanops Finsch, Ibis, 1880, p. 219 (Taluit); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 72 (Marshalls); Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 430 (Marshalls).

Parasula dactylatra personata Kuroda, in Momiyana, Birds Micronesia, 1922, p. 35 (Marshall Islands); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 232 (Marshall Islands).

Sula dactylatra personata Yamashina, Tori, 7, 1932, p. 407 (Medinilla); Hand-list Japanese Birds, rev., 1932, p. 187 (Medinilla, Marshall Islands); Hand-list Japanese Birds, 3d ed., 1942, p. 208 (Medinilla, Marshall Islands).

Geographic range.—Central and western Pacific from the Hawaiian Islands south to Australia, probably also in the Indian Ocean. In Micronesia: Mariana Islands—Medinilla; Marshall Islands—Jaluit?

Characters.—Adult: A large, white sea bird, with brown wings and tail; face dark blue; bill horn-colored with base orange-yellow in males and pink or light red in females; feet olive in males and lead gray in females.

Immature: Resembles adult, but head, wings, tail, chin and throat dark brown; some white mottling may be present on back and rump; bill dark; feet lead colored.

Nesting.—Yamashina (1932a:407) reports the taking of 12 eggs on February 19, 1931, at Medinilla Island in the Marianas.

Remarks.—No specimen has been examined by me from the area reported upon. Little is known regarding the distribution of the Masked Booby in Micronesia. It is found on the island groups which surround Micronesia and future field observations probably will add to our knowledge of its occurrence in this area. It is known to be resident only in the northern Marianas.

Sula sula rubripes Gould

Red-footed Booby

Sula rubripes Gould, Syn. Birds Australia, pt. 4, 1838, app., p. 7. (Type locality, New South Wales = Raine Island.)

Pelecanus piscator Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 296, 299 (Lougounor = Lukunor); *idem*, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 351 (Lugunor).

Dysporus piscator Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelews); *idem*, Proc. Zool. Soc. London, 1872, p. 90 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 47 (Palau).

Sula piscatrix Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 72 (Pelew, Luganor); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 64 (Rota, Palaos, Carolines); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Safford, Osprey, 1902, p. 70 (Rota); *idem*, The Plant World, 7, 1904, p. 267 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); *idem*, Guam, 1912, p. 19 (Guam); Cox, Island of Guam, 1917, p. 22 (Guam).

Sula piscator Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 432 (Pelew); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 24 (Guam).

Piscatrix sula rubripes Kuroda, in Momiyama, Birds Micronesia, 1922, p. 34 (Pelew, Luganor, Rota).

Sula sula rubripes Hand-list Japanese Birds, rev., 1932, p. 185 (Medinilla, Saipan, Rota, Palau, Lukunor, Likieb); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Yamashina, Tori, 10, 1940, p. 676 (Maug, Bikar); Hand-list Japanese Birds, 3d ed., 1942, p. 208 (Maug, Medinilla, Saipan, Rota, Palau, Lukunor, Bikar, Likieb).

Geographic range.—Indian Ocean east to central Pacific islands. In Micronesia: Mariana Islands—Maug, Medinilla, Saipan, Rota; Palau Islands—exact locality unknown; Caroline Islands—Lukunor; Marshall Islands—Bikar, Likieb, Bikini, Eniwetok.

Characters.—Adult: A large sea bird with plumage of variable color, mainly white or partly buff with black primaries and black-tipped secondaries, or grayish or brownish with white or grayish tail; throat blackish; face blue or green; bill bluish and lighter at tip; legs and feet red.

Immature: Resembles adult, but often wholly brownish, lighter ventrally; bill blackish; feet yellowish red. Immature resembles that of *S. leucogaster.*

Nesting.—Morrison obtained a male nestling at Bikini on May 3, 1946.

Specimens examined.—Total number, 10 (3 males, 7 females) from Marshall Islands, USNM—Bikini (April 28, May 1, 2, 3).

Remarks.—The writer saw several birds approximately 20 miles east of Eniwetok on January 7, 1945. Morrison obtained a series of birds at Bikini in April and May, 1946. Murphy (1936:861-870) presents a wealth of information concerning the bird. He points out the need for a better understanding of the plumages of the adult birds and gives evidence that the birds of different colors may occur within the same population. He describes the Red-footed Booby as nesting in trees and shrubs. This type of nesting environment is present at many of the islands in Micronesia.

Sula leucogaster plotus (Forster)

Brown Booby

Pelecanus Plotus Forster, Descr. Anim., ed. Licht., 1844, p. 278. (Type locality Near New Caledonia.)

Dysporus sula Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, p. 90 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 47 (Palau); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk).

Sula fusca Finsch, Ibis, 1880, p. 218 (Taluit).

Sula leucogastra Salvadori, Ornith. Papuasia, 3, 1882, p. 423 (Pelew, Carolinis); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 72 (Pelew, Ruk, Marshalls); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 63 (Palaos, Mariannes, Marshalls, Carolines); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne).

Sula sula Ogilvie-Grant, Cat. Birds British Museum, 26, 1898, p. 436 (Asuncion, Pelew); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 24 (Guam); Safford, Osprey, 1902, p. 66 (Mariannas); *idem,* The Plant World, 7, 1904, p. 267 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); *idem,* Guam, 1912, p. 19

(Guam); Prowazek, Die deutschen Marianen, 1913, p. 100 (Marianen); Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Marianne); Cox, Island of Guam, 1917, p. 22 (Guam); Uchida, Annot. Zool. Japon., 9, 1918, pp. 487, 493 (Sea off Mariana Islands).

Sula leucogaster plotus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 34 (Pelew, Ruk, West Faiu, Uracas, Saipan, Marshalls); Yamashina, Tori, 7, 1932, p. 407 (Medinilla); Hand-list Japanese Birds, rev., 1932, p. 185 (Uracas, Pagan, Medinilla, Saipan, Truk, West Fayu, Grimes, Marshalls); Hand-list Japanese Birds, 3d ed., 1942, p. 208 (Uracas, Pagan, Medinilla, Saipan, Grimes, West Fayu, Truk, Marshalls); Baker, Smithson, Misc. Coll., vol. 107, no. 15, 1948, p. 41 (Rota, Guam, Truk).

Geographic range.—Throughout tropical Pacific area and south to Australia. In Micronesia: Mariana Islands—Asuncion, Uracas, Pagan, Medinilla, Saipan, Rota, Guam; Palau Islands—exact locality unknown; Caroline Islands—Grimes, West Fayu, Truk, Kusaie; Marshall Islands—Jaluit, Eniwetok.

Characters.—Adult: A heavy sea bird dark brown except for white lower breast, belly, under tail, and auxillars; bill heavy and light bluish; face, gular pouch and feet greenish yellow.

Immature: Resembles adult, but lower breast, belly and under tail mottled with brown; feet light yellow.

Measurements.—Two adult males (Rota, Guam) measure: wing 386, 408; tail 194; exposed culmen 93, 98; tarsus 45, 49; two adult females (Rota, Kusaie): wing 380, 487; tail 193, 217; exposed culmen 94, 99; tarsus 45, 50.

Weights.—The author (1948: 41) records one immature female from Rota weighing 1042 grams.

Specimens examined.—Total number, 6 (3 males, 3 females), as follows: Mariana Islands, USNM—Rota, 3 (Oct. 24); AMNH—Guam, 1 (July 23); Palau Islands, AMNH—exact locality not given, 1 (Dec. 1); Caroline Islands, AMNH—Kusaie, 1 (April 19).

Nesting.—Few records have been published concerning nesting of the Brown Booby in Micronesia. Yamashina (1932a: 407) reports the taking of 12 eggs at Medinilla in the Mariana Islands on February 19, 1931. At Palau, Coultas (field notes) obtained reports that the bird nests at Kiangat, a small islet north of Babelthuap.

Parasites.—Uchida (1918:487, 493) obtained bird lice (Mallophaga), *Menopan brevipalpe* and *Lipeurus potens,* from the Brown Booby from the "sea off Mariana Islands."

Remarks.—The Brown Booby has not been found abundantly by observers in the Micronesian area. Coultas and Kubary, who spent considerable time in this region, observed the bird at only a few of the islands. Probably the bird does not nest abundantly in Micronesia, although small colonies may be present. The NAMRU2 party observed a flock of twelve brown boobies on high cliffs at Taipingot Peninsula at Rota on October 24, 1945. Birds were seen also at Guam in May, July and November, 1945, and at Truk in December of the same year. Coultas obtained a single specimen at Kusaie; the natives told him that it was not a resident of the island. The writer observed several Brown Boobies approximately twenty miles east of Eniwetok in the Marshall Islands on January 7, 1945. These were in the company of other sea birds.

Phalacrocorax melanoleucus melanoleucus (Vieillot)

Little Pied Cormorant

Hydrocorax melanoleucos Vieillot, Nouv. Dict. Hist. Nat., 8, 1817, p. 88. (Type locality, "Australasie," restricted to New South Wales.)

Carbo melanoleucus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, pp. 90, 114 (Pelew).

Graculus melanoleucus Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 48 (Pelew).

Microcarbo melanoleucus Salvadori, Ornith. Papuasia, 3, 1882, p. 410 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 72 (Pelew).

Phalacrocorax melanoleucus Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 398 (Pelew); Nehrkorn, Kat. Eiers., 1899, p. 235 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Pelew); Uchida, Annot. Zool. Japon., 9, 1918, p. 486 (Palau).

Ph [alacrocorax] melanoleucos Reichenow, Die Vögel, 1 1913, p. 127 (Palauinseln).

Microcarbo melanoleucus melanoleucus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 35 (Pelew).

Microcarbo melanoleucus melvillensis Mathews, Syst. Avium Australasianarum, 1, 1927, p. 228 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 186 (Babelthuap, Koror).

Haliëtor melanoleucos melanoleucos Peters, Check-list Birds World, 1, 1931, p. 93 (Pelew).

Pholacrocorax melanoleucus melanoleucus Mayr, Amer. Mus. Novit., no. 486, 1931, p. 5 (Pelew); Amadon, Amer. Mus. Novit., no. 1175, 1942, p. 2 (Palau); Mayr, Birds Southwest Pacific, 1945, pp. 50, 284 (Palau, Marianas); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 41 (Palau).

Phalacrocorax melanoleucos melvillensis Hand-list Japanese Birds, 3d ed., 1942, p. 207 (Pagan, Babelthuap, Koror, Angaur).

Geographic range.—Tasmania, Australia, Lesser Sunda north through Melanesia to Palau Islands. In Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Ngabad, Peleliu, Anguar.

Characters.—Adult: A small cormorant with upper parts black with dull greenish gloss; under parts white except vent and under tail-coverts which are sooty-black.

Measurements.—The author (1948: 41) gives the following measurements of two adult females from Peleliu: wing, 220 and 222; tail, 153 and 157; culmen from notch of suture between maxilla and quadratojugal bones, 35 and 36.

Specimens examined.—Total number, 15 (1 male, 12 females, 2 unsexed), as follows: Palau Islands, USNM—Peleliu, 6 (Aug. 27, Sept. 7, 10, 16); AMNH—exact locality not given, 9 (Nov. part).

Nesting.—Nehkorn (1899:235) recorded eggs taken at Palau. Some of the specimens obtained by Coultas in November, 1931, had swollen gonads. The author found no evidence of nesting in August and September, 1945, in the southern Palaus.

Food habits.—The author (1948: 41) found small fish in the stomachs of birds taken in August and September. The contents of each stomach averaged approximately 3 cc. in volume.

Parasites.—Uchida (1918:486) found the bird louse (Mallophaga), *Lipeurus subsetosus,* on the Little Pied Cormorant from Palau.

Remarks.—The Palaus mark the northernmost point of range of the Little Pied Cormorant. It does not occur in the Philippines and must have reached Palau from the New Guinea region. It is unknown at Yap and other "high" islands in the Carolines. A sight record of this species at Pagan in the northern Marianas, made by Orii and reported in the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:207), may be questioned. Amadon (1942:1) has studied the races of this species and points out that there is little geographic variation in the species; it is divisible into three subspecies. One of these is confined to New Zealand. Another occurs only on Rennell Island, Solomons. The six specimens taken by the NAMRU2 party at Peleliu included only two adults, whose measurements are within the range of those studied by Amadon.

The NAMRU2 party found the birds numerously in the southern Palaus in 1945. Birds were concentrated in the areas of mangrove swamp and on the tidal flats. In August and September, they were observed frequently in groups of 10 to 15, either sitting on the ground or perched on low mangroves or dead snags sunning themselves. Coultas (field notes) received reports that they nested at a freshwater lake on the "main island" (Babelthuap?)

Ripley (1948) reports the occurrence of "about a dozen anhingas (presumably *Anhinga melanogaster*)" at Babelthuap on 12 November 1946.

Fregata minor minor (Gmelin)

Pacific Man-o'-War

Pelecanus minor Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 572. (No type locality = Christmas Island, Indian Ocean.)

Pelecanus aquila? Quoy and Gaimard, Voy. "Uranie," Zool., 1824, p. 154 (Carolines).

Pelecanus aquilus? Lesson, Man. d'Ornith., 2, 1828, p. 354 (Carolines).

Atagen aquilus Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 61 (Ladrone or Marian Islands).

Tachypetes aquila Finsch, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk); Prowazek, Die deutschen Marianen, 1913, p. 100 (Marianen).

Tachypetes aquilus Finsch, Ibis, 1880, p. 333 (Taluit); *idem*, Journ. f. Ornith., 1880, pp. 296, 310 (Ponapé, Kuschai); *idem*, Ibis, 1881, pp. 109, 115 (Kuschai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 353 (Mortlock, Ruk).

Fregata aquila Salvadori, Ornith. Papuasia, 3, 1882, p. 403 (Carolines, Marshalls); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891), p. 71 (Ruk, Luganor, Ponapé, Ualan, Marshalls); Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 443 (Carolines, Marshalls); Finsch, Deut. Ver. zum Schultze der Vogelwelt, 25, 1900, p. 452 (Ponapé, Kuschai, Marshalls); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 24 (Guam); Safford, The Plant World, 7, 1904, p. 267 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 22 (Guam).

Fregata aquila palmerstoni Kuroda, in Momiyama, Birds Micronesia, 1922, p. 35 (Carolines, Marshalls).

Fregata minor peninsulae Mathews, Syst. Avium Australasianarum, 1, 1927, p. 233 (Carolines, Marshalls); Peters, Check-list Birds World, 1, 1931, p. 96 (Carolines?, Marshalls?).

Fregata minor palmerstoni Hand-list Japanese Birds, rev., 1932, p. 186 (Yap, Faraulep, Truk, Lukunor, Ponapé, Kusaie, Namu, Likieb); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Yamashina, Tori, 10, 1940, p. 676 (Maug, Bikar).

Fregata minor minor Hand-list Japanese Birds, 3d ed., 1942, p. 207 (Maug, Yap, Faraulep, Truk, Lukunor, Ponapé, Kusaie, Namu, Bikar, Likieb).

Fregata minor Borror, Auk, 64, 1947, p. 416 (Agrihan).

Geographic range.—Eastern Indian Ocean to western Pacific Ocean. Limits of range not certainly known. In Micronesia: Mariana Islands—Agrigan, Maug, Saipan, Guam; Caroline Islands—Yap, Faraulep, Truk, Lukunor, Ponapé, Kusaie; Marshall Islands—Namu, Bikar, Likieb, Kwajalein, Bikini.

Characters.—Adult male: Large sea bird with deeply forked tail; blackish but wing-coverts paler; head and back glossy purple and blue; breast lighter than belly. Adult female; Resembles adult male, but head blacker; chin and throat grayer; breast more whitish. Immature: Resembles adult, but head and throat whitish washed with buff; breast dark brown; belly whitish.

Measurements.—Two adult males measure: wing, 572; tail, 354, 396; exposed culmen, 98, 103; two adult females; wing, 583, 604; tail, 365; exposed culmen, 119, 127. These four specimens are from Bikini.

Specimens examined.—Total number, 10 (3 males, 7 females), from Marshall Islands, USNM—Bikini (March 11, 22, 29, 30, April 13, 29, May 3, 14).

Remarks.—The systematic position of the subspecies of *Fregata minor* in the Pacific area is not well established. I am following the committee who prepared the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:207) in using the name *F. m. minor,* although a thorough study may show that these birds have closer relationships to one of the other subspecies of the Pacific area.

Fregata minor has been reported only occasionally in the Marianas and probably is not resident there. Borror (1947:416) reports the bird at Agrihan on August 11, 1945, and Seale (1901:24) mentions one taken at Guam in November, 1889. No records are known from the Palaus. In the Carolines the birds are probably resident, especially in the eastern part. In the Marshalls the species is a conspicuous member of the bird colonies on the coral atolls. Wallace (field notes) observed two birds at Loi Island in Kwajalein Atoll on May 7, 1944. Morrison obtained ten specimens at Bikini in the period from March through May in 1946.

Fregata ariel ariel (Gray)

Least Man-o'-War

Atagen (sic) Ariel Gray, Gen. Birds, 3, 1845, col. pl. [185]. (Type locality, Raine Island, Queensland.)

Pelecanus minor Lesson, Traite d'Ornith., 1831, p. 607 (Mariannes, Carolines).

Tachypetes minor Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Mackenzie Group); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 90 (Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap).

Fregata minor Salvadori, Ornith. Papuasia, 3, 1882, p. 405 (Mariannes, Mackenzie); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 71 (Uap, Ngoli or Matelotas).

Tachypetes aquila var. *minor* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 65 (Rota, Carolines, Marshalls); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne).

Fregata ariel Ogilvie-Grant, Cat. Birds British Mus., 26, 1898, p. 447 (Marianas, Carolines); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 25 (Guam?); Safford, Osprey, 1902, p. 70 (Marianas); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Fregata ariel ariel Mathews, Birds Australia, 4, 1914-15, p. 285 (Carolines, Marshalls); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 36 (Yap, Ngoli, Rota); Hand-list Japanese Birds, rev., 1932, p. 186 (Rota, Yap, Ngulu, Uluthi); Hand-list Japanese Birds, 3d ed., 1942, p. 208 (Rota, Yap, Ngulu, Uluthi).

Geographic range.—China coast and Philippines south to Australia and east to Pacific islands. In Micronesia: Mariana Islands—Guam?, Rota; Caroline Islands—Yap, Ngulu, Ulithi.

Characters.—Adult male: Resembles *F. m. minor,* but smaller and blacker with upper parts lustrous greenish-blue and white patch on lower flank.

Adult female: Resembles adult male, but browner with paler nape and white breast. Immature: Resembles adult, but with head, chin, throat, and belly white washed with rufous.

Remarks.—Like *F. minor,* the Least Man-o'-War has not been observed often in Micronesia. Marche obtained one female at Rota in June, 1888. D. H. Johnson saw a bird thought to be of this species at Agfayan Bay, Guam, on 4 June 1945. Records from the western Carolines are few. There are no reports of this bird from the Palaus and the Marshalls. It may breed on some of the atolls in the Carolines.

The two species of man-o'-war birds may be difficult to distinguish in the field. The smaller size of *Fregata ariel* is perhaps the most useful character although it may be easily recognized also by the presence of the white flank patch, if it can be observed.

Both of the species of *Fregata* discussed in this report have representatives in the Atlantic, Indian and Pacific oceans. Murphy (1936:920) has shown that the man-o'-war birds are able to cross the Isthmus of Panamá between the Pacific and Atlantic oceans. This route may also be the means of dispersal for other species. The irregular distribution of these birds as well as of other sea birds in the oceanic islands of the Pacific may be caused by their remaining over waters which contain preferred foods and their avoidance of waters which lack preferred foods.

Butorides striatus amurensis Schrenck

Amur Green Heron

Ardea (Butorides) virescens var. *amurensis* Schrenck, Reise Amur Lande, 1, pt. 2, 1860, p. 441. (Type locality, Amurland.)

Butorides striatus javanicus Hand-list Japanese Birds, rev., 1932, p. 183 (Koror, Babelthuap).

Butorides striatus amurensis Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in northeastern Asia, China, Japan, Bonins. Winters south to Philippines and Malaysia. In Micronesia: Palau Islands—Babelthuap, Koror.

Specimens examined.—Total number, 2 females, from Palau Islands, AMNH—exact locality not given (Nov. 13, Dec. 17-18).

Remarks.—The Amur Green Heron has been recorded as a winter visitor to the Palau Islands. Two females taken by Coultas in November and December, 1931, are imature. He comments (field notes) that he saw, in all, three birds in taro patch and mangrove swamp habitat.

Bubulcus ibis coromandus (Boddaert)

Cattle Egret

Cancroma Coromanda Boddaert, Table Pl. enlum., 1783, p. 54. (Type locality, Coromandel.)

Ardeola ibis coromanda Hand-list Japanese Birds, rev., 1932, p. 183 (Koror).

Bubulcus ibis coromandus Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Koror, Babelthuap); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—India, Ceylon, east to China and Japan and south to Malaysia. In Micronesia: Palau Islands—Babelthuap, Koror.

Remarks.—The Japanese ornithologists have recorded the Cattle Egret from Babelthuap and Koror in the Palau Islands. It is a winter migrant.

Egretta intermedia intermedia (Wagler)

Plumed Egret

Ardea intermedia Wagler, Isis, 1829, p. 659. (Type locality, Java.)

Egretta intermedia intermedia Hand-list Japanese Birds, rev., 1932, p. 183 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 203 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 42 (Rota, Guam, Peleliu, Angaur, Ulithi).

Egretta intermedia Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 306, 310 (Ulithi); Baker, Ecol. Monogr., 16, 1946, p. 408 (Guam).

Geographic range.—India and Ceylon east to Malaysia, Philippines, China and Japan. In Micronesia: Mariana Islands—Saipan, Rota, Guam; Palau Islands—Koror, Peleliu, Angaur; Caroline Islands—Ulithi.

Characters.—Adult: A large white heron with green facial skin; black legs, feet and toes. In breeding plumage: Head with crest; neck and back with ornamental plumes; bill black. Winter plumage: Without crest or plumes; bill yellow with blackish tip. Immature: Resembles adult in winter plumage, but feathers soft and downy.

Measurements.—Five males from Saipan, Rota, Guam, and Angaur measure: wing, 295-321 (308); tail, 112-127 (119); culmen, 85-87 (87); tarsus, 111-118 (114); three females from Saipan, Ulithi, Angaur: wing, 294-301 (297); tail, 101-116 (110); culmen, 77-83 (80); tarsus, 108-115 (107).

Weights.—The author (1948:43) records the weights of two males from Guam as 445 and 463.

Specimens examined.—Total number, 8 (5 males, 3 females), as follows: Mariana Islands, USNM—Saipan, 2 (Sept. 29, Oct. 2)—Rota, 1 (Oct. 31)—Guam, 2 (June 13); Palau Islands, USNM—Angaur, 2 (Sept. 21); Caroline Islands, USNM—Ulithi, 1 (Aug. 15).

Food habits.—The NAMRU2 party found grasshoppers, other insects, spiders and lizards in the stomachs of egrets taken at Guam, Ulithi, and Angaur.

Parasites.—Wharton and Hardcastle (1946:306, 310) obtained the chiggers (Acarina), *Neoschöngastia egretta* and *N. ewingi,* from this egret from Ulithi.

Remarks. — The NAMRU2 party obtained Plumed Egrets at Rota, Guam, Ulithi, and Angaur in 1945. Previously, the only known record was from Koror, as reported in the Hand-list of Japanese Birds (Hachisuka *et al.*, 1932:183). In addition, in 1945, Joe T. Marshall, Jr., obtained two birds at Saipan, and Gleise (1945: 220) reported seeing "white herons" at Tinian, which probably were egrets. Gleise estimated the number of these birds at Tinian to be fifty; he found them in swampy areas. At Rota, the NAMRU2 party found a flock of sixteen birds in a cultivated field on October 31. At Guam, egrets were first observed on February 25, 1945, when a flock of fourteen was found in a fallow rice paddy near Piti. This flock remained in this area and were seen occasionally until as late as June 13, when two were taken as specimens. A short time later (June 30) the entire area was cleared for military use and the birds were seen no more. At Agfayan Bay a flock of sixteen birds was found on the beach on July 24 and on August 6. These birds kept apart from Reef Herons which were also in the area. In June, 1946, M. Dale Arvey observed egrets in swamps along the Ylig River at Guam. At Ulithi Atoll, three egrets were seen on August 15 at Potangeras Island, feeding in grassy areas adjacent to the beach. In the southern Palaus, the NAMRU2 party found egrets in August and September on tidal flats and open grasslands at Peleliu and Angaur. At Peleliu, a flock of twenty-five birds was seen on September 8 and a flock of eight birds on September 16. At Angaur approximately twenty birds were seen in groups of five or more on September 21. These birds, unlike the Reef Herons, preferred grasslands to beach areas for feeding and were usually seen in sizeable flocks.

There was no evidence of breeding; specimens examined were either immatures or adults in winter plumage, since they had yellow bills tipped with black and slight or no development of ornamental plumes. Birds taken at Guam in June and at Angaur in September had no ornamental plumes, while birds taken at Ulithi in August, at Saipan in September and October, and at Rota in late October show some development of the back plumes. Wharton and Hardcastle (1946:306) found the same species of chigger on Plumed Egrets from Ulithi and from Okinawa in the Riu Kiu Islands. The

NAMRU2 party observed the birds in Micronesia from February until October in 1945, and although the Plumed Egret may be considered as merely a visitor to Micronesia, it would not be surprising to find nests there. The fact that several new distributional records were obtained for Micronesia in 1945 may indicate that the birds have been overlooked by ornithologists in the past or that the birds are increasing the breadth of their winter (or breeding?) range.

Demigretta sacra sacra (Gmelin)

Reef Heron

Ardea sacra Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 640. (Type locality, Tahiti.)

Ardea jugularis Kittlitz, Observ. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 286, 299, 304 (Ualan, Lougounor, Guahan); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 63 (Ualan); Pelzeln, Reise "Novara," Vögel, 1865, pp. 118, 162, 120, 121 (Puynipet, Ualan).

Ardea (Herodias) atra Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 48 (Ladrone or Marian Islands, Caroline Islands).

Ardea sacra Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Matelotas Islands); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelews); Finsch and Hartlaub, Journ. f. Ornith., 1870, p. 137 (Pelews, Matelotas); Gray, Hand-list Birds, 3, 1871, p. 28 (Marian, Carolines, Pelews, Matelotas); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 104 (Pelew, Uap, Ualan); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 32 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 38 (Ponapé, Ualan); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 294, 306 (Ponapé, Kuschai); *idem*, Ibis., 1880, pp. 220, 330, 332 (Taluit); *idem*, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem*, Ibis, 1881, pp. 105, 106, 109, 115 (Kushai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 353 (Mortlocks, Ruk); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 51 (Jaluit, Kuschai); Oustalet, Le Nat., 1889, p. 261 (Mariannes); Wiglesworth, Ibis, 1893, p. 211 (Marshalls); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 36 (Guam, Marshalls, Palaos, Carolines); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln).

Demiegretta sacra Salvadori, Ornith. Papuasia, 3, 1882, p. 348 (Marshalls, Ualan, Ponapé, Ruck, Pelew, Mariannis); Wiglesworth, Abhandl. Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 67 (Marianne, Pelews, Luganor, Ruk, Ponapé, Ualan, Taluit); Hartert, Novit. Zool., 5, 1898, p. 64 (Saipan); Sharpe, Cat. Birds British Mus., 26, 1898, p. 137 (Pelew, Carolines, Marshalls); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 29 (Guam); Safford, Osprey, 1902, p. 67 (Marianas); *idem*, The Plant World, 7, 1904, p. 266 (Guam); Kuroda, Avifauna Riu Kiu, 1925, p. 129 (Micronesia); Bryan, Guam, Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Bequaert, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 266 (Kusaie).

Demigretta sacra Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 101 (Saipan, Tinian); Cox, Island of Guam, 1917, p. 21 (Guam); Bequaert, Mushi, 12, 1939, p. 81 (Kusaie); Warton, Ecol. Monogr., 16, 1946, p. 175 (Guam); Warton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 306, 316 (Ulithi, Guam).

Demiegretta jugularis Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Truk, Ponapé, Pelew).

Demiegretta jugularis grayi Uchida, Annot. Zool. Japon., 9, 1918, pp. 484, 488, 490 (Ponapé).

Demiegretta sacra sacra Kuroda, in Momiyama, Birds Micronesia, 1922, p. 36 (Guam, Saipan, Angaur, Luganor, Yap, Ngoli, Ruk, Ponapé, Kusaie, Taluit).

Demigretta sacra sacra Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 171 (Kusaie); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 198 (Carolines); Yamashina, Tori, 7, 1932, p. 406 (Ponapé); Hand-list Japanese

Birds, rev., 1932, p. 183 (Saipan, Guam, Babelthuap, Peliliu, Angaur, Ngulu, Yap, Truk, Lukunor, Ponapé, Kusaie, Jaluit, Majuro); Mayr and Amadon, Amer. Mus. Novit., no. 1144, 1941, p. 10 (Guam, Saipan, Palau, Ponapé, Kusaie, Ruk, Tah); Hand-list Japanese Birds, 3d ed., 1942, p. 203 (Saipan, Rota, Babelthuap, Peliliu, Angaur, Ngulu, Yap, Ulithi, Truk, Lukunor, Ponapé, Kusaie, Jaluit, Arhno, Majuro, Moloelab, Wotze, Likieb, Ailuk); Mayr, Birds Southwest Pacific, 1945, pp. 51, 284 (Micronesia); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 90 (Tinian); Strophlet, Auk, 63, 1946, p. 535 (Guam); Borror, Auk, 64, 1947, p. 417 (Agrihan); Stott, Auk, 64, 1947, p. 524 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 42 (Rota, Guam, Peleliu, Ulithi, Truk).

Demigretta sacra micronesiae Momiyama, Tori, 5, no. 22, 1926, p. 110 (Type locality, Caroline Islands; Pelew, Yap, Truk, Ponapé, Kusaie).

Geographic range.—Coasts of Asia and adjacent islands from Korea and Japan south to Malaysia, Australia, Melanesia, Polynesia and Micronesia. In Micronesia: Mariana Islands—Agrigan, Tinian, Saipan, Rota, Guam; Palau Islands—Babelthuap, Koror, Garakayo, Ngesebus, Peleliu, Ngabad, Anguar; Caroline Islands—Ulithi, Yap, Ngulu, Truk, Lukunor, Ponapé, Kusaie; Marshall Islands—Jaluit, Arhno, Majuro, Maloelab, Wotze, Likieb, Ailuk, Bikini, Eniwetok, Kwajalein.

Characters.—A medium-sized heron with three color phases: in gray phase color of body varies from "deep blackish-slate" to light bluish-slate, particularly on the breast, with a white gular stripe; wear and fading causes the color of the body to change to brownish-slate; bluish-gray ornamental plumes may be present on adult; in white phase color of body is pure white in adult stage; plumage of immature may be mottled; in mottled phase there may be a variable amount of gray and white (for complete study of plumages of *Demigretta sacra* see Mayr and Amadon, 1941:4).

Measurements.—Mayr and Amadon (1941:1) record the length of the wing of thirty adults from the Marianas and Carolines as 268-309 (284). Seven adult males obtained by the NAMRU2 party at Rota, Guam and Peleliu measure: wing, 287-307 (294); tail, 95-114 (101); culmen, 91-101 (96); tarsus, 78-87 (82); seven adult females, from Rota and Guam: wing, 265-285 (275); tail, 87-96 (91); culmen, 86-92 (89); tarsus, 72-79 (76).

Weights.—The author (1948:42) lists the following weights: four adult males from Guam (gray phase) 590-667 (614); two adult males from Guam (white phase) 600 and 662; five adult females from Guam and Rota (gray phase) 477-553 (506).

Specimens examined.—Total number, 80 (38 males, 40 females, 2 unsexed) as follows: Mariana Islands, USNM—Rota, 3 (Oct. 18, Nov. 2, 5)—Guam, 21 (May 11, June 6, 18, July 6, 8, 16, 24, 27, Aug. 6, 8, 27); AMNH—Saipan, 2 (July 22)—Guam, 9 (Feb. 11, Mar. 6, 7, April 11, Aug. 15, Sept. 14, 16, Nov. 27, Dec. 20); Palau Islands, USNM—Peleliu, 3 (Sept. 10, 16); AMNH—exact locality not given, 5 (Nov. 8, 21, 23); Caroline Islands, USNM—Ulithi, 1 (Aug. 15)—Kusaie, 1 (Feb. 8); AMNH—Truk, 3 (Feb. 18, May 20, Nov. 5)—Tah, 2 (Oct. 18)—Ponapé, 2 (Nov. 21, undated)—Kusaie, 26 (Jan. 25, 26, Feb., Mar. 10-20, 20-30, April 1-10, 18); Marshall Islands, USNM—Bikini, 2 (March 29, April 2).

Nesting.—The Reef Heron apparently nests on most of the islands in Micronesia. The eggs are laid in a nest of grass and twigs on or near the ground. Hartert (1898:64) records a nest found in grass at Saipan on July 28, 1895. Yamashina (1932a:406) reports on one egg taken at Ponapé on July 23, 1931. Marshall (1949:219, fig. 37) found a breeding bird in April at Tinian. Coultas (field notes) learned from the natives at Ponapé that the Reef Heron builds a nest of small sticks near the ground in the mangrove thickets. Two or three eggs are laid, and nests can be found at various times of the year. Mayr and Amadon (1941:4) comment on the prolonged breeding season and report six sets of eggs from Polynesia taken in January, March, April, September, October, and November.

Food habits.—The author (1948:42) found fish and crabs in the stomachs of birds taken at Guam, Ulithi and Peleliu.

Parasites.—Uchida (1918:484, 488, 490) found the following bird lice (Mallophaga) on the Reef Heron at Ponapé: *Nirmus orarius, Colpocephalum importunum,* and *Myrsidea teraokai.* Bequaert (1939:81 and 1941:266) found the fly (Hippoboscidae), *Ornithoctona plicata,* on the heron at Kusaie. Wharton (1946:175) and Wharton and Hardcastle (1946:306, 316) obtained chiggers (Acarina), *Neoschöngastia egretta* and *N. carveri,* from the Reef Heron at Guam and Ulithi.

Remarks.—The species *Demigretta sacra* contains two subspecies, the widespread *D. s. sacra* and a larger form, *D. s. albolineata* (Gray), known from New Caledonia and the Loyalty Islands. The latter subspecies is surrounded by the former, a distribution which closely parallels that in each of the species *Phalacrocorax melanoleucus* and *Gygis alba of* Oceania. Recently Delacour (in Delacour and Mayr, 1945b:105) has dropped the name *Demigretta* placing all of the forms of this genus in *Egretta.* He says, "We cannot accept the genus *Demigretta,* which is based on the more extended feathering of the tibia, the different length and texture of the feathers of the trains, the shortness of the tarsus and the presence of a dark gray color phase. The latter exists in the Madagascan and African subspecies of *Egretta garzetta.*"

The Reef Heron is a conspicuous member of the bird life of Micronesia, being recorded from most of the island groups. It prefers the placid and shallow waters of the lagoons and tidal beaches where it obtains the littoral animal life as food. The birds are seldom seen inland and usually frequent the beaches and rocky coasts. In this respect there is little opportunity for competition with the migratory Plumed Egret, which prefers the grassy upland and marsh areas and inland ponds. The Reef Heron is a quiet, usually solitary, and retiring bird, being exceedingly difficult to approach, especially when found on the open tidal flats.

The problem of plumages and color phases in the Reef Heron has been treated by Mayr and Amadon (1941:4-10). Specimens which they examined from Micronesia were found to be 54 percent gray, 40 percent white, and 6 percent mottled. Of the birds obtained by NAMRU2 field parties, fewer than 40 percent were white. Field counts showed a considerable variation in the ratio of grays to whites: Guam—6 grays to 4 whites; Ulithi—4 grays, 6 whites, 1 mottled; Palau—equal number of grays and whites; Truk—2 whites, 1 gray, 1 mottled. For some unknown reason, the gray birds were more easily approached than the white birds. Gleise and Genelly (1945:221) saw one white Reef Heron at Eniwetok. Wallace (field notes) found white herons more numerous than gray ones at Kwajalein in 1944 and 1945. Borror (1947:417) observed gray birds at Agrigan. Stott (1947:524) saw one blue heron on December 24, at Saipan. The 150 birds seen by him at Lake Susupe in December probably were Plumed Egrets.

In discussing the variation in the color phases of the Reef Heron throughout its range, Mayr (1924b:237) suggests that the reduced variability of small populations may not be due to accidental gene loss, but instead to the population having descended from a single pair or from one fertilized female. The descendents would naturally possess only those characters provided for in the genetic make-up of the parents. Reef Herons on New Zealand and in the Marquesas Islands all are gray, while at other island groups different proportions of gray and white individuals occur; such phenomena may result because of the genetic constitution of the "founders."

Nycticorax nycticorax nycticorax (Linnaeus)

Black-crowned Night Heron

Ardes Nycticorax Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 142. (Type locality, Southern Europe.)

Nycticorax griseus Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 105 (Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 69 (Uap).

Nycticorax nycticorax Sharpe, Cat. Birds British Mus., 26, 1898, p. 146 (Yap).

Nycticorax nycticorax nycticorax Kuroda, in Momiyama, Birds Micronesia, 1922, p. 36 (Mackenzie, Yap); Hand-list Japanese Birds, rev., 1932, p. 183 (Yap, Uluthi); Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Yap, Uluthi); Mayr, Birds Southwest Pacific, 1945, p. 302 (Marianas, Yap).

Geographic range.—Europe and Africa east to Japan and Malaysia. In Micronesia: Mariana Islands—Tinian; Palau Islands—Koror; Caroline Islands—Yap, Ulithi, Truk.

Specimens examined.—Total number, 2 immature females, as follows: Palau Islands, USNM—Koror, 1 (Nov. 27); Caroline Islands, AMNH—Truk, 1 (June 18).

Remarks.—The Black-crowned Night Heron is a winter visitor to western Micronesia. Marshall (1949:221) records six of these birds on Tinian on April 4, 1945, and one on Koror on November 27.

Nycticorax caledonicus pelewensis Mathews

Rufous Night Heron

Nycticorax caledonicus pelewensis Mathews, Bull. British Ornith. Club, 46, 1926, p. 60. (Type locality, Pelew Islands.)

Nycticorax caledonicus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew); Sharpe, Cat. Birds British Mus., 26, 1898, p. 158 (Pelew); Hartert, Novit. Zool., 7, 1900, p. 10 (Ruk); Reichenow, Die Vögel, 1, 1913, p. 255 (Palauinseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Pelew); Uchida, Annot. Zool. Japon., 9, 1918, p. 486 (Palau); Wetmore, in Towsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 172 (Uala, Truk Atoll); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 37 (Pelew, Ruk).

Nycticorax manillensis Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 105 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 33 (Palau); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 69 (Pelew, Ruk).

Nycticorax caledonicus pelewensis Mathews, Syst. Avium Australasianarum, 1, 1927, p. 200 (Pelew, Carolines); Peters, Proc. Boston Soc. Nat. Hist., 39, 1930, p. 271 (Pelew, Carolines); Peters, Check-list Birds World, 1, 1931, p. 115 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 183 (Palau, Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Babelthuap, Koror, Coracal, Truk); Amadon, Amer. Mus. Novit., no. 1175, 1942, p. 6 (Palau, Ruk); Mayr, Birds Southwest Pacific, 1945, p. 285 (Palau, Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 43 (Angaur, Peleliu, Garakayo, Truk).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Coracel, Garakayo, Peleliu, Ngabad, Angaur; Caroline Islands—Truk.

Characters.—Adult: Size medium; head and nape dark slaty-black; occipital plumes white with dark tips and shafts; back dark reddish-brown, lighter on sides of neck, wings, wing coverts, rump, and tail; under parts whitish with light reddish-brown on sides of neck extending to throat and upper breast; tibia with some brownish feathers; underwing pinkish; feet yellowish-brown; bill black.

Immature: Resembles adult, but upper parts mottled black with reddish-brown; underparts with lighter streaks of brown and whitish on breast; feet yellowish; bill black above, yellowish below.

Adult resembles *N. c. manillensis* Vigors, but is duller above.

Measurements.—Two adult males from Peleliu measure: wing, 293, 299; tail, 105, 107; culmen, 82, 89; tarsus, 79, 81; seven adult females from Peleliu: wing, 269-286 (280); tail, 101-106 (104); culmen, 76-84 (80); tarsus, 78-83 (80); one adult female from Truk: wing, 280; tail, 97; culmen, 83; tarsus, 79.

Specimens examined.—Total number, 27 (5 males, 18 females, 4 unsexed), as follows: Palau Islands, USNM—Peleliu, 9 (Aug. 31, Sept. 1, 5, 6, 8, Dec. 6); AMNH—exact locality not given, 16 (Nov. 7, 8, 13, 23, 25, Dec. 1, undated); Caroline Islands, USNM—Truk, 1 (Feb. 16); AMNH—Truk, 1 (May 25).

Nesting.—The NAMRU2 party observed a nesting colony of these night herons at Peleliu on August 29, 1945. Approximately eight nests were observed in a grove of saplinglike trees at the edge of a mangrove swamp. These nests were 15 to 20 feet above the ground; most of them contained one or two nestling birds. Two subadults and three nestlings in postnatal molt were obtained; no eggs were found. Marshall (1948:219) records breeding in August, September and December.

Food habits.—Baker (1948:43) reports that stomachs of night herons obtained by the NAMRU2 party at Peleliu contained a great variety of animal foods, including eels, fish, lizards (skinks), crabs, shrimp, and insects. The stomach of one adult contained 14 large grasshoppers and four fish, totaling about 15 cc. in volume. The nestlings had eels, skinks, and insects in their stomachs..

Parasites.—Uchida (1918:486) found the bird louse (Mallophaga), *Lipeurus baculus,* on the night heron at Palau.

Remarks.—Amadon (1942:4-8) has made the most recent study of the species *Nycticorax caledonicus* and recognizes eight subspecies from Australia and New Calendonia north to the Caroline and Bonin islands. This is one of the few tropical and subtropical species which has extended its range to the Bonin islands. The discontinuous distributions of this species prevents an accurate estimation of the route by which it reached the Bonins. The presence of the bird at Palau and at Truk makes it difficult to account for its absence at Yap and other intervening, and seemingly suitable, islands. Populations at Palau and Truk appear to be similar and are placed in the same subspecies, but when adequate material is available from Truk, further study may reveal that the populations on the two islands (Truk and Palau) are recognizably different.

At the southern Palau Islands, night herons were found by the NAMRU2 party in mangrove swamps, lagoons and on beaches. I found them to be inactive during the daytime; the birds were usually perched singly in trees or at the edge of the water. The birds appeared to have special roosting places and were observed sitting in the same place on several different occasions. McElroy of the NAMRU2 party reported seeing three night herons at Truk in December, 1945.

Gorsachius goisagi (Temminck)

Japanese Bittern

Nycticorax goisagi Temminck, Pl. Col., livr. 98, 1835, pl. 582. (Type locality, Japan.)

Gorsakius goisagi Hand-list Japanese Birds, rev., 1932, p. 184 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Eastern China, Japan, Riu Kius, Formosa, and Philippine Islands. In Micronesia: Palau Islands—Koror.

Remarks.—*Gorsachius goisagi* has been recorded from Koror in the Palau Islands. It may be classed as a rare migrant to western Micronesia.

Gorsachius melanolophus melanolophus (Raffles)

Malay Bittern

Ardea melanolopha Raffles, Trans. Linn. Soc. London, 13, 1822, p. 326. (Type locality, Western Sumatra.)

Nycticorax goisagi Hartlaub and Finsch, Proc. Zool. London, 1868, pp. 8, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, p. 89 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 68 (Pelew).

Nycticorax melanolophus Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 35 (Palau).

Gorsachius melanolophus Sharpe, Cat. Birds Brit. Mus., 26, 1898, p. 166 (Pelew).

Gorsahius melanolophus melanolophus Hand-list Japanese Birds, rev., 1932, p. 184 (Pelew); Hand-list Japanese Birds, 3d ed., 1942, p. 204 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Gorsachius melanolophus melanolophus Mathews, Syst. Avium Australasianarum, 1. 1927, p. 200 (Pelew).

Geographic range.—India, Ceylon, southern China, Formosa, Indochina, Malaysia. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—Captain Tetens obtained a specimen of this bittern at the Palau Islands which was reported on by Hartlaub and Finsch (1868a:8, 1868b:118). It is probably a rare straggler to western Micronesia. The specimen has not been seen by me; it may be of the subspecies *G. m. kutteri* (Cabanis), which is known from the Philippine Islands.

Ixobrychus sinensis (Gmelin)

Chinese Least Bittern

Ardea Sinensis Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 642. (Type locality, China.)

Ardea lepida Lesson, Traité d'Ornith., 1831, p. 573 (Marianne); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen).

Ardea sinensis Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan); Gray, Hand-list Birds, 3, 1871, p. 31 (Marian); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 105 (Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 33 (Palau, Yap); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk).

Ardea (Ardetta) sinensis Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 49 (Ladrone or Marian Islands).

Ardetta Sinensis Salvadori, Ornith. Papuasia, 3, 1882, p. 364 (Pelew, Carolines, Mariannis); Oustalet, Le Nat., 1889, p. 261 (Mariannes); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 68 (Marianne, Uap, Ruk, Pelew); Oustalet, Nouv. Arch, Mus. Hist. Nat. Paris, (3), 8, 1896, pp. 38, 39 (Guam, Saypan, Ponapi, Ruk, Palaos); Hartert, Novit. Zool., 5, 1898, p. 65 (Guam); Sharpe, Cat. Birds British Mus., 26, 1898, p. 227 (Marianne, Carolines, Pelew); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Prowazek, Die deutschen Marianan, 1913, p. 100 (Saipan); Cox, Island of Guam, 1917, p. 21 (Guam).

Ardetta bryani Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 27 (Type locality, Guam); Safford, Osprey, 1902, p. 66 (Guam); *idem,* The Plant World, p. 266 (Guam).

Ardetta sinensis sinensis Takatsukasa and Kuroda, Tori, 1, 1915, p. 50 (Ruk, Pelew).

Ixobrychus sinensis bryani Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, pp. 173, 175 (Guam); Kuroda, in Momoyama, Birds Micronesia, 1922, p. 37 (Guam, ?Yap, ?Mackenzie, ?Pelew); *idem,* Avifauna Riu Kiu, 1925, p. 134 (Guam, ?Yap, ?Pelew); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 202 (Guam, ?Pelew); Peters, Check-list Birds World, 1, 1931, p. 121 (Guam); Hand-list Japanese Birds, rev., 1932, p. 184 (Saipan, Tinian, Rota, Guam); Oberholser, Bull. U. S. Nat. Mus., 159, 1932, p. 18 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 205 (Saipan, Tinian, Rota, Guam); Amadon, Bull. Bernice P. Bishop Mus., 186, 1945, p. 25 (Guam); Stott, Auk, 64, 1947, p. 525 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 44 (Rota, Guam).

Ixobrychus sinensis moorei Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 173 (Type locality, Uala, Truk group); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 38 (Ruk); Kuroda, Avifauna Riu Kiu, 1925, p. 134 (Ruk); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 202 (Middle Carolines); Peters, Check-list Birds World, 1, 1931, p. 121 (Truk); Hand-list Japanese Birds, rev., 1932, p. 184 (Palaus, Yap, Truk); Oberholser, Bull. U. S. Nat. Mus., 159, 1932, p. 17 (Carolines, ?Pelews); Hand-list Japanese Birds, 3d ed., 1942, p. 205 (Babelthuap, Koror, Yap, Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 44 (Truk, Peleliu).

Ixobrychus sinensis Hartert, Vogel pal. Fauna, 10, 1920, p. 1260 (Truk, Palau, Guam); Mayr, Birds Southwest Pacific, 1945, p. 285 (Marianas, Palau, Yap, Truk); Watson, The Raven, 17, 1946, p. 41 (Guam); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 91 (Tinian); Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Delacour and Mayr, Birds Philippines, 1946, p. 29 (Guam); Strophlet, Auk, 63, 1946, p. 536, (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Ixobrychus sinensis sinensis Hachisuka, Birds Philippines, 1, 1932, p. 365 (Guam, Truk); Robinson and Chasen, Birds Malay Peninsula, 3, 1936, p. 195 (Marianne).

Ixobrychus sinensis palewensis Momiyama, Bull. Biogeogr. Soc. Japan, 2, 1932, p. 333 (Type locality, Pelew); Mathews, Ibis, 1933, p. 88 (Pelew).

Ixobrychus sinensis yapensis Momiyama, Bull. Biogeogr. Soc. Japan, 2, 1932, p. 333 (Type locality, Yap); Mathews, Ibis, 1933, p. 89 (Yap).

Geographic range.—Northeastern China and Japan south to Micronesia, Malaysia, Burma, India and Ceylon. Winter visitor to Papuan region. In Micronesia: Mariana Islands—Saipan, Tinian, Rota, Guam; Palau Islands—Babelthuap, Koror, Peleliu; Caroline Islands—Yap, Truk.

Characters.—Adult male: A small bittern with crown and short occipital crest slaty-black; mantle light buffy-brown; back and rump gray; tail black; wing-coverts brownish-buff; primaries and secondaries slaty-black; underparts yellowish buff; chin and throat whitish; sides of head and neck and a line of feathers across chest blackish edged with buff; bill yellowish green; feet greenish yellow.

Adult female: Resembles adult male, but with upper parts mottled brown and golden chestnut; underparts deep buff streaked with pale brown on neck.

Immature: Resembles adult, with upper parts heavily streaked with blackish-brown, and underparts streaked with chestnut and dark brown.

Measurements.—Measurements of specimens from Micronesia are given in table 16.

TABLE 16. MEASUREMENTS OF *Ixobrychus sinensis* FROM MICRONESIA

LOCATION	Sex	No.	Wing	Tail	Full culmen	Tarsus
Yap, Truk..........	males	6	132 130–134	43 41–47	56 54–59	44 42–47
Guam..............	males	11	134 127–138	47 45–50	57 55–60	46 45–47
Guam..............	females	10	130 127–134	46 44–49	57 55–59	45 43–47

Weights.—The author (1948: 44) records the weights of eight adult males from Guam as 82-103 (92) and eight adult females from Guam as 84-109 (95).

Specimens examined.—Total number, 69 (34 males, 27 females, 8 unsexed), as follows: Mariana Islands, USNM—Saipan, 1 (Sept. 30)— Tinian, 1 (Oct. 13)—Guam, 29 (May 16, June 4, 6, 7, 8, 14, 18, 19, July 10, 16, 18, 24, 27, Aug. 4); AMNH—Saipan, 1 (Aug. 6)—Tinian, 3 (Sept. 13)—Guam, 14 (Feb. 1, Mar. 13, 29, July 11, 13, 25, Aug. 1, 7, 13, Sept. 4, 10, Dec. 8); Palau Islands, AMNH—exact locality not given, 6 (Nov. 19, 21, 23, 25, Dec. 1, 18); Caroline Islands, USNM—Truk, 1 (Feb. 16); AMNH—Yap, 1 (not dated)—Truk, 12 (Feb. 9, Mar. 5, 17, May 7, June 13, 14, 15, Oct. 3, Nov. 1, 5, Dec. 20).

Nesting.—The author (1948:44) records a nest found by the NAMRU2 party near Achang Bay on Guam on June 6, 1945. It was found in a cane thicket at the edge of a fallow rice paddy, approximately four feet from the ground and was constructed of about three quarts of reeds and cane. Two eggs found in the nest are oval, white with a greenish cast and measure 33 by 24 and 34 by 24. On February 1, 1945, the writer found two recently occupied nests of the Chinese Least Bittern at Oca Point, Guam. These nests were in dense inkberry brush approximately five feet above the ground. The area was not marshy, the nearest water being at the beach some 300 yards away. Nearby one of the nests was found a young bittern, which apparently had only recently left the nest. The pin feathers were growing. A parent bird remained in the vicinity with the young bird until it left the area after March 9.

Food habits.—The Chinese Least Bittern feeds on animal foods obtained along waterways, marshes and beaches as well as in forests and fields. The NAMRU2 party observed several types of insects in the stomachs of birds taken at Guam. Seale (1901:27) found black crickets in stomachs of bitterns taken at Guam. Coultas (field notes) learned from the natives of the Palau Islands that the bittern feeds on land mollusks.

Parasites.—Wharton (1946:174) obtained the chigger (Acarina), *Trombicula acuscutellaris*, from the Chinese Least Bittern at Guam.

Remarks.—The Chinese Least Bittern has been regarded by many workers as consisting of several geographic races; as many as eight have been recognized. Other workers have concluded that *I. sinensis* is made up of highly variable populations and that it lacks well-fined geographic variation. Hartert (1920:1260), Hachisuka (1932: 365), and Mayr (1945a:285) have reached the latter conclusion. As yet this problem has not been satisfactorily solved; a thorough study is needed, but may not be possible until additional material, especially from the continental areas, can be obtained. In coloration there appears to be little difference between birds from the various localities in Micronesia. These birds may average slightly paler than populations from the continental areas, but on this basis I doubt that a person could recognize the Micronesian birds in a group of skins from many other localities. Birds in fresh plumage may show geographic differences better than slightly worn specimens. Measurements made by the author offer no clear-cut differences either.

I. sinensis was first recorded in Micronesia by Quoy and Gaimard (1824:536), whose ship, the "Uranie," stopped at Guam. They called the bird "Petit Héron aux ailes noires." Most of the ornithological collectors in the years following Quoy and Gaimard obtained this bittern in Micronesia. At Guam, its abundance and the ease with which it may be approached and shot is attested by the large series obtained by collectors: Seale (1901:27) took eight birds;

Marche (Oustalet, 1896:36) took eighteen skins; the NAMRU2 party took twenty-nine skins.

The Chinese Least Bittern is found in habitats associated with both salt water and fresh water, as well as in upland habitat in Micronesia. The bird appears to be well adapted to areas of open forest and coconut groves. Coultas (field notes) found the birds in taro patches in the Palaus. Although a considerable amount of field observing was done in the southern Palaus, the NAMRU2 party saw only one bird (September 13, 1945, at Peleliu). Perhaps the birds prefer Babelthuap and other large islands farther north in the chain. McElroy found bitterns in taro patches at Truk in December, 1945. The NAMRU2 party did not find any birds at Rota in October and November, 1945. Downs (1946:91) found the birds in upland sugar cane and beach habitats on Tinian.

Regarding the bittern in the Palaus, Coultas (field notes) writes, "Always found alone, never a pair. A bird that is not easily frightened. In the heat of the day, one finds it standing in the shade of a taro leaf quietly viewing the intruder and very reluctant about moving. I have tossed pieces of earth and sticks at the bird to encourage him to fly so that I would not blow him to pieces when I shot, but my efforts at dislodgement have been rewarded by harsh scolding squawks. It became necessary for me to move into proper gun range. I have also found them perched in low trees at the edge of taro swamps. In flight they are atrociously awkward. They can't keep a course and their legs dangle every-which way. Their jerky, slow flight usually ends abruptly when the bird becomes entangled in weeds or the branches of trees. Extracting himself from his predicament he is soon in another and invariably resorts to blasphemy."

Ixobrychus eurhythmus (Swinhoe)

Schrenck's Least Bittern

Ardetta eurhythma Swinhoe, Ibis, 1873, p. 74, pl. 2. (Type locality, Amoy Shanghai.)

Ixobrychus eurythmus Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Southeastern Siberia and Japan south to India and Malaysia. In Micronesia: Palau Islands—exact locality unknown.

Specimens examined.—Total number, 3 (2 males, 1 female), from Palau Islands, AMNH—exact locality not given (Nov. 19, 21, Dec. 3).

Remarks.—Coultas obtained three immature specimens at Palu in November and December, 1931.

Dupetor flavicollis flavicollis (Latham)

Black Bittern

Ardea flavicollis Latham, Ind. Ornith., 2, 1790, p. 701. (Type locality, India.)

Dupetor flavicollis Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 26 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Dupetor f. flavicollis Mayr, Birds Southwest Pacific, 1945, p. 302 (Guam).

Geographic range.—Central China south to Malaysia and India. In Micronesia: Mariana Islands—Guam.

Remarks.—Seale (1901:26) records a female shot at the Agaña River on Guam on June 11, 1900. The skin probably is in the Bernice P. Bishop Museum in Honolulu.

Anas oustaleti Salvadori

Marianas Mallard

Anas oustaleti Salvadori, Bull. British Ornith, Club, 4, 1894, p. 1. (Type locality, Mariannis Islands.)

Anas oustaleti Salvadori, Cat. Birds British Mus., 27, 1895, p. 189 (Guaham); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 49 (Guam); Hartert, Novit. Zool., 5, 1898, p. 66 (Guam, Saipan); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 25 (Guam, Saipan); Matschie, Journ. f. Ornith., 1901, pp. 110, 113 (Guam, Saipan); Safford, Osprey, 1902, p. 66 (Mariannas); *idem*, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, The Plant World, 7, 1904, p. 267 (Guam); Dubois, Syn. Avium, 2, 1904, p. 990 (Mariannes); Safford, Contr. U. S. Nat. Herb., 9, 1905, pp. 80, 126 (Guam); Prowazek, Die deutschen Marianen, 1913, pp. 47, 100 (Marianen); Cox, Island of Guam, 1917, p. 22 (Guam); Phillips, Nat. Hist. Ducks, 2, 1923, p. 53 (Guam, Saipan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 214 (Guam, Saipan); Berlioz, Bull. Mus. Hist. Nat. Paris, 2d ser., 1, 1929, p. 67 (Guam); Peters, Check-list Birds World, 1, 1931, p. 159 (Guam, Tinian, Saipan); Hand-list Japanese Birds, rev., 1932, p. 184 (Guam, Tinian, Saipan); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Kuroda, Tori, 11, 1941-42, pp. 99, 443 (Marianas); Hand-list Japanese Birds, 3d ed., 1942, p. 205 (Guam, Tinian, Saipan); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 1 (Marianne); Mayr, Birds Southwest Pacific, 1945, p. 285 (Marianas); *idem*, Audubon Mag., 47, 1945, p. 282 (Marianas); Baker, Trans, 11th N. Amer. Wildlife Conf., 1946, p. 208 (Guam); Stott, Auk. 64, 1947, p. 525 (Saipan); Baker, Smithson, Misc. Coll., vol. 107, no. 15, 1948, p. 45 (Saipan, Tinian); Momiyama, Pacific Science, 2, 1948, p. 121 (Saipan, Tinian, Guam).

Polionetta oustaleti Kuroda, in Momiyama, Birds Micronesia, 1922, p. 39 (Guam, Saipan).

Anas superciliosa oustaleti Hartert, Novit. Zool., 36, 1930, p. 112 (Guam, Saipan).

Anas platyrhynchos oustaleti Delacour and Mayr, Wilson Bull., 57, 1945, pp. 21, 39 (Marianas).

Geographic range.—Micronesia: Mariana Islands—Guam, Tinian, Saipan.

Characters.—From study of a large series of specimens of *Anas oustaleti*, Yamashina (1948) described two types of plumages: one type resembles that of *A. platyrhynchos* and another type resembles that of *A. poecilorhyncha*. He based his conclusions on both a study of prepared skins and observations of the molt of living specimens as reported by Kuroda (1941-1942). The following descriptions are quoted from Yamashina (1948:122).

Adult male in nuptial plumage of *A. platyrhynchos* type: "Whole head is dark green, except at the sides where buff feathers are plentifully intermingled, a dark brown streak through the eye, and faint white ring on the lower neck. Feathers on scapulars and sides of body are as those of *Anas* *poecilorhyncha*. Sides of body are vermiculated but some brown feathers are found even in the full nuptial plumage. Upper breast is dark reddish chestnut with dusky spots. Upper and under tail-coverts are as in *Anas platyrhynchos*. Speculum is as that of *Anas platyrhynchos*, but the tips of the greater coverts are buff instead of white. Central tail feathers are more or less curled upward. Base of bill is black, tip is olive color. Iris is dark brown. Feet, reddish-orange, webs darker." Eclipse plumage of adult male resembles that of *A. platyrhynchos*.

Adult male in nuptial plumage of *A. poecilorhyncha* type: "Resembles *Anas poecilorhyncha pelewensis* from the Palau Islands and Truk Island, but sides of head are browner, superciliary stripes and ground color of cheeks are more buffy. Feathers on upper breast and sides of body are more broadly edged with brown. Speculum is usually violet-purple as in the *platyrhynchos* type, but in two specimens from Saipan and Tinian, respectively, it is dark green as in *Anas poecilorhyncha pelewensis*. Tips of the secondaries are usually white, but sometimes very faint as in *Anas poecilorhyncha pelewensis*, and in one specimen from Saipan they are buffy. Bill is olive color with a black spot in the center of the upper mandible. Iris, dark brown. Feet, dark orange, darker in joints and webs." Eclipse plumage of adult male resembles the nuptial plumage.

Measurements.—Measurements of nine ducks from Guam and Saipan are: wing, 238-266 (252); tail, 75-84 (81); exposed culmen, 49-53 (51); tarsus, 41-43 (42).

Specimens examined.—Total number, 9 (5 males, 2 females, 2 unsexed), as follows: Mariana Islands, USNM—Saipan, 2 (Oct. 2, 3)—Guam, 1 (June 6); AMNH—Saipan, 2 (Aug. 7, 11)—Guam, 4 (Jan. 10, April 6, Dec. 11, 16).

Nesting.—At Guam, Seale (1901:25) found nests of the Marianas Mallard "among the reedy swamps and streams of the island." He obtained two downy young in June. Kuroda (1941-1942) reports nesting at Lake Challankanoa, Saipan, in July. He writes that nests contained 7 to 12 eggs. Ducklings and incubated eggs were obtained in June and July, but he is of the opinion that the breeding season may be longer. He notes that adults exhibit both nuptial plumage and eclipse plumage at the same time, suggesting that breeding may occur at various times in the year. A nest with seven eggs taken on July 4, 1941, at Hagoi Lake, Tinian, is described by Kuroda as having been found among rushes and constructed of dead leaves, stems, and roots and lined with down. He describes the eggs as being grayish-white with a pale greenish tinge, and measuring 61.6 by 38.9. Marshall (1949:202) saw a family of ducklings in April.

Remarks.—The Marianas Mallard is rare; probably it never has been very abundant in the small chain of islands to which it is restricted, because fresh water marshes and swamps are not extensive. The bird was first recorded by Bonaparte as *Anas boschas a. Freycineti* in 1865. This name was a *nomen nudum* and later the same specimen in the Paris Museum was named by Salvadori (1894) as *Anas oustaleti*. In 1888, Marche obtained six specimens at Guam; these were reported on by Oustalet (1896:49). Later collecting showed that the duck inhabited also the islands of Saipan and Tinian. There have been no records of this duck in the more northern islands of the Marianas. According to Yamashina (1948:121) in the period from 1931 to 1940, the Japanese obtained 38 specimens of the Marianas Mallard at Tinian and Saipan. In 1940, four birds from Tinian were shipped alive to Japan and kept in an aviary by Kuroda. At Tinian in 1940, one of the collectors observed two flocks of *A. oustaleti,* each containing 50 or 60 individuals. The Japanese took specimens at a lagoon area and at fresh water lakes. Yamashina describes one of the localities, Lake Hagoi on Tinian, as "a small body of fresh water surrounded by about 40 acres of marsh." During the war, servicemen reported the presence of the Marianas Mallard at both Saipan and Tinian. Moran (1946:261) counted twelve ducks at Saipan. Stott (1947:525) saw seven birds at Lake Susupe on Saipan in December, 1945. He writes that the birds were gentle and easily approached and that they preferred winding channels in reed beds to open water. Marshall obtained two ducks at Lake Susupe in early October, 1945. These specimens are in the United States National Museum. He (1949:202) found ducks at both Saipan and Tinian; twelve was the greatest number seen at any one time. Gleise (1945:220) estimated that there were twelve birds on Tinian in 1945, remarking that their habitat was swamp area.

At Guam and Rota, the NAMRU2 party failed to obtain any specimens but received reports of the presence of ducks on both islands. At Guam, reports were obtained of ducks of unknown species at a fallow rice paddy in August, 1944, and in a marsh near Agat on June 13, 1945. The presence of Japanese soldiers in the interior of Guam made it inadvisable to investigate marshes and swamps of the interior and the upper courses of streams. H. G. Hornbostel, as quoted by Phillips (1923:54), reported that ducks were found at Guam only in the Tolofofo River Valley. The NAMRU2 field parties investigated the lower reaches of this valley and found no evidence of the ducks. The upper part of this valley was used as an artillery range in 1945. Probably the firing of field guns was a disturbing influence to any birds that might have been there. If the ducks were on Guam at that time, they must have been secretive and restricted in their movements. At Rota, two ducks which might have been *A. oustaleti* were seen by the NAMRU2 party on October 20, 1945, in a cultivated field.

These recent reports indicate that the Marianas Mallard is secure for the present on the islands of Saipan and Tinian, but thoughtful conservation practices need to be placed in operation to insure its survival in the future.

Evolutionary history of Anas oustaleti.—In the past, most of the studies have pointed to a northern ancestry for *A. oustaleti.* Bryan (1941:187) has noted a relationship between *A. oustaleti* and the Laysan Duck (*A. laysanensis* Rothschild) and the Hawaiian Duck (*A. wyvilliana* Sclater). Amadon (1943:1) suggests that these three species of ducks are rather recent derivatives of the Common Mallard (*A. platyrhynchos*) and postulates the evolution of *A. wyvilliana* from migrants from North America. He further states that *A. laysanensis* and *A. oustaleti* may have been derived from *A. wyvilliana* or may represent independent colonizations. Delacour and Mayr (1945:21) go a step further and make these forms subspecies of *A. platyrhynchos,* saying that they are "dull-colored editions" of the Common Mallard, that because of isolation they have become reduced in size and have lost many of the characteristics of their ancestors. Recently, however, Yamashina (1948) has concluded that the Marianas Mallard has evolved as the result of hybridization between the two species, *A. platyrhynchos* and *A. poecilorhyncha.* His conclusions are based on a study of a large number of specimens, both museum skins and captive birds, in which he has been able to detect plumages of the *A. platyrhynchos* type and of the *A. poecilorhyncha* type (see Characters). He has noted specimens which have ninety percent of the characteristics of *A. platyrhynchos* and ten percent of the *A. poecilorhyncha* type. These percentages are reversed in specimens favoring the *A. poecilorhyncha* type. In his series of skins he finds the *A. poecciolrhyncha* type of plumage most frequently, in forty-four specimens out of fifty examined, while only six specimens have the *A. platyrhynchos* type of plumage. Yamashina cites also as evidence favoring his conclusion that hybridization has taken place the results obtained from the crossing of captive *A. platyrhynchos* and *A. poecilorhyncha.* It is his assumption that there has been a resident form of *A. poecilorhyncha* in the Marianas, apparently resembling closely that which occurs in the Palaus and at Truk (*A. p. pelewensis*), and that stragglers of *A. platyrhynchos* from the north occasionally reach the Marianas where hybridization between the two species occurs. Yamashina remarks (1948:123): "The opportunity for hybridization should occur more rarely in the south, and thus more frequent back-crossing of the hybrid with the indigenous *Anas poecilorhyncha* on Tinian and Guam explains the superabundance there of the *poecilorhyncha* type. As the hybridization should have taken place more frequently to the north in Saipan, the ratio of the occurrence of the *platyrhynchos* type is logically higher there." The Common Mallard (*A. p. platyrhynchos*) has not been recorded in Micronesia, but according to Yamashina (1948: 123) "winters frequently just north of the Marianas in the Bonin and Volcano Islands."

This remarkable explanation for the development of the Marianas Mallard is not questioned by this author, who feels that hybridization may be found to be the cause for other unusual forms of life in island habitats whose ancestry has not been explained. As Yamashina comments, the special environments of islands together with small and restricted populations of animals are factors which could favor such development.

Anas poecilorhyncha pelewensis Hartlaub and Finsch

Australian Gray Duck

Anas superciliosa var. *pelewensis* Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 108. (Type locality, Pelew Islands.)

Anas superciliosa Hartlaub and Finsch, Proc. Zool. London, 1868, pp. 8, 118 (Pelew); Sclater, Proc. Zool. Soc. London, 1869, p. 659 (Pelew); Gray, Hand-list Birds, 3, 1871, p. 82 (Pelew); Salvadori, Ornith. Papuasia, 3, 1882, p. 395 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 70 (Pelew); Salvadori, Cat. Birds British Mus., 27, 1895, p. 206 (Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 50 (Palaos).

Anas superciliosa pelewensis Dubois, Syn. Avium, 2, 1904, p. 990 (Pelew); Mathews, Birds Australia, 4, 1915, p. 90 (Pelew); Phillips, Nat. Hist. Ducks, 2, 1923, p. 113 (Pelew); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 215 (Pelew); Hartert, Novit. Zool., 36, 1930, p. 112 (Pelew); Peters, Check-list Birds World, 1, 1931, p. 160 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 184 (Palaus, Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 205 (Babelthuap, Peliliu); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 3 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 286 (Palaus, Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 45 (Peleliu, Truk).

Anas pelewensis Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 40 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 71 (Palau).

Polionetta superciliosa pelewensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 38 (Pelew).

Anas superciliosa rukensis Kuroda, "Gan to Kamo" (Geese and Ducks), 1939, page not numbered, description between pls. 52 and 53 (Type locality, Ruk); Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Truk).

Anas poecilorhyncha superciliosa Delacour and Mayr, Wilson Bull., 57, 1945, pp. 21, 39 (no locality given); Yamashina, Pacific Science, 2, 1948, p. 122 (Palau, Truk).

Geographic range.—Islands of Micronesia, Polynesia, and Melanesia. In Micronesia: Palau Islands—Babelthuap, Peleliu; Caroline Islands—Truk.

Characters.—Adult: A medium-sized duck with upper parts dark brown, feathers edged with buff; top of head blackish merging into gray on hind neck with narrow buff line below; eye-stripe broad and blackish; lower parts uniformly dark brown to gray brown, feathers edged with buff; face, chin and throat light buff with some dark streakings; under wing white; speculum green; bill plumbeous with nail black; legs yellow-brown to yellowish, webs dusky. *A. p. pelewensis* resembles *A. p. rogersi* Mathews, but is smaller with a wing length averaging as much as 20 mm. shorter.

Measurements.—As given by Amadon (1943:4) seven unsexed skins from the Palaus, studied by Finsch (1875:40), have wing lengths of 207, 212, 212, 214, 223, 235, 230. For an adult male taken by Coultas at Palau, the exposed culmen measures 45 and the tarsus 37.

Specimens examined.—Total number, 3 males from Palau Islands, AMNH—exact locality not given (Oct. 26, Nov. 25).

Remarks.—*A. p. pelewensis* is apparently rare in the Palau Islands. Coultas, who visited the Palaus in October to December, 1931, writes (field notes) that he received reports that the birds were present and nested in numbers on fresh water lakes. He took specimens in taro patches and comments that the ducks probably feed at night and have retiring habits during the day. At Peleliu in 1945, the NAMRU2 party received several reports of ducks but failed to find the birds. At Truk, in December, 1945, McElroy of the NAMRU2 party found ducks to be fairly numerous in rice paddies, marshes, and swamps. He observed that the birds roosted at Moen Island at night but that they apparently flew to outlying islands to spend the day. Richards observed ducks on Moen Island on August 28 and 29, 1947, and again in the period from January 19 to February 10, 1948. He saw several flocks of ducks including one containing "about a dozen ducks" at ponds along a roadway and at an airstrip. Kuroda named the population at Truk as distinct in 1939. I have not been able to examine his description and no specimens are available for study, but if the birds at Truk represent an independent colonization (different from that of the birds at Palau) they might exhibit recognizable variation. Amadon (1943: 5) has already pointed out that the shortness of the wing of specimens in the Palaus may merit subspecific status for the population. Delacour and Mayr (1945:21) propose that the Palau Gray Duck is a subspecies of *A. poecilorhyncha;* this treatment is followed in the present work.

Evolutionary history.—*A. p. pelewensis,* as Amadon (1943:1) has stated, represents a population of mallards which became separated from the ancestral stock in the Australian or Malayan area and when once differentiated, invaded New Zealand and other parts of Polynesia, Melanesia, and southwestern Micronesia. Amadon points out that its range in the Pacific islands is more or less complimentary to that of *A. oustaleti* in the Marianas and the Philippine Mallard (*A. poecilorhyncha luzonica* Fraser), as well as to the Hawaiian forms (*A. wyvilliana* Sclater and *A. laysanensis* Rothschild). The range of *A. p. pelewensis* gives one the impression that its present distribution may be only a stage in a gradual spreading of the species, for it certainly has not yet occupied all habitats suitable for it in southern Micronesia nor elsewhere in Oceania. As in the case of *A. oustaleti*, *A. p. pelewensis* appears to prefer areas of fresh, and possibly brackish, water on the larger islands.

A. p. luzonica is a near relative of *A. p. pelewensis* but has rufous-brown instead of buffy-brown coloring on the chin, throat, sides of head, and superciliary region. The underparts of the Philippine Mallard are much less mottled. The specula are similar. Both of these forms were probably derived from a mallard of the *A. p. poecilorhyncha* type.

Anas querquedula Linnaeus

Garganey Teal

Anas Querquedula Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 126. (Type locality, Europe, restricted to Sweden.)

Anas querquedula Marshall, Condor, 51, 1949, p. 221 (Tinian).

Geographic range.—Breeds in Europe and Asia. Winters from northern Africa to New Guinea. In Micronesia: Mariana Islands—Tinian.

Remarks.—Marshall (1949:221) obtained one of a pair of these ducks which he observed "daily in April on Lake Hagoi" at Tinian.

Anas crecca crecca Linnaeus

European Teal

Anas Crecca Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 126. (Type locality, Europe, restricted to Sweden.)

Querquedula crecca crecca Hand-list Japanese Birds, rev., 1932, p. 185 (Pagan).

Anas crecca crecca Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Pagan).

Anas crecca Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Geographic range.—Breeds in Iceland, northern Europe, Asia, and Aleutians. Winters south to northern Africa, Asia and Philippines. In Micronesia: Mariana Islands—Pagan.

Remarks.—The European Teal has been recorded by the Japanese at Pagan in the northern Marianas. It appears to be an uncommon winter visitor to Micronesia.

Anas crecca carolinensis Gmelin

Green-winged Teal

Anas carolinensis Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 533. (Type locality, Carolina to Hudson Bay.)

Anas carolinensis Reichenow, Ornith. Monatsber., 1901, p. 17 (Jaluit); Schnee, Ornith. Monatsber., 1901, p. 131 (Marshalls); *idem*, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln); Phillips, Nat. Hist. Ducks, 2, 1923, p. 235 (Marshall Islands).

Querquedula crecca carolinensis Hand-list Japanese Birds, rev., 1932, p. 185 (Marshall Islands).

Anas crecca carolinensis Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Marshall Islands).

Geographic range.—Breeds in northwestern and northcentral North America. Winters to West Indies, Central America and Mexico. In Micronesia: Marshall Islands—Jaluit.

Remarks.—Reichenow (1901:17) and Schnee (1901:131) record the Green-wing Teal in the Marshall Islands. It is the only record known for Micronesia. Bryan and Greenway (1944:104) record the teal as a migrant to the Hawaiian Islands.

Anas acuta acuta Linnaeus

Pintail

Anas acuta Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 126. (Type locality, Europe, restricted to Sweden.)

Dafila acuta acuta Hand-list Japanese Birds, rev., 1932, p. 185 (Pagan).

Anas acuta acuta Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Pagan).

Anas acuta Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Geographic range.—Breeds in Iceland, northern Europe and Asia. Winters south to northern Africa, Asia and Philippines. In Micronesia: Mariana Islands—Pagan, Guam; Palau Islands—exact locality unknown.

Remarks.—The Pintail has been recorded from Pagan and Guam in the northern Marianas and from the Palau Islands and is thought to be an uncommon visitor to Micronesia. At Guam, Flavin (field notes) recorded one female on October 27, 1945, and three females and two drakes on January 19, 1946. Marshall (1949:221) saw a flock of fifteen Pintails at Saipan on February 7, 1945.

Anas acuta tzitzihoa Vieillot

Pintail

Anas tzitzihoa Vieillot, Nouv. Dict. Hist. Nat., 5, 1816, p. 163. (Type locality, Mexico, *ex* Hernandez.)

Anas acuta americana Reichenew, Ornith. Monatsber., 1901, p. 17 (Jaluit); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln).

Anas acuta Schnee, Ornith, Monatsber., 1901, p. 131 (Marshalls); Phillips, Nat. Hist. Ducks, 2, 1923, p. 316 (Jaluit).

Anas acuta tzitzihoa Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Marshall Islands).

Geographic range.—Breeds in northwestern and northcentral North America. Winters south to West Indies, Panamá, and west to Hawaiian Islands. In Micronesia: Marshall Islands—Jaluit.

Remarks.—Reichenow (1901:17) and Schnee (1901:131) reported that flocks of ducks belonging to this and other American species were observed in the Marshall Islands in October, 1899, and May, 1900. This species may winter in the Hawaiian Islands, according to Peters (1931:167). If so it is not surprising that occasional visitors reach eastern Micronesia.

Anas penelope Linnaeus

Widgeon

Anas penelope Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 126. (Type locality, Europe, restricted to Sweden.)

Anas penelope Finsch, Ibis, 1880, pp. 332, 333 (Taluit); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln); Phillips, Nat. Hist. Ducks, 2, 1923, p. 175 (Taluit); Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Tinian, Yap, Jaluit); Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Mareca penelope Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 56 (Jaluit); Wiglesworth, Abhandl. und Ber Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 71 (Taluit); Finsch, Deut. Ver. zum Schultze der Vogelwelt, 18, 1893, p. 458 (Marshalls); Kuroda, in Momoyama, Birds Micronesia, 1922, p. 38 (Taluit); Hand-list Japanese Birds, rev., 1932, p. 185 (Tinian, Yap, Jaluit).

Geographic range.—Breeds in Iceland, northern Europe and Asia. Winters south to Africa, southern Asia and Philippines; casual to eastern North America. In Micronesia: Mariana Islands—Tinian; Caroline Islands—Yap; Marshall Islands—Jaluit.

Remarks.—The Widgeon may be an occasional winter visitor to Micronesia. The record at Jaluit in the Marshall Islands may be questioned.

Anas clypeata Linnaeus

Shoveller

Anas clypeata Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 124. (Type locality, Coasts of Europe, restricted to southern Sweden.)

Spatula clypeata Hand-list Japanese Birds, rev., 1932, p. 185 (Pagan); Yamashina, Tori, 10, 1940, p. 676 (Pingelap); Hand-list Japanese Birds, 3d ed., 1942, p. 206 (Pagan, Pingelap).

Anas clypeata Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Geographic range.—Breeds in northern Europe, Asia, North America and adjacent islands. Winters to northern Africa, southern Asia, Philippines, Hawaiians, southern United States to Central America. In Micronesia: Mariana Islands—Pagan, Tinian; Caroline Islands—Ponapé, Pingelap.

Specimens examined.—One female from Mariana Islands, USNM—Tinian (Oct. 12).

Remarks.—The Shoveller is known from localities in the Marianas and in the Carolines. In the collections of the American Museum of Natural History there is a female taken by Rollo Beck at Kauehi, Tuamotu Archipelago, on March 6, 1923. A specimen examined from Tinian was taken there by Joe T. Marshall, Jr., at Lake Hogoya on October 12, 1945. Richards obtained two Shovellers (one immature male and one immature female) at Ponapé on December 21, 1947, and January 6, 1948, respectively. He found them in a pond in a bomb crater. This duck appears to be a casual winter visitor to Micronesia and other parts of Oceania.

Aythya fuligula (Linnaeus)

Tufted Duck

Anas fuligula Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 128. (Type locality, Europe, restricted to Sweden.)

Fuligula cristata Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, p. 90 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 40 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 71 (Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 50 (Mariannes, Palaos).

Fuligula fuligula Salvadori, Cat. Birds British Mus., 27, 1895, p. 363 (Pelew); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1. 1901, p. 26 (Micronesia); Safford, Osprey, 1902, p. 70 (Mariannes); *idem,* The Plant World, 7, 1904, p. 268 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 38 (Mariane, Pelew, Yap); *idem,* Avifauna Riu Kiu, 1925, p. 143 (Pelew, Marianne).

Marila fuligula McGregor, Man. Philippine Birds, 1909, p. 199 (Marianne, Pelew).

Nyroca fuligula Phillips, Nat. Hist. Ducks, 3, 1925, p. 234 (Guam); Hand-list Japanese Birds, rev., 1932, p. 185 (Pagan, Saipan, Palau, Yap); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Aytha fuligula Hand-list Japanese Birds, 3d ed., 1942, p. 207 (Pagan, Saipan, Tinian, Guam, Yap, Palau).

Geographic range.—Breeds in Iceland, Europe, northern Asia. Winters in Europe, Africa, Asia, Malaysia, and parts of Oceana. In Micronesia: Mariana Islands—Pagan, Saipan, Tinian, Guam; Palau—exact locality unknown; Caroline Islands—Yap.

Remarks.—The Tufted Duck is a winter migrant to western Micronesia. It has been recorded only a few times and may be an irregular visitor. Flavin observed a duck, which he thought to be of this species, at Guam on January 19, 1946. Marshall (1949: 221) reports that two Tufted Ducks were seen at Lake Hagoi in April 1945.

Aythya valisineria (Wilson)

Canvasback

Anas valisineria Wilson, Amer. Ornith., 8, 1814, p. 103, pl. 70, f. 5. (Type locality, Eastern United States.)

Nyroca vallisneria Reichenow, Ornith. Monatsber., 1901, p. 17 (Jaluit); Schnee, Ornith. Monatsber., 1901, p. 131 (Marshalls); *idem,* Zool. Jahrbücher, 20, 1904, p. 390 (Marschall Inseln).

Nyroca valisineria Phillips, Nat. Hist. Ducks, 3, 1923, p. 124 (Marshall Islands).

Aythya valisineria Hand-list Japanese Birds, 3d ed., 1942, p. 207 (Marshall Islands).

Geographic range.—Breeds in northwestern and northcentral North America. Winters south to Gulf States, Florida and Mexico. In Micronesia: Marshall Islands—Jaluit.

Remarks.—Reichenow (1901:17) and Schnee (1901:131) reported three species of American ducks (*Aythya valisineria, Anas acuta tzitzihoa* and *Anas crecca carolinensis*) in the Marshalls in October, 1899, and May, 1900. These species may be stragglers to eastern Micronesia.

Accipiter soloënsis (Horsfield)

Chinese Goshawk

Falco Soloënsis Horsfield, Trans. Linn. Soc. London, 13, 1821, p. 137. (Type locality, Java.)

Accipiter soloënsis Hand-list Japanese Birds, rev., 1932, p. 182 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 203 (Yap, Rota); Mayr, Birds Southwest Pacific, 1945, p. 302 (Yap).

Geographic range.—Breeds in northern China south to Kwangtung. Winters to Malaysia. In Micronesia: Mariana Islands—Rota; Caroline Islands—Yap.

Remarks.—The Chinese Goshawk is a winter visitor to Micronesia and has been recorded at Rota and Yap. The NAMRU2 party saw several unidentified hawks in Micronesia in 1945. At Mt. Tenjo, Guam, Muennink saw a small hawk, resembling an accipiter, darting at swiftlets on June 8, 1945. At Angaur, the writer saw a small hawk flying through heavy vegetation along the rugged coast line on September 21, 1945. A hawk "*Butio* (?)" was reported at Saipan in 1945 by Moran (1946:262); this hawk may have been *Butastur indicus* (Gmelin). Marshall (1949:221) reports seeing "three kinds of hawks" on Palau in November, 1945. Obviously, further observations and collecting will increase our knowledge of the known number of kinds of hawks which visit Micronesia.

Accipiter virgatus gularis (Temminck and Schlegel)

Asiatic Sparrow Hawk

Astur (Nisus) gularis Temminck and Schlegel, in Siebold, Fauna Japon., Aves, 1845, p. 5, pl. 2. (Type locality, Japan.)

Accipiter nisoides Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 166 (Guam); Hartert, Novit. Zool., 5, 1898, p. 51 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 44 (Guam); Safford, Osprey, 1902, p. 70 (Marianas).

Accipiter gularis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 39 (Guam).

Accipiter virgatus gularis Hand-list Japanese Birds, rev., 1932, p. 182 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 203 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Accipiter virgatus nisoides Bryan, Guam. Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Geographic range.—Breeds in Japan and northern China. Winters south to Philippines and Malaysia. In Micronesia: Mariana Islands—Guam.

Remarks.—Oustalet (1895:166) records a male bird shot by Marche at Guam in October, 1887. Seale (1901:44) records a specimen taken at Guam by Owston's Japanese collectors. These are the only records found for Micronesia, and the hawk may be classed as a casual winter visitor. Strophlet (1946:535) observed "a small light-throated" falcon at Guam on November 7, 1945, which may have been of this species.

Pandion haliaetus melvillensis Mathews

Osprey

Pandion haliaëtus melvillensis Mathews, Australian Avium Rec., 1, 1912, p. 34. (Type locality, Melville Island.)

Pandion leucocephalus Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 49 (Palau).

Pandion haliaetus leucocephalus Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 1 (Pelew).

Pandion haliaëtus cristatus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 40 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 182 (Pelew); Hand-list Japanese Birds, 3d ed., 1942, p. 203 (Palau).

Pandion haliaëtus melvillensis Mayr, Birds Southwest Pacific, 1945, pp. 55, 286 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 46 (Guam, Palau).

Geographic range.—Malaysia, northern Australia, Melanesia. In Micronesia: Mariana Islands—Guam; Palau Islands—Peleliu.

Remarks.—The Osprey was first recorded at Palau by Finsch (1875:49). The author (1948:46) cites records obtained by C. K. Dorsey at Peleliu in 1944 and 1945. Dorsey saw the Osprey on several occasions; the NAMRU2 party did not find the bird while on their stay there in August and September, 1945. B. V. Travis of NAMRU2 saw an Osprey at Agaña Bay, Guam, in December, 1945. He observed the bird to be carrying a fish in its talons. Flavin observed the Osprey at Guam on January 28, 1945, and on December 23, 1945. Mayr (1945a:286) says that the Osprey apparently breeds at Palau. The bird seen in the Marianas may have been *P. h. haliaetus* (Linnaeus), a visitor from Asia, which is known to winter in the Philippines and adjacent areas.

The Osprey is the only resident member of the order Falconiformes, and it is principally a fish eater. The few records of mammal and bird eating hawks in Micronesia indicate that predation on insular vertebrate populations from this source is at a minimum. The absence of this predation may have a pronounced effect on the resident land birds, particularly from the standpoint of the perpetuation of nonadaptive mutations, which might be "weeded out" under what might be considered as normal predatory pressure in continental bird populations.

Falco peregrinus japonensis Gmelin

Peregrine Falcon

Falco japonensis Gmelin, Syst, Nat., 1, pt. 1, 1788, p. 257. (Type locality, Off the coast of Japan.)

Falco peregrinus Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 90 (Mackenzie); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 122 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 8 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 1 (Yap, Pelew); Hand-list Japanese Birds, rev. 1932, p.

182 (Yap, Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 202 (Yap, Palau); Mayr, Birds Southwest Pacific, 1945, p. 302 (Yap, Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 46 (Guam).

?Falco peregrinus calidus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 40 (Yap, Pelew).

Geographic range.—Breeds in northern Asia. Winters to southern Asia, Malaysia and Melanesia. In Micronesia: Mariana Islands—Guam; Palau Islands—exact locality unknown; Caroline Islands—Yap.

Remarks.—The Peregrine Falcon may be classed as a casual winter visitor to Micronesia. It has been recorded by Hartlaub and Finsch at Yap and Palau. A specimen from Yap was taken by Kubary in November, 1870. On November 2, 1945, at Guam as previously recorded (Baker, 1948:46) Irvin O. Buss saw a falcon alight on the superstructure of his ship. He watched it catch and eat a Common Noddy (*Anous stolidus*). As the ship approached the island, the bird flew to the rugged cliffs near Facpi Point. Strophlet (1946:535) saw a large falcon, "presumed to be a Duck Hawk," at Guam on November 16, 1945. Possibly these two observers saw the same bird. In July, 1945, Flavin observed a Peregrine Falcon at Guam. *F. p. fruitii* Momiyama, which is known from the Volcano Islands, may occur in Micronesia.

Megapodius lapérouse senex Hartlaub
Micronesian Megapode

Megapodius senex Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 820. (Type locality, Pelew Islands.)

Megapodius senex Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 7, 118 (Pelew); Gray, Hand-list Birds, 2, 1870, p. 256 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 103 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 29, pl. 5, fig. 2, 3 (Palau); Giebel, Thes. Ornith., 2, 1875, p. 547 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Oustalet, Ann. Sci. Nat., (6), art. 2, 1881, pp. 63, 140, 145, 171, 175 (Pelew); Tristram, Cat. Birds, 1889, p. 30 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 58 (Pelew); Oustalet, Ann. Sci. Nat., Zool., 11, 1891, p. 196 (Peleu); *idem*, Nouv. Arch Mus. Hist. Nat. Paris, (3), 8, 1896, p. 30 (Palaos); Ogilvie-Grant, Hand-book Game-birds, 2, 1897, p. 182 (Pelew); Hartert, Novit. Zool., 5, 1898, p. 62 (Pelew); Bolau, Mitteil, Naturhist. Mus. Hamburg, 1898, p. 69 (Palau); Finsch, Sammlung wissensch. Vorträge, 14 ser., 1900, p. 659 (Palau); Matschie, Journ. f. Ornith., 1901, p. 113 (Palau); Lister, Proc. Zool. Soc. London, 1911, p. 757 (Pelew).

Megapodius laperousii Ogilvie-Grant (part), Cat. Birds British Mus., 22, 1893, p. 460 (Pelew); Takastukasa and Kuroda, Tori, 1, 1915, p. 51 (Pelew); Kuroda, Dobutsu. Zasshi, 27, 1915, p. 390 (Pelew); *idem*, Dobutsu. Zasshi, 28, 1916, p. 69 (Pelew).

Megapodius laperousi Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 39 (Pelew); Safford (part), The Plant World, 7, 1904, p. 265 (Pelew); Uchida, Annot. Zool. Japon., 9, 1918, pp. 486, 487 (Palau).

Megapodius laperousii var. *senex* Dubois, Syn. Avium, 2, 1904, p. 787 (Pelew).

M[egapodius] lapeyrousei Reichenow (part), Die Vögel, 1, 1913, p. 273 (Palauinseln).

Megapodius laperousei senex Kuroda, in Momiyama, Birds Micronesia, 1922, p. 40 (Pelew).

Megapodius lapérouse senex Mathews, Syst. Avium Australasianarum, 1, 1927, p. 14 (Pelew); Takstsukasa, Birds Nippon, vol. 1, pt. 1, 1932, p. 13, pl. 4, 5 (Pelew); Yamashina, Tori, 7, 1932, p. 412 (Ngesebus, Auror, Peliliu); Hand-list Japanese Birds, rev., 1932, p. 198 (Palau); Peters, Check-list Birds World, 2, 1934, p. 6 (Palau); Yamashina, Tori, 10, 1940, p. 679 (Gayangas, Arumidin); Amadon, Amer. Mus. Novit., no. 1175, 1942, p. 9 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 286 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 46 (Garakayo, Peleliu, Ngabad).

Megapodius la pérouse senex Hand-list Japanese Birds, 3d ed., 1942, p. 223 (Babelthuap, Koror, Auror, Ngesebus, Peliliu, Gayangas, Arumidin).

Megapodius laperouse Wharton and Hardcastle, Journ. Parasitology, 32, 1946, p. 294 (Garakayo).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Auror, Kayangel, Garakayo, Ngesebus, Peleliu, Ngabad, Gayangas, Arumidin.

Characters.—Adult: A small megapode with top of head near "mouse gray"; forehead, sides of face and neck, chin, and throat thinly covered with feathers of the same color; mantle and upper breast grayish-black becoming dark olive-brown on wings; lower back, rump and upper tail-coverts dark brown; tail blackish-brown; underparts grayish-brown, lighter on midline of belly; under wings dark brown; exposed skin of head reddish to yellowish-red; bill yellowish, basally blackish; legs yellowish; feet and claws black; iris tan.

Measurements.—Measurements of three adult males: wing, 178, 182, 188; tail, 55, 63; culmen, 22.7, 23.3; tarsus, 55, 56, 57; of seven adult females: wing, 171-189 (182); tail, 46-68 (58); culmen, 25-30 (27); tarsus, 45-60 (55). Takatsukasa (1932:14) lists the following measurements: males—wing, 176-181; tail, 59-67; culmen, 25.5-26.0; tarsus, 58-61; females—wing, 177-187; tail, 62-68; culmen, 24.0-26.0; tarsus, 55-58.

Specimens examined.—Total number, 23 (11 males, 8 females, 4 unsexed), as follows: Palau Islands, USNM—Koror, 1 (Nov. 28)—Garakayo, 5 (Sept. 17, 18, 19)—Peleliu, 2 (Aug. 31, Sept. 1)—Ngabad, 1 (Sept. 11); AMNH—Palau, 16 (Nov., Dec., not dated).

Nesting.—The megapodes do not incubate their eggs, but the female deposits them in a moundlike structure of sand, volcanic ash, and forest litter or some other type of soil in which there is warmth sufficient to hatch the eggs after an extended period (perhaps 40 days or more) without further attention from the parent bird. The young dig out and lead an independent existence. Several megapodes may utilize one nest site, which ordinarily is at a low elevation near a beach or lagoon.

The NAMRU2 party obtained two downy chicks at Gayakayo Island on September 18 and 19, 1945. A female taken on September 1 at Peleliu contained large eggs. Coultas obtained two chicks (one in postnatal molt) in November and December, 1931. Kubary, as quoted by Takatsukasa (1932: 15), says that eggs may be found in the mounds throughout the year at Palau but are found most numerously in the south-east monsoon (April to November). Yamashina (1932a:412) reports on eggs taken in 1932 as folfows: eight eggs from Auror Island on January 15; one egg from Ngesebus Island on January 16; and four eggs from Peleliu Island on January 16. Takatsukasa (1932:15) states that eggs are most numerous in the mounds in the months of May and June. The chicks obtained by NAMRU2 in September were of such a size as to suggest that they too had been laid in June.

Takatsukasa (1932:15) comments, "Whilst Dr. Yaichirō Okada was in the Pelew Group, he found two nests on Kajangel Island, which is an uninhabited island about twelve sea-miles southeast of the island of Malacal. He says that he found two nests, one of which was obsolete and the other was in use.

The first one was oval in shape; the diameter of the largest part was twenty-four feet, and the smallest part was twenty feet, and it had a height of four feet. The second one was fan-shaped, as an obstacle existed at one side of the nest, and its diameter was twelve feet and the height was a little more than four feet, and the native whom he asked to dig out the eggs got three. One of the eggs contained a well-advanced embryo and the others were not so advanced as the first one. This distance from the top of the mound to the spot where the eggs were laid was about two and a half feet, and the natives made a great deal of effort to get these eggs. These nests were found in the bush by the natives." The NAMRU2 party observed a mound on Ngabad Island, a small islet near Peleliu, on September 11. It was much like those described by Takatsukasa, being approximately six feet high and some twelve or fifteen feet across. It was not excavated.

Molt.—Birds taken in August, September and November were molting body feathers. Birds taken in December were molting wing feathers.

Food habits.—Takatsukasa (1932:16) comments, "My collector reports to me that this bird diets on insects and tender shoots which it gets from under the soil by scratching with its large and powerful feet." According to Captain Tetens, as noted by Takatsukasa, the food of the bird consists of insects and berries. Birds taken by the NAMRU2 party had the following food items in their stomachs: adult female—2 cc. seeds, grit; adult female—3 cc. crab parts, grit; adult female—2 cc seeds, sand; male chick—1 cc. ground food, grit; female chick — 1 cc. ground food, grit, in crop 3 cc. small wood roaches (Blattidae).

Parasites.—Wharton and Hardcastle (1946:294) obtained the chigger (Acarina), *Neoschöngastia yeomansi,* from the megapode at Palau. Uchida (1918:486, 487) found the bird lice (Mallophaga), *Goniocotes minor* and *Lipeurus sinuatus,* on megapodes from the Palaus.

Remarks.—The NAMRU2 party arrived at the Palau Islands on August 23, 1945, with little notion that the megapode would be found on the war-torn island of Peleliu. As reported by the author (1946b: 209 and 1948:46) we found birds in small numbers in the relatively undisturbed areas of rough coral covered by jungle and a few birds in the heavy matting of viny and brushy vegetation which was rapidly covering the battlefields. The finding of a higher population on the more isolated and relatively undisturbed offshore islets (Ngabad, Garakayo) by the NAMRU2 party was an observation similar to those of Takatsukasa (1932:15, 16) and Coultas (field notes). Takatsukasa (1932:16) remarks, "Dr. Finsch said that this Megapode frequents nearly all the islands of the Pelew Group . . . but it is very noticeable that this bird has either disappeared, or only very rarely exists in the following islands: Koror, Ngarekobasanga, and especially the main island of Babelthuap." He quotes Otto Finsch as remarking that, "It seems that the bird occasionally moves from one island to another, as the bird is a good flier." Takatsukasa continues, "According to Tetens, this Megapode runs very swiftly among the bushes, and when it is startled it takes to the nearest tree. . . . Captain Wilson says nothing about the Megapode, but Dr. Finsch wrote that Captain Wilson is probably referring to the egg of this bird under 'Wild Fowls,' when he said that the natives of the Palaus do not eat the flesh of the birds, but they go to the woods and bring back the eggs; they do not appreciate the newly laid eggs, but they consider it as a delicacy to swallow the well advanced embryo."

The NAMRU2 party found the birds to prefer rough, coral jungle where there was considerable heavy undergrowth and ground litter. The birds were located by their loud screeches and cackles but were difficult to stalk. It was best to remain quiet and let them approach within shooting distance. Young chicks were extremely active and wild. One of the two chicks taken at Garakayo was obtained by a fortunate shot as the bird was flying rapidly through the brush. The natives use them as food, and I learned of one serviceman who had worked out a technique for trapping the birds. He traded the live birds to the natives for island souvenirs. As Wilson and Takatsukasa note, the natives apparently prefer the eggs to the adults as food, and in normal times of food abundance they probably do not molest the adults but hunt for their eggs. This seems logical, since if a determined trapping program were in operation by the natives, it should not take many decades to eliminate completely the entire population. On four islands visited by the NAMRU2 party in August and September, 1945, I estimated the following populations: Garakayo—20 to 30; Ngabad—5 to 10; Peleliu—10 to 20; Angaur—less than 10.

Megapodius lapérouse lapérouse Gaimard

Micronesian Megapode

Megapodius La Pérouse Gaimard, Bull. Gén. Univ. Annon. Nouv. Sci., 2, 1823, 451. (Type locality, Tinian, Archipel des Mariannes.)

Megapodius La Pérouse Quoy and Gaimard, Voy. "Uranie," Zool., 1824, pp. 127, 693, Atlas, pl. 33 (Tinian); *idem*, Ann. Sci. Nat. Paris, 6, 1825, p. 149 (Tinian)

Megapodius La Pérousii Quoy and Gaimard, Voy. "Uranie," Zool., 1824, p. 127, pl. 33 (Tinian); Wagler, Isis, 1829, p. 735 (Tinian, Guam, Rota); Gray, Cat. Birds Trop. Is. Pacific Oceon, 1859, p. 46 (Tinian); Oustalet, Ann. Sci. Nat., (6), art. 2, 1881, pp. 63, 138, 140, 143, 171, 175, 176, 177 (Tinian); *idem*, Le Nat., 1889, p. 261 (Mariannes); *idem*, Ann. Sci. Nat., Zool., 11, 1891, p. 196 (Tinian, Seypan, Pagon).

Megapodius La Peyrouse Lesson, Man. d'Ornith., 2, 1828, p. 221 (Tinian); *idem*, Compl. de Buffon, 2d ed., 2, Ois., 1838, p. 255 and accompanying plate (Tinian).

Megapodius laperousii Lesson, Traité d'Ornith., 1831, p. 478 (Mariannes); Gray, Hand-list Birds, 2, 1870, p. 256 (Marian); Ogilvie-Grant, Hand-book Game-birds, 2, 1897, p. 183 (Marianne); Dubois, Syn. Avium, 2, 1904, p. 787 (Mariannes); Lister, Proc. Zool. Soc. London, 1911, p. 757 (Marianne).

Megapodius Lapeyrousii Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen).

Megapodius La Peyrousii Reichenbach, Tauben, 1861, p. 5 (Marianen).

Megapodius la-perousi Gray, Proc. Zool. Soc. London, 1864, p. 43 (Guam, Botta, Tinian).

Megapodius laperousi Giebel, Thes. Ornith., 2, 1875, p. 547 (Marianae); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 39 (Marianas); Safford; Osprey, 1902, p. 68 (Tinian); *idem,* The Plant World, 7, 1904, p. 265 (Tinian); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 78 (Rota, Saipan, Pagan, Agrigan); Schnee, Zeitschr, f. Naturwisch., 82, 1912, p. 467 (Marianen); Prowazek, Die deutschen Marianen, 1913, pp. 47, 101 (Marianen); Linsley, Guam, Rec., vol. 12, no. 8, 1935, p. 249 (Rota, Saipan, Pagan, Agrigan).

Megapodius perousei Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 30 (Marianen); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 58 (Guam, Botta, Tinian, Pagon).

Megapodius laperousii Ogilvie-Grant (part), Cat. Birds British Mus., 22, 1893, p. 460 (Marianne).

Megapodius la perousei Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 26 (Saypan, Pagan, Rota, Agrigan, Tinian).

Megapodius laperouse Hartert, Novit. Zool., 5, 1898, p. 61 (Saipan, Tinian, Rota, Guam).

Megapodius laperousei Finsch, Sammlung wissensch. Vorträge, 14 ser., 1900, p. 660 (Marianen); Prowazek, Die deutschen Marianen, 1913, p. 87 (Marianen).

Megapodius lapeyrouse Matschie, Journ. f. Ornith., 1901, p. 113 (Guam, Saipan).

M[egapodius] lapeyrousei Reichenow (part), Die Vögel, 1, 1913, p. 273 (Mariannen).

Megapodius laperousei laperousei Kuroda, in Momiyama, Birds Micronesia, 1922, p. 40 (Guam, Saipan, Rota, Tinian, Pagan, Agrigan).

Megapodius lapérouse lapérouse Mathews, Syst. Avium Australasianarum, 1, 1927, p. 16 (Marianas); Takatsukasa, Birds Nippon, vol. 1, pt. 1, 1932, p. 6, pl. 4, 5 (Marianne); Yamashina, Tori, 7, 1932, p. 411 (Pagan Agrigan); Hand-list Japanese Birds, rev., 1932, p. 198 (Marianas); Peters, Check-list Birds World, 2, 1934, p. 7 (Marianne Islands); Yamashina, Tori, 10, 1940, p. 679 (Assongsong); Amadon, Amer. Mus. Novit., no. 1175, 1942, p. 9 (Asuncion, Saipan, Guam); Mayr, Birds Southwest Pacific, 1945, p. 286 (Marianas).

Megapodius laperousi laperousi Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Megapodius la pérouse la pérouse Hand-list Japanese Birds, 3d ed., 1942, p. 223 (Assongsong, Agrigan, Pagan, Almagan, Saipan, Tinian, Agiguan, Rota, Guam).

Geographic range.—Micronesia: Mariana Islands—Asuncion, Agrihan, Pagan, Almagan, Saipan, Tinian, Agiguan, Rota, Guam. Probably extinct on Saipan, Tinian, Rota, Guam.

Characters.—Adult: Resembles *M. l. senex,* but crown slightly darker gray; back, wing-coverts and scapulars more heavily washed with olivaceous-brown; mantle less slate; underparts paler and more brownish, especially belly. (Note —The specimens examined from the Marianas are old and rather worn in appearance.)

Measurements.—Two males measure: wing 180?, 182?; tail 62, 63; tarsus 55, 55; three females: wing 181?, 181?; tail 55, 59, 62; tarsus 54, 54, 56. Takatsukasa (1932: 10) lists the following measurements: males—wing, 155-169; tail, 54-62; culmen, 22.5-24; tarsus, 51-54; females—wing, 158-170; tail, 56-65; culmen, 23-25; tarsus, 50-55.

Specimens examined.—Total number, 10 (3 males, 4 females, 3 unsexed), as follows: Mariana Islands, AMNH—Guam, 1 (June 6)—Saipan, 6 (1895)—Asuncion, 3 (1904).

Nesting.—Concerning the nest of the Micronesian Megapode in the Marianas, Takatsukasa (1932:10) writes: "The nest is a large mound of sand mixed with grass and is made in the wooded land along the seashore. The mound is over one hundred feet in circumference and a few yards in height, and is built by the united efforts of the male and female, by scratching sand and grass with their large feet. The eggs are laid in this mound and they are hatched by the heat of the sun and that produced by the fermentation of the grass, and they are never hatched by the parent birds. The egg is of a pale brown, but always stained by nesting materials."

Takatsukasa (1932:11) quotes Oustalet as follows: "Specimens collected by Mr. Marche have proved that the breeding season of La Pérouse's Megapode is rather long, like the other species of the same family, it begins to breed in January or February and ends in June. Accordingly, in this period the eggs just laid, the chicks, the young and adult can be seen at one place, but Mr. Marche did not obtain any egg." Hartert (1898:61) records a chick taken on July 17. Yamashina (1932a: 411) records eggs taken in 1931 as follows: two eggs from Pagan, February 17; three eggs from Pagan, May 15; four eggs from Agrihan, June 24. The breeding season for both of the incubator birds, *M. l. senex* and *M. l. lapérouse*, is apparently from about January to August.

Remarks.—The Micronesian Megapode was first taken in the Marianas by the expedition of the Uranie. Bérard, a member of the expedition, obtained the bird at Tinian in December, 1820. Quoy and Gaimard (1824:27), who studied the birds of this expedition, reported that according to native tradition the species was in former times widely distributed in the Marianas and domesticated by the ancient people of the islands, but that in 1819 and 1820 the birds were not numerous on Tinian and not found on Guam and Rota. Marche (in Oustalet, 1896:27) obtained twenty-three birds at Saipan, one from Rota, two from Agrihan, and five from Pagan in 1887, 1888, and 1889; it is apparent that Quoy and Gaimard missed the bird at Rota. Marche was of the opinion that the megapodes were never domesticated and that they would probably not last much longer at Saipan and Rota owing to the incessant hunting for them by the natives. As in the Palaus, the natives apparently prefer the eggs to the adults. The latest collections of these birds in the Marianas were made by the Japanese. Yamashina (1932:411) obtained eggs in 1931 at Pagan and Agrihan, and again in 1940. He (1940:679) reported birds at Assongsong (Asuncion). Takatsukasa (1932:12) says, "A collector, working for Marquis Yamashina and myself, lately procured many specimens in Saipan and Pagan." Linsley (1935:249, 250) in searching for the megapode at Guam found little evidence of the birds. He interviewed people between the ages of forty-five and eighty and only two or three remembered seeing the bird. He said he saw one or two cross the road; but I suspect that they might have been rails (*Rallus owstoni*). Service personnel stationed at various islands in the Marianas during the late war have not reported the birds. The NAMRU2 party found no trace of the bird at Guam or Rota. Joe T. Marshall, Jr. (1949:203), did not find the bird at Saipan, Tinian, or Guam in 1945. Its status on Agiguan is unknown; isolated Japanese troops present on this small island from the time of the American invasion (1944) until the armistice (1945) may have used the birds for food and depleted the population seriously. At present the birds apparently still occur on islands in the northern Marianas. It seems that if these birds are to survive, they must be given some protection.

Evolutionary history.—The genus *Megapodius* consists, according to Peters (1934:1-7), of nine species which are distributed through the islands from the Philippines and Borneo to Australia and Melanesia. These have been redesignated under three specific names by Mayr (1938). Outlying forms occur in the Nicobar Group to the west and in Tonga (Niuafou Island) in the east and in the Palaus and Marianas to the extreme northeast. Lister (1911:757) is of the opinion that the megapodes may have reached these outlying islands by having been transported by the natives, by whom the eggs were highly valued as food. This idea is also maintained by Rutland (1896:29-30) and Christian (1926:260). Possibility and not factual evidence support this hypothesis. From their seeming ancestral stocks, *M. pritchardii* Gray of Niuafou Island and *M. lapérouse* of Micronesia are remarkably distinct which may indicate their early arrival at these islands and subsequent change from their ancestral stocks.

Like *M. pritchardii*, the Micronesian species is smaller than its relatives to the southwest and has short, rather rounded wings, although its feet are heavily built whereas those of *M. pritchardii* are lightly constructed. In comparing these birds with the species of megapode found in the Philippines, Celebes and Melanesia, it seems that both *M. prichardii* and *M. Lapérouse* are closely related to the widespread species, *M. freycinet*, which may have been ancestral to both. The differences between *M. prichardii* and *M. lapérouse* indicate that they represent independent invasions. Nevertheless these megapodes may have had a wider range in Oceania in former times; man may have eliminated the birds from some islands by using their eggs. The eggs are laid in conspicuous mounds which are easily found by man.

M. lapérouse differs from *M. freycinet* of New Guinea and other parts of Melanesia and the Philippines; its small size, short wing and pearl gray head are distinctive characters. It shows greatest resemblance to the subspecies in Celebes (*M. f. gilberti*) in size and to the subspecies in the Moluccas (*M. f. freycinet*) in coloring; possibly *M.*

lapérouse represents stock from one of these regions. Apparently the group as a whole evolved from a center of dispersal in the New Guinea area. Mayr (1942b:167) regarded all the species of *Megapodius* as belonging to one polytypic species, except *M. lapérouse* and *M. pritchardii,* which are allopatric species.

Coturnix chinensis lineata (Scopoli)

Painted Quail

Oriolus lineatus Scopoli, Del. Flor. et Faun. Insubr., fasc. 2, 1786, p. 87. (Type locality, Luzon, *ex* Sonnerat.)

Excalfactoria sinensis Hartert, Novit. Zool., 5, 1898, p. 61 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 37 (Guam); Safford, Osprey, 1902, p. 68 (Guam); *idem*, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, The Plant World, 7, 1904, p. 265 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 78 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Nelson, Proc. 1st Pan-Pacific Sci. Conf., 1921, p. 273 (Guam).

Excalfactoria chinensis lineata Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 176 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 41 (Guam); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 20 (Marianne); Hand-list Japanese Birds, rev., 1932, p. 198 (Guam); Peters, Check-list Birds World, 2, 1934, p. 96 (Guam); Bryan, Guam. Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 223 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 287 (Guam).

Excalfactoria chinensis Strophlet, Auk, 1946, p. 536 (Guam).

Coturnix chinensis lineata Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 47 (Guam).

Geographic range.—Philippines and parts of Malaysia. In Micronesia: Mariana Islands—Guam (introduced).

Characters.—Adult: A small quail with upper parts brown splotched with black and streaked with buff; males with face and throat black surrounded by white line, upper breast blue gray, lower breast, belly and under tail-coverts and tail near "burnt sienna"; females lighter than males, underparts pale brown, mottled with blackish on breast and sides of body; bill dark lead colored, feet yellow.

Measurements.—Three adult males from Guam measure: wing, 66, 67, 67; culmen, 9.2, 10.0, 10.3; tarsus, 18.1, 18.7, 22.6.

Weights.—Two adult males taken by NAMRU2 at Guam weigh 34.5 and 35.5 grams.

Specimens examined.—Total number, 3 males from Mariana Islands, USNM—Guam (Feb. 24, June 13, 28).

Remarks.—Seale (1901:37) writes that the Painted Quail was introduced to Guam from Manila, or the island of Luzon in the Philippine Islands, by Captain Pedro Duarty of the Spanish Army in 1894. It was a successful introduction; the bird is well adapted to the grasslands, open hillsides, and fallow rice paddies. The bird appears to offer no serious competition to native species, because there are few native birds which depend largely on this habitat. The NAMRU2 party obtained specimens at Mt. Santa Rosa and near Agat; others were seen as singles or pairs near Umatac and on Mount

Tenjo. Strophlet (1946:536) observed the birds in the southern part of Guam in 1945. He found them as singles or pairs in the months of September, October and November. Wilfred Crabb reported a covey of seven birds in June, 1945. Two males taken in June had enlarged testes. Seale (1901:37) obtained a nest of seven eggs.

Gallus gallus (Linnaeus)

Red Jungle Fowl

Phasianus Gallus Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 158. (Type locality, "India orientali, Pouli condor etc.," restricted to Pulo Condor, off mouths of the Mekong.)

Phasianus Gallus Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 284 (Ualan = Kusaie).

Gallus bankiva Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 103 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 29 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 298, 353 (Ponapé, Mortlock, Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 59 (Pelew, Caroline, Marianne, Marshall); Oustalet, Nouv. Arch. Mus. Hist. Nat., Paris, (3), 8, 1896, p. 25 (Saypan, Palaos, Marshall); Hartert, Novit. Zool., 5, 1898, p. 61 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1. 1901, p. 38 (Marianas); Safford, Osprey, 1902, p. 70 (Marianas).

Gallus ferrugineus Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 780 (Ponapé); *idem*, Ibis, 1881, p. 114 (Ponapé, Kushai).

Gallus gallus bankiva Kuroda, in Moniyama, Birds Micronesia, 1922, p. 41 (Saipan, Pelew, Ponapé, Marshall).

Gallus gallus Mathews, Syst. Avium Australasianarum, 1, 1927, p. 21 (Micronesia); Cram, Bull. U. S. Nat. Mus., 140, 1927, pp. 238, 328 (Guam); Bequaert, Mushi, 12, 1939, p. 81 (Kusaie); *idem*, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 266 (Kusaie); Mayr, Birds Southwest Pacific, 1945, pp. 57, 286 (Marianas, Carolines, Palaus); Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 294, 310 (Ulithi, Garakayo); Stott, Auk, 1947, p. 525 (Saipan).

Gallus gallus domesticus Hand-list Japanese Birds, rev., 1932, p. 198 (Marianas, Palaus, Carolines, Marshalls).

Gallus gallus micronesiae Hachisuka, Tori, 10, 1939 (1940), p. 600 (Type locality, Truk, also from Pelew, Rota, Yap, Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 222 (Saipan, Rota, Babelthuap, Koror, Yap, Truk, Lukunor, Ponapé, Kusaie, Marshalls).

Gallus gallus gallus Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 47 (Peleliu, Ngabad, Garakayo, Ulithi, Truk).

Geographic range.—Southeastern Asia and Malaysia; introduced into many islands of Oceana. In Micronesia: Mariana Islands—Saipan, Rota; Palau Islands—Kayangel, Babelthuap, Koror, Garakayo, Peleliu, Ngabad, Angaur; Caroline Islands—Ulithi, Yap, Truk, Lukunor, Ponapé, Kusaie; Marshall Islands—exact locality not known.

Specimens examined.—Total number, 3 (1 male, 2 females) as follows: Palau Islands, USNM—Garakayo, 1 (Sept. 19)—Peleliu, 1 (Sept. 13)—Ngabad, 1 (Sept. 11).

Parasites.—Cram (1927:238, 328) found the round worms (Nematoda), *Dispharnyx nasuta* and *Oxyspirura mansoni* in birds from Guam. Bequaert (1939:81 and 1941:266) found the fly (Hippoboscidae) *Ornithoctona plicata*, on fowl from Kusaie. Wharton and Hardcastle (1946:294, 310) obtained the chiggers (Acarina), *Neoschöngastia yeomansi* and *N. ewingi* from fowl at Ulithi and Garakayo.

Remarks.—The Red Jungle Fowl has been introduced in Micronesia, as it has been in other parts of Oceania. It is found on many of the islands of Micronesia, including the volcanic islands and the atolls. The NAMRU2 party did not find feral fowl at Guam but found the wary birds at Ulithi and in the Palaus. The birds at Ulithi were small and of a mixed breed. At Palau some fine examples of typical jungle fowl were observed. Coultas obtained similar specimens at Ponapé and Kusaie. The natives have apparently allowed these birds to go wild, but catch them for food. These wild stocks may represent the earlier "liberations" while domestic fowl kept by natives at present appear to include several other breeds probably obtained from Europeans.

The committee that prepared the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:222) points out that although many ornithologists believe the Red Jungle Fowl to be introduced in Micronesia and other parts of Oceania, it is their opinion (based on a series of more than 100 skins before them) that the population in Micronesia is racially distinct. They further comment, as did Hachisuka (1939b:600), that one may find hybrids between these birds and the domestic fowl belonging to the native peoples; this is commonly seen on the more populated islands such as Koror and Saipan. I have no doubt that these skins show distinct features; nevertheless, I am reluctant to recognize these by subspecific name, since the birds may be a mixture of domestic strains introduced by man at different times after the jungle fowl was first brought by the early Micronesians. It seems that the production of hybrids between the feral and domestic fowl, which we find there today, may have been going on ever since the European colonists arrived with their fancy breeds of chickens.

Phasianus colchicus Linnaeus

Ring-necked Pheasant

Phasianus colchicus Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 158. (Type locality, Africa, Asia = Rion.)

Phasianus torquatus Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 47 (Guam).

Geographic range.—Eastern China and northeastern Tonkin. Widely introduced into North America, Europe, and New Zealand. In Micronesia: Mariana Islands—Guam (introduced).

Remarks.—On July 4, 1945, fifty-seven Ring-necked Pheasants (sixteen cocks and forty-one hens) were liberated at Guam by personnel of the U. S. Navy. The birds were eleven weeks old when released, having been brought by plane from the hatcheries of the State Division of Game and Fish in California. Twenty-four birds were liberated at the site of CincPoa headquarters near Mt. Tenjo.

Thirty-three were placed near the FEA dairy farm, approximately one and one-fourth miles west of Price School. One month after release the birds were present at the liberation sites, although there were reports that some had drifted as far away as a mile or more. The birds were not banded. This liberation has been reported on by Quinn (1946:32-33) and by the author (1946b:211 and 1948:47). In using the name *P. colchicus*, I am following Delacour (in McAtee, 1945: 8) and the twenty-third supplement to the American Ornithologists' Union check-list of North American birds (Auk, 65, 1948: 440).

Rallus philippensis pelewensis (Mayr)

Banded Rail

Hypotaenidia philippensis pelewensis Mayr, Amer. Mus. Novit., no. 609, 1933, p. 3. (Type locality, Palau Islands.)

Rallus philippensis Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 37 (Palau); *idem*, Proc. Zool. Soc. London, 1877, p. 587 (Palau); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 59 (Pelew); Finsch, Deut. Ver. zum Schulze der Vogelwelt, 18, 1893, p. 459, Palau).

Rallus pectoralis Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 117, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 107 (Pelew).

Eulabeornis forsteri Gray (part), Hand-list Birds, 3, 1871, p. 57 (Pelew).

Hypotaenidia philippensis Salvadori (part), Ornith. Papuasia, 3, 1882, p. 261 (Pelew); Sharpe (part), Cat. Birds British Mus., 23, 1894, p. 39 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 42 (Pelew).

Eulabeornis philippensis? Mathews, Birds Australia, 1, 1910-1911, p. 199 (Pelew).

Hypotaenidia philippinensis philippensis Hand-list Japanese Birds, rev., 1932, p. 196 (Palau).

Rallus philippensis pelewensis Hand-list Japanese Birds, 3d ed., 1942, p. 220 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 287 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 48 (Peleliu, Garakayo).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Arakabesan, Garakayo, Peleliu, Angaur.

Characters.—Adult: A large, slender rail with black crown streaked with brown; superciliary stripe ashy-gray, lighter toward bill; eye stripe brown becoming more rufous behind eye and on nape; chin ashy-gray; throat near "mouse gray" tinged with olive especially toward breast; breast, belly and sides barred with black and white, with a broad "tawny" band on breast; posterior part of belly and vent buffy with some barring; under tail-coverts barred with black, white, and buff; mantle black with feathers subterminally barred with white; back, scapulars, inner wing-coverts, and rump black with white spotting and feathers edged with olive brown; outer wing-coverts, secondaries, and primaries barred with black and rufous with some buffy-white on outer webs; under wing barred black and white with some brownish markings; tail with both bars and blotches of black, white, and buffy-rufous; maxilla horn-colored; mandible yellowish; feet light brown.

R. p. pelewensis resembles *R. p. philippensis* Linnaeus of the Philippines, but is darker with nape more rufous-brown; upper parts marked with narrower and darker edgings to feathers and with pronounced whitish spotting.

Resembles *R. p. chandleri* (Mathews) of Celebes, but with wing shorter; more pronounced band on breast; bird darker above and below; rump and upper tail-coverts less spotted.

Measurements.—Specimens in the collection of the United States National Museum measure as follows: four adult males—wing, 130-134 (132); tail, 59-63 (61); full culmen, 30-37 (34); tarsus, 38-45 (43); four adult females—wing, 125-130 (127); tail, 54-61 (58); full culmen, 29-35 (32); tarsus, 38-42 (40). Mayr (1933c:4) lists the following measurements: twelve adult males—127-143 (134.6); tail, 54-65 (60); exposed bill, 25-28 (27.7); tarsus, 41-46 (43.5); three adult females—wing, 129, 136, 136; tail, 56, 57, 58; exposed bill, 23, 24, 25; tarsus, 40, 41, 42.

Specimens examined.—Total number, 27 (18 males, 9 females), as follows: Palau Islands, USNM—Garakayo, 4 (Sept. 18, 19, 20)—Peleliu, 4 (Aug. 27, 28, Sept. 16)—Arakabesan, 1 (Nov. 26); AMNH—exact locality not given, 18 (Oct., Nov., Dec.).

Nesting.—The condition of the gonads in specimens obtained indicates that the breeding season is principally in the fall and winter. Of adult rails taken by Coultas in October, November and December, 1931, 6 of 12 males and 3 or 4 females had enlarged gonads. In September, 1945, the NAMRU2 party obtained two adult males with swollen testes. Marshall (1949:219) recorded breeding in September and November.

Food habits.—Stomachs of rails obtained by the NAMRU2 party contained insects, seeds and small mollusks. Coultas (field notes) notes that the birds eat snails, roots and other vegetable matter.

Remarks.—*Rallus philippensis* is geographically widespread, being found from Tasmania and Australia north to Malaysia and the Philippines west to Cocos Keeling Island east to Melanesia and western Polynesia and north to the Palau Islands. The species is divisible into several subspecies. The one in the Palaus, although distinctive, does not appear to have undergone a higher degree of differentiation (even though isolated as a small population) than any of the subspecies in Malaysia or Melanesia. Perhaps the form on Palau as well as the relatively undifferentiated *Poliolimnas cinereus* are rather recent invaders of Micronesia, as compared with *Rallus owstoni* and *Aphanolimnas monasa*.

The Banded Rail is less secretive in habits than *Rallus owstoni* of Guam, and neither was seen to fly. At Angaur, Peleliu and Garakayo, the NAMRU2 party found the rail in areas of swamp and marsh as well as in the rocky uplands; it probably prefers the former habitats. Several rails were observed and shot in open places, but they probably prefer to remain in dense cover. Coultas found the birds at taro patches and swamps. I watched a rail feeding along an open trail on Garakayo. The bird was eating small mollusks and other items which were in the open area. Being a true skulker, the bird would make a quick dash to the feeding place, remain only a few moments, hurriedly return to the protective cover, and then repeat the process. The best means that I found of obtaining these birds was using traps baited with peanut butter and oatmeal. The trape had to be visited frequently or the ants made short work of the captured birds.

Rallus owstoni (Rothschild)

Guam Rail

Hypotaenidia owstoni Rothschild, Novit. Zool., 2, 1895, p. 481. (Type locality, Guam.)

?Rallus philippinus Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 51 (Marian or Ladrone Is.).

Rallus pectoralis Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 157 (Guam).

Eulabeornis forsteri Gray (part), Hand-list Birds, 3, 1871, p. 57 (Marian).

Hypotaenidia philippensis Pelzeln, Ibis, 1873, p. 41 (Marianne Isl.); Salvadori (part), Ornith. Papuasia, 3, 1882, p. 261 (Marianas); Sharpe (part), Cat. Birds British Mus., 23, 1894, p. 39 (Guam).

Rallus philippinus Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 59 (Guam).

Hypotaenidia owstoni Hartert, Novit. Zool., 5, 1898, p. 62 (Guam); Safford, Osprey, 1902, pp. 41, 67 (Guam); *idem*, The Plant World, 7, 1904, p. 265 (Guam); Dubois, Syn. Avium, 2, 1904, p. 961 (Mariannes); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 42 (Guam); Hartert, Novit. Zool., 34, 1927, p. 22 (Guam); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 84 (Guam); Hand-list Japanese Birds, rev., 1932, p. 196 (Guam).

Hypotaenidia marchei Oustalet, Nouv. Arch. Mus. Hist. Nat., Paris, (3), 8, 1896, p. 32 (Type locality, Guam).

Hypotaenidia oustini Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 30 (Guam).

Rallus owstoni Peters, Check-list Birds World, 2, 1934, p. 166 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 220 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 287 (Guam); *idem*, Audubon Mag., 47, 1945, p. 279 (Guam); Watson, Raven, 17, 1946, p. 41 (Guam); Strophlet, Auk, 1946, p. 536 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no 15, 1948, p. 48 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam.

Characters.—Adult: A large rail with head, neck, and eye stripe near "mummy brown" with feathers on sides of neck tipped with "russet"; superciliary stripe to back of neck, throat and upper breast near "mouse gray"; mantle, back, scapulars, and some upper wing-coverts dark olive-brown becoming browner on rump and upper tail-coverts; wings dark with brownish spots and barred with white; lower breast, abdomen, under tail-coverts, and tail blackish with white barrings; bill lead colored; feet dark brown; tibia brown; iris red.

Measurements.—Four adult males measure: wing, 120-123 (121); tail, 46-54 (50); full culmen, 37-43 (41); tarsus, 47-51 (50); six adult females measure: wing, 108-118 (112); tail, 38-46 (42); full culmen, 36-39 (37); tarsus, 43-47 (45).

Weights.—The NAMRU2 party obtained specimens with the following weights: two adult males 256, 257; four females 147, 153, 210, 252 grams.

Specimens examined.—Total number, 13 (5 males, 6 females, 2 unsexed), from Mariana Islands, USNM—Guam (Jan. 29, May 8, June 19, 20, 23, 28, 30, July 14, 19, 23, Sept. 8).

Nesting.—A nest was found by McElroy of the NAMRU2 party at Guam on October 24, 1945, in dense grass on a hillside near Mount Santa Rosa. The nest contained three eggs, which the author (1948:48) describes as "white with a pinkish cast and a scattering of small spots of colors near 'russet' and near 'pear blue' which are concentrated at the large ends. They measure 37.5 by 29.1, 39.1 by 28.0, and 40.7 by 29.0." Downey, black chicks were found on April 1, May 16, and May 26. M. Dale Arvey found a chick on August 2, 1946, near Tumon Bay. A parent bird with young ones was seen near Merizo on October 2. A male taken on January 26 had enlarged gonads. Seale (1901: 30) obtained a black chick in June or July. On the basis of the above observations it seems that the nesting season extends from spring to fall, although Marshall (1949:219) assumes that this rail breeds the year around.

Remarks.—The Guam Rail was first reported by Quoy and Gaimard who called it "Ralê tiklin," but was not described as new until 1895 by Rothschild. It appears to be equally at home in upland grassy areas and in jungle areas. The species was not seen frequently by the NAMRU2 party, although birds were occasionally observed crossing the roads. Few birds were shot; most of the specimens were taken in rat traps, which may be the most satisfactory method of obtaining them. Coultas took his specimens with the aid of a dog. On June 19, 1945, a small patch of woodland was being removed by a bulldozer. Four rails, which were hiding in this thicket, were surrounded and three were captured by hand. These birds tried to escape over the cleared ground by running with wings flapping but made no effort to fly. I am inclined to believe, as the natives do,that these birds are virtually incapable of actual flight.

The Guam Rail usually appeared to be a quiet bird, but at Tarague Point on July 12, 1945, I heard its loud penetrating cry; it was a series of rapid screeches. At the same time rapid movement made considerable noise in the undercover. The bird making the call suddenly appeared, either rapidly chasing, or being chased by, another rail. The birds had abandoned their usual skulking habits and had little concern for the observer. I took this to be breeding behavior, comparable to that of some of the North American rails during the mating period.

The Guam Rail is probably not in serious danger of extermination. It is utilized by the natives as food; they capture the bird, using dogs and trail snares. Its skulking habits and ability to inhabit most types of cover on the island should insure its existence for a long time to come.

Evolutionary history.—*Rallus owstoni* is endemic to the island of Guam with no closely related forms nearby. It is one of the several rails found in the Pacific which live on isolated islands. In comparison with other species in the region, it has some resemblance to both *R. torquatus* and *R. philippensis*. In general, the underparts of *R. owstoni* resemble those of the *R. philippensis* group, although the upper parts resemble somewhat those of *R. torquatus*. Certain specimens of *R. owstoni* have a slight indication of a pale pectoral band.

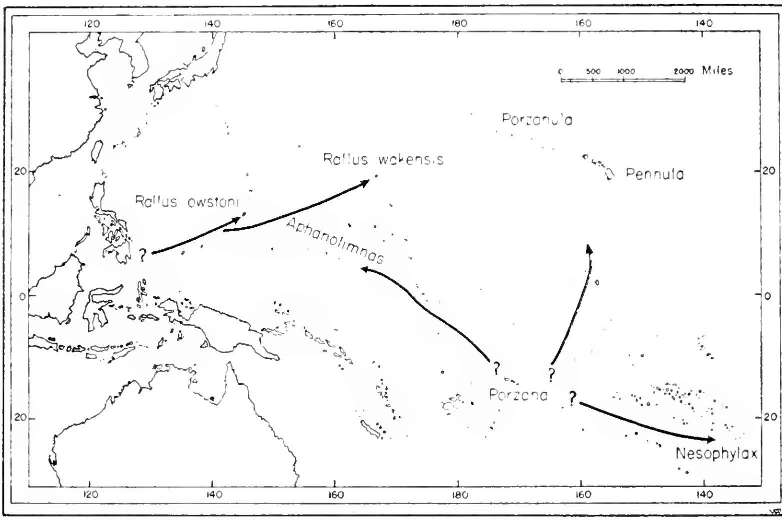

FIG. 9. Routes of dispersal of rails in the Pacific area.

The bill is shorter and heavier than that of *R. torquatus*, possibly more like that of *R. philippensis*. The short rounded wing is a distinctive character. The bird came from an ancestral stock possibly resembling *R. philippensis* and probably originated in the Philippine or Papuan areas. It may have invaded Micronesia at an early date and may have had a wider distribution in the islands in former times. Perhaps this same invasion resulted in the establishment of *R. wakensis* (Rothschild) at Wake. The supposed route of colonization is shown in figure 9.

Rallina fasciata (Raffles)

Malay Banded Crake

Rallus fasciatus Raffles, Trans. Linn. Soc. London, 13, pt. 2, 1822, p. 328. (Type locality, Benkulen, western Sumatra.)

Rallina fasciata Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 7, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 37 (Palau); Salvadori, Ornith. Papuasia, 3, 1882, p. 264 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 60 (Pelew); Sharpe, Cat. Birds British Mus., 23, 1894, p. 75 (Pelew); Finsch, Deut. Ver. zum Schulze der

Vogelwelt, 18, 1893, p. 459 (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 41 (Pelew); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 88 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 196 (Palau); Peters, Check-list Birds World, 2, 1934, p. 171 (Pelew); Hand-list Japanese Birds, 3d ed., 1942, p. 221 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 287 (Palau); Delacour, Birds Malaysia, 1947, p. 77 (Palau).

Geographic range.—Burma east and south to Malaysia and the Philippines. In Micronesia: Palau—exact locality unknown.

Remarks.—The Malay Banded Crake is known in the Palau Islands from birds taken by captains Tetens, Heinsohn, and Peters and by Kubary according to Finsch (1875: 37). It has not been taken by later collectors. Two unsexed and undated skins are in the collection of the American Museum of Natural History; these are from the Kubary collection.

Rallina eurizonoides eurizonoides (Lafresnaye)

Philippine Banded Crake

Gallinula eurizonoïdes Lafresnaye, Rev. Zool., 1845, p. 368. (No locality; the type agrees with specimens from the Philippine Islands.)

Rallina eurizonoides eurizonoides Hand-list Japanese Birds, rev. 1932, p. 196 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 221 (Koror).

Rallina eurizonoides subsp. Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Philippine Islands. In Micronesia: Palau Islands—Koror.

Remarks.—This crake is apparently a straggler to western Micronesia from the Philippine area.

Aphanolimnas monasa (Kittlitz)

Kusaie Black Rail

Rallus monasa Kittlitz, Denks. Riese russ. Amer. Micron. und Kamchat., 2, 1858, p. 30. (Type locality, Kushai.)

Rallus tabuensis? Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 286 (Ualan).

Ortygometra tabuensis Finsch, Journ. f. Ornith., 1880, pp. 297, 307 (Kusehai); *idem*, Ibis, 1881, pp. 106, 109 (Kushai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 60 (Ualan).

Kittlitzia monasa Hartlaub, Abhandl. nat. Ver. Bremen, 12, 1892, p. 391 (Kusehai); Finsch, Mitth. Ornith. Ver. Wien, 17, 1893, p. 1 (Kusehai).

Aphanolimnas monasa Sharpe, Bull. British Ornith. Club, 1892, p. 20 (Kuschai); Finsch, Deut. Ver. zum Schulze der Vogelwelt, 18, 1893, p. 457, pl. 4 (Ualan); Wiglesworth, Ibis, 1893, p. 214 (Kushai); Sharpe, Cat Birds British Museum, 23, 1894, p. 115 (Kushai); Matschie, Journ. f. Ornith., 1901, pp. 110, 113 (Ualan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 93 (Caroline Islands); Hand-list Japanese Birds, rev., 1932, p. 197 (Kusaie); Peters, Check-list Birds World, 2, 1934, p. 189 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 221 (Kusaie); Mayr, Birds Southwest Pacific, 1945, p. 288 (Kusaie); *idem*, Audubon Mag., 47, 1945, p. 280 (Kusaie).

Porzana tabuensis Sharpe, Cat. Birds British Mus., 23, 1894, p. 111 (Kushai).

Pennula monasa Dubois, Syn. Avium, 2, 1904, p. 969 (Kusehai).

Porzana tabuensis tabuensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 42 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie (probably extinct).

Characters.—Sharpe (1894:115) gives the following description: "Adult. Black with a bluish-grey reflexion; quills and tail somewhat browner; inner wing-coverts brownish with white spotting, outer edge of first primary dull brownish, chin and middle of the throat somewhat paler; bill blackish (Hartlaub.)."

Remarks.—Two specimens of this rail are known. The two were taken by Kittlitz on his visit to Kusaie in December and January of 1827-'28. Coultas made a search for the bird in 1931 and failed to obtain it; he suggested that the high population of introduced rodents may have been a factor contributing to its extinction. The bird is considered to be extinct by the authors of the Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:221).

The two known specimens are in Leningrad, and Mayr sent examples of *Porzana tabuensis* there for comparison. The following is a translation of the letter received by Mayr from Boris Stegmann dated at Leningrad, December 7, 1937.

"I have compared the two specimens of *Porzana tabuensis* with our specimens of *Aphanolimnas monasa*. The difference is in my opinion of generic value. *Aphanolimnas* is distinctly larger and more robust. The bill is not only absolutely but also relatively longer. Its length (measured from the forehead) reaches to the end of the second phalanx of the middle toe while it not nearly reaches it in *tabuensis*. The proportions of feet and toes are the same in both, but the feet are distinctly heavier in *Aphanolimnas*. The wings are relatively shorter in *Aphanolimnas* and the wing feathers are very soft. The wing is also much more rounded, the first primary is about 21 mm. shorter than the wing tip. The tail consists of very soft loose feathers which resemble only distantly true tail feathers. It is therefore questionable whether this bird was at all able to fly.

"The coloration is in general dull black, brownish black on head and wings, chin and upper throat are dark slate colored lighter in the middle. The under wing and tail-coverts are marked with scattered white spots (querflecken). The first primary has an irregular whitish brown margin on the outer web. The bill is dark and the feet yellowish."

Possibly this rail represents an ancient colonization of Kusaie from an ancestral stock of *Porzana* in Polynesia. Mayr. (1941b:203) is also of this opinion, and if this is true there is no close relationship between *Aphanolimnas* and the rails at Guam and Wake, *Rallus owstoni* and *R. wakensis*, which are probably colonizers from the Philippines or the Papuan area. Mayr (1943:46) remarks further that the Hawaiian flightless rail (*Peuula*) is of doubtful taxonomic position, but may be related to the "*Aphanolimnas*-Porzanoidea-*Nesophylax* stock," although there is no evidence that *Pennula* is not related to *Rallus*. Supposed colonization routes are shown in figure 9.

Poliolimnas cinereus micronesiae Hachisuka

White-browed Rail

Poliolimnas cinereus micronesiae Hachisuka, Bull. British Ornith. Club, 59, 1939, p. 151. (Type locality, Yap.)

Ortygometra quadristrigata Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, pp. 90, 107 (Pelew, Uap).

Ortygometra cinerea Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 38 (Palau, Yap); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); Salvadori, Ornith. Papuasia, 3, 1882, p. 273 (Yap, Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 61 (Pelew, Yap, Ruk); Finsch, Deut. Ver. zum Schulze der Vogelwelt, 18, 1893, p. 459 (Palau).

Ortygometra cinerea = quadristrigata Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk).

Poliolimnas cinereus Sharpe, Cat. Birds British Mus., 23, 1894, p. 130 (Pelew, Yap, Ruk); Hartert, Novit. Zool., 5, 1898, p. 64 (Guam); *idem,* Novit. Zool., 7, 1900, p. 9 (Ruk); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 30 (Guam); Safford, Osprey, 1902, p. 67 (Mariannes); *idem,* The Plant World, 7, 1904, p. 265 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 42 (Guam, Pelew, Yap, Ruk).

Porzana cinerea Stresemann, Novit. Zool., 21, 1914, p. 54 (Guam, Truk).

Porzana cinerea ocularis Hartert, Novit. Zool., 31, 1924, p. 264 (Ruk, Guam).

Poliolimnas cinereus collingwoodi Mathews, Syst. Avium Australasianarum, 1, 1927, p. 95 (Pelew, Marianne, Carolines); Hand-list Japanese Birds, rev., 1932, p. 197 (Guam, Koror, Yap, Truk); Hachisuka, Birds Philippine Islands, 1, 1932, p. 236 (Marianne, Pelew, Caroline); Peters, Check-list Birds World, 2, 1934, p. 198 (Marianne, Caroline, Pelew); Bryan, Guam Rev., vol. 13, no. 2, 1936, p. 15 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 288 (Guam, Palau, Yap, Truk, Bikini); Delacour and Mayr, Birds Philippines, 1946, p. 64 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 48 (Ulithi?, Truk).

Porzana cinerea collingwoodi Rensch, Mitt. Zool., 1931, p. 468 (Marianne, Karolinen, Palau).

Poliolimnas cinereus micronesiae Yamashina, Tori, 10, 1940, p. 679 (Bikini); Hand-list Japanese Birds, 3d ed., 1942, p. 221 (Guam, Babelthuap, Koror, Yap, Truk, Bikini).

Geographic range.—Micronesia: Mariana Islands—Guam; Palau Islands—Koror, Babelthuap; Caroline Islands—Yap, Ulithi?, Truk; Marshall Iislands—Bikini.

Characters.—Adult: A slightly built, long-legged rail with forehead and anterior crown light gray with darker, slate-colored feather shafts; color more olive-brown on occiput and nape; eyestripe dark slate extending to occiput; superciliary from bill to eye, and stripe below eye, white; chin and throat ashy-white; sides of head, neck and breast ashy-gray, lighter on breast and whitish on abdomen; sides of abdomen ashy-brown becoming more buffy on tibia and under tail-coverts; mantle olive-colored becoming lighter and more brownish on back, rump, and scapulars; wing-coverts similar in color but feathers with broad dark brown shaft-marks; wings brown, first primary with whitish outer web; under wing gray with some lighter streaks; tail dark brown, lighter on edges; bill horn colored, tan below; feet brown; iris vermillion.

Immature: Resembels adult, but head more rufous, upper parts marked with buffy rufous; eye stripe light rufous-brown; underparts tinged with rufous.

P. c. micronesiae differs from *P. c. collingwoodi* Mathews of the Philippines by having more pale gray and less olivaceous-brown on the nape and shoulder; darker on the under tail-coverts; and having a shorter culmen. *P. c. brevipes* (Ingram) of the Volcano Islands differs from *P. c. micronesiae* by being paler on upper parts, particularly back and wing-coverts and more washed with buff below; by having a shorter, thicker culmen; and by having a shorter tarsus.

Measurements.—Measurements are shown in table 17.

TABLE 17. MEASUREMENTS OF THREE SUBSPECIES OF *Poliolimnas cinereus*

LOCALITY	No.	Wing	Tail	Culmen	Tarsus
Poliolimnas cinereus collingwoodi					
Philippines, Talaut, Celebes	13	98 92–108	....	22.5 21.0-24.0	38.0 35.0-41.0
Poliolimnas cinereus micronesiae					
Guam..................	10	95 91–102	51 50–53	21.0 20.0-22.5	37.0 34.5-39.0
Palau..................	10	93 89–95	51 51–53	21.0 20.0-23.	37.0 34.0-38.0
Truk..................	5	95 94–97	51 51–53	21.0 20.5-22.	36.0 35.0-37.0
Poliolimnas cinereus brevipes					
S. Dionisio Island..	8	96 94–97	....	19.0 17.0 20.0	30.0 29.0-32.0

Specimens examined.—Total number, 25 (11 males, 13 females, 1 unsexed), as follows: Mariana Islands, AMNH—Guam, 10 (July 13, Aug. 1, 5, 7, 13, 19, 23, 31); Palau Islands, AMNH—exact locality not given, 10 (Nov. 11, 13, 15, 23, 25); Caroline Islands, AMNH—Truk, 5 (June 3, 8, 16, 17, 18).

Nesting.—Hartert (1900:9) describes two nests found on swampy ground. One contained three eggs, the other four eggs. He writes, "The eggs are pale buff, or cream-colour, speckled all over with brownish rufous, more frequently near the broad end. In some eggs, these spots are larger, in others minute, and there are often some, underlying pale purplish gray spots."

Remarks.—Superficially, the White-browned Rail of Micronesia is distinct from its near relative, *P. c. collingwoodi*, but the differences are not so well marked as they are between insular populations of other species of rails. It is probably a comparatively recent addition to the Micronesian avifauna, and its pattern of distribution may represent an early stage in the development of endemism in contrast to the pattern of later stages in the development of insular forms shown by the isolated rails, *Rallus owstoni* and *Aphanolimnas mo-*

nasa. The fact that *Poliolimnas cinereus* is found only on widely separated islands in Micronesia does not necessarily mean that it has become "extinct" on the intervening islands, but that it may be partial to the larger, "high" islands, or that it is actually present but remains to be discovered on these intervening islands when more intensive field investigations are made. Hachisuka (1939a:151), in naming the Micronesian form, comments that it has a shorter bill than *P. c. collingwoodi* of the Philippines and Celebes, and that it is intermediate between this subspecies and *P. c. brevipes* of the Volcano Island to the north. Within these three subspecies there are trends toward a shorter culmen and shorter tarsus and, less markedly, toward a shorter wing. From the evidence at hand, it can be concluded that *Poliolimnas* first colonized Micronesia probably from the Philippine area (or Papuan area) through the Palaus and Carolines, to the Marianas and north to the Volcano Islands. Further, this has probably been a relatively recent invasion, although the subspecies in the Volcano Islands shows marked change in length of tarsus and culmen. This extension of range to the islands north of the Marianas is unusual and resembles somewhat the distribution of *Nycticorax caledonicus* in the same general area.

The Micronesian White-browed Rail is a shy bird with the typical skulking habits of most rails. The NAMRU2 party did not find the bird at Guam, although reports were obtained that it was present in the marsh and swamp areas. Coultas (field notes) tells of observing the rail at Palau at a fresh water lake on Babelthuap, where it was difficult to obtain and apparently rare. Seale (1901:30) obtained a female specimen at Guam from native boys who snared it in a sweet potato patch near the Agaña River. This bird, taken in June or July, had eggs ready for laying. McElroy of the NAMRU2 party observed rails at Truk in brackish swamps, where he found them to be fairly common. A male which was taken in December had enlarged gonads. At Asor in the Ulithi Atoll, the NAMRU2 party learned that a small rail (possibly of this species) was found at taro patches in the early days of occupation, but that it was apparently eliminated by clearing operations. The taking of a bird at Bikini, as reported by Yamashina (1940:679), is further evidence that these birds may subsist on coral atolls as well as on the high volcanic islands; possibly the bird of the Marshalls may have been derived from the south rather than from the west. Unlike *Rallus owstoni*, this bird is apparently restricted to swampy areas, and may be eliminated from its habitat by drainage or clearing by man. It may always persist, however, in the taro patches maintained by the natives.

Gallinula chloropus subsp. near **orientalis** Horsfield

Gallinule

Gallinula orientalis Horsfield, Trans. Linn. Soc. London, 13, 1821, p. 195. (Type locality, Java.)

Gallinula chloropus indicus Hand-list Japanese Birds, rev., 1932, p. 197 (Babelthuap); Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 266 (Pelew, Coror).

Gallinula chloropus indica Hand-list Japanese Birds, 3d ed., 1942, p. 221 (Babelthuap).

Gallinula chloropus subsp. Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 49 (Peleliu, Angaur).

Geographic range.—Malaysia from southern Malay Peninsula to Celebes. In Micronesia: Palau Islands—Babelthuap, Koror, Peleliu, Angaur.

Characters.—Adult: Resembles *G. c. indica* Blyth, *G. c. lozanoi* Lletget and *G. c. guami* Hartert, but smaller and paler; upper wing-coverts less olivaceous-brown and more slate-colored; back, rump, and scapulars less richly washed with olivaceous-brown. Resembles *G. c. orientalis* from Java in size, but much paler.

Measurements.—An unsexed adult bird from Angaur measures: wing, 150; bill from rictes, 27.1; bill from nostril, 13.4; tarsus, 46.

Specimens examined.—Total number, 3 (2 males, 1 unsexed) from Palau Islands, USNM —Angaur (Sept. 21).

Remarks.—Owing to the lack of sufficient material, I am unable to determine the exact status of the resident gallinule in the Palau Islands. On the basis of a single, unsexed adult and two immatures there is not very much that can be said. The adult is smaller and paler than *G. c. indica, G. c. lozonoi,* and *G. c. guami.* It resembles specimens of the subspecies *G. c. orientalis* in size but is also paler than the skins of this race which I have examined. It seems closest to this latter subspecies to which I tentatively refer it. If it is closest to this subspecies, it probably reached Palau from the Celebean region, rather than from the Philippines or some other route. Whether specimens taken by the Japanese at Babelthuap and Koror are *G. c. indica* is questionable, unless the skins were from migrants which may visit Palau from the west or northwest. The Hand-list of Japanese Birds (Hachisuka *et al.*, 1942:177) records *G. c. indica* from the Bonin Islands.

The three Gallinules were taken by the NAMRU2 party at fresh and brackish water swamps at Angaur on September 21, 1945. Several Gallinules were seen in the area and several were observed also at Peleliu Island. One of the immatures was just growing its wing feathers, indicating that the birds must breed in the Palau Islands.

Gallinula chloropus guami Hartert

Gallinule

Gallinula chloropus guami Hartert, Novit. Zool., 24, 1917, p. 268. Type locality, Guam).

Fulica chloropus Quoy and Gaimard, Voy. "Uranie," Zool., 1824, p. 703 (Guam); Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan).

Gallinula galeata var. *sandwichensis* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 34 (Saypan, Tinian, Guam).

Gallinula chloropus Hartert, Novit. Zool., 5, 1898, p. 62 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 31 (Guam); Safford, Osprey, 1902, p. 67 (Marianas); *idem*, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, The Plant World, 7, 1904, p. 265 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 101 (Marianen); Cox, Island of Guam, 1917, p. 21 (Guam); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 177 (Guam); Strophlet, Auk, 63, 1946, p. 536 (Guam).

Gallinula chloropus guami Hartert, Vögel pal. Fauna, 15, 1921, p. 1843 (Guam); Kuroda, Avifauna Riu Kiu, 1925, p. 199 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 43 (Guam, Tinian, Saipan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 99 (Mariana Islands); Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 226 (Pagan); Hand-list Japanese Birds, rev., 1932, p. 197 (Guam, Tinian, Saipan, Pagan); Hachisuka, Birds Philippine Islands, 1, 1932, p. 241 (Guam); Peters, Check-list Birds World, 2, 1934, p. 204 (Marianne Islands); Bryan, Guam. Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 222 (Guam, Tinian, Saipan, Pagan); Mayr, Birds Southwest Pacific, 1945, p. 288 (Marianas); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 92 (Tinian); Stott, Auk, 1947, p. 525 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 49 (Guam, Tinian, Saipan).

Geographic range.—Micronesia: Mariana Islands—Pagan, Saipan, Tinian, Guam.

Characters.—Adult: Head and neck sooty black; upper back dark, bluish slate-gray; lower back and wing-coverts brownish; tail blackish-brown; wings dark brown, outer edge of first primary white; breast and upper abdomen dark slate-gray, feathers on sides of breast with longitudinal white streak; under wing dark with white edges; lower abdomen grayish with white-tipped feathers; vent black; under tail-coverts white; bill and frontal shield red, tip of bill yellowish; legs and feet olive-green.

Adult female: Resembles adult male but usually with smaller frontal shield.

Immature: Resembles adult, but forehead mottled white and brown, with sides of head less distinctly speckled with brown; crown, neck and upper back dusky brown; back, scapulars and upper tail-coverts olivaceous-brown; chin and throat whitish; breast feathers pearly-gray tipped with white; abdomen white; sides gray, washed with buff. Older birds are darker above and more brownish-gray below; frontal shield small.

G. c. guami resembles *G. c. indica,* but upper wing-coverts darker and near "olivaceous black"; back, rump and scapulars darker and less olivaceous brown, although not so dark as in *G. c. orientalis.* From *G. c. lozanoi, G. c. guami* differs in: slightly darker upper wing-coverts; richer olivaceous-brown on back, scapulars and rump; thinner culmen with possibly less yellow coloring on tip. *G. c. guami* resembles *G. c. sandvicensis* Streets of the Hawaiian Islands, but has less olive wash on the feathers and a smaller frontal shield.

Measurements.—Measurements of *Gallinula chloropus* are presented in table 18. In general, females are smaller than males.

Table 18. Measurements of *Gallinula chloropus*

Subspecies	No.	Wing	Bill from rictus	Bill from nostril	Tarsus
G. c. indica	15	164 158–173	27 24–29	14.4 13.1-18.1	48 44–50
G. c. orientalis	3	152 146–152	27 26–29	13.8 13.1-14.4	45 44–46
G. c. lozanoi	11	164 153–170	27 24–29	14.5 13.1-15.2	50 45–57
G. c. guami	11	164 156–171	27 24–28	14.7 13.1-16.2	49 47–56
G. c. sandvicensis	2	150–158	27	13.4	52–56

Weights.—From Guam an adult male weighed 291 grams and an adult female 256 (Baker, 1948:49).

Specimens examined.—Total number, 42 (16 males, 22 females, 4 unsexed), as follows: Mariana Islands, USNM—Guam, 5 (Feb. 24, May, June 5, 7, 18—Tinian, 3 (Oct. 12, 18)—Saipan, 3 (Sept. 28, 30); AMNH—Guam, 25 (Feb. 21, April 6, July 13, 28, 30, Aug. 1, 3, 6, 7, 13, 19, 23, 30, 31, Sept. 3, 17, Dec. 11—Tinian, 5 (June 11, Sept. 12, 13, 14).

Nesting.—Hartert (1898:63) reports nests of the Gallinule at Guam in grass and on swampy ground in December and March. A male with enlarged gonads was taken by the NAMRU2 party at Guam on June 7. Marshall (1949:219) is of the opinion that this bird breeds all year.

Food habits.—Seale (1901:31) found grass, insects, and larvae in stomachs obtained at Guam.

Remarks.—The subspecies *G. c. indica, G. c. lozanoi, G. c. guami,* and *G. c. sandvicensis* bear a close resemblance to one another in size and color. *G. c. guami* and *G. c. lozanoi* resemble each other so closely that it would be difficult to separate unlabeled specimens of the two subspecies. *G. c. orientalis* differs from all of the gallinules in smaller size and darker color. Study of these forms indicates that the Gallinule has colonized the Marianas from Asia probably by way of Japan and the Bonin and Volcano islands. The Hawaiian subspecies is probably of American origin, as pointed out by Mayr (1943:46), and is not a close relative of the Mariana subspecies. The fact that these insular subspecies have not undergone much differentiation does not necessarily mean that they are recent arrivals, but probably is a reflection of the lack of plasticity of the species; as a whole the species does not exhibit anywhere a great amount of geographic variaton. A thorough study of all insular populations of this species (including specimens from the Azores, Seychelles, Réunion, Mauritus, and the Greater and Lesser Antilles) might reveal the effect of isolation on the species in general. Its ability to become established on isolated islands is apparent, although it is indeed peculiar that the species has not reached the Caroline Islands.

The Gallinule in the Marianas is restricted to fresh water lakes, marshes and swamps on the islands of Guam, Tinian, Saipan and Pagan. Coultas (field notes), on visiting the island of Tinian in 1931, comments that the bird is rare and found at only one lake on the island. Downs (1946:92) noted the species in 1945, and Joe T. Marshall Jr. obtained three specimens at Lake Hagoya in October of the same year. Gleise (1945:220) estimated the population of Gallinules on Tinian in 1945 at 70 individuals. Stott (1947:525) reports that the birds were abundant at Lake Susupe, Saipan, in 1945. Seale (1901:31) found the Gallinule to be abundant at Guam in marshes and taro patches. In 1945, the NAMRU2 party found fairly large populations of the Gallinule in fresh water marshes and fallow rice paddies at Guam. The greatest concentration of birds appeared to be in the Agaña Swamp and along the Ylig River. They seldom ventured out into open water but preferred weedy edges into which they could suddenly dart when disturbed. It was interesting to note such wary behavior, for an observer would think that after the bird had been in an environment virtually devoid of birds of prey (except for an occasional migrant) for a number of generations, it would have lost such behaviorisms as a result of the absence of the selective processes involved in predation.

Porphyrio porphyrio pelewensis Hartlaub and Finsch

Purple Swamphen

Porphyrio melanotus Temm. var. *pelewensis* Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 107. (Type locality, Pelew Islands.)

Porphyrio melanotus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 117, 118 (Pelew); Gray, Hand-list Birds, 3, 1871, p. 64 (Pelew).

Porphyrio melanotus pelewensis Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 61 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 70 (Palau); Dubois, Syn. Avium, 2, 1904, p. 976 (Pelew); Mathews, Birds Australia, 1, 1911, p. 241 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 43 (Pelew); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 100 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 197 (Palau); Hachisuka, Birds Philippines, 1, 1932, p. 245 (Pelew).

Porphyrio pelewensis Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 39 (Palau); Salvadori, Atti Accad. Sci. Torino, 14, 1879, p. 1169 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Finsch, Deut. Ver. zum Schulze der Vogelwelt, 18, 1893, p. 459 (Palau); Sharpe, Cat. Birds British Mus., 23, 1894, p. 206 (Pelew); Nehrkorn, Nat. Eiers., 1899, p. 205 (Palau-Inseln); Matschie, Journ. f. Ornith., 1901, p. 113 (Palau); Reichenow, Die Vögel, 1, 1913, p. 216 (Palau-inseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 51 (Pelew).

Porphyrio cyanocephalus Elliot, Stray Feathers, 7 1878, pp. 10, 13 (Palau).

Porphyrio poliocephalus pelewensis Peters, Check-list Birds World, 2, 1934, p. 208 (Pelew); Hand-list Japanese Birds, 3d ed., 1942, p. 222 (Koror).

Porphyrio porphyrio pelewensis Mayr, Birds Southwest Pacific, 1945, p. 288 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 49 (Angaur).

Geographic range.—Micronesia: Palau Islands—Koror, Angaur.

Characters.—Adult: A large, purplish-blue, marsh bird with crown and sides of head dusky-black; wing-coverts purplish-blue; rest of upper parts dark, washed with olivaceous-brown; outer webs of primaries and secondaries tinged with purplish-blue; chin, axillaries and under wing-coverts dusky; under tail-coverts whitish; rest of underparts purplish-blue, blacker on abdomen.

Porphyrio p. pelewensis resembles *P. p. palliatus* Bruggemann of Celebes and *P. p. melanopterus* Bonaparte of the Moluccas and New Guinea but upper parts paler and slightly less glossy; lesser and primary wing-coverts more purplsh-blue and less greenish-blue; outer webs of primaries and secondaries lighter purplish-blue; underparts less blue with patch on throat and breast paler blue with less green (patch present on only one specimen from the Palaus).

Measurements.—Measurements of one male: wing, 227; tail, 81; culmen and shield, 62.5; tarsus, 77; of three females: wing, 212, 218, 227; tail, 77, 81, 86; culmen and shield, 57, 61, 64; tarsus, 75, 75, 77.

Specimens examined.—Total number, 6 (1 male, 3 females, 2 unsexed), as follows: Palau Islands, USNM—Angaur, 1 chick (Sept. 21) AMNH—exact locality not given, 5 (Nov. 13, 19, Dec. 17-19, undated).

Nesting.—A black, downy chick was captured on September 21, 1945, at the edge of a fresh-water lake on Angaur by Davidson of the NAMRU2 party (Baker, 1948:49). Two females taken by Coultas in December had enlarged gonads.

Remarks.—The Purple Swamphen in the Palaus stands out as one of the more distinctive subspecies of *P. porphyrio*. It also marks the most northeastern extension of the range of this species. The subspecies in the Palaus shows affinities to that found to the south and southwest and probably reached Micronesia via the Papuan area, Celebes or the Moluccas rather than from the Philippines. It is interesting that this bird, as well as several other species, has been able to establish itself at the Palau Islands, but has not extended its range farther into other islands of Micronesia. Perhaps, the bird is now in an early stage in its island occupation.

The Purple Swamphen is probably not abundant in the Palaus. It is a large and conspicuous bird, and its restriction to swamps and areas around lakes may allow native hunters to obtain it rather easily, particularly by snares or by organized drives. Coultas (field notes) obtained specimens in taro swamps; he saw only 4 individuals and remarks that the birds utter harsh cries at night. The NAMRU2 party flushed an adult from lake side vegetation at Angaur on September 21, 1945. This bird was not taken, but a downy young was obtained in the area the same day.

Fulica atra atra Linnaeus

Common Coot

Fulica atra Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 152. (Type locality, Europe, restricted to Sweden.)

Fulica atra Hartert, Novit. Zool., 5, 1898, pp. 64, 69 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 32 (Guam); Safford, Osprey, 1902, p. 70 (Marianas); *idem,* The Plant World, 7, 1904, p. 268 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 43 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam).

Fulica atra atra Hartert, Vögel pal. Fauna, 15, 1921, p. 1852 (Guam); Hand-list Japanese Birds, rev., 1932, p. 197 (Tinian, Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 222, (Tinian, Guam); Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Geographic range.—Breeds in Europe, northern Africa, and Asia. Winters south to Africa, Malaysia, southern Asia. In Micronesia: Mariana Islands—Tinian, Guam.

Remarks.—The Common Coot is a straggler to Micronesia in winter. It has been recorded from Guam and Tinian. An unsexed specimen in the collections of the American Museum of Natural History was taken at Guam in the fall of 1896 by one of Owston's collectors.

Squatarola squatarola (Linnaeus)

Black-bellied Plover

Tringa Squatarola Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 149. (Type locality, Europe, restricted to Sweden.)

Charadrius squatarola Hartert, Novit. Zool., 5, 1898, p. 66 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 35 (Micronesia); Safford, Osprey, 1902, p. 67 (Marianas).

Squatarola squatarola Hartert, Novit. Zool., 7, 1900, p. 9 (Ruk); Safford, The Plant World, 7, 1904, p. 266 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 22 (Guam); Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 72 (Ruk); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 15 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 216 (Saipan, Truk); Mayr, Birds Southwest Pacific, 1945, p. 36 (Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 50 (Guam).

Squatarola helvetica Takatsukasa and Kuroda, Tori, 1, 1915, p. 61 (Marianas, Ruk).

Squatarola squatarola hypomelaena Kuroda, in Momiyama, Birds Micronesia, 1922, p. 43 (Ruk, Saipan); Hand-list Japanese Birds, rev., 1932, p. 193 (Saipan, Truk).

Geographic range.—Breeds in arctic regions of Holarctica. Winters in Southern Hemisphere. In Micronesia: Mariana Islands—Guam, Saipan; Caroline Islands—Truk; Marshall Islands—Eniwetok.

Specimens examined.—One female from Mariana Islands. USNM—Guam (Aug. 27).

Remarks.—The Black-bellied Plover is an uncommon visitor to Micronesia. One bird was obtained by Markley of the NAMRU2 party at Guam on August 27, 1945; Flavin recorded five of these birds from November, 1944, to January, 1946. Bryan and Greenway (1944:109) record this species as an occasional visitor to the

Hawaiian Islands. Gleise and Genelly (1945:221) observed the Black-bellied Plover at Eniwetok in 1945.

Pluvialis dominica fulva (Gmelin)

Pacific Golden Plover

Charadrius fulvus Gmelin, Syst. Nat., 1, pt. 2, 1789. p. 687. (Type locality, Tahiti.)

Charadrius pluvialis Kittlitz, Obser. Zool., in Lutké., Voy. "Le Séniavine," 3, 1836, pp. 287, 299, 304 (Ualan, Longounor, Guahan); *idem,* Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, pp. 32, 55 (Ualan).

Charadrius virginianus Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen, Carolinen).

Charadrius longipes? Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 47 (Ladrone or Marian Islands, Oualan).

Pluvialis fulvus Schlegel, Mus. Pays-Bas, 6, no. 29, 1865, p. 52 (Micronesie).

Charadrius fulvus Finsch and Hartlaub, Fauna Central-polynesiens, 1867, p. 196 (Marianen, Ualan); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 117, 118 (Pelews); Finsch and Hartlaub, Journ. f. Ornith., 1870, p. 139 (Pelew); Finsch, Journ. f. Ornith., 1872, p. 52 (Pelew, Carolinen); Hartlaub and Finsch, Proc. Zool. Soc, London, 1872, pp. 89, 104 (Pelew, Mackenzie, Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 31 (Palau); *idem,* Journ. Mus. Godeffroy, 12, 1876, pp. 18, 38 (Ponapé); *idem.* Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem,* Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem,* Journ. f. Ornith., 1880, pp. 293, 305 (Ponapé, Kuschai); *idem,* Ibis, 1880, pp. 220, 331, 332 (Taluit); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 353 (Ponapé, Ruk); Finsch, Ibis, 1881, pp. 105, 106, 109, 113, 115 (Kushai, Ponapé); Salvadori, Ornith. Papuasia, 3, 1882, p. 395 (Carolines, Pelews, Marianas); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 55 (Jaluit, Milli, Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 63 (Marshall Islands, Ualan, Luganor, Ponapé, Ruk, Uap, Pelew, Marianne); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 46 (Guam, Hogoleu, Marshalls, Palaos); Hartert, Novit. Zool. 5, 1898, p. 66 (Guam); *idem,* Novit. Zool., 7, 1900, p. 9 (Ruk); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 36 (Micronesia); Schnee, Ornith. Monatsber., 1901, p. 132 (Marshalls); Safford, Osprey, 1902, p. 68 (Marianas); *idem,* The Plant World, 7, 1904, p. 266 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 389 (Marsehall-Inseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 51 (Ponapé).

Charadrius dominicus fulvus Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 22 (Guam).

Charadrius dominicus Sharpe, Cat. Birds British Mus., 24, 1896, p. 195 (Micronesia).

Pluvialis dominicus fulvus Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 89 (Kuschai, Pelew, Ruk, Marianas, Mackenzie, Ponapé); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 177 (Uala, Arhno, Rongelab); Kuroda, in Momiyama, Birds Micronesia,1922, p. 44 (Guam, Angaur, Ualan, Luganor, Ponapé, Ruk, Yap, Arhno); Hand-list Japanese Birds, 3d ed., 1942, p. 216 (Saipan, Tinian, Guam, Babelthuap, Koror, Peliliu, Angaur, Yap, Ulithi, Truk, Lukunor, Ponapé, Kusaie, Mille, Arhno, Majuro, Likieb).

Pluvialis apricarius fulvus Hand-list Japanese Birds, rev., 1932, p. 193 (Saipan, Tinian, Babelthuap, Koror, Pelilieu, Angaur, Yap, Uluthi, Truk, Lukunor, Ponapé, Kusaie, Mille, Arhno, Majuro, Likieb).

Pluvialis dominica fulva Peters, Check-list Birds World, 2, 1934, p. 244 (Oceania); Bryan, Guam, Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 3 (Saipan, Guam, Palau, Ponapé, Kusaie, Ruk, Tarawa); Mayr, Birds Southwest Pacific, 1945, p. 39 (Oceania); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 93 (Tinian); Strophlet, Auk, 1946, p. 536 (Guam); Borror, Auk, 1947, p. 417 (Agrihan); Stott, Auk, 1947, p. 525 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 50 (Guam, Rota, Peleliu, Garakayo, Ulithi, Truk).

Pluvialis dominica Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 306, 310, 313, 316, 318 (Ulithi, Guam); Wharton, Ecol. Monogr., 16, 1946, pp. 174, 175 (Guam).

Geographic range.—Breeds from Siberia to western Alaska. Winters from India east to Oceania; stragglers occur west to Africa and east to Pacific coast of North America. In Micronesia: Mariana Islands—Guam, Rota, Tinian, Saipan, Agrihan, Asuncion; Palau Islands—Angaur, Peleliu, Ngabad, Garakayo, Koror, Babelthaup; Caroline Islands—Yap, Ulithi, Truk, Lukunor, Ponapé, Kusaie; Marshall Islands—Mille, Arhno, Rongelab, Majuro, Likieb, Bikini.

Specimens examined.—Total number, 69 (39 males, 26 females, 4 unsexed), as follows: Mariana Islands, USNM—Guam, 17 (July 8, 19, 24, Aug. 31, Sept. 4, 17, 19, 26, Oct. 5, 8, 23, 24)—Rota, 5 (Oct. 20, 25); AMNH—Guam, 6 (Mar. 7, 8, 27, Aug. 15)—Saipan, 1 (Sept. 8)—Asuncion, 2 (Feb. 16); Palau Islands, USNM—Peleliu, 9 (Sept. 6-20)—Garakayo, 1 (Sept. 20); AMNH—exact locality not given, 7 (Oct. 13, Nov. 13, 15; Caroline Islands, USNM—Ulithi, 4 (Aug. 16, 21); AMNH—Kusaie, 9 (Mar. 10-30)—Ponapé, 2 (Dec. 15)—Truk, 3 (Feb. 6); Marshall Islands, USNM—Bikini, 3 (Mar. 4, 7, May 3).

Parasites.—Wharton (1946:174, 175) records the following chiggers (Acarina) from *Pluvialis* taken by the NAMRU2 party at Guam: *Acariscus pluvius, A. anous, Neoschöngastia carveri,* and *N. namrui;* and at Ulithi: *N. pauensis* and *N. ewingi.*

Weights.—Birds taken at Guam and Rota weighed as follows: seven males, 107-125 (117); four females, 109-120 (114).

Remarks.—The Pacific Golden Plover is one of the most abundant migratory shore birds to visit Micronesia. So characteristic of Micronesia is this species that almost all ornithologists who have made observations in the area have recorded it. Finsch observed the plover in the Carolines and Marshalls. Coultas made notes on, and collected specimens of, it in the Marianas, Carolines, and Palaus. The Hand-list of Japanese Birds (Hachisuka *et al.,* 1942:216) lists *Pluvialis* from 17 islands in Micronesia.

Stickney (1943:3, 4) discusses the migrations of the Pacific Golden Plover through Oceania, using as a basis for her remarks the data from the extensive collections made by the Whitney South Sea Expedition. She states that the northward migration begins in March from the southern islands (New Zealand and southern Australia). At Guam in 1945, the writer observed flocks of plover beginning on February 11. Birds were seen in small groups in March and April. In the latter month most of the birds seen were in nuptial plumage. For the year 1945, the latest spring record at Guam was April 28. In the same year, Gleise (1945:220) observed his last spring record at Tinian "between April 26 and 27." In 1946, Morrison obtained plover in nuptial plumage at Bikini on May 3.

In an effort to obtain dates when shore birds appeared at Guam, field parties of NAMRU2 made observations at several beaches in late spring, summer, and early fall, as is shown in table 8. Pacific Golden Plovers in post-nuptial molt were first observed and collected on July 8. Following this date, small flocks and later large flocks were more numerous; by September 29, plover were abundant. Similar findings were obtained at Ulithi (see table 9) and in the Palau Islands (see table 10) in August and September. The birds collected by the NAMRU2 party at Guam, Ulithi, Peleliu, and Garakayo in July, August, September, and early October were in postnuptial molt. Birds taken at Rota on October 20 and 26 were in winter plumage. Downs (1946:93) observed plover in small flocks at Tinian in 1945, beginning after September 5. Borror (1947:417) saw two birds at Agrihan on August 10, 1945.

The flocks of plover seen by the NAMRU2 party varied in size from three to 30 birds, the average being less than ten. Coultas (field notes) noted "large flocks" at the Palaus from October to December, 1931. Although plover was often found on the same beach as other birds, the NAMRU2 observers rarely saw plover together with other shore birds. However, on air strips *Pluvialis* occasionally occurred with small numbers of *Arenaria*, *Heteroscelus* spp., and *Numenius phaeopus*. *Pluvialis* and *N. phaeopus* were the only shore birds found to use open grassy flats and other inland areas at Guam and Peleliu in 1945.

Stickney (1943) records *Pluvialis* in late spring and summer from Polynesia, indicating these to be birds remaining in the winter range during the breeding season. The NAMRU2 party observed no Pacific Golden Plovers at Guam which might be regarded as non-migrants, but other species of shore birds were found which might be considered as such. The lingering of individuals in the winter range is not unusual among migratory birds, and as Stickney points out, most of the non-migrants retain their winter dress or assume an incomplete breeding plumage.

Charadrius hiaticula semipalmatus Bonaparte

Semipalmated Plover

Charadrius semipalmatus Bonaparte, Journ. Acad. Nat. Sci. Phila., 5, 1825, p. 98. New name for *Tringa hiaticula* Ord. not *Charadrius hiaticula* Linnaeus, in Wilson's Amer. Ornith., Ord. repr., 7, 1824, p. 65. (Type locality, Coast of New Jersey.)

Charadrius hiaticula Finsch, Ibis, 1880, p. 331 (Taluit); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Taluit or Bonham); Schnee, Zool. Jahrbücher, 20, 1904, p. 389 (Marschall-Inseln); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 45 (Taluit).

Geographic range.—Breeds from Arctic America south to coastal Canada. Winters from southern United States to South America. In Micronesia: Marshall Islands—Jaluit.

Remarks.—Finsch (1880d:331) reported this bird (sight record) at Jaluit in the Marshall Islands. Other than this observation, there is no history of the species in Micronesia.

Chardrius dubius curonicus Gmelin

Ring-necked Plover

Charadrius curonicus Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 692. (Type locality, Kurland.)

Charadrius dubius curonicus Hand-list Japanese Birds, rev., 1932, p. 194 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 217 (Yap); Mayr, Birds Southwest Pacific, 1945, p. 37 (Micronesia).

Geographic range.—Breeds in northern Europe and Asia. Winters from Africa east to Malaysia and Melanesia. In Micronesia: Caroline Islands—Yap.

Remarks.—The Ring-necked Plover has been recorded at Yap by the Japanese collectors. Mayr (1945a:37) remarks that the bird is an occasional migrant through Micronesia. Gleise and Genelly (1945:221) observed four "Papuan" Ring-necked Plovers at Eniwetok in 1945. Apparently no specimen was obtained.

Charadrius alexandrinus nihonensis Deignan

Kentish Plover

Charadrius alexandrinus nihonensis Deignan, Journ. Washington Acad. Sci., vol. 31, 1941, p. 106. (Type locality, Aomori, Hondo.)

Charadrius cantianus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew); *idem,* Proc. Zool. Soc. London, p. 89 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 31 (Palau).

Aegialitis cantianus Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Pelew); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Pelew).

Aegialitis alexandrinus dealbatus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 45 (Pelew).

Charadrius alexandrinus dealbatus Hand-list Japanese Birds, rev., 1932, p. 194 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 217 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 37 (Palau).

Geographic range.—Breeds in Japan and possibly on adjacent parts of the Asiatic mainland. Winters south to Malaya. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—The Kentish Plover is known from a single record obtained by Semper in the Palau Islands. It is tentatively assigned to *C. a. nihonensis,* which breeds directly north of the Palau Islands on Japan. *C. a. dealbatus* (Swinhoe) breeds more to the west on the Asiatic mainland and adjacent islands south of Japan. Additional specimens are needed before the subspecific status of migrants to Micronesia can be accurately determined.

Chardrius mongolus stegmanni Stresemann

Mongolian Dotterel

Charadrius mongolus stegmanni Stresemann, Ornith. Monatsb., 48, 1940, p. 55. New name for *Charadrius mongolus littoralis* Stegmann, 1937, preoccupied. (Type locality, Berhing Island.)

Charadrius sanguineus Lesson, Man. d'Ornith., 2, 1828, p. 330 (No type locality = Mariana Islands, *ex* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p.

48); *idem,* Traité d'Ornith., 1831, p. 544 (no locality = Mariana Islands); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen).

Charadrius monoglicus Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 48 (Guam, Jaluit, Palaos, Carolines); Hartert, Novit. Zool., 5, 1898, p. 66 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 36 (Guam); Safford, Osprey, 1902, p. 68 (Guam).

Aegialitis mongolus Hartert, Novit. Zool., 7, 1900, p. 9 (Ruk).

Aegialis mongola Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam).

Aegialites mongola Cox, Island of Guam, 1917, p. 22 (Guam).

Ochthodromus mongolicus Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Marianas, Ruk).

Charadrius mongolus Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 132 (Ruk); Mayr, Birds Southwest Pacific, 1945, p. 38 (Micronesia).

Charadrius mongolus mongolus Hartert, Vögel pal. Fauna, 11-12, 1920, p. 1543 (Marianen, Karolinen); Hand-list Japanese Birds, rev., 1932, p. 194 (Guam, Truk, Iuripik, Kusaie, Jaluit, Majuro); Peters, Check-list Birds World, 2, 1934, p. 253 (Carolines, Marianas); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 50 (Guam, Peleliu, Ulithi).

Cirrepidesmus mongolus mongolus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 44 (Guam, Ruk).

Charadrius mongolus stegmanni Hand-list Japanese Birds, 3d ed., 1942, p. 217 (Guam, Peliliu, Truk, Iuripik, Kusaie, Jaluit, Majuro).

Geographic range.—Breeds in northeastern Siberia and Bering Sea area. Winters south to eastern Malaysia, Melanesia, and Australia. In Micronesia: Mariana Islands—Guam; Palau Islands—Angaur, Peleliu; Caroline Islands—Ulithi, Truk, Iuripik, Kusaie; Marshall Islands—Jaluit, Majuro.

Specimens examined.—Total number, 10 (4 males, 5 females, 1 unsexed), as follows: Mariana Islands, USNM—Guam, 2 (June 7, Sept. 1); AMNH—Guam, 3 (Aug. 15, 18, Nov. 30); Palau Islands, USNM—Peleliu, 3 (Sept. 7-12); Caroline Islands, USNM—Ulithi, 1 (Aug. 22); AMNH—Truk, 1 (Feb. 8).

Remarks.—According to Oustalet (1896:48), Lesson used two specimens of this species, which were collected in the Marianas by the expedition in the "Uranie," as types for his *Charadrius sanguineus.*

The Mongolian Dotterel is a regular visitor to western Micronesia. It is recorded also from the Marshall Islands, which it probably reaches from the westward by way of the Carolines, since the species has not been recorded in the Hawaiian Islands.

A bird taken by the writer at Guam on June 7, 1945, was in winter plumage and probably nonmigratory. The species was recorded also at Guam in September. At Peleliu in September, 1945, the Mongolian Dotterel was seen frequently on tidal flats by the NAMRU2 party. On September 8 there was a flock of approximately fifty birds, in company with *Charadrius leschenaultii,* at Akarakoro Point. In August at Ulithi, birds were on the beaches in company with *Crocethia alba.* At Angaur on September 21, 1945, the species was with other shore birds in small groups at fresh water ponds.

I am tentatively referring all specimens examined to *C. m. steg-*

manni although at this writing (1948) I am inclined to the opinion that a critical reexamination of the referred specimens might reveal one or a few individuals of the subspecies *C. m. mongolus* Pallas.

Charadrius leschenaultii Lesson

Large Sand Dotterel

Charadrius Leschenaultii Lesson, Dict. Sci. Nat., ed. Levrault, 42, 1826, p. 36. (Type locality, Pondichery, India.)

Charadrius griseus Lesson, Traité d'Ornith., 1831,. p. 544 (Oulan).

Charadrius geoffroyi Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, p. 89 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 31 (Palau).

Aegialitis geoffroyi Salvadori, Ornith. Papuasia, 3, 1882, p. 299 (Ualan, Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Pelew, Ualan).

Ochthodromus geoffroyi Sharpe, Cat. Birds British Mus., 24, 1896, p. 217 (Pelew, Ualan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Pelew).

Pagoa leschenaultii Kuroda, in Momiyama, Birds Micronesia, 1922, p. 44 (Pelew, Kusiae, Yap).

Charadrius leschenaultii leschenaultii Hand-list Japanese Birds, rev., 1932, p. 193 (Yap, Kusaie, Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 216 (Yap, Kusaie, Palau).

Charadrius leschenaultii Mayr, Birds Southwest Pacific, 1945, p. 38 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 51 (Peleliu).

Geographic range.—Breeds in Asia south to Persia. Winters from Malaysia east to Australia and Melanesia. In Micronesia: Palau Islands—Peleliu; Caroline Islands—Yap, Kusaie.

Specimens examined.—Total number, 9 (2 males and 7 females), as follows: Palau Islands, USNM—Peleliu, 7 (Sept. 6-12); AMNH—exact locality not given, 2 (Nov. 21, 25).

Remarks.—The Large Sand Dotterel is a regular visitor to the Palau Islands. It has been recorded also at Yap and Kusaie in the Carolines, where it may be considered as an uncommon visitor.

At Peleliu, the species was seen on several occasions in September, 1945, by the NAMRU2 party. The birds were found on tidal flats in company with *Charadrius mongolus stegmanni* in flocks of 10 to 30 individuals.

Numenius phaeopus variegatus (Scopoli)

Whimbrel

Tantalus variegatus Scopoli, Del. Flor. et Faun. Insubr., fasc. 2, 1786, p. 92. (Type locality, Luzon, *ex.* Sonnerat.)

Scolopax phaeopus Lesson, Traité d'Ornith., 1831, p. 566 (Marianas).

Numenius phaeopus Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 287, 304 (Ualan, Guahan), Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 129 (Ualan); Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew, Matelotas); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Uap, Pelews); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 35 (Palau); *idem*, Journ. f Ornith., 1880, pp. 294, 307 (Ponapé, Kuschai); *idem*, Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem*, Ibis, 1881, pp. 107, 109, 115 (Kushai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 299, 353 (Ponapé, Mortlock, Ruk); Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 308, 316, 318, 320 (Ulithi, Guam); Wharton, Ecol. Monogr., 16, 1946, pp. 174, 175 (Guam).

Numenius tenuirostris Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 55 (Marianas, Ualan).

Numenius uropygialis Gray, Hand-list Birds, 3, 1871, p. 43 (Pelew).

Numenius variegatus Salvadori, Ornith. Papuasia, 3, 1882, p. 332 (Pelew, Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 66 (Marianne, Pelew, Matalotas, Luganor, Ruk, Ponapé, Ualan); Sharpe, Cat. Birds British Mus., 24, 1896, p. 361 (Micronesia); Safford, The Plant World, 7, 1904, p. 266 (Guam).

Numenius phaeopus variegatus Oustalet, Nouv. Arch. Mus. Hist. Nat Paris, (3), 8, 1896, p. 39 (Mariannes, Palaos, Carolines, Jaluit); Hartert, Novit. Zool., 5, 1898, p. 65 (Guam); *idem*, Novit. Zool., 7, 1900, p. 8 (Ruk); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 34 (Guam); Safford, Osprey, 1902, p. 67 (Marianas); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Marianas, Carolines, Pelews); Cox, Island of Guam, 1917, p. 21 (Guam); Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1649 (Guam); Hand-list Japanese Birds, rev., 1932, p. 192 (Marianas, Carolines, Palaus, Marshalls); Peters, Check-list Birds World, 2, 1934, p. 261 (Caroline, Marianne, Pelew); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Guam, Koror, Babelthuap, Ngulu, Yap, Uluthi, Iuripik, Truk, Lukunor, Ponapé, Kusaie, Jaluit, Wotze); Mayr, Birds Southwest Pacific, 1945, p. 39 (Micronesia); Strophlet, Auk, 1946, p. 537 (Guam); Stott, Auk, 1947, p. 525 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 51 (Guam, Angaur, Peleliu, Ulithi).

Phaeopus phaeopus variegatus Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 178 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 45 (Palaus, Carolines, Marians).

Geographic range.—Breeds in northeastern Asia. Winters from Malaysia east to Oceania. In Micronesia: Mariana Islands—Guam; Palau Islands—Angaur, Peleliu, Koror, Babelthuap; Caroline Islands—Ngulu, Yap, Ulithi, Truk, Lukunor, Iuripik, Ponapé, Kusaie; Marshall Islands—Jaluit, Wotze.

Specimens examined.—Total number, 26 (9 males, 17 females), as follows: Mariana Islands, USNM—Guam, 16 (June 4, 6, July 24, 26, 27, Sept. 1, 19, 25, Oct. 8); Palau Islands, USNM—Peleliu, 5 (Sept. 8, 12, 14)—Angaur, 4 (Sept. 21); Caroline Islands, USNM—Ulithi, 1 (Aug. 17).

Weights.—At Guam, the NAMRU2 party obtained the weights of two males, 373 and 435, and of six females, 295-426 (384).

Parasites.—Wharton (1946:174, 175) lists the following species of chiggers (Acarina) taken from the Whimbrel at Guam: *Acariscus pluvius, A. anous, Neoschöngastia strongi,* and *N. carveri;* and at Ulithi: *N. namrui* and *N. atollensis.*

Remarks.—The Whimbrel is an abundant visitor to western Micronesia. It was first taken by Quoy and Gaimard, who found it in the Marianas. It is recorded in the Marshall Islands (Jaluit and Wotze), but apparently reaches these islands from the west, since the species is unknown in the Hawaiin Islands.

As shown in table 8, the NAMRU2 party observed the Whimbrel at Guam on spring migration in March, 1945, the last record being on March 21. In June and July, single birds or small groups were occasionally seen on the tidal flats. Some of these birds may have been nonmigratory. Beginning on July 24, more birds were recorded as they began to migrate south after their nesting season.

Whimbrels were numerous from August until the conclusion of the observations in October. Birds were abundant at the Palaus in September; only a few were noted at Ulithi in late August. The Whitney South Sea Expedition of the American Museum of Natural History made collections of this species at several islands in Micronesia. At Ponapé, Coultas (field notes) writes that in November and December, 1930, a few birds were seen on the reefs and at the edges of mangrove swamps. At Peleliu in October to December, 1931, he found Whimbrels concentrated on a small islet between Koror and Babelthuap. At both Ponapé and Palau Coultas received reports that the birds remain at the islands throughout the year.

Numenius tahitiensis (Gmelin)

Bristle-thighed Curlew

Scolopax tahitiensis Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 656. (Type locality, Tahiti, Society Islands, based on the Otaheiti Curlew of Latham, Gen. Syn., 3, pt. 1, 1785, p. 122, no. 4.)

Numenius femoralis Finsch, Ibis, 1880, pp. 220, 331, 332 (Jaluit, Arno).

Numenius tahitiensis Seebohm, Geogr. Dist. Charadriidae, 1887, p. 332 (Marshalls); Wiglesworth, Abhandl. und Ber Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 66 (Marianne?, Marshalls); Sharpe, Cat. Birds British Mus., 24, 1896, p. 367 (Marianas, Marshalls); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Marianas, Pelews); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 49 (Marianas, Marshalls); Bent, Bull. U. S. Nat. Mus., 146, 1929, p. 143 (Jaluit); Hand-list Japanese Birds, rev., 1932, p. 192 (Saipan, Marshalls); Peters, Check-list Birds World, 2, 1934, p. 261 (Marshalls); Yamashina, Tori, 10, 1940, p. 677 (Jarchi); Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Saipan, Jaluit, Arhno, Maloelab, Wotze, Ailuk, Ringelab, Larchi); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 4 (Ponapé, Marshalls); Mayr, Birds Southwest Pacific, 1945, p. 39 (Marshalls, straggler to Carolines and Marianas).

Phaeopus tahitiensis Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 179 (Rongelab); Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 407 (Marianas, Marshalls).

Geographic range.—Breeds in western Alaska. Winters in eastern and central Polynesia. In Micronesia: Mariana Islands—Saipan; Caroline Islands—Ponapé; Marshall Islands—Jaluit, Arhno, Moloelab, Wotze, Ailuk, Rongelab, Larchi, Bikini.

Specimens examined.—Total number, 6 (3 males, 3 females), as follows: Caroline Islands, AMNH—Ponapé, 2 (Dec. 15); Marshall Islands, USNM—Bikini, 4 (Mar. 10, 14, April 2, 30).

Remarks.—The Bristle-thighed Curlew is a regular migrant through the Marshall Islands of eastern Micronesia. It is recorded as a straggler to the Caroline and Mariana islands. Stickney (1943: 4, fig. 1) shows a map and discusses the breeding and wintering ranges of this curlew. As can be observed from her map, the principal wintering areas are east and south of Micronesia. She records the species from the Bonin Islands, which is the westernmost record.

It is difficult to offer plausible reasons for the present migratory habits of the Bristle-thighed Curlew. It is related to both the Asiatic form, *N. phaeopus,* and to the American species, *N. hudsonicus,* but its origin is not understood. The characteristics of its route of migration resemble that of some continental migrants and might have come about by a slow adjustment of the species to its environment, probably through an expansion of range from the west.

Numenius madagascariensis (Linnaeus)

Long-billed Curlew

Scolopax madagascariensis Linnaeus, Syst. Nat., ed. 12, 1, 1766, p. 242. (Type locality, Madagascar, error = Manila, Philippine Islands, *fide* Stresemann.)

Numenius cyanopus Hartert, Novit. Zool., 5, 1898, p. 65 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 35 (Micronesia); Safford, Osprey, 1902, p. 67 (Marianas); *idem,* The Plant World, 7, 1904, p. 266 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1645 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 45 (Guam); Hand-list Japanese Birds, rev., 1932, p. 192 (Guam).

Numenius madagascariensis Hand-list Japanese Birds, 3d ed., 1942, p. 214 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 40 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 51 (Guam, Ngesebus).

Geographic range.—Breeds in eastern Siberia. Winters from Malayia east to Australia and Melanesia. In Micronesia: Mariana Islands—Guam; Palau Islands—Peleliu, Ngesebus.

Remarks.—The Long-billed Curlew is a regular visitor to western Micronesia, especially to the Palau Islands. It is apparently a less common migrant in the Marianas, although it has been recorded from Guam. At Guam, the NAMRU2 party observed a single bird on June 6 and two on October 3 at tidal beaches. At Peleliu these large curlews were seen on several occasions between September 9 and 16, 1945. They were found usually as singles feeding on tidal flats in company with other shorebirds.

Limosa lapponica baueri Naumann

Pacific Godwit

Limosa Baueri Naumann, Naturg. Vög. Deutschl., 8, 1836, p. 429. (Type locality, New Holland = Victoria, *apud* Mathews; Novit. Zool., 18, 1912, p. 220.)

Limosa uropygialis Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 299 (Mortlock).

Limosa novae-sealandiae Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 66 (Luganor).

Limosa lapponica baueri Hartert, Novit. Zool., 5, 1898, p. 65 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 34 (Guam); Safford, Osprey, 1902, p. 67 (Marianas); *idem,* The Plant World, 7, 1904, p. 266 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 101 (Marianen); Cox, Island of Guam, 1917, p. 21 (Guam); Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1641, (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 46 (Carolines, Marianas); Hand-list Japanese Birds, rev., 1932, p. 191 (Marianas, Carolines); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 5 (Guam, Palau); Mayr, Birds Southwest Pacific, 1945, p. 41

(Oceania); Strophlet, Auk, 1946, p. 537 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 52 (Guam, Peleliu).

Limosa lapponica novazealandiae Hartert, Novit. Zool., 7, 1900, p. 8 (Ruk); Hand-list Japanese Birds, 3d ed., 1942, p. 214 (Guam, Truk).

Limosa rufa uropygialis Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Marianas, Ruk).

Geographic range.—Breeds in northeastern Asia and northwestern North America. Winters from Malaysia east to Oceania. In Micronesia: Mariana Islands—Guam; Palau Islands—Peleliu; Caroline Islands—Truk.

Specimens examined.—Total number, 5 (2 males, 3 females), as follows: Mariana Islands, AMNH—Guam, 2 (Sept. 26); Palau Islands, USNM—Peleliu, 1 (Sept. 7); AMNH—exact locality not given, 2 (Nov. 21, 23).

Remarks.—The principal wintering grounds of the Pacific Godwit are probably in Australia and New Zealand according to Stickney (1943:5). The bird reaches these areas from Arctic breeding grounds by migrating to a great extent along the edge of the Asiatic Continent. It may also be considered as a regular migrant in western Micronesia, and probably reaches eastern Micronesia as an uncommon visitor, since it is occasionally recorded in the Hawaiian Islands.

At Guam in 1945, the NAMRU2 party found the Pacific Godwit at tidal beaches on April 26 and October 15. Strophlet (1946:537) recorded one bird from Guam on October 20, 1945. At Peleliu, the NAMRU2 party found birds at beaches on September 7 and 16. Coultas (field notes) reported that "a few" were seen at Peleliu from October to December, 1931. McElroy did not find any of these birds at Truk in December, 1945.

Tringa nebularia (Gunnerus)

Greenshank

Scolopax nebularis Gunnerus, in Leem, Beskr. Finm. Lapper, 1767, p. 251. (Type locality, District of Trondhjem, Norway.)

Glottis nebularius Kuroda, in Momiyama, Birds Micronesia, 1922, p. 47 (Yap); Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 225 (Truk); Hand-list Japanese Birds, rev., 1932, p. 191 (Yap, Truk).

Tringa nebularis Hand-list Japanese Birds, 3d ed., 1942, p. 214 (Yap, Truk); Mayr, Birds Southwest Pacific, 1945, p. 41 (Yap, Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 52 (Peleliu).

Geographic range.—Breeds in northern Eurasia. Winters in Mediterranean area, Africa, southern Asia, Malaysia, Australia and Melanesia. In Micronesia: Palau Islands—Peleliu; Caroline Islands—Yap, Truk.

Specimens examined.—Total number, 4 (1 male, 3 females) from Palau Islands, USNM—Peleliu (Aug. 28, Sept. 14, 15).

Remarks.—The Greenshank has been recorded at the Palau Islands and at Yap and Truk in the Caroline Islands. It is apparently a regular visitor to western Micronesia. It probably reaches the western Carolines as an occasional visitor from the region of the

Palaus to the westward, rather than from the northward, since the bird has not been observed in the Marianas.

The NAMRU2 party observed two small flocks of these birds at Peleliu in August and September, 1945. One group of six birds was found wading in the shallow water of a mangrove swamp on August 28. Another group of three birds was seen on a tidal beach on September 14 and 15, where they were observed feeding apart from other species of shore birds.

Tringa melanoleuca (Gmelin)

Greater Yellow-legs

Scolopax melanoleuca Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 659. (Type locality, Sandy shores of abrador = Chateau Bay, Labrador.)

Tringa melanoleuca Kuroda, Dobutsu. Zasshi, 46, 1934, p. 313 (Jaluit); Hand-list Japanese Birds, 3d ed., 1942, p. 214 (Jaluit).

Geographic range.—Breeds in Alaska and Canada. Winters from California east to the Gulf States and the West Indies and south to South America. In Micronesia: Marshall Islands—Jaluit.

Remarks.—Kuroda records one specimen of the Greater Yellow-legs from Jaluit Atoll in the Marshall Islands. It is a straggler to Oceania and has not been recorded in the Hawaiian Islands.

Tringa glareola Linnaeus

Wood Sandpiper

Tringa glareola Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 149. (Europe, restricted type locality, Sweden.)

Totanus glareola Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 43 (Guam); Hartert, Novit. Zool., 5, 1898, pp. 65, 69 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 34 (Guam); Safford, Osprey, 1902, p. 70 (Guam); *idem,* The Plant World, 7, 1904, p. 268 (Guam).

Rhyacophilus glareola Kuroda, in Momiyama, Birds Micronesia, 1922, p. 48 (Guam, Angaur).

Tringa glareola Hand-list Japanese Birds, rev., 1932, p. 191 (Guam, Angaur, Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 213 (Guam, Anguar, Koror); Mayr, Birds Southwest Pacific, 1945, p. 41 (Guam, Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 52 (Anguar).

Tringa glariola Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam).

Geographic range.—Breeds in northern Eurasia from Norway and Germany east to Siberia, Sakhalin, and Kamchatka. Winters from Africa east to southern Asia, Malaysia, and Australia. In Micronesia: Mariana Islands—Guam; Palau Islands—Anguar, Koror.

Specimens examined.—Total number, 2 (1 male, 1 female), as follows: Palau Islands, USNM—Angaur, 1 (Sept. 21); AMNH—exact locality not given, 1 (October 26).

Remarks.—Marche, in 1877, first recorded the Wood Sandpiper in Micronesia (at Guam). In the Marianas it is apparently an uncommon migrant but it is considered to be a regular visitor in the Palau Islands. At the Palaus in September, 1945, the writer found the bird at a fresh water pond on Angaur. It was not observed on the tidal beaches at Peleliu.

Actitis hypoleucos Linnaeus

Common Sandpiper

Tringa Hypoleucos Linnaeus, Syst. Nat., ed. 10, 1, 1858, p. 149 (Europe, restricted type locality, Sweden.)

Totanus hypoleucos Lesson, Traité d'Ornith., 1831, p. 552 (Marianas).

Totanus (Tringoides) hypoleucus Gray, Birds Trop. Is. Pacific Ocean, 1859, p. 51 (Marianas).

Actitis hypoleuca Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 8 (Pelew).

Actitis hypoleucus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 36 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 353 (Ruk, Mortlock); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Luganor, Marianne, Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris (3), 8, 1896, p. 43 (Guam, Palaos, Luganor).

Tringoides hypoleucos Gray, Hand-list Birds, 3, 1871, p. 46 (Pelew, Ladrone); Salvadori, Ornith. Papuasia, 3, 1882, p. 318 (Pelew).

Tringoides hypoleucus Sharpe, Cat. Birds British Mus., 24, 1896, p. 456 (Micronesia); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 51, 62 (Pelews, Marianas).

Totanus hypoleucus Hartert, Novit. Zool., 5, 1898, p. 65 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 34 (Guam); Safford, Osprey, 1902, p. 70 (Mariannes); *idem*, The Plant World, 7, 1904, p. 268 (Guam).

Actitis hypoleucos Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 372 (Micronesia); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 47 (Marianas, Carolines, Pelews); Peters, Check-list Birds World, 2, 1934, p. 269 (Micronesia); Bryan, Guam Rec., vol. 13, no. 1, 1936, p. 24 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 42 (Micronesia); Strophlet, Auk, 1946, p. 537 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 52 (Guam, Peleliu, Ulithi).

Tringa hypoleucos Hand-list Japanese Birds, rev., 1932, p. 191 (Marianas, Carolines, Pelews); Hand-list Japanese Birds, 3d ed, 1942, p. 214 (Saipan, Babelthuap, Koror, Peleliu, Angaur, Ulithi, Truk).

Geographic range.—Breeds in Europe and Asia. Winters from Africa east to Polynesia. In Micronesia: Mariana Islands—Guam, Saipan; Palau Islands—Angaur, Peleliu, Koror, Babelthuap; Caroline Islands—Ulithi, Truk, Lukunor.

Specimens examined.—Total number, 12 (4 males, 7 females, 1 unsexed), as follows: Mariana Islands, USNM—Guam, 4 (July 16, Sept. 20); AMNH—Saipan, 1 (July 27); Palau Islands, USNM—Peleliu, 3 (Sept. 9, 14),—Koror, 1 (Nov. 7); AMNH—exact locality not given, 2 (Nov. 11, 19); Caroline Islands, USNM—Ulithi, 1 (Aug. 22).

Weights.—The present author (1948:52) recorded the weight of one male taken at Guam as 67 grams, and of two females as 57 and 63 grams. These were fall migrants taken by the NAMRU2 party.

Remarks.—The Common Sandpiper has been known from Micronesia since the time of Lesson. Tetens, Peters and Kubary obtained specimens in the Palaus; the latter collector obtained the bird at Lukunor and probably also at Truk. In recent years several collectors have taken the birds in western Micronesia, where the species appears to be a regular visitor. Field observations by the NAMRU2 party indicate that the birds are usually found as singles and remain apart from other species of migratory shorebirds which visit the islands. The margins of inland ponds and beaches consisting of rocks and pebbles appear to be preferred over the sandy, tidal flats. At Peleliu on September 9, 1945, two birds were taken at a bare bank of coral at an inland pond. These were the only two Common Sandpipers seen at the island. A specimen taken by the NAMRU2 party at Ulithi on August 22 at a beach, piled with debris from ships, has its entire and underparts stained by fuel oil.

Heteroscelus brevipes (Vieillot)

Gray-tailed Tattler

Totanus brevipes Vieillot, Nouv. Dict. Hist. Nat., 6, 1816, p. 410. (No locality given, the type is from Timor.)

Totanus pedestris Lesson, Traité d'Ornith., 1831, p. 552 (Marianne, Ualan).

Totanus brevipes Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 287, 299, 304 (Ualan, Lougounor, Guahan); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 51 (Ladrone or Marian Is.); Pelzeln, Reise "Novara," Vögel, 1865, p. 129, 162 (Puynipet, Ualan).

Totanus incanus Finsch and Hartlaub (part), Fauna Centralpolynesians, 1867, p. 187 (Mariannen, Ualan, Puynipet); Salvadori (part), Ornith. Papuasia, 3, 1882, p. 322 (Micronesia); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 65 (Mulgrave, Taluit, Ualan, Ponapé, Ruk, Luganor, Uap, Pelew, Marianas); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 41 (Saypan, Guam, Jaluit, Carolines, Palaos).

Heteractitis brevipes Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 35 (Marianas); Safford, Osprey, 1902, p. 67 (Marianas); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 180 (Uala = Truk); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 170 (Carolines).

Heteractitis brevis Prowazek, Die deutschen Marianen, 1913, pp. 47, 101 (Marianen).

Heteroscelus brevipes Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 367 (Western Pacific); Peters, Check-list Birds World, 2, 1934, p. 270 (Carolines).

Tringa incana brevipes Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1623 (Guam, Truk); Hand-list Japanese Birds, rev., 1932, p. 191 (Palaus, Carolines); Hand-list Japanese Birds, 3d ed., 1942, p. 213 (Babelthuap, Koror, Angaur, Yap, Iuripik, Faraulep, Truk, Ponapé).

Heteroscelus incanus brevipes Kuroda, in Momiyama, Birds Micronesia, 1922, p. 47 (Pelew, Yap, Ruk); Kuroda, Avifauna Riu Kiu, 1925, p. 177 (Micronesia); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 5 (Saipan, Guam, Palau, Ruk, Kusaie); Mayr, Birds Southwest Pacific, 1945, p. 43 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 52 (Guam, Peleliu, Truk).

Heteroscelus incanus Wharton and Hardcastle (part), Journ. Parasitology, 32, 1946, pp. 296, 316, 318 (Guam, Peleliu).

Geographic range.—Breeds in eastern Siberia and adjacent areas. Winters south to Malaysia and east to Australia and Oceania. In Micronesia: Mariana Islands—Guam, Saipan; Palau Islands—Angaur, Peleliu, Koror, Babelthuap; Caroline Islands—Yap, Truk, Iuripik, Faraulep, Ponapé, Kusaie.

Specimens examined.—Total number, 39 (11 males, 27 females, 1 unsexed), as follows: Mariana Islands, USNM—Guam, 16 (June 4, 6, July 16, 24, Aug. 6, 27, Sept. 4, 6, 27, Oct. 23); AMNH—Saipan, 1 Sept. 8),—Guam, 5 (Feb. 11, Mar. 4, 13, Sept. 14, Dec. 5); Palau Islands, USNM—Peleliu, 7 (Sept. 6-8, 16); AMNH—exact locality not given, 4 (Nov. 8); Caroline Islands, USNM—Truk, 1 (Dec. 13); AMNH—Truk, 3 (Feb. 6, 26, Oct. 14),—Kusaie, 2 (Mar., April).

Weights.—Weights of birds obtained by the NAMRU2 party were as follows: three males from Guam, 90-104 (95); six females from Guam, 99-116 (104).

Remarks.—It is not clear whether some of the accounts cited above refer to this species or to the species, *Heteroscelus incanus*. Owing to the fact that specimens used in some of these early reports have not been examined by me, the identifications of the birds concerned cannot be verified and consequently it is impossible to be certain to which species some of the references pertain. In listing these accounts in the literature, I am following Sharpe (1896: 455) whenever possible.

Tattlers were among the first birds observed and taken in Micronesia. Quoy and Gaimard found them in the Marianas, and Kittlitz and Kubary recorded the species in the Carolines. Kubary also reported the birds at the Palaus.

The Gray-tailed Tattler apparently does not reach the Marshall Islands but visits only the western part of Micronesia. Stickney (1943:2) shows a map of the known geographic range of this species in Micronesia. The separation of *H. brevipes* and *H. incanus* in the field is not always possible. For identification, the NAMRU2 party depended primarily on specimens collected. At Guam, specimens of *H. brevipes*, thought to be nonmigratory, were taken in early June. These were in winter plumage. Beginning in mid-July there was an increase in the number of tattlers seen; apparently fall migration had begun. At Peleliu in September, 1945, the NAMRU2 party found tattlers to be numerous. Apparently all were of this species; no *H. incanus* were taken there. On September 8, approximately 75 individuals in small and large flocks were counted at Akarakoro Point on the tidal flats. The birds remained apart from the other shorebirds which were feeding at the same locality.

Heteroscelus incanus (Gmelin)

American Wandering Tattler

Scolopax incana Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 658, (Type locality, Eimeo = Moorea, Society Islands and Palmerton Islands.)

Totanus oceanicus Lesson, Mamm. et Ois., 2, 1847, p. 244 (Kusaie); Hartlaub, Archiv f. Naturgesch., 1852, p. 135 (Carolinen); *idem*, Journ. f. Ornith., 1854, pp. 167, 168 (Carolinen, Mariannen).

Tryanga glareola Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 365, 2, pp. 55, 86 (Ualan).

Totanus incanus Schlegel, Mus. Pays-Bas, 5, no. 27, 1864, p. 74 (Micronésie); Salvadori (part), Ornith. Papuasia, 3, 1882, p. 322 (Ualan, Puynipet, Marshalls, Mariannis); Wiglesworth (part), Abhandl. und. Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 65 (Mulgrave, Taluit, Ualan, Ponapé, Ruk, Luganor, Uap, Marianne, Pelew); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 41 (Saypan, Guam, Jaluit, Carolines, Palaos); Hartert, Novit. Zool., 5, 1898, p. 64 (Guam); *idem*, Novit. Zool. 7, 1900, p. 8 (Ruk); Schnee, Zool. Jahrbücher, 20, 1904, p. 389 (Marschall-Inseln).

Actitis incanus Finsch and Hartlaub (part), Fauna Centralpolynesions, 1867, p. 187 (Mariannen, Ualan, Puynipet); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Uap, Ualan); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 36 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 38 (Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 294, 306 (Ponapé, Kuschai, Marshalls); *idem*, Ibis, 1881, pp. 105, 109, 115 (Kushai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 299 (Mortlock); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 55 (Jaluit, Arno. Kuschai).

Actitis incana Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem*, Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem*, Ibis, 1880, pp. 219, 220, 330, 332 Milli or Mulgrave, Taluit).

Heteractitis incanus Sharpe, Cat. Birds British Mus., 24, 1906, p. 455 (Oceania); Safford, The Plant World, 7, 1904, p. 268 (Guam); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Yap, Ruk, Ponapé, Kusaie); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 179 (Kusaie); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 70 (westcentral Pacific).

Heteroscelus incanus Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 367 (Carolines, Marianas); Peters, Check-list Birds World, 2, 1934, p. 270 (Micronesia); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam): Watson, The Raven, 17, 1946, p. 42 (Guam); Wharton and Hardcastle (part), Journ. Parasitology, 32, 1946, pp. 296, 316, 318 (Guam, Peleliu); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 93 (Tinian); Strophlet, Auk, 1946, p. 537 (Guam); Wharton, Ecol. Monogr., 16, 1946, pp. 174, 175 (Guam); Borror, Auk, 1947, p. 417 (Agrihan).

Tringa incana incana Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1623 (Guam); Hand-list Japanese Birds, rev., 1932, p. 191 (Marianas, Carolines, Marshalls, Palaus); Hand-list Japanese Birds, 3d ed., 1942, p. 214 (Saipan, Guam, Koror, Angaur, Yap, Faraulep, Lamatrek, Truk, Ponapé, Kusaie, Jaluit, Mille, Arhno, Majuro, Maloelab, Wotze, Likieb, Ailuk).

Heteroscelus incanus incanus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 46 (Kusaie, Ruk, Ponapé, Yap, Marianas, Mulgrave, Taluit, Pelew); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 7 (Guam, Palau, Ponapé, Ruk, Kusaie); Mayr, Birds Southwest Pacific, 1945, p. 42 (Palau, Marianas); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 53 (Guam, Rota Ulithi).

Geographic range.—Breeds in Alaska south to Prince William Sound. Winters in North and South America and west in Oceania to Melanesia. In Micronesia: Mariana Islands—Guam, Rota, Saipan, Agrihan; Palau Islands—Angaur, Koror; Caroline Islands—Yap, Ulithi, Truk, Faraulep, Lamatrek, Ponapé, Kusaie; Marshall Islands—Jaluit, Mille, Arhno, Majuro, Maloelab, Wotze, Likieb, Ailuk, Bikini.

Specimens examined.—Total number, 47 (23 males, 20 females, 4 unsexed) as follows: Mariana Islands, USNM—Guam, 13 (May 21-29, Sept. 19-27, Oct. 10, 23),—Rota, 2 (Oct. 23, 25); AMNH—Guam, 4 (April 23, Aug. 16); Palau Islands, AMNH—exact locality not given, 1 (no date); Caroline Islands, USNM—Ulithi, 3 (Aug. 20, 22); AMNH—Truk, 1 (June 25),—Ponapé, 1 (Dec. 15),—Kusaie, 19 (Feb., Mar., April 1-10); Marshall Islands, USNM—Bikini, 3 (Feb. 26, 28, April 28).

Weights.—In 1948 (1948:53) I listed weights of two males from Guam as 175 (May) and 109 (September); weights of two females from Guam were 175 and 192 (both in May). These data were obtained by the NAMRU2 field party.

Parasites.—Wharton and Hardcastle (1946:296, 316, 318) list the following chiggers (Acarina) from tattlers taken by NAMRU2 collectors at Guam and Peleliu: *Neoschöngastia bougainvillensis*, *N. ewingi*, *N. carveri*, and *N. namrui*. Wharton (1946:174, 175) records the chiggers, *Acariscus pluvius* and *A. anous*, from tattlers from Guam. It is not certain from which species of *Heteroscelus* these chiggers were obtained.

Remarks.—Records indicate that the American Wandering Tattler is a regular visitor to eastern Micronesia, and that it only occasionally reaches the Palau Islands in western Micronesia.

The NAMRU2 field parties found *H. brevipes* as singles or in small groups of five or less. They remained apart from other species and appeared to prefer rocky beaches and coral-reef rocks to the sandy beaches. At Guam in 1945, the latest spring migrants were taken on May 29. These birds were in nuptial plumage. Birds taken at Bikini by Morrison on February 26 and April 28, 1946, were in worn, winter plumage. At Guam, the NAMRU2 observers obtained the first fall migrants on September 19. These observations in 1945, showed that *H. incanus* arrived at Guam on its southbound flight fully one month after the first individuals of *H. brevipes* began to appear (mid-July). This difference may partly result from the fact that the distance to the Asiatic breeding grounds of *H. brevipes* is not so great as that to the American breeding grounds of *H. incanus.*

Whether the two tattlers, *H. brevipes* and *H. incanus,* are distinct species (allopatric species insofar as breeding ranges are concerned), or whether they are mere subspecies (geographic races) is open to question. I failed to find evidences of intergradation in the few specimens which I examined critically; however, the final answer to the problem might be obtained by collecting series of birds from breeding grounds where ranges closely approach each other or overlap (if they do). Stickney (1943:6, 7) lists the distinctive differences in these two birds, particularly the character of the nasal groove, and does not mention having found any evidence of intergradation. Wetmore (in Townsend and Wetmore, 1919:180) gives evidence that they belong to two separate species.

Arenaria interpres interpres (Linnaeus)

Turnstone

Tringa Interpres Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 148, (Type locality, Europe and North America, restricted to Gotland, Sweden.)

Tringa interpres Quoy and Gaimard, Voy. "Uranie," Zool., 1824, p. 708 (Guam).

Strepsila collaris Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 287, 299, 304 (Ualan, Lougounor, Guahan); *idem,* Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 32 (Ualan).

Strepsilas interpres Kittlitz, Denk. Reise russ. Amer. Micron. und Kamchat., 2, 1858, pp. 32, 55, 86 (Ualan); Pelzeln, Reise "Novara," Vögel, 1865, p. 117 (Marianen); Finsch and Hartlaub, Fauna Ornith. Centralpolynesian, 1867, p. 200 (Marianen); Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, pp. 89, 104 (Pelew, Uap, Mackenzie); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 32 (Palau); *idem,* Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem,* Ibis, 1880, pp. 220, 330, 332 (Taluit); *idem,* Journ. f. Ornith., 1880, pp. 294, 306 (Ponapé, Kuschai); *idem,* Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem,* Ibis, 1881, pp. 105, 109, 115 (Kushai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 330, 353 (Ponapé, Nukuor, Ruk); Salvadori, Ornith. Papuasia, 3, 1882, p. 289 (Pelew, Mariannis); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 56 (Jaluit, Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891);

p. 63 (Ualan, Ponapé, Luganor, Nukuor, Ruk, Mackenzie, Pelew, Marianne); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 45 (Guam, Saypan, Hogoleu, Marshalls, Mackensie, Palaos); Hartert, Novit. Zool., 5, 1898, p. 66 (Guam); *idem,* Novit. Zool., 7, 1900, p. 9 (Ruk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 51 (Ponapé); Uchida, Annot. Zool. Japon., 9, 1918, p. 489 (Ponapé).

Cinclus interpres Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 48 (Ladrones).

Arenaria interpres Sharpe, Cat. Birds British Mus., 24, 1896, p. 92 (Micronesia); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 37 (Guam); Safford, Osprey, 1902, p. 68 (Marianas); *idem,* The Plant World, 7, 1904, p. 266 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 389 (Marshall Islands); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam), Cox, Island of Guam, 1917, p. 22 (Guam); Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 316, 320 (Guam, Peleliu); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 105 (Tinian); Strophlet, Auk, 1946, p. 537 (Guam); Wharton, Ecol. Monogr., 16, 1946, pp. 174, 175 (Guam); Borror, Auk, 1947, p. 417 (Agrihan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 53 (Guam, Rota, Peleliu, Truk).

Arenaria interpres oahuensis Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 66, 1919, p. 177 (Jaluit, Rongelab, Uala); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 45 (Guam, Saipan, Pelew, Angaur, Kusaie, Ponapé, Luganor, Nukuor, Ruk, Yap, Mackenzie, Taluit, Rongelab).

Arenaria interpres interpres Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 45 (Micronesia); Hand-list Japanese Birds, rev., 1932, p. 194 (Guam,, Saipan, Anguar, Kusaie, Ponapé, Luganor, Nukuor, Ruk, Yap, Mackenzie, Taluit, Rongelab, Mille, Majuro, Wotze, Likieb); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 217 (Guam, Saipan, Angaur, Kusaie, Ponapé, Luganor, Ruk, Yap, Mackenzie, Taluit, Rongelab, Mille, Majuro, Wotze, Likieb); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 8 (Guam, Palau, Ponapé, Kusaie).

Geographic range.—Breeds in northern parts of the Northern Hemisphere. Winters to Southern Hemisphere. In Micronesia: Mariana Islands—Guam, Rota, Saipan; Palau Islands—Angaur, Peleliu, Caroline Islands—Yap, Ulithi, Truk, Lugunor, Nukuor, Ponapé, Kuasaie; Marshall Islands—Jaluit, Rongelab, Mille, Majuro, Wotze, Likieb, Bikini.

Specimens examined.—Total number, 36 (17 males, 16 females, 3 unsexed), as follows: Mariana Islands, USNM—Guam, 7 (Oct. 10-26)—Rota, 2 (Oct. 20, Nov. 2); AMNH—Guam, 4 (Mar. 22, 27, Aug. 18); Palau Islands, USNM—Peleliu, 1 (Sept. 8); AMNH—exact locality not given, 3 (Dec. 8); Caroline Islands, USNM—Truk, 1 (Dec. 22); AMNH—Ponapé, 4 (Dec. 16)—Truk, 4 (Feb. 5, 7, July 14)—Kusaie, 7 (Mar. 10-30); Marshall Islands, USNM—Bikini, 3 (Feb. 26, Mar. 4).

Weights—The NAMRU2 party obtained the weights of four males taken at Guam and Rota as 77-99 (92) and one female from Guam as 90. These birds were obtained in October and November.

Parasites.—Wharton and Hardcastle (1946:316, 320) list the following chiggers (Acarina) from the Turnstone from Guam and Peleliu: *Neoschöngastia carveri* and *N. strongi.* Wharton (1946:174) records also *Acariscus anous* from the Turnstone at Guam. Uchida (1918:489) records the bird louse (Mallophaga), *Colpocephalum pediculoides,* from this bird at Ponapé.

Remarks.—The Turnstone is a regular visitor to Micronesia and to most other parts of Oceania. As pointed out by Stickney (1943:8), the material obtained by the Whitney South Sea Expedition yields evidence that the population which winters in Oceania is as widespread as that of *Pluvialis dominica fulva* but less abundant. The writer's observations at Guam, Ulithi and the Palaus are in agreement with this evidence. Stickney suggests that the reason the

Turnstone was not recorded by the Whitney South Sea Expedition in eastern Polynesia was because of "a tendency of the turnstone to hug the continental coasts more closely, avoiding extensive overseas migrations."

At Guam in 1945, the NAMRU2 party recorded the Turnstone on its northward migration as late as March 19; on its southward migration it was first seen at Guam on July 24. On its southward migration the bird was not numerous until September. Our observations indicated that in 1945, the principal waves of migration of the Turnstone appeared approximately two weeks after those of the Pacific Golden Plover and the Whimbrel. Stickney remarks that the spring migratory season in Oceania is completed in May and that the fall migratory season begins in August. Borror (1947:417) found small flocks on the beaches at Agrihan on August 10 and 11, 1945.

Bryan and Greenway (1944:112) indicate that the subspecies, *Arenaria interpres morinella*, which breeds in North America, east of Point Barrow, Alaska, may reach the Hawaiians. Careful examination of specimens from eastern Micronesia might reveal its presence there also. The name *Arenaria interpres oahuensis* (Bloxham) may apply to specimens from eastern Micronesia but Peters (1934:271) considers *oahuensis* to be inseparable from *Arenaria interpres interpres* (Linnaeus).

Gallinago megala Swinhoe

Marsh Snipe

Gallinago megala Swinhoe, Ibis, 1861, p. 343. (Type locality, Between Takoo and Pekin, China.

Gallinago heterocaca Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 36 (Palau).

Gallinago megala Salvadori, Ornith. Papuasia, 3, 1882, p. 337 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 67 (Pelew); Sharpe, Cat. Birds British Mus., 24, 1896, p. 624 (Pelew); Hartert, Novit. Zool., 5, 1898, p. 65 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 33 (Mariannas); Safford, Osprey, 1902, p. 67 (Mariannas); *idem*, The Plant World, 7, 1904, p. 266 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1665 (Palau, Guam); Mayr, Birds Southwest Pacific, 1945, p. 44 (Guam, Palau); Strophlet, Auk, 63, 1946, p. 537 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 54 (Angaur).

Subspilura megala Kuroda, in Momiyama, Birds Micronesia, 1922, p. 49 (Guam, Pelew).

Capella megala Hand-list Japanese Birds, rev., 1932, p. 193 (Guam, Koror); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Robinson and Chasen, Birds Malay Peninsula, 3, 1936, p. 170 (Pelew, Marianne); Hand-list Japanese Birds, 3d ed., 1942, p. 316 (Guam, Koror).

Geographic range.—Breeds in east-central Asia. Winters south to Malaysia, Australia, and parts of Melanesia. In Micronesia: Mariana Islands—Guam; Palau Islands—Koror, Angaur.

Specimens examined.—One female from Palau Islands, USNM—Angaur (Sept. 21).

Remarks.—The Marsh Snipe is a regular visitor to western Micronesia, being recorded from the Mariana and Palau islands. At Angaur on September 21, 1945, the NAMRU2 party observed four birds at the edge of a brackish water swamp, which was margined with reeds and other vegetation. Birds were not seen on tidal beaches at Peleliu. Strophlet (1946:537) records the Marsh Snipe at Guam on October 21 and December 3, 1945.

Gallinago gallinago gallinago (Linnaeus)

Common Snipe

Scolopax Gallinago Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 147. (Europe, restricted type locality, Sweden.)

Capella gallinago roddei Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 224 (Saipan).

Capella gallinago gallinago Hand-list Japanese Birds, rev., 1932, p. 193 (Saipan); Hand-list Japanese Birds, 3d ed., 1942, p. 216 (Saipan).

Gallinago gallinago Mayr, Birds Southwest Pacific, 1945, p. 44 (Saipan).

Geographic range.—Breeds in northern Eurasia. Winters in southern part of breeding range and south to Africa and east to Malaysia. In Micronesia: Mariana Islands—Saipan.

Remarks.—From Micronesia there is a single record of the taking of this bird at Saipan, apparently by Japanese collectors. It is probably an occasional straggler to the area, but owing to its similarity to *Gallinago megala* it may not often be recognized in the field.

Crocethia alba (Pallas)

Sanderling

Trynga alba Pallas, in Vroeg's Cat., 1764, Adumbr., p. 7. (Type locality, Coast of the North Sea.)

Calidris arenaria Finsch, Ibis, 1880, pp. 331, 332 (Taluit); *idem*, Mitth. Ornith. Ver. Wien, 1884, p. 56 (Jaluit); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 33 (Guam); Safford, Osprey, 1902, p. 70 (Mariannes); *idem*, The Plant World, 7, 1904, p. 268 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln).

Tringa arenaria Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Taluit); Hartert, Novit. Zool., 5, 1898, pp. 65, 69 (Guam).

Calidris alba Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 308 (Marshall Islands).

Crocethia alba Kuroda, in Momiyama, Birds Micronesia, 1922, p. 48 (Taluit, Guam); Hand-list Japanese Birds, rev., 1932, p. 193 (Taluit, Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Jaluit, Guam); Stickney, Amer. Mus. Novit., no. 1248, 1943, p. 9 (Guam, Jaluit); Mayr, Birds Southwest Pacific, 1945, p. 44 (Marianas, Marshalls); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 54 (Ulithi).

Geographic range.—Breeds in Arctic regions of the Northern Hemisphere. Winters to Southern Hemisphere. In Micronesia: Mariana Islands—Guam; Caroline Islands—Ulithi; Marshall Islands—Jaluit.

Specimens examined.—Total number, 5 (2 males, 3 females), as follows: Mariana Islands, AMNH—Guam, 4 (Dec. 2-4); Caroline Islands, USNM, 1 (Aug. 21).

Remarks.—Stickney (1943:8, 9) summarizes the available information concerning the Sanderling in Oceania. The bird may be classed as a regular visitor in eastern Micronesia; the most western record is from Ulithi in the western Carolines. It has been recorded also at Guam and Jaluit.

The NAMRU2 party secured one Sanderling from a flock of approximately thirty birds containing this species and *Charadrius mongolus stegmanni* at Pau Island, Ulithi Atoll, on August 21, 1945.

Calidris tenuirostris (Horsfield)

Asiatic Knot

Totanus tenuirostris Horsfield, Trans. Linn. Soc. London, 13, pt. 1, 1821, p. 192. (Type locality, Java.)

Calidris tenuirostris Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 54 (Peleliu).

Geographic range.—Breeds in northeastern Siberia. Winters from India east to Malaysia and Australia. In Micronesia: Palau Islands—Peleliu.

Specimens examined.—Four males from Palau Islands, USNM— Peleliu (Sept. 16).

Remarks.—The Asiatic Knot was observed and obtained by the NAMRU2 party at Peleliu in September, 1945. Flocks containing fifteen to twenty birds were noted at the tidal flats of Akarakoro Point on September 8 and 16. The birds appeared to remain apart from other shore birds in this area.

Erolia minuta ruficollis (Pallas)

Little Stint

Trynga ruficollis Pallas, Reise versch. Prov. Russ. Reichs, 3, 1776, p. 700. (Type locality, "Circa lacus salsos Dauriae campestris" = Kulussutai, southern Transbaikalia.)

Tringa minuta Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelew); Gray, Hand-list Birds, pt. 3, 1871, p. 50 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 36 (Palau).

Tringa albescens Salvadori, Ornith. Papuasia, 3, 1882, p. 316 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Pelew).

Limonites minuta Takatsukasa and Kudora, Tori, 1, 1915, p. 62 (Pelew).

Pisobia ruficollis Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 290 (Pelew).

Pisobia minuta ruficollis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 48 (Palau, Ulithi); Hand-list Japanese Birds, rev., 1932, p. 192 (Palau, Ulithi).

Calidris ruficollis ruficollis Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Palau, Ulithi).

Calidris minuta ruficollis Mayr, Birds Southwest Pacific, 1945, p. 45 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 54 (Rota, Peleliu).

Geographic range.—Breeds from northeastern Siberia to northwestern Alaska. Winters south from the Malay area to Australia. In Micronesia: Mariana Islands—Rota; Palau Islands—Angaur, Peleliu; Caroline Islands—Ulithi.

Specimens examined.—Total number, 16 (4 males, 12 females), as follows: Mariana Islands, USNM—Rota, 1 (Oct. 20); Palau Islands, USNM—Peleliu, 14 (Sept. 6-14)—Angaur, 1 (Sept. 21).

Remarks.—The Little Stint is apparently a regular visitor to the Palau Islands and a less common visitor to the Mariana Islands. At Peleliu and Angaur the NAMRU2 party found these birds in small flocks of 10 to 15 at tidal flats and at inland ponds. On tidal flats the species appeared to remain apart from other kinds of shore birds, but at inland ponds the Little Stint was found in company with other species. On shooting into a mixed flock of shore birds at an island pond at Angaur, the writer secured specimens of this species and also of *Erolia acuminata*.

Erolia subminuta (Middendorff)

Least Sandpiper

Tringa subminuta Middendorff. Reise Nord. und Ost. Siberien, 2, Th. 2, 1853, p. 222, pl. 19, fig. 6. (Type locality, Western slopes of the Stanovoi Mountains and mouth of the Udá.)

Pisobia minutilla subminuta Hand-list Japanese Birds, rev., 1932, p. 192 (Koror).

Calidris minutilla subminuta Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 45 (Palau).

Geographic range.—Breeds in northeastern Asia. Winters south to India and east to Malaysia. In Micronesia: Palau Islands—Koror.

Remarks.—The Least Sandpiper has been recorded in the Palau Islands by the Japanese investigators. It is probably an uncommon visitor to this area.

Erolia melanotos (Vieillot)

Pectoral Sandpiper

Tringa melanotos Vieillot, Nouv. Dict. Hist. Nat., 34, 1819, p. 462. (Type locality, Paraguay.)

Pisobia melanota Hand-list Japanese Birds, rev., 1932, p. 192 (Ponapé).

Calidris melanotos Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Ponapé).

Calidris melanota Mayr, Birds Southwest Pacific, 1945, p. 45 (Ponapé).

Geographic range.—Breeds on the Arctic coast of northeastern Asia and eastward into Arctic America. Winters to South America. In Micronesia: Caroline Islands—Ponapé.

Remarks.—The Pectoral Sandpiper has been recorded from Ponapé. Bryan and Greenway (1944:114) list the species as an "accidental" visitor to the Hawaiian Islands from North America.

Erolia acuminata (Horsfield)

Sharp-tailed Sandpiper

Totanus acuminatus Horsfield, Trans. Linn. Soc. London, 13, pt. 1, 1821, p. 192. (Type locality, Java.)

Tringa acuminata Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 8, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 106 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 35 (Palau); Salvadori, Ornith. Papuasia, 3, 1882, p. 314 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 64 (Pelew); Hartert, Novit. Zool., 5, 1898, p. 65 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 33 (Guam); Safford, Osprey, 1902, p. 70 (Marianas); *idem*, The Plant World, 7, 1904, p. 268 (Guam).

Heteropygia acuminata Sharpe, Cat. Birds British Mus., 24, 1896, p. 566 (Pelew); Hartert, Novit. Zool., 7, 1900, p. 8 (Ruk); Takatsukasa and Kuroda, Tori, 1, 1915,

p. 62 (Marianas, Ruk, Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 48 (Pagan, Pelew, Ruk).

Tringa maculata var. *acuminata* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3) 8, 1896, p. 44 (Pagan, Palaos).

Pisobia acuminata Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 276 (Caroline Islands).

Erolia acuminata Hartert, Vögel pal. Fauna, 11-12, 1920, p. 1586 (Palau, Karolinen); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam).

Pisobia acuminatus Hand-list Japanese Birds, rev., 1932, p. 192 (Ponapé, Truk, Pagan, Jaluit, Koror).

Calidris acuminata Hand-list Japanese Birds, 3d ed., 1942, p. 215 (Pagan, Jaluit, Koror, Truk, Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 45 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 54 (Guam, Angaur).

Geographic range.—Breeds in northeastern Siberia. Winters from the Malay Archipelago and Australia to the Southwest Pacific. In Micronesia: Mariana Islands—Guam, Pagan; Palau Islands—Angaur; Caroline Islands—Truk, Ponapé; Marshall Islands—Jaluit.

Specimens examined.—Total number, 4 (2 males, 2 females), as follows: Mariana Islands, USNM—Guam, 1 (Sept. 17); Palau Islands, USNM—Angaur, 3 (Sept. 21).

Remarks.—The Sharp-tailed Sandpiper is a regular visitor to western Micronesia and an uncommon visitor to eastern Micronesia. It was first recorded from the Palau Islands in 1868, where the bird was taken by Tetens, Heinsohn, and Kubary. In 1896 and 1898, records of this bird in the Mariana and Caroline islands were published by Oustalet and Hartert.

The NAMRU2 party obtained one specimen at Guam on September 17 and three at Angaur on September 21. At Angaur several birds of this species were seen at fresh water ponds in company with *Erolia minuta ruficollis, Limicola falcinellus sibirica, Tringa glareola,* and other shore birds.

Erolia ferruginea (Pontoppidan)

Curlew Sandpiper

Tringa ferrugineus Pontoppidan, Danske Atlas, 1, 1763, p. 624. (No type locality = Denmark.)

Calidris ferruginea Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 55 (Peleliu).

Geographic range.—Breeds in northern Asia. Winters from Africa east to Australia. In Micronesia: Palau Islands—Peleliu.

Specimens examined.—One female from Palau Islands, USNM—Peleliu (Sept. 6).

Remarks.—The NAMRU2 party obtained one female on September 6 at a tidal flat on Peleliu. The Curlew Sandpiper is seemingly a rare visitor to the Palau Islands from Asia. In using this specific name, I am following Mayr (in Delacour and Mayr, 1945: 107).

Limicola falcinellus sibirica Dresser

Broad-billed Sandpiper

Limicola sibirica Dresser, Proc. Zool. Soc. London, 1876, p. 674. (Type locality, Siberia and China.)

Limicola falcinellus sibirica Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 55 (Angaur).

Geographic range.—Breeds in northeastern Asia. Winters from India east to Australia. In Micronesia: Palau Islands—Angaur.

Specimens examined.—One male from Palau Islands, USNM—Angaur (Sept. 21).

Remarks.—A single male bird was taken by the NAMRU2 party at a fresh water pond on Angaur Island on September 21, 1945. This is the only known record for this bird from Micronesia.

Phalaropus lobatus (Linnaeus)

Northern Phalarope

Tringa lobata Linnaeus, Syst. Nat., ed. 10, 1, 1758, p. 148, in Emendanda, p. 824. (Type locality, Hudson Bay.)

Geographic range.—Breeds throughout Arctic region. Winters at sea in tropical and subtropical waters.

Remarks.—The Northern Phalarope has not been found in Micronesia. Mayr (1945a:46) records it in the pelagic areas north of the New Guinea region. The occurrence there suggests that migration is through the Microesian area.

Larus argentatus vegae Palmén

Herring Gull

Larus argentatus Brünn. var. *Vegae* Palmén, in Nordenskiöld, Vega-Exped. Vetensk. Iakttag., 5, 1887, p. 370. (Type locality, Pidlin, northeastern Siberia.)

Larus vegae Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 56 (Agrigan); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 20 (Marianas); Safford, Osprey, 1902, p. 70 (Marianas); *idem*, The Plant World, 7, 1904, p. 268 (Guam?).

Larus vegae Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Marianas).

Larus argentatus vegae Kuroda, in Momiyama, Birds Micronesia, 1922, p. 49 (Agrigan); Hand-list Japanese Birds, rev., 1932, p. 196 (Agrigan); Hand-list Japanese Birds, 3d ed., 1942, p. 220 (Agrigan).

Geographic range.—Breeds in northern Siberia. Ranges east to Alaska and south to the Philippines and the China coast. In Micronesia: Mariana Islands —Agrihan.

Remarks.—The Herring Gull is ascribed to Micronesia on the basis of one bird obtained by Marche in January, 1889, at Agrihan in the nothern Marianas and reported on by Oustalet (1896:56). The gull is considered a straggler to the northern Marianas from the northward. Stott (1947:525) observed a gull, which was thought to be this species or *Larus ridibundus*, at Lake Susupe, Saipan, in 1945.

Chlidonias leucopterus (Temminck)

White-winged Black Tern

Sterna leucoptera Temminck, Man. d'Ornith., 1815, p. 483. (Type locality, Coasts of the Mediterranean.)

Hydrochelidon leucoptera Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 57 (Guam); Hartert, Novit. Zool., 5, 1898, p. 67 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 20 (Guam); Safford, Osprey, 1902, p. 70 (Marianas); *idem*, The Plant World, 7, 1904, p. 268 (Guam); Hartert, Vögel pal. Fauna, 13-14, 1921, p. 1686 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 51 (Guam).

Chlidonias leucoptera Hand-list Japanese Birds, rev., 1932, p. 194 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 217 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 55 (Angaur).

Geographic range.—Breeds in central and southern Eurasia. Winters from Africa east to Australia. In Micronesia: Mariana Islands—Guam; Palau Islands—Angaur.

Measurements.—One adult male has the following measurements: wing, 211; tail, 72; exposed culmen, 27; tarsus, 20; one adult female: wing, 210; exposed culmen, 25.5. These specimens were taken at the Palau Islands.

Specimens examined.—Total number, 6 (3 males, 3 females), as follows: Palau Islands, USNM—Angaur, 1 (Sept. 21); AMNH—exact locality not given, 5 (Oct. 13).

Remarks.—The White-winged Black Tern was first collected at Guam in October, 1887, by Marche and reported on by Oustalet (1896:57). It was later taken at the Palau Islands by Coultas in 1931, and by the NAMRU2 party at Angaur in 1945. The bird is seemingly an uncommon winter visitor to Micronesia.

At Angaur, the NAMRU2 party obtained one of four terns seen at a small fresh water lake. Coultas took five birds at the Palau Islands. He writes (field notes) that a flock of 14 of the terns appeared at the island following a heavy typhoon. All birds examined are in winter plumage (September and October).

Sterna hirundo longipennis Nordmann

Black-billed Common Tern

Sterna longipennis Nordmann, in Erman's Verz. Thier. Pflanz., 1835, p. 17. (Type locality, Mouth of the Kutchui River, Sea of Okhotsk.)

Sterna longipennis Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 112 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 41 (Palau); Salvadori, Ornith. Papuasia, 3, 1882, p. 440 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 74 (Pelew); Saunders, Cat. Birds British Mus., 25, 1896, p. 67 (Pelew); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 21 (Pelew).

Sterna hirundo longipennis Hand-list Japanese Birds, rev., 1932, p. 195 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 218, (Palau); Mayr, Birds Southwest Pacific, 1945, p. 25 (Palau).

Geographic range.—Breeds in northeastern Asia. Winters south to Melanesia. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—Finsch (1875:41) states that Heinsohn and Kubary obtained specimens of this tern from the Palau Islands for the

Godeffroy Museum. These are the only records for the occurrence of the Black-billed Common Tern in Micronesia.

Sterna sumatrana sumatrana Raffles

Black-naped Tern

Sterna Sumatrana Raffles, Trans. Linn. Soc. London, 13, pt. 2, 1822, p. 329. (Type locality, Sumatra.)

Sterna melanauchen Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 306, 308 (Guahan, Ouleai); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 113 (Pelew, Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 41 (Palau); *idem,* Ibis, 1880, pp. 220, 330, 332 (Taluit); *idem,* Journ. f. Ornith., 1880, p. 295 (Ponapé); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem,* Ibis, 1881, pp. 113, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 299, 330, 353 (Ponapé, Mortlock, Nukuor, Ruk); Salvadori, Ornith. Papuasia, 3, 1882, p. 444 (Pelew, Mackenzie, Ruk, Ponapé, Marshalls); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 74 (Pelew, Uap, Ruk, Luganor, Nukuor, Ponapé, Taluit); Sanders, Cat. Birds British Mus., 25, 1896, p. 126 (Carolines, Pelews, Marshalls); Nehrkorn, Kat. Eiers., 1899, p. 222 (Palau); Hartert, Novit. Zool., 7, 1900, p. 10 (Ruk); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Ruk, Ponapé); Uchida, Annot. Zool. Japon., 9, 1918, pp. 483, 488 (Ponapé).

Sterna sumatrana Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 186 (Arhno).

Gygisterna sumatrana Kuroda, in Momiyama, Birds Micronesia, 1922, p. 52 (Pelew, Mackenzie, Yap, Ruk, Luganor, Nukuor, Ponapé, Taluit, Arhno).

Gygisterna sumatrana sumatrana Kuroda, Avifauna Riu Kiu, 1925, p. 192 (Carolines, Pelews).

Sterna sumatrana sumatrana Yamashina, Tori, 7, 1932, p. 410 (Aruno); Hachisuka, Birds Philippines, 2, 1932, p. 335 (Caroline, Pelew); Hand-list Japanese Birds, rev., 1932, p. 195 (Palau, Guam, Saipan, Yap, Truk, Lukunor, Nukuoro, Ponapé, Jaluit, Namu, Arhno, Majuro, Aurh); Peters, Check-list Birds World, 2, 1934, p. 336 (Caroline Islands); Mayr, List New Guinea Birds, 1941, p. 36 (Micronesia); Hand-list Japanese Birds, 3d ed., 1942, p. 218 (Babelthuap, Koror, Yap, Truk, Lukunor, Nukuoro, Ponapé, Jaluit, Namu, Arhno, Majuro, Aurh); Mayr, Birds Southwest Pacific, 1945, p. 24 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 55 (Peleliu, Ulithi).

Geographic range.—Micronesia, central Polynesia, northern Australia, Malaysia, west to India, and north to the Riu Kiu Islands. In Micronesia: Palau Islands—Babelthuap, Koror, Peleliu; Caroline Islands—Yap, Ulithi, Truk, Lukunor, Nukunro, Ponapé; Marshall Islands—Jaluit, Namu, Majuro, Aurh, Bikini.

Characters.—Adult: A small tern with a long, forked tail and white plumage often with pinkish cast except for mantle, back, rump, tail, wing-coverts, and scapulars which are pale pearl-gray; band across nape, spot in front of eye, and outer web of outer primary black; bill and feet black.

Immature: Resembles adult, but black and white mottling on upper parts.

Measurements.—Measurements are listed in table 19.

Specimens examined.—Total number, 15 (8 males, 6 females, 1 female?), as follows: Palau Islands, AMNH—exact locality not given, 4 (Oct.-Dec.); Caroline Islands, USNM—Ulithi Atoll, 6 (Aug. 15, 16, 20, 22); AMNH—Truk, 1 (Feb. 10); Marshall Islands, USNM—Bikini, 4 (March 26, April 30).

Nesting.—Nehrkorn (1899:222) recorded eggs taken at the Palau Islands. Yamashina (1932a:410) listed the finding of three nests containing one egg each on September 26, 1931, at Arhno in the Marshall Islands. The NAMRU2 party obtained no evidence of nesting at Ulithi or Palau in August and September, 1945. Coultas (field notes) obtained reports of the finding of two eggs at the Palau Islands in the period October to December, 1931.

Parasites.—Uchida (1918:483, 488) records the following Mallophaga taken at Ponapé from this tern: *Docophorus albemarlensis, Colpocephalum mileri,* and *Colpocephalum impertunum.*

Remarks.—There are no records for the Black-naped Tern from the Mariana Islands, although the species is known from the Palau, Caroline and Marshall Islands. At Ulithi Atoll, the NAMRU2 party observed these terns at the islands of Potangeras, Mangejang, Pau, and Losiep in August, 1945. They were found in groups of 4 to 15, either sitting on sandy beaches or rocky exposures or flying over the reefs. Unlike the Crested Tern, these birds appeared quite unafraid of man and would hover over a freshly killed or wounded individual of their own kind, making of themselves easy targets. The writer saw only one Black-naped Tern at the Palau Islands (Peleliu, on September 16, 1945). The birds seem to prefer the "low" atolls to the "high" volcanic islands of Micronesia.

Two subspecies of *Sterna sumatrana* are recognized by Peters (1934:336): *Sterna sumatrana mathewsi* known from islands of the western Indian Ocean and *Sterna s. sumatrana* from islands of Oceania, Australia, Malaysia, and China coast. There is a considerable area separating these subspecies. For populations in the Pacific area, other names which have been proposed are *Sterna sumatrana kempi* Mathews for birds from Torres Straits and *Gygis decorata* Hartlaub for birds from the Fiji Islands. A study of 201 specimens of this species from various parts of its range (in the collections of the American Museum of Natural History and the United States National Museum) shows that there is little color variation within the species. This observation is the same as that of Mathews (1912: 372).

As listed in table 19, measurements of the length of the wing show little variation. The length of the tail of birds from localities more remote from the continent of Asia (Micronesia, Phoenix, Union, Fiji, Samoa, Tonga, and the islands of the Indian Ocean: Aldabra and Providence) is, on the average, shorter than the length of the tail of birds from islands nearer the Asiatic mainland. This shortness is reflected also in the measurement of the difference between the shortest and longest tail feather.

TABLE 19. MEASUREMENTS OF SPECIMENS OF *Sterna sumatrana*

LOCALITY	No.	Wing	Tail	Difference: Longest and shortest tail feather	Exposed culmen	Tarsus
S. s. sumatrana Micronesia........	13	221 211-225	127 117-138	65 54-79	37 35-39	20.5 20.0-21.0
Phoenix and Union	5	228	113	66	37 36-38	19.5 18.5-20.0
Fiji, Samoa, Tonga	29	221 218-229	131 122-142	63 51-74	38 36-41	20.0 18.0-21.0
New Caledonia, Loyalty, New Hebrides	8	224 221-230	141 135-148	72 68-81	39 37-41	19.5 18.5-20.0
Queensland, Torres Straits	4	229	142 139-148	78 71-83	38 36-40	19.5 18.5-20.0
Solomons..........	52	227 220-232	144 129-162	77 66-95	36 34.0-38.5	19.0 18.5-20.5
New Guinea, Bismarcks	10	224 219-231	143 135-146	76 67-81	34 32.0 36.5	19.5 18.5-20.0
Malay area........	49	228 220-234	141 125-153	74 63-84	34 32.0-37.0	20.0 19.0-20.5
China coast, Riu Kiu	21	223 212-234	144 130-151	77 67-85	35 31.5-38.0	19.5 19.0-20.0
S. S. mathewsi Indian Ocean: Aldabra, Providence	10	220	125	71	38 35.0-40.0	19.0 18.0-20.0

The differences in the length of the exposed culmen of these terns shows that birds from islands more remotely oceanic possess longer bills than do those from islands closer to the Asiatic continent. Murphy (1938:538) has written that this phenomenon is characteristic among some species which have both continental and insular populations (or subspecies). Figure 10 shows the southeastern part of the range of the subspecies, *Sterna s. sumatrana*, and gives the average measurements of the exposed culmen of birds from several localities.

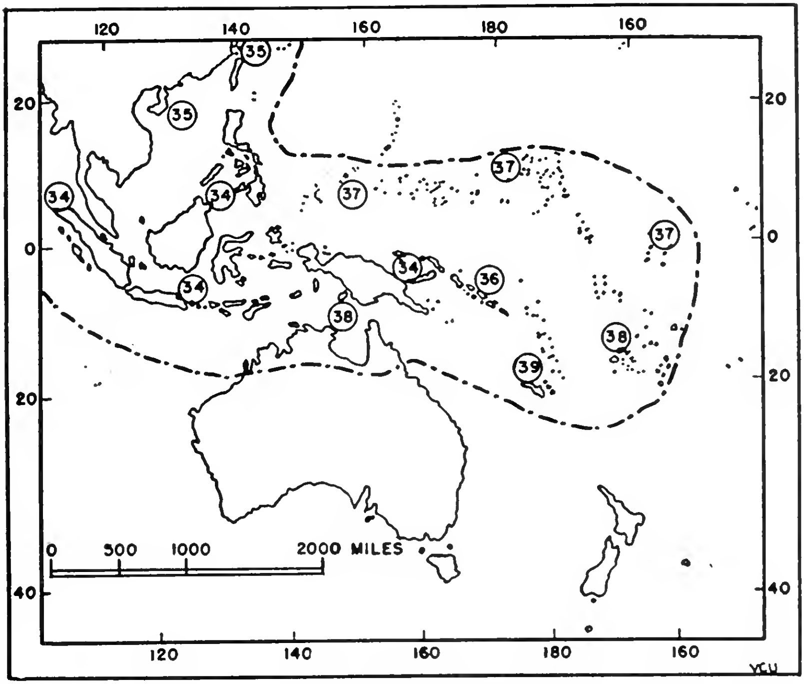

FIG. 10. Geographic variation in the average length of the exposed culmen of *Sterna sumatrana sumatrana*.

These localities are given in table 19. Terns with longer bills (37-39) were taken in Micronesia, in the Polynesian islands, and in northern Australia. Terns with shorter bills (34-36) were taken in Melanesia, Malaysia, and the coastal region of China, but there appears to be no abrupt line of demarkation between them. Further evidence of this tendency may be obtained from the literature. Kuroda (1925: 191) gives the measurements of the exposed culmen of seven males and five females from the Riu Kius as averaging 35 mm. (range 31-40.5). It is also of interest to note that the length of the exposed culmen of the males averages one to two mm. longer than that of the females. The status of *Sterna sumatrana mathewsi* may be questioned. I find no characters separating my series of mostly poor specimens. The systematic position of this subspecies from the Indian Ocean (and likewise the status of subspecies of other sea birds which range into the Indian Ocean) may not be known with certainty until additional material is obtained.

Sterna lunata Peale

Spectacled Tern

Sterna lunata Peale, U. S. Expl. Exped., 8, 1848, p. 277. (Type locality, Vincennes Island, Paumotu Group.)

Sterna lunata Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 831 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 90, 113 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 41 (Palau); Saunders, Cat. Birds British Mus., 25, 1896, p. 100 (Pelew); Takatsukasa and Kuroda, 1, 1915, p. 62 (Ruk, Pelew); Hand-list Japanese Birds, rev., 1932, p. 195 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 218 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 26 (Micronesia).

Onychoprion lunatus Salvadori, Ornith. Papuasia, 3, 1882, p. 451 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 76 (Pelew).

Melanosterna lunata Kuroda, in Momiyama, Birds Micronesia, 1922, p. 52 (Pelew).

Geographic range.—Breeds in Oceania from the Hawaiian Group south to Fiji and the Tuamotus and west to the Moluccas. In Micronesia: Palau Islands—exact locality not known.

Remarks.—Finsch (1875:41) recorded specimens taken by Tetens, Peters and Kubary at the Palau Islands. Coultas obtained one immature male at sea south of the eastern Caroline Islands at 1° 25′ N and 159° E on October 19, 1930. The Spectacled Tern ranges throughout the tropical Pacific, spending considerable time at sea, and probably reaches most parts of Micronesia in its travels.

Sterna anaetheta anaetheta Scopoli

Bridled Tern

Sterna Anaethetus Scopoli, Del. Flor. et Faun, Insubr., fasc. 2, 1786, p. 92. (Type locality, "In Guinea" = Panay, Philippine Islands, *ex.* Sonnerat.)

Sterna anaestheta Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Pelew).

Melanosterna anaestheta anaestheta Kuroda, in Momiyama, Birds Micronesia, 1922, p. 52 (Pelew).

Sterna anaethetus anaethetus Hand-list Japanese Birds, rev., 1932, p. 195 (Palau); Yamashina, Tori, 10, 1940, p. 678 (Bikar); Hand-list Japanese Birds, 3d ed., 1942, p. 218 (Palau. Bikar).

Sterna anaetheta anaetheta Mayr, Birds Southwest Pacific, 1945, p. 26 (Palau).

Geographic range.—Breeds from Malaysia to Australia and Oceania and north to Formosa. Ranges west to Ceylon and north to Japan. In Micronesia: Palau Islands—exact locality not known; Marshall Islands—Bikar.

Measurements.—Four adult males from the Palau Islands have the following measurements: wing 246-254, longest tail feather 147-177, shortest tail feather 71-72, exposed culmen 40-44, tarsus 21-23; one adult female: wing 266, exposed culmen 40.5, tarsus 22.5.

Specimens examined.—Total number, 7 (4 males, 3 females) from Palau Islands, AMNH—exact locality not given (Dec. 20).

Remarks.—The Bridled Tern is known from the Palau Islands and from Bikar in the Marshall Islands. In Micronesia, the species apparently reaches the northeastern extent of its range. In the Palaus, Coultas found the terns on small outlying islands. He observed them to fly to sea early in the day and to return to the islands in the evening. Of the seven specimens obtained by him, two males and one female had enlarged gonads (Dec. 20).

Sterna fuscata oahuensis Bloxham

Sooty Tern

Sterna Oahuensis Bloxham, Voy. "Blonde," 1826, p. 251. (Type locality, Oahu, Hawaiian Islands.)

Sterna fuliginosa Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 39 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem*. Journ. f. Ornith., 1880, p. 295 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Ponapé).

Onychoprion fuscata infuscata Kuroda, in Momiyama, Birds Micronesia, 1922, p. 51 (Ponapé).

Sterna fuscata nibilosa Hand-list Japanese Birds, rev., 1932, p. 195 (Ponapé); Yamashina, Tori, 10, 1940, p. 677 (Helen Reef); Hand-list Japanese Birds, 3d ed., 1942, p. 218 (Ponapé, Helen Reef).

Sterna fuscata oahuensis Mayr, Birds Southwest Pacific, 1945, p. 25 (Micronesia).

Geographic range.—Breeds from the Hawaiian, Marcus, and Bonin islands south to the Phoenix Islands and Micronesia. In Micronesia: Mariana Islands—Asuncion; Palau Islands—Helen Reef; Caroline Islands—Ponapé.

Specimens examined.—Total number, 1 unsexed from Mariana Islands, AMNH—Asuncion (Jan. 18).

Remarks.—The systematic position of the Sooty Tern in Micronesia is uncertain; in using this name I am following Peters (1934: 338), who comments that the species "is badly in need of revision." Coultas obtained one immature female at 0° 9′ S and 159° 50′ E, a position south of the eastern Caroline Islands. The bird is tentatively placed in the subspecies *S. f. oahuensis*. The Sooty Tern probably does not breed in large numbers in Micronesia, unless it be in the northern Marianas. Bryan (1903:97) reports that this species is very abundant at Marcus Island, which is north and east of the Marianas.

Sterna albifrons sinensis Gmelin

Least Tern

Sterna sinensis Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 608. (Type locality, China, *ex* Latham.)

Sterna albifrons Marshall, Condor, 51, 1949, p. 221 (Saipan).

Geographic range.—Found on coastal areas from Korea and China south to New Guinea. In Micronesia: Mariana Islands—Saipan.

Specimens examined.—One female from Mariana Islands, USNM—Saipan (Sept. 26).

Remarks.—Marshall (1949:221) took one of two Least Terns at Lake Susupe on Saipan on September 26, 1945. The specimen taken, a female, is in post juvenal molt.

Thalasseus bergii pelecanoides (King)

Crested Tern

Sterna pelecanoides King, Surv. Intertrop. and Western Coasts Australia, 2, 1827, p. 422. (Type locality, Torres Strait, northern Queensland.)

Sterna bergii Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 50 (Palau); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem*, Ibis, 1880, pp. 330, 332 (Ratak Chain); *idem*, Journ. f. Ornith., 1880, p. 295 (Ponapé); *idem*, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem*, Ibis, 1881, pp. 113, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 299, 330, 353 (Ponapé, Mortlock, Nukuor, Ruk); Salvadori, Ornith. Papuasia, 3, 1882, p. 434 (Ruk, Ponapé, Marshalls); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 51 (Jaluit); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 74 (Pelew, Luganor, Nukuor, Ruk, Ponapé, Marshall Islands); Hartert, Novit. Zool., 7, 1900, p. 10 (Ruk); Saunders, Cat. Birds British Mus., 25, 1896, p. 89 (Ponapé, Marshalls); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Ponapé); Uchida, Annot. Zool. Japon., 9, 1918, pp. 483, 488 (Ponapé).

Sterna bergeri Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln).

Sterna bergii cristata Stresemann, Novit. Zool., 21, 1914, p. 58 (Truk).

Thalasseus bergii pelecanoides Oberholser, Pros. U. S. Nat. Mus., 49, 1915, p. 523 (Marshall Islands); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 51 (Luganor, Nukuor, Ruk, Ponapé, Marshall Islands); Kuroda, Avifauna Riu Kiu, 1925, p. 188 (Marshall Islands); Hand-list Japanese Birds, rev., 1932, p. 194 (Palau, Faraulep, Truk, Lukunor, Mukuoro, Ponapé, Jaluit, Mille, Aurh, Maloelab, Ailuk); Yamashina, Tori, 10, 1940, p. 677 (Helen Reef, Babelthuap); Hand-list Japanese Birds, 3d ed., 1942, p. 218, (Babelthuap, Helen Reef, Faraulep, Truk, Lukunor, Nukuoro, Ponapé, Jaluit, Mille, Aurh, Maloelab, Ailuk).

Thalasseus bergii cristatus Peters, Check-list Birds World, 2, 1934, p. 342 (Carolines, Marshalls); Mayr, Birds Southwest Pacific, 1945, p. 26 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 55 (Peleliu, Ngajangel [Kayangel], Truk).

Geographic range.—Malaysia and east coast of Australia south to Tasmania, east to Melanesia and Polynesia, north to Phoenix Islands and Micronesia (see figure 11). In Micronesia: Palau Islands—Helen Reef, Peleliu, Babelthuap; Caroline Islands—Ulithi, Truk, Faraulep, Lukunor, Nukuoro, Ponapé; Marshall Islands—Jaluit, Mille, Aurh, Moloelab, Ailuk, Bikini.

Characters.—Adult: A large, white tern with back, rump, tail, wing-coverts, wing, and axillaries pearl gray; outer edges of primaries pearly grayish-black; crown black with crest; bill greenish-yellow with blackish base; feet black. Crown black, mottled with white and mantle paler in postnuptial plumage.

Immature: Resembles adult, but crown and back dark, mottled with white and crest small.

Measurements.—Measurements of Crested Terns of the Pacific area are listed in table 20.

Specimens examined.—Total number, 10 (6 males, 4 females), as follows: Caroline Islands, USNM—Ulithi, 1 (Aug. 21); AMNH—Truk, 2 (May 7, Dec. 5)—Ponapé, 3 (Nov. 1, 7); Marshall Islands, USNM—Bikini, 4 (March 4, 11, 12).

Parasites.—Uchida (1918:483, 488) obtained the following species of bird lice (Mallophaga) from the Crested Tern at Ponapé: *Docophorus albemarlensis* and *Colpocephalum importunum*.

Remarks.—Oberholser (1915:520-526, pl. 66) lists five subspecies (*T. b. cristatus*, *T. b. halodramus*, *T. b. pelecanoides*, *T. b. rectirostris*, and *T. b. poliocercus*) in the region including the coast of

China, the Riu Kiu Islands, Malaysia, Melanesia, eastern Australia, Polynesia, and Micronesia. Only one subspecies, *T. b. cristatus*, is recognized in this area by Stresemann (1914:58), Hartert (1921: 1695-1696), and Peters (1934:341-342), who mention that there is much variation in size and coloring. Measurements, as shown in table 20, indicate a wide range of sizes but, in most series, the aver-

TABLE 20. MEASUREMENTS OF *Thalasseus bergii* IN THE PACIFIC AREA

LOCATION	No.	Wing	Longest tail feather	Shortest tail feather	Exposed culmen	Tarsus
Thalasseus bergii pelecanoides						
Palaus, Carolines, Marshalls	6	343 334-352	168 153-184	82 80-85	60 58-65	....
Christmas, Phoenix, Tuamotus, Society, Fiji, Loyalty, New Hebrides	48	344 329-362	170 145-198	83 77-92	58 54-64	27 25-29
Eastern Australia..	14	345 338-349	165 152-174	88 84-92	58 55-63	27 26-29
New Guinea, Bismarck Archipelago, Moluccas	18	342 332-361	168 144-194	81 75-87	59 53-64	27 26-28
Totals........	86	344 329-362	169 144-198	83 75-92	58 53-65	27 25-29
Thalasseus bergii cristatus						
Philippines, China, Formosa, Riu Kius	18	332 324-342	162 149-182	81 78-87	58 55-64	28 26-30
Thalasseus bergii gwendolenae						
Western Australia..	14	354 339-369	171 162-182	86 81-91	58 53-65	27 25-29

ages are nearly the same. Nevertheless, it is evident that birds from the coast of China, the Riu Kius, Formosa, and the Philippines have a distinctly shorter wing than birds from the Moluccas, Melanesia, eastern Australia, Polynesia, and Micronesia. Further evidence of this is presented by Kuroda (1925:186) who lists the measurements of the wing of eight Crested Terns from the Riu Kiu Islands as 322 to 340 (average 330). The occurrence of populations with shorter wings has already been pointed out in the work of Oberholser (1915:520-526), who divided the short-winged birds into two subspecies. It seems advisable to recognize but one subspecies, *T. b.*

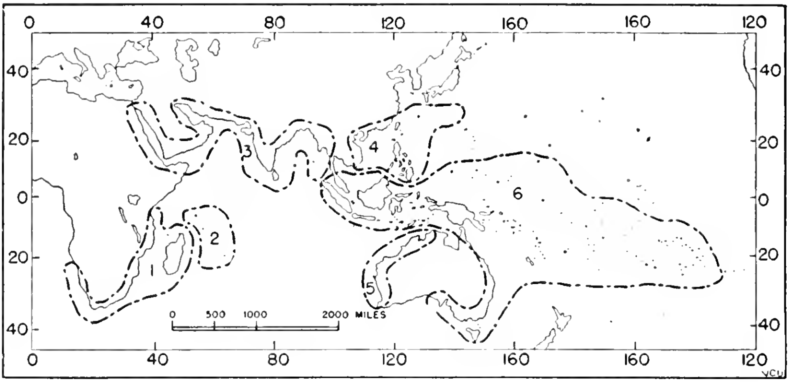

FIG. 11. Geographic distribution of *Thalasseus bergii.* (1) *T. b. bergii;* (2) *T. b. thalassinnus;* (3) *T. b. velox;* (4) *T. b. cristatus;* (5) *T. b. gwendolenae;* (6) *T. b. pelecanoides.*

cristatus, for the birds with short wings and another subspecies, *T. b. pelecanoides,* to include the birds with the longer wings (see figure 11). The average measurements of the length of wings of these two subspecies, 332, and 344, differ significantly, although there is some overlap in measurements. A few specimens at hand from the western part of Malaysia are in poor condition and not measurable.

Most specimens of *T. b. cristatus* and *T. b. pelecanoides* have lighter-colored upper parts than specimens of *T. b. velox,* but not so light-colored as specimens of *T. b. gwendolenae.* Size probably is a better character than color to use in separating these groups.

In Micronesia, the NAMRU2 party observed Crested Terns at Ulithi, Peleliu and Truk, in August, September, and December, 1945, respectively. Birds were seen as singles or in small groups flying over the reefs. The birds were wary and difficult to approach, but they were conspicuous and easily identified.

Procelsterna cerulea saxatilis W. K. Fisher

Blue-gray Tern

Procelsterna saxatilis W. K. Fisher, Proc. U. S. Nat. Mus., 26, 1903, p. 559. (Type locality, Necker Island, Hawaiian Islands.)

Procelsterna cerulea saxatilis Yamashina, Tori, 10, 1940, p. 678 (Bikar); Hand-list Japanese Birds, 3d ed., 1942, p. 219 (Bikar); Mayr, Birds Southwest Pacific, 1945, p. 27 (Micronesia).

Geographic range.—Known from Marcus Island and the western Hawaiian Islands. In Micronesia: Marshall Islands—Bikar.

Remarks.—Yamashina (1940:678) recorded the taking of eight of these terns (5 adult males, 3 adult females) on July 10, 1932, at Bikar in the Marshall Islands. He gives the following measurements: wing, 180.5-188; tail, 104-113.5; exposed culmen, 24-26.5. This is the only known record for the species in Micronesia.

Anous stolidus pileatus (Scopoli)

Common Noddy

Sterna pileata Scopoli, Del. Flor. et Faun. Insubr., fasc. 2, 1786, p. 92. (No type locality = Philippines, *ex.* Sonnerat.)

Sterna stolida Chamisso, in Kotzebue's Voy. "Rurick," 3, 1821, pp. 150, 157 (Marshall Islands); Kittlitz, Kupfertaf. Naturgesch. Vögel, 3, 1833, p. 27, pl. 36, fig. 1 (Mordloks-Inseln); *idem,* Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 286, 299, 308, 309 (Ualan, Lougounor, Ouleai); *idem,* Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 364, 2, pp. 77, 86 (Ualan); Wiglesworth, Ibis, 1893, p. 212 (Marshalls).

Anous stolidus Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 137 (Mortlock); *idem,* Journ. f. Ornith., 1854, p. 168 (Carolinen); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 59 (Carolines); Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 236 (Mordlocks, Puynipet = Ponapé); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); *idem,* Proc. Zool. Soc. London, 1872, pp. 90, 112 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 42 (Palau); *idem,* Journ. Mus. Godeffroy, 12, 1876, pp. 18, 40 (Ponapé); *idem,* Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); *idem,* Journ. f. Ornith., 1880, pp. 295, 307 (Ponapé, Ruck, Kuschai); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk, Ponapé, Kuschai); *idem,* Ibis, 1881, pp. 105, 109, 115, 246, 247 (Kuschai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 330, 353 (Mortlock, Nukuor, Ruk); Salvadori, Ornith. Papuasia, 3, 1882, p. 455 (Pelews, Carolines, Marshalls); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 51 (Jaluit, Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 76 (Pelew, Mortlock, Ruk, Nukuor, Ponapé, Ualan, Marshalls); Saunders, Cat. Birds British Museum, 25, 1896, p. 136 (Pelew, Carolines, Marshalls); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 59 (Saypan, Guam, Rota, Agrigan, Hogoleu = Truk, Kushai, Ponapi, Marshalls); Hartert, Novit. Zool., 5, 1898, p. 68 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 21 (Guam); Safford, Osprey, 1902, p. 66 (Mariannas); Bryan, Occ. Papers Bernice P. Bishop Mus., 2, 1903, p. 101 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marshall-Inseln); Safford, The Plant World, 7, 1904, p. 267 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 100 (Marianen); Takastukasa and Kuroda, Tori, 1, 1915, p. 51 (Ponapé, Ruk); Cox, Island of Guam, 1917, p. 22 (Guam); Uchida, Annot. Zool. Japon., 9, 1918, pp. 484, 488 (Palau, Ponapé); Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Wharton and Hardcastle, Journ. Parasitology, 32, 1946, pp. 292, 296, 306 (Guam, Ulithi).

Anous pileatus Pelzeln, Reise "Novara," Vögel, 1865, pp. 155, 162 (Puynipet= Ponapé).

Anous stolidus pileatus Hartert, Novit. Zool., 7, 1900, p. 9 (Ruk); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 183 (Kusaie); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 49 (Guam, Saipan, Pelew, Mortlock, Ruk, Wolea, Nukuoro, Ponapé, Kusaie, Marshalls); Hand-list Japanese Birds, rev., 1932, p. 195 (Koror, Urukthapel, Angaur, Saipan, Guam, Wolea, Truk, Mortlock, Lukunor, Nukuoro, Ponapé, Kusaie, Jaluit, Mille, Aurh, Wotze); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Yamashina, Tori, 10, 1940, p. 678 (Assongsong, Babelthuap); Hand-list Japanese Birds, 3d ed., 1942, p. 219 (Saipan, Assongsong, Guam, Babelthuap, Koror, Urukthapel, Peliliu, Angaur, Wolea, Truk, Mortlock, Lukunor, Nukuoro, Ponapé, Kusaie, Taluit, Mille, Aurh, Wotze); Borror, Auk, 1947, p. 417 (Agrihan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 56 (Rota, Guam, Peleliu, Ngabad, Ulithi, Truk).

Anous stolidus unicolor? Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 547 (Guam).

TABLE 21. MEASUREMENTS OF *Anoüs stolidus* OF THE PACIFIC AREA

LOCATION	No.	Wing	Tail	Exposed culmen
Anoüs stolidus ridgwayi				
Isabella, Cocos, Clipperton Islands....	18	278 260–295	158 147–166	41 38–42
Anoüs stolidus galapagensis				
Galapagos Islands..................	11	277 2 4–282	151 142–160	40 38–42
Anoüs tolidus pileatus				
Hawaiian Islands: Nihoa to Mi way...	35	281 268–299	162 149–176	42 38–40
Wake Islands......................	8	278 273–285	159 152–170	41 39–43
Mariana Islands: Guam, Rota........	12	280 275–:88	167 159–187	41 39–43
Palau Islands......................	9	278 268–283	161 155–166	41 39–42
Caroline Islands....................	41	282 270–291	164 :50–173	42 39–45
Marshall Islands....................	3	282 270–289	164 154–174	42 41–43
Ellice, Phoenix, Danger, Suvarov Islands	27	284 265–295	162 152–174	41 39–44
Christmas Island....................	13	287 280–292	162 152–174	43 40–46
Marquesas Islands..................	19	282 275–291	163 155–170	42 40–43
Tuamotu Archipelago...............	38	287 277–299	165 154–173	42 39–46
Society, Austral, Cook, Rapa Islands..	16	290 2 3 –301	164 155–173	43 40–45
Oeno, Henderson, Ducie, Easter Islands	6	293 285–298	164 154–175	44 41–45
Samoa, Fiji, Tonga..................	19	285 277–295	164 153–173	42 39–44
Kermadecs, Norfolk.................	23	276 269–289	158 148–173	41 38–43
New Hebrides, Solomons, New Guinea area............................	31	278 265–287	158 150–172	41 3 –44

TABLE 21.—*Concluded*

LOCATION	No.	Wing	Tail	Exposed culmen
Northwest Australia	9	263 258–267	145 138–152	40 38–42
South China Sea area, Strait of Malacca	4	271 262–278	153 148–257	39 37–40
Riu Kius, Japan	5	268 259–275	148 143–155	39 37–40
Indian Ocean area: Seychelles. Aldbra, Providence, Somaliland	20	276 270–286	154 146–164	41 39–42

Geographic range.—Islands in the Indian Ocean east to tropical parts of western and central Pacific. In Micronesia: Mariana Islands—Agrihan, Asuncion, Saipan, Rota, Guam; Palau Islands—Kayangel, Babelthuap, Koror, Urukthapel, Ngabad, Peleliu, Angaur; Caroline Islands—Ulithi, Truk, Wolea, Mortlock, Lukunor, Nukuoro, Ponapé, Kusaie; Marshall Islands—Jaluit, Mille, Aurh, Wotze, Bikini, Kwajalein.

Characters.—Adult: A large, dark-brown tern with grayish crown and whitish forehead; line above eye white; crescent of white on lower eyelid; lores blackish; bill black; feet brownish, iris dark.

Immature: Resembles adult, but lighter and browner and top of head grayish-brown.

A. s. pileatus resembles *A. s. ridgwayi,* but darker and less brownish, although not so dark as *A. s. galapagensis;* forehead and crown usually duller; length of wing and tail average larger (282 and 161) than in *A. s. ridgwayi* (278 and 158) and *A. s. galapagensis* (277 and 151).

Measurements.—Measurements of the Common Noddy of the Pacific area are listed in table 21.

Weights.—In 1948 (1948:56) I listed the weights of specimens from Guam and Rota as follows: four adult males 187-204 (197); three adult females 177-203 (189).

Specimens examined.—Total number, 92 (43 males, 39 females, 10 unsexed), as follows: Mariana Islands, USNM—Guam, 7 (May 24, June 15, July 6, 21)—Rota, 3 (Oct. 18, 24); AMNH—Guam, 4 (April 21, 27, Aug. 18)—Asuncion, 1 (Jan. 18); Palau Islands, USNM—Peleliu, 2 (Sept. 1)—Ngabad, 1 (Sept. 11); AMNH—exact locality not given, 6 (Nov. 3, 8); Caroline Islands, USNM—Ulithi, 3 (Aug. 15)—Kusaie, 1 (Feb. 8); AMNH—Truk, 15 (Feb. 1, 8, 25, March 10, May 6, June 12, 13, Nov. 25, Dec. 25)—Ponapé, 20 (Dec. 3, 5, 8, 12, 15)—Kusaie, 24 (Jan., March 10-30, April 1-10); Marshall Islands, USNM—Bikini, 5 (Feb. 28, March 2, 19).

Nesting.—Murphy (1936:1152) writes that the Atlantic subspecies, *A. s. stolidus,* breeds in tropical localities every month of the year, although there may be a part of the resident population away at sea at any given time. In the Pacific area, Kirby (1925:187) found nests "on platforms of sticks built on tufts of grass" at Christmas Island in August. In Micronesia, Coultas obtained young birds at Kusaie in January and April and commented (field notes) that they probably nest "spasmodically at all times of the year." At Ponapé, Coultas observed nests in high trees in December, and birds obtained by him in that month had enlarged gonads. At Bikini, Morrison obtained eggs on March 2 and 19, and young on March 19. At Palau, Coultas took one female tern in postnatal molt on November 8. Adults obtained by him in that month had enlarged gonads. At Ulithi, the NAMRU2 party recorded one nest containing a single egg on August 21. At the same atoll the NAMRU2 party received reports of a large colony of nesting noddys in May to July, 1945. In the following August few noddies were seen by the NAMRU2 party. McElroy found nests on cliffs and in coconut trees at Truk in December, 1945. Hartert (1900:10) reports on eggs taken at Truk in the period from March to July 1. The NAMRU2 party observed birds carrying nest materials at Peleliu on August 28 but failed to find the nests. At Guam, the writer found terns in numbers varying from 4 to 75 in May to July, 1945, along the rocky cliffs but no evidence of nesting activity was obtained. Strophlet (1946:537) reports that nests may have been present on Orote Peninsula at Guam on December 13, 1945. Coultas (field notes) is of the opinion that the birds do not nest at Guam but do nest farther north in the Marianas. Borror (1947:417) found two colonies at Agrihan on August 10, 1945. Thus, there are records of nesting in nine months of the year in Micronesia; although I suspect that the larger flocks of terns have more regular breeding habits correlated with their pelagic feeding activities. "Stragglers" probably nest irregularly.

Food habits.—The author (1948:56) records small fish and crustaceans in stomachs of terns taken at Ulithi and Peleliu. At Ypao Point, Guam, birds were seen to fly back and forth in the day from their roosts on the sea-cliffs. On one occasion I saw these birds feeding approximately a half mile from shore.

Parasites.—Wharton (1946:174) and Wharton and Hardcastle (1946:292, 296, 306) list the following species of chiggers (Acarina) from the Common Noddy from Guam and Ulithi: *Neoschöngastia bougainvillensis, N. americana solomonis, N. egretta, Acariscus pluvius,* and *A. anous.* Uchida (1918:484, 488) found the bird louse (Mallophaga), *Nirmus separatus,* on terms at Palau and at Ponapé he found *Colpocephalum milleri* on the bird. Bequaert (*in litt.*) has identified a fly (Hippoboscidae) as *Olfersia aenescens* from a tern from Rota.

Remarks.—Of the Common Noddy Tern of the Pacific area, three subspecies are recognized by Peters (1934:346-347). *Anoüs stolidus ridgwayi* is known from islands off the western coast of Mexico and Central America; *A. s. galapagensis is* recorded from the Galapagos Archipelago; and *A. s. pileatus* is found on tropical islands throughout the Pacific and west to Madagascar and the African coast in the Indian Ocean. These subspecies differ from one another principally in color, as noted by Ridgway (1919:545); *A. s. galapagensis* is the darkest form, *A. s. ridgwayi* is less blackish and more brownish in color of body, and *A. s. pileatus* is between the two in coloring. *A. s. pileatus* averages larger in length of wing and tail, but these measurements do not appear to be significant from a taxonomic standpoint.

As shown in table 21, measurements of length of wing for specimens from throughout most of the Pacific area are almost the same. Length of tail is correspondingly uniform. There is a gradual increase in size of birds in the Tuamotus and Societies and east to Easter Island. In this region the average measurement for length of wing is 293 millimeters. The lengths of wing and tails are shorter in specimens from the Kermadecs and Norfolk Island, which may indicate relationships with the smaller birds of the Australian area, Western Melanesia and possibly Malaysia and the Riu Kiu Islands. I am unable to determine the subspecific status of the birds from the Kermadecs and Norfolk Island, because of the lack of sufficient material from the Australian region and Malaysia. Possibly Mathews' name, *A. s. gilberti,* is valid for the noddys of Australia and also for the birds at Norfolk and the Kermadecs. The small-sized birds of the Riu Kiu Islands have been designated as *A. s. pullus* by Bangs. When specimens from the type locality of *A. s. pileatus* in the Philippine Islands are available, the true relationships of the populations from Micronesia and the other areas in the Pacific can be ascertained.

The tern found in the Hawaiians has the palest body and the most chalky-white forehead of any of the birds of the Pacfiic. Bryan (1903:101) found terns from Marcus Island to agree with specimens from Guam and to be "slightly darker" than birds from Midway and Laysan in the Hawaiian chain. The birds from the Riu Kius are darker and thus similar to the few specimens seen from Malaysia. Birds from Polynesia and Melanesia possess the most sooty underparts while those from Micronesia are only slightly less pale. This condition also seems to be true for the birds in the Australian area and for specimens seen from islands in the Indian Ocean. With fading, or wear, or both, there is a change from dusky black to dusky brown in the plumage; effort was made by me to compare specimens with reltaively similar conditions of plumage. In summary, the systematic position of the Common Noddy Terns of the Pacific seemingly depends on the characteristics of specimens from the type locality in the Philippines. When topotypes are available for study, they may be found to be nearer the darker forms of Malaysia or may tend toward the paler, oceanic forms. The Hawaiian population probably is distinct.

In Micronesia the Common Noddy Tern is not a conspicuous bird except during its breeding period. Probably it spends most of its life at sea, being unlike *Gygis alba* in this respect. Large flocks seem less wary of man than are small groups and singles, which are often easily disturbed. Birds of this species appear to prefer the low atolls and offshore islets where both tall vegetation and bare ground are utilized for nesting or roosting. At Ponapé, Coultas (field notes) observed the birds to fly to sea at daybreak and to begin to return to their roosts by 4:00 pm. Wallace (field notes) observed similar activities at Kwajalein in May, 1944, where he saw approximately forty individuals in a flock with *Gygis alba.*

Anoüs stolidus is divided naturally into an Atlantic subspecies, which is distinguished by its browner color, and into several subspecies which are distinguished by their blacker color in the Pacific and Indian oceans. Whether the genus and species evolved in the Atlantic or in the Pacific region is not known. If it were the Pacific region, the center of differentiation may very well have been the islands of Oceania. There, relatively little variation is observable within populations covering a large area. To the eastward, birds along the American coast are darker or lighter, to the northward, the birds of Hawaii are paler, to the southward and southwestward, the birds are smaller and to the westward, the birds are smaller and darker. The virtual absence of ground-living, predatory animals which might prey on nesting colonies has probably been a reason for the lack of discrimination by this tern in selecting breeding sites. This is probably true of other birds which nest in colonies.

Anous tenuirostris marcusi (Bryan)

White-capped Noddy

Micranous marcusi Bryan, Occ. Papers Bernice P. Bishop Mus., 2, 1903, p. 101. (Type locality, Marcus Island.)

Sterna tenuirostris Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 286, 308 (Ualan, Ouleai); *idem,* Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 64 (Ualan).

Anous tenuirostris Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 113 (Pelew, Carolines); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 42 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 330 (Mortlock, Nukuor); Stott, Auk, 64, 1947, p. 526 (Saipan).

Anous melanogenys Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Palau); *idem,* Journ. f. Ornith., 1880, pp. 295, 308 (Ponapé, Kuschai); *idem,* Ibis, 1880, pp. 219, 220, 332 (Taluit, Arno); *idem,* Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem,* Ibis, 1881, pp. 107, 109, 115 (Kuschai, Ponapé); Salvadori, Ornith. Papuasia, 3, 1882, p. 456 (Pelew, Ponapé, Marshalls); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 52 (Jaluit, Arno, Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no.

6, 1890-1901 (1891), p. 77 (Pelew, Ualan, Ponapé, Nukuor, Luganor, Ruk); Hartert, Katalog Vogelsamml. Senckenb., 1891, p. 238 (Ualan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 62 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 50 (Pelew, Ruk, Wolea, Luganor, Nukuor, Ponapé, Kusaie, Marshalls).

Anous leucocapillus Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 781 (Ponapé); Nehrkorn, Journ. f. Ornith., 1879, p. 410 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeoffry, 1881, p. 281 (Ponapé); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 52 (Jaluit); Tristram, Cat. Coll. Birds, 1889, p. 10 (Pelew); Salvadori, Ornith. Papuasia, 3, 1882, p. 457 (Pelew); Wiglesworth, Abhandl. und Ber Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 77 (Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 60 (Saypan, Palaos, Ruk, Luganor, Nukuor, Ponapi, Kuschai, Bonham); Hartert, Novit. Zool., 5, 1898, p. 68 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 20 (Saipan?); Safford, Osprey, 1902, p. 66 (Marianas); *idem*, The Plant World, 7, 1904, p. 267 (Guam); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Cox, Island of Guam, 1917, p. 22 (Guam).

Micranous leucocapillus Saunders, Cat. Birds British Mus., 25, 1896, p. 145 (Pelew, Caroline Islands); Nehrkorn, Kat. Eiers., 1899, p. 222 (Kusai); Hartert, Novit. Zool., 7, 1900, p. 9 (Ruk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 51 (Pelew).

Megalopterus minutus marcusi Mathews, Birds Australia, 2, 1912, p. 423 (Marianas?); Ridgway, Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 553 (Mariannes?); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 146 (Mariannes); Hachisuka, Birds Philippines, 2, 1932, p. 343 (Mariannes).

Megalopterus tenuirostris leucocapillus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 50 (Saipan, Pelew, Ruk, Ponapé, Kusaie).

Megalopterus minutus minutus Fisher and Wetmore, Proc. U. S. Nat. Mus., 79, 1931, p. 45 (Caroline Islands).

Anous minutus worcesteri Yamashina, Tori, 7, 1932, p. 409 (Coror, Namo, Iringlab); Hand-list Japanese Birds, rev., 1932, p. 195 (Saipan, Babelthuap, Koror, Truk, Ponapé, Kusaie, Ebon, Namorik, Jaluit, Elmore, Mille, Aurh, Wotze, Ailuk); Yamashina, Tori, 10, 1940, p. 678 (Assongsong, Saipan); Hand-list Japanese Birds, 3d ed., 1942, p. 219 (Assongsong, Saipan, Babelthuap, Koror, Peliliu, Truk, Ponapé, Kusaie, Ebon, Namorik, Jaluit, Elmore, Mille, Aurh, Wotze, Ailuk).

Anous minutus marcusi Peters, Check-list Birds World, 2, 1934, p. 347 (Caroline Islands).

Anous minutus Bequaert, Mushi, 12, 1939, p. 82 (Ponapé); *idem*, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 253 (Ponapé, Palau).

Anous tenuirostris marcusi Mayr, Birds Southwest Pacific, 1945, p. 27 (Micronesia); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 56 (Peleliu, Ulithi, Truk).

Geographic range.—Marcus, Wake, and Micronesia. In Micronesia: Mariana Islands—Asuncion, Saipan, Guam?; Palau Islands—Babelthuap, Koror, Peleliu; Caroline Islands—Ulithi, Truk, Ponapé, Luganor, Nukuor, Wolea; Marshall Islands—Ebon, Namorik, Jaluit, Elmore, Mille, Aurh, Wotze, Ailuk.

Characters.—Adult: A small tern with sooty-black plumage, grayer on rump and tail; forehead and crown white becoming grayer on nape to merge with blackish on shoulder; narrow, black superciliary stripe; lores black, lower eyelid with white streak, upper eyelid with white spot. Resembles *A. t. melanogenys* but wing and tail longer and superciliary stripe narrower. Resembles *A. t. minutus* but with narrower, black superciliary stripe.

Immature: Resembles adult, but crown more whitish, this coloration ending abruptly at nape, with mottling in some birds; plumage of body with brownish wash.

Measurements—Measurements are listed in table 22.

Specimens examined.—Total number, 51 (27 males, 22 females, 2 unsexed), as follows: Mariana Islands, AMNH—Asuncion, 1 (Jan. 18); Palau Islands, USNM—Peleliu, 2 (Sept. 9, 12); AMNH—exact locality not given, 2 (Nov. 3); Caroline Islands, USNM—Ulithi, 4 (Aug. 20); AMNH—Truk, 5 (Nov. 16, 21, 22)—Ponapé, 15 (Dec. 15)—Kusaie, 17 (Jan. 10, March 10-30, April 1-10); Marshall Islands, USNM—Bikini, 4 (May 2, 14); AMNH—no locality given, 1 (Sept. 3).

TABLE 22. MEASUREMENTS OF *Anoüs tenuirostris* OF THE PACIFIC AREA

LOCATION	No.	Wing	Tail	Exposed culmen
Anoüs tenuirostris melanogenys				
Hawaiian Islands	29	222 210–229	113 105–120	44 41–48
Anoüs tenuirostris marcusi				
Wake Islands	8	227 218–231	118 112–124	45 44–48
Mariana I lands	1	223	117	44
Palau Islands	3	228 227–228	122 117–126	43 41–45
Caroline Islands	32	229 220–240	120 113–127	4[illegible] 40–47
Marshall Islands	5	224 222–229	118 114–123	44 41–46
Anoüs tenuirostris minutus				
Christmas Island	13	227 220–234	120 108–128	44 41–46
Phoenix, Howland, Union, Danger, Suvarov Islands	9	229 226–233	119 113–124	46 42–48
Marquesas Islands	10	226 220–233	117 115–124	45 42–48
Tuamotu Archip lago	17	229 222–234	118 112–126	45 42–47
Society, Cook, Austral Islands	12	230 223–238	118 114–120	46 43–47
Samoa, Fiji, Tonga Islands	6	228 224–231	118 115–121	44 42–47
Kermadec, Norfolk Isl'ds, New Zealand	15	226 219–235	116 112–121	44 42–47
New Hebrides, Solomon, Bismarck, Admiralty Islands, New Guinea	34	229 222–237	117 109–130	43 40–46
Anoüs tenuirostris diamesus				
Clipperton, Cocos Islands	14	230 224–237	120 114–127	44 41–47

Nesting.—Few reports have been obtained concerning the nesting of the White-capped Noddy in Micronesia. Finsch (1881b:107) recorded nests, and Nehrkorn (1899:222) reported on eggs taken at Kusaie. Yamashina (1932a: 409) recorded the taking of eggs at Koror in the Palau Islands on January 19 and November 10 and in the Marshalls at Namo on October 19, and at Iringlab on October 21. No evidence of nestings was obtained by the NAMRU2 party in 1945, although a number of birds were seen at Ulithi in August. Coultas (field notes) writes that a colony of approximately 20 birds began nesting about Christmas time on a small offshore island near Ponapé. Nests were placed in the crotches of limbs of mangroves, 8 to 15 feet above the ground.

Food habits.—The NAMRU2 party found small fish in the stomachs of terns taken at Ulithi and Peleliu.

Parasites.—Bequaert (1939:82 and 1941:253) records the fly (Hippoboscidae), *Alfersia aenescens,* from the White-capped Noddy taken at Ponapé and Palau.

Remarks.—The subspecies of *Anoüs tenuirostris* are well differentiated by color and to a lesser extent by measurements. Table 22 lists measurements which show that the Hawaiian subspecies, *A. t. melanogenys,* has the shortest wing and the shortest tail whereas the subspecies from Cocos and Clipperton islands, *A. t. diamesus,* has the longest wing and the longest tail. The exposed culmen varies in length but little among the four subspecies. The systematic position of *A. t. worcesteri* from Cavilli Island in the Sula Sea has not been determined because of lack of material. In the third edition of the Hand-list of Japanese Birds (Hachisuka *et al.,* 1942:219) the birds from Micronesia are referred to *A. t. worcesteri* as they are also in other recent publications by the Japanese. Specimens from the Philippines are needed for examination to determine satisfactorily the subspecies status of the birds under consideration.

Field observations indicate that the White-capped Noddy is not abundant in the Mariana Islands. According to Oustalet (1896:60), Marche obtained a female at Saipan in June, 1888, and Yamashina (1940:678) records five adults from Assongsong (Asuncion). Owston's collectors obtained a specimen at Asuncion on January 18, 1904. In the Palaus, Carolines, and Marshalls birds of this species are numerous and have been observed or collected at many of the islands. Coultas with the Whitney South Sea Expedition obtained specimens at Kusaie, Ponapé and Palau. He found them along the shores of the large islands and, especially, on the smaller offshore islets. At Ulithi Atoll in August, 1945, the NAMRU2 party observed small flocks of four to ten individuals flying offshore and feeding inside the reef. They were frequently observed in company with *Sterna sumatrana*. Fewer birds were seen in September, 1945, at the Palau Islands by the NAMRU2 party.

Gygis alba candida (Gmelin)

White Tern

Sterna candida Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 607. (Type locality, Christmas Island.)

Gygis candida Finsch, Ibis, 1880, p. 220 (Taluit); Saunders (part), Cat. Birds British Mus., 25, 1896, p. 149 (Marshalls); Schnee, Zool. Jahrbücher, 20, 1904, p. 390 (Marschall-Inseln).

Gygis alba Finsch, Ibis, 1880, pp. 330, 332 (Taluit); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 78 (Marshalls); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 58 (Saypan, Pagan, Agrigan, Marshalls); Safford, Guam, 1912, p. 19 (Guam); Strophlet, Auk, 63, 1946, p. 537 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam); Stott, Auk, 64, 1947, p. 525 (Saipan); Baker (part), Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 57 (Guam, Rota, Saipan).

Gygis alba kittlitzi Hartert, Novit. Zool., 5, 1898, p. 67 (Saipan, Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 21 (Guam); Safford, Osprey, 1902, 66 (Marianas); *idem*, The Plant World, 7, 1904, p. 267 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 80 (Guam); Mathews (part), Birds Australia, 2, 1912, p. 443 (Marianas); Prowazek, Die deutschen Marianen, 1913, p. 100 (Marianan); Cox, Island of Guam, 1917, p. 22 (Guam); Ridgway (part), Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 559 (Mariannes)); Kuroda, Avifauna Riu Kiu, 1925, p. 193 (?Mariannes); Yamashina, Tori, 7, 1931, p. 410 (Saipan); Yamashina, Tori, 7, 1932, p. 409 (Iringlab, Namo, Aruno); Hand-list Japanese Birds (part), rev., 1932, p. 196 (Guam, Tinian, Saipan, Pagan, Agrigan, Jaluit, Mille, Aurh, Wotze, Likieb, Mejit); Yamashina (part), Tori, 10, 1940, p. 678 (Assongsong).

Gygys alba Wheeler, Report Island of Guam, 1900, p. 13 (Guam).

Gygis albus kittlitzi Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 50 (Guam, Saipan, Pagan, Agrigan, Marshalls).

Leucanous albus kittlitzi Mathews (part), Syst. Avium Australasianarum, 1, 1927, p. 143 (Marianne).

Gygis alba microrhyncha La Touche (part), Handbook Birds Eastern China, 2, 1933, p. 335 (Marianne).

Gygis alba candida Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Hand-list Japanese Birds (part), 3d ed., 1942, p. 219 (Guam, Tinian, Saipan, Pagan, Agrigan, Assongsong, Jaluit, Mille, Aurh, Wotze, Likieb, Mejit); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 94 (Tinian); Borror, Auk, 64, 1947, p. 417 (Agrihan).

Geographic range.——Northern Pacific from Bonins and Marianas east to Wake and Hawaiian Chain, south to Marshall, Phoenix, Christmas and Fanning islands (see figure 12). In Micronesia: Mariana Islands—Guam, Rota, Tinian, Saipan, Pagan, Agrihan; Marshall Islands—Jaluit, Mille, Aurh, Wotze, Likieb, Mejit, Eniwetok, Bikini, Kwajalein.

Characters.—Adult: A small tern with ivory-white plumage except for black, narrow, orbital ring; shafts of primary quills dark brown; shafts of tail feathers blackish; bill black with bluish base; tarsus dark bluish with yellowish webs; iris and skin black.

Immature: Resembles adult, but with light brown mottlings on upper parts, especially on the mantle; feathers softer, bill shorter.

Measurements.—Measurements are listed on table 23.

Weights.—The NAMRU2 party obtained weights of 11 adult males from Guam and Rota as 110 (97-124); weights of 6 adult females from Guam as 108 (100-116). These specimens were taken from May to October, 1945.

Specimens examined.—Total number, 41 (23 males, 14 females, 4 unsexed), as follows: Mariana Islands, USNM—Guam, 20 (May 24, 29, June 6, 8, 14, 15, 16, 18, 23, July 10, 19, 20)—Rota, 2 (Oct. 19, 27)—Saipan, 1 (Sept. 26); AMNH—Guam, 4 (March 7, 9, 20)—Tinian, 1 (Sept. 8)—Asuncion, 4 (Jan. 1, 18, 25); MCZ—Saipan, 3 (Jan. 7, March 20, April 17); Marshall Islands, USNM—Bikini, 6 (Feb. 27, March 2, 16, 19).

Nesting.—*Gygis alba* does not construct a nest but places its single egg rather precariously in the crotch of a branch in a tree (or on rock). In Micronesia nesting activities have been observed at various times of the year. Yamashina (1932a:409, 410) reported on eggs taken in the Marianas at Saipan on February 2 and in the Marshalls at Arhno on September 26, at Iringlab on October 21 and at Namo on October 19. At Guam a pair of White Terns was seen in a large tree on March 27, 1945, by the NAMRU2 observers. Because of their behavior, it was suspected that they had an egg or young in the tree. Further inspection revealed, on March 31, a downy young sitting in the tree. The young bird was attended by the parents until it began to fly on April 17. Hartert (1898:68) reports that eggs of the White Tern were taken at Saipan on July 28 and August 11. Morrison obtained a male nestling on March 16 and eggs on March 22 at Bikini in 1946.

Remarks.—The White Tern is usually restricted to the remote islands in the Pacific, Indian and South Atlantic oceans; there, according to the latest treatment, which is that of Peters (1934:348, 349), six subspecies are recognized. In studying the geographical variation of the species, the writer has examined 595 adult specimens, including previously unstudied material collected by the Whitney South Sea Expedition, which is deposited in the American Museum of Natural History.

This ivory-white species presents an unsual problem in that there are few characters available to distinguish the subspecies. Measurements of taxonomic value include those of the wing, tail, exposed culmen, and depth and the shape of the culmen. There appears to be no significant secondary sexual difference between males and females, and measurements of the two sexes are combined. The chief problem within this species seems to hinge on how to classify isolated, but relatively similar, populations. The examination of the large series of specimens from the Whitney collections has yielded more complete information to assist in the solution of this problem.

Gygis alba alba (Sparrman) of the South Atlantic Ocean (Fernando de Noronha, South Trinidad, Ascension, and St. Helena islands) and *G. a. monte* Mathews of the Indian Ocean (Seychelles, Aldabra, Mascarene and Chagos islands) are isolated populations. Specimens examined are those which have previously been studied by other workers; measurements are shown in table 23.

With the exception of *G. a. microrhyncha*, *G. a. monte* has the smallest average length of wing of all of the subspecies of *G. alba*

In *G. a. alba* the length of wing as well as most of the other measurements differ but slightly from those of some of the populations in the Pacific area although the slender bill of the Atlantic bird is a distinctive character, as pointed out by Murphy (1936:1166).

TABLE 23. MEASUREMENTS OF SUBSPECIES OF *Gygis alba* FROM THE ATLANTIC AND INDIAN OCEAN AREA

SUBSPECIES	No.	Wing	Longest tail feather	Shortest tail feather	Exposed culmen	Depth culmen	Tarsus
Gygis alba alba...	24	246 239-256	99 93-111	71 68-77	40 35-44	8.0 7.5-9.0	14.5 13.0-16.5
Gygis alba monte	35	232 224-244	106 98-116	71 64-81	39 37-44	8.5 8.0-8.5	13.5 12.5-14.0

The taxonomic position of the White Terns of the Pacific area has been one of uncertainty for a long time; as Peters (1934:349) puts it, "It is obvious that the last word on the Pacific races of Gygis has not yet been said." A principal feature of the problem in this region is the presence in the Marquesas of a well-marked subspecies, *G. a. microrhyncha,* virtually surrounded by a wide-ranging and relatively undifferentiated form, *G. a. pacifica* (Lesson) (see figure 12). The small cormorant (*Phalacrocorax melanoleucus brevicauda* Mayr) from Rennell Island, Solomons, is another example of a distinct form surrounded by a widely distributed subspecies.

In all, 55 adult specimens of *G. a. microrhyncha* have been examined from the following islands in the Marquesas Group: Mukahiva, Eiau, Motane, Hivaoa, Uapu, Tahuata, Uahuka, Fatuhiva. The measurements are listed in table 24, and show that the White Tern in the Marquesas is a much smaller bird than the other subspecies and has a shorter bill, wing, and tail. The tail possesses a shallow fork as compared with the deeper fork of the tail of other subspecies. In addition, the depth of the culmen averages two millimeters less in the subspecies in the Marquesas. The presence of a wider, black eye-ring is also a distinguishing character in this subspecies.

Gygis a. microryhncha was for a long time treated as a species distinct from *G. alba* but has recently been considered as a subspecies *G. alba* by Peters and others. On the islands of Hatutu and Motane in the Marquesas, the Whitney South Sea Expedition obtained some birds which appear to be intergrades between the two subspecies of White Terns in the area. The measurments of nine birds which show intergradation between *G. a. microrhyncha* and *G. a. pacifica* are listed in table 24. Probably the Marquesas population is tending toward complete reproductive isolation.

Peters (1934:348, 349) recognizes three other subspecies from the Pacific area: *G. a. rothschildi* Hartert from Laysan, Lisiansky, and Krusenstern islands; *G. a. candida* (Gmelin) from "the Carolines east to Christmas Island and south to the Tonga and Society Islands"; and *G. a. royana* Mathews from Norfolk and the Kermadec Islands. Birds from Revilla Gigedo, Cocos and Clipperton islands, although geographically isolated, are placed in *G. a. candida*. On the basis of a critical study of specimens at hand, the populations in the Pacific fit into three groups. Small birds, *G. a. candida*, are found in the North Pacific from the Bonins and Marianas east to Wake and the Hawaiian Chain and south to the Marshall, Phoenix, Christmas and the Fanning islands (see figure 12).

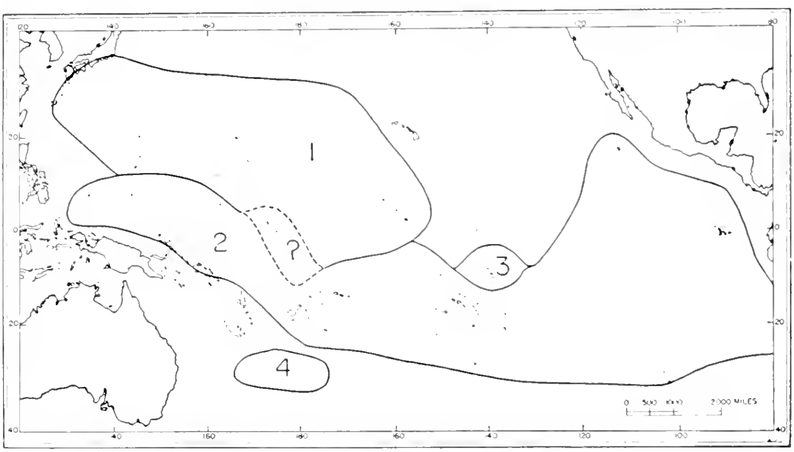

FIG. 12. Geographic distribution of *Gygis alba* in the Pacific area. (1) *G. a. candida*; (2) *G. a. pacifica*; (3) *G. a. microrhyncha*; (4) *G. a. royana*.

Larger birds, *G. a. pacifica*, are found in the Central Pacific and South Pacific from the Carolines in the west southeastward through Melanesia and eastward through Samoa, to the Tuamotus and Easter to Cocos, Clipperton, and Revilla Gigedo islands. In the Southwest Pacific, at Norfolk and the Kermadec Islands, a longer-winged populations occurs; it is separable as *G. a. royana*. The measurements of these birds are given in table 24.

TABLE 24. MEASUREMENTS OF *Gygis alba* FROM THE PACIFIC AREA

LOCATION	No.	Wing	Longest tail feather	Shortest tail feather	Exposed culmen	Depth culmen	Tarsus
Gygis alba candida (Gmelin) Japan, Bonins	4	238	109	65	36 34-38	....	....
Mariana Islands	35	237 227-246	111 98-120	69 61-75	38 36-41	9.0	13.0 12.0-14.0
Wake Islands	10	236 232-243	109 101-118	69 64-77	38 37-41	....	13.0 13.0-14.0
Hawaiian Islands	36	235 220-246	109 102-118	68 64-74	37 33-40	8.5 8.0-9.0	13.0 12.0-14.0
Marshall Islands	4	234 231-238	111 107-115	71 70-73	39 38-40	....	....
Phoenix, Howland, Hull, Canton Islands	8	238 237-240	107 101-116	70 64-76	39 37-41	8.5	14.0 ....
Fanning, Washington, Christmas Islands	19	238 227-242	107 97-119	68 65-72	38 37-42	8.0 7.5-9.0	13.5 12.0-15.0
Totals	116	236 220-246	109 107-120	69 61-77	38 33-42	8.5 7.5-9.0	13.0 12.0-15.0
Gygis alba pacifica (Lesson) Caroline, Palau Islands	33	245 236-253	116 112-125	73 67-76	42 38-44	8.5	13.5 13.0-13.5
Bismarck Arch., Solomon Islands	12	247 242-256	116 105-129	74 68-78	42 39-45	....	....
Samoa, Wallis, Fiji, Tonga, Niue Islands	20	247 239-254	115 110-127	71 67-78	42 39-44	....	....
Line, Danger Islands	13	245 238-252	115 107-118	73 69-78	41 39-42	....	....
Cook, Austral Islands	29	247 241-255	114 104-124	73 65-78	42 40-45	....	....
Society Islands	37	249 241-257	113 107-126	71 62-76	42 40-45	8.5 8.0-9.0	13.5 12.0-14.0
Tuamotu Arch.	118	245 236-252	114 107-127	72 62-82	42 38-46	....	....
Rapa, Bass Rocks, Oeno, Henderson, Ducie, Pitcairn, Easter Islands	54	247 240-255	113 106-126	73 63-84	41 40-45	....	....
Clipperton, Cocos Islands	10	245 240-253	115 110-120	72 71-73	40 38-43	8.5 8.5-9.5	13.5 13.0-14.0
Totals	326	246 226-257	114 104-129	72 62-84	42 38-46	8.5 8.0-9.5	13.5 12.0-14.0

TABLE 24.—*Concluded*

LOCATION	No.	Wing	Longest tail feather	Shortest tail feather	Exposed culmen	Depth culmen	Tarsus
Intergrades between *G. a. microrhyncha* and *G. a. pacifica*..	9	237 230-247	105 93-122	74 67-89	38 36-41	7.5 7.0-8.0	13.0 12.0-14.0
Gygis alba microrhyncha.......	55	218 211-235	78 72-96	64 60-75	36 32-39	6.5 6.0-8.0	12.0 11.0-12.5
Gygis alba royana Mathews Norfolk Island..............	16	250 242-257	113 105-124	73 68-79	42 41-44	....	....
Kermadec Islands...........	12	251 244-255	115 110-121	75 71-81	43 40-46	....	....
Totals..................	28	250 242-257	114 105-124	74 68-81	42 40-46	....	....

The measurements indicate that there is a gradient in size from small in the north to large in the south; however, there is a definite separation in average measurements—ten millimeters in length of wing and four millimeters in length of exposed culmen—between the two populations which are designated as *G. a. candida* and *G. a. pacifica*. In studying material from Micronesia and the Hawaiian Islands, I (1948:57) pointed out the similarities between birds of the Marianas and the Hawaiians and separated these from terns found in the Caroline Islands. The systematic position of the White Tern in the Gilbert and Ellice islands will remain in doubt until specimens are available for examination.

G. a. royana is provisionally retained as the name for the Fairy Tern of the Kermadecs and Norfolk Island; there is considerable overlap in measurements between *G. a. royana* and *G. a. pacifica*. Measurements have given evidence of the degrees of structural resemblance of the White Terns of the different islands, but it is not certain that the groupings made on this basis are natural; more data is needed on ecology and life history. Of particular importance is to learn whether these birds fly regularly from island to island. On the basis of eleven months of rather continuous observation in Micronesia, I suspect that the White Tern has little tendency to make inter-island migrations. This might account for the differences in size in the populations at Guam in the Marianas (*G. a. candida*) and at Ulithi in the Carolines (*G. a. pacifica*) where only approximately 400 miles of open water separate the two islands. The occurrence of the distinct *G. a. microrhyncha* in the Marquesas may be accounted for by such nonmigratory behavior. Mayr

(1945a:27), however, is of the opinion that White Terns found in the Bismarck Archipelago, the Solomons, Santa Cruz and New Hebrides islands may not breed there, which is another way of saying that they are migrants. Swarth (1934:221) and Murphy (1936: 1268) record the wandering of the White Tern to the Galapagos Islands, probably from breeding grounds at Cocos Island. Swarth suggests that the tern is not established at the Galapagos because of the presence of colder water in the area. Murphy (1936:1166) is of the opinion that the South Atlantic White Terns are sedentary, but reports evidence of pelagic migration in the Pacific at the Kermadecs. The fact that *G. alba* is restricted in its distribution to widely separated groups of islands in tropical and subtropical areas of the South Atlantic, Indian and Pacific oceans may indicate that the birds at one time had a more extensive range than at present, probably including even coastal regions of the continents and large continental islands.

Gygis alba pacifica (Lesson)

White Tern

Sterna pacifica Lesson, Ann. Sci. Nat., 4, 1825, p. 101. (Type locality, Society Islands, Paumotu Islands, and Bora Bora.)

Sterna alba Kittlitz, Kupfertaf. Naturgesch. Vögel, 3, 1833, p. 28 (Carolinen); *idem*, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 286, 299, 308 (Ualan, Lougounor, Ouleai).

Gygis candida Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 137 (Carolinen); Hartlaub, Journ. f. Ornith., 1854, p. 168 (Carolinen); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 382, 2, 1858, pp. 39, 60 (Ualan); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 59 (Caroline Islands); Saunders (part), Cat. Birds British Mus., 25, 1896, p. 149 (Pelew, Carolines); Takatsukasa and Kuroda, Tori, 1, 1915, p. 51 (Ruk, Pelew).

Gygis alba Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 233 (Carolinen); Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 832 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 9, 118 (Pelew); Finsch and Hartlaub, Journ. f. Ornith., 1870, p. 140 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 90, 114 (Pelew, Uap, Ualan); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 6, 43 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 40 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 782 (Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 295, 309 (Ponapé, Kuschai); *idem*, Proc. Zool. Soc. London, 1880, p. 577 (Ruk); *idem*, Ibis, 1881, pp. 105, 106, 109, 115, 246, 247 (Kushai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 299, 330, 353 (Mortlock, Nukuor, Ruk); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 52 (Kuschai); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 78 (Pelew, Uap, Luganor, Nukuor, Ruk, Ponapé, Ualan); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 8, 1896, p. 58 (Palaos, Carolines; Baker (part), Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 57 (Peleliu, Ulithi, Truk, Kusaie).

Gygis alba kittlitzi Hartert, Katalog Vogelsamml. Senckenb., 1891, p. 237 (Type locality, Ulea = Wolea); *idem*, Novit. Zool., 7, 1900, p. 10 (Ruk); Dubois, Syn. Avium, 2, 1904, p. 1020 (Carolines); Mathews (part), Birds Australia, 2, 1912, p. 443 (Carolines); Ridgway (part), Bull. U. S. Nat. Mus., 50, pt. 8, 1919, p. 559 (Carolines); Kuroda (part), Avifauna Riu Kiu, 1925, p. 193 (Carolines); Hand-list Japanese Birds (part), rev., 1932, p. 196 (Pelew, Yap, Wolea, Luganor, Ruk, Ponapé, Kusaie); Yamashina (part), Tori, 10, 1940, p. 678 (Babelthuap).

Gygis albus kittlitzi Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 50 (Pelews, Yap, Wolea, Luganor, Nukuor. Ruk, Ponapé, Kusaie).

Leucanous albus kittlitzi (Mathews (part), Syst. Avium Australasianarum, 1, 1927, p. 143 (Carolines).

Gygis alba candida Peters, Check-list Birds World, 2, 1934, p. 349 (Carolines); Hand-list Japanese Birds (part), 3d ed., 1942, p. 219 (Babelthuap, Koror, Angaur, Yap, Wolea, Truk, Lukunor, Nukuoro, Ponapé, Kusaie).

Geographic range.—Central and southern Pacific from Carolines southeast through Melanesia and east through Samoa to Tuamotus, Easter to Cocos and Clipperton (see figure 12). In Micronesia: Palau Islands—Angaur, Peleliu, Garakayo, Koror, Babelthuap, Kayangel; Caroline Islands—Yap, Ulithi, Wolea, Truk, Lukunor, Ponapé, Kusaie.

Characters.—Resembles *G. a. candida,* but size larger, wing length of adult males and females 236-253 (245); length of exposed culmen 38-44 (42).

Measurements.—Measurements are listed in table 24.

Specimens examined.—Total number, 36 (22 males, 12 females, 2 unsexed), as follows: Palau Islands, USNM—Peleliu, 1 (Sept. 1); AMNH—exact locality not given, 1 (Nov. 13); Caroline Islands, USNM—Ulithi, 12 (Aug. 14, 15, 16, 20, 21)—Truk, 1 (Dec. 13); AMNH—Truk, 7 (Mar. 8, May 7, June 8, Nov. 11, 26)—Ponapé, 1 (undated)—Kusaie, 10 (Jan., Feb., March 20-30, April 1-10); MCZ—Yap, 3 (Jan. 13).

Nesting.—The NAMRU2 party learned that in May and June, 1945, several young White Terns were seen at Asor, Ulithi Atoll, by service personnel. These young were observed in breadfruit trees within a recreational area; the presence of the service personnel seemingly had little disturbing effect on the terns. At Bulubul, another island of this atoll, a downy young was obtained on August 22. Hartert (1900:10) reports that eggs of the White Tern were found on the ground and in forks of branches of trees at Truk in June.

Food Habits.—The author (1948:58) reports that stomachs of birds taken at Ulithi and Peleliu contained fish, insects and marine crustaceans. Probably the birds feed to a large extent along the edge of the tidal reef. They almost certainly obtain food also on the islands as indicated by the presence of insects in stomach contents; this is not surprising since the birds frequent woodland habitats.

Remarks.—*Gygis alba* is one of the most characteristic birds in Micronesia. It is seemingly more numerous at the coral atolls than at the high, volcanic islands. At the latter islands the birds prefer the coastal coconut grove environment. At Pau and Bulubul, two small islands in the Ulithi Atoll, the writer counted approximately 100 birds on August 21, 1945. Kittlitz was the first to publish an account of these birds in the Caroline Islands. Tetens, Peters, Semper and Kubary reported their presence in the Palaus. No doubt, these terns attract the attention of every traveler in the islands owing to their conspicuously white beauty and their seemingly friendly behavior toward man. Their habit of hovering in small flocks close over the head of the observer is indeed spectacular.

Columba livia Gmelin

Blue Rock Pigeon

Columba domestica β livia Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 769. (No type locality = Europe.)

Columba livia Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Marshall, Condor, vol. 51, 1949, p. 221 (Tinian).

Geographic range.—Europe and Asia Minor. Introduced to many parts of the world. In Micronesia: Mariana Islands—Guam, Tinian.

Remarks.—In 1945, the NAMRU2 party observed pigeons about the towns on Guam, particularly at the town of Inarajan. Bryan (1936:24) writes that the birds were introduced by the United States Navy and Marine Corps at Guam; the stock originating from escaped carrier pigeons. Marshall (1949:221) records this bird from Tinian.

Ptilinopus porphyraceus ponapensis (Finsch)

Crimson-crowned Fruit Dove

Ptilonopus ponapensis Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 779. (Type locality, Ponapé.)

Ptilinopus? fasciatus Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 18, 37 Ponapé).

Ptilopus fasciatus Elliot, Proc. Zool. Soc. London, 1878, p. 536 (Ponapé); Tristram, Cat. Birds, 1889, p. 44 (Ponapé).

Ptilopus ponapensis Schmeltz, Verhandl. Ver. nat. Unterhatlung Hamburg, 1877 (1879), pp. 178, 179 (Ponapé); Finsch, Proc. Zool. Soc. London, 1880, p. 576 (Ruk, Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 291, 303 (Ponapé); *idem*, Proc. Zool. Soc. London, 1880, p. 578 (Ruk, Ponapé); idem, Ibis, 1881, pp. 113, 115 (Ponapé); Wiglesworth, Ibis, 1891, p. 583 (Ponapé, Ruk); *idem*, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 50 (Ponapé, Ruk); Salvadori, Cat. Birds British Mus., 21, 1893, p. 93 (Ponapé, Ruk); Oustalet, Nouv. Arch. Mus. Hist. Nat., Paris, (3), 7, 1895, p. 222 (Ponapé); Nehrkron, Kat. Eiers., 1899, p. 180 (Ruk); Dubois, Syn. Avium, 2, 1904, p. 736 (Ruck, Ponapé); Reichenow, Die Vögel, 1, 1913, p. 354 (Ruk, Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Ruk, Ponapé); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 189 (Uala, Ponapé).

Ptilinopus ponapensis Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Hartert, Novit. Zool., 7, 1900, p. 7 (Ruk, Ponapé); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 42 (Ponapé); Matschie, Journ. f. Ornith., 1901, p. 113 (Ruck, Ponapé); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 32 (Ponapé); Bequaert, Mushi, 12, 1939, pp. 81, 82 (Ponapé); Mayr. Proc. 6th Pacific Sci. Congr., 4, 1939 (1941), p. 204 (Ponapé); Bequaert, Occ. Papers Bernice P. Bishop Mus., 16, 1941, pp. 266, 290 (Ponapé).

Ptilnopus Ponapensis Christian, The Caroline Islands, 1899, p. 357 (Ponapé).

Ptilinopus poncpensis ponapensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 57 (Ponapé, Ruk); Yamashina, Tori, 7, 1932, p. 408 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 190 (Ponapé, Ruk); Peters, Check-list Birds World, 3, 1937, p. 31 (Ruk, Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 213 (Ponapé, Truk).

Ptilinopus porphyraceus ponapensis Ripley and Birckhead, Amer. Mus. Novit., no. 1192, 1942, p. 7 (Ruk, Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 289 (Truk, Ponapé); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 59 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk, Ponapé.

Characters.—Adult male: A green fruit dove with forehead, anterior lores and crown near "pansy purple," faintly margined with yellow; occiput, sides of head, neck, upper breast grayish-green with bifid feathers of midbreast more olivaceous; chin and midthroat light yellow; breast, sides and tibia green; midpart of lower breast dark bluish-green, tinged with dark purple; lower abdomen, vent, and undertail yellow, under tail-coverts deeper yellow tinged with orange; upper parts dark green; wings metallic green on outer webs and tips, inner secondaries and some posterior scapulars with purple spots near tips; primarieis and secondaries edged on outer webs with yellowish; under-wing gray with yellow edges on hind, under wing-coverts; upper side of tail metallic green with terminal, broad yellow band; under side of tail gray; bill lead-colored, feet wine-brown, iris whitish to pale brown. Adult female resembles adut male, but slightly smaller and duller.

Immature: Resembles adult, but entirely green with yellow edgings on feathers and lacking crimson crown and colored breast patch.

Measurements.—Measurements of subspecies of *P. porphyraceus* in Micronesia are presented in table 25.

TABLE 25. MEASUREMENTS OF *Ptilinopus porphyraceus* IN MICRONESIA

SUBSPECIES	Number	Wing	Exposed culmen	Tarsus
P. p. ponapensis....	12 males	137 (133-141)	14 (13-15)	25 (24-27)
	11 females	133 (126-137)	14 (13-15)	25 (24-26)
P. p. hernsheimi.....	6 males	134 (130-138)	13 (12-14)	25 (24-26)
	5 females	127 (125-130)	13 (12-13)	25 (24-25)
P. p. pelewensis.....	10 males	133 (131-134)	15 (13-15)	25 (23-26)
	4 females	133 (130-138)	15 (14-15)	24 (23-24)

Specimens examined.—Total number, 81 (52 males, 26 females, 3 unsexed), as follows: Caroline Islands, USNM—Truk, 4 (Feb. 16, Dec. 24); AMNH—Truk, 24 (Jan., June, Oct.)—Ponapé, 53 (Nov., Dec.).

Nesting.—Yamashina (1932a:408) reports on eggs taken at Ponapé on the following dates: July 10, 12, August 1, 12, 15, 21. Only one egg was found to a nest. Hartert (1900:8) records nests containing eggs in May and June at Truk. Coultas (field notes) describes the nest as a flimsy affair. At Ponapé in November and December he found nests on low branches (10 to 20 feet from the ground) each containing a single egg. Nests were found also in the tops of tree ferns. Females taken in these months had enlarged gonads.

Parasites.—Bequaert (1939:81, 82, and 1941:266, 290) records the two flies (Hippoboscidae), *Ornithoctona plicata* and *O. pusilla,* from the fruit dove at Ponapé.

Remarks.—McElroy of the NAMRU2 party found the birds in mountainous areas at Truk in December, 1945. At Ponapé in November and December, 1931, Coultas (field notes) comments that the bird is rapidly disappearing owing to persistent hunting by the natives and, at that time, by the Japanese. He found the birds to be strictly forest-living and to frequent the larger fruit-bearing trees of the lowlands and the mountain sides. Coultas writes that the Japanese hunters attracted the doves by the use of calls. The natives catch the birds with a gum mixture obtained from bread-fruit gum and coconut oil.

Ptilinopus porphyraceus hernsheimi (Finsch)

Crimson-crowned Fruit Dove

Ptilopus Hernsheimi Finsch., Journ. f. Ornith., 1880, p. 303. (Type locality, Kuschai.)

Ptilopus hernsheimi Finsch, Proc. Zool. Soc. London, 1880, p. 577 (Kuschai); Reichenow and Schalow, Journ. f. Ornith., 1881, p. 75 (Kuschai); Finsch, Ibis, 1881, pp. 106, 107, 108 (Kushai); Wiglesworth, Ibis, 1891, p. 583 (Ualan); *idem,* Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 51 (Ualan); Salvadori, Cat. Birds British Mus., 21, 1893, p. 94 (Ualan); Oustalet, Nouv. Arch. Mus. Hist. Nat., Paris, (3), 7, 1895, p. 222 (Oualan); Dubois, Syn. Avium, 2, 1904, p. 736 (Kuschai); Reichenow, Die Vögel, 1, 1913, p. 355 (Kuschai); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 189 (Kusaie).

Ptilinopus hernsheimi Matschie, Journ. f. Ornith., 1901, p. 113 (Ualan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 33 (Kusaie).

Ptilinopus ponapensis hernsheimi Kuroda, in Momoyama, Birds Micronesia, 1922, p. 57 (Kusaie); Hand-list Japanese Birds, rev., 1932, p. 190 (Kusaie); Peters, Check-list Birds World, 3, 1937, p. 31 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Kusaie).

Ptilinopus marshallianus Peters and Griscom, Proc. New England Zool. Club, 10, 1928, p. 104 (Type locality, Ebon); Hand-list Japanese Birds, rev., 1932, p. 190 (Ebon).

Ptilinopus ponapensis marshallianus Peters, Check-list Birds World, 3, 1937, p. 31 (Ebon); Hand-list Japanese Birds, 3d ed., 1942, p. 213 (Ebon).

Ptilinopus porphyraceus hernsheimi Ripley and Birckhead, Amer. Mus. Novit., no. 1192, 1942, p. 6 (Kusaie, Ebon); Mayr, Birds Southwest Pacific, 1945, p. 289 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie; Marshall Islands—Ebon (extinct?).

Characters.—Adults: Resembles *P. p. ponapensis,* but occiput, nape, sides of head more gray and less greenish-yellow; chin and midthroat paler; crown coloring very faintly margined with yellow; tail band brighter yellow; under tail-coverts more orange; abdominal spot may be present as a brownish-red tinge; abdomen slightly more yellowish.

Immature: Resembles immature of *P. p. ponapensis.*

Measurements.—Measurements are listed in table 25. Ripley and Birckhead (1942:7) give the measurements of the only known specimen from Ebon (Marshall Islands) as: wing, 124; tail, 74; bill from base, 15.

Specimens examined.—Total number, 11 (6 males, 5 females), as follows: Caroline Islands, USNM—Kusaie, 1 (Feb. 9); AMNH—Kusaie, 10 (Jan., Feb., March, April).

Remarks.—I am following Ripley and Birckhead (1942:6) in identifying the dove from Ebon Island as of the subspecies *P. p. hernsheimi.* This specimen from Ebon may, however, represent the final vestige of a formerly well-distributed population in the Marshall Islands. This distribution is of particular interest because it may show the pathway by which these small fruit pigeons invaded eastern Micronesia from Polynesia.

The small fruit dove at Kusaie has apparently the same habitat requirements as others of the species. Coultas (field notes) comments that in 1931 the birds were "quite common." He found them in the high trees on the mountain sides away from the native villages and gardens.

Ptilinopus porphyraceus pelewensis Hartlaub and Finsch

Crimson-crowned Fruit Dove

Ptilinopus pelewensis Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 7. (Type locality, Pelew Islands.)

Ptilinopus pelewensis Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 118 (Pelew); Gray, Hand-list Birds, 2, 1870, p. 225 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 101 (Pelew); Gräffe, Journ. Mus. Godeffroy, 1, 1873, pl. 7, fig. 5 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 24 (Palau); Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 37 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Matschie, Journ. f. Ornith., 1901, p. 113, (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 56 (Pelew); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 32 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 190 (Palau); Peters, Check-list Birds World, 3, 1937, p. 31 (Babeltop, Korror); Hand-list Japanese Birds, 3d ed., 1942, p. 213 (Babelthuap, Koror).

Ptilonopus pelewensis Finsch, Proc. Zool. Soc. London, 1874, p. 94 (Pelew).

Ptilopus pelewensis Giebel, Thes. Ornith., 3, 1877, p. 366 (Pelew); Elliot, Proc. Zool. Soc. London, 1878, p. 531 (Palau); Schmeltz, Verhandl. Ver. nat. Unterhatlung Hamburg, 1877 (1879), p. 178 (Pelew); Tristram, Cat. Birds, 1889, p. 44 (Pelew); Wiglesworth, Ibis, 1891, p. 584 (Pelew); *idem*, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 48 (Pelew); Salvadori, Cat. Birds British Mus., 21, 1893, p. 86 (Pelew); Dubois, Syn. Avium, 2, 1904, p. 736 (Pelew); Reichenow, Die Vögel, 1, 1913 p. 354 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Pelew).

Ptilinopus porphyraceus pelewensis Ripley and Birckhead, Amer. Mus. Novit., no. 1192, 1942, p. 7 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 289 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 60 (Peleliu, Ngabad, Garakayo).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad, Anguar.

Characters.—Adult male: A green fruit pigeon with anterior lores and crown purple, margined with pale yellow; forehead paler than crown; chin and midthroat pale yellow; neck, sides of head, and breast greenish-gray, darker on occiput; feathers of upper breast cross-banded with partly concealed violet bands; abdomen orange, its lower part and region of vent yellow; sides greenish; tibia grayish; under tail-coverts near "Indian lake" with yellowish-orange edgings; upper parts green; wings metallic green, secondaries and primaries margined on outer webs with yellow; inner secondaries spotted with violet-blue near tips; under wing gray; upper side of tail green with pale yellow terminal band; under side of tail gray; bill lead-colored; feet dark blood-red.

Adult female: Resembles adult male, but upper parts greener with upper side of wing and upper tail-coverts washed with olivaceous-brown; breast duskier. Immature resembles adult, but lacks purple crown, violet breast spot, orange abdomen and maroon under tail-coverts; upper and lower parts margined with yellow; forehead pale green; supercillary stripe pale yellow.

P. p. pelewensis resembles *P. p. ponapensis*, but crown more purple; yellow tail-bar narrower; bifurcated, central breast feathers violet; abdomen orange; and under tail-coverts near "Indian lake".

Measurements.—Measurements are presented in table 25.

Specimens examined.—Total number, 14 (10 males, 4 females), as follows: Palau Islands, USNM—Koror, 3 (Nov. 14, Dec. 3)— Garakayo, 1 (Sept. 19)—Peleliu, 3 (Aug. 27, Sept. 1, 4)—Ngabad, 2 (Sept. 11)—Pelew, 2 (Mar. 1, 2); AMNH—Palau, 3 (Oct., Dec.).

Nesting.—At Ngabad Island on September 11, 1945, the NAMRU2 party found a nest in jungle in a low tree about six feet above the ground. It was loosely constructed and contained a single white egg, size 31 by 23 mm. Another nest was found at Ngabad the same day. It was on the branch of a tree approximately 20 feet from the ground. The nest was not examined other than to observe a parent bird on the nest. Three males obtained in August and in September had enlarged testes. Males taken in December by Coultas had enlarged testes.

Food Habits.—Stomachs examined by the NAMRU2 party contained fruit parts and seeds. This species seemingly obtains its foods from the large fruit-producing trees and to a lesser extent from the smaller shrubs or from ground berries.

Remarks.—*P. p. pelewensis* was found in small numbers at all islands visited in the southern Palaus by the NAMRU2 party in 1945. At Peleliu, the bird was restricted to undisturbed woodlands and thickets, although some were seen in the thickly growing vegetation covering over the battle areas. The bird evidently lives a solitary existence; it was only rarely observed in pairs. It was often located by its calls. Coultas (field notes) reports that in 1931 the species was becoming rare in the Palaus, owing to persistent hunting by the Japanese, who sold the bird for 25 sen each.

Ptilinopus roseicapillus (Lesson)

Marianas Fruit Dove

Columba roseicapilla Lesson, Traité d'Ornith., 6, 1831, p. 472. (Type locality, Marianne Islands.)

Columba roseicapilla Lesson, Compl. de Buffon, 2d ed., 2, Oiseaux, 1838, p. 278 (Mariannes).

Columba purpurata Kittlitz, Kupfertaf. Naturgesch. Vögel, 3, 1833, p. 25, pl. 23, fig. 2 (Guahan); *idem*, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan).

Ptilinopus purpuratus Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen); Hartert, Katalog Vogelsamml. Senckenb., 1891, p. 190 (Guaham).

Ptilopus roseicapillus Bonaparte, Comptes Rendus Acad. Sci. Paris, 39, 1854, p. 877 (Mariannes); *idem*, Icon. Pigeons, 1857, pl. 23 and desc. letterpress (Mariannes); Schlegel, Mus. Pays-Bas, 6, no. 35, 1873, p. 8 (Guam); Giebel, Thes. Ornith., 3, 1877, p. 368 (Mariannae); Elliot, Proc. Zool. Soc. London, 1878, p. 537 (Marianne); Oustalet, Le Nat., 1889, p. 261 (Mariannes); Wiglesworth, Ibis, 1891, p. 584 (Marianne); *idem*, Abhandl. und Ber Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 48 (Marianne); Salvadori, Cat.Birds British Mus., 21, 1893, p. 108 (Marianne Islands); Oustalet, Nouv. Arch. Mus. Hist. Nat., Paris, (3), 7, 1895, p. 218 (Saypan, Guam, Rota); Safford, The Plant World, 7, 1904, p. 264 (Guam); Dubois, Syn. Avium, 2, 1904, p. 736 (Mariannes); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 78 (Guam); Schnee, Zeitschr. f. Naturwiseh., 82, 1912, p. 465 (Marianen); Prowazek, Die deutschen Marianen, 1913, p. 101 (Marianen); Reichenow, Die Vögel, 1, 1913, p. 354 (Marianen); Cox, Island of Guam, 1917, p. 20 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam); Thompson, Guam and its people, 1942, p. 23 (Guam).

Kurukuru roseicapillus Prévost and Des Murs, Voy. "Venus," Oiseaux, 1855, pp. 221, 231, 257, 259, 269 (Guam).

Ptilopus roseicapilla Bonaparte, Consp. Avium, 2, 1855, p. 21 (Mariannis).

Ptilonopus roseicapillus Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 37 (Guam); Reichenbach, Tauben, 1861, p. 96 (Mariannen); Finsch, Proc. Zool. Soc. London, 1874, p. 94 (Mariannes).

Ptilinopus roseicapillus Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, pp. 122, 127 (Mariannen); Gray, Hand-list Birds, 2, 1870, p. 225 (Ladrones); Hartert, Novit. Zool., 5, 1898, p. 60 (Guam, Rota, Saipan); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 39 (Guam, Rota, Saipan); Matschie, Journ. f. Ornith., 1901, p. 113 (Guam, Saipan); Safford, Osprey, 1902, p. 68 (Marianas); *idem*, Amer. Anthro., 4, 1902, p. 711 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 56 (Guam, Rota, Saipan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 33 (Marianne); Hand-list Japanese Birds, rev., 1932, p. 190 (Tinian, Saipan, Rota); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Guam, Rota, Tinian, Saipan); Mayr, Birds Southwest Pacific, 1945, p. 288 (Marianas); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 95 (Tinian); Watson, The Raven, 17, 1946, p. 42 (Guam)); Strophlet, Auk, 63, 1946, p. 538 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam); Stott, Auk, 64, 1947, p. 526 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 59 (Guam, Rota).

Ptilopus diadematus Giebel, Thes. Ornith., 3, 1877, p. 363 (Marianae).

Ptilinopus roseicapilla Peters, Check-list Birds World, 3, 1937, p. 31 (Saipan, Tinian, Rota, Guam); Ripley and Birckhead, Amer. Mus. Novit., no. 1192, 1942, p. 3 (Guam, Rota, Tinian, Saipan).

Geographic range.—Micronesia: Mariana Islands—Guam, Rota, Tinian, Saipan.

Characters.—Adult male: A green dove with crown, forehead, anterior lores, and spot at base of mandible near "aster purple," margined with pale yellow especially on top of head; chin and throat pale yellow to white; sides of head greenish-gray, darker on occiput; breast green with pearly-gray tinge on feathers of middle part; lower breast with dark purple patch; abdomen orange with yellowish-green coloring at midline; anal region and lower tail-coverts yellow, tinged with orange on lower tail-coverts; sides and tibia greenish with yellow tinges; upper parts green, more yellowish-green on rump; wings glossy, upper wing-coverts brighter in middle and margined with yellow; under side of wing and under side of tail gray; upper side of tail green with broad grayish terminal band margined with yellow; iris pale yellow; bill grass-green; legs and feet reddish-black.

Adult female: Resembles male, but slightly smaller with neck greener. Immature resembles adult, but lacking colored crown; body feathers edged with yellow.

Birds from Guam, Rota, and Tinian exhibit no conspicuous differences. *P. roseicapillus* is closest to *P. regina* of southern Papua, Lesser Sunda Islands, and Australia being, according to Ripley and Birckhead (1942:3), "Similar to *regina*, but crown and abdominal band darker; malar apex concolorous with crown; hind neck more grayish; tail-bar wider and paler."

Measurements.—Measurements of *P. roseicapillus* are presented in table 26.

Weights.—In 1948 (1948:59) I listed the weights of 14 adult males as 81-103 (90), of 4 adult females as 85-99 (92), and of one nestling in post natal molt as 44 grams. These were taken at Guam.

Specimens examined.—Total number, 43 (32 males, 10 females, 1 unsexed), as follows: Mariana Islands, USNM—Guam, 28 (March 8, May 25, 27, June 3, 12, 14, July 2, 6, 10, 18, 19, 29, Aug. 21)—Rota, 3 (Oct. 28, 31, Nov. 2)—Tinian, 1 (Oct. 26); AMNH—Guam, 8 (Aug.)—Tinian, 3 (Sept.).

Table 26. Measurements of *Ptilinopus roseicapillus*

Number	Wing	Tail	Exposed culmen	Tarsus
32 adult males......	127 (122-133)	80 (75-84)	14 (13-15.3)	25 (24-27)
10 adult females....	124 (121-130)	76 (75-79)	13 (12-13.7)	24 (22-25.5)

Nesting.—At Guam, I obtained records of nests of fruit doves on March 1, 27, and May 7, 1945. David H. Johnson observed a pair of fruit doves in the act of copulation on May 26, 1945. Birds with enlarged gonads were taken by the NAMRU2 party in March and July. A nestling in postnatal molt, just beginning to fly, was taken on July 6. Seale (1901:39) reports two nests, each containing one white egg, taken in the period from May to July. These nests were found in trees eight to ten feet above the ground.

Food habits.—The Marianas Fruit Dove feeds on fruits and seeds of trees and shrubs. The birds are apparently strictly tree dwellers; I saw no birds on the ground. A favorite fruit is that of a flowering shrub known as the "ink berry." Birds were collected which contained stomachs full of these small black berries. The fruit of the papaya is also a favorite food.

Remarks.—The NAMRU2 party found the Marianas Fruit Dove at Guam to be fairly numerous in undisturbed jungle, and more abundant in the heavy, second-growth, scrub-forest as was found on Amantes Point in 1945. The birds were secretive but were easily located by their calls. They were usually found as singles sitting quietly concealed in thick vegetation. Birds were seen flying rather infrequently, and then only for short distances. The removal of large tracts of jungle to provide space for the construction of air strips and installations in the late war has disturbed some of the habitat of these birds. Although vast tracts of forest were undisturbed, the birds probably have decreased at Guam. Coultas (field notes) found the birds common at the northern end of Guam in 1931. He commented that natives catch them with snares and bird lime for the local markets. At Tinian in 1931, Coultas found few birds. Downs (1946:95) and Stott (1947:526) record the birds at Tinian and Saipan, respectively, in 1945. At Rota, the NAMRU2 party found the dove to be numerous.

Evolutionary history of Ptilinopus in Micronesia.—Oceania is especially rich in species and subspecies of the genus *Ptilinopus*. Ripley and Birckhead (1942) have made the most recent and most thorough contribution concerning these birds. They state that the center of distribution for the genus lies in the Papuan region. Within the Oceanic region there are several species of *Ptilinopus* which in one way or another are rather closely related; Rensch (1938:277) uses these as examples of species which have been formed by isolation. These include *P. perousii* from Samoa, Fiji, and Tonga; *P. mercierii* from the *Marqueasas; P. dupetithouarsii* from the Marquesas; *P. huttoni* from Rapa; *P. purpuratus* from Henderson, Tuamotus, Societies; *P. porphyraceus* from Samoa, Fiji, Tonga, Carolines, Solomons, New Hebrides, New Caledonia, and adjacent areas; and *P. roseicapillus* from Marianas. In all of these birds the crown is wine-red except in *P. dupetithouarsii* in which it is whitish. *P. porphyraceus* appears to be more closely related to *P. purpuratus* than to any other species and is characterized by an often brightly washed spot of color of some shade of red or orange on the breast. These birds may have invaded Micronesia from the region of the Solomon Islands, although it appears more likely that they arose in the Samoa-Fiji-Tonga region and moved northward, probably by way of the Marshall Islands. *P. p. hernsheimi* from Kusaie and *P. p. ponapensis* from Ponapé and Truk resemble *P. p. faciatus* Peale from Samoa more closely than they do any other subspecies. *P. p. pelewensis* from Palau, on the other hand shows little relation to these other two Micronesian subspecies and appears to be closest to *P. p. porphyraceus* of Fiji and Tonga or possibly to *P. grayi* from Melanesia. Ripley and Birckhead (1942:7) suggest that the subspecies at Palau owes its marked divergence to its isolated position at the periphery of the range of the species. *P. p. pelewensis* probably represents an independent and an earlier colonization, possibly from a stock different from that from which the two subspecies in the Carolines arose. The presence in the Palaus of subspecies singularly different from subspecies in the Carolines can also be observed in other genera, as for example, *Rhipidura,* and *Myiagra.* Figure 13 shows the inferred routes of colonization of *Ptilinopus* to Micronesia.

P. roseicapillus seemingly represents a remnant, or perhaps a successful straggler, of an early invasion to Micronesia. Ripley and Birckhead (1942:2) classify this species as "Old Stock," along with *P. monachus, P. coronulatus* and *P. regina.* Its pathway of invasion to the Marianas was probably directly northward from the Papuan area and not by way of the Polynesian islands. Its resemblance to the species *P. regina* of southern Papua, Lesser Sundas, and Australia is most unusual, especially since there is a separation between the two species of some 1,400 miles; this is pointed out by Ripley and Birckhead (1942:4). As I have said

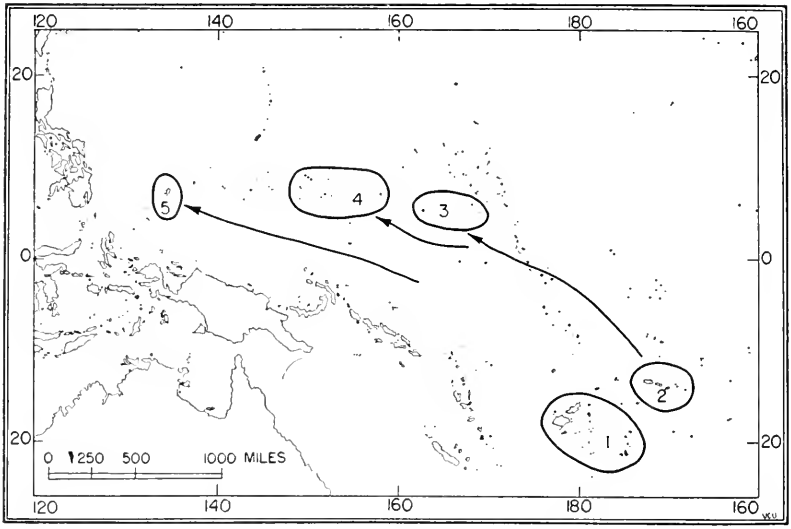

Fig. 13. Geographic distribution of *Ptilinopus porphyraceus* and routes of its dispersal. (1) *P. p. porphyraceus;* (2) *P. p. fasciatus;* (3) *P. p. hernsheimi;* (4) *P. p. ponapensis;* (5) *P. p. pelewensis.*

(1948:59) elsewhere, "On the basis of its characters the Mariana birds would merit only subspecific separation, but owing to the great distance between the two doves and the possibility of independent origin and subsequent convergence, it may be more advisable to continue to regard the two as separate species."

Ducula oceanica monacha (Momiyama)

Micronesian Pigeon

Globicera oceanica monacha Momiyama, Birds Micronesia, March, 1922, p. 4. (Type locality, Yap.)

Columba oceanica Lesson and Garnot (part), Dict. Sci. Nat., éd. Levrault, 40, 1826, p. 317 (Pelew); Lesson (part), Man. d'Ornith., 2, 1828, p. 166 (Pelew); *idem* (part), Voy. "La Coquille," Zool., 2, 1828, pp. 432, 709 (Pelew); *idem,* Compl. de Buffon, 2d ed., 2, Oiseaux, 1838, p. 292 (Pelew); Prévost and Knip, Les Pigeons, 2, 1838-43, p. 49 (Pelew).

Carpophaga oceanica Hartlaub (part), Archiv. f. Naturgesch., 18, 1852, p. 115 (Pelewinseln); *idem,* Proc. Zool. Soc. London, 1867 (1868), p. 830 (Pelew); Gray (part), Hand-list Birds, 2, 1870, p. 229 (Pelew); Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, pp. 89, 101 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 26 (Palau); *idem* (part), Proc. Zool. Soc. London, 1877 (1878), pp. 775, 780 (Palau); Salvadori (part), Cronaca del R. Liceo-Ginnasio Cavour, 1878, pp. 3, 8 (Pelew); *idem,* Ibis, 1879, p. 364 (Pelew); Tristram, Cat. Birds, 1889, p. 42 (Pelew); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 52 (Pelew); Matschie (part), Journ. f. Ornith., 1901, p. 113 (Palau); Dubois (part), Syn. Avium, 2, 1904, p. 743 (Pelew); Reichenow (part), Die Vögel, 1, 1913, p. 351 (Palau).

Globicera oceanica Bonaparte (part), Consp. Avium, 2, 1855, p. 31 (Pelew); Reichenbach (part), Tauben, 1861, p. 120 (Pelew); Salvadori (part), Cat. Birds British

Mus., 21, 1893, p. 176 (Pelew); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 52 (Pelew); Uchida, Annot. Zool. Japon., 9, 1918, pp. 486, 489 (Palau).

Carpophaga (Globicera) oceanica Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 41 (Pelew).

Carpophaga pacifica Finsch and Hartlaub (part), Fauna Centralpolynesiens, 1867, p. 145 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 7, 118 (Pelew); Finsch and Hartlaub, Journ. f. Ornith., 1870, p. 134 (Pelew).

Globicera oceanica monacha Kuroda, in Momiyama, Birds Micronesia, 1922, p. 55 (Yap); Mathews, Syst. Avium Australasianarum, 1, 1927,, p. 46 (Yap); Yamashina, Tori, 7, 1932, p. 408 (Yap); Hand-list Japanese Birds, rev., 1932, p. 189 (Uap, Palau, Current = Palo Anna).

Globicera oceanica momiyamai Kuroda, in Momiyama, Birds Micronesia, March, 1922, pp. 25, 56 (Type locality, Angaur); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 46 (Pelew); Kuroda, Ibis, 1927, p. 719 (Pelew).

Muscadivora oceanica winkleri Neumann, Verhandl. Ornith. Ges. Bayern, 25, Sept. 1, 1922, p. 234 (Type locality, Palau).

Ducula oceanica monacha Peters, Check-list Birds World, 3, 1937, p. 43 (Yap, Babelthuap, Koror, Angaur, Current); Hand-list Japanese Birds, 3d ed., 1942, p. 211 (Yap, Babelthuap, Koror, Angaur, Current); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 11 (Yap, Palau); Mayr, Birds Southwest Pacific, 1945, p. 289 (Palau, Yap); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 66 (Peleliu, Garakayo, Babelthuap).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Angaur, Pulo Anna; Caroline Islands—Yap.

Characters.—Adult: Resembles *D. o. oceanica* from Kusaie but throat, breast, head, and neck light ashy-gray; feathers around bill grayish-white; abdomen and under tail-coverts tipped with light brown.

Immature: Resembles adult, but underparts paler; back lacking dark bluish spots; back feathers and wing feathers edged with light brown.

Measurements.—Measurements of *D. oceanica* are listed in table 27.

TABLE 27. MEASUREMENTS OF *Ducula oceanica*

SUBSPECIES	Number	Wing	Exposed culmen	Tarsus
D. o. monacha...	8 males....	228 (219-233)	....	36 (34-37)
	6 females..	221 (214-228)	22.5 (22.0-23.0)	31 (29-33)
D. o. teraokai...	5 males....	230 (225-237)	23.5 (23.0-25.0)	34 (33-35)
	8 females..	231 (221-238)	23.0 (21.5-24.5)	34 (33-35)
D. o. townsendi..	8 males....	226 (211-234)	24.0 (23.5-25.0)	34 (32-35)
	5 females..	226 (215-233)	24.0 (23.0-24.5)	33 (32-34)
D. o. oceanica...	4 males....	222 (217-228)	25.0 (24.5-26.0)	35 (34-36)
	13 females..	219 (213-226)	24.0 (23.0-25.0)	32 (30-34)
*D. o. ratakensis**	6 males....	(211-217)	(25 -27)	....
	3 females..	(208-213)	(25 -26)	....

*From Takatsukasa and Yamashina (1932:221).

Specimens examined.—Total number, 17 (9 males, 8 females), as follows: Palau Islands, USNM—Garakayo, 1 (Sept. 19)—Peleliu, 7 (Aug. 27, 28, 29, Sept. 4, 5); AMNH— Palau, 9 (Oct., Nov. 13, 15, 21, Dec. 1).

Nesting.—Yamashina (1932a:408) records the finding of one egg at Yap on

December 3, 1930. The NAMRU2 party obtained no evidence of breeding activity of these pigeons at the Palaus in August and September, 1945. Coultas, in November and December of 1931, obtained birds with enlarged gonads at Palau. Probably the nesting season begins in November or December.

Food habits.—The pigeons feed on both fruits and green stuffs. The NAMRU2 party found berries, fruit parts and green plant materials in stomachs of birds taken in September, 1945. The birds were found to be exceedingly fat at this time.

Parasites.—Uchida (1918:486, 489) records the bird lice (Mallophaga), *Goniocotes carpohagae* and *Colopocephalum unicolor,* from this pigeon at Palau.

Remarks.—The Micronesian Pigeon at Palau was first observed in 1783, when Captain Henry Wilson of the packet "Antelope" was shipwrecked in these islands. In his account of the islands, as compiled by George Keate (Wilson, 1788), Wilson described the large pigeons, which were kept as pets by the natives and were eaten by only certain classes of people. In 1826, Lesson and Garnot made first reference to the birds found by Wilson. It was almost 100 years after Wilson's visit that the bird was again observed; this time it was obtained by the sea captains, Tetens and Heinsohn, and by Kubary, the collector for the Godeffroy Museum.

It is surprising that a pigeon as large and conspicuous as this one has not already been exterminated by man on these small islands. Every traveller to the islands, who has made observations, writes that the pressure of hunting on these birds is severe. Coultas (field notes) reports that in 1931 the birds were "very scarce and wild." He comments that the Japanese hunters obtained the birds and received the market price of 35 sen for each one. He writes, "There is a group of Japanese hunters in the islands who vie with one another to see who can obtain the most birds. They are all atrocious shots but some employ natives and since so many of them are in the business they are inflicting considerable damage to the bird life. During my stay there one Japanese was sentenced to six weeks hard labor for hiring native hunters. The native hunter who preferred charges claimed that money was due him for having shot some 3,500 birds and the account had been standing over a year." Price (1936b:491) shows a picture of a captive pigeon at Palau. The natives used this bird as a calling decoy to attract others within range of their blowguns.

The NAMRU2 party observed pigeons at all islands visited in August and September, 1945. At Peleliu, the pigeons were found to be restricted to relatively undisturbed areas where tall trees remained or where shrubs were present on the faces of overhanging cliffs. The shrubs on cliffs were favorite roosting places. Although the pigeons remained in these relatively inaccessible areas, they were not especially difficult to obtain with shotguns. I can see that it might be difficult for unarmed hunters to obtain the birds. The present writer (1946b:210) has recorded the extensive utilization of pigeons, rails and megapodes by Japanese troops and by their prisoners of war at Babelthuap and Koror during the latter part of the war.

During our stay at Peleliu we were unable to learn whether the pigeon was still present at Pulo Anna (Current Island), a coral island some 160 miles southeast of Peleliu. The U. S. Navy frequently dispatched a ship to the island, but we did not learn of it until our stay at Peleliu was nearly over. Dr. C. K. Dorsey, then of the U. S. Naval Epidemiology Unit at Peleliu, reported that various kinds of birds were numerous at Pulo Anna, but he did not recall seeing the pigeon. This pigeon may occur also at Fais, a raised coral island west of Yap and Ulithi in the Carolines. I know of no reports dealing with the avifauna of this phosphate island, but I examined several pictures, taken by Navy landing parties and the Military Government personnel, which show the island to be covered with extensive and luxuriant vegetation. I suspect that an intensive survey of the island will reveal several new records for birds.

Ducula oceanica teraokai (Momiyama)

Micronesian Pigeon

Globicera oceanica teraokai Momiyama, Birds Micronesia, 1922, p. 2. (Type locality, Tol, Truk Islands.)

Columba oceanica Kittlitz (part), Kupfertaf. Naturgesch. Vögel, 3, 1833, p. 25, pl. 33, fig. 1 (Lugunor); *idem* (part), Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 299 (Lougounor); Hartlaub (part), Archiv f. Naturgesch., 18, 1852, pp 115, 185, (Mordlockinseln).

Carpophaga (Globicera) pacifica Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 41 (Mortlock's Island).

Carpophaga pacifica Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 146 (Lugunor).

Carpophaga oceanica Finsch, Proc. Zool. Soc. London, 1880, p. 576 (Ruk); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 330, 353 (Nukuor, Ruk); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 52 (Luganor, Ruk, Nukuor); Hartert, Novit. Zool., 7, 1900, p. 8 (Ruk).

Globicera oceanica Salvadori (part), Cat. Birds British Mus., 21, 1893, p. 176 (Ruk); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 52 (Ruk).

Globicera oceanica teraokai Kuroda, in Momiyama, Birds Micronesia, 1922, p. 55 (Ruk, ?Mortlock, ?Nukuor); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 45 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 189 (Truk).

M[uscadivora] o[ceanica] oceanica Neumann (part), Verhandl. Ornith. Ges. Bayern, 25, 1922, p. 234 Ualan = Truk).

Ducula oceanica teraokai Peters, Check-list Birds World, 3, 1937, p. 43 (Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Truk); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 11 (Truk); Mayr, Birds Southwest Pacific, 1945, p. 289 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk, ?Lukunor, ?Nukuoro.

Characters.—Adult: Resembles *D. o. monacha*, but slightly darker on crown, nape, and mantle; back more bluish and less greenish, underparts slightly darker chestnut. Differs from *D. o. townsendi* by being paler and gray on crown, nape, shoulder, side of neck, and upper breast; abdomen and under tail-coverts slightly deeper chestnut. Differs from *D. o. oceanica* by larger size; upper parts paler; abdomen and under side of tail deeper chestnut. I agree with Amadon (1943:11) that this subspecies is only doubtfully distinct from *D. o. monacha* and that it might be advisable to unite these under one subspecific name.

Measurements.—Measurements are listed in table 27.

Specimens examined.—Total number, 14 (5 males, 9 females, 1 unsexed) from Caroline Islands, AMNH—Truk (Nov., Dec.).

Remarks.—The Micronesian Pigeon at Truk was observed by Kittlitz (1836:299) and later by Kubary at the islands of Lukunor and Nukuoro. Momiyama (1922:4) remarks that he did not see specimens from these two islands but concludes that they probably belong to the subspecies named from Truk. It is possible that birds at these two atolls have been exterminated, although adequate field investigations have not been made.

There is little information published concerning the natural history of this subspecies. McElroy, who visited Truk in December, 1945, did not find the bird; however, he did not visit all of the islands in the group during his stay.

Ducula oceanica townsendi (Wetmore)

Micronesian Pigeon

Globicera oceanica townsendi Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 191. (Type locality, Ponapé).

Carpophaga oceanica Finsch (part), Proc. Zool. Soc. London, 1877 (1878), p. 780 (Ponapé); Nehrkorn, Journ. f. Ornith., 1879, p. 407 (Ponapé); Finsch (part), Journ. f. Ornith., 1880, p. 292 (Ponapé); *idem*, 1881, pp. 113, 115 (Ponapé); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 52 (Ponapé); Matschie (part), Journ. f. Ornith., 1901, p. 113 (Guam, error = Ponapé).

Globicera oceanica Salvadori (part), Cat. Birds British Mus., 21, 1893, p. 176 (Ponapé).

Globicera oceanica townsendi Momiyama, Birds Micronesia, 1922, p. 6 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 55 (Ponapé); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 45 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 190 (Ponapé).

Ducula oceanica townsendi Peters, Check-list Birds World, 3, 1937, p. 44 (Ponapé); Bequaert, Mushi, vol. 12, no. 2, 1939, pp. 81, 82 (Ponapé); *idem*, Occ. Papers Bernice P. Bishop Mus., 16, 1941, pp. 266, 290 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Ponapé); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 11 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 289 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: Resembles *D. o. teraokai*, but darker. Rsembles closely *D. o. oceanica* but larger and darker on crown and nape; lower parts slightly paler but chin more cream-buff in color. As Adamon (1943:11) states, there is little difference between *D. o. townsendi* and *D. o. oceanica* except in size.

Measurements.—Measurements are listed in table 27.

Specimens examined.—Total number 21 (11 males, 9 females, 1 unsexed), as follows: Caroline Islands, USNM—Ponapé, 2 (Feb. 11, 12); AMNH—Ponapé, 19 (Nov. 22, 29, Dec. 1, 2, 3).

Nesting.—Coultas (field notes) writes that the pigeon at Ponapé nests the year around, probably two or three times a year. He describes the nest as being made of loose twigs and as placed on a fork of a limb in a tall tree. One egg is laid. Coultas saw "two or three" females nesting in December.

Parasites.—Bequaert (1939:81, 82 and 1941:266, 290) found the flies (Hippoboscidae), *Ornithoctona plicata* and *O. pusilla*, on pigeons from Ponapé.

Remarks.—Coultas (field notes) writes that in 1930 several Japanese made a livelihood as professional hunters of pigeons at Ponapé. He notes, "Two or three years ago, 4 or 5 Japanese, each, averaged from 75 to 100 birds per day, which they sold to the inhabitants for 35 sen (17½ cents) per bird. . . . Now these same hunters are fortunate if they obtain 4 or 5 Ducula each per day and are able to do so only by starting before daylight and covering great distances. Other birds are now replacing Ducula on the market." Coultas further records in his notes that the hunters used calls to attract the pigeons. In 1930, Coultas regarded the pigeon at Ponapé as a rapidly disappearing species; he found it only in small areas in remote regions of the mountains. With the shipping of supplies cut off to the Japanese garrison forces at Ponapé, as well as at Kusaie, Truk, and Yap by the effective American blockade during the latter part of the war, it is probable that the pigeons were hunted more intensively by the Japanese hunting parties than ever before. Richards obtained two specimens at Ponapé in the period from August, 1947, to January, 1948.

Ducula oceanica oceanica (Lesson and Garnot)

Micronesian Pigeon

Columba oceanica Lesson and Garnot, Dict. Sci. Nat., éd., Levrault, 40, 1826, p. 316. (Type locality, Oualan = Kusaie.)

Columba oceanica Lesson (part), Voy. "La Coquille," Zool.; Atlas, 1826, pl. 41; vol. 2, 1828, pp. 432, 708 (Oualan or Strong); *idem*, (part), Man. d'Ornith., 11, 1828, p. 166 (Oualan); Kittlitz (part), Kupfertaf. Naturgesch. Vögel, 3, 1833, p. 25, pl. 23, fig. 1 (Ualan); *idem* (part), Observ. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 284 (Ualan); Lesson, Compl. de Buffon, 2d ed., 2, Oiseaux, 1839, p. 292 (Oualan); Prévost and Knip (part), Les Pigeons, 2, 1838-43, p. 47, pl. 24 (Oualan); Bonaparte, Comptes Rendus Acad. Sci. Paris, 39, 1854, p. 1072 (Oualan); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, pp. 39, 49, 62 (Ualan).

Carpohaga oceanica Hartlaub (part), Archiv f. Naturgesch., 18, 1852, pp. 115, 185 (Ualan); *idem*, Journ. f. Ornith., 1854, p. 168 (Carolinen=Kusaie); Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, p. 101 (Ualan); Schlegel, Mus. Pays-Bas, 6, no. 35, 1873, p. 87 (Oualan); Salvadori (part). Cronaca del R. Liceo-Ginnasio Cavour, 1878, pp. 3, 8 (Oualan); Finsch (part), Ibis, 1880, pp. 220, 331, 332 (Taluit); *idem* (part), Journ. f. Ornith., 1880, pp. 292, 304 (Kuschai); *idem*, Ibis, 1881, p. 108 (Kuschai); *idem*, Mitth. Ornith. Ver. Wien, 1884, p. 50 (Kuschai, Jaluit); Hartert, Katalog Vogelsamml, Senckenb., 1891, p. 190 (Ualan); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 52 (Ualan, Taluit); Matschie (part), Journ. f. Ornith., 1901, p. 113 (Ualan).

Globicera oceanica Bonaparte (part), Consp. Avium, 2, 1855, p. 31 (Oualan); *Idem*, Comptes Rendus Acad. Sci. Paris, 43, 1856, p. 835 (Oualan); Reichenbach (part), Tauben, 1861, p. 120 (Oualan); Salvadori (part), Cat. Birds British Mus., 21, 1893, p. 176 (Kushai).

Carpophaga pacifica Finsch and Hartlaub (part), Fauna Centralpolynesiens, 1867, p. 145 (Ualan).

Carpophaga (Globicera) oceanica Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 41 (Oualan).

Globicera oceanica oceanica Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 191 (Kusaie); Momiyama (part), Birds Micronesia, 1922, p. 6 (Kusaie, Taluit); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 55 (Kusaie, Taluit); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 45 (Kusaie); Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 221 (Jaluit, Iringlob, Kusaie); Hand-list Japanese Birds, rev., 1932, p. 190 (Kusaie, Jaluit, Elmore).

Muscadivora oceanica oceanica Neumann (part), Verhandl. Ornith. Ges. Bayern, 25, 1922, p. 234 (Kushai).

Ducula Oceanica oceanica Peters, Check-list Birds World, 3, 1937, p. 44 (Kusaie, Jaluit, Elmore); Bequaert, Mushi, 12, 1939, p. 81 (Kusaie); *idem*, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 266 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Kusaie, Jaluit, Elmore); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 11 (Kusaie, Jaluit, Elmore); Mayr, Birds Southwest Pacific, 1945, p. 289 (Kusaie, Jaluit, Elmore).

Geographic range.—Micronesia: Caroline Islands—Kusaie; Marshall Islands—Jaluit, Elmore.

Characters.—Adult male: A large knob-billed pigeon with breast gray, washed with buff; head and neck dark gray; feathers at base of bill and on chin buff-white; abdomen and under tail-coverts near "burnt sienna," sides grayer; mantle, back, rump, upper tail-coverts, wings and tail bronze-green edged with a dark bluish sheen; under side of wing and under side of tail brown; bill and knob black; feet blackish-red; iris reddish-brown. Adult female resembles adult male but smaller and possibly a little darker bluish-green on back, wings, and tail.

D. o. oceania resembles *D. o. townsendi*, but is smaller with upper parts slightly darker and abdomen and under side of tail lighter.

Measurements.—Measurements are presented in table 27.

Specimens examined.—Total number, 47 (25 males, 22 females), as follows: Caroline Islands, USNM—Kusaie, 2 (Feb. 8, 9,); AMNH—Kusaie, 45 (Jan., Feb., March).

Parasites.—Bequaert (1939:81 and 1941:266) obtained the fly (Hippoboscidae) *Ornithoctona plicata* from the pigeon at Kusaie.

Remarks.—The Micronesian Pigeon at Kusaie has been known since 1824, when from June 5 to June 15 of that year personnel from the corvette "La Coquille" visited the island and observed the bird. Kittlitz visited Kusaie and observed the pigeon in December, 1827, and January, 1828. Finsch (1880c and 1880d) found the bird in the

Marshalls at Jaluit. Takatsukasa and Yamashina (1932:221) record the bird from Elmore in the Marshalls. Coultas (field notes) writes that the pigeon was numerous at Kusaie in 1931. He remarks that they appear stupid and are easily killed by the natives, who use a call to attract them. With regard to their habits he writes, "About four o'clock in the afternoon these birds begin congregating in the high trees trees of the lowlands close to the salt water where they roost for the night. At daybreak they begin migrating to the high mountain sides and peaks where they spend the time feeding."

Ducula oceanica ratakensis (Takatsukasa and Yamashina)

Micronesian Pigeon

Globecera oceanica ratakensis Takatsukasa and Yamashina, Dobutsu. Zasshi, 44 1932, p. 221. (Type locality, Aruno.)

Columba australis Chamisso, in Kotzebue's, Vcy. "Rurick," 3, 1821, p. 157 (Radak).

Carpophaga oceanica Finsch, Ibis, 1880, p. 331 (Arno); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 52 (Arno); *idem*, Ibis, 1893, p. 211 (Marshalls).

Globicera oceanica oceanica Momiyama (part), Birds Micronesia, 1922, p. 5 (Arno); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p.55 (Arno).

Globicera oceanica ratakensis Hand-list Japanese Birds, rev., 1932, p. 190 (Arhno, Wotze); Mathews, Ibis, 1933, p. 87 (Aruno, Wozzie).

Ducala oceanica ratakensis Peters, Check-list Birds World, 3, 1937, p. 44 (Arno, Wotje); Hand-list Japanese Birds, 3d ed., 1942, p. 212 (Arhno, Wotze); Amadon, Amer. Mus. Novit., no. 1237, 1943, p. 12 (Arno, Wotje); Mayr, Birds Southwest Pacific, 1945, p. 289 (Arno, Wotje).

Geographic range.—Micronesia: Marshall Islands (Radak Chain)—Wotje, Arhno.

Characters.—Takatsukasa and Yamashina (1932:221) describe this subspecies as follows, "This form differs from all other forms of *Globicera oceanica* by its smaller size, more bronze-sheen on the back, more vinaceous grey on the breast and duller brown on the abdomen." On examining two specimens from Arno in the collection of the Museum of Comparative Zoölogy, Amadon (1943:12) writes that he finds no distinguishing color characters between *D. o. oceanica* and *D. o. ratakensis*. He also questions whether there is any difference in size between the two populations.

Measurements.—Measurements are listed in table 27.

Remarks.—Chamisso (1821), the naturalist on board the ship "Rurick," was the first person to write of the pigeon in the Radak Chain of the Marshall Islands. The ship visited this area in 1817. Finsch (1880b) published an account of the bird when he visited the area about 1880. Takatsukasa and Yamashina (1932:221) described this bird as new on the basis of an examination of nine skins taken at Arhno and Wotje.

Evoluntionary history of Ducula oceanica in Micronesia.—The distribution and evolutionary history of *Ducula oceanica* have been treated by Mayr (1940) and Amadon (1943). These authors place

D. oceanica within a superspecies containing *D. pacifica* (Melanesia to Samoa and Cook Islands), *D. aurorea* (Society Islands), *D. galeata* (Marquesas Islands), and possibly other species in Papua and Malaysia. According to Mayr (1942b:fig. 7), *D. pacifica* is the species which is ancestral to other species of pigeons in Oceania. Apparently *D. oceanica* was derived from this ancestral stock and reached Micronesia via the Ellice and Gilbert islands. Records of *Ducula* were obtained in the Gilbert Islands in the days of exploration; Amadon (1943:11) tentatively refers these to *D. o. oceanica*.

The irregular distribution of *D. oceanica* in the islands of Micronesia and the fact that the bird exists on both "high" volcanic islands as well as on "low" coral atolls suggest that the present population may be a remnant of a once more widely distributed one. The fact that *D. oceanica* may be divided into several subspecies shows that a greater amount of geographic variation has occurred as compared with its probable ancestral stock, *D. pacifica,* which is virtually undifferentiated over most of its extensive range. The pigeon of Micronesia has a more rounded wing than that of *D. pacifica,* which might, as Amadon has suggested, cause the bird to be more sedentary and lend itself more readily to differentiation through geographic isolation. *D. pacifica* is known to fly from island to island. As shown by the measurements in table 27, the length of wing of *D. oceanica* differs, in the various insular populations, being longer in the west and shorter in the east. This cline has been discussed by Amadon (1943:11).

It is interesting that *Ducula* or some other large pigeon has not become established in the Mariana Islands. *Ducula* is present at Yap and Truk, which are not very distant from Guam. Another tropical pigeon, *Columba vitiensis,* has extended its range northward and reached the Bonin Islands; probably it arrived there via the Philippines or the Riu Kiu Islands. Thus, there are representatives of large pigeons on islands to the southeast, south, west and northwest of the Marianas, but none has become established in the Marianas themselves.

Streptopelia bitorquata dusumieri (Temminck)

Philippine Turtle Dove

Columba dusumieri Temminck, Pl. col., livr. 32, 1832, p. 188. (Type locality, Vicinity of Manila, Luzon, Philippine Islands.)

Colombe Dussumier Quoy and Gaimard, Voy. "Uranie," Zool., 1824, pp. 35, 680 (Mariannes); *idem*, Ann. Sci. Nat. Paris, 6, 1825, p. 148 (Mariannes).

Columba dusumieri Wagler, Syst. Avium Columba, 1827, p. 266, sp. 99 (Marianis).

Columba Dussumieri Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan).

Streptopelia gaimardi Bonaparte, Consp. Avium, 2, 1854, p. 66 (Type locality, Mariannes); *idem,* Comptes Rendus Acad. Sci. Paris, 40, 1855, p. 18 (Mariannes); Reichenbach, Tauben, 1862, p. 76 (Mariannen).

Turtur (Streptopelia) Giamardi Gray, Cat. Birds Trop. Is. Pacific Oceon, 1859, p. 43 (Guam).

Turtur gaimardi Gray, Hand-list Birds, 2, 1870, p. 239 (Marian).

Turtur dussumieri Schlegel, Mus. Pays-Bas, 6, no. 35, 1873, p. 120 (Mariannes); Wiglesworth, Abhandl. Und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 54 (Marianne); Salvadori, Cat. Birds British Mus., 21, 1893, p. 423 (Mariannes); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 222 (Guam); Hartert, Novit. Zool., 5, 1898, p. 60 (Guam, Saipan); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 43 (Marianas); Safford, Osprey, 1902, p. 68 (Marianas); *idem,* Amer. Anthro., 4, 1902, p. 711 (Guam); *idem,* The Plant World, 7, 1904, p. 264 (Guam); Dubois, Syn. Avium, 2, 1904, p. 760 (Marianne); Safford, Contr. U. S. Nat. Herb., 9, 1905, p. 78 (Guam); Schnee, Zeitschr. f. Naturwisch., 82, 1912, p. 466 (Marianen); Prowazek, Die deutschen Marianen, 1913, p. 101 (Marianen); Reichenow, Die Vögel, 1, 1913, p. 341 (Marianen); Cox, Island of Guam, 1917, p. 20 (Guam).

Streptopelia dussumieri Kuroda, in Momiyama, Birds Micronesia, 1922, p. 54 (Guam, Saipan); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 62 (Marianas); Hand-list Japanese Birds, rev., 1932, p. 189 (Saipan, Tinian, Rota).

Tuttur dessumieri Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam).

Streptopelia bitorquata dusumieri Peters, Check-list Birds World, 3, 1937, p. 96 (Marianne); Hand-list Japanese Birds, 3d ed., 1942, p. 211 (Saipan, Tinian, Rota); Mayr, Birds Southwest Pacific, 1945, p. 289 (Marianas); Watson, The Raven, 17, 1946, p. 41 (Guam); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 96 (Tinian); Strophlet, Auk, 1946, p. 538 (Guam); Stott, Auk, 1947, p. 526 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 60 (Guam, Rota).

Streptopelia bitorquata Baker, Trans. 11th N. American Wildlife Conf., 1946, p. 208 (Guam); *idem,* Condor, 49, 1947, p. 125 (Guam).

Geographic range.—Philippine Islands, Sula Archipelago, northern Borneo. In Micronesia: Mariana Islands (introduced)—Guam, Rota, Tinian, Saipan.

Characters.—Adult: A medium-sized dove with head and nape near "light Quaker drab" with a vinous tinge; chin and upper throat whitish becoming near "vinaceous buff" on lower throat and to near "vinaceous-faun" on breast and upper abdomen; lower abdomen, vent, and under tail-coverts white; tibia grayish; neck feathers dark with grayish centers and metallic greenish-slate edges; color near "Japan rose"; back, rump, upper tail-coverts, scapulars, upper wing-coverts, and inner secondaries dark "drab"; sides, upper wing coverts, outer secondaries, and under wing-coverts lead colored; primaries blackish edged with light gray; central tail feathers like back but paler, outer feathers of tail darker with brownish tinge on edges; outermost tail feathers blackish tipped with gray and with outer webs whitish; bill dark; feet reddish; iris orange.

Measurements.—Measurements of 15 adult males from Guam, Rota and Tinian: wing, 154-162 (158); tail, 127-135 (130); culmen, 16.2-18.1 (17.2); tarsus, 24-27 (25.5); of 10 adult females from Guam and Rota: wing, 150-162 (156); tail, 120-130 (127); culmen, 16.2-19.1 (17.5); tarsus, 24-26 (25). No differences in measurements were found between populations from Guam, Rota and Tinian.

Weights.—The author (1948:61) reports the weights of five adult males as 130-167 (152) and of six adult females as 135-159 (146). These birds were taken at Guam.

Specimens examined.—Total number, 27 (16 males, 11 females), as follows: Mariana Islands, USNM—Guam, 21 (Feb. 7, May 25, 26, June 9, July 6, 7, 10, 18, 23, Aug. 2, 11, Sept. 8, Oct. 8)—Rota, 4 (Oct. 18, 22, 23, Nov. 2)—Tinian, 2 (Oct. 24, 25).

Nesting.—The NAMRU2 party found evidences of nesting by this dove at Guam in February, March, April, and June. Nests were observed on May 29 and June 28. On the latter date a nest containing one nestling and one unhatched egg was found near Mount Santa Rosa. The nest was situated approximately five feet from the ground in a low bush. Two eggs taken by Necker at Rota on October 31, 1945, are white and measure 29.6 by 23.0 and 30.1 by 23.0. Strophlet (1946:538) observed a bird carrying nest materials at Guam on November 13. Hartert (1898:60) reports on nests found at Guam in April and May. Each nest contained one egg. It is probable that this bird nests at all times of the year. The nuptial flight of these birds reminds one very much of that of the mourning dove of North America.

Remarks.—The Philippine Turtle Dove was introduced from the Philippines to Guam and other islands of the southern Marianas by the Spanish probably in the 18th Century; it was in 1771-1774 that the Philippine deer (*Rusa*) was introduced to Guam. Perhaps these birds were initially introduced as caged birds or possibly were liberated to offer hunting for the colonial governors. They have been a very successful introduction and are well established. At Guam (see Baker 1947b:124), this species comprised 15.5 percent of all birds seen along roadways. Although open areas appear to be preferred by this dove and although it may be on the increase owing to the clearing operations of the war effort, it appears to be equally adapted to forested areas and coconut groves. It feeds on the ground to a large extent, fitting into an ecologic niche which few other species of birds of the islands occupy. It was even observed feeding on sandy beaches and tidal flats at low tide.

In 1931, Coultas found the dove to be numerous at Guam, but thought that it was in danger of extinction at Tinian and Saipan owing to extensive hunting. Downs (1946:96) reported that in 1945 the dove was abundant at Tinian. Gleise (1945:22) estimated the population of these doves at 300 on Tinian in 1945. From the remarks of Stott (1947:526), we may assume that the population at Saipan is in no immediate danger of extinction.

A comparison of specimens from the Marianas with those from the Philippines reveals no significant difference between the two. Bonaparte described the dove in the Marianas as new, naming it *Sterptopelia gaimardi*. The name *Turtur prevostianus* has been used by some authors to denote the dove in the Marianas, but this was through error as explained by Salvadori (1893:410). This name refers to a dove found on Marianne, an island of the Seychelles in the Indian Ocean.

Gallicolumba canifrons (Hartlaub and Finsch)

Palau Ground Dove

Phlegoenas canifrons Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 101. (Type locality, Pelew Islands.)

Phlegoenas canifrons Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 27, pl. 5, fig. 1 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 57 (Pelew); Hartert; Novit. Zool., 5, 1898, p. 61 (Pelew); Matschie, Journ. f. Ornith., 1901, p. 113 (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 53 (Pelews).

Phlogoenas canifrons Sclater, Proc. Zool. Soc. London, 1877, p. 112 (Pelew); Salvadori, Ornith, Papuasia, 3, 1882, p. 169 (Pelew); *idem*, Cat. Birds British Mus., 21, 1893, p. 592 (Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 227 (Palaos); Bolau. Mitteil. Naturhist. Mus. Hamburg, 1898, p. 68 (Palau); Dubois, Syn. Avium, 2, 1904, p. 772 (Pelew).

Phaps canifrons Giebel, Thes. Ornith., 3, 1877, p. 89 (Pelew).

Gallicolumba canifrons canifrons Mathews, Syst. Avium Australasianarum, 1, 1927, p. 74 (Pelew).

Gallicolumba canifrons Hand-list Japanese Birds, rev., 1932, p. 189 (Palau); Mayr, Amer. Mus. Novit., no. 828, 1936, p. 4 (Palau); Peters, Check-list Birds World, 3, 1937, p. 136 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 211 (Babelthuap); Mayr, Birds Southwest Pacific, 1945, p. 290 (Palau); Mayr, Audubon Mag., 47, 1945, p. 282 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 62 (Garakayo, Peleliu).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad, Angaur.

Characters.—Adult male: A small, ground dove with forehead, crown, sides of head, chin, throat, and breast ashy gray, lighter on forehead, chin, and throat, and washed with "light vinaceous-faun" on breast; occiput, nape and mantle dark "ferruginous"; rest of upper parts glossed with bronze-olive; lesser and middle wing-coverts tipped with metallic purple; wings reddish-brown with dark brown tips; under side of wing reddish-brown to brown; abdomen, vent and under tail-coverts dark grayish-brown; tail colored like back, outer feathers have a paler brown terminal band rather obscure; bill horn colored; feet red; iris brown.

Female: A female molting into adult plumage is cinnamon colored, mottled with dark brown; on the back an olive-green sheen is beginning to appear; tail brown with some greenish sheen; tips of tail edged with light brown; bill and feet light brown.

Measurements.—Measurements of six adult males are: wing, 112-119 (115); tail, 65-72 (70); exposed culmen, 15.3-16.1 (15.7); tarsus, 30.1-31.2 (30.8); of one female in postjuvenal molt: wing, 107; tail, 69; exposed culmen, 17.1; tarsus, 30.

Specimens examined.—Total number, 8 (7 males, 1 female), as follows: Palau Islands, USNM—Koror, 1 (Nov. 18)—Garakayo, 2 (Sept. 17, 19)—Peleliu, 2 (Sept. 1, Dec. 5)—Ngabad, 1 (Sept. 11); AMNH—exact locality not given, 1 (Dec. 1).

Food haibts.—Stomachs of specimens taken by the NAMRU2 party at Peleliu and Garakayo contained one and one-half to two cc. of hard seeds and seed parts.

Remarks.—The Palau Ground Dove, according to Amadon (1943: 19), is a member of a superspecies containing *G. hoedti* (Wetar), *G. beccarii* (New Guinea, Bismarcks, Solomons), *G. sanctaecrucis* (Santa Cruz, New Hebrides), and *G. stairi* (central Polynesia).

G. canifrons apparently came to the Palaus from either New Guinea or the region of the Bismarck Archipelago, evolving from *G. beccarii* or some related form. The Palau Ground Dove has a copper-colored occiput, nape, and shoulder patch, but otherwise it resembles this Melanesian species, *G. becarii*. Amadon (1943:20) discusses two types of plumage of females in *G. stairi;* one is a male type of plumage. The lack of female specimens prevents me from determining whether this characteristic is present in *G. canifrons*.

Coultas (field notes) had difficulty in obtaining even one specimen of *G. canifrons* in the Palaus in 1931. He concluded that either the bird was practically extinct or that he just could not find it. From the experience of the NAMRU2 party in the southern Palaus in 1945, I would think that he merely did not find the bird. Although it is probably rare in comparison with some other members of the family Columbidae of these islands, we found this bird on most of the islands visited.

The NAMRU2 party arrived at Palau expecting to find the ground dove a fairly conspicuous member of the avifauna and expecting to see it sitting in trees and flying across the roads much in the same manner as did the ground dove at Guam, *G. x. xanthonura*. At first, we did not find the bird, but in the dense jungles a low, penetrating, and intermittent, call was heard which may be described as a moan. This was the call of the ground dove. The bird was difficult to discover because its color blended so well with the shadows and dark background of the coral rocks and forest litter. The bird was very active and moved along rapidly pecking at food particles. Also it was wary. Once the distinctive call note was recognized, it was not difficult to locate the area in which the bird was living; however, finding the bird was difficult. On one occasion I stalked a dove for at least a half an hour knowing that it was always within fifty yards of me. A bird that was flushed, flew about twenty-five feet and dropped down in open forest litter and disappeared. On the basis of specimens collected and call notes heard, I estimate that the population of the Palau Ground Dove on the islands visited in 1945 was as follows: Peleliu—a minimum of 15 (found in most forested areas which were not greatly damaged by the invasion operations); Garakayo—a minimum of 10 (the doves were found to live equally well on the steep hillsides or in flat jungle on this islet); Ngabad—5 to 10 (doves were heard in several areas on this small islet); Angaur—not estimated (one call was heard in brush near the edge of a fresh water lake).

Gallicolumba xanthonura xanthonura (Temminck)
White-throated Ground Dove

Columba xanthonura Temminck, Pl. col., livr. 32, 1823, pl. 190. (Type locality, Mariannes.)

Columba xanthonura Lesson, Compl. de Buffon, 2nd ed., 2, Oiseaux, 1838, p. 281 (Mariannes).

Columba Pampusan Quoy and Gaimard, Voy. "Uranie," Zool., 1824, pp. 121, 681, pl. 30 (Mariannes); Dumont, Dict. Sci. Nat., ed. Levrault, 40, 1826, p. 345 (Guam); Lesson, Traité d'Ornith., 1831, p. 471 (Mariannes); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen).

Columba erythroptera Lesson, Traité d'Ornith., 1831, p. 471 (Mariannes); Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen).

Columba xanthura Prévost and Knip, Los Pigeons, 2, 1838-43, p. 45, pl. 23 (Guam).

Pampusana xanthua Bonaparte, Consp. Avium, 2, 1854, p. 89 (Mariannis); *idem*, Comptes Rendus Acad. Sci. Paris, 40, 1855, p. 207 (Mariannes); Reichenbach, Tauben, 1861, p. 39 (Guam).

Caloenas (Pampusana) xanthura Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 45 (Guam).

Phlegoenas erythroptera Reichenbach, Tauben, 1861, p. 41 (Mariannen).

Caloenas xanthura Gray, Hand-list Birds, 2, 1870, p. 247 (Marian).

Phlegoenas yapensis Hartlaub and Finsch, 1872, p. 102 (Type locality, Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, pp. 122, 123 (Yap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 57 (Yap); Hartert, Novit. Zool., 5, 1898, p. 61 (Yap); Matschie, Journ. f. Ornith., 1901, p. 113 (Yap).

Pampusana rousseaui Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 103 (Marianne).

Phaps erythroptera Giebel (part), Thes. Ornith., 3, 1877, p. 89 (Marianne).

Phaps xanthura Giebel, Thes. Ornith., 3, 1877, p. 91 (Marianne).

Phaps yapensis Giebel, Thes. Ornith., 3, 1877, p. 91 (Uap).

Phlegoenas virgo Reichenow, Journ. f. Ornith., 1885, p. 110 (Type locality, Palau-Inseln, error = Guam).

Phlogaenas erythroptera Oustalet, Le Nat., 1889, p. 261 (Mariannes).

Phlegoenas pampusan Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 55 (Marianne); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 224 (Saypan, Guam, Rota).

Phlogoenas yapensis Salvadori, Cat. Birds British Mus., 21, 1893, p. 593 (Uap); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 227 (Mackensie); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 68 (Yap); Dubois, Syn. Avium, 2. 1904, p. 772 (Uap).

Phlogoenas pampusan Salvadori, Cat. Birds British Mus., 21, 1893, p. 602 (Marianne).

Phlegoenas xanthonura Hartert, Novit. Zool., 5, 1898, p. 60 (Guam, Saipan); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Matschie, Journ. f. Ornith., 1901, p. 113 (Guam, Saipan); Safford, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, Osprey, 1902, p. 68 (Mariannas); *idem*, The Plant World, 7, 1904, p. 264 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 78 (Guam); Cox, Island of Guam, 1917, p. 20 (Guam).

Phlogoenas xanthonura Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 42 (Marianas); Reichenow, Die Vögel, 1, 1913, p. 331 (Mariannen); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 24 (Guam).

Phlegoenas xanthonura xanthonura Kuroda, in Momiyama, Birds Micronesia, 1922, p. 54 (Guam, Rota, Saipan).

Phlegoenas xanthonura yapensis Kuroda, in Momoyama, Birds Micronesia, 1922, p. 54 (Yap).

Gallicolumba xanthonura Mathews, Syst. Avium Australasianarum, 1, 1927, p. 75 (Marianas, Mackenzie); Hand-list Japanese Birds, rev., 1932, p. 189 (Pagan, Almagan, Saipan, Tinian, Rota, Mackenzie); Mayr, Amer. Mus. Novit., no. 828, 1936, p. 4

(Marianne); Peters, Check-list Birds World, 3, 1937, p. 136 (Marianne, Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 211 (Yap, Assongsong, Pagan, Almagan, Saipan, Tinian, Rota); Strophlet, Auk, 1946, p. 538 (Guam); Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Gallicolumba canifrons yapensis Mathews, Syst. Avium Australasianarum, 1, 1927, p. 74 (Yap).

Terricolumba xanthonura Yamashina, Tori, 10, 1940, p. 677 (Assongsong).

Gallicolumba xanthonura xanthonura Mayr, Birds Southwest Pacific, 1945, p. 290 (Marianas, Yap); Watson, The Raven, 17, 1946, p. 41 (Guam); Stott, Auk, 1947, p. 526 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 61 (Guam, Rota Yap).

Gallecolumba xanthonura xanthonura Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 96 (Tinian).

Geographic range.—Micronesia: Mariana Islands—Asuncion, Pagan, Almagan, Saipan, Tinian, Rota, Guam; Caroline Islands—Yap.

Characters.—Adult male: Forehead, face, chin, throat, and upper breast white, lightly washed with pale buff; crown, occiput, sides of head, and nape rusty brown to dark brown; rest of upper parts dark bronze-olive; feathers of mantle and upper wing-coverts broadly edged with metallic purple-violet; primaries, under wing-coverts and axillaries brown; tail, lower breast and rest of underparts dark brown; bill and feet dark brown.

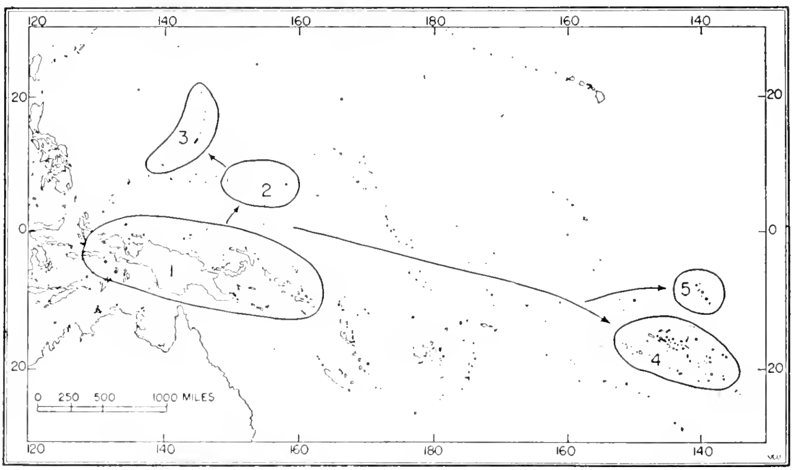

FIG. 14. Geographic distribution of *Gallicolumba* of Micronesia and Eastern Polynesia and routes of its dispersal. (1) *G. jobiensis;* (2) *G. x. kubaryi;* (3) *G. x. xanthonura;* (4) *G. erythroptera;* (5) *G. rubescens.*

Adult female: Resembles adult male, but smaller and with underparts colored between "ochraceous-tawny" and "cinnamon brown" instead of dark brown and white; head and neck darker and with more rufous than underparts; remainder of upper surface resembles underparts but with striking olive green sheen, especially on upper wing-coverts; primaries brown but outer webs lighter; tail rufous-brown, with a broad, black subterminal band.

The male type of plumage in the adult female is: breast light drab tinged with light brown and darkening anteriorly; crown resembles that of normal female although darker and becoming lighter and grayer on neck and nape;

shoulder and wing-coverts compare favorably with that of adult male although lighter and with yellowish tinge; back bronzed olive-green as in normal female but mantle with a few purplish feathers characteristic of male; abdomen near "olive brown" with buffy-brown edges to feathers.

Immature male: Resembles adult male, but head and nape darker brown; throat and upper breast may be more brown and less white.

Immature female: Resembles adult female, but with more rufous coloring; olive-green sheen on feathers reduced in amount or absent.

Measurements.—Measurements are found in table 28.

TABLE 28. MEASUREMENTS OF *Gallicolumba xanthonura*

SUBSPECIES	Number	Wing	Tail	Culmen	Tarsus
G. x. xanthonura..	43 males....	146 (139-153)	102 (97-111)	22.0 (21.0-23.0)	32 (31-33)
	31 females..	136 (131-141)	94 (90-98)	20.5 (20.0-21.5)	30 (28-32)
G. x. kubaryi.....	7 males...	157 (152-160)	....	23.0 (20.5-23.5)	35 (33-35)
	7 females..	148 (145-151)	....	23.0 (22.5-23.5)	33 (32-34)

There is little difference in the measurements of specimens from Guam, Rota, Tinian, Saipan, and Asuncion. No specimens from Yap were available for examination.

Weights.—The NAMRU2 party obtained weights of this ground dove from Guam as follows: seven adult males 119-154 (130); seven adult females 96-150 (118).

Specimens examined.—Total number, 96 (50 males, 38 females, 8 unsexed) as follows: Mariana Islands, USNM—Guam, 29 (Mar. 18, April 4, 17, May 20, 28, June 2, 9, 13, 14, 15, 20, 23, 24, 27, 28, July 2, 6, 10, 23, Aug. 11, 21)—Rota, 6 (Oct. 20, 22, 25, 26, Nov. 1, 2)—Tinian, 4 (Oct. 24, 26); AMNH—Guam, 40 (Jan. 17, 30, Feb. 12, 20, March 3, 5, 7, 11, 13, 23, April 13, 19, June 13, 15, July 10, 25, Aug. 4, 10, 11, 13, 15, 18, 20, 21, 22, Sept. 4, Dec. 26, 30)—Tinian, 8 (Sept. 7, 10, 11, 12, 13)—Saipan, 6 (July 13, 15, Aug. 24, Sept. 7, 8)—Asuncion, 3 (Jan. 18, Feb. 7, June).

Nesting.—The NAMRU2 party found the ground dove nesting at Guam in the winter and spring months beginning in late January. Nests were observed in tall trees, many of which were well isolated from other trees and vegetation. On February 10 a nest was discovered in a breadfruit tree near one of the NAMRU2 barracks on Oca Point. It was approximately 50 feet above the ground. On February 26 I found pieces of egg shell beneath the tree. Occasionally during the day, the male, but never the female, was observed sitting on this nest. On February 10, a dove (the male) was observed building a nest in a large banyan tree at Oca Point. Another nest was being constructed by a female on March 7. On March 17 a young female dove, just beginning to fly, was taken; another was found on April 3. Adult birds with enlarged gonads were taken in April, May, June, and July. Marche, according to Oustalet (1895:224), obtained eggs in May, 1887.

Food habits.—Stomachs of doves taken at Guam contained fruits and fruit parts. On March 9, a dove was observed feeding on the berries of the shrub known as "inkbush." This appeared to be a favorite food. Seale (1901:42) also mentions that this berry is a preferred food.

Parasites.—Wharton (1946:174) lists the chigger (Acarina), *Trombicula* sp., from the ground dove at Guam.

Remarks.—At Guam, the NAMRU2 party observed the ground dove to be fairly common in 1945. Along roadways, the present author (1947b:124) found that individuals of this species comprised 2.5 percent of the total population of birds observed, and the ground dove was seen on 31.2 percent of 125 road counts made. The male was much more in evidence than the female and was frequently seen flying high over the roadways and jungle areas; eighty percent of the ground doves seen while road-counts were being made were males. The female was found less frequently; it was a less conspicuous bird and was seen only occasionally in flight. Neither sex appeared to have the secretive, terrestrial habits of *G. canifrons* of the Palau Islands. On the basis of our observations at Guam, I would say that the name "ground dove" for the bird at Guam is not descriptive. The birds were found to spend considerable time in tall trees; the closest that I saw them to the ground was when they were feeding only three to four feet from the ground in the ink berry bushes.

The call note of this dove is much like that of the Palau Ground Dove; Seale (1901:42) describes it as follows, "These pigeons seem to prefer the deep jungle, from whence their deep low moan, like the sound of a man dying in great distress, comes with a wierd uncanny effect, heightened by the gloom and darkness of the unknown forest. . . . This sound, which always seems to come from a long distance, is very misleading, and one is considerably surprised to find he is perhaps within a few feet of the bird." Seale writes that they were very common on Guam in 1900. In 1931, Coultas found the dove "quite common at the north end of the island." The bird apparently prefers the dense forest or second growth brushy areas, but was found also in the partly cleared areas surrounding the NAMRU2 headquarters at Oca Point in 1945. At Rota, the NAMRU2 party found the birds to be numerous in 1945. Coultas observed only a few birds on Tinian in 1931; Downs (1946:96) found only a small population at this island in 1945. The extensive cultivation and clearing activities at Tinian have removed much of the habitat suitable for these, as well as other birds. At Saipan, Stott (1947:526) writes that the bird is common on "brush-covered hillsides and semi-wooded country." There is little information published regarding the status of this dove in the northern Marianas.

Gallicolumba xanthonura kubaryi (Finsch)

White-throated Ground Dove

Phlegoenas Kubaryi Finsch, Journ. f. Ornith., 1880, p. 292. (Type locality, Ruck and Ponapé.)

Phlegoenas erythroptera Bonaparte, Consp. Avium, 2, 1854, p. 89 (Carolines); Reichenbach, Tauben, 1862, p. 41 (Carolines); Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 780 (Ponapé); *idem*, Ibis, 1881, p. 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 353 (Ponapé, Ruk); Tristram, Cat. Birds, 1889, p. 41 (Ruk).

Phlegoenas kubaryi Reichenow and Schalow, Journ. f. Ornith., 1881, p. 75 (Ruk, Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 55 (Ruk, Ponapé); Hartert, Novit. Zool., 7, 1900, p. 8 (Ruk, Ponapé); Matschie, Journ. f. Ornith., 1901, p. 113 (Ruck, Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 53 (Ruk, Ponapé).

Phlogoenas erythroptera Finsch, Proc. Zool. Soc. London, 1880, p. 576 (Ponapé, Ruk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Ruk).

Phlogoenas kubaryi Salvadori, Cat. Birds British Mus., 21, 1893, p. 599 (Ruk, Ponapé); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 227 (Caroline = Truk); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 68 (Ruck); Reichenow, Die Vögel, 1, 1913, p. 331 (Karolinen).

Phlegaenas kubaryi Christian, The Caroline Islands, 1899, p. 357 (Ponapé).

Gallicolumba kubaryi Mathews, Syst. Avium Australasianarum, 1, 1927, p. 74 (Caroline Is.); Hand-list Japanese Birds, rev., 1932, p. 189 (Truk, Ponapé); Peters, Check-list Birds World, 3, 1947, p. 136 (Ruk, Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé); Bequaert, Mushi, 12, 1939, p. 81 (Ponapé); *idem* Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 266 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 211 (Truk, Ponapé).

Gallicolumba xanthonura kubaryi Mayr, Birds Southwest Pacific, 1945, p. 290 (Truk, Ponapé); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 62 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk, Ponapé.

Characters.—Adult male: Resembles adult male of *G. x. xanthonura*, but larger with crown, nape, and hind neck sooty-black; upper back and lesser upper wing-coverts purplish-violet, extending lower on back than in *G. x. xanthonura*.

Adult female: Resembles adult male, but smaller and paler with upper back glossy, bronze-green margined with purplish-violet; lower back and rump glossy, olive-green; upper tail-coverts greenish-brown; central tail feathers blackish-brown; innermost secondaries bright, glossy green tinged with bluish.

Measurements.—Measurements are presented in table 28.

Specimens examined.—Total number, 21 (9 males, 11 females, 1 unsexed), as follows: Caroline Islands, USNM—Truk, 1 (July); AMNH—Ponapé, 13 (Nov. Dec.)—Truk, 7 (Jan., Feb., May).

Nesting.—At Ponapé in November and December, Coultas obtained specimens which had enlarged gonads. He did not find the nest of this bird but writes (field notes) that the natives told him that the nest is placed in the top of the tree fern 10 or 15 feet above the ground. In contrast, the ground dove at Guam may select a nesting site considerably higher in the tree. Coultas reports that one egg is laid by *C. x. kubaryi*.

Food habits.—Coultas (field notes) writes that the bird feeds and lives on the ground at Ponapé. He lists food as small snails, seeds, and worms.

Parasites.—Bequaert (1939:81 and 1941:266) records the fly (Hippoboscidae), *Ornithoctona plicata,* from the ground dove at Ponapé.

Remarks.—Coultas (field notes) writes that in 1930 the ground dove at Ponapé was rare in the forested areas and generally found more along the sea coast and in the upland valleys. Coultas describes its call as an infrequent shrill, whistle-like call. He writes that hunting by the Japanese and natives was reducing the population of *G. x. kubaryi* at Ponapé in 1930. In 1945, McElroy of the NAMRU2 party found the dove at Truk on forested slopes in tall trees, and reported that its habits at Truk were similar to those of *C. x. xanthonura* at Guam. In 1947-1948, Richards noted (*in litt.*) that the dove at Ponapé was rare (he saw only one specimen). At Truk, he found the bird to be "rather common" in thickets, dry gullies, and flying over grassy slopes. He found the bird near sea level, never in country above 300 feet in altitude and not in deep forest. I offer no explanation for the conflicting reports concerning the habits of this species, unless it be that the bird is capable of varying its habits to fit particular habitats; for example, in jungle areas it may be ground-living and in open woodlands it may be tree-living.

Evolutionary history of Gallicolumba in Micronesia.—There have been two unrelated invasions of Micronesia by the genus *Gallicolumba.* One invasion established *G. canifrons* at the Palau Islands. The other established the populations of *G. xanthonura* in the Caroline and Mariana islands, Mayr (1936:4) points out that *G. xanthonura* is related to *G. jobiensis* (New Guinea and Northern Melanesia), *G. erythroptera* (Society and Tuamotu islands), and *G. rubescens* (Marquesas Islands). This group may be regarded as a superspecies. The adults of *G. jobiensis,* the male and female, resemble one another. In both, the head, neck, and auriculoloral stripes are sooty-black; the eye stripe, chin, throat, and breast are white; the abdomen is dark; and the upper parts are blackish with a coppery sheen. Immatures are rusty-brown. *G. xanthonura* is closely related to *G. jobiensis,* and they conceivably, along with *G. erythroptera,* might be considered conspecific. The close relationship between the *G. xanthonura* in Micronesia and *G. erythroptera* has been noted by Oustalet (1896:71). Among named kinds, *G. x. kubaryi* most closely resembles *G. jobiensis* with sooty-black coloring present on the head. The male and female of *G. x. kubaryi* closely resemble each other, although immature type of plumage may occur in adult females as indicated by the immature plumage of a bird containing well-developed eggs taken at Ponapé by Coultas.

In *G. x. xanthonura* the male lacks the sooty-black head and has lost some of the coppery sheen from the middle of the back. The female has taken on the immature type of plumage, except for occasional near-male type plumage. In *G. erythroptera* the male has lost some of the sooty-black coloring on the forehead, anterior crown, and loral area and some of the coppery sheen in the middle of the back. The female of *G. erythroptera* resembles the female of *G. x. xanthonura* except that the throat and breast are faintly outlined by the brownish color. The head and malar stripe are also outlined in this manner. Some females have some coppery gloss on the shoulder and a few white feathers on the breast; these may be considered as in the near-male type of plumage.

The tendencies in the evolution of these insular populations of *Gallicolumba* include a reduction of sooty-black on the head and a reduction of coppery gloss on the back of the male and the reduction of malelike plumage in the female. *G. rubescens* of the Marquesas Islands is smaller and darker. It retains the coppery gloss on the back and has, in addition, a white bar on the tail and one on the wing. On the basis of color and structural characters, it is apparent that this superspecies of *Gallicolumba* has evolved from a center of evolution in the region of New Guinea (as shown in figure 14) with a colonization of Micronesia, from which (probably from *G. x. kubaryi*) an invasion of eastern Polynesia occurred establishing *G. erythroptera* in the Society and Tuamotu islands, although it is also possible that *G. erythroptera* may have reached Polynesia by way of a more direct route from Melanesia. Such a pathway of colonization as that just described is not unusual since representatives of other general including *Acrocephalus, Myzomela,* and *Zosterops* may have followed similar paths of dispersal from Micronesia into Polynesia. Apparently a population isolated in the Marquesas has evolved the distinctive *G. rubescens*.

Caloenas nicobarica pelewensis Finsch

Nicobar Pigeon

Caloenas nicobarica var. *pelewensis* Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 159 (in reprint p. 27). (Type locality, Palau.)

Caloenas nicobarica pelewensis Mathews, Syst. Avium Australasianarum, 1, 1927, p. 77 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 188 (Palau); Peters, Check-list Birds World, 3, 1937, p. 139 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 210

(Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 291 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 62 (Garakayo).

Caloenas nicobarica Salvadori, Ornith. Papuasia, 3, 1882, p. 211 (Pelew); Wiglesworth, Abhandl. und. Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 57 (Pelew).

Caloenas pelewensis Salvadori, Cat. Birds British Mus., 21, 1893, p. 618 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 69 (Palau); Matschie, Journ. f. Ornith., 1901, p. 113 (Palau); Reichenow, Die Vögel, 1, 1913, p. 328 (Palauinseln); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Pelew).

Caloenas nicobaricus pelewensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 53 (Pelew).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Grarkayo.

Characters.—Adult: A large heavy-bodied pigeon with head, neck, and upper breast blackish; rest of plumage metallic bluish-green with coppery sheen; wings glossy green; tail and under tail-coverts white; feathers of hind-neck long and lanceolate; bill heavy and slightly hooked with lump at base.

Resembles C. n. nicobarica (Linnaeus), but slightly smaller and with upper parts metallic bluish-green and underparts darker and less green.

Measurements.—One adult female measures: wing, 232; tail, 82; culmen, 31; tarsus, 44; one immature female: wing, 236; tail, 89; culmen, 32; tarsus, 45.

Specimens examined.—Total number, three females from Palau Islands, AMNH—exact locality not given (undated).

Remarks.—*C. nicobarica* is distributed from the Nicobar Islands east through Malaysia to Melanesia as a single undifferentiated form. In the northeasternmost part of its range, in the Palau Islands, it exhibits geographic variation and is considered to be subspecifically distinct from the rest of the population. *C. nicobarica* appears to have no close relatives. It may represent the last remnant of some ancient group of pigeons.

The Nicobar Pigeon is rare. Coultas, who visited the islands in 1931, did not obtain the bird. The only specimens available for study are those in the collections of the American Museum of Natural History taken by Kubary in the period between 1870 and 1880. The NAMRU2 party did not obtain specimens but saw the bird on five occasions at the island of Garakayo in the middle Palaus. The writer expected the bird to be ground-living in habit, but the individuals, which I saw at Garakayo, were either perched on scrubby vegetation on high and inaccessible cliffs or were flying high overhead. In its flight overhead, the short, white tail was a particularly conspicuous mark of identification. The flight reminded me very much of that of the Black Vulture (*Córagyps atrátus*) of North America. No birds were found at Peleliu or Angaur, and the small population of this pigeon that remains is probably restricted to uninhabited coral islets, as Mayr (1945a:291) has already noted. Marshall (1949: 207) saw one bird on Peleliu and one on Koror in November and December, 1945. This endemic subspecies is probably on the road to extinction unless governmental protection can be established and enforced.

Trichoglossus rubiginosus (Bonaparte)

Ponapé Lory

Chalcopsitta rubiginosus Bonaparte, Comptes Rendus Acad. Sci. Paris, 30, February, 1850, p. 134; Consp. Avium, 1, after April 15, 1850, p. 3. (Type locality, "ex Insulis Barabay et Guebe," error = Ponapé.)

Chalcopsitta rubiginosus Bonaparte, Proc. Zool. Soc. London, 1850, p. 26, pl. 16 ("Ins. Barabay et Guebe," error = Ponapé); Pelzeln, Reise "Novara," Vögel, 1865, pp. 99, 162 (Puynipet); Reichenow, Journ. f. Ornith., 1881, p. 162 ("Nordwestl. Polynessische subregion Carolinen" = Ponapé); Tristram, Cat. Birds, 1889, p. 73 (Ponapé); Finsch, Deut. Verein zum Schultze der Vogelwelt, 18, 1893, p. 458 (Carolinen = Ponapé); Matschie, Journ. f. Ornith., 1901, p. 112 (Ponapé).

Domicella rubiginosa Finsch, Die Papageien, 2, 1868, p. 781 (Puynipet); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 88 (Puinipet).

Lorius rubiginosus Gray, Hand-list Birds, 2, 1870, p. 153 (Puynipet); Schlegel, Mus. Pays-Bas, 3, no. 38, 1874, p. 58 (Puynipet).

Lorius rubiginosa Giebel, Thes. Ornith., 2, 1875, p. 502 (Senjawin = Ponapé).

Trichoglossus rubiginosus Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 18 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem*, Journ. f. Ornith., 1880, p. 284 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Finsch, Ibis, 1881, pp. 110, 111, 114 (Ponapé); *idem*, Mitth. Ornith. Ver. Wien, 1884, p. 49 (Ponapé); Hartert, Kat. Vogelsammi. Senckenb., 1891, p. 161 (Puypinet); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6 1890-1891 (1891), p. 8 (Ponapé); Peters, Check-list Birds World, 3, 1937, p. 151 (Ponapé); Mayr, Proc. Sixth Pac. Sci. Congr., 4, 1941, p. 204 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 201 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 291 (Ponapé).

Eos rubiginosa Salvadori, Ornith. Papuasia, 1, 1880, p. 267 (Puynipet); *idem*, Cat. Birds British Mus., 20, 1891, p. 29 (Ponapé); Christian, The Caroline Islands, 1899, p. 357 (Ponapé); Finsch, Notes Leyden Mus., 22, 1900, p. 142 (Ponapé); Dubois, Syn. Avium, 1902, p. 29 (Puinipet); Uchida, Annot. Zool. Japon., 9, 1918, pp. 484, 493 (Ponapé); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 192 (Ponapé).

Chalcopsittacus rubiginosus Finsch, Sammlung wissensch. Vorträge, 14th Ser., 1900, p. 639 (Ponapé).

Oenopsittacus rubiginosus Reichenow, Die Vögel, 1, 1913, p. 443 (Karolinen = Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 58 (Ponapé); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 295 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 181 (Ponapé).

Eos rubiginosus Takastukasa and Kuroda, Tori, 1, 1915, p. 53 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: A medium-sized, dark raspberry-red lory with head and nape deep purplish-red; upper back, scapulars, and upper wing-coverts raspberry-red, edged with blackish; lower back, rump, and upper tail-coverts more purplish; tail yellowish-green becoming more yellow and less green toward tip; wings black with outer webs olivaceous-green; outer edges of primaries more yellowish; lores, chin, auriculars, sides of head, and neck deep purplish-red, chin feathers faintly barred with raspberry and edged with blackish; throat, breast, abdomen, and flanks raspberry-red, feathers edged with blackish except on lower abdomen; under tail-coverts orange-red, under wing-coverts deep purple with black edges; bill of male orange, of female paler yellow; feet black; iris of male light yellowish-orange, of female grayish-white.

Immature: Resembles adult, but with narrow and more sharply pointed tail feathers.

Measurements.—Measurements are presented in table 29.

TABLE 29. MEASUREMENTS OF *Trichoglossus rubiginosus*

SEX	No.	Wing	Tail	Culmen from cere	Tarsus
Adult males	18	147 (143-153)	105 (100-110)	20 (19-20)	16 (15-17)
Adult females	13	142 (141-146)	101 (98-104)	19 (18-19)	16 (15-17)

Specimens examined.—Total number, 31 (18 males, 13 females), as follows: Caroline Islands, USNM—Ponapé, 2 (Feb. 12); AMNH—Ponapé, 29 (Nov.).

Nesting.—According to Coultas (field notes) the nest is placed in the top of a coconut tree or in a hollow of a large forest tree. He says that one egg is laid, but does not record dates of nesting. Four of the birds taken by Coultas at Ponapé in November had swollen gonads.

Molt.—Specimens taken in November by Coultas were either in fresh plumage or were completing the molt when obtained.

Parasites.—Uchida (1918:484, 493) found the bird lice (Mallophaga), *Psittaconirmus harrisoni* and *Eomenopon denticulatus,* on the Ponapé Lory.

Remarks.—There is little written information concerning the habits of the Ponapé lory. Mayr (1945a:291) describes the bird as being "very noisy" and with "habits apparently similar to *T. haematodus.*" Coultas made a number of observations on this species; some of these unpublished notes are essentially as follows: *Trichoglossus* is common on Ponapé. It is found everywhere on the island, preferring the coconut palms; it is noisy and quarrelsome. The parrot travels usually in small groups of two to six or eight birds, keeping up a continuous chatter all of the time. This chatter quiets down into a very pleasant-sounding crooning-tone after sunset. *Trichoglossus* is a continual nuisance to the hunter, inquisitive and easily attracted by the slightest noise, to which the bird responds with a frantic yapping that frightens everything within a radius of a mile. One sometimes finds a bird alone working quietly about among the low trees of the high mountain ridges. The natives' name for the bird, "se ridt," means "always hide out in rain." The bird stays under a big leaf and keeps dry during the rain. This lory is intelligent, easily tamed, and sometimes learns to repeat a few words.

Evolutionary history of Trichoglossus rubiginosus.—The Ponapé Lory is the only native parrot in Micronesia. It is an aberrant species and seemingly is of long residence on the island, as indicated by its differences from related forms to the southward and southwestward. The bird shows some relationships to *T. ornatus* (Linnaeus) of Celebes, but the plumage of *T. rubiginosus* lacks the brilliant red, green, and yellow of this bird. The plumage of the Ponapé Lory is also softer in texture; this is a character exhibited also by other Micronesian birds, for example, *Cleptornus* and *Colluricincla*. *T. rubiginosus* and *T. ornatus* correspond, however, in having the feathers of the breast edged with blackish. *T. rubiginosus* resembles also *T. flavovirides* of Celebes and Sula in that the edges of the feathers of the breast are dark, no markings are present on the inner web of the wing, and feathers of the upper back are edged with dark coloring. *T. rubiginosus* may have been derived from either of these two species; however, it shows a close relationship also to the *T. haematodus* group from the Papuan region. In any case, the Ponapé Lory, isolated in Micronesia, has not the multicolored plumage of its relatives and has, instead, a rather uniformly colored plumage. The presence of this parrot at only a single island in Micronesia is difficult to explain; perhaps at one time the bird was more widely distributed in Micronesia, or it may be that the population represents a single successful invasion to Ponapé. Like *Aplonis pelzelni*, another endemic species at Ponapé, this lory may have reached the island as a straggler, perhaps being carried north by the prevailing winds in the post-nesting season.

Cuculus canorus telephonus Heine

Common Cuckoo

Cuculus telephonus Heine, Journ. f. Ornith., 1863, p. 332. (Type locality, Japan.)

Cuculus canorus Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 100 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 12 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 10 (Pelew); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Pelew).

Cuculus canorus telephonus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 57 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 181 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 201 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in northeastern Asia and Japan. Winters south to India, Malaysia, and Melanesia. In Micronesia: Palau Islands—exact locality not given.

Remarks.—The Common Cuckoo is a straggler on winter migration to the Palau Islands.

Cuculus saturatus horsfieldi Moore

Oriental Cuckoo

Cuculus horsfieldi Moore, in Moore and Horsfield, Cat. Birds Mus. Hon. East-India Co., 2, 1856-58 (1857), p. 703. (Type locality, Java.)

Cuculus striatus Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 100 (Pelew); Finsch. Journ. Mus. Godeffroy, 8, 1875, pp. 4, 12 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Pelew).

Cuculus intermedius Wiglesworth. Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 10 (Pelew).

Cuculus optatus optatus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 57 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 181 (Palau).

Cuculus saturatus horsfieldi Hand-list Japanese Birds, 3d ed., 1942, p. 201 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in eastern Asia and Japan. Winters south to India, Malaysia, and Melanesia. In Micronesia: Palau Islands—Babelthuap, Koror.

Remarks.—The Oriental Cuckoo reaches the Palau Islands as a winter visitor. On November 11 and 25 of 1931, Coultas obtained four immature birds at Palau near taro swamps. The natives told him that the cuckoo visited the islands each year from December to June. On September 21 at Angaur the NAMRU2 party saw one bird which may have been this cuckoo.

Eudynamis taitensis (Sparrman)

Long-tailed New Zealand Cuckoo

Cuculus taitensis Sparrman, Mus. Carls., fasc., 2, 1787, pl. 32. (No type locality = Tahiti.)

Eudynamis tahitiensis Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap).

Eudynamis taitiensis Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 49 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 20 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem*, Journ. f. Ornith., 1880, pp. 284, 298 (Ponapé, Kuschai, Palaos, Marshalls); *idem*, Ibis, 1880, pp. 331, 332 (Taluit); *idem*, Ibis, 1881, pp. 104, 108, 113, 114 (Kushai, Uleai, Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 281, 299, 353 (Ponapé, Mortlock, Ruk); Christian, The Caroline Islands, 1899, p. 358 (Ponapé).

Urodynamis taitensis Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 53 (Jaluit, Ponapé, Palau); Bogert, Amer. Mus. Novit., no. 933, 1937, p. 9 (Palau, Ruk, Kusaie, Ponapé, Truk, Iringlove, Wozzie, Auru, Jaluit, Ratak); Peters, Check-list Birds World, 4, 1940, p. 40 (Palaus, Carolines, Marshall); Hand-list Japanese Birds, 3d ed., 1942, p. 201 (Palau, Truk, Lukunor, Ponapé, Kusaie, Jaluit, Elmore, Aurh, Wotze).

Urodynamis taiticnsis Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 11 (Pelew, Ualan, Ponapé, Luganor, Taluit); *idem*, Ibis, 1893, p. 212 (Marshalls); Hartert, Novit. Zool., 7, 1900, p. 7 (Ruk); Finsch, Notes Leyden Mus., 22, 1900, p. 120 (Ponapé, Palau, Kuschai, Ruk, Mortlock, Uleai, Jaluit); Takatsukasa and Kuroda, Tori, 1, 1915, p. 52 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 58 (Pelew, Ualan, Ponapé, Luganor, Ruk, Taluit); Hand-list Japanese Birds, rev., 1932, p. 180 (Palau, Kusaie, Ponapé, Luganor, Truk, Jaluit, Elmore, Aurh, Wotze).

Urdynamis taitiensis Finsch, Sammulung wissensch. Vorträge, 14th ser., 1900, p. 659 (Palau).

Eudynamis taitiensis Schnee, Zool. Jahrbücher, 20, 1904, p. 389 (Marshalls); Mayr, Birds Southwest Pacific, 1945, p. 302 (Micronesia).

Geographic range.—Breeds in New Zealand and adjacent islands. Winters chiefly in Polynesia, also Melanesia and Micronesia. In Micronesia: Palau

Islands—exact locality unknown; Caroline Islands—Yap, Lukunor, Truk, Ponapé, Kusaie; Marshall Islands—Jaluit, Elmore, Auru, Wotze, Bikini.

Characters.—Adult: A large, long-tailed cuckoo with upper parts dark brown; top of head spotted with white; wings, upper back and tail barred with rufous; underparts pale rufous or buffy-rufous with shafts of feathers streaked with brown.

Specimens examined.—Total number, 4 (2 males, 2 females), as follows: Caroline Islands, AMNH—Truk, 1 (Jan. 7)—Kusaie, 2 (March); Marshall Islands, USNM—Bikini, 1 (May 1).

Remarks.—Bogert (1937) has summarized the information known concerning the migration of the New Zealand Long-tailed Cuckoo. Its principal winter range is in eastern and central Polynesia: Fiji, Samoa, Tonga, Union, Cook, Society, and Tuamotu islands. The bird reaches the northern extent of its range in the Marshall and Caroline islands (see map in Bogert, 1937:3-4). There are no records for the Marianas and only one record from the Palaus (taken by Peters, as recorded by Finsch, 1875:49). The bird is seemingly much more numerous as a winter visitor in the Marshall Islands than in the Caroline Islands. Coultas (field notes) writes that the cuckoo appears at Kusaie about the first of February. Bogert (1937) remarks that the cuckoo arrives at New Zealand for the breeding period in October or November and leaves for the northern wintering grounds in February or March.

Bogert (1937:11) discusses briefly the history of migration of this bird. She presents as a possible reason for the migration the fact that the cuckoo feeds principally on caterpillars and that as a consequence it moves northward to the tropics during the winter months because this food is not available at the breeding grounds in the winter months. Perhaps this cuckoo in developing its ability to fly long distances over water on migration has expanded the breadth of its range eastward into the oceanic islands, rather than westward through Malaysia and Melanesia, because it has found less competition from resident birds and from other migrants for feed and habitat. On many of the islands and atolls of the Pacific Basin, this species is the only land bird known.

Otus podarginus (Hartlaub and Finsch)

Palau Scops Owl

Noctua podargina Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 90. (Type locality, Pelew Islands.)

Noctua podargina Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 8, pl. 1, fig. 1 and 2 (Palau); Giebel, Thes. Ornith., 2, 1875, p. 720 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau).

Ninox podargina Sharpe, Cat. Birds British Mus., 2, 1875, p. 151 (Palau); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 51 (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 61 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 181 (Palau).

Scops podargina Sharpe, Cat. Birds British Mus., 2, 1875, p. 313 (Palau); Nehrkorn. Journ. f. Ornith., 1879, p. 394 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Dresden, no. 6, 1890-1891 (1891), p. 3 (Pelew); Matschie, Journ. f. Ornith., 1901, p. 112 (Palau); Dubois, Syn. Avium, 2, 1904, p. 883 (Pelew).

P[isorhina] podargina Reichenow, Die Vögel, 1913, p. 424 (Palau).

Otus podarginus Mathews, Syst. Avium Australasianarum, 1, 1927, p. 268 (Palau); Mayr. Amer. Mus. Novit., no. 1269, 1944, p. 3 (Palau); *idem*, Birds Southwest Pacific, 1945, p. 291 (Palau).

Pyrroglaux podargina Yamashina, Tori, 10, 1938, p. 1 (Pelew); Peters, Check-list Birds World, 4, 1940, p. 109 (Babelthuap, Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 202 (Palau).

Geographic range.—Micronesia: Palau Islands—Koror, Babelthuap, Angaur.

Characters.—Adult male: A small owl with forehead and superciliary area whitish tinged with buff and narrowly barred blackish-brown; feathers at base of upper mandible with long, blackish shafts, crown and back rufous-brown; some feathers on neck narrowly barred ochraceous and black; some scapulars with outer webs barred dark brown and white; rump and upper tail-coverts dark rufous, barred white and dark brown; tail rufous, barred indistinctly dark brown, inner webs barred white and dark brown; wings sandy rufous, outer edges of all but first primary spotted buffy-white; lores rufous, shafts white; indistinct eye ring rufous; ear-coverts whitish with rufous tips, chin white; throat white narrowly barred with wavy dark lines and tipped with rufous; breast pale rufous, feathers barred with white and black; abdomen paler rufous; under tail-coverts often barred with black and white without rufous wash; under wing-coverts white barred with dark brown; bill and feet whitish; iris brown.

Adult female: Resembles adult male, but darker brown above with fine vermiculations of blackish color; underparts may be pale or dark rufous with slight or heavy white and brown barrings and spots.

Immature: Resembles adult male, but upper parts darker brown; forehead, crown, and back barred ochraceous and black; scapulars with white shaft streaks and spots of white; underparts more heavily barred.

Measurements.—Eight males measure: wing, 155-163 (159); tail, 82-88 (84); culmen, 22.0-23.5 (23.0); tarsus, 32-35 (33); two females measure: wing, 158, 165; tail, 83, 90; culmen, 23.5, 24.0; tarsus, 33, 35.

Specimens examined.—Total number, 11 (9 males, 2 females), as follows: Palau Islands, USNM—Koror, 1 (Nov. 3); AMNH—exact locality not given, 10 (Oct., Nov., Dec.).

Remarks.—Coultas (field notes) found the Palau Scops Owl fairly common around villages on the island of Koror. He obtained specimens at night with the use of a flashlight. He writes that the bird moves about considerably remaining on one perch and calling for only approximately three minutes. The bird stays in the mangrove thickets in the daylight hours. Marshall (1949:207) also found the owl at Koror as well as at Peleliu in 1945. He observed 33 pairs on Koror (approximately one-half of the total population) and four pairs on Peleliu. The NAMRU2 party did not find the owl in the southern Palaus in 1945.

Yamashina (1938:1) gave the Palau Scops Owl the generic name, *Pyrroglaux.* Mayr (1944b:3) has reviewed this treatment and presents evidence to show that the name *Pyrroglaux* should not be recognized and that the bird correctly belongs in the genus *Otus.* He presents a detailed discussion to show its relationship to *O. spilocephalus,* and that the characters possessed by *O. podarginus* are no more different or unusual than those found in other members of this widespread genus. It is pointed out that the reduction of the feathering is probably caused by the change in habitat—from a colder one in Asia to a warmer, tropical one in the Palaus. The bird is probably derived from *O. spilocephalus* of Asia and Malaysia.

Asio flammeus flammeus (Pontoppidan)

Short-eared Owl

Strix Flammea Pontoppidan, Danske, Atlas, 1, 1763, p. 617, pl. 25. (Type locality, Sweden.)

Strix stridula Quoy and Gaimard, Voy. "Uranie," Zool., 1824, pp. 680, 696 (Mariannes); *idem,* Ann. Sci. Nat. Paris, 6, 1825, p. 149 (Mariannes).

Otus brachyotus Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen); Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 18 (Mariannen?).

Asio accipitrinus Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 3 (Marianne); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 168 (Mariannes); Hartert, Novit. Zool., 5, 1898, p. 51 (Marianne); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 44 (Mariannes); Safford, Osprey, 1902, p. 68 (Marianas); *idem,* Amer. Anthro., 4, 1902, p. 711 (Guam); *idem,* The Plant World, 7, 1904, p. 263 (Tinian); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Tinian); Prowazek, Die deutschen Marianen, 1913, p. 88 (Marianen).

Asi accipitrimus Wheeler, Report Island of Guam, 1900, p. 12 (Guam).

Asio flammeus sandwichensis Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 61 (Marianne); Hand-list Japanese Birds (part), rev., 1932, p. 182 (Marianas).

Asio flammeus ponapensis Hand-list Japanese Birds (part), 3d ed., 1942, p. 202 (Pagan).

Asio flammeus flammeus Mayr, Birds Southwest Pacific, 1945, p. 292 (Marianas).

Geographic range.—Breeds in Europe, Asia, and North America. Winters to tropics. In Micronesia: Mariana Islands—Pagan, Tinian.

Remarks.—The Short-eared Owl was taken at Tinian by Quoy and Gaimard (1824:680, 696) and in recent years has been recorded at Pagan. The committee which prepared the Hand-list of Japanese Birds (Hachisuka *et al.,* 1942:202) writes that the bird taken at Pagan has a short wing (288) and indicates that it belongs to *A. f. ponapensis.* In the present work this bird is considered to be *A. f. flammeus,* a migrant from Asia; possibly, however, there is an unrecorded resident population of the Short-eared Owl in the northern Marianas, which may be closely related to *A. f. ponapensis* of Ponapé. Owls may have at one time been resident in the southern Marianas. At Guam, for instance, owls are well known to the native peoples, and there is suitable habitat for the owl in the extensive grassland areas of the island. Perhaps an owl was resident at Guam and at other islands but has been eliminated partly by the overgrazing and burning of the grassy habitats preferred by the owl.

Asio flammeus ponapensis Mayr

Short-eared Owl

Asio flammeus ponapensis Mayr, Amer. Mus. Novit., no. 609, 1933, p. 1. (Type locality, Ponapé.)

Otus brachyotus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 18 (Ponapé); *idem,* Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem,* Journ. f. Ornith., 1880, p. 283 (Ponapé); *idem,* Mitth. Ornith. Ver. Wien, 1884, p. 47 (Ponapé); *idem,* Sammlung wissensch. Vorträge, 14 ser., 1900, p. 659 (Ponapé).

Asio brachyotus Finsch, Ibis, 1881, pp. 113, 114 (Ponapé).

Asio accipitrinus Ridgway, Proc. U. S. Nat. Mus., 4, 1882, p. 367 (Strong's Island = Kusaie); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 3 (Ponapé); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 169 (Ponapi).

Asio flammeus sandwichensis Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 61 (Ponapé); Hand-list Japanese Birds (part), rev., 1932, p. 182 (Ponapé).

Asio flammeus ponapensis Kelso, Oölogist, 1938, p. 183 (Kusaie); Peters, Check-list Birds World, 4, 1940, p. 170 (Ponapé); Hand-list Japanese Birds (part), 3d ed., 1942, p. 202 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 291 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé, Kusaie?

Characters.—Adult: a large, short-eared owl, dark brown above streaked with buff and lighter below streaked with dark brown. An adult female has upper parts dark brown, outer webs of feathers buffy to give a streaked appearance; rump pale buff, feathers edged subterminally with darker brown; scapulars like head and back; wing-coverts dark brown tipped and edged with splotches of buffy to buffy-rufous; primaries and secondaries brown with large spots of pale rufous; tail brown barred with whitish buff spots, webs with dark centers; forehead whitish tinged with buff; region below and behind eye dark; chin pale with rufous tinged sides; throat and breast rufous-buff with heavy streaks of brown, becoming narrower on abdomen and under tail; under wing-coverts buffy streaked with dark brown; axillaries buffy; feathering of tibia and tarsus pale buff; bill dark slate; feet grey-brown; iris yellow.

Resembles *A. f. flammeus*, but wing shorter and color darker.

Measurements.—Mayr (1933:2) lists the following measurements for two adult females: wing, 295, 307; tail, 135, 139; culmen, 17, 17.5; and tarsus, 48, 51.

Specimens examined.—Total number, 2 females, from Caroline Islands, AMNH-Ponapé (Dec.).

Nesting.—Coultas (field notes) writes that the Short-eared Owl at Ponapé builds its nest in the grass on the ground. He did not observe the nest but received reports of it from the natives.

Remarks.—The owl at Ponapé has been known since the time of Kubary. Coultas, visiting the island in 1930, was the first naturalist to record very much concerning the habits. According to him (field notes) the bird inhabits the open grasslands of Ponapé and apparently has somewhat the same habits as other members of the species. He estimated the population in 1930 as two dozen or more. He found the birds extremely secretive during the daylight hours. They were observed flying over the patches of grassland at twilight and on moonlight nights. He comments that the catlike call of this owl is heard occasionally in the night. Richards writes (*in litt.*) that twice in late December, 1947, he saw this owl in a forested area near the summit of Jokaj Island (900 feet).

Kelso (1938:138) records the Short-eared Owl from Kusaie on the basis of a specimen taken by Gulick, which Ridgway (1882:367) thought came from the West Indies. The specimen is labeled Strong's Island, which is an old name for Kusaie. Kelso gives the measurements of this bird as: wing, 275; tail, 141; culmen from cere, 19.5, and comments that the wings are shorter than those of specimens from Asia. The skin is in the U. S. National Museum.

The Short-eared Owl at Ponapé closely resembles *A. f. flammeus* but is slightly smaller and darker. Apparently the owl came to Ponapé as a straggler on migration from Asia, and becoming acclimated and adapted to the grassy areas at Ponapé remained as a resident. The occurrence of *A. f. flammeus* in the Marianas on migration offers evidence as to how the bird originally reached Ponapé.

Caprimulgus indicus jotaka Temminck and Schlegel

Jungle Nightjar

Caprimulgus jotaka Temminck and Schlegel, in Siebold's Fauna Japonica, Aves, 1847, p. 37, pl. 12, 13. (Type locality, Japan.)

Caprimulgus indicus jotaka Hand-list Japanese Birds, rev., 1932, p. 179 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 199 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in eastern Asia and Japan. Winters south to tropics. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—According to the committee who prepared the Handlist of Japanese Birds (Hachisuka *et al*, 1942:199), one female was obtained by Oba in the Palaus in November, 1930. The skin was placed in the Kuroda collection. Coultas obtained a male on December 9, 1931, in the Palaus, which is in the American Museum of Natural History. The bird is apparently an occasional migrant to western Micronesia.

Caprimulgus indicus phalaena Hartlaub and Finsch

Jungle Nightjar

Caprimulgus phalaena Hartlaub and Finsch, Proc Zool. Soc. London, 1872, p. 91. (Type locality, Pelew.)

Caprimulgus phalaena Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 13, pl. 2, fig. 1, 2 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 17 (Pelew); Hartert, Cat. Birds British Mus., 16, 1892, p. 545 (Pelew); *idem*, Das Tierreich, no. 1, 1897, p. 51 (Palau); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 65 (Palau); Matschie, Journ. f. Ornith., 1901, p. 112 (Palau); Dubois, Syn. Avium 1, 1902, p. 124 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 154 (Palau); Mathews, Syst. Avium. Australasianarum, 1, 1927, p. 396 (Pelew); Hachisuka, Birds Philippines, 2, 1934, p. 120 (Pelew).

Caprimulgus indicus phalaena Kuroda, in Momiyama, Birds Micronesia, 1922, p. 61 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 179 (Palau); Peters, Check-list Birds World, 4, 1940, p. 204 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 199 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 292 (Palau).

Geographic range.—Micronesia: Palau Islands—Babeltuap, Koror, Garakayo.

Characters.—Adult male: "Above grayish-brown, very finely vermiculated, more rufous on the back, with large longitudinal streaks and a few cross markings; scapulars partly with pale buff bands, mostly pale gray at the basal portion; primaries deep brown, with a white spot to the inner web of the first primary not extending to the shaft, second and third primary with fine spots to the inner web extending to the shaft and obsolete white spots to the outer web, fourth primary with a smaller and less pure white spot; chin and throat blackish brown, barred with rufous, with two white spots on the throat; breast brownish gray, vermiculated and spotted with brown and blackish; abdomen dirty ochraceous buff barred with brown, the bars wider on the lower tail-coverts; retrices rufous-brown with blackish bars, outer ones with broad white terminal spots." (Hartert, 1892:545.) Bill basally whitish with black tip; feet blackish pink; iris dark brown.

Adult female: According to Hartert (1892:545) similar to male, but with small, more or less obsolete, rufous-buff (not white) spots on the primaries; rectrices without white spots.

Immature: Resembles adult but paler and less distinctly marked.

C. i. phalaena resembles *C. i. jotaka*, but is paler; the male is more broadly barred and more buffy on abdomen and under side of tail; the female has paler spots on wing.

Measurements.—Measurements of four males: wing, 161-168 (165); tail, 118-129 (124); culmen, 22; tarsus, 14.0-15.1 (14.5); of four females: wing, 161-165 (163); tail, 118-127 (123); culmen, 22; tarsus, 14.5-15.6 (15.1).

Specimens examined.—Total number, 8 (4 males, 4 females), as follows: Palau Islands, USNM—Koror, 3 (Nov. 3, 20, 29); AMNH—exact locality not given, 5 (Oct., Nov., Dec.).

Remarks.—This subspecies of the Jungle Nightjar is restricted to the Palau Islands and particularly to those islands possessing damp, shady forests and mangrove swamps. In September, 1945, two birds were observed at the edge of a mangrove swamp at Garakayo at twilight by the NAMRU2 party, but neither of them was taken. Coultas (field notes) found the nightjar in mangrove swamps. He writes that they remain quiet there during the daylight hours. He took specimens both in the evening and at dawn. He considers the bird as not very common. Marshall (1949:208) obtained specimens at Koror in 1945.

Among the races of *C. indicus*, the coloration of *C. i. phalaena* resembles most closely that of *C. i. jotaka;* probably *C. i. phalaena* was derived from *C. i. jotaka* of Asia. Apparently this bird arrived at the Palaus by way of the Philippines. It is found only in these islands of Micronesia and maybe another one of that group of species which reached the Palaus without expanding their ranges farther into Micronesia.

Collocalia inexpectata pelewensis Mayr

Edible Nest Swiftlet

Collocalia pelewensis Mayr, Amer. Mus. Novit., no. 820, 1935, p. 3. (Type locality, Palau Islands.)

Collocalia vanicorensis Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 829 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 4, 116, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, p. 89 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 15 (Palau); *idem* (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 24 (Palau); *idem* (part), Proc. Zool. Soc. London, 1880, p. 575 (Palaos); *idem* (part), Ibis, 1881, p. 104 (Pelew); Tristram, Cat. Birds, 1889, p. 111 (Pelew); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 18 (Pelew); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Palau).

Collocalia vanikorensis Gray, Hand-list Birds, 1, 1869, p. 66 (Pelew); Giebel, Thes. Ornith., 1, 1872, p. 737 (Pelew).

Collocalia fuciphaga Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 189 (Palaos); Reichenow, Die Vögel, 2, 1914, p. 161 (Palau).

Collocalia francica Takatsukasa and Kuroda, Tori, 1915, p. 53 (Pelew).

Collocalia fuciphaga inquieta Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 62 (Pelew).

Collocalia unicolor amelis Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 63 (Pelew).

Collocalia fuciphaga amelis Hand-list Japanese Birds, rev., 1932, p. 179 (Palau).

Collocalia (*vanikorensis*) pelewensis Mayr, Amer. Mus. Novit., no. 828, 1936, p. 11 (Palau).

Collocalia germani pelewensis Mayr, Amer. Mus. Novit., no. 915, 1937, p. 18 (Palau).

Collocalia inexpectata pelewensis Peters, Check-list Birds World, 4, 1940, p. 224 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 292 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 63 (Garakayo, Peleliu).

Collocalia vanikorensis pelewensis Hand-list Japanese Birds, 3d ed., 1942, p. 199 (Babelthuap, Koror).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Angaur.

Characters.—Adult, according to Mayr (1935:3): "Small; tarsus naked; upper parts dark fuscous-green, with a brownish tone on back; crown not much darker than back; rump pale but no distinct light gray bar across rump as in *C. spodiopygia;* color of the rump showing much individual variation, bases of feathers always being pale gray, but tips sometimes strongly glossy green; inner margins of wing-feathers not particularly light; feathers of chin and throat soft, with fuscous bases and rather sharply defined silvery-gray edges, but no shaft-streaks; abdomen dull gray, slightly darker than throat, inconspicuous shaft-streaks on breast and abdomen, more pronounced shaft-streaks on under tail-coverts; longest under tail-coverts fairly glossy green; white loral spot inconspicuous."

Measurements.—Measurements are listed in table 30.

TABLE 30. MEASUREMENTS OF *Collocalia inexpectata in Micronesia*

SUBSPECIES	No.	Wing	Tail
C. i. pelewensis	14	111 (109-113)	50 (47-51)
C. i. bartschi	13	108 (105-108)	54 (52-57)

Specimens examined.—Total number, 20 (12 males, 8 females), as follows: Palau Islands, USNM—Peleliu, 1 (Sept. 13)—Garakayo, 2 (Sept. 18)—Koror, 3 (Nov. 5, 6, 7); AMNH—exact locality not given, 14 (Oct., Dec.).

Remarks.—The NAMRU2 party found the swiftlet to be numerous on islands in the southern Palaus in 1945. The birds were observed flying in clearings and about the cliffs. Coultas writes (field notes) that they nest in caves on the smaller islands.

Collocalia inexpectata bartschi Mearns

Edible Nest Swiftlet

Collocalia bartschi Mearns, Proc. U. S. Nat. Mus., 36, 1909, p. 476. (Type locality, Guam.)

Cypselus inquietus Kittlitz (part), Obser. Zool., in Lutké., Voy. "Le Séniavine," 3, 1836, p. 304 (Guahan); *idem* (part), Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 26 (Guahan).

Collocalia nidifica Gray (part), Ann. Mag. Nat. Hist., (3), 17, 1866, p. 125 (Marianne); *idem* (part), Hand-list Birds, 1, 1869, p. 65 (Marianne).

Collocalia vanicorensis Finsch (part), Journ. Mus. Godeffroy, 12, 1876, p. 24 (Marianen); *idem* (part), Ibis, 1881, p. 105 (Guam); Oustalet, Le Nat., 1889, p. 260 (Mariannes); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 18 (Marianne); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Guam, Saipan).

Collocalia fuciphaga Sclater, Proc. Zool. Soc. London, 1865, p. 616 (Marianne); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 187 (Mariannes); Hartert, Novit. Zool., 5, 1898, p. 53 (Rota, Guam, Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 46 (Marianas); Safford, Osprey, 1902, p. 60 (Marianas); *idem*, The Plant World, 7, 1904, pp. 84, 263 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 102 (Marianen); Cox, Island of Guam, 1917, p. 21 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam).

Collocalia fuchphaga Wheeler, Report Island of Guam, 1900, p. 13 (Guam).

Collocalia fuciphaga fuciphaga Oberholser (part), Proc. Acad. Nat. Sci. Phila., 1906, p. 186 (Guam).

Collocalia unicolor amelis Oberholser, Proc. Acad. Nat. Sci. Phila., 1906, p. 193 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 63 (Guam).

Collocalia fuciphaga tachyptera Obersolser, Proc. U. S. Nat. Mus., 42, 1912, p. 20 (Type locality, Guam); Stresemann, Verhandl. Ornith. Gesellsch. Bayern, 12, 1914, p. 11 (Guam); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Marianas); Kuroda, in Momiyama, Birds Michnoseia, 1922, p. 62 (Guam, Saipan, Rota).

Collocalia unicolor bartschi Kuroda, in Momiyama, Birds Micronesia, 1922, p. 63 (Guam).

Collocalia fuciphaga bartschi Mathews, Syst. Avium Australasianarum, 1, 1927, p. 402 (Guam); Hand-list Japanese Birds, rev., 1932, p. 178 (Marianas).

Collocalia vanikorensis bartschi Mayr, Amer. Mus. Novit., no. 828, 1936, p. 11 (Marianne); Hand-list Japanese Birds, 3d ed., 1942, p. 198 (Saipan), Rota, Guam).

Collocalia germani bartschi Mayr, Amer. Mus. Novit., no. 915, 1937, p. 18 (Marianne).

Collocalia inexpectata bartschi Peters, Check-list Birds World, 4, 1940, p. 224 (Marianne); Mayr, Birds Southwest Pacific, 1945, p. 292 (Marianas); Watson, The Raven, 17, 1946, p. 41 (Guam); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 105 (Tinian); Stott, Auk, 64, 1947, p. 526 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 63 (Guam, Rota).

Collocalia inexpectata Strophlet, Auk, 63, 1946, p. 538 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam, Rota, Tinian, Saipan.

Characters.—Resembles *C. i. pelewensis,* but with wing shorter; upper parts lighter; underparts more brownish and lacking dark shaft-streaks on breast and abdomen; feathers on lores whiter basally.

Measurements.—Measurements are presented in table 30.

Weights.—The present author (1948:63) lists the weights of seven adult males as 6.4-7.3 (6.8); of three adult females as 6.8-7.6 (7.1). These birds were taken at Guam.

Specimens examined.—Total number, 48 (17 males, 19 females, 12 unsexed), as follows: Mariana Islands, USNM—Guam, 21 (Jan. 29, May 20, June 21, July 20, 29)—Rota, 1 (Oct. 27); AMNH—Guam, 18 (Jan. 22, 29, Feb. 15, July 10, Aug. 11, 12)—Saipan, 8 (Sept. 17).

Remarks.—The taxonomic relationships of the species and subspecies of the genus *Collocalia* are not fully known. The many different name combinations applied to the five kinds named from Micronesia are evidence of the lack of agreement among previous writers as to the correct systematic positions of the kinds. The genus is widely distributed in southeastern Asia and adjacent islands and is divisible into a number of species and subspecies. This diversity is apparently influenced by the restriction of the birds to local habitats caused, as Stresemann (1931b:83) states, by the necessity of staying by their nesting areas which are in caves. Stresemann also points out that the birds are thus dependent on "narrowly limited ecological conditions." The birds are confined to certain areas and are, therefore, isolated from other populations. Most of the volcanic islands of Micronesia have numerous caves which are suitable to the swiftlets for nesting. *C. inexpectata* evolved in the Malayan region and apparently spread to Micronesia via the Philippines to Palau and to the Marianas. The two subspecies of *C. inexpectata* in Micronesia resemble closely those to the westward but are smaller. I am following Peters (1940:224) in the treatment of these, and although some future reviser may rearrange these species and subspecies, it appears to me that the Micronesian swiftlets fall into the two natural groups (*C. inexpectata* and *C. inquieta*) now recognized, even though their parent stocks in Malaysia, in my opinion, are inadequately known.

At Guam and Rota, the NAMRU2 party found swiftlets concentrated at cliff areas, flying about in large groups. Away from the cliffs fewer were seen and singles were observed in woodland openings, over fields, and in the coconut groves. On May 18, 1945, a colony of nesting birds was found approximately two miles east of Agaña on Guam. This colony was in a coral sink-hole which was approximately 75 feet deep and 60 feet in diameter. The nests were grouped in clusters of 5 to 25 or more, on underhanging ledges, sheltered from the light. The nests, which were fastened securely to the irregular ledges, were knocked down by shots from our collecting guns. Approximately 250 nests were found; no eggs were observed, the nests containing young birds. The young were in various stages of development; some were with little feather growth, others were completely feathered. Nests examined contained only one young each. The pile of guano below each cluster of nests was large; an estimate made at the time indicated that there were 10 or more tons in each pile. Guano deposits in large quantities were found also in caves at Amantes Point, Guam.

Collocalia inquieta inquieta (Kittlitz)

Carolines Swiftlet

Cypselus inquietus Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 285. (Type locality, Ualan.)

Cypselus inquietus Kittliz (part), Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 26 (Ualan).

Collocalia ualensis Streubel, Isis, 1848, p. 368 (no type locality = Kusaie?).

Collocalia nidifica ualensis Gray, Ann. Nat. Hist., 17, 1866, p. 123 (Caroline Islands = Kusaie?).

Collocalia vanicorensis Finsch (part), Journ. Mus. Godeffroy, 12, 1876, p. 24 (Ualan); *idem* (part), Proc. Zool. Soc. London, 1880, p. 575 (Kuschai); *idem* (part), Journ. f. Ornith., 1880, pp. 285, 298 (Kuschai); *idem* (part), Ibis, 1881, pp. 104, 108 (Kushai); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 18 (Ualan); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ualan).

Collocalia fuciphaga Hartert (part), Cat. Birds British Mus., 16, 1892, p. 498 (Kuschai); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 190 (Oualan).

Collocalia fuciphaga fuciphaga Obersolser (part), Proc. Acad. Nat. Sci. Phila., 1906, p. 186 (Ualan).

Collocalia fuciphaga vanikorensis Oberholser (part), Proc. U. S. Nat. Mus., 42, 1912, p. 20 (Kusaie).

Collocalia fuciphaga inquieta Stresemann, Verhandl. Ornith. Gesellsch. Bayern, 12, 1914, pp. 9, 11 (Ualan); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 62 (Kusaie); Hand-list Japanese Birds (part), rev., 1932, p. 179 (Kusaie).

Collocalia inquieta inquieta Mayr, Amer. Mus., Novit., no. 915, 1937, p. 11 (Kusaie); Peters, Check-list Birds World, 4, 1940, p. 225 (Kusaie); Mayr, Birds Southwest Pacific, 1945, p. 292 (Kusaie).

Collocalia vanikorensis inquieta Hand-list Japanese Birds, 3d ed., 1942, p. 199 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie.

Characters.—Adult: Upper parts dark (sooty-black) with a slight greenish gloss on head and back and a more conspicuous bluish-purple gloss on the wings and tail; feathers of lores white, tipped with black; underparts smoky-gray; feet brownish; bill black; iris dark brown.

Measurements.—Measurements are presented in table 31.

Specimens examined.—Total number, 42 (21 males, 20 females, 1 unsexed), as follows: Caroline Islands, USNM—Kusaie, 1 (Feb. 8); AMNH—Kusaie, 41 (Jan., Feb., March).

Remarks.—Kittliz obtained this swiftlet when he visited Kusaie from December 8, 1827, to January 1, 1828. In 1931, Coultas found

TABLE 31. MEASUREMENTS OF *Collocalia inquieta*

SUBSPECIES	No.	Wing
Collocalia i. inquieta	11	119 (116-125)
Collocalia i. ponapensis	10	110 (107-114)
Collocalia i. rukensis	......	(112-119.5)*

* (Mayr, 1935:3).

the bird common at Kusaie. The name *Collocalia ualensis,* published by Streubel in Isis in 1848, p. 368, is without mention of a locality, but is later used by Gray to denote the swiftlet in the Caroline Islands.

Collocalia inquieta rukensis Kuroda

Carolines Swiftlet

Collocalia fuciphaga rukensis Kuroda, Tori, 1, 1915, pp. 58, 59, pl. 3, fig. 1. (Type locality, Ruk.)

Collocalia vanicorensis Finsch (part), Proc. Zool. London, 1880, p. 575 (Ruk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 18 (Uap and Ruk); Hartert, Novit. Zool., 7, 1900, p. 11 (Ruk); Matschie, Journ. f. Ornith., 1901, p. 112 (Yap, Ruk).

Collocalia fuciphaga vanikorensis Oberholser (part), Proc. U. S. Nat. Mus., 42, 1912, p. 20 (Uala = Truk).

Collocalia fuciphaga rukensis Takatsukasa and Kuroda, Tori, 1, 1915, p. 53 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 62 (Ruk, Yap); Kuroda, Ibis, 1927, p. 706 (Truk); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 402 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 178 (Ruk).

Collocalia fuciphaga inqueta Kuroda, in Momiyama, Birds Micronesia, 1922, p. 62 (Ruk).

Collocalia inquieta rukensis Mayr, Amer. Mus. Novit., no. 915, 1937, p. 11 (Ruk); Peters, Check-list Birds World, 4, 1940, p. 225 (Truk, Yap); Mayr, Birds Southwest Pacific, 1945, p. 292 (Yap, Truk).

Collocalia vanikorensis rukensis Hand-list Japanese Birds, 3d ed., 1942, p. 198 (Truk, Yap).

Geographic range.—Micronesia: Caroline Islands—Truk, Yap.

Characters.—Adult: Resembles *C. i. inquieta* but with wing shorter.

Measurements.—Measurements are given in table 31.

Specimen examined.—One unsexed bird from Caroline Islands, USNM—Truk (Feb. 16).

Remarks.—Little is known concerning this swiftlet. The bird at Yap is referred to this race; I have not seen specimens from this island. McElroy reports seeing no swiftlets at Truk in December, 1945. *C. i. rukensis* appears to be intermediate in size between *C. i. inquieta* and *C. i. ponapensis.* Richards writes *(in litt.)* that he found swiftlets common at Truk in 1948. He also noted a large swiftlike bird in "January or February," 1948, near the summit of

Mount Tonáchian on Moen Island. From his description, the bird may have been a large migratory swift, possibly *Apus pacificus* or *Chaetura caudacuta*, neither of which have been reported previously from Micronesia.

Collocalia inquieta ponapensis Mayr

Carolines Swiftlet

Collocalia vanikorensis ponapensis Mayr, Amer. Mus. Novit., no. 820, 1935, p. 3. (Type locality, Ponapé.)

Collocalia vanicorensis Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 23 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem* (part), Journ. f. Ornith., 1880, p. 285 (Ponapé); *idem*, Ibis, 1881, p. 115 (Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 18 (Ponapé); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ponapé).

Collocalia fuciphaga Hartert, Cat. Birds British Mus., 16, 1892, p. 498 (Ponapé).

Collocalia fuciphaga vanikorensis Takatsukasa and Kuroda, Tori, 1, 1915, p. 53 (Ponapé).

Collocalia fuciphaga inquieta Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 62 (Ponapé).

Collocalia vanikorensis ponapensis Mayr, Amer. Mus. Novit., no. 828, 1936, p. 12 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 198 (Ponapé).

Collocalia inquieta ponapensis Mayr, Amer. Novit., no. 915, 1937, p. 11 (Ponapé); Peters, Check-list Birds World, 4, 1940, p. 225 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 292 (Ponapé).

Collocalia inquieta Mayr, Proc. 6th Pac. Sci. Congr., 4, 1941, p. 204 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: According to Mayr (1936:12), "Very similar to *inquieta*, but much smaller; on the upper parts apparently somewhat less glossy, and not so dark, more brownish; under parts very variable. sometimes very dark (partly on account of greasing), sometimes quite silvery on the throat; very dark specimens show some greenish gloss not only on the longest under tail-coverts, but also on the entire under side, except on the throat; rump of the same color as the back; tarsus unfeathered."

Measurements.—Measurements are listed in table 31.

Specimens examined.—Total number, 37 (19 males, 18 females) from Caroline Islands, AMNH—Ponapé (Nov., Dec.).

Nesting.—Coultas obtained young birds from nests in caves in November and December.

Remarks.—I am following Mayr (1937:11) and Peters (1940: 225) in this treatment of these Caroline swiftlets, even though the differences between *C. inquieta* and *C. vanikorensis* appear to be slight indeed. *C. inquieta* appears closest to the forms of *C. vanikorensis* in Northern Melanesia. The birds found in New Guinea and the Solomons are similar in size to the birds in the Carolienes, while those in the Moluccas, Admiralties and Lihir are larger. Color differences are slight with the pale color of the sides of the head and underparts being variable. All of these dark-rumped birds evidently evolved in the Melanesian area.

Halcyon cinnamomina cinnamomina Swainson

Micronesian Kingfisher

Halcyon cinnamomina Swainson, Zool. Illustr., 2, 1821, text to pl. 67. (No type locality = Guam.)

Halcyon cinnamomina Hartlaub, Journ. f. Ornith., 1854, p. 167 (Marianen = Guam); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 5 (Ladrone or Marian Islands = Guam); Sharpe (part), Monogr. Alced., 1868-71, pp. xxxii, 213, pl. 80 (Guam); Gray, Hand-list Birds, 1, 1869, p. 93 (Mariannes = Guam); Oustalet, Le Nat., 1889, p. 260 (Mariannes = Guam); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 16 (Guam); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 175 (Guam); Hartert, Novit. Zool., 5, 1898, p. 53 (Guam); Matschie, Journ. f. Ornith., 1901, pp. 112, 113, 114 (Guam); Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Strophlet, Auk, 63, 1946, p. 538 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Alcedo ruficeps Dumont, Dict. Sci. Nat., 29, 1823, p. 273 (Mariannes = Guam); Pucheran, Rev. et Mag. de Zool., 1853, p. 387 (Mariannes = Guam); Hartlaub, Journ. f. Ornith., 1855, p. 423 (Mariannen = Guam).

Dacela ruficeps Lesson, Traité d'Ornith., 1831, p. 247 (Mariannes = Guam).

Halcyon cinnamomeus Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 304 (Guahan).

Dacelo cinnamomina Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 131 (Guaham); Schlegel, Mus. Pays-Bas, 3, no. 17, 1863, p. 39; no. 39, 1874, p. 29 (Mariannes = Guam); Giebel, Thes. Ornith., 2, 1875, p. 3 (Mariannae = Guam).

Todiramphus cinnamominus Cassin, U. S. Expl. Exped. 1838-'42, 1858, pp. 220, 225 (Ladrone or Marianna Islands = Guam).

Sauropatis cinnamomina Cabanis, Mus. Hein., 2, 1859-'60, p. 159 (Marianen); Salvadori (part), Ornith. Papuasia, 1, 1880, p. 481 (Marianne = Guam).

Halcyon cinnamominus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 20 (Marianen = Guam); Sharpe, Cat. Birds British Mus., 17, 1892, p. 259 (Marianne = Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 45 (Guam); Safford, Osprey, 1902, p. 69 (Guam); Dubois, Syn. Avium, 1, 1902, p. 108 (Guam); Safford, The Plant World, 7, 1904, p. 263 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Mearns, Proc. U. S. Nat. Mus., 36, 1909, p. 476 (Guam); Reichenow, Die Vögel, 2, 1914, p. 116 (Marianen = Guam); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Mariannes = Guam); Cox, Islands of Guam, 1917, p. 21 (Guam); Thompson, Guam and its people, 1942, p. 23 (Guam).

Halcyon rufigularis Sharpe, Cat. Birds British Mus., 17, 1892, p. 260 (No type locality = Guam).

Halcyon cinnamanea Wheeler, Report Island of Guam, 1900, p. 12 (Guam).

Halcyon cinnamonius Prowazek, Die deutschen Marianen, 1913, p. 102 (Marianen = Guam).

Souropatis cinnamominus Kuroda, in Momiyama, Birds Micronesia, 1922, p. 59 (Guam).

Hyposyma cinnamomina Mathews, Syst. Avium Australasianarum, 1, 1927, p. 384 (Marianne = Guam).

Halcyon cinnamomina cinnamomina Hand-list Japanese Birds, rev., 1932, p. 179 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 293 (Guam); Peters, Check-list Birds World, 5, 1945, p. 206 (Guam); Watson, The Raven, 17, 1946, p. 41 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 63 (Guam).

Halcyon cinnamomius Bryan, Guam, Rec., vol. 13, no. 2, 1936, p. 25 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam.

Characters.—Adult male: Head, neck, upper back, and entire under surface near "Sanford's brown"; auriculars black with bluish wash; narrow black line extending around nape; orbital ring black; lower back, lesser wing-coverts, and scapulars deep greenish-blue; outer webs of wing feathers and tail blue;

rump resembles tail but slightly lighter; under wing-coverts greenish-blue; feet dark brown; bill black, base of mandible paler; iris dark brown.

Adult female: Resembles adult male, but chin, throat, and upper breast paler; rest of underparts and under wing-coverts white; a few cinnamon-tipped feathers on tibia and at bend of wing; back and scapulars darker olive-green and less blue.

Immature: Resembles adult, but brown of crown mixed with greenish-blue; back and wing-coverts edged with pale cinnamon; chin and throat whitish; rest of underparts buffy-white in male and paler in female; feathers on breast and nape with dark edgings.

Measurements.—Measurements are listed in table 32.

TABLE 32. MEASUREMENTS OF *Halcyon cinnamomina*

SUBSPECIES	Number	Wing	Tail	Exposed culmen	Tarsus
H. c. cinnamomina	31 males	102 (96-105)	77 (73-83)	37 (35-39)	15 (14-17)
	25 females	102 (99-106)	79 (74-84)	38 (35-38)	15 (14-17)
H. c. pelewensis...	5 males	89 (88-89)	61 (58-64)	39 (38-40)	14 (13-14)
	4 females	88 (88-89)	64 (61-67)	39 (38-39)	14 (13-14)
H. c. reichenbachii	14 males	99 (96-101)	74 (72-77)	41 (39-43)	16 (16-17)
	15 females	100 (96-102)	74 (71-76)	41 (39-42)	16 (15-17)

Weights.—The NAMRU2 party obtained the following weights: 11 adult males, 56-62 (59); 10 adult females, 58-76 (66).

Specimens examined.—Total number, 72 (40 males, 32 females), as follows: Mariana Islands, USNM—Guam, 38 (Feb. 14, 24, March 8, May 25, 26, 30, June 2, 3, 4, 6, 13, 14, 16, 18, 19, 28, 29, July 6, 7, 10, 18, 20, Aug. 24, 30, Nov. 19); AMNH—Guam, 34 (Jan., Feb., March, April, July, Aug., Sept., Nov., Dec.).

Nesting.—In 1945, the NAMRU2 party found the kingfisher nesting in the months of March, April, May, and July. Nests were placed in hollows of trees, usually ten or more feet above the ground. On April 3, a nest was found in a banyan tree approximately 25 feet above the ground in a hollow limb. There were two entrances to the nest cavity and both the male and female were observed to feed the young. They did not enter the hollow but placed food in the protruding beaks of the young; the parents and nestling both were exceedingly noisy throughout most of the feeding period. On July 8, McElroy found a nest containing two white eggs, partly incubated, in a cavity of a felled coconut palm at Agfayan Bay.

Molt.—Examination of specimens indicates that the time of molt is irregular or that molting may occur at any time of the year. However, there may be a peak in molting in July, August and September; many of the adult birds taken then show evidence of molting of wing and tail. This is immediately following the period of greatest nesting activity.

Food habits.—The Micronesian Kingfisher at Guam feeds on various kinds of animal life; lizards and insects are the principal items. Of three birds taken on February 14, the stomach of one contained a blue-tailed skink; one contained parts of insects and one contained parts of a gecko. I watched a kingfisher capture and swallow a skink on January 14. The bird remained motionless on its perch until the reptile approached within striking distance. Seale (1901:45) writes that the bird has a bad reputation as a chicken thief. He remarks, "I rather doubted his ability in this line until one day I actually saw him attack a brood of small chicks quite near me, and he would have undoubtedly secured one had not the mother hen rushed to the rescue."

Parasites.—Wharton (1946:174) obtained the chigger (Acarina), *Trombicula* sp., from the Guam Kingfisher.

Remarks.—In 1820, Quoy and Gaimard (1824:35) obtained five specimens of this kingfisher at Guam and called the bird "Martin-chasseur à têterouse." Kittlitz recorded the bird in March, 1828. Marche obtained a series of 57 skins at Guam in 1887 and 1888; these were sent to the Paris Museum. Sharpe described the female as a separate species in 1892. There is considerable variation in the coloration of adult birds, which is mostly due to fading, as suggested by Hartert (1898:52). Some individuals have the crown feathers much abraided as a result of rubbing the crown against the edge of the nest holes as the birds enter and leave them.

The kingfisher is fairly common at Guam. It is primarily a bird of the forest, preferring particularly the marginal habitats between woodlands and openings. I saw only a few birds in open country; only rarely were birds seen sitting on the telephone lines along the roads. The writer (1947b:124) found that of all the birds frequenting habitat along roadways on Guam, the kingfisher comprised only 1.2 percent. Thus, it can be said that it is not a bird of very conspicuous habits, although its noisy "rattle" may be heard in the day and at night.

Halcyon cinnamomina pelewensis Wiglesworth

Micronesian Kingfisher

Halcyon pelewensis Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 15. (Type locality, Pelew Islands.)

Halcyon reichenbachii Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 4, 118 (Pelew); Sharpe, Cat. Birds British Mus., 17, 1892, p. 261 (Pelew).

Halcyon cinnamomina Sharpe (part), Monogr. Alced., 1868-'71, pp. xxxii, 213, pl. 30 (Pelew); Tristram (part), Cat. Birds, 1889, p. 92 (Pelew).

Dacelo reichenbachii Schlegel, Mus. Pay-Bas, 3, no. 39, 1874, p. 29 (Pelew).

Halcyon reichenbachi Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 11 (Palau); Reichenow, Die Vögel, 2, 1914, p. 116 (Palau).

Halcyon cinnamominus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 20 (Palau).

Sauropatis cinnamomina Salvadori (part), Ornith. Papuasia, 1, 1880, p. 481 (Pelew).

Halcyon pelewensis Hartert, Novit. Zool., 5, 1898, p. 53 (Pelew); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 53 (Pelew); Uchida, Annot. Zool. Japan., 9, 1918, p. 483 (Palau).

Halcyon Reichenbachi var. *pelewensis* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 186 (Pelew).

Halcyon cinnamominus var? *pelewensis* Dubois, Syn. Avium, 1, 1902, p. 108 (Pelew).

Sauropatis reichenbachii pelewensis Kuroda, in Momiyama, Birds Micronesia, 1932, p. 60 (Angaur).

Hyposyma cinnamomina pelewensis Mathews, Syst. Avium Australasianarum, 1, 1927, p. 385 (Palau).

Halcyon cinnamomina pelewensis Hand-list Japanese Birds, rev., 1932, p. 180 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 293 (Palau); Peters, Check-list Birds World, 5, 1945, p. 206 (Babelthuap, Koror); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, pp. 63, 64 (Peleliu, Ngabad).

Geographic range.—Micronesia: Palau Islands—Kayangel, Babelthuap, Koror, Garakayo, Ngabad, Angaur.

Characters.—Adult: Resembles adult of *H. c. cinnamomina,* but smaller and with underparts white; auriculars with less bluish wash; outer webs of outer tail feathers edged with white.

Immature: Resembles immature female of *H. c. cinnamomina,* but smaller with white underparts edged with black on throat, breast, and upper abdomen; outer webs of outer tail feathers edged with white.

Measurements.—Measurements are presented in table 32.

Specimens examined.—Total number, 17 (8 males, 8 females, 1 unsexed), as follows: Palau Islands, USNM—Babelthuap, 1 (Nov. 30)—Peleliu, 1 (Sept. 10)—Ngabad, 3 (Sept. 11); AMNH—exact locality not given, 12 (Oct., Nov., Dec.).

Food habits.—Stomachs of specimens obtained by the NAMRU2 party at Palau contained insects. One male had a large cicada in its stomach. Coultas (field notes) writes that foods of this bird consist of grubs and ants.

Parasites.—Uchida (1918:483) found the bird louse (Mallophaga), *Docophorus alatoclypestus,* on this bird at Palau.

Remarks.—In 1945, the NAMRU2 party found this kingfisher in forested areas and at the edges of mangrove swamps on small islands near Peleliu. Only six birds were seen. The bird was located by listening for and determining the direction of its rasping call. After a search of the area of leafy foliage from where the call was coming, the bird would be seen sitting motionless on a near-by perch. McElroy of the NAMRU2 party saw a kingfisher with cinnamon underparts at Bulubul Island at Ulithi Atoll on August 21, 1945. It was not taken.

Halcyon cinnamomina reichenbachii (Hartlaub)

Micronesian Kingfisher

Todirhamphus Reichenbachii Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 131. (Type locality, Ponapé.)

Halcyon cinnamominus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 19 (Ponapé); *idem,* Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem,* Journ. f. Ornith., 1880, p. 285 (Ponapé); *idem,* Journ. f. Ornith., 1880, p. 285 (Ponapé); *idem,* Mitth. Ornith. Ver. Wien, 1884, p. 47 (Ponapé).

Sauropatis cinnamomina Salvadori (part), Ornith. Papuasia, 1, 1880, p. 481 (Ponapé).

Halcyon cinnamomina Finsch, Ibis, 1881, pp. 112, 114 (Ponapé); Tristram (part), Cat. Birds, 1889, p. 92 (Ponapé).

Halcyon mediocris Sharpe, Cat. Birds British Mus., 17, 1892, p. 260 (Type locality, Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891),

p. 16 (Ponapé); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, pp. 177, 180, 181, 184, 185, 186 (Ponapi); Reichenow, Die Vögel, 2, 1914, p. 116 (Ponapé).

Halcyon reichenbachi Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 15 (Ponapé); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris. (3), 7, 1895, pp. 176, 180, 181, 182, 183, 184, 185, 186 (Ponapi); Hartert, Novit. Zool., 5, 1898, p. 53 (Ponapé); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Halcyon cinnamominus var. *reichenbachi* Dubois, Syn. Avium, 1, 1902, p. 108 (Ponapé).

Halcyon cinnamominus var. *mediocris* Dubois, Syn. Avium, 1, 1902, p. 108 (Ponapé).

Halcyon reichenbachii Takatsukasa and Kuroda, Tori, 1, 1915, p. 53 (Ponapé).

Sauropatis mediocris Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 195 (Ponapé).

Sauropatis reichenbachii reichenbachii Kuroda, in Momiyama, Birds Micronesia, 1922, p. 60 (Ponapé).

Hyposyma cinnamomina reichenbachii Mathews, Syst. Avium Australasianarum, 1, 1927, p. 384 (Ponapé).

Halycyon cinnamomina reichenbachii Hand-list Japanese Birds, rev., 1932, p. 180 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 293 (Ponapé); Peters, Check-list Birds World, 5, 1945, p. 206 (Ponapé).

Halcyon cinnamomina reichenbachi Bequaert, Mushi, 12, 1939, p. 82 (Ponapé); *idem,* Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 290 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult male: Resembles adult male of *H. c. cinnamomina*, but with slightly smaller wing and smaller tail; slightly longer bill; top of head paler cinnamon; feathers of back tipped with cinnamon and bordered by backish; underparts white.

Adult female: Resembles adult male, but feathers forward of black nape band may be mixed white and cinnamon; back and scapulars duller and less olive.

Immature: Resembles adult, but crown streaked with greenish-black; back and scapulars darker; wing-coverts edged with cinnamon, in male chin and throat creamy, sides of throat, breast, and flanks cinnamon, and axillaries, under wing-coverts, abdomen, under tail-coverts paler cinnamon; in female chin and throat white and rest of underparts paler than in male.

Measurements.—Measurements are presented in table 32.

Specimens examined.—Total number, 49 (25 males, 24 females), as follows: Caroline Islands, USNM—Ponapé, 1 (Feb. 12); AMNH—Ponapé, 48 (Nov., Dec.).

Molt.—Most of the specimens taken by Coultas in November and December are either worn or in molt.

Parasites.—Bequaert (1939:82 and 1941:290) records a fly (Hippoboscidae), *Ornithoica pusilla,* from the Micronesian Kingfisher at Ponapé.

Remarks.—The difference in coloration between the adults and immatures has resulted in considerable confusion concerning the taxonomy of this subspecies. According to Wiglesworth (1891a:15), the name *Halcyon reichenbachii* was established by Gustav Hartlaub in 1852 for a kingfisher with a white abdomen in the Dresden Museum, which had been figured by Reichenbach (Synopsis Avium, Alcedineae, 1851) and called *Todiramphus cinnamomina.* This specimen had been mislabeled and Hartlaub and Finsch (1868a:4), noting a resemblance between this bird and specimens from the Palau Islands, used the name *H. reichenbachii* for the birds from the Palaus. Later, when specimens from Ponapé were taken, Hartlaub's bird was found to be identical with them; thus the name *H. reichenbachii* could be restricted to the bird at Ponapé, and Wiglesworth supplied the new name *H. pelewensis* for the population at Palau. *H. mediocris* was used by Sharpe to designate the cinnamon-breasted birds at Ponapé, because they were assumed to belong to a species different from the white-breasted ones. This confused situation was not clarified until additional collections were obtained by the Japanese.

Coultas (field notes) comments on the conspicuously different field characters of the two color types in this bird. In 1930, he found the bird common and usually in marginal habitat in the lowlands and at the edges of mangrove swamps.

Evolutionary history of Halcyon cinnamomina.—The three races of kingfishers belonging to the species *H. cinnamomina* have been derived from *H. chloris.* The principal distinction between the two species is the presence of the cinnamon coloring in *H. cinnamomina,* although within *H. chloris* there are some subspecies possessing traces of this coloration. The link between these two species, as pointed out to me by Mayr, appears to be *H. chloris matthias* Heinroth of the St. Matthias and Squally islands, which is colored like *H. chloris* except that on the head, especially on the occiput, there is a faint wash of color ranging from buff to ochre. This coloration of the head is a step toward the condition in the Micronesian populations of *H. cinnamomina.*

In *H. c. pelewensis* and *H. c. reichenbachii,* the adult birds resemble each other, although the former subspecies is slightly smaller. The immatures of *H. c. reichenbachii,* however, possess cinnamon coloring on the cheeks, sides of body, and breast in addition to that present on the crown and nape. The crown and nape are of this same color in the adults. In the subspecies at Guam, *H. c. cinnamomina,* the adult male has the immature type of plumage found in *H. c. reichenbachii.* The female of *H. c. cinnamomina* has this cinnamon coloring on the throat, but the breast, abdomen and under tail are white. The original stock from which the Micronesian birds came may have invaded the area via the Palau Islands, although Mayr (1940) is of the opinion that they reached Micronesia via Ponapé (eastern Carolines) and spread to Guam and Palau. He states further (1942b:181, 182) that the presence of *H. cinnamomina* and *H. chloris* as reproductively isolated groups in the Palaus may not indicate that they are distinct species, but that they represent the overlap of terminal links of the same species, which have diverged to such an extent as to leave these terminal links reproductively isolated.

Halcyon chloris teraokai Kuroda

White-collared Kingfisher

Halcyon chloris teraokai Kuroda, Tori, 1, 1915, p. 56, pl. 3, fig. 3. (Type locality, Pelew.)

Halcyon albicilla Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 828 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 4, 118 (Pelew); Gray (part), Hand-list Birds, 1, 1869, p. 93 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 49 (Palau, Mackenzie, Matetotas); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 171 (Pelew).

Halcyon chloris Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 93 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 10 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 14 (Pelew); Mayr, Amer. Mus. Novit., no. 469, 1931, p. 3 (Pelew).

Dacelo albicilla Giebel (part), Thes. Ornith., 2, 1875, p. 1 (Pelew).

Halcyon sanctus Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 50 (Palau); Sharpe, Cat. Birds British Mus., 17, 1892, p. 267 (Pelew).

Dacelo albicilla Giebel (part), Thes. Ornith., 2, 1875, p. 1 (Pelew).

Sauropatis chloris Salvadori, Ornith. Papuasia, 1, 1880, p. 470 (Pelew).

Halcyon chloris teraokai Uchida, Annot. Zool. Japon., 9, 1918, p. 482 (Palau); Kuroda, Ibis, 1927, p. 707 (Pelew); Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 484 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 180 (Palau); Bequaert, Mushi, 2, 1939, p. 82 (Palau); *idem*, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 290 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 201 (Babelthuap, Koror, Angaur); Mayr, Birds Southwest Pacific, 1945, p. 293 (Palau); Peters, Check-list Birds World, 5, 1945, p. 209 (Babelthuap, Koror, Angaur); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 64 (Peleliu, Garakayo).

Sauropatis chloris teraokai Oberholser, Proc. U. S. Nat. Mus., 55, 1919, p. 357 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 59 (Angaur); Mathews, Syst. Avium Australasianarum, 1, 1927, p. 381 (Palau).

Geographic range.—Micronesia: Palau Islands—Kayangel, Babelthuap, Koror, Garakayo, Peleliu, Angaur.

Characters.—Adult male: Dorsal surface bluish, head slightly darker, back and scapulars more greenish, rump lighter blue; outer webs of feathers of wing and of tail dark blue, entire first primary blue, inner webs of other primaries black; collar and underparts white; ariculars black with bluish wash, the black extending around neck above white band; spot on upper lores and narrow line above eye white; orbital ring and lower part of lores black; under wing-coverts white; under tail black; feet black; bill black, mandible with whitish base; iris dark brown.

Adult female: Resembles adult male, but crown and back more green and less blue; auriculars with greenish-blue wash.

Immature: Resembles adult, but feathers of forehead edged with buff; spot on lores and underparts buffy margined with dusky.

H. c. teraokai resembles closely *H. c. chloris* (Boddaert), but more greenish and less bluish, especially on tail.

Measurements.—Measurements are listed in table 33. Adult males and females have similar measurements and are treated together.

TABLE 33. MEASUREMENTS OF *Halcyon chloris* IN MICRONESIA

SUBSPECIES	No.	Wing	Tail	Exposed culmen	Tarsus
H. c. teraokai.......	17	113 (110-116)	76 (72-81)	45 (41-52)	14 (13-16)
H. c. orii..........	9	111 (109-116)	80 (78-83)	44 (42-45)	16 (15-16)
H. c. albicilla.......	17	116 (109-119)	81 (78-84)	46 (42-49)	16 (14-17)
H. c. owstoni.......	3	115 (114-116)	81 (80-82)	44 (42-45)	17 (16-17)

Specimens examined.—Total number, 53 (25 males, 28 females), as follows: Palau Islands, USNM—Garakayo, 3 (Sept. 20)—Peleliu, 14 (Aug. 27, 29, 30, 31, Sept. 1, 5, 6, Nov. 7): AMNH—exact locality not given, 36 (Oct., Nov., Dec.).

Food habits.—Unlike *H. cinnamomina*, *H. chloris* obtains much of its food by fishing in inland waters or in tidal flats and lagoons. It does, however, obtain terrestrial foods also. Stomachs of birds taken by the NAMRU2 party at Palau contained insects, fish, crab, and shrimp. One stomach contained 3 cc. of fragments of crab, another 2 cc. of shrimp and other crustacea, and another 2 cc. of grasshoppers. Marshall (1949:210) records the house mouse as a food of this bird.

Parasites.—Uchida (1918:483) records the bird louse (Mallophaga), *Docophorus alatoclypeatus*, from this bird at at Palau. Bequaert (1939:82 and 1941: 290) lists the fly (Hippoboscidae), *Ornithoica pusilla*, from *H. c. teraokai*.

Remarks.—The White-collared Kingfisher at Palau is a showy and conspicuous bird. It cannot be classed as a forest bird but seems to prefer openings and marginal woodlands. Its range does not overlap that of the secretive and inconspicuous *H. cinnamomina pelewensis*, which prefers the denser forests. In 1945, the NAMRU2 party found *H. c. teraokai* to be numerous in the cleared battle areas at Peleliu and Angaur. A favorite perch of this bird was the telephone lines, from which a number of our specimens were shot. Usually the bird was observed singly; occasionally two birds were found together. A pair was seen in copulation on August 29. The call of this bird, a loud and harsh rattle, is noticeably different from the low rasping note of *H. c. pelewensis*. Coultas found *H. c. teraokai* to be numerous in 1931. He comments (field notes) that the bird frequents salt water areas, especially the mangrove swamps. He noted the bird fishing at the outer reef.

Halcyon chloris orii Takatsukasa and Yamashina

White-collared Kingfisher

Halcyon chloris orii Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 484. (Type locality, Rota.)

Halcyon albicillus Sharpe (part), Cat. Birds British Mus., 17, 1892, p. 249 (Marianne = Rota).

Halcyon albicilla Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 169 (Rota); Hartert (part), Novit. Zool., 5, 1898, p. 53 (Rota).

Sauropatis albicillus Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 58 (Rota).

Halcyon chloris orii Hand-list Japanese Birds, rev., 1932, p. 180 (Rota); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Rota, Saipan as straggler); Mayr, Birds Southwest Pacific, 1945, p. 293 (Rota); Peters, Check-list Birds World, 5, 1945, p. 210 (Rota); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 64 (Rota).

Geographic range.—Micronesia: Mariana Islands—Rota.

Characters.—Adult: Resembles *H. c. teraokai,* but loral spot larger and more buffy; occiput lightly streaked with white and white line above eye; top of head and back more oily green and less blue, darker in female.

Immature: Resembles adult, but underparts and loral spot buffy with dusky edges; feathers of forehead tipped with buff; remainder of upper parts slightly darker.

Measurements.—Measurments are listed in table 33.

Weights.—The author (1948:64) lists the weights of two adult females as 84 and 85.

Specimens examined.—Total number, 11 (4 males, 6 females, 1 unsexed), from Mariana Islands, USNM—Rota (Oct. 18, 19, 22, 26, Nov. 2).

Molt.—The 11 specimens taken by the NAMRU2 party at Rota in October and November are in molt.

Remarks.—The kingfisher at Rota was taken by Marche in June and July, 1888, and reported by Oustalet (1895:169). It was taken later by the Japanese and described by Takatsukasa and Yamashina as a new subspecies. Apparently, no other specimens were taken until the NAMRU party visited Rota in October and November, 1945, and obtained 11 skins. The bird is conspicuous and common at Rota.

The color characters of white feathers intermingled with the bluish coloring of the crown and the occiput and the large, whitish loral spot place this subspecies as intermediate between *H. c. teraokai* and the two subspecies known from the more northern Marianas.

Halcyon chloris albicilla (Dumont)

White-headed Kingfisher

Alcedo albicilla Dumont, Dict. Sci. Nat., éd. Levrault, 29, 1823, p. 273. (Type locality, Marianne = Tinian.)

Alcedo albicilla Pucheran, Rev. et Mag. Zool., 1853, p. 388 (Marianne = Tinian); Hartlaub, Journ. f. Ornith., 1855, p. 423 (Mariannen = Tinian); Cassin, U. S. Expl Exped. 1838-'42, 1858, p. 225 (Mariannes = Tinian).

Todiramphus albicilla Reichenbach, Syn. Avium, Alcedineae, 1851, p. 30 (Mariannen = Tinian).

Halcyon albicilla Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen = Tinian); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 5 (Ladrone or Marian Islands = Tinian); Gray (part), Hand-list Birds, 1, 1869, p. 93 (Mariannes = Tinian); Oustalet, Le Nat., 1889, p. 260, (Saypan); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 14 (Marianne = Tinian); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 169 (Saypan); Hartert (part), Novit. Zool., 5, 1898, p. 52 (Saipan); Matschie, Journ. f. Ornith., 1901, pp. 112, 113, 114 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 45 (Saipan).

Dacelo albicilla Giebel (part), Thes. Ornith., 2, 1875, p. 1 (Marianne = Tinian).

Sauropatis albicilla Salvadori, Ornith. Papuasia, 1, 1880, p. 470 (Marianne = Tinian).

Halcyon albicillus Sharpe (part), Cat. Birds British Mus., 17, 1892, p. 249 (Marianne = Saipan).

Halcyon saurophagus Schnee, Zeitschr. f. Naturwisch., 82, 1912, p. 463 (Saipan).

Sauropatis albicillus Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 58 (Saipan).

Leucalcyon albicilla albicilla Mathews (part), Syst. Avium Australasianarum, 1, 1927, p. 376 (Saipan).

Halcyon chloris albicilla Hand-list Japanese Birds, rev., 1932, p. 180 (Saipan, Tinian); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Saipan), Tinian, Yap?); Mayr, Birds Southwest Pacific, 1945, p. 293 (Saipan, Tinian); Peters, Check-list Birds World, 5, 1945, p. 210 (Saipan, Tinian); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 97 (Tinian); Stott, Auk, 64, 1947, p. 526 (Saipan).

Geographic range.—Micronesia: Mariana Islands—Saipan, Tinian.

Characters.—Adult: Resembles *H. c. teraokai*, but slightly larger; pileum white; white collar broad; black band on nape narrow and faint in some individuals; back and scapulars more oily green and less blue.

Immature: Resembles adult, but pileum pale buff streaked with bluish-green; back and scapulars darker; upper wing-coverts edged with white; breast feathers edged with dusky black.

Measurements.—Measurements are listed in table 33.

Specimens examined.—Total number, 20 (12 males, 8 females, as follows: Mariana Islands, USNM—Saipan, 1 (Sept. 27)—Tinian, 4 (Oct. 18, 23, 26); AMNH—Saipan, 11 (July 8, 9, 11, 13, 15, 17, August 5, 21, 26)—Tinian, 4 (Sept. 7, 8, 10).

Nesting.—Hartert (1898:42) records an egg found in a hole of a tree at Saipan on July 31, 1895. He writes that the egg "is only slightly glossy, very thin, pure white, but soiled all over with deep brown spots, evidently from the decaying wood in the nest hole. It measures 33:25 mm."

Molt.—Most of the birds taken in July, August, September, and October are in molt.

Remarks.—Quoy and Gaimard, who visited the Marianas while on the expedition in the "Uranie," obtained this kingfisher at Tinian. Additional material was taken by Marche in 1887 at Saipan and by Owston's Japanese collectors in 1895. In 1932, Coultas (field notes) found the bird to be common on both Tinian and Saipan, especially in open country. At Saipan, Stott (1947:526) found the birds as singles or in pairs on wooded hillsides. At Tinian, Gleise (1945: 220) estimated the population in 1945 as 150 .

The completely white head in *H. c. albicilla* closely resembles that in *H. s. saurophaga* Gould of Melanesia. These two species resemble each other in several other respects. *H. saurophaga* is smaller than *H. chloris* with black or greenish blue on the anterior part of the ear-coverts and the color of the back, wings, and tail is more greenish. The presence of both *H. saurophaga* and *H. chloris* on the same islands in Melanesia is an indication that the two groups are specifically distinct.

Halcyon chloris owstoni Rothschild

White-collared Kingfisher

Halcyon owstoni Rothschild, Bull. British Ornith. Club, 15, 1904, p. 6. (Type locality, Asuncion.)

Halcyon albicillus Sharpe (part), Cat. Birds British Mus., 17, 1892, p. 249 (Marianne = Pagan, Agrigan).

Halcyon albicilla Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, pp. 169, 170 (Pagan, Agrigan); Hartert, Novit. Zool., 5, 1898, p. 52 (Pagan, Agrigan).

Sauropatis chloris owstoni Kuroda, in Momiyama, Birds Micronesia, 1922, p. 59 (Asuncion).

Leucalcyon albicilla owstoni Mathews, Syst. Avium Australasianarum, 1, 1927, p. 376 (Asuncion).

Halcyon chloris owstoni Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 484 (Asuncion); Hand-list Japanese Birds, rev., 1932, p. 180 (Asuncion); Hand-list Japanese Birds, 3d ed., 1942, p. 200 (Assongsong, Pagan, Almagan); Mayr, Birds Southwest Pacific, 1945, p. 293 (Almagan, Pagan, Agrigan, Asuncion); Peters, Check-list Birds World, 5, 1945, p. 209 (Asuncion, Pagan, Alamagan); Borror, Auk, 64, 1947, p. 417 (Agrighan).

Geographic range.—Micronesia: Mariana Islands—Asuncion, Agrigan, Pagan, Almagan.

Characters.—Adult: Resembles *H. c. albicilla,* but hind part of crown blue-green and black collar broader.

Immature: Resembles adult, but forehead buffy and edges of feathering on anterior crown, upper wing-coverts, and tips of secondaries brownish.

Measurements.—Measurements are listed in table 33.

Specimens examined.—Total number, 4 (2 males, 1 female, 1 unsexed), as follows: Mariana Islands, AMNH—Asuncion, 4 (Jan., July).

Remarks.—Marche obtained specimens of this bird at Pagan in November, 1887, and at Agrigan in December, 1888, and in February, 1889. Owston's Japanese collectors obtained birds at Asuncion in 1904, which were named as new by Rothschild. Apparently he used an immature specimen in preparing the diagnosis of his new subspecies. Borror (1947:417) visited Agrigan in 1945 and obtained specimens of this kingfisher. He reports that the bird is a "common and abundant species and probably nests on the island."

Evolutionary history of Halcyon chloris in Micronesia.—*Halcyon chloris* is distributed from eastern Africa at the Red Sea eastward through southern Asia to Malaysia, Australia and the Pacific islands. Peters (1945:207-213) recognized 47 subspecies within this species.

In its colonization of Micronesia, *H. chloris* apparently arrived first at the Palaus probably from the Philippines or the Moluccas.

Whether *H. cinnamomina* was established at Palau prior to the arrival of *H. chloris* is unknown. *H. chloris teraokai* dominates most of the available habitats at Palau, although it has differentiated but little from subspecies to the west and southwest of Palau. Among named kinds it most closely resembles *H. c. chloris* (Boddaert) of the Moluccas, Lesser Sundas and adjacent areas in color and structure. The species did not succeed in establishing itself in the Carolines or at Guam, but did so in the Marianas at Rota and northward. In comparison with other subspecies of *H. chloris* those in the Marianas are characterized by a slight increase in size and a replacement of the bluish-green coloring of the head either partly or wholly by white. It is noteworthy that on the islands of Tinian and Saipan, which occupy a geographically intermediate position in the Mariana chain, the bird has an almost completely white head, whereas the birds on islands to the north and south have only partly white heads.

The geographic ranges of *H. chloris* and *H. cinnamomina* in Micronesia overlap only at Palau as shown by Mayr (1942b:181). Even here each is restricted to a different habitat. Possibly the present ranges resulted from competition between each group, and both may have had more extensive ranges in Micronesia in the past. Another possibility is that the original stock of *H. chloris* arrived in Micronesia via the Palaus and that of *H. cinnamomina* via Ponapé (eastern Carolinas), and that the resulting successful colonizations were a matter of chance. If this were the case the present day ranges may represent the total amount of dispersal that has taken place. The absence of kingfishers from Kusaie, Yap, Truk and other apparently suitable islands favors this possibility.

Eurystomus orientalis connectens Stresemann

Dollar Bird

Eurystomus orientalis connectens Stresemann, Novit. Zool., 20, 1913, p. 302. (Type locality, Moa.)

Eurystomus orientalis connectens Yamashina, Tori, 10, 1940, p. 675 (Babelthuap); Hand-list Japanese Birds, 3d ed., 1942, p. 199 (Babelthuap).

Eurystomus orientalis pacificus Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Celebes and adjacent islands, Lesser Sunda Islands from Lombock to Damar, Southeastern Islands. In Micronesia: Palau Islands—Babelthuap.

Remarks.—Yamashina (1940:675) records an adult male taken at Babelthuap in 1938. He assigns it to *E. o. connectens,* comparing it with a series of 15 specimens of this race from Celebes, Halmahera and Batchian. Mayr (1045a:302) refers this visitor to Palau to *E. o. pacificus* (Latham); this form is migratory and may fly north from Australia to the Melanesian area between breeding seasons.

Hirundo rustica gutturalis Scopoli

Eastern Barn Swallow

Hirundo gutturalis Scopoli, Del. Flor. et Faune, Insubr., 2, 1786, p. 96. (Type locality, "in Nova Guinea," error = Panay, Philippine Islands.)

Hirundo rustica Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 112 (Yap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap).

Hirundo rustica gutturalis Hand-list Japanese Birds, rev., 1932, p. 178 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 198 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau); Baker, Smithson. Mus. Coll., vol. 107, no. 15, 1948, p. 65 (Guam, Angaur, Ngesebus).

Geographic range.—Breeds in northeastern Asia, winters south to Australia and Pacific islands. In Micronesia: Mariana Islands—Guam, Tinian; Palau Islands—Babelthuap, Koror, Ngesebus, Peleliu, Angaur; Caroline Islands—Yap.

Specimens examined.—Total number, 13 (9 males, 3 females, 1 unsexed), as follows: Mariana Islands, USNM—Tinian, 10 (Oct. 23, 25); Palau Islands, USNM—Babelthuap, 1 (Nov. 27)—Angaur, 1 (Sept. 21); AMNH—exact locality not given, 1 (Oct. 26).

Remarks.—This swallow is a winter migrant to western Micronesia from Asia. In the Palau Islands in September, 1945, the NAMRU2 party saw the swallow at Ngesebus and Angaur in small flocks. At Guam, the NAMRU2 party saw one bird on October 7 and four birds flying near Agaña River on October 11. Strophlet (1946:535) saw one bird on October 28, 1945, and six birds on November 16 at Guam. Marshall (1949:221) found swallows at Tinian, Saipan and Palau from October to February. He found only immature birds.

Edolisoma tenuirostre monachum (Hartlaub and Finsch)

Cicada Bird

Campephaga monacha Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 99. (Type locality, Pelew Islands.)

Volvocivora monacha Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 19, pl. 3, fig. 2-3 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, p. 28 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau).

Lalage monacha Sharpe, Cat. Birds British Mus., 4, 1879, p. 105 (Pelew); Tristram, Cat. Birds, 1889, p. 186 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 25 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 53 (Palau); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Dubois, Syn. Avium. 1, 1902, p. 303 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 276 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 68 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 175 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 194 (Babelthuap, Koror).

Edolisoma monacha Mathews, Syst, Avium Australasianarum, 2, 1930, p. 541 (Pelew).

Edolisoma tenuirostre monacha Stresemann, Ornith. Monatsber., 47, 1939, p. 126 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 294 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 65 (Peleliu).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Peleliu.

Characters.—Adult male: Forehead, crown, nape, back, and underparts near "Tyrian blue"; auriculars darker than back; lores and chin black; throat black washed with blue gray; wing feathers black, margined with pale blue; black tail tipped with whitish, and basal part of middle two rectrices colored like back; under wing dark except for whitish inner margins of secondaries; bill and feet black; iris dark brown.

Adult female: Resembles adult male, but forehead and under eye pale buff; superciliary stripe darker buff; crown, nape, and sides of neck dark slate-blue; mantle brown, feathers with buffy centers; back brown washed with burnt brown; feathers of rump and upper tail-coverts with terminal black bar edged with buff; wing and tail brownish-black, primaries margined with buff, innermost three secondaries and upper wing-coverts broadly edged with lighter buff, tail tipped with buff, more broadly so on outermost tail feathers, two outermost tail feathers with outer edge buff; two central tail feathers basally dark ochre; ear-coverts buff, tinged with black; chin, throat, and under wing-coverts deep buff; breast, abdomen, and flanks buff, feathers with subterminal blackish bar; under tail buff.

Immature: Resembles adult female, but crown, nape, and sides of neck brown; back faintly mottled with buff; tail feathers and primary wing-coverts tipped with white; younger birds may have upper parts margined with pale buff.

Measurements.—Measurements are listed in table 34.

Specimens examined.—Total number, 23 (13 males, 10 females), as follows: Palau Islands, USNM—Koror, 4 (Nov. 6, 14, 26, Dec. 5)—Peleliu, 2 (Aug. 29, 30); AMNH—exact locality not given, 17 (Oct., Nov., Dec.).

TABLE 34. MEASUREMENTS OF *Edolisoma tenuirostre* IN MICRONESIA

SUBSPECIES	No.	Wing	Tail	Exposed culmen	Tarsus
E. t. monachum.............	10	98 96-103	80 76-83	21.0 20.0-22.5	23.0 22.5-24.0
E. t. insperatum............	35	109 107-112	86 82-91	23.0 22.0-24.0	24.0 23.0-25.0

Molt.—Molt in this bird appears to take place in the period from August to December. Most of the specimens taken in August, October, November and December were in molt. None was taken in other months.

Food habits.—This bird feeds principally on insects. A female taken on August 29 had in its stomach about one and a half cc. of parts of grasshopper. Marshall (1949:212) records both animal and vegetable matter in the stomach of this bird.

Remarks.—The Cicada Bird at Palau inhabits the jungles, especially the marginal areas between the thick jungle and the more open woodlands. In 1945, the NAMRU2 party observed only two birds, both of which were obtained. These were found at Peleliu in a small area of undisturbed woodland at the edge of a mangrove swamp.

Each bird was perched approximately 25 feet above the ground on the outer branches of a densely foliated tree. The bird is thought not to be so rare as our records indicate; probably its secretive habits conceal it from man except as he makes special search for it. Coultas (field notes) describes the bird as one of the true forest. He found it shy and retiring and possessing a very weak voice.

It may be noted that Delacour (1946:2) does not accept the genus *Edolisoma* but places birds which are currently assigned to it in the genus *Coracina*.

Edolisoma tenuirostre nesiotis (Hartlaub and Finsch)

Cicada Bird

Campephaga nesiotis Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 98. (Type locality, Uap.)

Campehaga nesiotis Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap).

Volvocivora nesiotis Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 28 (Yap).

Edoliisoma nesiotis Sharpe, Cat. Birds British Mus., 4, 1879, p. 56 (Yap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 25 (Uap); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 53 (Yap); Matschie, Journ. f. Ornith., 1901, p. 112 (Yap); Dubois, Syn. Avium, 1, 1902, p. 299 (Uap); Reichenow, Die Vögel, 2, 1914, p. 274 (Karolinen = Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 68 (Mackenzie, Yap).

Edolisoma nesiotis Mathews, Syst. Avium Australasianarum, 2, 1930, p. 542 (Mackenzie group); Hand-list Japanese Birds, rev., 1932, p. 174 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 194 (Yap).

Edolisoma tenuirostre nesiotis Stresemann, Ornith. Monatsber., 49, 1939, p. 126 (Yap); Mayr, Birds Southwest Pacific, 1945, p. 294 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—Adult male: Resembles adult male of *E. t. monachum*. Adult female: Resembles adult female of *E. t. monachum*, but wings and upper parts less buffy and more rufous; eye-stripe rufous; breast barred on sides only.

Remarks.—No specimen of the Cicada Bird from Yap has been examined by me. For a long time this bird was thought to be a species distinct from any other member of this genus, but Stresemann (1939:126) arranged it as a subspecies of *Edolisoma tenuirostre*. The type specimen is an immature, and the adult is unknown. The presence of rufous coloring shows a relationship with *E. t. insperatum* of Ponapé, but Mayr, who has examined the type of *E. t. nesiotis* in the Hamburg Museum, and has obligingly showed me his notes on the bird, says that it has a greater resemblance to the Cicada Bird at Palau especially because of the amount of barring on the underparts. The true status of this bird, as well as that of other members of the avifauna of Yap, will be incompletely known until such time as good collections are available from this island group.

Edolisoma tenuirostre insperatum (Finsch)

Cicada Bird

Volvocivora inseperata Finsch, Proc. Zool. Soc. London, 1875, (1876), p. 644. (Type locality, Ponapé.)

Volvocivora insperata Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 27 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 779 (Ponapé); *idem*, Ibis, 1881, pp. 110, 112, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé).

Volvozivora insperata Finsch, Journ. f. Ornith., 1880, p. 289 (Ponapé).

Lalage insperata Sharpe, Cat. Birds British Mus., 4, 1879, p. 108 (Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 25 (Ponapé); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 53 (Ponapé); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Ponapé); Reichenow, Die Vögel, 2, 1914, p. 276 (Karolinen = Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 68 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 174 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 194 (Ponapé).

Lisomada insperata Mathews, Novit. Zool., 24, 1928, p. 372 (new generic name); *idem*, Syst. Avium Australasianarum, 2, 1930, p. 545 (Ponapé).

Edolisoma tenuirostre insperata Stresemann, Ornith. Monatsber., 47, 1939, p. 126 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 294 (Ponapé).

Edolisoma tenuirostre Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult male: Resembles adult male of *E. t. monachum,* but larger; upper parts more grayish-blue; wings with outer edges bluish-gray and inner webbings grayish-white; central tail feathers with subterminal, roundish, black spots; two outermost tail feathers black tipped with broad, pale bluish-gray coloring; lores more bluish-gray and less black; ear-coverts pale bluish-gray; chin, throat, breast, abdomen, flanks, under wing, and under tail-coverts grayish-blue; bill and feet black; iris dark brown.

Adult female: Resembles adult female of *E. t. monachum,* but larger; forehead slate-gray; crown brownish-gray, browner on nape; back chocolate-brown; rump rufous; upper tail-coverts more cinnamon; wing and tail brownish-black, outer margins or primaries edged with buff; outer margins of secondaries and upper wing-coverts except primary wing-coverts edged with rufous; central tail feathers like back but tipped with buff, other tail feathers more broadly tipped with buff; lores grayish-black; malar stripe to auriculars darker and more brownish-black with lighter shafts; underparts rufous, under wing paler and more buffy.

Immature: Resembles adult female, but forehead grayish tinged with ochre; crown and neck brown becoming slightly more reddish on back and more burnt reddish-brown on rump; tail edged and tipped with buff; primaries tipped with whitish, secondaries broadly edged with buff, primary wing-coverts tipped with buffy-white; lores blackish; ear-coverts rufous with lighter shafts; tail feathers pointed while in adult more rounded. Younger birds resemble older ones, but plumage except wings and tail may be spotted or barred with buff and black with whitish margins.

Measurements.—Measurements are listed in table 34.

Specimens examined.—Total number, 46 (23 males, 23 females), from Caroline Islands, AMNH—Ponapé (Nov., Dec.).

Nesting.—Coultas (field notes) writes that the nest is cup-shaped, made of grasses and strands of hair fern, and placed at low elevations in small trees and bushes. He was told that two eggs are laid. He comments that the nesting season had just been completed in November and December (the time of his visit to Ponapé), because he noted juveniles being attended and fed by the adults.

Molt.—Most of the specimens taken by Coultas in November and December are in fresh plumage or in the final stages of molt, indicating that the molt was initiated possibly in September and would be completed possibly in January. This time of molt appears to be approximately one month later than the time of molt of *E. t. monachum* of Palau. Probably the bird at the Palau Islands breeds slightly earlier in the year than the subspecies on Ponapé.

Examination of the large series of birds taken by Coultas at Ponapé shows the presence of three types of plumages. The writer has not made a thorough diagnosis of these plumages, but suspects that the phenomenon obtained here is the same as was found by Mayr (1933e) in his study of *Neolalage banksiana* (Gray), which is a related bird. Immatures of *E. t. insperatum* seemingly present two plumages, which, if Mayr's arrangement is followed, may be interpreted as a more primitive or "retarded" type in one case, with less striking plumage, barred with black and buff, and a more advanced or "progressive" type in the other case, with plumage of the latter resembling more the adult type, especially the adult female. It was not ascertained whether any of these specimens represented adult birds in "retarded" plumage.

Remarks.—The Cicada Bird at Ponapé resembles in habits its related subspecies at Palau. Coultas (field notes) writes that it is a forest bird, with retiring habits. He observed the birds in small groups, and describes their musical call notes as "to-to-wee, to-to-wee" repeated several times.

Evolutionary history of Edolisoma tenuirostre in Micronesia.—Mayr (in Stresemann, 1939:126) first pointed out the close relationship between the cicada birds of Micronesia and *Edolisoma tenuirostre* of the Solomon Islands. Up to that time the Micronesian birds were considered to belong to the genus *Lalage.* The cicada birds probably invaded Micronesia along two independent routes from a dispersal center in the Papuan area. The form at Palau, *E. t. monachum*, resembles closely several of the subspecies to the south and southwest, particularly those in the New Guinea area. Aside from the smaller size of the Palau form there are differences in coloration between this bird and those of Melanesia. In the adult female and the juvenile there are differencs in the amount of barring on the underparts and in the shade of color on the upper parts. In the adult male there are differences in the marginal coloring of the primaries and secondaries. *E. t. nesiotis* may have arrived at Yap from Palau. Little is known concerning the taxonomic position of this bird. On the basis of the information available, it appears closer to the Palau bird than the Ponapé bird in color; however, in size it probably more closely approaches the latter subspecies.

The Ponapé Cicada Bird, *E. t. insperatum*, appears to represent a colonization distinct from that which established the populations at Yap and Palau. This conclusion is based on the fact that the adult female of *E. t. insperatum* has distinctive reddish coloring and lacks the barring on the underparts, and that it may have been derived from an ancestral stock, which was reddish and not barred, such as *E. t. remotum* of the New Ireland area. The three subspecies in Micronesia may represent remnants of a single colonization, since additional material from Yap may prove that this island population has characters intermediate between those of the other subspecies of Micronesia.

Dicrurus macrocercus harterti S. Baker

Black Drongo

Dicrurus ater harterti S. Baker, Novit. Zool., 26, 1918, p. 299. (Type locality, Formosa.)

Dicrurus macrocercus Baker, Trans. 11th N. Amer. Wildlife Conf., 1946, p. 211 (Rota).

Dicrurus macrocercus harterti Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 65 (Rota).

Geographic range.—Formosa. In Micronesia: Mariana Islands—Rota (introduced).

Specimens examined.—Total number, 7 (4 males, 3 females), from Mariana Islands, USNM—Rota (Oct. 18, 19, Nov. 2).

Remarks.—This drongo was introduced from Formosa to Rota by the Japanese South Seas Development Company (Nanyo Kohatsu Kabushiki Kaisha) apparently in 1935. An illustrated booklet, printed by this organization and seen by members of the NAMRU2 party at the Rota Civil Government headquarters, showed pictures of the captive birds before release and indicated that they had been brought to Rota for the purpose of controlling destructive insects. Dr. Charles Vaurie has examined these birds and compared them with a series of drongos from Formosa in the collection of the American Museum of Natural History.

The drongo appears well adapted at Rota, where it prefers cultivated areas and the bombed village sites to thick woodlands. Birds were found in small flocks often perched in large shade trees in village areas. Weights of two immature males are 53 and 61 grams. One adult male measures: wing, 144, tail, 153, culmen, 26, tarsus, 22.

Corvus kubaryi Reichenow

Marianas Crow

Corvus Kubaryi Reichenow, Journ. f. Ornith., 1885, p. 110. (Type locality, Palau, error = Guam.)

Corvus solitarius Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guahan); Bonaparte, Comptes Rendus Acad. Sci. Paris, 37, 1853, p. 830 (Mariannes);

Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 143 (Guahan); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 216 (Guam and Rota).

Corvus spec. Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen); Gray, Hand-list Birds, 2, 1870, p. 12 (Marianne).

Corvus kubaryi Hartert, Novit. Zool., 5, 1898, p. 59 (Guam, Rota); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Matschie, Journ. f. Ornith., 1901, p. 112 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1901, p. 55 (Guam); Safford, Osprey, 1902, p. 69 (Guam); *idem*, The Plant World, 7, 1904, pp. 3, 264 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Prowazek, Die deutschen Marianen, 1913, pp. 87, 102 (Marianen); Reichenow, Die Vögel, 2, 1914, p. 306 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Marianne); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 69 (Guam, Rota); Meinertzhagen, Novit. Zool., 33, 1926, p. 73 (Guam); Hand-list Japanese Birds, rev., 1932, p. 169 (Guam, Rota); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 187 (Guam, Rota); Mayr, Birds Southwest Pacific, 1945, p. 298 (Guam, Rota); Watson, The Raven, 17, 1946, p. 41 (Guam); Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Strophlet, Auk, 1946, p. 540 (Guam); Baker, Ecol. Monogr., 16, 1946, p. 408 (Guam); *idem*, Condor, 49, 1947, p. 125 (Guam); *idem*, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 66 (Guam, Rota).

Corone phillipina Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 46 (Marianne).

Corone kubaryi Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 46 (Pelew, error = Guam).

Geographic range.—Micronesia: Mariana Islands—Guam, Rota.

Characters.—Adult: A small, black crow with a slight greenish-black gloss on head; back, wings, and tail with bluish-black gloss; underparts with dull, greenish-black gloss; bases of feathers light grayish, more nearly white on neck, producing a somewhat ragged appearance; nasal bristles short but extending over nostrils and base of culmen; bill and feet black; iris dark brown. Female smaller.

Immature: Resembles adult, but feathers with less gloss; wings and tail browner.

Measurements.—Measurements of *Corvus kubaryi* are listed in table 35.

Weights.—The NAMRU2 party obtained weights of the Marianas Crow as follows: from Guam, 5 males, 231-270 (256), 11 females 205-260 (242); from Rota, 1 male, 256; 1 female, 260 grams.

TABLE 35. MEASUREMENTS OF *Corvus kubaryi*

Location	Number and sex	Wing	Tail	Full culmen	Tarsus
Guam...	9 males	236 (229-244)	165 (158-170)	55 (51-57)	51 (49-52)
	19 females	227 (222-241)	151 (143-166)	50 (47-54)	50 (46-54)
Rota....	3 males	235 (233-236)	167 (166-169)	54 (53-56)	50 (49-51)

Specimens examined.—Total number, 49 (20 males, 27 females, 2 unsexed), as follows: Mariana Islands, USNM—Guam, 26 (May 25, 29, June 4, 7, 8, 9, 18, 28, 29, July 10, 12, 18, Sept. 5, 11)—Rota, 4 (Oct. 22, 25, 29); AMNH—Guam, 19 (Jan., Feb., March, Aug., Sept., Dec.).

Nesting.—In the spring of 1945, the NAMRU2 party obtained records of nesting activities by crows. One nest was observed on March 8 in a banyan tree. Specimens collected from May to September were not in breeding condition, and it is thought that the nesting period is concentrated in the winter and spring months. Watson (1946:41) reports finding a young crow being fed on May 8 by an adult.

Molt.—The Marianas Crow molts in the period from May to August or September. Most of the birds taken by the NAMRU2 party in this period were in the process of molt. Skins obtained at Rota in late October also exhibit signs of molt. Specimens taken in December, January and February are in fresh or slightly worn plumage. The crow presents an exceedingly shabby appearance in molt, because the grayish and whitish basal parts of the feathers are exposed.

Food habits.—The crow is an omnivorous feeder. Stomachs examined contained both plant and animal food. Both Seale (1901:55) and Safford (1905:79) comment on the damage which the crow does to the corn crop at Guam. Seale remarks that the crow has a reputation for plundering nests of other birds. The NAMRU2 party saw crows being chased by starlings on several occasions.

Parasites.—Wharton (1946:174) obtained the chigger (Acarina), *Trombicula* sp., from the crow at Guam.

Remarks.—The Marianas Crow is confined to the forested areas and to the coconut plantations at Guam. The birds were seen as singles or in small flocks, often along the roadways. In a count of the number of birds seen along the roadways of Guam, the author (1947:124) found crows to constitute 2.4 per cent of the total population of birds counted and observed the crow on 21.6 per cent of the 125 roadway counts made. Coultas (field notes) noted the birds at the northern part of Guam. The NAMRU2 party found the birds distributed in most parts of the island but usually they were infrequent near areas where large numbers of service personnel were stationed. The birds were often noisy when flying in small flocks or in pairs; Seale (1901:55) also notes this. When observed in jungle areas, the birds were generally quiet, feeding and perching in dense foliage. At Rota, the NAMRU2 party found the bird to be fairly numerous and with habits resembling those of the crow at Guam. No differences in color or structure could be found between the specimens of crows obtained at the two islands.

Kittlitz (1836:305) was the first person to write an account of the crow at Guam. He called it *Corvus solitarius* and remarked that he later found the same species in the Philippines. Wiglesworth (1891a:46) also considered the crow at Guam to resemble one found in the Philippines and called it *Corone phillipina.* Later Reichenow named the bird *Corvus kubaryi* with the type locality as the Palau Islands. This locality proved to be erroneous and the bird was judged to be from Guam by Hartert (1898:59), who did not use the name *C. solitarius* because it was a *nomen nudum,* and recognized *C. kubaryi* as the correct name.

Evolutionary history of Corvus kubaryi.—Meinertzhagen (1926: 59) writes that "Environmental influences seem to be mainly, if not entirely, responsible for geographic differences in the genus *Corvus.*" Such may be the case in *C. kubaryi,* which is a small, dull-colored crow with a relatively unmodified bill. In structure, it has little resemblance to other crows found in the Pacific area. Kittlitz was the first to note a resemblance between the bird at Guam and one in the Philippines. Oustalet (1896:70) wrote that the bird at Guam is related to crows of the Moluccas and New Guinea. Although not closely related to the Hawaiian Crow, *C. tropicus,* both have little gloss on their feathers, a character which is common to many of the insular populations of crows. Mayr (1943:46) is of the opinion that the Hawaiian bird was derived from a North American ancestor, although Bryan (1941:187) suggests that it is related to *C. macrorhynchus* of southeastern Asia and remarks that the Hawaiian Crow, "has some relation to the Guam Crow." In looking for the ancestral stock of *C. kubaryi,* the several species of crows which occur to the north, west and south of the Marianas have been examined. In size and general structure, *C. kubaryi* appears to be closest to the *C. enca* group, and not as closely related to the *C. macrorhynchus* group. The small size, the shape of the culmen, the lack of pointed feathers on the breast, and the presence of white on the basal parts of the feathers of the nape are characters which *C. kubaryi* has in common with *C. enca.* Nasal bristles cover the frontal base of the culmen in *C. kubaryi;* this character is found also in *C. enca florensis. C. kubaryi* differs from the *C. enca* group by lacking the purple sheen on the upper parts; this sheen is conspicuous in the latter species. *C. kubaryi* appears to have little in common with *C. meeki* of the Solomons and *C. orru* of the Moluccas and New Guinea area. There is apparently no close relation between the Marianas Crow and the crow which reaches the Bonins. The latter crow, according to the Hand-list of Japanese Birds (Hachisuka *et al.,* 1932:1), is called *C. coronoides hondoensis* Momiyama and is apparently now extinct in the Bonins.

In summary, it may be said that *C. kubaryi* is an isolated and modified species of crow, which probably has been living at Guam and Rota for a considerable length of time. Whether it once lived on other islands in Micronesia is unknown, but it is entirely possible that the present population may represent a remnant of one which formerly had a more extensive distribution. The characters which show its distinctness from possible ancestral species include its small size, its slender bill, and its dull coloration. It is thought to have been derived from the *C. enca* group, *C. e. pusillus* of the Philippines or *C. e. celebensis* of the Celebean area.

Luscinia calliope calliope (Pallas)

Siberian Rubythroat

Motacilla Calliope Pallas, Reise durch versch. Prov. russ. Reichs, 3, 1776, pp. 261, 325, 697. (Type locality, Yenesei.)

Luscinia calliope calliope Hand-list Japanese Birds, rev., 1932, p. 178 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in northeastern Asia. Winters south to Malaysia. In Micronesia: Palau Islands—Koror.

Remarks.—The Siberian Rubythroat is considered to be a casual winter visitor to the Palau Islands.

Monticola solitaria philippensis (Müller)

Chinese Blue Rock Thrush

Turdus philippensis Müller, Natursystem Supplements-und Register-Band, 1776, p. 145. (Type locality, Philippine Islands, *ex* Buffon.)

Monticola philippensis philippensis Hand-list Japanese Birds, rev., 1932, p. 177 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Monticola solitarius philippensis Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Koror).

Geographic range.—Breeds in northeastern Asia and Japan. Winters south to Malaysia. In Micronesia: Palau Islands—Koror.

Remarks.—The Chinese Blue Rock Thrush is apparently an infrequent winter visitor to the Palau Islands.

Turdus obscurus obscurus Gmelin

Dusky Thrush

Turdus obscuras Gmelin, Syst. Nat., 1, 1789, p. 816. (Type locality, Lake Baikal.)

Turdus obscuras Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 96 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 22 (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 66 (Pelew).

Merula obscura Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 39 (Pelew).

Turdus obscuras obscuras Hand-list Japanese Birds, rev., 1932, p. 177 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Koror); Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in northeastern Asia. Winters south to Malaysia. In Micronesia: Palau Islands—Koror.

Remarks.—The Dusky Thrush is considered to be a casual winter visitor to the Palau Islands. It was first taken there by Captain Heinsohn, according to Hartlaub and Finsch (1872:96).

Psamathia annae Hartlaub and Finsch

Palau Bush-warbler

Psamathia annae Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 5, pl. 2. (Type locality, Pelew Islands.)

Psamathia annae Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 116, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 94 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 5, 22 (Palau); Nehrkorn, Journ. f. Ornith., 1879, pp. 399, 404 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Sharpe, Cat. Birds British Mus., 7, 1883, p. 101 (Pelew); Tristram, Cat. Birds, 1889, p. 155 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 40 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898. p. 57 (Palau); Matschie, Journ. f. Ornith., 1901, p. 112 (Palau); Reichenow, Die Vögel, 2, 1914, p. 536 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 67 (Pelew); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 629 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 177 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Babelthuap, Koror, Peleliu); Delacour, Ibis, 84, 1942, p. 514 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 294 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 197 (Peleliu, Ngabad).

Calamodyta annae Gray, Hand-list Birds, 1, 1869, p. 208 (Pelew).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad.

Characters.—Adult: A medium-sized warbler with a rather long bill and tail; upper parts near "buff olive," slightly lighter on head; lores olive-gray to olive-green; supraloral stripe and orbital ring pale yellow-buff; auriculars yellow-brown; underparts lighter and more olive-yellow than back, especially in midsection; chin paler; sides, tibia and under tail-coverts darker and more olivaceus; wings and tail dark brown with outer edges olive; under wing-coverts light yellow; axillaries more whitish; upper mandible horn-colored,, darker at base; lower mandible yellowish, darker at base; legs and feet light yellowish-brown; iris grayish-brown. Adult female resembles adult male but is slightly smaller. Immature: Resembles adult but forehead and crown slightly lighter and more yellowish; back and rump more brownish.

Measurements.—Measurements are listed in table 36.

TABLE 36. MEASUREMENTS OF *Psamathia annae*

SEX	No.	Wing	Tail	Exposed culmen	Tarsus
Adult males............	7	74 (72-77)	64 (62-68)	21.0 (19.5-22.5)	28.5 (27.0-30.0)
Adult females..........	11	69 (65-74)	58 (55-61)	21.0 (19.5-22.0)	26.5 (25.0-29.0)

Specimens examined.—Total number, 23 (9 males, 14 females), as follows: Palau Islands, USNM—Koror, 5 (Nov. 7, 9, 11, 18, 19)—Peleliu, 4 (Aug. 29, 30, Sept. 4, Dec. 5)—Ngabad, 1 (Sept. 11); AMNH—exact locality not given, 13 (Nov., Dec.).

Nesting.—Nehrkorn (1879:399, 404) records the egg of *Psamathia* from Palau. The NAMRU2 party obtained no evidence of nesting of this bird in

August and September, 1945. In 1931, Coultas secured birds in November and December, which had enlarged gonads. Marshall (1949:219) records breeding in November and December.

Molt.—Most of the skins taken from August to December have worn or molting feathers. Apparently there is a high point in the molting process in autumn and early winter.

Food habits.—Stomachs obtained from birds taken by the NAMRU2 party in August and September contained parts of insects and small seeds. One stomach contained about one-half cc· of parts of insects. Coultas (field notes) found the bird scratching "on the ground for seeds as well as working in the low trees and bushes." Marshall (1949:212) records insects and snails as food items.

Remarks—*Psamathia* has the habit of a typical bushwarbler, occurring in jungle undergrowth and along woodland margins. In 1945, specimens were obtained by the NAMRU2 party in the scrub vegetation which was growing over the devastated battle areas of Peleliu. The bird was not common in this habitat, nor was it very numerous on the smaller offshore islands. Coultas (field notes) found the bird to be rather tame and frequently to live close to human habitation. Its call, as noted by Coultas, is a loud whistle that breaks off into a beautiful song. The bird is quick in its movements; one seen by the writer at Ngabad was constantly moving about in low, second-growth vegetation and was making a low, whistling call. The resemblance of *Psamathia* to *Rukia palauensis* is noteworthy. These two unrelated birds live together in jungle areas, although *Psamathia* is perhaps confined more to the forested undergrowth and is more solitary in its habits. Aside from its longer legs and bill, *Psamathia* closely resembles *Rukia* in shape and coloration. They appear to have developed along somewhat similar evolutionary lines with regard to structure, color and ecologic requirements.

The Palau Warbler was first discovered by Captain Tetens and described as belonging to a new genus by Hartlaub and Finsch (1868a:5). In the original description the authors remark that, "The generic position of this new form is in the *Calamoherpe* group; the feet are the same as in *Calamoherpe;* but the beak is weaker and slenderer, and the wings are very different. *Calamoherpe* has the first quill quite spurious, the third is the longest, and the second and sixth are subequal. In *Calamoherpe* there are twelve tail-feathers; in *Psamathia* I can find only ten. *Tatare* is a very different form, with a scutellated tarsi, a very different structure of the plumage, a much more elongated beak, and a twelve-feathered tail. *Tatare syrinx* is a typical *Calamoherpe.* In the structure of the wing of

Psamathia, there seems to be a great resemblance to the genus *Arundinax* of Blyth, a form with which it is not in my power to compare." The genera *Calamoherpe* and *Tatare* are now included in *Acrocephalus;* the describers were comparing the Palau Warbler with the reed-warblers of Micronesia and Polynesia.

Sharpe (1883:93) writes that the Palau Bush-warblers are "Aberrant reed warblers, and should, in my opinion, be placed in future classifications of the Cichlomorphae near the genera *Cettia* and *Acrocephalus,* from which they are separated by their larger first primary only. Through *Megalurus* and *Sphenoeacus* they approach the grass-warblers and Cisticolae especially."

Mayr (1941b:203) cites *Psamathia* as an example of "restricted endemism" and points out that the nearest relative occurs in the Philippines. Delacour (1942:514), in a discussion of the bush-warblers of the genera *Cettia, Bradypterus* and related forms, says, "*Psamathia annae,* from Palau Islands, is related to *Cettia,* differing mainly in its much longer bill and legs."

Psamathia is a specialized bush-warbler and has followed a pattern of evolution which characterizes some of the other island birds in that the bill and legs are long and the wing is rather short and rounded. *Psamathia* resembles many of the bush-warblers, as well as the reed-warblers (*Acrocephalus*); in general, body coloring being paler below and darker above. It differs from *Acrocephalus* by having a longer tenth primary, smaller second and third primaries, only ten tail feathers, a more rounded wing, differently shaped nostrils, and by much softer plumage (the latter character is found also in *Collurcincla tenebrosus* and *Cleptornis marchei* of Micronesia). Rather than being related to the reed-warblers, as was supposed by Hartlaub and Finsch, *Psamathia* seems closest to *Cettia,* especially to *Cettia (Horeites) diphone seebohmi* of the Philippine Islands. *Psamathia* has a longer bill than this bird, but the general appearance and structure of the feet, tail, wing, body and bill are the same.

Acrocephalus luscinia luscinia (Quoy and Gaimard)

Nightingale Reed-warbler

Thryothorus luscinius Quoy and Gaimard, Voy. "l'Astrolabe," Zool., 1, 1830, p. 202, pl. 5, fig. 2. (Type locality, Marian Is. = Guam.)

Sylvia syrinx Kittlitz (part), Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 306 (Guahan); *idem* (part), Denkw. Reise russ. Amer. Micron. und Kamchat, 2, 1858, p. 141 (Guaham).

Tatare luscinia Gray, Genera Birds, 3, 1849, App. 8 (Marian Is. = Guam); Hartlaub, Journ. f. Ornith., 1854, p. 167 (Mariannen = Guam); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 14 (Ladrone or Marian Is. = Guam); Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 31 (Guaham); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 41 (Guam); Büttikofer, Notes Leyden Mus., 14, 1892, p. 16 (Guam); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 209 (Guam).

Tatare luscinius Bonaparte, Consp. Avium, 1, 1850, p. 224 (Guam); *idem*, Comptes Rendus Acad. Sci. Paris, 41, 1855, p. 1111 (Mariannes = Guam); Gray, Hand-list Birds, 1, 1869, p. 194 (Ladrone = Guam).

Hybristes [*luscinia*] Reichenbach, Syst. Avium, 1850, pl. 57, fig. 7 (no locality = Guam).

Acrocephalus orientalis Pelzeln, Reise, "Novara," Vögel, 1865, p. 64 (Guaham).

Tatares luscinius Giebel, Thes. Ornith., 3, 1877, p. 599 (Marianae).

Acrocephalus mariannae Tristram, Ibis, 1883, p. 45 (Type locality, Guam).

Tatare mariannae Sharpe, Cat. Birds British Mus., 7, 1883, p. 528 (Marianne = Guam); Oustalet, Le Nat., 1889, p. 260 (Mariannes = Guam).

Acrocephalus luscinia Hartert, Novit. Zool., 5, 1898, p. 57 (Guam, Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 53 (Guam, Saipan); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Guam, Saipan); Safford, Osprey, 1902, p. 69 (Guam); Dubois, Syn. Avium, 1, 1902, p. 369 (Marianne); Safford, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, The Plant World, 7, 1904, p. 264 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, pp. 30, 79 (Guam); Reichenow, Die Vögel, 2, 1914, p. 545 (Marianen); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 67 (Guam, Saipan); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam); Thompson, Guam and its people, 1942, p. 23 (Guam); Strophlet, Auk, 1946, p. 539 (Guam).

Conopoderas luscinia Mathews, Syst. Avium Australasianarum, 2, 1930, p. 594 (Marianas); Hand-list Japanese Birds, rev., 1932, p. 177 (Marianas).

Conopoderas luscinia hivae Yamashina, Bull. Biogeogr. Soc. Japan, 12, 1942, p. 81 (Type locality, Saipan); Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Almagan, Saipan).

Conopoderas luscinia luscinia Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Guam).

Acrocephalus luscinia luscinia Mayr (part), Birds Southwest Pacific, 1945, p. 294 (Guam, Saipan, Almagan); Stott, Auk, 1947, p. 526 (Saipan); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 67 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam, Saipan, Almagan.

Character.—Adult: A rather large warbler with long, curved bill; upper parts near "Saccardo olive"; feathers of head grayer because of darker shafts; rump paler and browner; lores dark; supraloral stripe light buffy-yellow; auriculars, cheeks, and sides of neck slightly darker; chin, throat, breast, and abdomen pale buffy-yellow; tibia darker and more olivaceous-brown; under tail-coverts pale yellow-buff; wing and tail feathers brown, edged with ochraceous; under wing grayish, inner edges lighter; axillaries pinkish-white; upper mandible dark horn colored; lower mandible lighter yellow; feet light gray; iris brown. Female resembles male but is slightly smaller.

Table 37. Measurements of *Acrocephalus luscinia*

Subspecies	No.	Sex	Wing	Tail	Exposed culmen	Tarsus
A. l. luscinia.....	11	males	84 (81-86)	83 (80-86)	36.0 (35.5-39.0)	30.5 (30.0-31.0)
	1	female	78	73	37.0	28.5
A. l. syrinx......	31	males	78 (76-80)	71 (68-75)	26.5 (25.0-27.0)	26.5 (25.0-29.0)
	12	females	75 (74-78)	68 (65-70)	25.5 (24.0-27.0)	26.0 (24.0-26.0)

Immature: Resembles adult, but upper parts duller and more brown and less olive; underparts less yellow; wing and tail feathers lighter brown.

Measurements.—Measurements are listed in table 37.

Weights.—The weights of three adult males obtained at Guam by the NAMRU2 party are 30, 30, and 31 grams. An adult female from Guam weighed 27 grams.

Specimens examined.—Total number, 12 (11 males, 1 female), as follows: Mariana Islands, USNM—Guam, 6 (June 2, 13, July 2, 18)—Saipan, 6 (Sept. 27, 30).

Nesting.—Oustalet (1895:209) writes that Marche found nests at Guam in June, 1887. The NAMRU2 party obtained two males with enlarged gonads in June, 1945.

Molt.—Specimens taken in June, July, and September are either in worn plumage or in molt. Birds in worn plumage become a faded straw-brown above. Oustalet apparently interpreted this coloring of the worn plumage as a seasonal coloration.

Food habits.—Seale (1901:53) reports that four stomachs which he examined contained insects and larvae. Marshall (1949:21) lists as food items: lizards, snails, spiders, and insects.

Remarks.—The Nightingale Reed-warbler at Guam is restricted to cane thickets and adjacent areas in and near fresh and brackish water marshes. In 1945, the NAMRU2 party found the bird fairly numerous in some of these habitats. Seale (1901:53) writes, "This bird is now quite scarce on the island of Guam. It lives exclusively among the reedy swamps, and those swamps are now being drained to make room for the Chinaman's rice paddies." Mayr (1945a:295) also notes the rarity of the species. As a result of the late war, the cultivation of rice was reduced and the reed-warbler probably has been able to increase in some of the now fallow areas. The most extensive range of this bird at Guam is found in the Agaña Swamp, where there is a large area consisting of thick cane. Here, and in the other large cane patches, the chief hazard to the bird population appears to be fire. In dry periods, the entire habitat might be easily destroyed by fire. The birds are extremely shy; their melodious songs may be heard in the reeds, but their active movements in the thick cane are difficult to observe. While hunting for these birds along the edges of Agaña Swamp on June 2, the writer observed, or located the calls of, at least six or seven individuals but could only get within shooting range of three birds. Within the cane thickets, these birds feed and move about near the ground or the surface of the water. Rarely do they perch in a conspicuous manner in the upper parts of the cover. Their color patterns blend perfectly with the coloration of the dry cane stalks. Perhaps failure to find many of the birds because of their secretive habits has caused many observers to assume that the bird is near extinction. Nevertheless, it is my contention that the bird, being restricted to these limited areas, has never been very abundant at Guam. The absence of natural enemies, especially snakes, may be one of the principal reasons why they have been able to survive.

Reed-warblers were not found by the NAMRU2 party at Rota in 1945, nor have they been reported from Tinian. Yamashina in 1942 described the populations at Saipan and Almagan as distinct. I have not seen this description, but on the basis of examinations of specimens from Saipan, I can see no recognizable differences between these and birds from Guam.

Acrocophalus luscinia syrinx (Kittlitz)

Nightingale Reed-warbler

Sylvia syrinx Kittlitz, Mém. Acad. Imp. Sci. St. Petersbourg, 2, 1835, p. 6, pl. 8. (Type locality, Lugunor and Ulcei = Woleai.)

Sylvia syrinx Kittlitz (part), Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 297 (Lougounor); *idem*, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 92 (Ualan, Lugunor, Ulea).

Eparnetes [*syrinx*] Reichenbach, Syst. Avium, 1850, pl. 57 (no locality = Carolines); Bonaparte, Comptes Rendus Acad. Sci. Paris, 41, 1855, p. 1111 (Carolines).

Tatare syrinx Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 131 (Ualan, Lugunor); Pucheran, Voy. Pôle Sud, 3, 1853, p. 92 (Hogoleu = Truk); Hartlaub, Journ. f. Ornith., 1854, pp. 164, 168 (Hogoleu); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 14 (Ualan); Sharpe, Cat. Birds British Mus., 7, 1883, p. 527 (Carolines); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 41 (Ruk, Ualan, Luganor. Uleei, Nukuor, Ponapé); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 210 (Ruk, Ponapi, Mortlock, Kusaie, Uleei, Nukuor).

Acroecphalus orientalis Pelzeln, Reise "Novara," Vôgel, 1865, pp. 63, 162 (Puynipet, Lugunor, Ulcei).

Calamodyta syrinx Gray, Hand-list Birds, 1, 1869, p. 208 (Ualan); Giebel, Thes. Ornith., 1, 1872, p. 529 (Carolin.).

Calamoherpe syrinx Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 17 (Ponapé, Lugunor, Ruck, Ualan, Uleei); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); *idem*, Journ. f. Ornith, 1880, pp. 287, 297 (Ponapé, Ruck, Mortlocks, Kuschai); *idem*, Proc. Zool. Soc. London, 1880, p. 575 (Ruk, Ponapé); *idem*, Ibis, 1881, pp. 108, 112, 115, 247 (Kuschai, Ruck, Ponapé, Mortlocks); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 298, 330, 353 (Ponapé, Mortlocks, Nukor, Ruk); Finsch, Ibis, 1883, p. 143 (Ruck); *idem*, Mitth. Ornith. Ver. Wien, 1884, p. 49 (Ponapé); *idem*, Sammlung wissensch. Vorträge, 14 ser., 1900, p. 659 (Carolinen).

Acroeephalus syrinx Seebohm, Cat. Birds British Mus., 5, 1881, p. 100 (Ponapé); Tristram, Ibis, 1883, p. 44 (Ponapé, Ruk, Mortlock, Lugunor, Uleei); *idem*, Cat. Birds, 1889, p. 152 (Ponapé, Ruk); Nehrkorn, Kat. Eiers., 1899, p. 33 (Ponapé, Ruk); Hartert (part), Novit. Zool., 5, 1898, p. 58 (Carolines); *idem*, Novit. Zool., 7, 1900, p. 3 (Ruk); Scale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 53 (Ponapé); Matschie, Journ. f. Ornith., 1900, pp. 112, 113 (Ruk, Ponapé, Ualan); Dubois, Syn. Avium, 1, 1902, p. 369 (Ponapé); Reichenow, Die Vögel, 2, 1914, p. 545 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Ponapé, Ruk); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Conopoderas syrinx Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 214 (Ponapé, Truk); Takatsukasa and Yamashina, Dobotsu. Zasshi, 43, 1931, p. 485 (Caroline Is.); Yamashina, Tori, 7, 1932, p. 405 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 177 (Carolines).

Acrocephalus stentoreus syrinx Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 67 (Ruk, Ualan, Lugunor, Wolea, Nukuoro, Ponapé).

Conopoderas luscinia syrinx Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Wolea, Lamotrek, Truk, Lukunor, Nukuoro, Ponapé, Kusaie).

Acrocephalus luscinia syrinx Mayr, Birds Southwest Pacific, 1945, p. 294 (Carolines); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 67 (Truk).

Geographic range.—Micronesia: Caroline Islands—Woleai, Lamotrek, Truk, Lukunor, Nukuoro, Ponapé, Kusaie.

Characters.—Adult: Resembles *A. l. luscinia,* but smaller; with shorter, straighter bill; head and neck more reddish-brown; back, rump, wing, and tail edged with cinnamon; flight feathers faintly tipped with white.

Immature: Resembles adult, but lighter and more rufous in color; wings and rump paler, wings edged with rufous buff.

Measurements.—Measurements are listed in table 37.

Specimens examined.—Total number, 62 (35 males, 20 females, 7 unsexed), as follows: Caroline Islands, USNM—Ponapé, 1 (Feb. 12)—Truk, 4 (Feb. 16, Mar. 15); AMNH—Ponapé, 35 (Nov., Dec.)—Truk, 22 (Feb., March, May, June, Nov.).

Nesting.—Birds nest in reedy swamps and scrub vegetation in the Caroline Islands, although Finsch (1881b:115), recording a field note by Kubary, states that nests were found in trees at Mortlock Atoll (= Lukunor). Yamashina (1932a:405) reports the collecting of seven sets of eggs at Ponapé in July and August, 1931. The sets consisted of one or two eggs each. McElroy of the NAMRU2 party obtained specimens with enlarged gonads at Truk in December and noted that birds were carrying nest materials to cane swamps. Of the birds secured by Coultas in November and December at Ponapé, only a small number had enlarged gonads. He also found nests containing no eggs in low bushes at Ponapé. Hartert (1900:3) reports that at Truk Owston's Japanese collectors obtained "many nests" from the end of May to the beginning of July. These nests contained one or two eggs and were found 7 to 20 feet above the ground in breadfruit, coconut and ivory-nut palm trees. Hartert writes, "The eggs are white, covered with darker and lighter brown patches, and underlying ashy grey or lavender-grey spots. These spots are generally thicker near the broad end, sometimes forming a loose ring, and they are sometimes equally spread over the whole surface." He lists measurements of 48 eggs.

Molt.—Of the specimens examined by me, those taken in the spring and summer are in fresh or worn plumage; those taken in fall and winter are in molt, with a few skins exhibiting worn or fresh plumage in the latter period. Apparently the peak in the molting process occurs from September to December.

Food habits.—The reed-warbler is an insect feeder. Coultas, in his observations of the bird at Ponapé, relates that he was able to locate the warbler by listening for the "snapping of the mandibles as the bird is catching food."

Remarks.—From the observations of Kittlitz, Kubary, Coultas, McElroy, and others, it is apparent that the Nightingale Reed-warbler in the Caroline Islands is restricted to the lower elevations of the islands. Whereas the reed-warbler at Guam seems closely associated with cane swamps and adjacent vegetation, the bird in the Carolines may range more extensively into brush lands, forest margins and grass lands. Coultas (field notes) notes that the reed-warbler at Ponapé is a "common bird of the small bush and grass-lands. One is attracted by its warbler-like song. The bird spends hours perched on a stem of a bush caroling the time of day. When feeding, one finds it on the ground or working away quietly among the bushes. *Acrocephalus* is a friendly bird who does not become frightened easily. He responds to man-made calls."

The Nightingale Reed-warbler is found on many of the islands in the Caroline Chain, including both the "high" volcanic islands (Ponapé and Truk) and the "low" coral islands (Lukunor and Nukunor). Although the bird has been recorded at Kusaie by Kittlitz and Finsch, it was not taken there by Coultas in 1931. Reed-warblers are unknown at Yap, Ulithi, Fais or at other islands of the extreme western Carolines, or in the Palau Archipelago.

They are unrecorded also in the Marshall Islands, but at Nauru in the Gilbert Islands, to the southeast, an isolated population of this bird occurs and has been named *A. l. rehsei* (Finsch).

Acrocephalus luscinia yamashinae (Takatsukasa)

Nightingale Reed-warbler

Conopoderas yamashinae Takatsukasa, Dobutsu. Zasshi, 43, 1931, p. 485. (Type locality, Pagan.)

Tatare syrinx Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 210 (Pagan).

Acrocephalus syrinx Hartert (part), Novit. Zool., 5, 1898, p. 58 (Pagan); Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 53 (Pagan).

Acrocephalus stentoreus syrinx Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 67 (Pagan).

Conopoderas yamashinae Hand-list Japanese Birds, rev., 1932, p. 177 (Pagan).

Conopoderas luscinia yamashinae Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Pagan).

Acrocephalus luscinia yamashinae Mayr, Birds Southwest Pacific, 1945, p. 294 (Pagan).

Geographic range.—Micronesia: Mariana Islands—Pagan.

Characters.—Resembles A. l. syrinx, but duller and more brownish and less olive-rufous on back, rump and tail; bill shorter and more curved.

Takatsukasa (1931:485) gives the following description: "Upperparts dark olive brown, paler on the lower rump; remiges and rectrices dark olive-brown, margined with brown. Superciliary stripe distinct and buff; chin, throat, breast and abdomen pale brown; ear-coverts, sides of neck, sides of breast and flanks dusty greyish brown, belly and under tail-coverts pale buff. Bill clove brown, legs grey, and iris Van Dyke brown." He continues, "It differs from *Conopoderas syrinx* of Caroline Islands by its colouration and the shape of the bill, namely in the new form the culmen is more curved and more stout, and the tail is less roundish and nearly square."

Measurements.—Takatsukasa and Yamashina (1931b:485) lists the following measurements: 13 adult males—wing, 75-80; tail, 65-70; culmen, 20-22; 6 adult females—wing, 73-77; tail, 60-65; culmen, 20-22.

Mayr examined seven specimens from Pagan in the Paris Museum. His measurements are: five males—wing, 76-79; tail, 66-69; bill from nostril, 14-14.5; two females—wing, 75, 77; tail, 66, 67; bill from nostril, 14.5, 15.

Remarks.—No specimens have been examined by me. Oustalet (1895:210) was the first to note the difference between the reed-warblers from Pagan and those from Guam and Saipan (*A. l. luscinia*). He regarded those from Pagan as similar to the population in the Carolines, calling them *Tatare syrinx*. Hartert, Seale, and Momiyama followed Oustalet in this regard, and it was not until 1931 that the population at Pagan was recognized as distinct, when further collections were made by the Japanese.

Acrocephalus luscinia nijoi (Yamashina)

Nightingale Reed-warbler

Conopoderas luscinia nijoi Yamashina, Tori, 10, 1940, p. 674. (Type locality, Agiguan.)

Conopoderas luscinia nijoi Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Agiguan).

Acrocephalus luscinia luscinia Mayr (part), Birds Southwest Pacific, 1945, p. 294 (Agiguan).

Geographic range.—Micronesia: Mariana Islands-Agiguan.

Characters.—Adult: Resembles *A. l. lusciana,* but with shorter bill. Yamashina (1940:674) describes the birds as, "upper parts much less rusty in colour and the flanks and bellies are darker and more brownish than those of the specimens from Almagan and Saipan."

Measurements.—Yamashina (1940:674) gives the measurements of five adult birds from Agiguan as: exposed culmen 27-29, bill from nostril 17.0-20.0; as compared with 27 adult birds from Almagan and Saipan as: exposed culmen 30-34, bill from nostril 21.2-24.5.

Remarks.—No specimens have been examined by me. The island of Agiguan is a very small one lying offshore from Tinian and not far from Saipan, where *A. l. luscinia* occurs. *A. l. nijoi* is given tentative recognition, on the basis of the measurements of the five adult specimens given by Yamashina. These indicate that the population has a distinctly shorter bill.

Evolutionary history of Acrocephalus luscinia.—The species of *Acrocephalus* in Micronesia and Polynesia have received several taxonomic treatments. In regard to the Micronesian forms, Quoy and Gaimard called the population at Guam *Thryothorus* while Kittlitz called the population in the Carolines, *Sylvia*. Evidently to emphasize the distinctness of these two birds, Reichenbach in 1850 renamed the bird in the Marianas as *Hybristes* and the bird in the Carolines as *Eparnetes*. The birds were later placed in the genus, *Tatare*, by Hartlaub, Gray, Sharpe and other workers. Gray also used the name, *Calamodyta*, for the bird in the Carolines.

The generic term, *Calamoherpe,* was employed also by a number of workers for the Caroline population. Sharpe (1883:525) placed the reed-warblers in the family Timelidae and retained the name, *Tatare,* for the Micronesian and Polynesian forms. In distinguishing *Acrocephalus* from *Tatare* he has the following to say of *Acrocephalus:* "besides having a much shorter bill, possesses a very much more pointed wing, the distance between the primaries and the secondaries being much more than the length of the hind toe and claw; whereas in *Tatare* the wing is much more obtuse, and the distance between the primaries and the secondaries is less than the length of the hind toe and claw." More recent authors have followed Shrape using the generic name, *Conopoderas* (= *Tatare,* old name preoccupied). However, Tristram (1883:38-46) regarded the separation of these oceanic forms from *Acrocephalus* as a taxonomic error. He said that this is "one of the very few links (the others being the solitary *Hirundo tahitica* and the Merulae) between the avifauna of Oceania and our own; and it has a much wider range east and west than either of the other links, extending from the Carolines in the east to the Marquesas in the west." Mayr has pointed out (orally to the writer) that the separation of the Oceanic reed-warblers from *Acrocephalus* is an unnatural one, although it is perfectly true that the extreme members (*A. caffra* and *A. l. luscinia*) have a very long bill, but forms with shorter bills like *A. l. syrinx* point to the close affinity between the continental species and these insular birds. This has also been noted by Hartert (1898: 58). Mayr (*in litt.*) comments that "There is no difference between *Acrocephalus* and *Conopoderas* in regard to the wing formula, provided that we compare the Polynesian species with the tropical forms of *Acrocephalus* (such as *toxopei* and *cervinus*). The character mentioned by Sharpe is very artificial and merely indicates the difference in the wing between a migrant of the temperate zone and a resident of the tropics. There is no denying that some of the warblers of eastern Polynesia are no longer reed-warblers but have become dwellers of trees and bushes. However, this same tendency prevails among some of the unquestionable species of *Acrocephalus* (*scirpaceus* and *palustris*) and at any rate a slight change in habits is not sufficient for generic separation." Earlier, Mayr (1942b:169) used *Conopoderas* as one of the several genera that is based on "morphologically distinct geographic forms." The degree of modification that has occurred in these oceanic reed-warblers, would, if the birds were in a continental area, undoubtedly be considered worthy of specific or even generic rank by some authors; however, as Mayr (1942b:162) points out, "the majority of well-isolated subspecies have all the characters of good species and are indeed considered to be such by the more conservative systematists." Owing to their differentiation, the Micronesian and Polynesian reed-warblers might not be considered by some ornithologists as belonging to a single superspecies; however, all evidence seems to point to the origin of this group by a single invasion from Asia."

Tristram (1883:41) was the first worker to recognize the relationship of the Micronesian and Polynesian reed-warblers to the continental forms, when he placed them within the genus *Acrocephalus*. Rothschild (1893:2) further stated, "*Tatare* cannot be separated generically from *Acrocephalus*." In discussing the status of the Hawaiian species, *A. familiaris*, Hartert (1898:58) also follows this treatment. Bryan (1941:187) also comments on the relationship of the "miller" birds of Laysan and Nihoa to species at Guam, Christmas and other islands of the Pacific.

The reed-warblers of Polynesia and Micronesia represent an ancient invasion from Asia. The continental form, *Acrocephalus arundinaceous*, is apparently closest to the ancestral stock of these oceanic birds. This species resembles the oceanic populations in size, general coloring, shape of bill, and wing and tail structure. Some of the continental races of this species have a shorter first primary which is similar to that in the oceanic forms. How rapid the spread was of the reed warbler through the large insular area that it now occupies is unknown. *A. syrinx* of Micronesia has a shortened wing and some populations have a long bill. Species in Polynesia have stronger wings than the one in Micronesia, but have become differentiated in other ways, as, for example, by the long bill of *A. caffra* and the small size of *A. aequinoctialis*. In addition, call notes have become varied, as noted by Chapin (in Mayr, 1942b:54). Also certain of the reed-warblers have become bush and tree-living birds. The Hawaiian birds are reduced in size and have become tree-living in a manner similar to that of other Polynesian species. These modifications of the reed-warblers of the Oceanic area appear, according to Murphy and Mathews (1929), to indicate their long-time residence in the islands, as compared with subspecies of *A. arundinaceous* that are found in Melanesia. The latter birds, which are not ancestral to the Polynesian birds, resemble closely their Asiatic ancestors and have also retained their swamp-living habits. This would seem to indicate that the birds in Melanesia may be of more recent occurrence. Stresemann (1939b:324) presents a map of the distribution of *A. arundinaceous* in southeastern Asia and adjacent islands. The original stock came from a point in China, north of Indochina, spreading to the Philippines and to Celebes, from where it reached the Solomons and New Guinea via the Lesser Sundas and Australia.

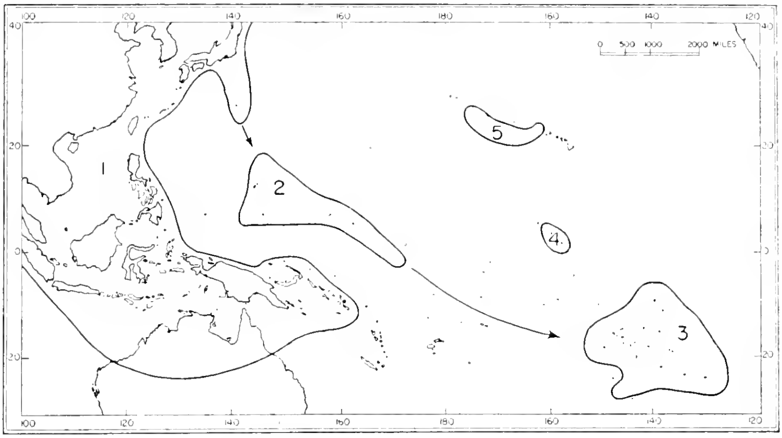

FIG. 15. Geographic distribution of *Acrocephalus* in the Pacific area and routes of its dispersal. (1) *A. arundinaceus*; (2) *A. luscinia;* (3) ranges of *A. atypha, A. caffra,* and *A. vaughani*; (4) *A. aequinoctialis*; (5) *A. familiaris.*

The path of invasion of Oceania by the reed-warbler is pictured in figure 15. Probably the birds became established in Micronesia by an invasion from the Bonins, where *A. arundinaceus orientalis* is known to occur today. From the Marianas and Carolines, the birds spread to Polynesia; *A. l. rehsei* of the Gilbert Islands (Nauru) might well be a connecting link. Possibly, the Hawaiian birds came as a separate invasion *via* the Volcano and Bonin islands or through the Micronesia Chain, or through the Line and Christmas islands from the south. It seems evident, however, that owing to their geographic proximity and comparative structural similarity, the species in Hawaii is closest to *A. luscinia* of Micronesia. The absence of reed-warblers from the western Carolines and Palaus seems to reduce the possibility of an invasion from the Philippine region. However, reed-warblers are absent from the Marshall and the northern Gilbert islands, where there is undoubtedly suitable habitat for their occurrence. Possibly these islands were once occupied by the birds but they were eliminated by natural causes or by man and his land uses.

Rhipidura rufifrons uraniae Oustalet

Rufous-fronted Fantail

Rhipidura Uraniae Oustalet, Bull. Soc. Philom. Paris, (7), 5, 1881, p. 76. (Type locality, Mariannes = Guam.)

Rhipidura pectoralis Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 17 (Ladrone or Marian Is. = Guam).

Rhipidura uraniae Reichenow and Schlow, Journ. f. Ornith., 1884, p. 398 (Mariannes = Guam); Hartert, Novit. Zool., 5, 1898, p. 53 (Guam); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 20 (Marianne = Guam); Büttikofer, Notes Leyden Mus., 15, 1893, p. 76 (Guam); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 48 (Guam); Safford, Osprey, 1902, p. 69 (Guam); Dubois, Syn. Avium, 1, 1902, p. 277 (Guam); Safford, The Plant World, 7, 1904, p. 263 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Mearns, Proc. U. S. Nat. Mus., 36, 1909, p. 477 (Guam); Schnee, Zeitschr. f. Naturwisch., 82, 1910, p. 464 (Marianen = Guam); Reichenow, Die Vögel, 2, 1914, p. 267 (Marianen = Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 65 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam).

Rhipidura atrigularis Reichenow, Journ. f. Ornith., 1885, p. 110 (Type locality, Palau, error = Guam); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 21 (Pelew, error = Guam); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Marianne = Guam).

Rhipidura versicolor Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 190 (Guam).

Rhipidura rufifrons uraniae Mathews, Syst. Avium Australasianarum, 2, 1930, p. 490 (Marianne = Guam); Hand-list Japanese Birds, rev., 1932, p. 176 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Guam); Mayr, Birds Southwest Pacific, 1945, p. 295 (Guam); Watson, The Raven, 17, 1946, p. 42 (Guam); Mayr and Moynihan, Amer. Mus. Novit., no. 1321, 1946, pp. 3, 9 (Guam); Baker, Proc. Biol. Soc. Washington, 59, 1946, p. 77 (Guam); *idem*, Smithson. Misc. Coll., vol. 107, no. 15, 1948,, p. 67 (Guam).

Rhipidura rufifrons Wharton, Ecol. Monogr., 16, 1948, p. 174 (Guam); Strophlet, Auk, 1946, p. 339 (Guam).

Geographic range.—Micronesia: Mariana Islands-Guam.

Characters.—Adult: Forehead and anterior crown near "cinnamon-buff"; lores and orbital ring black, auriculars more brownish than lores; malar stripe white; a few feathers in posterior malar region tipped with "citrine drab"; anterior part of chin white; posterior part of chin, throat, and upper breast black; feathers on breast edged with white; lower breast, abdomen, sides, flanks, tibia, vent, and under tail-coverts near "royal brown," becoming lighter on breast and more rufous on under tail-coverts; sides of neck and back near "Dresden brown," becoming grayer on neck and crown where feathers have darker shafts; rump and upper tail-coverts near "orange rufous"; basal half of tail slightly lighter than rump; terminal part of tail black, tipped with white; wings dark edged with coloring like back; under wing grayish with axillaries tipped with buffy-white; bill black with base of upper mandible lighter; feet dark brown; iris dark brown.

Immature: Resembles adult, but head, neck, scapulars, and secondaries edged with rufous; feathers of chin and throat edged with whitish. Younger birds may have less rufous on head but feathers of body more rufous with creamy edges.

Measurements.—Measurements are listed in table 38.

TABLE 38. MEASUREMENTS OF *Rhipidura rufifrons* IN MICRONESIA

SUBSPECIES	Number and sex	Wing	Tail	Exposed culmen	Tarsus
R. r. uraniae.....	11 males	66 (64-69)	78 (75-82)	13.6 (13.1-14.5)	16.6 (15.6-17.2)
	6 females	65 (61-68)	76 (73-81)	12.3 (11.6-12.5)	16.8 (16.1-17.6)
R. r. saipanensis..	7 males	68 (68-69)	81 (80-83)	13.3 (13.0-13.5)	17.3 (16.2-18.4)
	6 females	64 (62-66)	76 (72-81)	12.7 (12.4-13.4)	17.9 (17.2-18.1)
R. r. mariae......	2 males	65, 67	82, 82	12.1, 12.4	17.1, 17.2
R. r. kubaryi.....	14 males	77 (75-79)	88 (82-95)	14.4 (13.6-15.0)	20.0 (19.0-21.0)
	10 females	72 (69-75)	87 (83-90)	14.5 (14.0-15.0)	20.0 (20.0-20.5)

Weights.—The NAMRU2 party recorded the weights of nine males as 9.0-10.0 (9.0); of three females as 7.2-9.6 (8.8) grams.

Specimens examined.—Total number, 41 (19 males, 14 females, 8 unsexed), as follows: Mariana Islands, USNM—Guam, 17 (May 29, 30, June 6, 14, 18, July 12, 20); AMNH—Guam, 24 (Jan., Feb., March, Aug., Sept., Dec.).

Nesting.—Hartert (1898:54) recorded nests taken at Guam in February and March.

Molt.—On the basis of specimens examined, it is apparent that molt begins in August or September and continues through the months of the fall.

Parasites.—Wharton (1946:174) obtained the chigger (Acarina), *Trombicula* sp., from this bird at Guam.

Remarks.—The Rufous-fronted Fantail at Guam is a bird of the forest and forest scrub. It prefers the areas where leafy undergrowth is present. It moves rapidly about continually fluttering its wings and spreading its long fanlike tail. The birds are usually observed in pairs. On January 21, 1945, E. W. Coleman of the NAMRU2 party killed a fantail but before he could retrieve it, a large toad (*Bufo marinus*) seized the fallen bird and carried it into a hole in the ground.

Rhipidura rufifrons saipanensis Hartert

Rufous-fronted Fantail

Rhipidura saipanensis Hartert, Novit. Zool., 5, 1898, p. 54. (Type locality, Saipan).

Rhipidura versicolor Oustalet, Le Nat., 1889, p. 260 (Mariannes = Saipan); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 21 (Marianne = Saipan); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 190 (Saipan).

Rhipidura saipanensis Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 48 (Saipan); Dubois, Syn.

Avium, 1, 1902, p. 277 (Saipan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 63 (Marianne = Saipan).

Rhipidura rufifrons saipanensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 65 (Saipan); Mathews, Syst, Avium Australasianarum, 2, 1930, p. 490 (Saipan); Hand-list Japanese Birds (part), rev., 1932, p. 176 (Saipan, Tinian); Hand-list Japanese Birds (part), 3d ed., 1942, p. 195 (Saipan, Tinian); Mayr (part), Birds Southwest Pacific, 1945, p. 295 (Saipan, Tinian); Mayr and Moynihan (part), Amer. Mus. Novit., no. 1321, 1946, p. 3 (Saipan, Tinian); Baker, Proc. Biol. Soc. Washington, 59, 1946, p. 77 (Saipan, Tinian); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 98 (Tinian).

Rhipidura lepida saipanensis Stott, Auk, 64, 1946, p. 527 (Saipan).

Geographic range.—Micronesia: Mariana Islands—Saipan, Tinian.

Characters.—Adult: Resembles adult of *R. r. uraniae,* but forehead and anterior crown more rufous; posterior crown and nape lighter; rump and upper tail-coverts lighter and richer in color; white malar stripe broader; chin with white feathering more extensive, covering edge of upper throat.

Measurements.—Measurements are listed in table 38.

Specimens examined.—Total number, 16 (9 males, 6 females, 1 unsexed), as follows: Mariana Islands, USNM—Saipan, 1 (Dec. 15)—Tinian, 3 (Oct. 16, 23); AMNH—Saipan, 6 (July, Aug.)—Tinian, 6 (Sept.).

Molt.—Molt begins in July and extends through the autumn. Most of the specimens examined, that were taken in this period, are in molt.

Food habits.—Stott (1947:527) writes that the fantail forages for insects in the undergrowth and also while on the wing captures flying insects. Downs (1946:99) made similar observations concerning this bird at Tinian.

Remarks.—In studying the collection of faintails obtained by Marche at Guam and Saipan, Oustalet (1895:191) reached the conclusion that the birds from these two islands were the same as the bird from Yap, which he called *R. versicolor.* He thought that the white-throated birds were in breeding plumage, and that the black-throated birds (from Guam) were in autumn and winter dress. This error was corrected by Hartert (1898:53).

Downs (1946:98-100) has published some interesting observations concerning the fantail at Tinian. He describes feeding behavior and the song which he says is "a beautiful rolling whistle, starting rather shrilly, then rolling on. Something like a meadow-lark and song sparrow combined." Gleise (1945:220) estimated the population of fantails at Tinian to be "40-50" in 1945. In 1931, Coultas found the bird at Tinian but not at Saipan. Stott (1947:527) observed the bird at Saipan "in forested areas and vine-draped crevices in the lava above Magicienne Bay."

Rhipidura rufifrons mariae R. H. Baker

Rufous-fronted Fantail

Rhipidura rufifrons mariae R. H. Baker, Proc. Biol. Soc. Washington, 59, 1946, p. 7. (Type locality, Rota.)

Rhipidura rufifrons saipanensis Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 222 (Rota); Hand-list Japanese Birds (part), rev., 1932, p. 176 (Rota); Hand-list Japanese Birds (part), 3d ed., 1942, p. 195 (Rota); Mayr (part), Birds

Southwest Pacific, 1945, p. 295 (Rota); Mayr and Moynihan (part), Amer. Mus. Novit., no. 1321, 1946, p. 3 (Rota).

Rhipidura rufifrons mariae Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 68 (Rota).

Geographic range.—Micronesia: Mariana Islands—Rota.

Characters.—Adult: Resembles adult of *R. r. saipanensis,* but with richer brown coloring on the breast and abdomen; darker above, especially the forehead, rump, and basal part of tail; chin with small mount of white; malar line of white thinner.

Measurements.—Measurements are listed in table 38.

Weights.—Baker (1946:78) records the weights of two adult males from Rota as 8.3 and 9.0 grams.

Specimens examined.—Total number, 2 males, from Mariana Islands, USNM—Rota (Oct. 22).

Remarks.—Takatsukasa and Yamashina (1932:222) published the first account of the fantail from Rota although Coultas (field notes) obtained a report of its presence at Rota in 1931. The NAMRU2 party obtained the two specimens studied, and reported that the birds were numerous in the forested areas of Rota in 1945.

Rhipidura rufifrons versicolor Hartlaub and Finsch

Rufous-fronted Fantail

Rhipidura versicolor Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 96. (Type locality, Uap.)

Rhipidura versicolor Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Sharpe, Cat. Birds British Mus., 4, 1879, p. 320 (Yap); Nehrkorn, Journ. f. Ornith., 1879, p. 402 (Yap); Oustalet, Bull. Soc. Philom. Paris, (7), 5, 1881, p. 76 (Uap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 21 (Uap); Büttikofer, Notes Leyden Mus., 15, 1893, p. 78 (Uap); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 191 (Yap); Hartert, Novit. Zool., 5, 1898, p. 54 (Yap); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 54 (Yap); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Yap); Dubois, Syn. Avium, 1, 1902, p. 277 (Yap); Reichenow, Die Vögel, 2, 1914, p. 267 (Jap); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Mackenzie = Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 66 (Yap); Hand-list Japanese Birds, rev., 1932, p. 176 (Yap).

Rhipidura rufifrons versicolor Mathews, Syst. Avium Australasianarum, 2, 1930, p. 489 (Uap); Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Yap); Mayr, Birds Southwest Pacific, 1945, p. 295 (Yap); Mayr and Moynihan, Amer. Mus. Novit., no. 1321, 1946, p. 3 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—Adult: Resembles *R. r. uraniae,* but chin and upper throat white; upper parts darker; abdomen whitish.

The description of the adult given by Hartlaub and Finsch (1872:96) is "Upper parts a rich brown with a slight reddish tinge; forehead bright rufous; upper and under tail-coverts rufous; throat white, margined underneath by an irregular jugular band of pure black; pectoral plumes black, broadly margined with yellowish white; middle of abdomen whitish, sides of a paler olive-brown under wing-coverts whitish; wing-feathers blackish brown; tail feathers brownish black, all largely tipped with white, the four middle ones rufous at the base, the white terminal spots becoming smaller towards the middle; beak fuscous, the under mandible paler except at tip; feet fuscous."

Hartert (1898:54) writes that *R. r. saipanensis* differs from the bird at Yap "in having the bases of all rectrices rufous, the rump and upper tail-coverts rufous. The sides of the abdomen are not olive-brown, but rufous."

Remarks.—No specimens of the Rufous-fronted Fantail of Yap have been seen by me. On the basis of published descriptions and comments, it appears that the bird is subspecifically distinct from the forms in the Marianas but shows close relationships to them. *R. r. versicolor* has the chin and throat white; *R. r. saipanensis* has the chin and part of the throat white and a heavy, white line in the malar region; *R. r. mariae* has the chin and only a small amount of the throat white and a thinner, white malar stripe; *R. r. uraniae* has only a small amount of white present on the chin and a very thin, white line in the malar region.

Rhipidura rufifrons kubaryi Finsch

Rufous-fronted Fantail

Rhipidura kubaryi Finsch, Proc. Zool. Soc. London, 1875 (1876), p. 644. (Type locality, Ponapé.)

Rhipidura kubaryi Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 29, pl. 2, fig. 2 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 779 (Ponapé); Nehrkorn, Journ. f. Ornith., 1879, p. 403 (Ponapé); Finsch, Journ. f. Ornith., 1880, p. 289 (Ponapé); *idem*, Ibis, 1881, pp. 110, 112, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Tristram, Cat. Birds, 1889, p. 198 (Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 20 (Ponapé); Büttikofer, Notes Leyden Mus., 15, 1893, p. 76 (Ponapé); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Ponapé); Dubois, Syn. Avium, 1, 1902, p. 277 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 54, 64 (Ponapé); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zool., 63, 1919, p. 204 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 65 (Ponapé); Yamashina, Tori, 7, 1932, p. 403 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 176 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Ponapé).

Rhipidura kubarii Sharpe, Cat. Birds British Mus., 4, 1879, p. 314 (Ponapé); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 55 (Ponapé).

Rhipdura rufifrons kubaryi Mayr, Birds Southwest Pacific, 1945, p. 295 (Ponapé); Mayr and Moynihan, Amer. Mus. Novit., no. 1321, 1946, pp. 3, 6, 9, 11, 12, 15, 16 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: Upper parts smoky olivaceous-brown, less smoky on rump and upper tail-coverts; anterior forehead and supraloral region narrowly edged with white; lores and orbital ring black; auriculars brown; feathers of chin and malar region tipped with white; rest of chin and throat black, lower feathers of throat edged with white; abdomen dark olivaceous-brown with whitish mid-portion anteriorily; sides and under tail-coverts ashy, the latter broadly tipped with white; wings and tail dark, tail tipped with white and outer rectrices more broadly so; axillaries and under wing-coverts gray, broadly tipped with white; bill and feet black, mandible basally whitish; iris dark brown.

R. r. kubaryi resembles *R. r. uraniae,* but larger; lacking rufous coloring; smaller and shorter, white malar stripe; white on chin reduced.

Measurements.—Measurements are listed in table 38.

Specimens examined.—Total number, 40 (24 males, 15 females, 1 unsexed), as follows: Caroline Islands, USNM—Ponapé, 1 (Feb. 12); AMNH—Ponapé, 39 (Nov., Dec.).

Nesting.—Yamashina (1932a:403) records nests containing one or two eggs taken at Ponapé in 1931 on the following dates: July 11, August 2, 14, 19, 22, 30. Coultas (field notes) obtained reports that the eggs are two in number and laid in a cup-shaped nest of grass and fern, which is placed near the ground.

Molt.—Many of the specimens examined that were taken in November and December are in fresh or slightly worn plumage. Only a few are molting. Apparently molt occurs earlier, perhaps beginning in August and continuing until October or November.

Remarks.—Coultas obtained a large series of these birds at Ponapé in 1931. He writes (field notes) that the fantail is a common bird and is found in forest and brush lands. This bird has a nervous behavior similar to that of other fantails and is constantly "wagging its long tail." Coultas describes it as an aggressive bird, chasing honey-eaters and white-eyes.

Rhipidura lepida Hartlaub and Finsch

Palau Fantail

Rhipidura lepida Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 6. (Type locality, Pelew Islands.)

Rhipidura lepida Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew Islands); Gray, Hand-list Birds, 1, 1869, p. 331 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 97 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 21, pl. 4, fig. 2-3 (Palau); Sharpe, Cat. Birds British Mus., 4, 1879, p. 322 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Tristram, Cat. Birds, 1889, p. 198 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 21 (Pelew); Büttikofer, Notes Leyden Mus., 15, 1893, p. 81 (Pelew); Bolau, Mitteil, Naturhist. Mus. Hamburg, 1898, p. 55 (Palau); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Dubois, Syn. Avium, 1, 1902, p. 278 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 267 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 66 (Pelew); Mathews, Syst. Avium A9ustralasianarum, 2, 1930, p. 484 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 176 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 196 (Babelthuap, Koror, Peliliu); Mayr and Moynihan, Amer. Mus. Novit., no. 1321, 1946, pp. 3, 5, 8, 10, 12, 19 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 68 (Peleliu).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad.

Characters.—Adult: Upper parts near "cinnamon-rufous," slightly lighter on the upper wing-coverts, scapulars, edges of inner secondaries, and rump; lores blackish; orbital ring and auriculars dark brown; chin, upper throat, and malar region white; lower throat and upper breast black with ashy-gray sides; lower breast whitish; rest of underparts like back but slightly paler; wings dark; tail black with tips rufous, inner rectrices with rufous tips narrower than on tail; under wing-coverts and axillaries broadly edged with rufous; bill blackish, lower mandible whitish at base; feet brownish; iris dark brown. Female slightly smaller.

Immature: Resembles adult, but head and neck brown; throat coloring dingy; patch on breast blackish cinnamon. Younger individuals may be more tinged with rufous above and below.

Measurements.—Measurements are listed in table 39.

TABLE 39. MEASUREMENTS OF *Rhipidura lepida*

NUMBER AND SEX	Wing	Tail	Culmen	Tarsus
7 adult males	80 (77-83)	89 (85-94)	15.5 (14.5-16.0)	23.3 (23.0-24.0)
7 adult females	77 (76-79)	86 (83-88)	15.5 (14.5-15.5)	22.5 (21.7-23.0)

Specimens examined.—Total number, 18 (9 males, 9 females), as follows: Palau Islands, USNM—Koror, 2 (Nov. 6, 18)—Babelthuap, 1 (Nov. 27)—Peleliu, 4 (Aug. 29, 30, 31); AMNH—exact locality not given, 11 (Nov., Dec.).

Molt.—Some of the birds taken in August are in molt. Specimens taken in November and December are mostly in fresh plumage. Apparently this bird molts in late summer and early fall.

Remarks.—In 1945 the NAMRU2 party found the Palau Fantail in small numbers at Peleliu, Garakayo and Ngabad. At Peleliu the birds were noted as singles or in pairs in brushy undergrowth in forested areas. The birds were observed also in the second growth vegetation in the battle areas. Coultas (field notes) found the bird to be rare and restricted to the true forest, when he visited the Palau Islands in 1931. The fantail is one of the most attractive birds found in the jungles of the Palau Islands. Its bright rufous coloring is conspicuously displayed by the rapid movements of the wings and tail as the bird moves and feeds in the undergrowth. The population is apparently not large, and the individual or pair of birds probably ranges in a relatively large home territory.

Evolutionary History of Rhipidura in Micronesia.—The evolutionary history of *Rhipidura* in Micronesia has been studied considerably more than that of some of the other genera in the area. Oustalet (1896:70) notes a close relation between *Rhipidura* of the Marianas and *R. rufifrons* of Australia. Mayr (1941b:202, 203) regards the genus *Rhipidura* as typical of the Polynesian area and remarks that speciation within this genus has proceeded at a relatively rapid rate. Mayr and Moynihan (1946) have devoted a 21-page paper to a thorough discussion of the *R. rufifrons* group, based on the extensive collections at the American Museum of Natural History. They remark that no other genera are closely related to *Rhipdura* and that evolution has proceeded further in *R. rufifrons* than in any other species of the genus. These authors regard the Papuan area, probably New Guinea, as the original home of this group. From their study they point out that many of the subspecies of *R. rufifrons* of the Papuan area, especially those of the Louisiades and the Solomons, appear to be the least specialized of the species, and that this lack of specialization in these subspecies indicates that the ancestral stock of the species *R. rufifrons* acquired its specificity somewhere in that area. With regard to the kinds of *Rhipdura* in Micronesia, Mayr and Moynihan (1946:fig. 2) have logically found three separate colonizations within the area: one represented today by *R. lepida* at Palau; one of subspecies of *R. rufifrons* at Yap and in the Marianas; and one by *R. r. kubaryi* at Ponapé.

R. lepida, according to Mayr and Moynihan (1946), is a result of an early colonization by *Rhipidura.* It is related to *R. dedemi, R. superflua,* and *R. teijsmanni,* which are mostly monotypic or have only two or three subspecies within the species. These three species are found in the region including Celebes and the Moluccas. *R. lepida* apparently invaded the Palau Islands from Celebes or an adjacent area and, among named species, most closely resembles *R. teijsmanni.* Both of these species have a white chin and throat, black breast patch, and rufous abdomen. *R. lepida* has become differentiated chiefly by the presence of a rufous head and back, a more distinct breast band, and proportionately different amounts of rufous and black coloration of the tail feathers.

Mayr and Moynihan (1946:6) give as the chief characters of *R. rufifrons* the following: "a rufous forehead, a grayish brown head and upper back, a well-defined rufous rump, a white chin and throat, a black breast band with scaling at its lower edge, and a dark brown tail with a distinct rufous base and a white tip." The Micronesian subspecies of *R. rufifrons* at Yap and in the Marianas display these characters. Of the four subspecies found in the area including Yap and the Marianas, *R. r. versicolor, R. r. saipanensis, R. r. mariae* and *R. r. uraniae,* the two first named most closely approach the ancestral stock, which may have been *R. r. commoda* Hartert of the northern Solomons or some near relative in Melanesia. The amount of white on the chin and throat and on the malar stripe, in *R. r. versicolor* and *R. r. saipanensis* is probably nearer that which obtained in the ancestor. At Rota, *R. r. mariae,* exhibits less white on the throat and a thinner, white malar stripe, while at Guam, *R. r. uraniae* possesses only a small amount of white on the chin and only a very thin line of white in the malar region. This variation in coloration suggests that the birds may have originally become established at Yap, Saipan and Tinian and later, birds from Saipan and Tinian spread to Rota and lastly to Guam.

R. r. kubaryi of Ponapé, although considered as a subspecies of *R. rufifrons* by most workers, has lost the rufous coloring found in most members of the species. Mayr and Moynihan (1946:6) point to its evolution through subspecies in the Santa Cruz Islands, where in *R. r. agilis* Mayr the rufous of the lower back is restricted to the upper tail-coverts, and in *R. r. melanolaema* Sharpe and *R. r. utupuae* Mayr the rufous is absent. In the latter two subspecies, as well as in *R. r. kubaryi,* the forehead is white instead of rufous.

The invasion of Micronesia by *Rhipidura* has undoubtedly been the result of abnormally long flights by a relatively weak flyer. The fact that *Rhipidura* has succeeded in establishing itself at only a few of the seemingly suitable islands in Micronesia may indicate that the possibilities for chance migration and resulting colonization are small, but that new colonization may be expected in the future.

It is my opinion that the populations of *Rhipidura,* as I have observed them in Micronesia, are small because each individual or pair of birds is dependent on a relatively large area of woodland to satisfy its habitat requirements, especially for food. This suggestion needs to be tested by observation made in the field. In comparison with the insect fauna of New Guinea or some other large island, that of Micronesia is indeed small in number of kinds. Hesse, Allee and Schmidt (1937:524) explain the absence of insectivorous animals such as "swallows, swifts, flycatchers, and insectivorous bats" in island communities on the basis of the small number of flying insects in these communities. Probably *Rhipidura* is able to forage for sedentary insect life as well as for the flying forms.

Metabolus rugensis (Hombron and Jacquinot)

Truk Monarch

Muscicapa Rugensis Hombron and Jacquinot, Ann. Sci. Nat. Paris, (2), 16, 1841, p. 312. (Type locality, Roug = Truk.)

Monarcha rugensis Hartlaub, Archiv. f. Naturgesch., 18, 1852, p. 133 (Gruppe Roug. = Truk); *idem,* Journ. f. Ornith., 1854, p. 168 (Carolinen = Truk); *idem,* Proc. Zool. Soc. London, 1867 (1868), p. 829 (Hogoleu = Truk); Gray, Hand-list Birds, 1, 1869, p. 321 (Caroline = Truk); Giebel, Thes. Ornith., 2, 1875, p. 614 (Carolinae = Truk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk).

Colluricincla rugensis Pucheran, Voy. Pôle Sud, Zool., 3, 1853, p. 62 (Ruk); Hartlaub, Journ. f. Ornith., 1854, p. 162 (Roug = Truk).

Metabolus rugensis Bonaparte, Comptes Rendus Acad. Sci. Paris, 38, 1854, p. 650 (no locality = Truk); Sharpe, Cat. Birds British Mus., 4, 1879, p. 238 (Ruk); Finsch, Proc. Zool. Soc. London, 1880, p. 575 (Ruk); Tristram, Cat. Birds, 1889, p. 197 (Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 19 (Ruk); Nehrkorn, Kat. Eiers., 1899, p. 26 (Ruk); Hartert, Novit. Zool., 7, 1900, p. 4 (Ruk); Matschie, Journ. f. Ornith., 1901, p. 112 (Ruk); Reichenow, Die Vögel, 2, 1914, p. 262 (Karolinen = Truk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Ruk); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zool., 63, 1919, p. 203 (Truk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 63 (Ruk); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 470 (Ruk); Yamashina, Tori, 7, 1932, p. 404 (Truk); Hand-list Japanese Birds, rev., 1932, p. 178 (Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 197 (Truk); Mayr, Birds Southwest Pacific, 1945, p. 295 (Truk).

Monarcha (Metabolus) rugensis Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 19 (Caroline Islands).

Geographic range.—Micronesia: Caroline Islands—Truk.

Characters.—Adult male: White feathers (with dark bases) throughout except for black ones on forehead, lores, chin, and throat; chin and throat with steel-blue gloss; tips of second to fifth or seventh primaries black, black coloring extending along inner webs; shafts of primaries and basal half of tail feathers black; bill and feet black.

Adult female: Resembles adult male, but generally sooty-black, darker above; under tail-coverts and sometimes rump splotched with white; white coloring may also be present on tips of secondaries, on chin, and on tail.

Immature: Resembles adult, but bright cinnamon on upper parts and on wings and tail; inner webs of primaries grayish or dark brown, shafts of primaries lighter on basal half; lores, chin and throat white or washed with creamy-buff; breast and abdomen whitish, washed with cinnamon, sides darker rufous, under wing-coverts, axillaries, and under tail-coverts usually light rufous although somewhat variable in color; basal part of bill yellow, tip of bill horn colored. Immatures may be observed in all stages of color change toward the adult condition.

Measurements.—Measurements are listed in table 40.

TABLE 40. MEASUREMENTS OF *Metabolus rugensis*

NUMBER AND SEX	Wing	Tail	Culmen	Tarsus
8 males	103 (98-105)	91 (88-93)	27 (26-28)	26 (25-27)
6 females	100 (97-101)	87 (86-89)	27 (26-28)	26 (25-27)

Specimens examined.—Total number, 27 (14 males, 13 females), as follows: Caroline Islands, USNM—Truk, 2 (Feb. 16, not dated); AMNH—Truk, 25 (Jan. 29, Feb. 1, 8, 10, 11, May 6, 9, June 11, 13, 14, 15, Oct. 11, 31, Nov. 2, 11, Dec. 3, 12, 17, 20).

Nesting.—Yamashina (1932a:404) reports on the taking of a nest containing one egg at Natsushima, Truk Atoll, in May, 1931. According to Hartert

(1900:5) Owston's collectors obtained nests on June 1, 4, and 12. Two were in breadfruit trees about twenty feet above the ground. Each nest contained one egg. Hartert writes, "The eggs are cream-coloured, speckled with brownish red, more frequently and often very thickly on the large end, and with some deeper lying pale purplish grey patches, and one has some very fine black lines on the large end."

Molt.—A study of adult specimens obtained at various times of the year indicates that *Metabolus* normally molts in the period from about October through January.

Mayr (1933e:1-10) has studied the variation of immature and adult plumages in *Neolalage banksiana* (Gray) and other birds pointing out the occurrence of "retarded" and "progressive" plumages. Bogert has followed this work in interpreting the condition of the plumages in *Metabolus*, and through the kindness of Ernst Mayr I have examined Bogert's unpublished manuscript on the series of *Metabolus* at the American Museum of Natural History, from which the following account of the plumage is taken.

In the series of skins, there are specimens of non-molting, immature males with "normal" plumage (that is to say, plumage with upper parts cinnamon-colored and lower parts whitish and darker buff) taken in October and in February. There are also specimens of non-molting, immature females with "normal" plumage taken in November and in May. These immatures are in fresh or slightly worn plumages. In addition, there is one non-molting, male specimen (November) which has some white on the crown and throat, some black on the lores and chin, but because the black feathers are fresh, the specimen is considered to be a "transition" bird and may be either a "retarded" adult or a "progressive" immature male. One non-molting female (October) shows some sooty-black mottling on the chin and throat and a few black feathers on the crown; this is apparently a "progressive" immature because the lower mandible has a yellow basal part, characteristic of the immature. Another female (June) shows black feathers on the crown, nape, chin, throat, and breast; this bird is in the process of molting with the black feathers representing new growth and is an immature assuming the adult condition—in "progressive" plumage. One non-molting male (January) has an intermingling of white feathers in the cinnamon coloring of the head and body, black on the forehead, chin and throat, primaries black with cinnamon edges, and bill similar in color to that of the adult; it is considered to be an adult with "retarded" plumage. Two molting males (December) resemble adults except for cinnamon coloring on shoulders, back, primaries, retrices and a slight cinnamon wash on breast feathers; these may be "retarded" adults. One molting female (June) has mixed cinnamon and sooty-black feathering; this may also be a "retarded" adult. Another molting female (December) with more sooty-black feathering and less cinnamon feathering is also considered to be a "retarded" adult. In fully adult birds there is considerable individual variation, especially in the males where the amount of black on the throat, the extent of the black on the terminal part of the primaries, and the extent of the black on the basal part of the tail feathers is variable. Scattered white feathers may be present on adult females.

Remarks.—Hombron and Jacquinot first obtained the Truk Monarch, but it was not until the time of Kubary and of the Japanese collectors of Owston that very much was learned concerning the bird. In 1945, McElroy of the NAMRU2 party reported that he found no birds at the several islands of Truk that he visited in December. Some of the Japanese residents of the islands told McElroy that they did not know the bird. Evidently, its numbers are low or it has been eliminated, at least on the islands then populated by the Japanese.

Metabolus belongs to a group of flycatchers including the genera *Pomarea, Mayrornis, Neolalage, Monarcha,* and *Clytorhynchus.* The different plumages of the adults and the immatures are not unusual in this group of genera, this feature being observed in many of the flycatchers of Oceania. Mayr (1933c:1) points out some of the relationships between *Metabolus* and some of these other genera; he comments that all of them have rather thin bills, in contrast to those of other flycatchers.

Metabolus became established at Truk probably as the result of an independent colonization. It is a well differentiated genus showing little resemblance to *Monarcha godeffroyi* of Yap. In looking over the genera found in the Pacific area, it appears that *Metabolus* is closest to *Clytorhynchus* of the Melanesian region, especially to *Clytorhynchus hamlini* Mayr, which is resident at Rennell in the Solomon Islands. The bills of these two birds are similar, both being long and thin, with a pronounced hook. In coloration there is some resemblance; *C. hamlini* has the blackish forehead and chin like the male *Metabolus* and also the burnt-orange underparts. In *C. hamlini,* however, the sexes are similar, *Metabolus* also resembles *C. nigrogularis.* Like *Metabolus,* the immatures of this latter species are different in color from the adults.

Monarcha godeffroyi Hartlaub

Yap Monarch

Monarcha godeffroyi Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 829, pl. 38. (Type locality, Yap.)

Monarcha godeffroyi Finsch, Journ. Mus. Godeffroy, 8. 1875, p. 50 (Yap); Sharpe, Cat. Birds British Mus., 4, 1879, p. 432 (Yap); Nehrkorn, Journ. f. Ornith., 1879, p. 403 (Yap); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 56 (Yap); Dubois, Syn. Avium, 1, 1902, p. 289 (Yap); Reichenow, Die Vögel, 2, 1914, p. 261 (Yap); Mayr, Birds Southwest Pacific, 1945, p. 295 (Yap).

Monarcha godeffroyi Gray, Hand-list Birds, 1, 1869, p. 321 (Yap); Hand-list Japanese Birds, rev., 1932, p. 175 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 194 (Yap).

Monarches godeffroyi Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 97 (Yap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 63 (Yap).

Pomarea godeffroyi Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 19 (Yap); Matschie, Journ. f. Ornith., 1901, p. 112 (Yap).

Monarcharses geoffroyii Mathews, Bull. British Ornith. Club, 45, 1925, p. 94 (new generic name); *idem*, Syst. Avium Australasianarum, 2, 1930, p. 514 (Yap).

Monarcharses godeffroyi Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 486 (Yap?).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—Adult male: according to Sharpe (1879:432) "General colour above white, from the hind neck to the rump and including scapulars; wings black, the quills browner; upper tail-coverts and tail black; head all around black, including the lower throat; sides of neck and rest of under surface, from the foreneck downwards, pure white; thighs and under tail-coverts black; under wing-coverts black, quills ashy blackish below; white along the inner edge of the primaries; 'bill entirely blue; feet whitish blue; iris black' (Kubary M. S.)."

Adult female: "Entirely black, excepting the hind neck and upper mantle, sides of neck, lower throat, and fore neck, which are pure white" (Sharpe, 1879:432).

Immature: "Above brown, the head and hind neck ashy grey, the scapulars rufescent at the tips, the rump rufous, becoming paler and more fulvous on the upper tail-coverts; wing-coverts dusky brown, broadly edged externally with rufous-buff, becoming fulvous on the median and greater coverts; quills dark brown, externally edged with rufous, the primaries narrowly, the secondaries more broadly, the innermost of the latter edged and tipped with buff; tail-feathers ashy brown, narrowly edged with ochraceous brown and tipped with white, more broadly on the outer feathers; lores and a broad eyebrow rufous-buff; ear-coverts rather deeper rufous, shading on to the sides of the throat; under surface of body light cinnamon-rufous inclining to rufous on the throat and under tail-coverts; under wing-coverts light cinnamon, like the breast; quills light brown below, whitish along the inner web; 'bill horn-colour, the point brown, under mandible paler, feet dirty white, iris black' (Kubary M. S.)." (Sharpe, 1879:433).

Remarks.—No specimens of this species have been seen by me. Most taxonomists have regarded this bird as a member of the genus *Monarcha*, although Mathews did propose the name *Monarcharses* for this bird. On the basis of descriptions and pictures (especially plate 38 in Hartlaub, 1868:828) the bird appears to be related to the monarch flycatchers of the Melanesian area. It may be closest to *Monarcha menckei* from the Bismarcks, *M. manadensis* of the New Guinea region, *M. barbatus* from the Solomons or to *M. leucurus* from Buru. The drab color of the immatures and the black and white color of the adults are characteristics of the Yap Monarch which are shared with some of the other species of *Monarcha*. The connection between *M. godeffroyi* and *Metabolus rugensis* of Truk is not known, but they evidently represent separate colonizations. *M. takatsukasae* of Tinian appears to be an offshoot of *M. godeffroyi* of

Yap, in which the black and white plumage has been suppressed (or never developed). As indicated by the published descriptions, the immature of *M. godeffroyi* shows a close resemblance to the adult of *M. takatsukasae*. The latter also shows relationships to immature specimens of *M. leucotis* and to *M. guttula* of Melanesia.

The relationship of the two species of *Monarcha* in Micronesia to the Hawaiian Flycatcher, *Chasiempsis sandwichensis* is not known. It is apparent that this Hawaiian form was derived from some ancestor from Melanesia, which arrived in the Hawaiian Islands by way of either Polynesia or Micronesia. Mayr (1943:45) has already pointed out that *Chasiempsis* is "related to the *Monarcha* group (*Pomarea*, *Mayrornis*, etc.)."

Monarcha takatsukasae (Yamashina)

Tinian Monarch

Monarcharses takatsukasae Yamashina, in Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 485. (Type locality, Tinian.)

Monarcha takatsukasae Yamashina, Tori, 7, 1932, p. 400 (Tinian); Hand-list Japanese Birds, rev., 1932, p. 175 (Tinian); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Tinian); Mayr, Birds Southwest Pacific, 1945, p. 296 (Tinian); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 100 (Tinian).

Geographic range.—Micronesia: Mariana Islands—Tinian.

Characters.—Adult male: Forehead, lores, eyering, auriculars, and underparts rufous, chin paler; under tail-coverts white; crown and nape dark slate-gray; back reddish-brown; rump white; wing and tail dark brown, outer edges of first three primaries white, tail with white tips, more broadly tipped on outer tail feathers; outer edges of scapulars and secondaries buffy but tips more whitish, forming two wing bars; under wing-coverts whitish; bill slate-blue, tip pearl; feet dark slate; iris dark brown.

Adult female: Resembles adult male, but slightly smaller and crown more brownish.

Immature: Resembles adult, but base of bill lighter and underparts paler.

According to the original description by Yamashina, *M. takatsukasae* resembles closely the immature *M. godeffroyi* of Yap in coloration; however, the Tinian Monarch has a shorter wing.

Measurements.—Measurements are listed in table 41.

TABLE 41. MEASUREMENTS OF *Monarcha takatsukasae*

NUMBER AND SEX	Wing	Tail	Full culmen	Tarsus
6 males	70 (67-72)	68 (65-70)	18.0 (17.5-19.0)	22.0 (21.0-23.0)
10 females	67 (65-68)	67 (64-69)	17.2 (17.0-19.0)	22.5 (21.7-23.0)

Specimens examined.—Total number, 20 (10 males, 10 females), as follows: Mariana Islands, USNM—Tinian, 10 (Oct.); AMNH—Tinian, 9 (Sept.); KMNH—Tinian, 1 (Sept.).

Nesting.—Yamashina (1932a:400, 401) records two nests of the Tinian Monarch. He writes of one nest containing two eggs taken at Churo, Tinian, on January 29, 1932, that was "hung on a fork of an upward pointing branch of a road side tree commonly called 'Oba' 1.5 m. high from the ground in a forest. . . . The ground color of the egg shells is white. The spots are pale reddish-brown and distributed all round the surface like small dots, being concentrated especially round the larger end." Another nest containing three eggs was found on January 29, 1932. Yamashina writes that the eggs measure 20.5 x 15, 21 x 15, and 18 x 15 mm. In describing these nests Yamashina notes, "The shape of the two nests mentioned above is like a deep cup. The outer layer of them is made chiefly of dead leaves, fibers, cotton, wools and moss, and the inner layer of fine stems and fibers only."

Downs (1946:101) writes that a nest found near Lake Hagoi at Tinian on August 31, 1945, "was about three feet from the ground carefully woven into the framework of a triangular crotch. . . . It was composed exteriorly of small leaves, scattered white feathers, and heavy grass; interiorly of grasses only." In the nest he found a young bird which "was black-skinned, with ugly white quills and a few short dark feathers on its tail and wings. The back feathers were rusty brown as were the tufted head feathers." Marshall (1949:219) assumes that this bird breeds all year.

Molt.—Birds taken by Coultas in September are in fresh plumage.

Remarks.—The Tinian Monarch is known only from Tinian, where it was described in 1931 by Yamashina. Downs (1946:100-103) presents a detailed account of this bird as he saw it in 1945. He found it living in brushy woodlands where other birds, including *Rhipidura rufifrons*, were observed. From his description, the actions and food-catching behaviors of this bird must be much like those of *Rhipidura*. Gleise (1945:220) estimated the population of these birds to be 40 to 50 in 1945.

Myiagra oceanica erythrops Hartlaub and Finsch

Micronesian Broadbill

Myiagra erythrops Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 6. (Type locality, Pelew Islands.)

Myiagra erythrops Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew Islands); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 97 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 20 (Palau); Giebel, Thes. Ornith., 2, 1875, p. 658 (Pelew); Nehrkorn, Journ. f. Ornith., 1879, pp. 399, 403 (Palau); Sharpe, Cat. Birds British Mus., 4, 1879, p. 383 (Pelew); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 23 (Pelew); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 195 (Palaos); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 55 (Palau); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Dubois, Syn. Avium, 1, 1902, p. 283 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 260 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 64 (Pelew); Yamashina, Tori, 10, 1940, p. 674 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Babelthuap, Koror); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 69 (Peleliu, Ngabad, Garakayo).

Submyiagra erythrops Mathews, Syst. Avium Australasianarum, 2, 1930, p. 504 (Palau); Hand-list Japanese Birds, rev., 1932, p. 176 (Palau).

Myiagra oceanica erythrops Mayr, Birds Southwest Pacific, 1945, p. 296 (Palau).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad.

Characters.—Adult male: Crown, occiput, nape, and auriculars dark "slate-blue"; forehead, lores and orbital ring dark "cinnamon-rufous"; black and upper wing-coverts olive-brown; rump more like crown; underparts near "cinnamon," paler on middle of abdomen, sides, and under tail-coverts; wings and tail dark brown, edged with white; secondaries edged with brownish; under wing-coverts whitish with dusky bases; bill and feet black.

Adult female: Resembles adult male, but slightly smaller and paler in color.

Immature: Resembles adult, but head and rump browner; forehead, lores, and orbital ring sandy in some individuals, more rufous in others; underparts usually paler than in adult; bill basally lighter.

Measurements.—Measurements are listed in table 42.

TABLE 42. MEASUREMENTS OF ADULT SPECIMENS OF *Myiagra oceanica*

SUBSPECIES	Number and sex	Wing	Tail	Full culmen	Tarsus
M. o. erythrops.....	14 males	69 (68-71)	53 (51-56)	16.4 (16.0-17.3)	19.5 (18.5-20)
	11 females	66 (64-68)	51 (48-53)	16.1 (15.5-17.0)	19.5 (18.5-20)
M. o. freycineti.....	25 males	70 (67-73)	60 (57-64)	16.3 (15.8-17.0)	19.5 (18.5-20)
	16 females	67 (65-70)	57 (55-62)	16.0 (15.5-17.0)	19.0 (18.0-19)
M. o. oceanica......	11 males	81 (78-83)	68 (65-71)	20.1 (19.5-20.5)	20.0 (19.5-21)
	10 females	79 (77-81)	66 (65-68)	20.0 (20.0-20.5)	20.0 (19-20.5)
M. o. pluto.........	14 males	82 (79-83)	74 (71-77)	17.5 (17.5-18.0)	19.0 (18.5-20)
	14 females	80 (78-84)	73 (69-77)	17.5 (17.0-18.0)	19.0 (18.5-20)

Specimens examined.—Total number, 33 (17 males, 15 females, 1 unsexed), as follows: Palau Islands, USNM—Babelthuap, 1 (Nov. 27)—Koror, 4 (Nov. 6, 19, 26)—Garakayo, 1 (Sept. 18)—Peleliu, 2 (Aug. 30)—Ngabad, 2 (Sept. 11); AMNH—exact locality not given, 23 (Oct., Nov., Dec.).

Molt.—Molt apparently takes place in fall and early winter. Of the specimens examined, there is little evidence of molt in those obtained in August and September while there is considerably more evidence of molt in those taken in November and December.

Food habits.—A bird taken by the writer on September 17, 1945, at Garakayo had approximately one-half cc. of insect parts in its stomach.

Remarks.—The Micronesian Broadbill at Palau is a friendly little bird and easily called-up to within a few yards of a person by imitating its note. It was seen by the NAMRU2 party in 1945 as singles and in pairs in the dense underbrush of the undisturbed forested areas. The bird was seen at only one woodland area at Peleliu (Southeastern Peninsula), but it was observed more frequently on the smaller islands of Ngabad and Garakayo. Coultas (field notes) also notes that in 1931 this bird was found more frequently on the smaller islands. *Myiagra* was found to be much less conspicuous at Palau than *Rhipidura lepida*. *Myiagra* appears to be less active, more solitary in its habits, and possibly more restricted in the territory that it covers in feeding than *Rhipidura*.

Myiagra oceanica freycineti Oustalet

Micronesian Broadbill

Myiagra freycineti Oustalet, Bull. Soc. Philom. Paris, (7), 5, 1881, p. 73. (Type locality, Mariannes = Guam.)

Myiagra freycineti Reichenow and Schalow, Journ. f. Ornith., 1884, p. 395 (Mariannes = Guam); Oustalet, Le Nat., 1889, p. 260 (Mariannes = Guam); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 24 (Marianne = Guam); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 194 (Guam); Hartert, Novit. Zool., 5, 1898, p. 54 (Guam); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 50 (Guam); Safford, Osprey, 1902, p. 69 (Guam); *idem*, Amer. Anthro., 4, 1902, p. 711 (Guam); *idem*, The Plant World, 7, 1904, p. 263 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Reichenow, Die Vögel, 2, 1914, p. 260 (Marianen); Cox, Island of Guam, 1917, p. 21 (Guam); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 65 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 68 (Guam).

Submyiagra freycineti Mathews, Syst. Avium Australasianarum, 2, 1930, p. 504 (Guam); Hand-list Japanese Birds, rev., 1932, p. 176 (Guam).

Myiagra oceanica freycineti Mayr, Birds Southwest Pacific, 1945, p. 296 (Guam).

Myiagra oceanica Strophlet, Auk, 1946, p. 539. (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam.

Characters.—Adult male: A small flycatcher with head and neck near "dark delft blue" with a metallic luster; lores and anterior forehead ashy-gray, more bluish and darker on auriculars and sides of neck than on lores; back and upper wing-coverts near "green-blue slate" but darker and with metallic luster less apparent than on head; rump grayer than back; chin and throat white; breast light "cinnamon," fading to pale buff and white on abdomen, sides, and under tail-coverts; tibia smoky-gray, tips of feathers paler; wings dark brown edged with light bluish-gray; tail bluish-slate, especially middle rectrices, tips of tail feathers edged with white; bill and feet black; iris dark brown.

Adult female: Resembles adult female of *M. o. erythrops*, but crown and neck near "deep Payne's gray," auriculars grayer than neck; anterior forehead and lores buffy and tinged with cinnamon; back browner than lores with upper wing-coverts and scapulars edged with slightly lighter brown; rump resembles crown but grayer; underparts paler than those of *M. o. erythrops,* especially chin and throat; tibia more brownish.

Immature male: Resembles adult male, but back more brown and less blue-green, lacking luster; anterior forehead more rufous; scapulars, upper wing-coverts, and wings edged with light brown; underparts variable but generally more buffy than those of adult.

Immature female: Resembles adult female, but more brown and less blue on head and back; underparts more buffy; base of bill paler.

Measurements.—Measurements are listed in table 42.

Weights.—The author (1948:68) records the weights of five adult males as 10.5-12.5 (11.9), and those of two adult females as 11.4 and 12.0 grams.

Specimens examined.—Total number, 64 (33 males, 22 females, 9 unsexed), as follows: Mariana Islands, USNM—Guam, 26 (Jan. 21, March 16, May 21, 29, 30, June 1, 3, 14, 24, 26, July 10, 12, 13, 20, 23, Aug. 30); AMNH—Guam, 38 (Jan., Feb., March, July, Aug.).

Nesting.—The writer (1948:68) records a nest containing one egg found by Muennink at Guam near Mt. Santa Rosa on May 7, 1945. The nest was in a bamboo stump approximately six feet from the ground. The egg hatched on about May 21. Seale (1901:50) reports on a nest and egg taken in the period from May to July. The NAMRU2 party obtained a female on March 15 with an enlarged gonad. Strophlet (1946:539) observed a pair of broadbills building a nest on September 20, 1945; it was completed on October 4 and was approximately seven feet above the ground. Hartert (1898:33) reports on a nest taken at Guam on February 14, 1895.

Molt.—As shown by the specimens examined, molt begins in June or July.

Food habits.—The stomach of a bird obtained on January 21, 1945, contained one unidentified bug (Hemiptera) and several parts of other insects.

Remarks.—The Micronesia Broadbill at Guam is not a common bird, and like its relative *Rhipidura rufifrons* is an inhabitant of forested areas, especially those containing brushy undercover. It is an active bird, although less conspicuous than *Rhipidura.* The birds were found as singles or in pairs. The pair of birds which had a nest at the west base of Mount Santa Rosa in May, 1945, allowed the observers to approach closely to them. The birds are easily attracted by squeaking sounds. There is considerbale variation in the amount of cinnamon coloring on the breasts of adult birds.

The Micronesian Broadbill at Guam was first discovered by Quoy and Gaimard, who called it "Moucherolle à gorge rouge." Kittlitz (1836:304) evidently records two species of flycatchers from Guam, which he calls *Muscicapa.* I judge these birds to be *Myiagra* and *Rhipidura.* It was not until 1881 that Oustalet recognized this bird to be new. The first large series of specimens was obtained by Marche for the Paris Museum and was reported on by Oustalet (1895:194). Marche collected 12 skins in August and September, 1887, and 4 additional skins in February, 1889.

Myiagra oceanica oceanica Pucheran

Micronesian Broadbill

Myiagra oceanica Pucheran, Voy. Pôle Sud, Zool., 3, 1853, p. 77. (Type locality, Hogoleu = Truk.)

Myiagra oceanica Hartlaub, Journ. f. Ornith., 1854, p. 168 (Carolinen = Truk): Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 18 (Hogoleu = Truk); Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 94 (Hogoleu = Truk); Gray, Hand-list Birds, 1, 1869, p. 328 (Caroline Is. = Truk); Pelzeln, Journ. f. Ornith., 1875, p. 51 (Hogoleu = Truk); Sharpe, Cat. Birds British Mus., 4, 1879, p. 383 (Hogoleu = Truk); Nehrkorn, Journ. f. Ornith., 1879, p. 403 (Ruk); Finsch, Proc. Zool. Soc. London, 1880, p. 575 (Ruk); Oustalet, Bull. Soc. Philom. Paris, (7), 5, 1881, p. 73 (Carolines = Truk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Reichenow and Schalow, Journ. f. Ornith., 1884, p. 395 (Carolines = Truk); Tristram, Cat. Birds, 1889, p. 200 (Ruk); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 23 (Ruk); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 196 (Hogoleu = Truk); Nehrkorn, Kat. Eiers., 1899, p. 30 (Ruk); Hartert, Novit. Zool., 7, 1900, p. 5 (Ruk); Matschie, Journ. f. Ornith., 1901, pp. 111, 112, 113 (Ruck); Dubois, Syn. Avium, 1, 1902, p. 283 (Hogoleu = Truk); Reichenow, Die Vögel, 2, 1914, p. 260 (Karolinen = Truk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Ruk); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 204 (Truk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 64 (Ruk); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 68 (Truk).

Myiagra albiventris Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 93 (Hoguleu = Truk); Giebel, Thes. Ornith., 2, 1875, p. 658 (Carolinae = Truk).

Submyiagra oceanica Mathews, Syst. Avium Australasianarum, 2, 1930, p. 505 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 175 (Truk).

Myiagra oceanica oceanica Mayr, Birds Southwest Pacific, 1945, p. 296 (Truk)

Geographic range.—Micronesia: Caroline Islands—Truk.

Characters.—Adult male: Resembles *M. o. freycineti,* but larger with crown and nape less green and with less metallic luster; lores and anterior forehead darker gray; chin, throat, and sides of neck more buffy-cinnamon; back, rump, upper wing-coverts, and scapulars less blue and more ashy gray; tibia, wings, and tail more brownish.

Adult female: Resembles adult male, but smaller with less blue and more gray on crown; lores and anterior forehead lighter·

Immature: Resembles adult, but crown and nape grayish, slate-blue; underparts paler.

Measurements.—Measurements are listed in table 42.

Specimens examined.—Total number, 23 (12 males, 10 females, 1 unsexed), as follows: Caroline Islands, USNM—Truk, 2 (Feb. 16); AMNH—Truk, 21 (Feb., June, Nov., Dec.).

Nesting.—Hartert (1900:5) reports the taking of several nests in the period from March to July by Owston's Japanese collectors. One nest contained two eggs, the other nests contained one.

Remarks.—The broadbill at Truk was first taken by Hombron and Jacquinot, who called it "Platyrhynque océanien." Later, Kubary obtained material which was studied by Finsch (1880e:575).

In December, 1945, McElroy of the NAMRU2 party examined two adults with enlarged gonads. Specimens obtained by him at Truk were lost in shipment to the United States. In coloration this subspecies is closest to *M. o. freycineti;* in size it is closest to *M. o. pluto.*

Myiagra oceanica pluto Finsch

Micronesian Broadbill

Myiagra pluto Finsch, Proc. Zool. Soc. London, 1875 (1876), p. 644. (Type locality, Ponapé.)

Myiagra pluto Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 19 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 779 (Ponapé); Sharpe, Cat. Birds British Mus., 4, 1879, p. 380 (Ponapé); Nehrkorn, Journ. f. Ornith. 1879, p. 464 (Ponapé); Finsch, Journ. f. Ornith., 1880, p. 288 (Ponapé); *idem*, Proc. Zool. Soc. London, 1880, p. 576 (Ponapé); *idem*, Ibis, 1881, pp. 110, 112, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 280 (Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 23 (Ponapé); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 195 (Ponapi); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 55 (Ponapé); Nehrkorn, Kat. Eiers., 1899, p. 26 (Ponapé); Christian, The Caroline Islands, 1899, p. 358 (Ponapé); Matschie, Journ. f. Ornith., 1901, pp. 111, 112, 113 (Ponapé); Dubois, Syn. Avium, 1, 1902, p. 283 (Ponapi); Reichenow, Die Vögel, 2, 1914, p. 260 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 54 (Ponapé); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 204 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 64 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 195 (Ponapé).

Submyiagra pluto Mathews, Syst. Avium Australasianarum, 2, 1930, p. 505 (Ponapé); Yamashina, Tori, 1, 1932, p. 401 (Ponapé); Hand-list Japanese Birds. rev., 1932, p. 176 (Ponapé).

Myiagra oceanica pluto Mayr, Birds Southwest Pacific, 1945, p. 296 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult male: A dark, bluish-gray broadbill with head, ear-coverts, and nape dark, metallic, steel-blue; back and rump darker and more slate-blue than head; upper tail-coverts blackish; tail black edged with greenish gloss; wings dark brown, scapulars and secondaries with outer edges tinged with metallic bluish-gray; lores black; chin, throat, and upper breast dark with light metallic-blue wash; lower breast and abdomen slate-gray; under wing-coverts brownish-black; bill black; feet bluish-black; iris dark brown. Female resembles male, but slightly smaller and somewhat duller. Immature duller.

Measurements.—Measurements are listed in table 42.

Specimens examined.—Total number, 42 (23 males, 19 females), as follows: Caroline Islands, USNM—Ponapé, 3 (Feb. 11); AMNH—Ponapé, 39 (Nov., Dec.).

Nesting.—Yamashina (1932a:401) records nests and eggs of the Ponapé broadbill. The nests were at heights of between .9 and 2.2 meters above the ground. Nests, each containing a single egg, were obtained on July 21, 25, and August 6. The eggs measure 19.5 by 16, 20.5 by 15.7, 20.5 by 16, and 20.2 by 16. Coultas (field notes) describes the nest as a cup-shaped structure, made of fine grasses and ferns, and placed in small trees and bushes at low elevations. Of specimens taken by Coultas in November and December, 1931, approximately fifty percent of the males had enlarged gonads. According to his specimen labels, none of the females was in breeding condition.

Molt.—Of the large series of broadbills taken by Coultas, approximately twenty percent of those taken in November were in molt whereas only approximately ten percent of those taken in December were in molt. Specimens taken in February were not in molt. It is evident that molting takes place in the fall, possibly from August to December.

Remarks.—The coloration of the Micronesian Broadbill at Ponapé is in marked contrast to that of other representatives of *Myiagra* in Micronesia, being dark, bluish-gray in color. Probably the bird has taken on melanistic characters, which is not unusual in birds which have become isolated; examples of this condition may be observed in *Rhipidura*, *Terpsiphone* and other genera.

Coultas (field notes) writes that the bird is "Common everywhere on the island except in the grasslands. Two birds are working together usually, darting around in the low trees, among the branches or on the ground. The birds are playful, friendly and inquisitive. I should not call them noisy as one or more will sit for many minutes watching the intruder without making a peep. Their call, "Que Que," is a spasmodic outburst that might be repeated many times or just once. The male, presumably, erects the long crown feathers when calling. Perhaps both male and female do this, I can't say. The bird flutters on the wing and displays the feathers as does *Rhipidura*. When sitting, the bird often erects the crest and fluffs the tail and feathers."

Evolutionary History of Myiagra oceanica.—According to Mayr (1933d:1) *Myiagra* "is easily recognizable by its broad bill and the color pattern which is similar in all species." The range of the genus *Myiagra* extends from Australia and Tasmania westward to Timor, northward to the Moluccas, and Micronesia, and eastward to Polynesia. *Myiagra oceanica* is restricted to Micronesia and consists of four subspecies, which until recently have been considered as four separate species. Unlike many of the species of this genus, *M. oceanica* shows comparatively little sexual dimorphism. The male of *M. oceanica* has metallic coloring on the head and the upper back and often has rich, rufous coloring on the breast. The female is less brilliant in coloring, lacking the sheen. The four subspecies vary from each other in size, color and even, to some extent, in basal breadth of the bill. *M. oceanica* resembles several broadbills, including *M. galeata* of the Moluccas, *M. rubecula* of Australia, *M. vanikorensis* of Fiji, and *M. ruficollis* of Australia and the Lesser Sundas; however, in my opinion, it has probably been derived from *M. galesta* of the Moluccan area or from a closely related species. In Micronesia, *M. o. oceanica* and *M. o. freycineti* appear to resemble closely this parent stock, whereas *M. o. ery-*

throps and *M. o. pluto* are more differentiated but are considered to have been derived from this same colonization. *M. o. pluto* bears some resemblance to *M. atra* of the Papuan area, particularly in the dark coloring; this is probably only a parallel evolution, since they have little else in common. *M. vanikorensis* of the Fiji area is close to *M. oceanica* in color and structure; the two species, I suspect, have been derived from a common source rather than from each other. Study of the evolutionary history of the entire genus is necessary before we can understand fully the derivation of the Micronesian and Polynesian species. It seems safe to say that the center of dispersal has been in the Australian region; the lack of diversity of this genus within the Papuan area is at present unexplained.

Muscicapa narcissina narcissina Temminck

Narcissus Flycatcher

Muscicapa narcissina Temminck, Pl. Col., 3, 1835, pl. 577, fig. 1. (Type locality, Japan.)

Musicapa narcissina narcissina Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in eastern Asia and Japan. Winters south to Malaysia. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—Mayr (1945a:302) records the Narcissus Flycatcher as a migrant visitor to the Palau Islands on the basis of two specimens in the Turloff collection, formerly in the Zoölogical Museum in Hamburg.

Musicapa griseisticta (Swinhoe)

Chinese Gray-spotted Flycatcher

Hemichelidon griseisticta Swinhole, Ibis, 1861, p. 330. (Type locality, Amoy.)

Hemichelidon griseisticta Hand-list Japanese Birds, rev., 1932, p. 175 (Koror); Hand-list Japanese Birds, 3d ed., 1942, p. 194 (Koror).

Muscicapa griseisticta Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau); Marshall, Condor, vol. 51, 1949, p. 221 (Palau).

Geographic range.—Breeds in northwestern Asia and Japan. Winters south to Malaysia. In Micronesia: Palau Islands—Koror.

Remarks.—The Chinese Gray-spotted Flycatcher is a casual winter visitor to the Palaus. Marshall (1949:221) took two specimens at Palau on November, 1945.

Colluricincla tenebrosa (Hartlaub and Finsch)

Palau Morning Bird

Rectes tenebrosus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 6. (Type locality, Pelew Islands.)

Rectes tenebrosus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 118 (Pelew Islands); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 99 (Pelew); Finsch, Journ Mus Godeffroy, 8, 1875, pp. 4, 18, pl. 3, fig. 1 (Palau); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no 6, 1890-1891 (1891), p. 27 (Pelew).

Colluricincla tenebrosa Gray, Hand-list Birds, 1, 1869, p. 386 (Pelew); Dubois, Syn. Avium, 1, 1902, p. 496 (Pelew); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 5 (Palau); *idem*, Birds Southwest Pacific, 1945, p. 297 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 69 (Pelelilu, Ngabad, Garakayo).

Pinarolestes tenebrosus Sharpe, Cat. Birds British Mus., 3, 1877, p. 298 (Pelew); Matschie, Journ. f. Ornith., 1901, p. 112 (Palau); Reichenow, Die Vögel, 2, 1914, p. 296 (Palau); Takasukasa and Kuroda, Tori, 1, 1915, p. 54 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 69 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 174 (Palau).

Myiolestes tenebrosus Tristram, Cat. Birds, 1899, p. 188 (Pelew).

Caleya tenebrosus Mathews, Syst. Avium Australasianarum, 2, 1930, p. 649 (Pelew).

Malacolestes tenebrosus Mayr, Amer. Mus. Novit., no. 590, 1933, p. 5 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Babelthuap, Koror, Peliliu).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad.

Characters.—Adult: Upper parts between "snuff brown" and "bister," head blacker; chin, throat, and upper breast like upper parts but darker; lower breast and abdomen lighter and more buffy, sides darker; feathers of underparts with darker shafts producing a streaked appearance; underside of wing and under tail-coverts light-colored; bill dark brown; feet lighter brown; iris yellowish. Female smaller.

Immature: Resembles adult, but head and neck lighter; ear-coverts, sides of neck, throat, upper breast darker; lower breast and abdomen paler.

Measurements.—Measurements are listed in table 43.

TABLE 43. MEASUREMENTS OF *Colluricincla tenebrosus*

NUMBER AND SEX	Wing	Tail	Full culmen	Tarsus
20 males	104 (100-107)	76 (73-79)	23.5 (22.5-24.5)	31 (29-31)
9 females	97 (94-101)	73 (71-76)	23.0 (22.0-24.0)	30 (30-31)

Specimens examined.—Total number, 32 (21 males, 11 females), as follows: Palau Islands, USNM—Koror, 6 (Nov. 5, 18)—Garakayo, 3 (Sept. 18)—Peleliu, 5 (Aug. 29, 30, Sept. 1, 6)—Ngabad, 2 (Sept. 11); AMNH—exact locality not given, 16 (Oct. 8, 13, 26, Nov. 11, 13, 17, 19, 21, 23, Dec. 9).

Molt.—The molting process in this species seemingly takes place from August until December. Most of the birds taken by the NAMRU2 party in August and September were in molt. Molting specimens were obtained by Coultas in October, November and December.

Food habits.—The Palau Morning Bird feeds on plant and animal materials. Stomachs obtained by the NAMRU2 party contained green plant material, seeds, insect parts, and grit. The bird feeds principally on the ground or in low bushes.

Remarks.—The Palau Morning Bird is a thrushlike bird which spends its time on or near the ground in areas where ground cover is thick. In 1945, the NAMRU2 party found the bird in the thick matting of vines which had covered over the battle-cleared areas. I did not find the bird at elevations of more than three to four feet above the ground. When flushed, it would flutter a short distance and disappear into the brush. It has a sweet song and may be considered as one of the finest singers in Micronesia. It heralds the break of day with its melodious carol, and its name is derived from its calling early in the morning. I heard the bird only infrequently in the hot part of the day, although it would sing when the skies were overcast. Its song could be heard also as evening approached. The bird is moderately common, and evidently is more abundant on the smaller islands than on Peleliu. Its occurrence on the smaller islands was noted also by Coultas.

The taxonomic status of the Palau Morning Bird has been one of uncertainty as shown by the fact that the bird has been treated under six generic names since its discovery by Captain Tetens. Mayr (1933a:5) erected a new genus, *Malacolestes*, for the morning bird pointing to its differences from "*Rhectes* (= *Pitohui*) and *Pinarolestes* (= *Myiolestes*)." Later, he (1944b:5) disregards this name and places the bird in the genus *Collurcincla* stating that its special characters "are due to isolation." This treatment is followed here. The Palau Morning Bird is the most northern representative of a group of birds which have their center of dispersal in the New Guinea and Australian area. As Mayr has pointed out, *C. tenebrosus* appears closest to the *C. megarhynchus* group of New Guinea. These species have bills of similar shape, coloration which is darker above and lighter below, soft feathers on underparts, and streaked appearance of throat and breast. The resemblances between *C. tenebrosus* and *C. megarhynchus* might be such as to indicate that these are merely subspecifically distinct from each other.

Artamus leucorhynchus pelewensis Finsch

White-breasted Wood-swallow

Artamus pelewensis Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 41. (Type locality, Palau.)

Artamus leucorhynchus Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 116, 118 (Pelew); *idem*, Proc. Zool. Soc. London, 1872, pp. 89, 99 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 18 (Palau); Walden, Ibis, 1876, p. 188 (Pelew).

Artamus pelewensis Finsch, Proc. Zool. Soc. London, 1877 (1878), p. 739 (Pelew); Tweeddale, Ibis, 1878, p. 385 (Pelew); Sharpe, Cat. Birds British Mus., 13, 1890, p. 9 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 26 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 62 (Palau); Matschie, Journ. f. Ornith., 1901, p. 112 (Palau); Dubois, Syn. Avium, 1, 1902, p. 533 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 346 (Pelew).

Artamus leucorhynchus pelewensis Stresemann, Novit. Zool., 20, 1913, p. 293 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Babelthuap, Koror); Mayr, Birds Southwest Pacific, 1945, p. 297 (Palau).

Artamus melanoleucus pelewensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 69 (Pelew); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 635 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 174 (Palau).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Angaur.

Characters.—Adult: Upper surface black, except for back which is slightly brownish and for rump which is white; underparts white, except for chin, throat and upper breast which are black; wings with grayish tips; bend of wing black; bill milky blue, nostril and tip black; feet black; iris dark brown.

Immature: Resembles adult, but black feathers with brownish tinges; primaries tipped with white.

Measurements.—Measurements are listed in table 44.

TABLE 44. MEASUREMENTS OF *Artamus leucorhynchus pelewensis* Finsch

NUMBER AND SEX	Wing	Tail	Culmen	Tarsus
5 males	134 (132-136)	68 (66-69)	25 (24-26)	16.5 ....
4 females	134 (132-136)	68 (67-69)	24	17.0 (16.5-17.0)

Specimens examined.—Total number, 12 (7 males, 5 females), from Palau Islands, AMNH—exact locality not given (March, Nov., Dec.).

Remarks.—Little is known concerning the habits and distribution of the white-breasted Wood-Swallow at Palau. Coultas obtained a series of eight birds in 1931; he writes (field notes) that his native hunter took every bird that he saw. The natives told him that they did not know the nest of the bird. Coultas concluded that the bird was not common. He commented that it may be found perched in the top of a tree on a dead branch or "even displaying in the air." The NAMRU2 party found no evidence of this bird in the southern Palaus in 1945. The specimens obtained by Coultas in November and December, 1931, were in molt and had small gonads.

This wood-swallow is the only Micronesian representative of *Artamus leucorhynchus*. Like several other species of birds it has become established only at the Palau Islands, and has either been unsuccessful in colonizing other parts of Micronesia or has not had the opportunity to do so. This bird had been compared with specimens representing ten subspecies of *A. leucorhynchus* in Melanesia and Malaysia. *A. l. pelewensis* differs from these subspecies examined by its blacker appearance, with only a faint brownish wash on the back, and by its shorter, first primary. The curvature of the upper mandible of the bird in the Palaus is similar to that of *P. l. leucorhynchus* of the Philippines; the mandible is less curved than that of *P. l. celebensis* of Celebes; the mandible is slightly thicker than that of *P. l. leucopygialis* of the New Guinea and Australian region. In length of wing *P. l. pelewensis* resembles closely *P. l. leucorhynchus; P. l. celebensis* has a longer wing and *P. l. leucopygialis* has a shorter one. Stresemann (1913:293) points to a close relationship between *P. l. pelewensis* and *P. l. musschenbreeki* of Tenimber and Babber islands and *P. l. melaleucus* of New Caledonia; Mayr (1945a:284) says the bird in the Palaus came from the Papuan area. Probably *A. l. pelewensis* has reached the Palau Islands from the New Guinea area by way of the Philippines.

Aplonis opacus opacus (Kittlitz)

Micronesian Starling

Lamproth[ornis] opaca Kittlitz, Kupfertaf. Naturgesch. Vögel, 2, 1833, p. 11, pl. 15, fig. 2. (Type locality, Ualan = Kusaie.)

Turdus colombinus Lesson (part), Traité d'Ornith., 1832, p. 406 (Carolines-= Kusaie?).

Lamproth[ornis] opaca Kittlitz, Mém. Acad. Imp. Sci. St. Petersbourg, 2, 1935, p. 7 (Ualan); *idem* (part), Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 285, 297 (Ualan); Pelzeln, Reise "Novara," Vögel, 1865, p. 68 (Ualan).

Lamprotornis columbinus Bonaparte (part), Consp. Avium, 1, 1850, p. 417 (Carolinen = Kusaie?).

Lamprotornis columbina Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 133 (Ualan); *idem* (part), Journ. f. Ornith., 1854, p. 168 (Carolinen = Kusaie?); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 376 (Ualan).

Calornis opaca Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 26 (Oualau=Kusaie); Tristram, Cat. Birds, 1889, p. 255 (Kusai); Hartert, Kat, Vogelsamml. Senckenb., 1891, p. 75 (Ualan).

Calornis kittlitzi Finsch and Hartlaub (part), Fauna Central polynesiens, 1867, p. 109 (Ualan, Puynipet, Marianen; type locality, by subsequent restriction, Ualan = Kusaie); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, p. 23 (Ualan).

Calornis kittlitzii Hartlaub, Proc. Zool. Soc. London, 1867 (1868), p. 830 (Ualan).

Amadina Kittlitzi Gray, Hand-list Birds, 2, 1870, p. 58 (Ualan).

Calornis pacifica Sharpe, Ibis, 1876, p. 47 (Caroline Is.=Kusaie?); Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 49 (Kuschai).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, p. 32 (Ualan); *idem* (part), Journ. f. Ornith., 1880, pp. 289, 301 (Kuschai); *idem*, (part), Proc. Zool. Soc. London, 1880, p. 576 (Kuschai); *idem*, (part), Ibis, 1881, pp. 103, 104, 108, 111 (Kuschai).

Aplonis kittlitzi Sharpe (part), Cat. Birds British Mus., 13, 1890, p. 136 (Kuschai); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Ualan); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 216 (Oualan); Hartert (part), Novit. Zool., 5, 1898, p. 59 (Ualan); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ualan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Kusaie).

Lamprocorax kittlitzi Dubois (part), Syn. Avium, 1, 1902, p. 542 (Kuschai).

Aplonis opaca Oberholser, Bull. U. S. Nat. Mus., 98, 1917, p. 59 (Ualan); Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 219 (Kusaie).

Aplonis kittlitzi kittlitzi Momiyama (part), Tori, 2, 1920, p. 1 (Kusaie).

Aplonis opaca opaca Momiyama (part), Birds Micronesia, 1922, pp. 6, 12 (Kusaie); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 70 (Kusaie); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 847 (Kusaie); Takatsukasa and Yamashina, Tori, 7, 1931, p. 109 (Kusaie); Hand-list Japanese Birds, rev., 1932, p. 170 (Kusaie).

Aplornis opaca opaca Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Kusaie).

Aplonis opacus opacus Mayr. Birds Southwest Pacific, 1945, p. 298 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie.

Characters.—Adult: Feathers black with dusky appearance caused by lighter bases; edges of feathers with slight amount of steel-green gloss; underparts slightly duller than upper parts; bill black, with maxilla rather strongly curved; feet black, iris yellow. Females slightly smaller.

Immature: Resembles adult, but upper parts more brown and less black; underparts dusky with edges of feathers tinged with smoky yellow producing a streaked appearance; base of bill horn-colored.

Measurements.—Measurements are listed in table 45.

Specimens examined.—Total number, 30 (18 males, 12 females), as follows: Caroline Islands, USNM—Kusaie, 5 (Feb. 8); AMNH—Kusaie, 25 (Jan., Feb., March).

Remarks.—The Micronesian Starling at Kusaie was first taken by Kittlitz (1833:11), who named it in the following manner: "*Turdus columbinus* Gm. L. oder *Lamproth. opaca* Lichenstein." The bird was later given the name of *Calornis kittlitzi* by Finsch and Hartlaub (1867:109). Oberholser (1917:59) has shown that the specific name *opaca* is applicable, since the manuscript name *Lam-*

TABLE 45. MEASUREMENTS OF ADULT SPECIMENS OF *Aplonis opacus*

SUBSPECIES	Number and sex	Wing	Tail	Full culmen	Depth of culmen at nostril
A. o. opacus	15 males	124 121-125	80 76-85	24 24-26	9.5 9.0-10.0
	12 females	119 115-125	77 72-82	24 23-26	9.0 8.5-9.0
A. o. ponapensis	17 males	133 130-138	87 85-91	27 26-29	9.5 9.0-10.0
	11 females	126 122-127	83 81-85	27 26-28	9.0 8.5-9.0
A. o. angus	16 males	129 125-131	88 84-92	28 27-29	9.5 8.0-9.0
	7 females	124 121-129	85 83-88	27 25-28	8.5 8.0-9.0
A. o. orii	11 males	128 124-131	86 83-90	27 25-28	7.5 7.5-8.5
	7 females	124 121-126	79 77-82	26 25-27	7.5 7.5-8.0
A. o. guami	41 males	128 120-136	86 81-92	27 24-29	9.5 8.5-10.5
	32 females	121 117-126	84 78-89	26 24-30	9.5 8.5-10.5

prothornis opaca of Lichtenstein is made available by Kittlitz's published description and figure, and since it is the earliest name used. Mathews (1938:342) reports that the name *Aplornis* appeared a few days before the name *Aplonis*. I have been unable to check his source of information.

The Micronesia Starling is one of the most abundant birds at Kusaie. Coultas (field notes) observed the bird in all parts of the island, when he visited there in 1931. He found the bird in flocks of two to six or more and noted that birds in immature plumage seemed to outnumber the birds in adult plumage approximately five to one. This subspecies is characterized by the presence of only a slight amount of gloss on the black feathers of the adult.

Aplonis opacus ponapensis Takatsukasa and Yamashina

Micronesian Starling

Aplonis opaca ponapensis Takatsukasa and Yamashina, Tori, 7, 1931, p. 109. (Type locality, Ponapé.)

Calornis columbina Pelzeln, Reise "Novara," Vögel, 1865, pp. 88, 162 (Puynipet).

Calornis kittlitzi Finsch and Hartlaub (part), Fauna Centralpolynesiens, 1867, p. 109 (Puynipet); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 298 (Ponapé).

Calornis opaca Gray (part), Hand-list Birds, 2, 1870, p. 27 (Seniavin = Ponapé).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 32 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 779 (Ponapé); *idem* (part), Journ. f. Ornith., 1880, p. 289 (Ponapé); *idem*, (part), Proc. Zool. Soc. London, 1880, p. 576 (Ponapé).

Calornis pacifica Finsch, Ibis, 1881, p. 115 (Ponapé); *idem*, (part), Mitth. Ornith. Ver. Wien. 1884, p. 49 (Ponapé).

Aplonis kittlitzi Sharpe (part), Cat. Birds British Mus., 13, 1890, p. 136 (Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Ponapé); Bolau (part), Mitteil. Naturhist. Mus. Hamburg, 1898, p. 62 (Poapé); Nehrkorn, Kat. Eiers., 1899, p. 122 (Ponapé); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ponapé); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 (Ponapé).

Lamprocorax kittlitzi Dubois (part), Syn. Avium, 1, 1902, p. 542 (Ponapé).

Aplonis opaca Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 219 (Ponapé); Mayr. Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Aplonis kittlitzi kittlitzi Momiyama (part), Tori, 2, 1920, p. 1 (Ponapé).

Aplonis opaca opaca Momiyama (part), Birds Micronesia, 1922, p. 12 (Ponapé); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 70 (Ponapé).

Aplonis opaca ponapensis Yamashina, Tori, 7, 1932, p. 394 (Ponape); Hand-list Japanese Birds, rev., 1932, p. 170 (Ponapé).

Aplonis opaca ponapensis Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Ponapé).

Aplonis opacus ponapensis Mayr. Birds Southwest Pacific, 1945, p. 297 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: Resembles *A. o. opacus*, but larger with a longer bill and richer green luster on the back and breast.

Immature: Resembles immature of *A. o. opacus*, but underparts more brightly streaked but still dingy in appearance.

Measurements.—Measurements are listed in table 45.

Specimens examined.—Total number, 47 (31 males, 16 females), as follows: Caroline Islands, USNM—Ponapé, 1 (Feb. 11); AMNH—Ponapé, 46 (Nov., Dec.).

Nesting.—Yamashina (1932a:394) reports the taking of an egg on August 2, 1931, and two eggs on August 30, 1931, at Ponapé. Coultas (field notes) writes that the nests of these birds are hidden in the tops of the tree-ferns and in holes in the trees. The natives told him that the starling lays two eggs.

Molt.—Most of the adult specimens taken by Coultas in November and December, 1931, are in molting plumage.

Remarks.—Coultas (field notes) writes that the starling is a common bird at Ponapé. He found it in flocks of from two to 12 or more birds. As at Kusaie he noted more birds in the immature plumage than in the adult plumage at Ponapé. The starling occurs in large numbers even though the people of the island hunt this bird persistently for part of their food supply.

The Micronesian Starling at Palau has the longest wing of any of the subspecies of *Aplonis opacus.* It most closely resembles *A. o. opacus;* both of these subspecies have only a faint amount of bronzy-green luster of the feathers, and the immatures have dingy yellow streaks on the abdomen.

Aplonis opacus angus Momiyama

Micronesian Starling

Aplonis opaca anga Momiyama, Birds Micronesia, 1922, p. 6. (Type locality, Toroas, Ruk Island.)

Lamproth[*ornis*] *opaca* Kittlitz (part), Observ. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 297 (Lougounor = Lukunor).

Lamprotornis columbinus Bonaparte (part), Consp. Avium, 1, 1850, p. 417 (Carolinen = Lukunor?).

Lamprotornis columbina Hartlaub (part), Journ. f. Ornith., 1854, p. 168 (Carolinen = Lukunor?).

Calornis kittlitzi Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, pp. 89, 100 (Mackenzie = Ulithi?); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, p. 23 (Mackenzie = Ulithi?); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, pp. 298, 330, 353 (Mortlock, Nukuor, Ruk).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 8, 1875, p. 23 (Mackenzie = Ulithi?); *idem* (part), Journ. f. Ornith., 1880, p. 290 (Ruck, Mortlocks); *idem* (part), Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem* (part), Ibis, 1881, p. 111 (Ruk).

Calornis pacifica Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 49 (Rukgruppe).

Aplonis kittlitzi Sharpe (part), Cat. Birds British Mus., 13, 1890, p. 136 (Ruk, Lugunor); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Ruk or Luganor, Nukuor); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 216 (Ruk, Nukuor, Luganor); Hartert (part), Novit. Zool., 5, 1898, p. 59 (Ruk, Luganor); *idem*, Novit. Zool., 7, 1900, p. 6 (Ruk); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ruck); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 (Ruk).

Lamprocorax kittlitzi Dubois (part), Syn. Avium, 1, 1902, p. 542 (Ruk, Luganor).

Aplonis opaca Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 219 (Truk).

Aplonis kittlitzi kittlitzi Momiyama (part), Tori, 2, 1920, p. 1 (Truk, Wolea).

Aplonis opaca anga Kuroda, in Momiyama, Birds Micronesia, 1922, p. 71 (?Luganor or Ruk, ?Nukuor, Wolea or Oleai); Takatsukasa and Yamashina, Tori, 32, 1930, p. 109 (Ruk); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 847 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 170 (Uluthi, Feys, Wolea, Ifalik, Faraulep, Lamotrek, Truk, Nukuoro).

Aplornis apaca anga Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 458 (Truk?); Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Uluthi, Feys, Wolea, Ifalik, Faraulep, Lamotrek, Truk, Nukuoro).

Aplonis opacus angus Mayr, Birds Southwest Pacific, 1945, p. 297 (Truk and western Carolines); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, pp. 70, 71 (Ulithi Truk).

Geographic range.—Micronesia: Caroline Islands—Ulithi, Fais, Wolea, Ifalik, Faraulep, Lamotrek, Truk, Nukuoro, Lukunor.

Characters.—Adult: Resembles *A. o. opacus*, but larger and with bill less deep and feathers with distinct greenish luster both on the upper parts and the lower parts. Female smaller.

Immature: Resembles immature of *A. o. opacus*, but underparts streaked with brighter, buffy-yellow coloring.

Measurements.—Measurements are listed in table 45.

Specimens examined.—Total number, 38 (24 males, 14 females), as follows: Caroline Islands, USNM—Ulithi, 27 (Aug. 15, 16, 19, 20, 21, 22)—Truk, 2 (Feb. 16, Dec. 13); AMNH —Truk, 9 (Jan. 29, Feb. 1, 28, June 14, Oct. 9, 14).

Nesting.—Hartert (1900:6) reports that at Truk nests of the starling were obtained by Owston's Japanese collectors from May to July and one in March. Nests contained from one to three eggs each.

Molt.—Adult birds taken by the NAMRU2 party at Ulithi in August are in molting plumage.

Food habits.—The stomachs of starlings obtained in August at Ulithi contained pieces of fruit and seeds. Twelve stomachs contained between one and three cc. of these foods. Papaya and small berries were the foods most frequently observed in the stomachs.

Remarks.—The Micronesian Starling of the central and western Carolines is one of the few land birds which lives on both the "high" islands and the "low" coral islands in Micronesia. It is found on several of the coral atolls in the Carolines. In the Hand-list of Japanese Birds (Hachisuka *et al*, 1932:170), the birds at Ulithi and Fais are placed in the subspecies *A. o. angus*, although these islands are only a short distance from Yap, at which place another subspecies, *A. o. kurodai*, occurs. Specimens from Yap are not available for comparison. Specimens from Ulithi and from Truk closely resemble one another.

The NAMRU2 party found the starling to be numerous at Truk and at Ulithi in 1945. At both places the natives make use of the birds as food. At Truk, McElroy found a larger number of birds in immature plumage than that of birds in adult plumage. Similar observations have been made at several other islands in Micronesia.

At Ulithi, the NAMRU2 party found the starling at all islands in the atoll visited in 1945. The bird was more numerous at the islands of Potangeras and Mangejang, and less numerous at the island of Losiep; the former two islands were occupied—at the time of the visit in 1945—by service personnel and the vegetation was disturbed, whereas Losiep was uninhabited and rarely visited by people. I attribute the smaller population of starlings at Losiep to the fact that on this island the large monitor lizard, *Varanus indicus*, was numerous while at Potangeras and Mangejang it was apparently entirely absent. These large lizards depend principally on the birds, rodents, and insects for their food supply. At Potangeras the rat *Rattus exulans* was exceedingly numerous, while at Losiep no sign of rodents was found nor were any taken in traps set during the daytime.

Aplonis opacus kurodai Momiyama

Micronesian Starling

Aplonis kittlitzi kurodai Momiyama, Tori, 2, 1920, p. 1. (Type locality, Yap.)

Calornis kittlitzi Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, p. 100 (Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 123 (Yap); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, pp. 5, 24 (Yap); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 298 (Yap).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, p. 32 (Yap).

Aplonis kittlitzi Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Yap); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 216 (Yap); Hartert (part), Novit. Zool., 5, 1898, p. 58 (Yap); Bolau (part), Mitteil. Naturhist. Mus. Hamburg, 1898, p. 62 (Yap); Matschie (part), Journ. f. Ornith., 49, 1901, p. 112 (Yap); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Yap).

Aplonis opaca kurodai Momiyama, Birds Micronesia, 1922, p. 11 (Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 71 (Yap); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 848 (Yap); Hand-list Japanese Birds, rev., 1932, p. 170 (Yap).

Aplonis opaca kurodai Takatsukasa and Yamashina, Dobutsu, Zasshi, 43, 1931, p. 458 (Yap?); Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Yap).

Aplonis opacus kurodai Mayr, Birds Southwest Pacific, 1945, p. 297 (Yap); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 71 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—Adult: According to Momiyama (1922:11), "Similar to *A. o. anga* from Ruk group, but the bill thicker (9-10.5 mm.; that of the latter 8.5-9.5 mm.) and much longer (24-27.5 mm.; that of the latter 21.5-25 mm.) and the wing also longer in average (119.5-130 mm. instead of 116.5-129.5 mm.). It differs from typical *opaca* by the edge of feathers of both body sides very distinctly tinged with a bronzy-green lustre, by the bill being longer and thicker (in typical *opaca* exposed culmen 21.5-24.5 mm., depth of bill 9-9.5 mm.)."

Immature: "Similar to the immature of the typical form, but both sides of body somewhat deeper in colour and the edge of feathers distinctly tinged with lustrous bronzy-green. It differs from the same stage of *A. o. anga* by the under-parts being without pale-yellowish area." Momiyama (1922:11).

Young: "Similar to the young of typical bird, but differs from it by the mantle being very faintly tinged with bronzy-green and by the under-parts being somewhat tinged with brown. In the same stage of the typical form, the under-parts are much more greyish-ashy in colour." Momiyama (1922:11).

Remarks.—No specimens have been examined. Momiyama (1920:1) regarded the birds at Yap and at Saipan as *A. o. kurodai.* Later (1922:10) he separated the birds at Saipan as *A. o. harterti,* remarking that the birds from Saipan differ "from *A. o. kurodai* Momiyama from Yap islands, by the green lustre on both sides of body being less distinct and showing tendency to a purplish lustre, by the bill being decidedly shorter, and by the same thickness."

Price (1936a:19) describes a method by which starlings and other birds are captured by the natives of Yap. The natives make slashes in the trunk of a breadfruit tree and allow the exuding juice to harden. This material is then chewed until soft and adhesive. It is then placed on a stick which has been secured directly under a papaya fruit. When the birds alight on this perch, they become stuck and are captured.

Aplonis opacus orii (Takatsukasa and Yamashina)

Micronesian Starling

Aplornis opaca orii Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 458. (Type locality, Coror, Pelew Islands.)

Calornis kittlitzii Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 7, 117, 118 (Pelew).

Calornis opaca Gray (part), Hand-list Birds, 2, 1870, p. 27 (Pelew).

Calornis kittlitzi Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, p. 89 (Pelew); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, pp. 5, 23 (Palau); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 298 (Palau).

Calornis kittlitzi Kubary, Journ. Mus. Godeffroy, 4, 1873, p. 225 (Palau-Inseln).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 32 (Palau); *idem* (part), Journ. f. Ornith., 1880, p. 289 (Palau); *idem* (part), Proc. Zool. Soc. London, 1880, p. 576 (Palau); *idem* (part). Ibis, 1881, p. 111 (Pelew).

Aplonis kittlitzi Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Pelew); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 212 (Palaos); Hartert (part), Novit. Zool., 5, 1898, p. 58 (Pelew); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Palau); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 (Pelew).

Aplonis opaca subsp nov.? Momiyama, Birds Micronesia, 1922, p. 13 (Pelew); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 72 (Pelew).

Aplornis opaca orii Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Babelthuap, Koror, Peliliu, Anguar).

Aplonis opaca orii Hand-list Japanese Birds, rev., 1932, p. 169 (Palau); Yamashina, Tori, 10, 1940, p. 673 (Palau).

Aplonis opacus orii Mayr, Birds Southwest Pacific, 1945, p. 297 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 71 (Peleliu, Ngesebus, Garakayo).

Geographic range.—Micronesia: Palau Islands—Kayangel, Babelthuap, Koror, Garakayo, Ngesebus, Peleliu, Ngabad. Angaur.

Characters.—Adult: Resembles adult of *A. o. opacus,* but slightly larger with bill longer and shallower, and feathers with distinct greenish gloss both on the upper parts and the lowerparts. Resembles *A. o. angus* in the amount of greenish gloss on feathers, but bill shallower. Depth of bill of *A. o. opacus* measures, on the average, 9.5 for males and 9.0 for females; of *A. o. angus* 8.5 for both males and females; of *A. o. orii* 7.5 for both males and females.

Immature: Resembles immature of *A. o. angus,* but streaking on underparts duller.

Measurements.—Measurements are listed in table 45.

Specimens examned.—Total number, 40 (21 males, 19 females), as follows: Palau Islands, USNM—Koror, 3 (Nov. 6)—Garakayo, 2 (Sept. 19)—Ngesebus, 1 (Sept. 20)—Peleliu, 7 (Aug. 28, 29, 30, 31, Sept. 5); AMNH—exact locality not given, 27 (Oct., Nov., Dec.).

Molt.—Many of the specimens taken in August and September show evidence of molt; most of the specimens taken in October, November and December are not in molt.

Remarks.—The amount of greenish gloss on the feathers of *A. o. orii* and *A. o. angus* appears to be the same, but the streaked underparts of the immature of *A. o. orii* are duller than those of the immature of *A. o. angus.* The shallower bill in the Palau starling is caused by the lower edge of the mandible being generally straighter than that in *A. o. angus* and *A. o. opacus.* In comparing *A. o. orii* with *A. o. kurodai,* Takatsukasa and Yamashina (1931a:458) state that "the greenish gloss is less pronounced and of a duller shade than that of *A. o. kurodai* Momiyama."

The starling is probably the most abundant land bird in the Palaus. It was found as singles or in small flocks at all islands visited by the NAMRU2 party in 1945. As at the other islands of Micronesia, the starling at Palau is noisy and conspicuous. It is a most inquisitive bird, often following the collector through the woodlands. Apparently the starling prefers the open woodlands and marginal areas to the thicker jungles; as a result of clearing operations during the war, the bird probably has increased. The starling is primarily a vegetarian; I found no animal matter in stomachs examined at Palau or at Ulithi or Guam. At Palau, as at other islands, more of the starlings seen were in immature plumage than in adult plumage. Coultas (field notes) found the birds to be abundant at Koror and highly prized as food by the natives and Japanese. He writes, "It is surprising what a fine wholesome meal certain people can get out of handful of rice and a starling's breast."

Aplonis opacus guami Momiyama

Micronesia Starling

Aplonis opaca guami Momiyama, Birds Micronesia, 1922, p. 9. (Type locality, Guam).

Turdus columbinus Lesson (part), Traité d'Ornith., 1831, p. 406 (Mariannes = Guam).

Lamproth[*ornis*] *opaca* Kittlitz (part), Kupfertaf. Naturgesch. Vögel, 2, 1833, p. 11, pl. 15, fig. 2 (Marianen = Guam); *idem* (part), Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, pp. 298, 304 (Guahan).

Lamprotornis columbinus Bonaparte (part), Consp. Avium, 1, 1850, p. 417 (Mariann. = Guam).

Lamprotornis columbina Hartlaub (part), Journ. f. Ornith., 1854, p. 167 (Mariannen = Guam); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, pp. 367, 376 (Guaham).

Calornis opaca Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 26 (Ladrone or Marian Is.); *idem,* (part), Hand-list Birds, 2, 1870, p. 27 (Ladrone = Guam?).

Calornis kittlitzi Finsch and Hartlaub (part), Fauna Centralpolynesiens, 1867, p. 109 (Marianen = Guam?); Oustalet, Le. Nat., 1889, p. 261 (Mariannes).

Calornis columbina Giebel (part), Thes. Ornith., 2, 1875, p. 427 (Marianae = Guam?).

Calornis pacificus Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 32 Marianne).

Aplonis kittlitzi Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 44 (Marianne; Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 212 (Guam, Saypan); Hartert (part), Novit. Zool., 5, 1898, p. 58 (Guam, Saipan); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 54 (Marianas); Matschie, Journ. f. Ornith., 1901, p. 112 (Guam); Safford, Osprey, 1902, p. 69 (Guam); *idem,* The Plant World, 7, 1904, p. 264 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Mearns, Proc. U. S. Nat. Mus., 36, 1909, p. 477 (Guam); Takatsukasa and Kuroda (part), Tori. 1, 1915, p. 64 (Marianas); Cox, Island of Guam, 1917, p. 21 (Guam); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam).

Aplonis opaca Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 219 (Guam).

Aplonis kittlitzi kurodai Momiyama, Tori, 2, 1920, p. (Saipan).

Aplonis opaca guami Kuroda, in Momiyama, Birds Micronesia, 1922, p. 71 (Guam); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 847 (Guam); Yamashina, Tori, 7, 1932, p. 394 (Saipan, Rota); Hand-list Japanese Birds, rev., 1932, p. 169 (Guam, Rota, Tinian, Saipan).

Aplonis opaca harterti Momiyama (part), Birds Micronesia, 1922, p. 10 (Type locality, Saipan); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 71 (Saipan); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 847 (Saipan).

Aplornis opaca harterti Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 487 (Saipan).

Aplornis opaca guomi Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 221 (Tinian, Rota); Hand-list Japanese Birds, 3d ed., 1942, p. 188 (Saipan, Tinian, Rota, Guam).

Aplonis opacus guami Mayr, Birds Southwest Pacific, 1945, p. 297 (Guam, Rota, Tinian, Saipan); Watson, The Raven, 17, 1946, p. 41 (Guam); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 103 (Tinian); Stott, Auk, 1947, p. 527 (Saipan, Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 69 (Guam, Rota, Tinian, Saipan).

Aplonis opacus Wharton, Ecol. Monogr., 16, 1946, p. 174 (Guam); Strophlet, Auk, 1946, p. 540 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam, Rota, Tinian, Saipan.

Characters.—Adult: Resembles closely *A. o. angus* in the amount of greenish gloss present on the body feathers, but with slightly shorter and deeper bill.

Immature: Resembles the immature of *A. o. angus* but streaks on underparts brighter and less-dingy yellow.

Measurements.—Measurements are listed in table 45. The writer (1948:69) has given average measurements for the length of wing of adult males from Guam as 127, from Rota as 122, from Tinian as 131, and from Saipan as 131;

for depth of bill of adult males from Guam as 9.0, from Rota as 9.0, from Tinian as 9.5, and from Saipan as 10.0.

Weights.—The NAMRU2 party obtained weights of six adult males from Guam as 84-96 (87); of eight adult females from Guam as 78-108 (86); of two juvenal males from Guam as 88 and 90; of five juvenal females from Guam as 77-87 (80); of two adult males from Rota as 70 and 83; and of five juvenal males from Rota as 64-80 (76).

Specimens examined.—Total number, 95 (55 males, 37 females, 3 unsexed), as follows: Mariana Islands, USNM—Guam, 44 (Jan. 21, 22, Feb. 5, March 8, 13, April 12, May 18, 22, 24, 27, 29, 30, June 3, 4, 6, 14, 16, 18, July 6, 7, 14, 20, Aug. 24, Oct. 8, Nov. 19, 23)—Rota, 12 (Oct. 18, 19, 26, 27, Nov. 2)—Tinian, 4 (Oct. 12, 18); AMNH—Guam, 16 (Jan. 23, 24, 29, March 3, 12, 13, 24, May, Aug. 12, Nov. 23, 28, Dec. 26)—Tinian, 15 (Sept. 7, 8, 10, 11, 12)—Saipan, 4 (July 9, 17, Aug. 26, Sept. 2).

Nesting.—The NAMRU2 party found evidence of nesting by starlings at Guam as early as January 28, in 1945. On this date a bird was seen to carry food into a hollow tree at Oca Point. Signs of nesting activities were observed in the months that followed, the last record being obtained on June 11. Starlings nest in cavities in trees, in holes in rocky cliffs, and probably in the tops of coconut palms. On June 2 a nest was found by Muennink in a cavity of a banyan tree at Oca Point, Guam. The nest was approximately 12 feet from the ground and consisted of a flattened mass of green foliage at the bottom of the cavity. Two eggs found in the nest have been described by the author (1948:69) as "Niagara green" with scattered, irregular spots of color, near "russet," "Mars brown" and "pallid purple-drab," most abundant near the large ends. Measurements are 32.1 by 22.1 and 32.0 by 22.4.

Yamashina (1932a:394) records two eggs taken at Saipan on April 14, 1931; two eggs taken at Rota on March 10, 1931; and one egg taken at Rota on March 11, 1931. Seale (1901:54) writes that the starling nests in a hole in the dead trunk of the coconut palm and may lay three or four eggs Hartert (1898:59) reports that two eggs were taken at Guam on March 11

Food habits.—Probably the chief food of the starling at Guam is the fruit and seeds of the papaya. This plant grows in most parts of the island, especially in the lowlands where land uses have disturbed the climax vegetation. Many of the garden plots lay fallow during the war and were allowed to grow up in thick stands of papaya. As a fruit began to ripen, the starlings would peck out one side of a ripe fruit, feeding on the tissues and the seeds. It was seldom that a fully ripe papaya fruit was found that had not been at least partly eaten by the starlings. Apparently the birds do not feed on the fruit before it is fully ripened. Seeds of other types of vegetation were also eaten by the birds.

Parasites.—Wharton (1946:174) records the chigger (Acarina), *Trombicula* sp., from the starling at Guam.

Remarks.—According to Oustalet (1895:212), the starling was taken in the Marianas by the expedition in the "Uranie" in 1820 and by the expedition in the "Astrolabe" in 1829. Kittlitz, who visited Guam from March 1-20, 1828, also recorded the starling. It was not until 1922, however, that the starling in the Marianas was recognized as subspecifically distinct from the birds in the Carolines and Palaus.

The Japanese ornithologists named the bird at Guam as *A. o. guami* and the bird at Saipan as *A. o. harterti,* but later regarded these as a single subspecies *A. o. guami.* Momiyama (1920:2) had, previously to the naming of the new forms in the Marianas, considered the bird at Saipan as belonging to the same subspecies as that found at Yap. Among named kinds, *A. o. guami* found at Guam, Rota, Tinian, and Saipan appears to be most closely related to *A. o. angus.* These two subspecies differ in that the streaking of the underparts in the immatures is brighter in *A. o. guami* and duller in *A. o. angus.* The bird at Saipan has a longer wing and a deeper bill than the bird at Guam; however, birds at Tinian show intermediate measurements.

At Guam, the starling is the most numerous land bird. The writer (1947b:124), in counting birds along the roadways of Guam, recorded the starling on all of the 125 counts and found the birds to include more than one-half (57.3 percent) of all the birds seen. Starlings may have increased during the years of the war, with the disruption of normal agricultural activities allowing the growth of papaya and other food plants in fallow areas; however, the use of the birds as food by the islanders probably increased during the war.

As at other islands in Micronesia, the numbers of birds in immature plumage at Guam seemingly exceeds the number of birds in adult plumage. Animals which may prey on the starling at Guam include the feral house cat, *Rattus mindanensis, Corvus kubaryi,* and the large lizard *Varanus indicus.* The starling spends little time on the ground; it feeds principally in the trees, which might limit the amount of damage done to it by the feral house cats which are numerous on the island. The rat, *R. mindanensis,* is a semi-arboreal animal and may feed on eggs and young birds in nest cavities of trees or on cliffs. The crow, *C. kubaryi,* has a reputation for stealing chicken eggs from poultry yards and may prey on the eggs and young of the starling. The monitor lizard, *V. indicus,* is known to prey on the starling, as well as on the domestic chickens at farm houses. On January 31, 1945, one of these large lizards was seen descending a tree after robbing a nest of a starling; one of the starling's eggs was seen in the mouth of the lizard. The noise and commotion set up by the parent birds and by other starlings, which had been attracted to the area, did not appear to perturb the uninvited guest.

Downs (1946:103) writes that the starling at Tinian is less common than the white-eye, *Zosterops conspicillata saypani.* Gleise (1945:220) estimated the population of starlings on Tinian at 200.

Coultas (field notes) found the starling abundant at Tinian in 1931, but he did not find the bird at Saipan. According to Stott (1947: 527), the starling was abundant at Guam but "appeared to be common only locally on Saipan." He saw large flocks at the Marpi Point and Kingman Point areas on Saipan but found the bird less numerous elsewhere on the island. At Rota, the NAMRU2 party found the birds to be numerous and widely distributed over the island in 1945.

At Guam, the present writer observed behavior of the starling on January 31, 1945, which may have been a courtship ceremony. Two adults were perched on a palm frond approximately 20 feet above the ground. The bird which was perched more distally on the frond opened its tail fan-fashion, spread its wings and at irregular intervals picked up in its beak a part of the frond and then released it. As this behavior was taking place, the birds would call in a sweet ascending song, which reminded me very much of the song of the redwing blackbird of North America. This was indeed a contrast to the usual squawking notes of this subspecies.

Aplonis opacus aeneus (Takatsukasa and Yamashina)

Micronesian Starling

Aplornis opaca aenea Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 487. (Type locality, Pagan.)

Aplonis kittlitzi Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 212 (Pagan, Agrigan).

Aplonis opaca harterti Momiyama (part), Birds Micronesia, 1922, p. 11 (Pagan, Agrigan); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 71 (Pagan, Agrigan).

Aplornis opaca aenea Hand-list Japanese Birds, 3d ed., 1942, p. 187 (Asongsong = Asuncion, Agrigan, Pagan, Almagan).

Aplornis opaca aenea Takatsukasa and Yamashina, Dobutsu. Zasshi, 44, 1932, p. 221 (Pagan, Almagan).

Aplonis opaca aenea Hand-list Japanese Birds, rev., 1932, p. 169 (Agrigan, Pagan, Almagan); Yamashina, Tori, 10, 1940, p. 673 (Asongsong).

Aplonis opacus aeneus Mayr, Birds Southewest Pacific, 1945, p. 297 (Agrigan, Pagan, Almagan); Borror, Auk, 64, 1947, p. 417 (Agrihan).

Geographic range.—Micronesia: Mariana Islands—Alamagan, Pagan, Agrihan, Asuncion.

Characters.—Adult: According to Takatsukasa and Yamashina (1931:487), *A. o. aeneus* resembles *A. o. orii* of Palau, but has a bronze rather than green luster. *A. o. aeneus* resembles *A. o. opacus*, but has a smaller bill.

Remarks.—No specimens of this subspecies have been examined by me. Little information is available regarding the occurrence of this subspecies in the northern Marianas. Oustalet (1895:212) writes that Marche collected four specimens at Pagan and three at Agrihan. Borror (1947:417) writes that in 1945, it was a "common and abundant species" at Agrihan. He obtained one specimen between July 27 and August 14 and comments that it had a grasshopper in its stomach.

Evolutionary history of Aplonis opacus.—*Aplonis opacus* is known from the Mariana, Palau, and Caroline islands in Micronesia. It consists of several subspecies, which have relatively few distinguishing characteristics. No starlings are known in the Marshall and Gilbert islands, although atolls occur in these island-chains that offer a habitat approximately the same as those in the western Carolines now occupied by *A. o. angus.*

In regard to parental stock, Sharpe (1876:47) considered *A. opacus* as "nothing but a slightly more metallic race of *C. mysolensis,* with a still stouter bill." The species with which Sharpe compared *A. opacus* is known from Mysol, Buru, and Ceram. Oustalet (1896:70) thought that the *Aplonis* in Micronesia belonged to a group of starlings whose members are scattered through the Pacific islands including Cook, Samoa, Tonga, Fiji, New Britain, New Guinea, Banta, Mysol, Salwatti, and Timor. Mayr (1941b:204) is of the opinion that *Aplonis* in Micronesia was derived from central Polynesia. Amadon (1943:8), in his study of the genera of starlings, places *A. opacus* within a superspecies containing *A. cinerascens, A. tabuensis, A. fuscus,* and possibly *A. feadensis* and *A. cantoroides.* All of these are blackish birds with greenish gloss with immatures having the underparts streaked. In comparing *A. opacus* with these mentioned species and with other species of *Aplonis,* I find that *A. opacus* more closely resembles *A. feadensis* and *A. cantoroides* than any others. Although there are differences in size of the bill, wing, and tail, these structures are proportionally the same. The streaked underparts of the immatures of *A. cantoroides* are much like that of the immatures of *A. opacus,* whereas the immatures of *A. feadensis* are only faintly streaked with whitish below. The eye of *A. cantroides* is red, and that of *A. opacus* is more nearly yellow. The ancestral stock from which *A. opacus* developed in Micronesia seemingly reached the area from Melanesia. In Micronesia the birds dispersed to various groups of islands from some point in the Caroline Islands. The birds are absent from the Marshall Islands. Perhaps the birds never reached the Marshall Islands or they may have been present in former times and disappeared since then.

Aplonis pelzelni Finsch

Ponapé Mountain Starling

Aplonis pelzelni Finsch, Proc. Zool. Soc. London, 1875 (1876), p. 644. (Type locality, Ponapé.)

Aplonis pelzelni Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 32, pl. 2, fig. 3 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 779 (Ponapé); *idem*, Journ. f. Ornith., 1880, p. 290 (Ponapé); *idem*, Ibis, 1881, pp. 110, 112, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Sharpe, Cat. Birds British Mus., 13, 1890, p. 136 (Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 43 (Ponapé); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 215 (Ponapi); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 62 (Ponapé'); Matschie, Journ. f. Ornith., 1901, pp. 111, 112 (Ponapé); Dubois, Syn. Avium, 1, 1902, p. 542 (Ponapé); Reichenow, Die Vögel, 2, 1914, p. 355 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 70 (Ponapé); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 849 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 170 (Ponapé); Bequaert, Mushi, 12, 1939, p. 82 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, pp. 204, 213 (Ponapé); Bequaert, Occ. Papers Bernice P. Bishop Mus., 16, 1941, p. 290 (Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 298 (Ponapé).

Aplornis pelzelni Hand-List Japanese Birds, 3d ed., 1942, p. 189 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: A small, dark starling with upper parts sooty-brown, darker on head with forehead and lores blackish; wings, rump, upper tail-coverts, and tail lighter and more brownish than head; underparts paler and washed with olive-brown; bill and feet black; iris brown.

Immature: Resembles adult, but lighter brown, especially the underparts.

A. pelzelni differs from *A. opacus* by having no gloss on the feathers, smaller size, more slender bill, and a brown iris.

Measurements.—Measurements are listed in table 46.

Specimens examined.—Total number, 59 (32 males, 24 females, 3 unsexed), from Caroline Islands, AMNH—Ponapé (Dec).

Nesting.—Coultas (field notes) obtained reports that the Ponapé Mountain Starling nests in cavities in trees and lays two eggs.

TABLE 46. MEASUREMENTS OF *Aplonis pelzelni*

NUMBER AND SEX	Wing	Tail	Exposed culmen	Depth of bill at nostril	Tarsus
10 adult males	103 101-105	65 63-67	20.0 19.0-21.0	6.5 6.0-7.0	27 26-28
10 adult females	99 97-102	61 57-64	19.5 19.5-20.5	6.0 6.0-6.5	27 26-27

Parasites.—Bequaert (1939:82 and 1941:290) records the fly (Hippoboscidae), *Ornithoica pusilla,* from *A. pelzelni.*

Remarks.—Coultas (field notes) writes that "the Mountain Starling is a bird of the true mountain forest. . . . I did not record it below 1,400 feet. Natives tell me that the Mountain Starling formerly covered the whole of the island and that now some individuals can be found on the low atoll of Ant, to the westward of Ponapé. Unfortunately, I was not permitted to visit either Ant or Pakin." Coultas notes also that the birds are quiet and usually travel in pairs. They are easily attracted by squeaking the lips against the hand or by the cries of a wounded bird. Many of these starlings were taken in fruit trees. Coultas describes the call of *A. pelzelni* as "weaker and finer" than that of *A. opacus*. These two species may be found together, according to Coultas, but *A. opacus* is apparently the more aggressive and often drives *A. pelzelni* away. Richards (*in litt.*) found this bird to be "very rare" while on his visit to Ponapé in 1947-1948. He observed two individuals on January 15, 1948, at an elevation of approximately 600 or 700 feet. A male was taken.

Evolutionary history of Aplonis pelzelni.—The Ponapé Mountain Starling is a distinctive bird which evidently represents an ancient and single colonization of Micronesia. It lacks the green gloss which is found on many of the other starlings of the Pacific region. It has a brown iris, and the immatures lack the streaked underparts which are characteristic of *A. opacus* and other species. The structure of its wing resembles that of *A. opacus*, but the primaries are more rounded. It is apparently better adapted to forested uplands, whereas *A. opacus* and its relatives, *A. cantoroides* and *A. feadensis*, appear to prefer lowland forests and coconut plantations. In habits and habitat preference, *A. pelzelni* seems to resemble *A. santovestris*, which is restricted to mountain environment on Espiritu Santo in the New Hebrides. The describers of this starling, Harrisson and Marshall (1937:149), write that "*Aplonis santovestris* apparently most closely resembles *A. pelzelni* from Ponapé, especially in bill and tarsus." According to the description, *A. santovestris* is approximately the size of *A. pelzelni* with brownish coloring, crown dark brown, lower back and rump dark rufous, wing and tail blackish-brown, underparts rufous-brown, and iris grayish-green. These two birds are separated geographically and apparently exhibit evidences of parallel development. Possibly they came from a common ancestral stock. Mayr (1941b:204) writes that *A. pelzelni* belongs with the starlings of the Polynesian area. I have compared *A. pelzelni* with other starlings of the Southwest Pacific, including *A.*

feadensis, *A. cantoroides*, and *A. zealandicus*, but see no close resemblances.

Aplonis corvinus (Kittlitz)

Kusaie Mountain Starling

Lamprothornis corvina Kittlitz, Kupfertaf. Naturgesch. Vögel, 2, 1833, p. 12, pl. 15, fig. 3. (Type locality, Ualan = Kusaie.)

Lamprothornis corvina Kittlitz, Mem. Acad. Imp. Sci. St. Peterbourg, 2, 1835, p. 7, pl. 9 (Ualan); *idem*, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 285 (Ualan).

Lamprotornis corvina Bonaparte, Consp. Avium, 1, 1850, p. 417 (Ualan); Hartlaub, Archiv. f. Naturgesch., 18, 1852, p. 133 (Ualan); Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 2, 1858, pp. 25, 43, 59, 103 (Ualan); Finsch, Ibis, 1881, p. 104 (Kuschai).

Lamprocorax corvinus Hartlaub, Journ. f. Ornith., 1854, p. 168 (Carolinen = Kusaie); Sclater, Ibis, 1859, p. 327 (Caroline = Kusaie); Dubois, Syn. Avium, 1, 1902, p. 543 (Kuschai).

Calornis (Lamprocorax?) corvina Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 25 (Oualan).

Sturnoides corvina Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 108 (Ualan); Finsch, Journ. f. Ornith., 1880, pp. 297, 302 (Kuschai).

Calornis corvina Gray, Hand-list Birds, 2, 1870, p. 27 Caroline = Kusaie); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 100 (Ualan); Giebel, Thes. Ornith., 2, 1875, p. 427 (Caroline = Kusaie); Sharpe, Cat. Birds British Mus., 13, 1890, p. 137 (Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 46 (Ualan or Kushai); Matschie, Journ. f. Ornith., 1901, p. 112 (Ualan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Kusaie).

Sturnoides corvinus Finsch, Ibis, 1881, pp. 107, 108 (Kushai).

Kittlitzia corvina Hartert, Kat. Vogelsamml. Senckenb., 1891, p. 75 (Ualan); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 72 (Kusaie); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 853 (Kusaie); Hand-list Japanese Birds, rev., 1932, p. 169 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 187 (Kusaie).

Aplonis corvina Reichenow, Die Vögel, 2, 1914, p. 356 (Ualan); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 213 (Kusaie).

Aplonis corvinus Mayr, Birds Southwest Pacific, 1945, p. 298 (Kusaie).

Geographic range.—Micronesia: Caroline Islands — Kusaie, probably extinct for many years.

Characters.—According to Sharpe (1890:137), "Shining black; each feather with a glossy margin, varying from steel-green to purplish red; bill and feet black (Kittlitz)."

Remarks.—Kittlitz obtained two specimens of a unique starling at Kusaie when he visited the island in December and January, 1827-'28. He named the birds as new and deposited the specimens in the museum in St. Petersburg. The bird has not been found at Kusaie since that time. Sharpe (1890:137-138, footnote) writes "This species I have never seen, and Dr. Finsch did not meet with it during his visit to Kuschai. He writes to me:—'It no doubt exists on Kuschai, just as it did when Kittlitz visited the island. Nobody has reached the mountains in the interior since Kittlitz's time; and it is strictly a mountain bird.'" Coultas spent considerable time searching the higher areas of Kusaie for the bird in 1931.

The Kusaie Mountain Starling apparently represents an early invasion of Micronesia, independent of that of any other starling in the area and perhaps the earliest of the three colonizations by starlings in Micronesia. The drawing of the bird as pictured by Kittlitz (1833:pl. 14, fig. 3) shows the long bill to be one of its distinctive characters. This suggests relationship to *A. atrifuscus* of Samoa, as noted by Mayr (1942a:6). *A. atrifuscus* is larger than *A. opacus* with a longer bill and gloss on some of the feathering of the body; it looks a good deal like the drawing of *A. corvinus* by Kittlitz. *A. corvinus* may also have some relation to *A. magnus* of Biak, although this species has a longer tail and a shorter bill. *A. corvinus* probably has undergone an evolutionary development which parallels that of *A. atrifuscus* and possibly other species in the Polynesian and Melanesian areas. The ancestral stock from which *A. corvinus* was derived may have been close to *A. grandis*, which is found in the Solomon area. *A. grandis* is a forest bird, somewhat solitary in habits.

Sturnus philippensis (Forster)

Violet-backed Starling

[*Motacilla*] *philippensis* Forster, Ind. Zool., 1781, p. 41. (Type locality, Philippines.)

Sturnus philippensis Mayr, Birds Southwest Pacific, 1945, p. 302 (Palau).

Geographic range.—Breeds in Japan. Winters to the Philippine Islands. In Micronesia: Palau Islands—exact locality unknown.

Remarks.—Mayr (1945a:302) records this starling as a migrant visitor to the Palau Islands. Coultas obtained an immature female of this species at Palau on October 13, 1931.

Sturnus cineraceus Temminck

Ashy Starling

Sturnus cineraceus Temminck, Pl. Col. 2, 1832, pl. 556. (Type locality, Japan.)

Spodiopsar cineracea Kishida, Lansania, 1, 1929, p. 17 (Saipan); Hand-list Japanese Birds, 3d ed., 1942, p. 187 (Saipan).

Geographic range.—Breeds in eastern Asia and Japan. Winters in southern China and Philippines. In Micronesia: Mariana Islands—Saipan.

Remarks.—The Ashy Starling has been reported from Saipan by Kishida. It probably is a casual winter migrant.

Cleptornis marchei (Oustalet)

Golden Honey-eater

Ptilotis Marchei Oustalet, Le Nat., 1889, p. 260. (Type locality, Saypan.)

Cleptornis marchei Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 35 (Saypan); Hartert, Novit. Zool., 5, 1898, p. 56 (Saipan); Matschie, Journ. f. Ornith., 1901, p. 112 (Saipan); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 60 (Saipan); Dubois, Syn. Avium, 1, 1902, p. 722 (Marianne =

Saipan); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Marianne = Saipan); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 75 (Saipan); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 788 (Saipan); Hand-list Japanese Birds, rev., 1932, p. 171 (Saipan); Hand-list Japanese Birds, 3d ed., 1942, p. 190 (Saipan); Mayr, Birds Southwest Pacific, 1945, p. 298 (Saipan); Stott, Auk, 64, 1947, p. 527 (Saipan).

Ptilotis (*Cleptornis*) *marchei* Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 202 (Saypan).

Geographic range.—Micronesia: Mariana Islands—Saipan.

Characters.—Adult: A small honey-eater with head, rump, and underparts near "light cadmium" becoming lighter on the chin and darker on the nape; back near "orange-citrine"; wings and tail feathers brown with outer edges colored like back and inner edges whitish; orbital ring pale yellow; breast, belly, sides, and under tail- and upper tail-coverts near "raw sienna"; under wing-coverts pale yellow; axillaries yellow; bill and feet light yellow-brown, maxilla darker; iris chestnut-brown. Immature has lighter bill.

Measurements.—Measurements are listed in table 47.

TABLE 47. MEASUREMENTS OF *Cleptornis marchei*

NUMBER AND SEX	Wing	Tail	Full culmen	Tarsus
7 adult males.	79 (77-80)	64 (61-66)	19.5 (19.0-20.0)	26 (25-27)
5 adult females.	73 (72-75)	58 (56-59)	18.0 (17.5-18.5)	24 (23-25)

Specimens examined.—Total number, 17 (9 males, 8 females), as follows: Mariana Islands, USNM—Saipan, 4 (July 11, Dec. 15); AMNH—Saipan, 13 (July 8, Aug. 1, 10, 13, 14, 21, 30, Sept. 3, 7, 9, 15).

Nesting.—Hartert (1898:56) reports that one nest of the Golden Honey-eater was found on July 7. It was hung from a fork of a branch, "like the nest of a golden Oriole." He writes that four other nests were obtained in late August. Hartert describes the egg as "pale blue without gloss, spotted over and over with rufous, more so on the thicker end, and measures about 20:15 mm."

Molt.—Specimens taken in July, August, and September are molting.

Remarks.—Oustalet (1895:202) writes that Marche obtained 25 specimens of the Golden Honey-eater at Saipan in May, June, and July, 1887. Little is known regarding its habits; Moran (1946:262) writes that the bird "reminds one of the prothonotary warbler, with a long, curved, black bill." Stott (1947:527) writes that "it appears to be restricted to a single habitat, that of dense forest." He found the bird in forest on the north shore of Magicienne Bay. Coultas obtained only one specimen on his visit to Saipan in 1931. Marshall (1949:216) records some interesting observations of this bird made in 1945. He notes (*op. cit.* p. 219) that the bird breeds in January, February and April.

Not only is it remarkable that the Golden Honey-eater has become established on a single island in a rather closely associated chain of islands, but it is also difficult to determine from where the bird came. It seemingly has no close relatives in the Micronesian area. Oustalet (1895:202) points out that one has to go to New Guinea, Moluccas, Australia, Fiji, Samoa, and Tonga in order to find related forms. In looking through the large collections of Meliphagidae in the American Museum of Natural History, I found only a few genera to which the Saipan Golden Honey-eater seems to be closely related. *Timeliopsis* of New Guinea has some resemblances to *Cleptornis*, although the coloration is different. *Timeliopsis* has a similar bill, but has a longer tail and longer wing; the shortness of the wing in *Cleptornis* is not unusual since other insular forms also exhibit this characteristic.

Perhaps *Cleptornis* is closer to the genus *Meliphaga* of New Guinea and Australia, which has become differentiated into a number of diverse species and subspecies. *Cleptornis* compares rather favorably with *M. pencillata carteri* of Australia, but differs by the softness of its feathers and the shorter wing and shorter tail. It shows also some affinities with *M. flava* of Australia, particularly in shape of bill; the coloration of the feathers is light olive-green in *M. flava*. The bird at Saipan seemingly has no relationships with the Hawaiian honey-eaters.

Myzomela cardinalis rubratra (Lesson)

Cardinal Honey-eater

Cinnyris rubrater Lesson, Dict. Sci. Nat., éd. Levrault, 50, 1827, p. 30. (Type locality, Oualan=Kusaie.)

Cinnyris rubrater Lesson (part), Voy. "La Coquille," Zool., 2, 1828, pp. 433, 678 (Oualan): *idem* (part), Man. d'Ornith., 2, 1828, p. 55 (Oualan); *idem* (part), Traité d'Ornith., 1831, p. 299 (Oualan); Kittlitz (part), Kupfertaf. Naturgesch. Vögel, 1832, p. 6, pl. 8, fig. 1 (Ualan); *idem* (part), Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, pp. 364, 381; 2, 1858, pp. 39, 49 (Ualan).

Certhia Cardinalis Kittlitz, Mém. Acad. Imp. Sci. St. Pétersbourg, 2, 1835, p. 4 (Ualan).

Cinnyris cardinalis Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 285 (Ualan).

Myzomela sanguinolenta Bonaparte, Consp. Avium, 1, 1850, p. 394 (no loc. = Kusaie?).

Myzomela rubrater Hartlaub (part), Archiv. f. Naturgesch., 18, 1852, pp. 109, 131 (Ualan); Finsch and Hartlaub, Fauna Centralpolynesiens, 1867, p. 57 (Ualan).

Myzomela rubratra Hartlaub (part), Journ. f. Ornith., 1854, p. 168 (Carolinen = Kusaie); *idem* (part), Proc. Zool. Soc. London, 1867 (1868), p. 829 (Carolines = Kusaie); Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, p. 95 (Ualan); Giebel (part), Thes. Ornith., 2, 1875, p. 681 (Carolinae = Kusaie); Finsch (part), Journ. Mus. Godeffroy, 12, 1876, p. 26 Ualan); Forbes (part), Proc. Zool. Soc. London, 1879, p. 271 (Ualan); Finsch (part), Journ. f. Ornith., 1880, pp. 285, 298 (Kuschai); *idem* (part), Ibis, 1881, pp. 103, 108, 111 (Kuschai); *idem* (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Ualan); Hartert, Kat. Vogelsamml. Senckenb., 1891,

p. 31 (Ualan); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 31 (Ualan); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, pp. 201, 202 (Kushai); Hartert (part), Novit, Zool., 5, 1898, p. 56 (Ualan); Dubois (part), Syn. Avium, 1, 1902, p. 716 (Carolines = Kusaie).

Certhia sanguinolenta Kittlitz, Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, p. 364 (Ualan).

Myzomela major Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 11 (Oualan?).

Myzomela rubrata Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ualan).

Myzomela rubratra rubratra Wetmore, Proc. Biol. Soc. Washington, 30, 1917, p. 117 (Kusaie); Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 219 (Kusaie); Momiyama, Birds Micronesia, 1922, pp. 15, 20, 21, 22, (Kusaie); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 72 (Kusaie); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 743 (Oualan); Hand-list Japanese Birds (part), rev., 1932, p. 172 (Kusaie); Hand-list Japanese Birds (part), 3d ed., 1942, p. 191 (Kusaie).

Myzomela cardinalis rubratra Mayr, Birds Southwest Pacific, 1945, p. 299 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie.

Characters.—Adult male: Head (except lores), neck back, rump, upper tail-coverts, chin, throat, breast, and upper abdomen black with feathers tipped with coloring between "scarlet" and "scarlet-red"; rest of feathering black; bill long and curved and black; feet black; iris dark brown.

Adult female: Resembles adult male, but smaller; red coloring duller;

TABLE 48. MEASUREMENTS OF *Myzomela cardinalis* OF *Micronesia*

SUBSPECIES	Number and sex	Wing	Tail	Full culmen	Tarsus
M. c. rubratra	21 adult males	79 (76-81)	55 (53-56)	19.5 (18.5-20.5)	22 (21-22)
	20 adult females	71 (69-74)	49 (45-51)	18.5 (17.5-19.5)	20 (19-21)
M. c. dichromata	24 adult males	78 (76-80)	53 (51-56)	21.5 (20.0-23.0)	22 (21-23)
	22 adult females	69 (66-72)	47 (45-49)	19.0 (17.5-20.5)	20 (19-21)
M. c. major	9 adult males	77 (75-78)	55 (54-59)	20.0 (19.5-20.5)	22 (21-22)
	2 adult females	70	50	19.0, 20.5	21.5
M. c. saffordi	47 adult males	73 (69-77)	55 (51-56)	20.0 (19.0-20.5)	22 (21-24)
	14 adult females	65 (63-71)	49 (46-51)	18.5 (17.5-19.5)	21 (19-21)
M. c. kurodai	2 adult males	74, 75	52	20.0, 20.5	20, 21
M. c. kobayashii	17 adult males	74 (71-76)	54 (51-57)	20.5 (19.0-22.0)	21 (20-22)
	8 adult females	67 (65-68)	48 (45-50)	18.0 (17.5-19.0)	20 (19-21)

wings and tail more brownish and less blackish; abdomen and under tail-coverts dark gray.

Immature: Resembles adult, but duller and less blackish and more grayish with less red coloring on feathers and an olivaceous-brown tinge to plumage.

Measurements.—Measurements are listed in table 48.

Specimens examined.—Total number, 62 (35 males, 27 females), as follows: Caroline Islands, USNM—Kusaie, 3 (Feb. 9); AMNH—Kusaie, 59 (Jan., Feb., March).

Nesting—Finsch records the taking of eggs of the honey-eater at Kusaie on February 26 and March 10, 1880.

Molt.—Evidence of molt was observed in a few specimens taken in January and in larger number of birds taken in March. In addition, some skins obtained in March showed fresh plumage. Although there is little evidence available, I suppose that nesting activities of *M. r. rubratra* at Kusaie occur in the winter months of December, January, February, and March, and that molt begins in January, especially in the males, and possibly reaches a peak in March.

Remarks.—*M. r. rubratra* was first described by Lesson, who referred to it under the name *Cinnyris rubrater.* The bird was found by Lesson at Kusaie, when he visited the island in June, 1924, as a member of the expedition from the ship "La Coquille." In his description he also stated that the bird was found in the Philippines by Dussumier. The report of the bird's occurrence in the Philippines proved to be erroneous, as was pointed out by Wetmore (in Townsend and Wetmore, 1919:220). Oustalet (1895:200) contended that Lesson's description was based on the specimens taken by Quoy and Gaimard in the Marianas; he stated that none of the birds which Lesson mentions from Kusaie was preserved. Bonaparte also considered *Cinnyris rubrater* to be from the Marianas, and he gave the name *Myzomela major* to the honey-eater of the Caroline Islands (apparently including Kusaie) on the basis of specimens taken by Hombron and Jacquinot at Truk. Wetmore (in Townsend and Wetmore, 1919:220) settles the argument and assigns Lesson's name *rubratra* to the honey-eater at Kusaie; apparently this treatment is the correct one inasmuch as Lesson used his own field notes and records of the occurrence of this honey-eater at Kusaie in preparing his description, even if the actual specimens were not preserved. This arrangement makes Bonaparte's name *major* available for the population at Truk and makes Wetmore's name *saffordi* available for the population in the Marianas. The placing of the honey-eaters of Micronesia within the species *Myzomela cardinalis* by Mayr (1932:19) is, I think, justified.

Little information is available concerning the habits of the honey-eater at Kusaie. In 1931, Coultas (field notes) regarded the bird as common in the lowlands, especially in the coconut groves. He did not find the bird at high elevations on the island.

Myzomela cardinalis dichromata Wetmore

Cardinal Honey-eater

Myzomela rubratra dichromata Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 220. (Type locality, Ponapé.)

Myzomela rubratra Pelzeln, Reise "Novara," Vögel, 1865, pp. 55, 162 (Puynipet = Ponapé); Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 26 (Ponapé); *idem*, Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); Forbes (part), Proc. Zool., Soc. London, 1879, p. 271 (Ponapé); Finsch (part), Journ. f. Ornith., 1880, p. 285 (Ponapé); *idem* (part), Proc. Zool. Soc. London, 1880, p. 575 (Ponapé); *idem* (part), Ibis, 1881, pp. 111, 115 (Ponapé); *idem* (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 31 (Ponapé); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 202 (Ponapi).

Myzomela rubrata Nehrkorn (part), Journ. f. Ornith., 1879, p. 397 (Ponapé); Christian, The Caroline Islands, 1899, p. 358 (Ponapé); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ponapé); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Myzomela chermesina Gadow, Cat. Birds British Mus., 9, 1884, p. 137 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Ponapé).

Myzomela rubratra dichromata Momiyama, Birds Micronesia, 1922, pp. 15, 20, 21, 22 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 73 (Ponapé); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 743 (Ponapé).

Myzomela rubratra rubratra Yamashina, Tori, 7, 1932, p. 395 (Ponapé); Hand-list Japanese Birds (part), rev., 1932, p. 172 (Ponapé); Hand-list Japanese Birds (part), 3d ed., 1942, p. 191 (Ponapé).

Myzomela cardinalis dichromata Mayr, Birds Southwest Pacific, 1945, p. 299 Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult male: Resembles adult males of *M. c. rubratra*, but with more extensive black markings on lores and below eye; tips of feathers lighter "scarlet."

Adult female: Resembles adult female of *M. c. rubratra*, but duller and with red coloring much reduced; head, neck, shoulder, ear-coverts, and sides of neck sooty brownish-gray; rest of upper parts dark brownish-gray with plumage of middle of back, rump, and upper tail-coverts tipped with scarlet; wings and tail dark brown with outer edges olivaceous-gray; chin and throat reddish; breast light brownish-gray, may be washed with reddish; axillaries, abdomen, and under tail-coverts grayish.

Immature male: Resembles adult male, but scarlet coloring less brilliant and thinner on forehead, middle of back, rump, upper tail-coverts, and underparts and absent, or nearly absent, on crown and neck.

Immature female: Resembles adult female, but scarlet coloring thinner and present only on underparts, back, rump, and upper tail-coverts; abdomen and under tail-coverts washed with buff.

Measurements.—Measurements are listed in table 48.

Specimens examined.—Total number, 52 (26 males, 24 females, 2 unsexed), as follows: Caroline Islands, USNM—Ponapé, 3 (Feb. 11, 12); AMNH—Ponapé, 49 (Nov., Dec.).

Nesting.—Yamashina (1932a:395) records a large collection of eggs of the honey-eater, taken at Ponapé in 1931. Of 13 sets of eggs listed, 10 include two eggs per set and 3 include one egg per set. These were obtained from July 20 to

September 2. Coultas (field notes) found one nest with young in a tree-fern in the period of November and December, 1930. The nest was cup-shaped and made of fern and fine grasses and lined with lichens. Coultas writes that only the female feeds the young. He suspects that the honey-eater nests at all times of the year.

Molt.—Most of the birds taken by Coultas in November and December are in molting plumage.

Remarks.—The Cardinal Honey-eater at Ponapé is, according to Coultas, found in most habitats of the island. He found it to be an aggressive bird, often chasing the white-eye *Zosterops cinerea.* The committee (Hachisuka *et al.*) which prepared the Hand-list of Japanese Birds in both the revised edition (1932) and the third edition (1942) does not recognize the Ponapé honey-eater as separable from the bird at Kusaie. I see no reason for this action and find the bird at Ponapé to be a well-marked subspecies.

Myzomela cardinalis major Bonaparte

Cardinal Honey-eater

Myzomela major Bonaparte, Comptes Rendus Acad. Sci. Paris, 38, 1854, p. 264. (Type locality, "ex Ins. Carolinis ab Homb. et Jacq." = Truk.)

Myzomela major Gray, Hand-list Birds, 1, 1869, p. 153 (Caroline = Truk); Giebel, Thes. Ornith., 1875, p. 681 (Carolinae = Truk?); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Ruk); Kuroda, Dobutsu. Zasshi, 27, 1915, p. 28 (Ruk); *idem*, Dobutsu. Zasshi, 28, 1916, p. 71 (Ruk).

Myzomela rubratra Finsch (part), Proc. Zool. Soc. London, 1880, p. 575 (Ruk); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 253 (Ruk); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 31 (Ruk); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 202 (Ruk); Hartert (part), Novit. Zool., 5, 1898, p. 56 (Ruk); *idem* (part), Novit. Zool., 7, 1900, p. 2 (Ruk); Dubois (part), Syn Avium, 1, 1902, p. 714 (Carolines = Truk?).

Myzomela rubrata Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ruck); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 (Ruk).

Myzomela rubratra rubrata Wetmore (part), in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 221 (Uala).

Myzomela rubrata wetmorei Momiyama, Birds Micronesia, 1922, p. 15 (Type locality, Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 73 (Ruk); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 743 (Ruk); Hand-list Japanese Birds, rev., 1932, p. 172 (Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 190 (Truk).

Myzomela cardinalis major Mayr, Birds Southwest Pacific, 1945, p. 299 (Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 72 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk.

Characters.—Adult male: Resembles adult male of *M. c. rubrata,* but tips of plumage lighter "scarlet,"

Adult female: Resembles adult female of *M. c. rubrata,* but underparts more heavily tipped with scarlet; abdomen and under tail-coverts black; tail slightly darker. Differs from *M. c. dichromata* by presence of scarlet tips on feathers of head.

Immature male: Resembles adult female, but scarlet coloring of tips of feathers of head and neck narrower.

Immature female: Resembles immature female of *M. c. rubrata,* but upper parts grayer; underparts darker.

Measurements.—Measurements are listed in table 48.

Specimens examined.—Total number, 19 (13 males, 6 females), as follows: Caroline Islands, USNM—Truk, 2 (Feb. 16, Dec. 13); AMNH—Truk, 17 (Feb., March, Nov., Dec.).

Nesting.—Concerning the honey-eater at Truk, Hartert (1900:2) writes "many nests were found from end of May to July, and one in March." McElroy examined three males in December, which had swollen testes. As seems to be the case with other races of this species, the Cardinal Honey-eater at Truk may nest at all times of the year.

Molt.—Specimens examined that were taken in November, December and February are in fresh or in molting plumages.

Remarks.—Bonaparte described his *Myzomela major* as "Similis praecedenti, sed major et percoccinea." He compares it here with *Myzomela rubrata,* which he considered as a resident of the Mariana Islands. According to Oustalet (1895:202) Hombron and Jacquinot obtained one specimen of the honey-eater at Truk in 1841. This subspecies, as well as most of the others of *M. cardinalis* in Micronesia, is best distinguished by the characteristics of the female. The male of the different subspecies shows much less geographic variation.

Myzomela cardinalis saffordi Wetmore

Cardinal Honey-eater

Myzomela rubratra saffordi Wetmore, Proc. Biol. Soc. Washington, 30, 1917, p. 117. (Type locality, Guam.)

Cinnyris rubrater Lesson (part), Dict. Sci. Nat., éd. Levrault, 50, 1827, p. 30 (Mariannes); *idem* (part), Voy. "La Coquille," Zool., 2, 1828, p. 678 (Mariannes); *idem* (part), Man. d'Ornith., 2, 1828, p. 55 (Mariannes); *idem* (part), Traité d'Ornith., 1831, p. 299 (Mariannes); Kittlitz (part), Kupfertaf. Naturgesch. Vögel, 1, 1832, p. 6, pl. 8, fig. 1 (Guaham); *idem* (part), Denkw. Reise russ. Amer. Micron. und Kamchat., 1, 1858, pp. 364, 381; 2, 1858, pp. 39, 49 (Guaham).

Certhia cardinalis Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 304 (Guaham).

Myzomela rubrater Hartlaub (part), Archiv f. Naturgesch., 18, 1852, p. 109 (Mariannen); Finsch and Hartlaub (part), Fauna Centralpolynesiens, 1867, p. 57 (Guaham).

Myzomela rubratra Bonaparte, Comptes Rendus Acad. Sci. Paris, 38, 1854, p. 263 (Mariannes); Hartlaub (part), Journ. f. Ornith., 1854, p. 167 (Mariannen); Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 11 (Guam); *idem* (part), Hand-list Birds, 1, 1869, p. 154 (Marian); Finsch (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 26 (Marianen); Forbes (part), Proc. Zool. Soc. London, 1879, p. 270 (Marianis); Giebel (part), Thes. Ornith., 2, 1875, p. 681 (Marinae); Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Guam); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 31 (Marianne); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 197 (Guam, Rota, Saypan, Pagan, Agrigan); Hartert (part), Novit. Zool., 5, 1898, p. 55 (Guam, Saipan, Pagan, Agrigan); *idem* (part), Novit. Zool., 7, 1900, p. 2 (Guam); Wheeler, Report Island of Guam, 1900, p. 13 (Guam); Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 55 (Marianae); Safford, The Plant World, 7, 1904, p. 263 (Guam); *idem*, Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Mearns, Proc. U. S. Nat. Mus., 36, 1909, p. 477 (Guam); Reichenow (part), Die Vögel, 2, 1914, p. 482 (Marianen); Takatsukasa and

Kuroda (part), Tori, 1, 1915, p. 64 (Marianas); Cox, Island of Guam, 1917, p. 21 (Guam).

Myzomela rubrata Oustalet, Le Nat., 1889, p. 260 (Mariannes); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Guam, Saipan); Safford, Osprey, 1902, p. 69 (Guam); Prowazek, Die deutschen Marianen, 1913, p. 101 (Saipan).

Myzomela rubratra saffordi Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 221 (Guam, Saipan); Momiyama, Birds Micronesia, 1922, pp. 17, 20, 21, 22 (Guam, Rota, Saipan, Pagan, Agrigan); Kuroda in Momiyama, Birds Micronesia, 1922, p. 74 (Guam, Rota, Saipan, Pagan, Agrigan); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 744 (Guam); Yamashina, Tori, 7, 1932, p. 395 (Marianas?); Hand-list Japanese Birds, rev., 1932, p. 171 (Marianas); Bryan, Guam Rec., vol. 13, no. 2, 1936, p. 25 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 190 (Guam, Rota, Agiguan, Tinian, Saipan, Almagan, Pagan, Agrigan, Assongsong).

Mizomela rubrata saffordi Yamashina, Tori, 19, 1940, p. 673 (Assongsong, Agiguan).

Myzomela cardinalis saffordi Mayr, Birds Southwest Pacific, 1945, p. 299 (Marianas); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 103 (Tinian); Borror, Auk, 1947, p. 417 (Agrihan); Stott, Auk, 1947, p. 527 (Saipan, Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 72 (Guam, Rota).

Myzomela cardinalis Watson, The Raven, 17, 1946, p. 41 (Guam); Strophlet, Auk, 1946, p. 540 (Guam); Baker, Condor, 49, 1947, p. 125 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam, Rota, Tinian, Agiguan, Saipan, Almagan, Pagan, Agrihan, Asuncion.

Characters.—Adult male: Resembles *M. c. rubratra*, but smaller with red coloring lighter and more orange; edges of wing and tail feathers olivaceous. Differs from adult males of *M. c. dichromata* and *M. c. major* by smaller size and presence of olivaceous edgings on wing and tail feathers.

Adult female: Resembles adult female of *M. c. rubratra*, but smaller and paler with upper parts dark olivaceous-gray, sparsely mottled with scarlet; outer edges of wing and tail feathers greenish-olive; abdomen and under tail-coverts buffy-gray. Differs from *M. c. dichromata* by smaller size and presence of scarlet tips of feathers on top of head. Differs from *M. c. major* by smaller size and presence of broad olivaceous edges on tail feathers.

Immature male: Resembles adult male, but red coloring less brilliant, upper parts, lower breast, and abdomen more narrowly edged with the red coloring; plumage of breast, abdomen, and under tail-coverts buffy-gray, lighter in very young birds.

TABLE 49. MEASUREMENTS OF ADULT MALES OF *Myzomela cardinalis saffordi* FROM THE MARIANA ISLANDS

ISLAND	No.	Wing	Tail	Full culmen	Tarsus
Guam	35	72 (69-75)	54 (51-56)	20.0 (19.5-20.5)	22 (21-23)
Rota	1	73	....	20.0	22
Tinian	5	73 (71-74)	53 (52-55)	19.5 (19.0-20.0)	22 (21-24)
Saipan	4	74 (72-76)	54 (53-55)	19.5 (19.0-20.5)	22 (22-23)
Agrihan	1	77	55	20.0	22

Immature female: Resembles adult female, but paler with upper parts darker brown; underparts pale buffy-brown; outer edges of wing and tail feathers greenish-olive, more extensive than in adult.

Measurements.—Measurements of the subspecies of *M. cardinalis* in Micronesia are listed in table 48. Measurements of male specimens of *M. c. saffordi* from various islands in the Marianas are listed in table 49.

Weights.—The author (1948:72) records weights of *M. c. saffordi* from Guam as: 17 adult males, 12.7-18.0 (15.0), and 5 adult females, 10.4-15.0 (12.7).

Specimens examined.—Total number, 80 (61 males, 17 females, 2 unsexed), as follows: Mariana Islands, USNM—Guam, 43 (Jan. 22, May 26, 30, June 2, 3, 5, 7, 8, 9, 13, 18, 19, 25, 28, July 6, 10, 12, 17, 19, 20, 21, Sept., Nov. 20, 21)—Rota, 2 (Oct. 10)—Tinian, 3 (Oct. 23, 25)—Saipan 2 (Sept. 27, 30); AMNH—Guam, 23 (Jan. 22, 23, Feb. 5, 7, 9, 16, March 8, 10, 11, 13, 23, June 28, July 8, 21, Aug. 22, Nov. 25, Dec. 4, 11)—Tinian, 2 (Sept. 7, 14)—Saipan, 3 (July 8, Aug. 5, 22)—Asuncion, 1 (June)—Agrihan, 1 (June).

Nesting.—Seale (1901:55) obtained nests and eggs in the period from May to July at Guam. He found the nests 8 to 15 feet above the ground. Strophlet (1946:540) observed a pair of honey-eaters with two young on October 9 at Guam. In 1945 at Guam the NAMRU2 party obtained individuals with enlarged gonads on January 22, June 2, 5, July 21 and 23, and found evidence of nesting on June 16. Hartert (1898:56) writes that Owston's Japanese collectors obtained nests in January, February, and March. Each nest contained two eggs; they were placed four to eight feet from the ground. Probably the Cardinal Honey-eater in the Marianas nests at most times of the year.

Molt.—Specimens, with molting plumage, have been examined that were taken at most times of the year. I suspect that this bird molts at irregular intervals.

Food habits.—The honey-eater feeds partly on insect life and partly on nectar and juices from flowers. At Guam, the honey-eater was frequently found at flowers of the ink berry bush, where evidently both nectar and insects were obtained. The birds were attracted also to the coconut palms, especially when the reproductive parts of the palms were developing.

Remarks.—The Cardinal Honey-eater is one of the most conspicuous land birds in the Mariana Islands. Its scarlet plumage and characteristic fluttering flight cause it to stand out against its habitat of forest, scrub, and garden. At Guam, the author (1947b:124) found the honey-eater on 37.6 percent of the 125 roadside birds counts made in 1945. The species included 3.9 percent of all of the birds observed on these counts. Seale (1901:55) and Strophlet (1946:540) also commented on its abundance at Guam; however, in 1931, Coultas (field notes) wrote that the bird was rare; he obtained only one skin at Guam. At Rota, the NAMRU2 party found the honey-eater to be abundant. Coultas obtained only a few birds at Tinian and Saipan in 1931. In 1945, Downs (1946:103) saw only a single pair at Tinian; Gleise (1945:220) estimated the population at Tinian to be 12 in 1945. At Agrihan, Borror (1947:417) reported that the honey-eater was a common bird in 1945.

Table 49 lists the measurements of males of *M. c. saffordi* from several islands in the Marianas. Measurements of birds from Guam, Rota, Tinian, and Saipan are fairly similar, although the birds at Saipan seem to have a slightly longer wing than those at Guam. A single skin from Agrigan has larger measurements than those of birds obtained in the southern Marianas. Whether the birds in the northern Marianas are separable because of larger size can only be ascertained by the studying of more material from that region.

Mayr (1945a:102) writes that males of *M. cardinalis* seem to outnumber the females by approximately four to one. On the basis of collections and field observations, the males were found to outnumber the females in the Micronesian islands; although the ratio may not be so great as four to one. At Guam, the NAMRU2 party obtained 21 males and 8 females. Although these birds are often seen as pairs (male and female), single males are frequently observed. The females do not appear to have more secretive habits than the males.

Myzomela cardinalis kurodai Momiyama

Cardinal Honey-eater

Myzomela rubratra kurodai Momiyama, Birds Micronesia, 1922, p. 17. (Type locality, Yap.)

Myzomela rubratra Hartlaub and Finsch (part), Proc. Soc. London, 1872, pp. 89, 94 (Uap); Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 122 (Yap); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, p. 4 (Yap); Forbes (part), Proc. Zool, Soc. London, 1879, p. 271 (Yap); Wiglesworth (part), Abhandl. und. Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p.. 31 (Uap); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 202 (Yap); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Yap); Kuroda, Dobutsu. Zasshi, 27, 1915, pp. 331, 332 (Yap).

Myzomela rubrata Matschie (part), Journ. f. Ornith., 1901, p. 112 (Yap).

Myzomela rubrata kurodai Kuroda, in Momiyama, Birds Micronesia, 1922, p. 74 (Yap); Mathews, Syst, Avium Australasianarum, 2, 1930, p. 743 (Yap); Hand-list Japanese Birds (part), rev., 1932, p. 172 (Yap); Hand-list Japanese Birds (part), 3d ed., 1942, p. 190 (Yap).

Myzomela cardinalis kurodai Mayr, Birds Southwest Pacific, 1945, p. 299 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—Adult male: According to Momiyama (1922:17), *M. c. kurodai* is "Similar to *M. r. saffordi* Wetmore from Southern Marianne islands, but the tarsus is decidedly shorter, not exceeding 21 mm. (more than 21 mm. in *M. r. saffordi*), and the colour of plumage is not so much tinged with vermillion. It differs from *M. r. rubratra, M. r. dichromata,* and *M. r. wetmorei* by the body measuring much shorter, and by the scarlet colour of plumage being less pronounced. The length of bill in *M. r. wetmorei* and *kurodai* is nearly the same."

Adult female: According to Momiyama (1922:17), "Upper-parts of body dark olivaceous brown; under-parts, including chin, throat and fore neck like upper-parts, but somewhat paler; breast and abdomen yellowish ashy-white;

head, lower back, rump, upper tail-coverts, chin, throat as well as lower breast tinged with scarlet (the red colour more distinct on lower back but less so on lower breast); pale olive margin to the outer web of flight-feathers."

Measurements.—Measurements are listed in table 48.

Specimens examined.—Total number, 2 males, from Caroline Islands, AMNH—Yap (Sept.).

Remarks.—This subspecies is tentatively recognized as distinct from *M. c. kobayashii* of Palau. No female has been examined, and the two males seen and the description by Momiyama indicate that the population at Yap closely resembles the one at Palau. The Hand-list of Japanese Birds (Hachisuka *et al.*, 1932:172) places the birds from Yap and Palau in the same subspecies.

Myzomela cardinalis kobayashii Momiyama

Cardinal Honey-eater

Myzomela rubratra kobayashii Momiyama, Birds Micronesia, 1922, p. 19. (Type locality, Pelew Islands.)

Cinnyris rubrater Lesson (part), Dict. Sci. Nat., éd., Levrault, 50, 1827, p. 30 (Pelew); *idem* (part), Voy. "La Coquille," Zool., 1, 1828, p. 678 (Pelew); *idem* (part), Man. d'Ornith., 2, 1828, p. 55 (Pelew).

Myzomela rubratra Gray (part), Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 11 (Pelew); Hartlaub (part), Proc. Zool. Soc. London, 1867 (1868), p. 829 (Pelew); Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 5, 116, 118 (Pelew); Gray (part), Hand-list Birds, 1, 1869, p. 154 (Pelew); Hartlaub and Finsch (part), Proc. Zool. Soc. London, 1872, pp. 89, 94 (Pelew); Finsch (part), Journ. Mus. Godeffroy, 8, 1875, pp. 4, 16 (Palau); *idem* (part), Journ. Mus. Godeffroy, 12, 1876, pp. 17, 26 (Palau); Forbes (part), Proc. Zool. Soc. London, 1879, p. 270 (Pelew); Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Palau); Gadow, Cat. Birds British Mus., 9, 1884, p. 129 (Pelew); Tristram, Cat. Birds, 1889, p. 206 (Pelew); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 31 (Pelew); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 202 (Palaos); Nehrkorn, Kat. Eiers., 1899, p. 79 (Palau-inseln); Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 57 (Pelew); Reichenow (part), Die Vögel, 2, 1914, p. 482 (Palau); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Pelew).

Myzomela rubratra Nehrkorn (part), Journ. f. Ornith., 1879, p. 397 (Palau); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Palau); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 55 (Pelew); Kuroda, Dobutsu. Zasshi, 28, 1916, p. 71 (Pelew).

Myzomela rubratra kobayshii Kuroda, in Momiyama, Birds Micronesia, 1922, p. 74 (Pelew); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 722 (Pelew).

Myzomela rubratra kurodai Hand-list Japanese Birds (part), rev., 1932, p. 172 (Palau); Hand-list Japanese Birds (part), 3d ed., 1942, p. 190 (Babelthuap, Koror, Peleliu).

Mizomela rubratra kurodai Yamashina, Tori, 10, 1940, p. 674 (Palau).

Myzomela cardinalis kobayashii Mayr, Birds Southwest Pacific, 1945, p. 299 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 72 (Peleliu).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Angaur.

Characters.—Adult male: Resembles *M. c. rubratra,* but smaller and with red coloring darker, near "scarlet-red"; margins of wing feathers olivaceous. Differs from adult males of other subspecies of *M. cardinalis* by red coloring of feathers being darker.

Adult female: Resembles adult female of *M. c. dichromata* but red coloring darker, top of head only partly red; abdomen, under tail-coverts, and axillaries buff-gray; outer edges of wing and tail feathers light olive. Differs from adult females of other subspecies of *M. cardinalis* by having top of head only partly red.

Immature male: Resembles adult male, but red coloring lighter and thinly distributed; wings and tail browish-olive; abdomen and under tail-coverts grayish.

Immature female: Resembles adult female, but red coloring paler and underparts more buffy and less grayish.

Measurements.—Measurements are listed in table 48.

Specimens examined.—Total number, 42 (28 males, 11 females, 3 unsexed), as follows: Palau Islands, USNM—Koror, 4 (Nov.)—Peleliu, 11 (Aug. 29, 30, 31, Sept. 1, 5); AMNH—exact locality not given, 27 (Oct., Nov., Dec.).

Molt.—Many of the specimens taken from late August to December are in molt. Of the adult males obtained during this period almost a half had enlarged testes.

Food habits.—Stomachs of specimens obtained by the NAMRU2 party in August and September, 1945, contained vegetable matter, seeds and small insects.

Remarks.—Honey-eaters were found by the NAMRU2 party in open woodlands, in coconut groves and about human habitations. They were not seen in dense jungle areas, and appeared to prefer the plantation areas.

The Cardinal Honey-eater at Palau is distinguished from other subspecies of *M. cardinalis* in Micronesia by its deeper red coloring. In size, it closely resembles the bird at Yap and in the Marianas.

Evolutionary history of Myzomela cardinalis in Micronesia.—The genus *Myzomela* is found in Australia, northward to Timor, Tenimber, Moluccas, Celebes, Melanesia, Polynesia and Micronesia. The range of the species *M. cardinalis* includes the islands from the eastern Solomons, New Hebrides, and Loyalty Islands east to central Polynesia and north to Micronesia. It appears likely that *M. cardinalis* was derived, probably along with *M. nigrita*, *M. lafargei* and others, from an ancestral stock in the Melanesian area. Within the species *M. cardinalis* there is one group of subspecies which exhibits a marked degree of sexual dimorphism, with the males having a much greater amount of red coloration than the females. These subspecies occur in the southern part of the range of the species (Loyalty, Santa Cruz, New Hebrides, and Samoa islands). A second group of subspecies exhibit a lesser amount of sexual dimorphism, the females possessing more of the red coloration and resembling the males more closely. This second group includes subspecies which occur in the more northern part of the range of the species (Solomons, Micronesia, and Rotuma islands). The males of the various subspecies of *M. cardinalis* vary one from another considerably less than do the females.

Figure 16 shows the probable routes of colonization used by *M. cardinalis* to attain its present distribution in the Pacific islands. The subspecies in the eastern Solomon Islands (*M. c. pulcherrima* Ramsey and *M. c. sanfordi* Mayr) may be representative of the first colonization by the supposed ancestral stock. From a focal point in this area, *M. cardinalis* has dispersed by what may be considered as

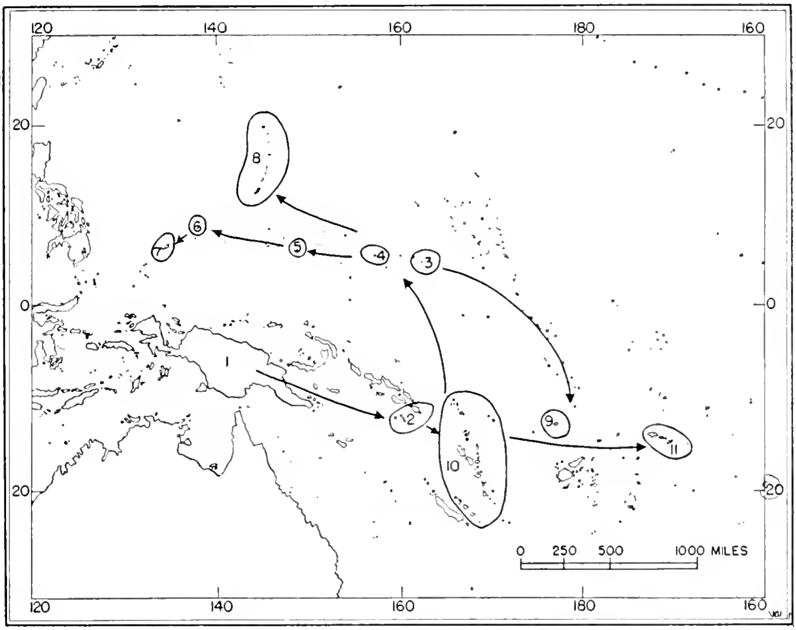

FIG. 16. Geographic distribution of *Myzomela cardinalis* and routes of its dispersal. (1) Probable center of dispersal of *Myzomela;* (2) ranges of *M. c. sanfordi* and *M. c. pulcherrima* in the Solomon Islands; (3) *M. c. rubratra;* (4) *M. c. dichromata;* (5) *M. c. major;* (6) *M. c. kurodai;* (7) *M. c. kobayashii;* (8) *M. c. saffordi;* (9) *M. c. chermesina;* (10) range of *M. cardinalis* in the Santa Cruz, New Hebrides, Banks and Loyalty islands; (11) *M. c. nigriventris.*

two routes. One route evidently was to the south as far as the Loyalty Islands with a side branch extending to the Samoan Islands where *M. c. nigriventris* Peale occurs. The second route extended north to the islands of Micronesia. The Caroline Islands were seemingly inhabited initially, with invasions of the Palaus made via Yap, and of the Marianas via Kusaie or Ponapé (as indicated by the comparison of specimens). Mayr (in conversation) has pointed out the close relationship between the subspecies in Micronesia and *M. c.*

chermesina Gray of Rotuma Island. This subspecies at Rotuma, which is located between Santa Cruz and Samoa, resembles closely *M. c. dichromata* of Ponapé, especially in the case of the female. It is evident that the honey-eater arrived at Rotuma from Micronesia, rather than from the Solomon and Santa Cruz area to the west.

Zosterops conspicillata conspicillata (Kittlitz)

Bridled White-eye

Dicaeum conspicillatum Kittlitz, Kupfertaf. Naturgesch. Vögel, 2, 1833, p. 15, pl. 19, fig. 1. (Type locality, Guaham.)

Dicaeum conspicillatum Kittlitz, Mém. Acad. Imp. Sci. St. Pétersbourg, 2, 1835, p. 3, pl. 4 (Guaham); *idem,* Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 305 (Guaham).

Zosterops conspicillatum Bonaparte, Consp. Avium, 1, 1850, p. 398 (Mariann. = Guam).

Zosterops conspicillata Reichenbach, Syn. Avium, 1852, p. 92 (Guaham); Hartlaub, Journ. f. Ornith., 1854, p. 187 (Mariannen = Guam); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 16 (Guam); Hartlaub, Journ. f. Ornith., 1865, pp. 5, 17 (Guaham); Gray, Hand-list Birds, 1, 1869, p. 163 (Ladrone = Guam); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 95 (Guaham); Giebel, Thes. Ornith., 3, 1877, p. 775 (Ladrone = Guam); Gadow, Cat. Birds British Mus., 9, 1884, p. 187 (Guam); Wiglesworth, Abhand. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Guam); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 205 (Guam); Hartert (part), Novit. Zool., 5, 1898, p. 57 (Guam); Hartert, Novit. Zool., 7, 1900, p. 3 (Guam); Matschie (part), Journ. f. Ornith., 1901, pp. 112, 113 (Guam); Seale, Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 58 (Guam); Finsch (part), Das Tierreich, no. 15, 1901, p. 37 (Guam); Safford, Osprey, 1902, p. 69 (Guam); Dubois, Syn. Avium, 1, 1902, p. 711 (Guam); Safford, The Plant World, 7, 1904, p. 264 (Guam); *idem,* Contr. U. S. Nat. Herb., 9, 1905, p. 79 (Guam); Takatsukasa and Kuroda (part), Tori, 1, 1901, p. 64 (Marianne = Guam); Cox, Island of Guam, 1917, p. 21 (Guam); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 706 (Guam); Bryan, Guam. Rec., vol. 13, no. 2, 1936, p. 25 (Guam); Strophlet, Auk, 1948, p. 540 (Guam).

Zosterops conspicillatus Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 76 (Guam).

Zosterops conspicillata conspicillata Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 227 (Guam); Hand-list Japanese Birds, rev., 1932, p. 173 (Guam); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Guam); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Guam); *idem,* Birds Southwest Pacific, 1945, p. 299 (Guam); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, pp. 72, 73 (Guam).

Geographic range.—Micronesia: Mariana Islands—Guam.

Characters.—Adult: A small white-eye with upper parts near "serpentine green," becoming slightly lighter on the rump; orbital ring broad and white; fronto-loral band light yellowish-white; auriculars grayish-green; chin and throat yellowish-white; breast and abdomen dingy yellow; wing and tail feathers dark brown with greenish-yellow edges; upper mandible horn colored, lower mandible lighter yellow; legs and feet dark olive-gray; iris light umber. Adult female may be lighter on underparts.

Immature: Resembles adult, but underparts paler yellow and upper mandible light yellowish-brown.

Measurements.—Measurements of *Z. c. conspicillata* are listed in table 50. Males and females have measurements which are nearly equal.

TABLE 50. MEASUREMENTS OF THE SUBSPECIES OF *Zosterops conspicillata*

SUBSPECIES	No.	Wing	Tail	Full culmen	Tarsus
Z. c. conspicillata	43	56 (52-59)	41 (37-43)	13.5 (13.0-14.5)	19 (18-20)
Z. c. saypani	29	52 (50-55)	38 (35-40)	12.5 (12.0-13.5)	18 (17-19)
Z. c. rotensis	3	53 (51-55)	42 (42-43)	13.0 (13.0-13.5)	18 (18-19)
Z. c. semperi	28	55 (54-57)	38 (36-41)	12.5 (12.0-13.5)	18 (17-19)
Z. c. owstoni	22	55 (52-57)	36 (34-38)	12.5 (12.0-13.0)	19 (18-20)
Z. c. takatsukasai	16	54 (53-55)	36 (34-39)	13.0 (13.0-14.0)	19 (19-20)

Weights—The author (1948:73) records the weights of 11 adult males as 9.5-14.0 (10.5), of 3 adult females as 8.0-10.0 (9.3).

Specimens examined.—Total number, 61 (33 males, 17 females, 11 unsexed), as follows: Mariana Islands, USNM—Guam, 27 (May 24, 29, 30, June 2, 3, 25, 28, July 12, 18, 19, 20, 23, 26, Sept., Oct. 8); AMNH—Guam, 34 (Jan., March, July, Aug., Sept., Nov., Dec.).

Nesting.—Seale (1901:58) reports the taking of one nestling and three nests with eggs of the bridled white-eye at Guam in the period from May to July. The NAMRU2 party obtained little evidence of nesting in late May to July. Three males taken in the period of June and July had enlarged gonads. Hartert (1898:57) records several nests taken in February and March at Guam. He writes, "The nest is a fairly deep cup, placed in the fork of a branch, woven together of fine grasses and roots, and on the outside ornamented with cobwebs, wool and cottonwood, varying in width from 8 to 5 cm. The clutches consist of 2 or 3 eggs. The eggs are pale blue, like all *Zosterops* eggs. They measure 18:13, 17:13.2, 17:12.2, 15.5:12:5, 17:13.5, and between these measurements." Coultas obtained specimens with enlarged gonads in August. According to Oustalet (1895:207), Marche found nests and young in May or June.

Remarks.—Kittlitz obtained the Bridled White-eye at Guam, when he visited the island, in March, 1828. He found the birds common and they reminded him of titmice. Marche obtained a series of 21 skins at Guam in August and September, 1887, and in February and March, 1888. Seale (1901:58) observed the birds in flocks of 10 to 20 in roadside bushes and in waste areas. He mentions that their principal foods are insects. The NAMRU2 party found the birds to be restricted to certain areas on Guam, where they were found in small flocks moving about in low trees. They were taken at only five localities, two of these being at the northern end of the island in vegetation along the high, coastal cliffs. The other localities were in the central part of the island in low trees in the uplands. Strophlet (1946:540) found them in grasslands on the foothills. Arvey (field notes) saw a flock of 12 white-eyes at Mount Tenjo in July, 1946.

The white-eye is a very active bird, always moving rapidly through the vegetation or flying across open areas to disappear into scrub foliage. As they move about they make a twittering sound, which is considered to be a flocking call.

Zosterops conspicillata saypani Dubois

Bridled White-eye

Zosterops conspicillata Saypani Dubois, Syn. Avium, 1, 1902, p. 711. (Type locality, Saypan.)

Zosterops conspicillata Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 205 (Saypan); Hartert (part), Novit. Zool., 5, 1898, p. 57 (Saipan); Finsch (part), Das Tierreich, no. 15, 1901, p. 37 (Saipan); Matschie (part), Journ. f. Ornith., 1901, pp. 112, 113 (Saipan); Prowazek, Die deutschen Marianen, 1913, p. 101 (Saipan); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Marianne = Saipan).

Zosterops conspicillata var. *saypani* Snouckaert, Alauda, (2), 3, 1931, p. 22 (Saypan).

Zosterops conspicillatus Kuroda (part), in Momiyama, Birds Micronesia, 1922; p. 76 (Saipan).

Zosterops saipani Mathews, Syst. Avium Australasianarum, 2, 1930, p. 706 (Saipan).

Zosterops conspicillata saipani Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 227 (Saipan); Hand-list Japanese Birds, rev., 1932, p. 173 (Saipan, Tinian); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Saipan, Tinian); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Tinian, Saipan); *idem*, Birds Southwest Pacific, 1945, p. 299 (Saipan, Tinian); Downs, Trans. Kansas Acad. Sci., 49, 1946, p. 104 (Tinian); Stott, Auk, 64, 1947, p. 527 (Saipan); Baker, Smithson, Misc. Coll., vol. 107, no. 15, 1948, p. 73 (Saipan, Tinian).

Zosterops conspicillatus saipani Yamashina, Tori, 7, 1932, p. 398 (Tinian).

Geographic range.—Micronesia: Mariana Islands—Tinian, Saipan.

Characters.—Adult: Resembles *Z. c. conspicillata,* but slightly smaller with fronto-loral band more greenish yellow; auriculars olivaceous; orbital ring narrower; upper parts brighter olive; underparts pale yellowish-white; bill darker. Birds from Saipan resemble closely birds from Tinian, but upper parts may be slightly brighter and underparts slightly more yellowish; iris chestnut.

Measurements.—Measurements are listed in table 50. Twenty-three birds from Tinian measure: wing, 51 (50-53); tail, 38 (35-41); full culmen, 12.0 (12.0-13.0); tarsus, 18 (17-18); six birds from Saipan measure: wing, 54 (52-55); tail, 37 (35-39); full culmen, 13.0 (13.0-15.0); tarsus, 18 (17-19). Birds from Saipan are slightly larger than birds from Tinian.

Specimens examined.—Total number, 33 (18 males, 13 females, 2 unsexed), as follows: Mariana Islands, USNM—7 (Oct. 7, 8, 9, 10, 23); AMNH—26 (July, Aug., Sept.).

Nesting.—Yamashina (1932a:398) records the taking of three nests of the Bridled White-eye at Tinian on January 8, 1932. The nests contained one, two, and three eggs, respectively. The color of the eggs is uniformly pale blue; the nests were situated two to four meters from the ground. Oustalet (1895:207) writes that Marche obtained records of nesting at Saipan in the period from

May to July. Of 18 birds taken by Coultas at Tinian in September, 1931, one-half of them had enlarged gonads.

Molt.—Specimens examined that were taken in July, August, September, and October have molting plumage.

Remarks.—Marche obtained the first skins of this white-eye at Saipan; he got 23 specimens in May, June, and July, 1887. The population at Saipan was initially considered similar to that at Guam; it was later given subspecific separation by Dubois. The birds at Tinian exhibit some differences from the birds at Saipan, and it is possible that these two populations should be regarded as subspecifically distinct from one another.

In 1931, Coultas (field notes) found this white-eye common at Saipan and Tinian. He writes "The little fellow has adjusted himself to the gardens and shrubs in the villages. He is a seed eater and makes himself at home now around human habitation. I have seen him climbing over potted plants on the window ledges of dwellings. His cheerful little sibilation uttered continuously while at work or while on the wing makes him friends wherever he goes. He is no longer a bird of the forest as he has none here to go to." Several observers in the late war have published notes on this white-eye. Stott (1947:527) writes that he was reminded of the bush-tit (*Psaltriparus*) when he observed the behavior of this white-eye; Moran (1946:262) writes that it is "Similar in size and behavior to our vireos." Gleise (1945:220) estimated the population of white-eyes at Tinian at 500 plus in 1945. Downs (1946:104-105) found the birds to be abundant at Tinian; he found them in small flocks in low brush or trees and at edges of open fields as well as elsewhere. He saw a white-eye eating "a large green fuzzy caterpillar."

Zosterops conspicillata rotensis Takatsukasa and Yamashina

Bridled White-eye

Zosterops semperi rotensis Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 486. (Type locality, Rota.)

Zosterops semperi Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 207 (Rota); Hartert (part), Novit. Zool., 5, 1898, p. 57 (Rota); Finsch (part), Das Tierreich, no. 15, 1901, p. 30 (Rota); Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 58 (Rota); Dubois (part), Syn. Avium, 1, 1902, p. 710 (Rota); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Marianne=Rota).

Zosterops semperi semperi Momiyama (part), Birds Micronesia, 1922, p. 23 (Rota); Kuroda, (part) in Momiyama, Birds Micronesia, 1922, p. 75 (Rota).

Zosterops semperi rotensis Snouckaert, Alauda. (2), 4, 1932, p. 459 (Rota); Yamashina, Tori, 7, 1932, p. 399 (Rota); Hand-list Japanese Birds, rev., 1932, p. 178 (Rota).

Zosterops conspicillata rotensis Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Rota); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Rota); *idem,* Birds Southwest Pacific, 1945, p. 299 (Rota); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 73 (Rota).

Geographic range.—Micronesia: Mariana Islands—Rota.

Characters.—Adult: Upper parts and sides of neck between "warbler green" and "pyrite yellow" becoming lighter on the rump; auriculars light yellowish-green; orbital ring white; fronto-loral band narrowly tinged with yellow; underparts dingy yellow; wing and tail feathers dark with light greenish-yellow edges; upper mandible light brown; lower mandible light yellowish-brown; feet light brown.

Resembles *Z. c. conspicillata,* but brighter greenish-yellow above; chin and throat yellow like rest of underparts; fronto-loral band tinged with bright yellow; auriculars resemble closely the upper parts in color; narrow orbital ring.

Measurements.—Measurements are listed in table 50.

Specimens examined.—Total number, 5 (3 males, 1 female, 1 unsexed), from Mariana Islands, USNM—Rota (Oct. 18, 20, 22).

Nesting.—Yamashina (1932a:399) records the taking of one nest containing two eggs at Rota on March 7, 1931.

Molt.—Specimens taken in October were in molt.

Remarks.—Oustalet (1895:207) reported on two specimens of white-eye taken at Rota by Marche. He considered them as being similar to the birds at Palau. The birds at Rota were named as a separate subspecies by Takatsukasa and Yamashina in 1931. The NAMRU2 party found the birds to be numerous at Rota in October, 1945.

Zosterops conspicillata semperi Hartlaub

Bridled White-eye

Zosterops semperi Hartlaub, in Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 117. (Type locality, Pelew Islands.)

Zosterops semperi Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 95 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 16, pl. 4, fig. 1 (Palau); Giebel, Thes. Ornith., 3, 1877, p. 777 (Pelew); Nehrkorn, Journ. f. Ornith., 1879, p. 396 (Palau); Finsch (part), Journ. f. Ornith., 1880, p. 286 (Palau); *idem* (part), Ibis, 1881, p. 111 (Pelew); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Palau); Gadow (part), Cat. Birds British Mus., 9, 1884, p. 183 (Pelew); Tristram, Cat. Birds, 1889, p. 212 (Pelew); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Pelew); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Palaos); Hartert (part), Novit. Zool., 5, 1898, p. 57 (Pelew); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Finsch (part), Das Tierreich, no. 15, 1901, p. 30 (Palau); Seale (part), Occ. Papers Bernice P. Bishop Mus., 1, 1901, p. 58 (Pelew); Dubois (part), Syn. Avium, 1, 1902, p. 710 (Palau); Takatsukasa and Kuroda (part), Tori, 1, 1915, pp. 55, 64 (Pelew).

Zosterops semperi semperi Hartert, Novit. Zool., 7, 1900, p. 2 (Pelew); Momiyama (part), Birds Micronesia, 1922, pp. 22, 23 (Pelew); Kuroda (part), in Momiyama, Birds Micronesia, 1922, p. 75 (Pelew); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 705 (Pelew); Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 486 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 174 (Palau).

Zosterops conspicillata semperi Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 227 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Babelthuap, Koror, Peliliu); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Palau); Mayr, Birds Southwest Pacific, 1945, p. 299 (Palau); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1945, p. 73 (Garakayo).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu.

Characters.—Adult: Resembles adult of *Z. c. rotensis,* but fronto-loral band lighter yellow, and coloring is usually not continuous above; auriculars paler; breast and abdomen paler yellow; maxilla and feet darker; mandible whitish. Resembles adult of *Z. c. conspicillata,* but brighter greenish-yellow above; coloring of chin and throat like that of rest of underparts; auriculars colored like back; fronto-loral band narrowly tinged with bright yellow and not completely connected above; orbital ring narrow; iris grayish-white.

Measurements.—Measurements are listed in table 50.

Specimens examined.—Total number, 30 (15 males, 14 females, 1 unsexed), as follows: Palau Islands, USNM—Babelthuap, 2 (Nov. 27)—Koror, 4 (Nov. 14, 19)—Garakayo, 4 (Sept. 18, 19); AMNH—exact locality not given, 20 (Oct., Nov., Dec.).

Molt.—All birds examined (taken in September, October, and November) are in molting plumage.

Food habits.—At Garakayo, birds were observed in small flocks feeding in low trees. Two stomachs examined, which were from individuals of these flocks, contained very small seeds.

Remarks.—Oustalet (1895:207) first pointed out the realtionship between the Bridled White-eye at Palau and the one at Rota. Hartert (1898:57) thought that the occurrence of the same kind of bird at Palau and at Rota was "very peculiar." It was not until 1931 that Takatsukasa and Yamashina separated the two populations by name.

Coultas (field notes) found the Bridled White-eye to be uncommon in the Palaus in 1931. He observed them in the tops of trees, noting that they were wary and easily frightened away by the shooting of a gun. Coultas writes that he found the birds to be numerous at Peleliu; in 1945, the NAMRU2 party did not find the birds at that island. The only locality where they were found to occur was on the small island of Garakayo where the writer shot four Bridled White-eyes on September 18 and 19. He found two or three small flocks in low trees near the summit of a hill on the island. Approximately 25 birds were in this area.

Zosterops conspicillata owstoni Hartert

Bridled White-eye

Zosterops semperi owstoni Hartert, Novit., Zool., 7, 1900, p. 2. (Type locality, Ruk.)

Zosterops semperi semperi Finsch (part), Journ. f. Ornith., 1880, p. 287 (Ruck); *idem* (part), Proc. Zool. Soc. London, 1880, p. 575 (Ruk); *idem* (part), Ibis, 1881, p. 110 (Ruk); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Gadow (part), Cat. Birds British Mus., 9, 1884, p. 183 (Central Carolines = Truk); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Ruk); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Ruk); Hartert (part), Novit. Zool., 5, 1898, p. 57 (Ruk); Nehrkorn, Kat. Eiers, 1899, p. 80 (Ruk).

Zosterops semperi owstoni Dubois, Syn. Avium, 1, 1902, p. 710 (Ruk); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 223 (Truk); Momiyama, Birds Micronesia, 1922, p. 24 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 75 (Ruk); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 705 (Ruk); Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 496 (Ruk); Yamashina, Tori, 7, 1932, p. 400 (Truk); Hand-list Japanese Birds, rev., 1932, p. 174 (Truk).

Zosterops owstoni Finsch, Das Tierreich, no. 15, 1901, p. 31 (Ruk); Matschie (part), Journ. f. Ornith., 1901, pp. 112, 113 (Ruck); Reichenow, Die Vögel, 2, 1914, p. 470 (Karolinen=Truk); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 55, 64 (Ruk).

Zosterops conspicillata owstoni Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 277 (Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Truk); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Truk); *idem*, Birds Southwest Pacific, 1945, p. 299 (Truk); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, pp. 73, 74 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk.

Characters.—Adult: Resembles adult of *Z. c. semperi,* but upper parts darker olive and less yellowish-green; fronto-loral band deeper yellow; auriculars slightly darker; black line on lores and under eye more distinct; underparts deeper yellow; abdomen with greenish tinges. Resembles adult of *Z. c. rotensis,* but upper parts duller, more green and less yellow; fronto-loral band lighter and less distinct, coloring near that of *Z. c. semperi;* auriculars darker green; underparts slightly darker, more olive-green and less yellow.

Measurements.—Measurements are listed in table 50.

Specimens examined.—Total number, 23 (12 males, 10 females, 1 unsexed), as follows: Caroline Islands, USNM—Truk, 3 (Feb. 16); AMNH—Truk, 20 (Feb., March, May, Nov.).

Nesting.—Yamashina (1932a:400) records the taking of a nest with one egg at Truk in May. Hartert (1900:2) records nests containing single eggs taken at Truk from May to July. Nests were found in bushes and trees four to eight feet above the ground. The eggs are pale blue. He gives measurements of seven eggs.

Remarks.—Kubary obtained the first specimens of the Bridled White-eye at Truk. Hartert described the population as a new subspecies using material taken by Owston's collectors. The bird was named in honor of Alan Owston. McElroy of the NAMRU2 party visited Truk in December, 1945. He found this white-eye in the mountainous areas at Moen and Udot islands.

Zosterops conspicillata takatsukasai Momiyama

Bridled White-eye

Zosterops semperi takatsukasai Momiyama, Birds Micronesia, 1922, p. 22. (Type locality, Ponapé.)

Zosterops semperi (part), Finsch, Journ. f. Ornith., 1880, p. 286 (Ponapé); *idem* (part), Proc. Zool. Soc. London, 1880, p. 575 (Ponapé); *idem* (part), Ibis, 1881, p. 115 (Ponapé); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Finsch (part), Mitth. Ornith. Ver. Wien, 1884, p. 48 (Ponapé); Gadow (part), Cat. Birds British Mus., 9, 1884, p. 183 (Central Carolines, Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Ponapé); Oustalet (part), Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Ponapi); Finsch, Das Tierreich, no. 15, 1901, p. 30 (Ponapé); Dubois (part), Syn, Avium, 1, 1902, p. 710 (Ponapé); Takatsukasa and Kuroda (part), Tori, 1, 1915, pp. 55, 64 (Ponapé).

Zosterops owstoni Matschie (part), Journ. f. Ornith., 1901, pp. 112, 113 (Ponapé).

Zosterops semperi takatsukasai Kuroda, in Momiyama, Birds Micronesia, 1922, p.

76 (Ponapé); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 705 (Ponapé); Snouchaert, Alauda, (2), 3, 1931, p. 22 (Ponapé); Takatsukasa and Yamashina, Tori, 7, 1932, p. 400 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 174 (Ponapé).

Zosterops conspicillata takatsukasai Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 227 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 193 (Ponapé); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Ponapé); *idem*, Birds Southwest Pacific, 1945, p. 299 (Ponapé); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 73 (Ponapé).

Zosterops conspicillata Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: Resembles adult of *Z. c. semperi*, but slightly smaller with fronto-loral area more sulfur-yellow; underparts brighter, especially the coloring of the abdomen and under tail-coverts; iris light chestnut.

Measurements.—Measurements are listed in table 50.

Specimens examined.—Total number, 20 (10 males, 9 females, 1 unsexed) from Caroline Islands, AMNH—Ponapé (Nov., Dec.).

Nesting.—Yamashina (1932a:400) records nests and eggs of *Z. c. takatsukasai*. The nests, each containing a single egg, were taken on July 10 and 20, 1931. Coultas (field notes) writes that the nest consists of a small, cup-shaped structure of grasses and hair. The natives told him that two eggs were laid. In birds taken by Coultas in November the gonads were beginning to enlarge; specimens taken in December had swollen gonads. From the evidence at hand, it would appear that the Bridled White-eye at Ponapè breeds at two periods of the year, the winter and the summer.

Molt.—Specimens examined, which were taken by Coultas in November and December, are in fresh plumage.

Remarks.—In 1931, Coultas (field notes) found this white-eye to be rare at Ponapé. He obtained almost every one that he saw to get his series of 20 specimens. He found the birds usually in pairs around yellow-flowering bushy trees. A specimen taken by Richards had "small insects" in its stomach.

Zosterops conspicillata hypolais Hartlaub and Finsch

Bridled White-eye

Zosterops hypolais Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 95. (Type locality, Uap.)

Zosterops hypolais Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 122 (Yap); Giebel, Thes. Ornith., 3, 1877, p. 776 (Carolinae = Yap); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 (Yap); Gadow, Cat. Birds British Mus., 9, 1884, p. 186 (Uap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Uap); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Uap); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 60 (Yap); Finsch, Das Tierreich, no. 15, 1901, p. 24 (Yap); Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Yap); Dubois, Syn. Avium, 1, 1902, p. 708 (Uap); Reichenow, Die Vögel, 2, 1914, p. 469 (Karolinen = Yap); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Mackenzie = Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 76 (Yap); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 700 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Yap).

Zosterops conspicillata hypolais Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 227 (Yap); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Yap); *idem*, Birds Southwest Pacific, 1945, p. 299 (Yap).

Zosterops hyolais Hand-list Japanese Birds, rev., 1932, p. 173 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—According to Hartlaub and Finsch (1872:95), "Upper parts of a pale greyish green, throat and under tail-coverts a pure but very pale whitish-yellow; breast and abdomen of a mixed pale grey and pale yellow; wing- and tail-feathers pale blackish, margined with greenish colour of the back; under wing-coverts and inner margins of remiges white; eye-ring indistinct; beak fuscous, the under mandible paler, except at the tip; feet plumbeous."

Remarks.—No specimen has been examined by me. I am following Stresemann (1931:227) in placing the Bridled White-eye at Yap as a subspecies of *Z. conspicillata.* This is one arrangement; the committee who prepared the Hand-list of Japanese Birds (1942: 192) treat this bird as a separate species. The Japanese probably have more specimens of this bird than anyone else and may be in a better position to judge its taxonomic status. Specimens of this white-eye were taken by Fisher in 1946 at Yap. His report (soon to be published) may throw additional light on the degree of distinctness of *Z. c. hypolais.* On the basis of published descriptions it is evident that *Z. c. hypolais* has a few characters in common with other members of the species.

Evolutionary history of Zosterops conspicillata.—The small olive-green and yellow white-eyes of Micronesia have been considered as belonging to several species by authors in the past. As late as 1930, Mathews (1930; 700, 706) placed them in four species. Stresemann (1931a:227) put them all in the species *Z. conspicillata,* an arrangement which is being followed in this report. It is evident, however, that these subspecies of *Z. conspicillata* can be associated into three groups. The author (1948:73) states that *Z. c. conspicillata* and *Z. c. saypani* have pale chins and throats, light fronto-loral bands. blackish coloring at the bend of the wings and broad, white orbital rings. Another group, *Z. c. rotensis, Z. c. semperi, Z. c. owstoni,* and *Z. c. takatsukasai,* have bright yellow chins and throats, matching the rest of the underparts, obscure fronto-loral bands, which are narrowly tinged with yellow, yellowish coloring at the bend of the wings, and narrow, white orbital rings. *Z. c. hypolais* apparently falls into a third group by itself, as indicated by the published descriptions. There is apparently some variation in the color of the eyes of these subspecies; they may be either whitish or chestnut in color. The data are insufficient to determine the significance of this color character.

Z. conspicillata is restricted to Micronesia and appears to have little close relationship to other species of the genus. *Z. conspicil-*

lata shows little affinity to white-eyes to the north and northwest of Micronesia belonging to the species *Z. japonica,* of which representatives are found in the Bonin and Volcano islands. *Z. conspicillata* shows greater affinity to species found to the west and to the south of Micronesia.

It may have colonized Micronesia from the south or southeast (Polynesia), even though the species is absent at Kusaie; however, *Z. conspicillata* shows more relationships to species now living to the westward and the southwestward, and it probably invaded Micronesia from some place in that direction. *Z. conspicillata* differs from species found in Melanesia and Malaysia chiefly in color of the forehead, lores, fronto-loral band, crown, nape, breast, abdomen, orbital ring, and bill. Also there are differences in the breadth of the orbital ring.

Z. conspicillata shows evidence of relationships with *Z. nigrorum* of the Philippines and *Z. montanus* of the Philippines and other parts of Malaysia. *Z. nigrorum* resembles *Z. c. semperi* of Palau in size, but is brighter yellow-green above with a darker and less curved bill and brighter underparts. The fronto-loral band and the lores are colored the same in *Z. nigrorum* and *Z. c. semperi. Z. montanus* resembles *Z. conspicillata* especially in size and in shape of the bill. *Z. lutea intermedia* of the Makassar area shows some affinity to *Z. conspicillata,* although the bill is heavier. The Micronesia species also bears a close resemblance to *Z. griseotincta* of the Papuan region. This is especially true of *Z. c. takatsukasai* at Ponapé; however, *Z. griseotincta* has a heavier and larger bill. *Z. lateralis* from southern Melanesia and Australia is not very different from *Z. conspicillata* aside from its grayish and brownish coloring.

Z. conspicillata probably was derived from an ancestral stock which came to Micronesia from the Philippine or Moluccan area, rather than directly from Melanesia. *Z. conspicillata* seemingly shows the closest resemblance to *Z. nigrorum* or to some of its relatives in the Australo-Moluccan area. The subspecies at Palau, *Z. c. semperi,* appears to be the connecting link. Whether the form at Yap represents an independent colonization is not known; such might also be true in the case of the subspecies at Guam and at Saipan and Tinian. If these are considered as separate colonizations, then the populations can be regarded as separate species. Mayr, (in conversation) has pointed out the affinity of the white-eye at Samoa, *Z. samoensis,* with *Z. conspicillata* and suggests that *Z. samoensis* is derived from the Micronesian species.

Zosterops cinerea cinerea (Kittlitz)

Micronesian Dusky White-eye

Drepanis cinerea Kittlitz, Kupfertaf. Naturgesch. Vögel, 1, 1832, p. 6, pl. 8, fig. 2. (Type locality, Ualan = Kusaie.)

Drepanis cinerea Kittlitz, Mém. Acad. Imp. Sci., St. Pétersbourg, 2, 1835, p. 4, pl. 5 (Ualan); *idem,* Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 285 (Ualan); Reichenbach, Syn. Avium, 1853, p. 242 (Ualan); Kittlitz, Denkw. Reise, russ. Amer. Micron. und Kamchat., 1, 1858, p. 367 (Ualan).

Zosterops cinerea Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 131 (Ualan); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 16 (Oualan); *idem,* Hand-list Birds, 1, 1869, p. 163 (Caroline = Kusaie); Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 96 (Ualan); Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 27 (Ualan); *idem,* Ibis, 1881, pp. 107, 108 (Kuschai); Gadow, Cat. Birds British Mus., 9, 1884, p. 198 (Kushai); Tristram, Cat. Birds, 1889, p. 210 (Kuschai); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 36 (Ualan); Hartert, Kat. Vogelsamml., Senckenb., 1891, p. 31 (Ualan); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Oualan); Finsch, Das Tierreich, no. 15, 1901, p. 45 (Kusaie); Dubois, Syn. Avium, 1, 1902, p. 713 (Kusaie); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 55, 64 (Kusaie); Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 224 (Kusaie); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 230 (Kusaie); Hand-list Japanese Birds, rev., 1932, p. 173 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Kusaie).

Dicaeum cinereum Hartlaub, Journ. f. Ornith., 1854, p. 168 (Carolinen = Kusaie).

Zosterops cinereus Finsch, Journ. Mus. Godeffroy, 8, 1875, p. 17 (Ualan); *idem,* Journ. f. Ornith., 1880, pp. 286, 297, 300 (Kuschai); *idem,* Mitth. Ornith. Ver. Wien, 1884, p. 48 (Kuschai).

Zosterops Kittlitzi Finsch, Journ. f. Ornith., 1880, p. 300 (Type locality, Kusaie); Reichenow and Schalow, Journ. f. Ornith., 1881, p. 94 (Kusaie?).

Tephras cinereus Matschie, Journ. f. Ornith., 1901, pp. 111, 112, 113 (Ualan).

Tephras cinerea Kuroda, in Momiyama, Birds Micronesia, 1922, p. 77 (Kusaie); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 712 (Oualan).

Zosterops cinerea cinerea Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Kusaie?); *idem,* Birds Southwest Pacific, 1945, p. 300 (Kusaie).

Geographic range.—Micronesia: Caroline Islands—Kusaie.

Characters.—Adult: A small, dusky white-eye with upper parts smoky olivaceous-gray; lores dingy white; auriculars brownish; no white orbital ring; wing and tail feathers dark brownish-gray with paler greenish-gray outer edges; underparts pale ashy-gray, chin lighter, flanks darker; bill black; feet light brown; iris brown.

Measurements.—Measurements of *Z. cinerea* are listed in table 51. Males and females have approximately equal measurements.

TABLE 51. MEASUREMENTS OF *Zosterops cinerea*

SUBSPECIES	No.	Wing	Tail	Culmen	Tarsus
Z. c. cinerea................	47	63 (60-65)	37 (35-39)	15.0 (14.0-16.5)	20 (19-20)
Z. c. ponapensis............	38	59 (57-61)	38 (36-40)	13.5 (13.0-14.5)	20 (18-21)
Z. c. finschii................	30	65 (63-67)	43 (40-46)	17.5 (16.0-18.5)	21 (20-23)

Specimens examined.—Total number, 50 (33 males, 17 females), as follows: Caroline Islands, USNM—Kusaie, 1 (Feb. 9); AMNH—Kusaie, 49 (Jan., Feb., March).

Nesting.—Coultas found that approximately one-half of the males which he obtained in March, 1931, had swollen gonads.

Molt.—Many of the birds obtained in January and February were molting, and many of those obtained in March were in fresh plumage.

Remarks.—Coultas obtained a large series of these birds at Kusaie in 1931, where he found them to be common.

Zosterops cinerea ponapensis Finsch

Micronesian Dusky White-eye

Zosterops ponapensis Finsch, Proc. Zool. Soc. London, 1875 (1876), p. 643. (Type locality, Ponapé.)

Zosterops ponapensis Finsch, Journ. Mus. Godeffroy, 12, 1876, pp. 17, 27, pl. 2, fig. 1 (Ponapé); *idem.* Proc. Zool. Soc. London, 1877 (1878), p. 778 (Ponapé); Nehrkorn, Journ. Mus. Godeffroy, 1879, p. 396 (Ponapé?); Finsch, Journ. f. Ornith., 1880, pp. 286, 300 (Ponapé); *idem*, Ibis. 1881, pp. 110, 111, 115 (Ponapé); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Ponapé); Finsch, Mitth. Ornith. Ver. Wien, 1884, p. 48 (Ponapé); Gadow, Cat. Birds British Mus., 9, 1884, p. 198 (Ponapé); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 36 (Ponapé); Bolau, Mitteil. Naturhist. Mus. Hamburg. 1898, p. 60 (Ponapé); Nehrkorn, Kat. Eiers., 1899, p. 80 (Ponapé); Finsch, Das Tierreich, no. 15, 1901, p. 46 (Ponapé); Dubois, Syn. Avium, 1, 1902, p. 713 (Ponapé); Reichenow, Die Vögel, 2, 1914, p. 470 (Ponapé); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 55, 65 (Ponapé); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 230 (Ponapè); Yamashina, Tori, 7, 1932, p. 397 (Ponapé); Hand-list Japanese Birds, rev., 1932, p. 173 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Ponapé).

Tephras ponapensis Matschie, Journ. f. Ornith., 1901, pp. 111, 112, 113 (Ponapé); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 77 (Ponapé); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 712 (Ponapé).

Zosterops ponapenensis Wetmore, in Townsend and Wetmore, Bull. Mus. Comp. Zoöl., 63, 1919, p. 224 (Ponapé).

Zosterops cinerea ponapensis Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Ponapé?); *idem*, Birds Southwest Pacific, 1945, p. 300 (Ponapé).

Geographis range.—Micronesia: Caroline Islands——Ponapé.

Characters.—Adult: Resembles adult of *Z. c. cinerea*, but smaller with upper parts umber-brown, forehead pale gray; underparts mostly pale gray, sides of breast and abdomen brownish-buff;; under tail-coverts pale buffy-gray.

Measurements.—Measurements are listed in table 51.

Specimens examined.—Total number, 47 (28 males, 17 females, 2 unsexed), as follows: Caroline Islands, USNM—Ponapé, 1 (Feb. 11); AMNH—Ponapé, 46 (Nov., Dec.).

Nesting.—Yamashina (1931a:397-398) describes two nests of *Z. c. ponapensis*, each containing one egg. These were taken at Ponapé on August 4 and 11, 1931. The nests were located 2.5 meters from the ground. The eggs are light blue and pale greenish-blue in color; one measures 18.5 by 13.5. He writes, "The nest consists of two layers, the inner and the outer. The outer layer is made of fine roots, fibers, leaves and petals, interwoven with a large quantity of cotton-wool, and the inner layer is made of fibers of fine roots only." Coultas found that a large number of birds taken in November had enlarged gonads, especially the males; in December, fewer birds with swollen gonads were obtained.

Remarks.—Coultas found this white-eye to be common at Ponapé, when he visited that island in November and December, 1930. He observed the birds in flocks and found them noisy and quarrelsome. They feed in bushes and small trees on seeds and insects. Richards obtained "small large-seeded blackish berries" from the stomach of a female from Ponapé. He found the birds to frequent low altitudes in and about native gardens.

Zosterops cinerea finschii (Hartlaub)

Micronesian Dusky White-eye

Tephras finschii Hartlaub, in Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, p. 6, pl. 3. (Type locality, Pelew Islands.)

Tephras finschii Hartlaub and Finsch, Proc. Zool. Soc. London, 1868, pp. 117, 118 (Pelew Islands).

Zosterops finschii Gray, Hand-list Birds, 1, 1869, p. 164 (Pelew); Gadow, Cat. Birds British Mus., 9, 1884, p. 197 (Pelew); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 60 (Palau).

Zosterops finschi Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, pp. 89, 96 (Pelew); Finsch, Journ. Mus. Godeffroy, 8, 1875, pp. 4, 17 (Palau); *idem*, Journ. Mus. Godeffroy, 12, 1876, p. 27 (Palau); Giebel, Thes. Ornith., 3, 1877, p. 775 (Pelew); Finsch, Journ. f. Ornith., 1880, p. 300 (Pelew?); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 407 (Palau); Tristram, Cat. Birds, 1889, p. 211 (Pelew); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 36 (Pelew); Finsch, Das Tierreich, no. 15, 1901, p. 45 (Palau); Dubois, Syn. Avium, 1, 1902, p. 713 (Pelew); Reichenow, Die Vögel, 2, 1914, p. 470 (Palau); Takatsukasa and Kuroda, Tori, 1, 1915, pp. 55, 64 (Pelew); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 230 (Palau); Hand-list Japanese Birds, rev., 1932, p. 173 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Babelthuap, Koror).

Tephras finschi Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Palau); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 77 (Pelew); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 712 (Pelew).

Zosterops cinerea finschi Mayr, Birds Southwest Pacific, 1945, p. 300 (Palau).

Zosterops cinerea finschii Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 74 (Peleliu, Garakayo).

Geographic range.—Micronesia: Palau Islands—Babelthuap, Koror, Garakayo, Peleliu, Ngabad.

Characters.—Adult: Resembles adult of *Z. c. cinerea*, but upper parts mostly browner; wing and tail feathers browner; head blacker; rump lighter than back; auriculars grayish-brown; lores dark; sides of head and neck brownish; underparts mostly dark; chin and throat smoky gray; breast and abdomen more brown less gray; sides, flanks and under tail-coverts brown. Resembles adult of *Z. c. ponapensis*, but larger with underparts more buffy; upper parts darker.

Measurements.—Measurements are listed in table 51.

Specimens examined.—Total number, 37 (15 males, 19 females, 3 unsexed), as follows: Palau Islands, USNM—Babelthuap, 1 (Nov. 27)—Koror, 3 (Nov. 4, 5)—Garakayo, 6 (Sept. 18)—Peleliu, 5 (Aug. 27, Sept. 10); AMNH—exact locality not given, 22 (Oct. Nov., Dec.).

Molt.—Many of the specimens of *Z. c. finschii* taken in the period from August to December show evidences of molt. Some of the birds taken in November and in December appear to be in fresh plumage. All three subspecies of *Z. cinera* evidently undergo a period of molt in the late summer and fall.

Remarks.—The Micronesian Dusky White-eye of Palau was found on several of the islands of the southern Palaus by the NAMRU2 party in 1945. The bird was observed in flocks of five or more individuals moving rapidly through the foliage of trees and shrubs. It was not found in the dense, undisturbed jungle areas, but rather in second growth vegetation and along the margins of woodlands. At Peleliu, birds were noted in trees and shrubs along the roadways; at Garakayo, birds were seen in low trees near the summits of hills. At Garakayo, *Z. cinerea* and *Z. conspicillata* were found in the same areas near the tops of the hills. Both species appeared to be feeding on seeds of the same trees (unidentified but resembling the hibiscus). *Z. cinerea* was more numerous than *Z. conspicillata* and appeared (from observations made on September 18, 1945) to be the dominant species and was seen to chase the smaller *Z. conspicillata* away. Coultas (field notes) found *Z. cinerea* "fairly common" in 1931 at Palau.

Evolutionary history of Zosterops cinerea.—The dusky white-eyes of Micronesia were considered as separate species until 1944, when Mayr (1944b:7) treated them as conspecific, stating that the bird at Ponapé has characters intermediate between those at Kusaie and Palau. Earlier, Hartert (1900:3) suggested a close association between *Z. cinerea* and the species at Truk (now *Rukia ruki*). Mayr concludes that *Z. cinerea* and *R. ruki* are not closely related, and points out that the absence of a white orbital ring in *Z. cinerea* does not necessarily mean that the bird should be considered as belonging to a genus other than *Zosterops*.

The pathway of colonization and the ancestral stock of *Z. cinerea* are not certainly known. Among the white-eyes of the Polynesian, Melanesian and Malayan areas, there are few kinds which *Z. cinerea* resembles closely. Mayr (1941b:204) writes that the *Z. cinerea* at Ponapé was derived from either Polynesia or Papua. I find little in common between *Z. cinerea* and the species in these areas, and in my opinion *Z. cinerea* is closest to *Z. atriceps* of the Moluccas. *Z. atriceps* has plumage which is part grayish and part brownish. Its underparts resemble those of *Z. c. cinerea* but are paler gray; crown, neck, and shoulder much like that of *Z. c. ponapensis* and *Z. c. finschii;* and bill resembling that of *Z. c. cinerea*. *Z. atriceps* differs by having olive-green coloring on back and wings and yellowish coloring on under side of tail. Thus, it is possible that *Z. cinerea* invaded Micronesia from the Moluccan region, reaching either Palau or Ponapé initially.

Rukia palauensis (Reichenow)

Palau Greater White-eye

Cleptornis palauensis Reichenow, Journ. f. Ornith., 1915, p. 125. (Type locality, Babeldzuap = Babelthuap, Palauinseln.)

Megazosterops palauensis Stresemann, Ornith. Monatsber., 38, 1930, p. 159 (Baobeltaob); Snouckaert, Alauda (2), 3, 1931, p. 26 (Palau); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 235 (Baobel Taob = Babelthuap); Mathews, Ibis, 1931, p. 48 (Palau); Hand-list Japanese Birds, rev., 1932, p. 172 (Palau); Yamashina, Tori, 10, 1940, p. 674 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 191 (Babelthuap, Peleliu).

Rukia palauensis Mayr, Amer. Novit., no. 1269, 1944, p. 7 (Palau); *idem*, Birds Southwest Pacific, 1945, pp. 294, 300 (Peliliu); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, pp. 67, 74 (Peleliu).

Geographic range.—Micronesia: Palau Islands-Babelthuap, Peleliu.

Characters.—Adult: A large white-eye with upper parts near "Saccardo's olive" (some individuals darker brown), head and neck more olivacious, rump browner; auriculars blackish with pale yellow streaks; narrow supra-orbital stripe pale olive; orbital ring indistinct; underparts near "olive lake," chin lighter, under tail-coverts light yellowish-brown; wing and tail feathers dark brown, except for tawny outer edges and whitish inner edges; maxilla horn-color; mandible yellowish to tawny; feet tawny; iris grayish-brown.

Measurements.—Measurements of *Rukia* are listed in table 52. Measurements of males and females are comparable within the same species.

TABLE 52. MEASUREMENTS OF *Rukia*

SPECIES	No.	Wing	Tail	Culmen	Tarsus
R. palauensis	19	80 (76-84)	54 (51-57)	21.5 (20.0-22.5)	25 (24-26)
R. ruki	8	81 (76-85)	52 (51-52)	21.5 (20.0-23.0)	23 (22-24)
R. sanfordi	18	70 (67-71)	44 (41-47)	23.0 (22.0-24.0)	21 (20-22)

Specimens examined.—Total number, 21 (12 males, 9 females), as follows: Palau Islands, USNM—Peleliu, 11 (Aug. 27, 29, 30, Sept. 4, 5, 6, 7, Dec., 4, 5); AMNH—Peleliu?, 10 (Dec.).

Molt.—Specimens taken in August and September are in worn plumage, a few individuals show evidence of molt. Specimens taken in December are in fresh plumage, although two or three individuals are in the final stages of molt. This places the period of molt as September, October, and November. Nesting evidently occurs in the summer; one male taken on August 27, 1945, had enlarged gonads.

Remarks.—The Palau Greater White-eye was described under the generic name *Cleptornis* by Reichenow. This generic allocation was not followed by subsequent authors; Stresemann proposed the generic name *Megazosterops* in 1930, and Mayr (1944b:7) placed this white-eye in the genus *Rukia* along with other large white-eyes from Micronesia. In employing this name, Mayr writes, "The generic names *Rukia* (for *ruki*) and *Kubaryum* (for *oleaginea*) were published simultaneously in the same publication. As first reviser I select the name *Rukia,* which not only is shorter but is also based on a species which I have been able to examine."

R. palauensis is recorded from Babelthuap and Peleliu of the Palau Islands. In 1931, Coultas found the birds only at the island of Peleliu, where he obtained nine specimens from a flock. In 1940, Yamashina (1940:674) writes that it is a very rare species at Palau. Marshall (1949:219) found the bird at Peleliu but at no other islands visited. In 1945, the NAMRU2 party obtained eight specimens at Peleliu from two localities on the eastern side of the island in jungle areas relatively undisturbed by war activities. The birds were fairly common in the brush and vines of the jungle undergrowth at these two areas. There were no flocks seen; usually singles or pairs were noted. The bird bears a striking resemblance to *Psamathia annae,* which lives in the same environment and has a somewhat similar coloration, shape and posture. These two birds probably have undergone a parallel development. Competition between the two was not noted. *Psamathia* is evidently less restricted in its distribution.

R. palauensis has a restricted distribution in the Palau Islands, as indicated by the observations of Coultas, the Japanese and the NAMRU2 party. The disturbance resulting from the war activities has undoubtedly influenced the population and restricted further the preferred habitat of this white-eye, especially at Peleliu.

Rukia oleaginea (Hartlaub and Finsch)

Yap Greater-White-eye

Zosterops oleaginea Hartlaub and Finsch, Proc. Zool. Soc. London, 1872, p. 95. (Type locality, Uap.)

Zosterops oleaginea Gräffe, Journ. Mus. Godeffroy, 2, 1873, p. 122 (Yap); Gadow, Cat. Birds British Mus., 9, 1884, p. 187 (Yap); Finsch, Das Tierreich, no. 15, 1901, p. 24 (Yap); Dubois, Syn. Avium, 1, 1902, p. 708 (Uap); Reichenow, Die Vögel, 2, 1914, p. 469 (Karolinen=Yap); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Mackenzie); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 230 (Yap); Hand-list Japanese Birds, rev., 1932, p. 173 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 192 (Yap).

Zosterops oleagina Giebel, Thes. Ornith., 3, 1877, p. 777 (Mackenzie); Schmeltz and Krause, Ethnogr. Abth. Mus. Godeffroy, 1881, p. 391 ((Yap); Wiglesworth, Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 37 (Uap); Oustalet, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 7, 1895, p. 208 (Uap); Bolau, Mitteil. Naturhist. Mus. Hamburg, 1898, p. 60 (Yap).

Tephras oleaginea Matschie, Journ. f. Ornith., 1901, pp. 112, 113 (Yap).

Kubaryum oleaginus Momiyama, Birds Micronesia, 1922, p. 1 (Yap); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 77 (Yap).

Kubaryum oleagineum Mathews, Syst. Avium Australalianarum, 2, 1930, p. 712 (Yap).

Rukia oleaginea Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Yap); *idem*, Birds Southwest Pacific, 1945, p. 300 (Yap).

Geographic range.—Micronesia: Caroline Islands—Yap.

Characters.—According to Hartlaub and Finsch (1872:95), "General colour a deep oil-green, with a decided fulvous hue; underparts a little paler, and a little more yellowish; eye-ring satin-white; ears blackish; upper and under tail coverts with a slight rufous tinge; wing- and tail-feathers blackish, with oil-green margins; under wing-coverts whitish-grey; beak fulvous, under mandible, except at the tip, yellowish; feet pale, probably yellow; iris reddish white."

Remarks.—No specimens of *R. oleaginea* have been examined by me, and I am following Mayr (1944b:7) in including it with the other large white-eyes of Micronesia in the genus *Rukia.*

Rukia ruki (Hartert)

Truk Greater White-eye

Tephras ruki Hartert, Bull. British Ornith. Club, 7, 1897, p. 5. (Type locality, Ruk.)

Tephras ruki Hartert, Ibis, 1898, p. 144 (Ruk); *idem*, Novit. Zool., 7, 1900, p. 3 (Ruk); Matschie, Journ. f. Ornith., 1901, pp. 111, 112, 113 (Ruck); Mathews, Syst. Avium Australasianarum, 2, 1930, p. 712 (Ruk).

Zosterops ruki Finsch, Das Tierreich, no. 15, 1901, p. 46 (Ruk); Dubois, Syn. Avium, 1, 1902, p. 713 (Ruk); Reichenow, Die Vögel, 2, 1914, p. 470 (Ruk); Takatsukasa and Kuroda, Tori, 1, 1915, p. 64 (Ruk); Stresemann, Mitt. Zool. Mus. Berlin, 17, 1931, p. 230 (Truk); Hand-list Japanese Birds, rev., 1932, pp. 172 (Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 191 (Truk).

Rukia ruki Momiyama, Birds Micronesia, 1922, p. 2 (Ruk); Kuroda, in Momiyama, Birds Micronesia, 1922, p. 78 (Ruk); Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Truk); *idem*, Birds Southwest Pacific, 1945, p. 301 (Truk).

Geographic range.—Micronesia: Caroline Islands—Truk.

Characters.—According to Hartert (1897:5), "Entirely sepia-brown, the inner webs of the remiges and under wing-coverts lighter, inclining to whitish; the primaries darker, the outer webs bordered with the same colour as the back. Bill black; iris red; tarsi and feet orange-rufous; claws mouse-brown." *R. ruki* may be distinguished from other species of *Rukia* by its dark olive-brown coloring.

Measurements.—Measurements are listed in table 52.

Specimens examined.—Total number, 7 (4 males, 2 females, 1 unsexed), from Caroline Islands, AMNH—Truk (Nov., Dec.).

Remarks.—This white-eye was first obtained by Owston's collectors in 1895 at Truk. Hartert (1900:3) writes, "It is most peculiar that the late J. Kubary, who was an excellent collector, and who spent more than fourteen months on Ruk, did not obtain this bird. It is probably not numerous, and occurs only on a certain secluded spot not visited by Kubary." In like manner, *R. palauen-*

sis was not described from Palau until 1915, although several collectors had visited the island at previous times. Hartert included the Truk Greater White-eye in the genus *Tephras* of Hartlaub. Later, Momiyama (1922:2) made this bird the type for his new genus *Rukia*, in which Mayr has placed all of the large white-eyes of Micronesia.

Rukia sanfordi (Mayr)

Ponapé Greater White-eye

Rhampozosterops sanfordi Mayr, Ornith. Monatsber., 39, 1931 [mailing date, Nov. 4, 1931, *ex* Mayr, 1944b:8], p. 182. (Type locality, Ponapé.)

Cinnyrorhyncha longirostra Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931 [printed date, Oct. 15, 1931, but mailing date for extra-Japanese recipients, Nov. 23, 1931, *ex* Mayr, 1944b:8], p. 599. (Type locality, Ponapé); Hand-list Japanese Birds, rev., 1932, p. 172 (Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 191 (Ponapé).

Cinnyrorhyncha longirostris Mathews, Ibis, 1933, p. 94 (Ponapé).

Rhamphozosterops sanfordi Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Rukia sanfordi Mayr, Amer. Mus. Novit., no. 1269, 1944, p. 7 (Ponapé); *idem*, Birds Southwest Pacific, 1945, p. 301 (Ponapé).

Geographic range.—Micronesia: Caroline Islands—Ponapé.

Characters.—Adult: upper parts buffy-olive, head greenish, rump and upper tail-coverts buffy-brown; wing and tail feathers dark brown, outer edges yellowish-olive; underparts grayish-buff, chin and throat faintly washed with greenish-yellow; under tail-coverts darker; bill long, curved and brownish-black, base of mandible paler; feet yellowish; iris chestnut. *R. sanfordi* is distinguished from other species of *Rukia* by its smaller size, its paler coloration and its longer and more curved bill.

Measurements.—Measurements are listed in table 52.

Specimens examined.—Total number, 18 (12 males, 6 females), from Caroline Islands, AMNH—Ponapé (Nov., Dec.).

Remarks.—Coultas obtained this white-eye at Ponapé in 1931; he writes (field notes) that it is "a very rare bird on Ponapé. I found them at one tree, a sort of a gum-tree, at about 2,000 feet, where they were collecting from the flowers of the tree. I was attracted by their deep-throated sibilation that is uttered while feeding. They were not in the least disturbed by the noise of the gun and remained long enough for me to collect a substantial series. One old man, who lives not far from the tree, was the only one I could find who knew the bird." Six males and one female taken in December had swollen gonads. Richards found this bird to be rare at Ponapé in 1947-1948. He writes (field notes) that the bird was seen twice (he obtained one male), once in deep forest at about 700 feet and once at the summit of Jokaj at 900 feet. He observed a group of three birds "wildly and loudly chasing one another from tree to tree." The male obtained had yellowish sap adhering to its bill.

The Ponapé Greater White-eye has an appearance very much like that of some of the honey-eaters. Takatsukasa and Yamashina (1931c:599) write, "General appearance very much like either *Cinnyris* or *Myzomela,* but it differs from them by its very small first primary, which is far shorter than the primary coverts, and also the smooth cutting edge of the bill, though the bill is similarly shaped as to that of *Cinnyris.* These characteristics show that this bird belongs to *Zosteropidae* but not *Nectarinidae* or *Meliphagidae.*"

Mayr and the Japanese workers, Takatsukasa and Yamashina, published descriptions of this white-eye at Ponapé almost simultaneously. Mayr (1944b:8) contends that his name, *Rhamphozosterops sanfordi,* is valid because the mailing date of the journal (Ornithologische Monatsberichte) in which *R. sanfordi* was proposed was November 4, 1931, while his investigations show that the earliest mailing date to European and American ornithologists and libraries of the issue of Dobutsugaku Zasshi in which the name *Cinnyrorhyncha longirostra,* proposed by Takatsukasa and Yamashina, appeared was November 23, 1931. Mayr (1944b:8) points out that Japanese friends of the authors of the name *C. longirostra* assert that they saw copies of the description [inferentially printed copies] prior to November 23, 1931. These Japanese, as far as is known, have not claimed that they saw copies before November 4, 1931, and Mayr's conclusion that his name, *R. sanfordi,* has priority is here accepted. If the name *C. longirostra* Takasukasa and Yamashina appeared in printed form and if copies, in requisite number, were distributed to specialists or libraries in Japan, or anywhere else, on or before November 3, 1931, the name *C. longirostris* has priority over R. *sanfordi.*

Evolutionary history of Rukia in Micronesia.—There is little known concerning the status of the large white-eyes of Micronesia. Most of them were not found by the earlier collectors and are at present reported to be rare or restricted in their distribution. Little is known concerning the food preferences and nesting activities of the birds and also whether they are actually in danger of extermination or whether their populations are normally as low as have been reported. Originally described under four different generic names, they are now considered as belonging in a single genus, *Rukia.*

I have compared specimens of *Rukia* with those of other members of the family Zosteropidae found in the Pacific area. *Rukia* is apparently not closely related to *Z. conspicillata* and *Z. cinerea* of Micronesia but has been derived from a different source or sources.

The author has compared *Rukia* with the genera *Zosterops, Woodfordia, Hypocryptadius, Apoia, Chlorocharis, Pseudozosterops,* and *Tephrozosterops.* Results of these comparisons indicate that large and well-differentiated white-eyes are found on a number of the islands of Oceania. These white-eyes include *Woodfordia, Rukia, Zosterops inornata, Z. albogularis, Z. tenuirostris,* and *Z. strenua.* These birds are all large, have large bills (either longer or stouter or both), large and long tarsi, and often short and rounded wings. *Rukia* apparently has undergone a differentiation which parallels that which has taken place in these other white-eyes, but there is no evidence of a close relationship between these birds and *Rukia.* There are some resemblances between *Rukia* and *Woodfordia superciliosa* of Rennell Island; *W. superciliosa* is the same size and has a bill somewhat similar to that of *R. ruki* and a coloration not very different from that of *R. sanfordi. R. ruki* and *R. sanfordi* may have been derived originally from a common ancestral stock in Melanesia, with subsequent isolation on small islands for considerable time where differentiation took place. *Rukia* also shows some resemblance to the genus *Apoia,* especially to *A. pinaiae* of Ceram. There is also a possibility that the large white-eyes of Micronesia are merely highly modified species of the genus *Zosterops;* this has been suggested by Mayr (1944b:7). It is my opinion that *Rukia* is a valid genus and is as much different from the genus *Zosterops* (or more so) than other recognized genera of large white-eyes (*Woodfordia* and *Apoia*). There is also the strong possibility that the large white-eyes of Micronesia have been derived from more than one source (and are falsely united in one genus); however, it is my feeling that they represent a single colonization, which successfully established itself at four islands and evolved into four divergent species. Possibly *R. oleaginea* is the least specialized and is closest to the ancestral stock; however, this supposition is based on study of the original description and on a colored plate of the bird in a paper by Kuroda (1922b:pl. 7, fig. 4).

In summary, it seems that the large Micronesian white-eyes of the genus *Rukia* came originally from Melanesia. Possibly they came from Malaysia. Probably the birds have been derived from a single ancestral stock, that became established at four islands of Micronesia and became differentiated along diverse lines, so much so that some ornithologists have considered them as belonging to separate endemic genera.

Erythrura trichroa trichroa (Kittlitz)

Blue-faced Parrot-finch

Fringilla trichroa Kittlitz, Mém. Acad. Imp. Sci. St. Pétersbourg, 2, 1835, p. 8, pl. 10. (Type locality, Ualan = Kusaie.)

Fringilla trichroa Kittlitz, Obser. Zool., in Lutké, Voy. "Le Séniavine," 3, 1836, p. 285 (Ualan); *idem,* Denk. Reise russ. Amer. Micron. und Kamchat., 2, 1858, p. 38 (Ualan).

Estrelda trichroa Gray, Genera Birds, 2, 1849, p. 369 (Kusaie?); Gray, Cat. Birds Trop. Is. Pacific Ocean, 1859, p. 27 (Oualan).

Erythrura trichroa Bonaparte, Consp. Avium, 1, 1850, p. 457 (Ualan); Hartlaub, Archiv f. Naturgesch., 18, 1852, p. 133 (Carolinen = Kusaie); *idem,* Journ. f. Ornith., 1854, p. 168 (Carolinen = Kusaie); Gray, Hand-list Birds, 2, 1870, p. 58 (Ualan); Giebel, Thes. Ornith., 2, 1875, p. 118 (Carolinen = Ualan); Finsch, Journ. Mus. Godeffroy, 12, 1876, p. 36 (Ualan); *idem* (part), Journ. f. Ornith., 1880, pp. 290, 297, 302 (Kusaie); *idem* (part), Ibis, 1881, pp. 104, 108 (Kuschai); Salvadori (part), Ornith. Papuasia, 2, 1881, p. 442 (Carolinis = Kusaie?); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 281 (Kusaie); Sclater (part), Ibis, 1881, p. 545 (Ualan); Sharpe (part), Cat. Birds British Mus., 13, 1890, p. 385 (Carolines = Kusaie); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 42 (Ualan); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ualan); Dubois (part), Syn. Avium, 1, 1902, pp. 583 (Carolines = Kusaie); Takatsukasa and Kuroda (part), Tori, 1, 1915, p. 64 (Kusaie).

Erythrura kittlitzi Bonaparte, Consp. Avium, 1, 1850, p. 457 (*ex* Bonaparte MSS.) (Type locality, Ualan); Gray, Hand-list Birds, 2, 1870, p. 58 (Caroline Islands= Kusaie).

Erythrura trichros trichros Hartert (part), Novit. Zool., 7, 1900, p. 6 (Kusaie); Kuroda (part), in Momiyama, Birds Micronesia, 1922, pp. 27, 29, 78 (Kusaie); Mayr (part), Amer. Mus. Novit., no. 489, 1931, p. 4 (Kusaie); Takatsukasa and Yamashina, Tori, 7, 1931, p. 110 (Kusaie); Hand-list Japanese Birds, rev., 1932, p. 170 (Kusaie); Hand-list Japanese Birds, 3d ed., 1942, p. 189 (Kusaie); Mayr, Birds Southwest Pacific, 1945, p. 302 (Kusaie).

Chloromunia trichroa trichroa Mathews (part), Syst. Avium Australasianarum, 2, 1930, p. 840 (Ualan).

Geographic range.—Micronesia: Caroline Islands—Kusaie.

Characters.—Adult: A small finch with thick, stout bill; head, neck, back, and scapulars between "parrot green" and "grass green"; forehead, orbital area, auriculars, and malar area bluish; sides of neck green tinged with yellowish; edge of forehead and lores blackish; wing-coverts and outer margins of wings yellowish-green; underparts like back but paler green; rump, upper tail-coverts and outer edges of tail feathers near "Pompeian red"; wing and tail feathers mostly brownish; bend of wing greenish; under wing-coverts brownish; axillaries buffy tinged with greenish; bill black; feet light yellowish-brown; iris brown. Adult female duller than male.

Immature: Resembles adult, but lacks bluish coloring on sides of head and on forehead; underparts washed with buffy brown; rump and tail duller carmine.

Measurements.—Measurements are listed in table 53.

Specimens examined.—Total number, 14 (12 males, 2 females), from Caroline Islands, AMNH—Kusaie (Feb., March, April).

Molt.—Specimens taken in February and March have mostly new feathers, molt having been almost completed when obtained.

Remarks.—Kittlitz was the first person to describe the Blue-faced Parrot-finch; he found it at Kusaie when he visited the island in the winter of 1827-28. Later, it was found to have an extensive range in

TABLE 53. MEASUREMENTS OF *Erythrura trichroa* in Micronesia

SUBSPECIES	No.	Wing	Tail	Culmen	Tarsus
E. t. trichroa	6	58 (57-59)	46 (43-48)	13.0 (12.5-13.5)	17 (16-17)
E. t. clara	29	59 (57-62)	45 (41-50)	13.5 (13.0-14.5)	17 (17-18)
*E. t. pelewensis**	1	61.5	51	13.5	18

* Kuroda (1922:28).

Micronesia, Melanesia, northern Australia, Celebes, and the Moluccas. This small finch may be kept as a pet in a cage by native peoples, but as far as I know there is no evidence that the bird has been introduced to island areas as a result of this practice.

Coultas observed the finch at Kusaie in 1931; he wrote (field notes) that it is a common bird but difficult to obtain. He found it in most parts of the island and at all elevations; the bird appeared to prefer dense underbrush of the jungle or marginal vegetation. He found no evidence of breeding activity in February, March or April.

Erythrura trichroa clara Takatsukasa and Yamashina

Blue-faced Parrot-finch

Erythrura trichroa clara Takatsukasa and Yamashina, Tori, 7, 1931, p. 110. (Type locality, Ruk Island.)

Erythrura trichroa Finsch (part), Journ. f. Ornith., 1880, p. 290 (Ponapé, Hügeln = Truk); *idem*, Proc. Zool. Soc. London, 1880, p. 576 (Ruk); *idem* (part), Ibis, 1881, pp. 104, 110, 112, 115 (Ponapé); Schmeltz and Krause (part), Ethnogr. Abth. Mus. Godeffroy, 1881, p. 353 (Ruk); Salvadori (part), Ornith. Papuasia, 2, 1881, p. 442 (Ponapé); Sclater (part), Ibis, 1881, p. 545 (Ponapé, Ruk); Sharpe (part), Cat. Birds British Mus., 13, 1890, p. 385 (Carolines = Truk, Ponapé); Wiglesworth (part), Abhandl. und Ber. Zool. Mus. Dresden, no. 6, 1890-1891 (1891), p. 42 (Ponapé, Ruk); Nehrkorn, Kat. Eiers, 1899, p. 122 (Ruk); Matschie (part), Journ. f. Ornith., 1901, p. 112 (Ruk, Ponapé); Dubois (part), Syn. Avium, 1, 1902, p. 583 (Carolines = Ponapé); Takatsukasa and Kuroda (part), Tori, 1, 1915, pp. 55, 64 (Ponapé); Mayr, Proc. 6th Pacific Sci. Congr., 4, 1941, p. 204 (Ponapé).

Erythrura trichroa trichroa Hartert (part), Novit. Zool., 7, 1900, p. 6 (Ruk, Ponapé); Kuroda (part), in Momiyama, Birds Micronesia, 1922, pp. 27, 28, 29, 78 (Ponapé, Ruk); Mayr (part), Amer. Mus., Novit., no. 489, 1931, p. 4 (Ponapé, Ruk).

Chloromunia trichroa Mathews, Birds Australia, 12, 1925, p. 208 (Ruk).

Chloromunia trichroa trichroa Mathews (part), Syst. Avium Australasianarum, 2, 1930, p. 840 (Carolines = Truk, Ponapé).

Erythrura trichroa clara Hand-list Japanese Birds, rev., 1932, p. 170 (Truk, Ponapé); Hand-list Japanese Birds, 3d ed., 1942, p. 189 (Truk, Ponapé); Mayr, Birds Southwest Pacific, 1945, p. 302 (Truk, Ponapé); Baker, Smithson. Misc. Coll., vol. 107, no. 15, 1948, p. 74 (Truk).

Lobospingus trichroa clara Mathews, Ibis, 1933, p. 96 (Ruk, Ponapé).

Geographic range.—Micronesia: Caroline Islands—Truk, Ponapé, Lukunor?

Characters.—Adult: Resembles adult of *E. t. trichroa,* but slightly larger with underparts more yellowish and less greenish; blue on head slightly paler;

sides of neck tinged more strongly with yellowish. Birds from Ponapé are slightly paler than those from Truk.

Measurements.—Measurements are listed in table 53. Birds from Ponapé and Truk differ but little in measurements.

Specimens examined.—Total number, 39 (22 males, 16 females, 1 unsexed), as follows: Caroline Islands, USNM—Truk, 2 (May 5, Dec.); AMNH—Truk, 15 (March, June, Nov.) —Ponapé, 22 (Dec.).

Molt.—Birds taken in March and June are not in molt. Some of the specimens obtained in November and December are in molt.

Remarks.—The differences between *E. t. trichroa* at Kusaie and *E. t. clara* at Ponapé and Truk are slight. Takatsukasa and Yamashina (1931d:110) separate *E. t. clara* from *E. t. trichroa* of Kusaie on the basis of a paler blue coloring on head, body more yellowish green and sides of neck more distinctly golden-yellow.

Coultas obtained specimens at Ponapé in 1930 and reports (field notes) that the bird occurs in the extensive grassland areas of the island but that the numbers are small. He estimates the population to be less than 100 individuals. He learned that the Japanese had trapped them for shipment to Japan as caged birds. Coultas writes that the finch at Ponapé "is very shy and flies readily when he is disturbed. As soon as a call of alarm is uttered the whole flock flies up from the ground and heads for the true forest where they will hide. They will also work along in the grass, and make a getaway. The bird has a little hissing sybilation that it utters when on the wing." He found the bird in flocks of 3 to 20; immatures were frequently found alone.

McElroy of the NAMRU2 party obtained a female at Moen Island in the Truk Atoll in December, 1945. He found small flocks of these birds in dense vegetation along streams.

Erythrura trichroa pelewensis Kuroda

Blue-faced Parrot-finch

Erythrura trichroa pelewensis Kuroda, in Momiyama, Birds Micronesia, 1922, p. 27. (Type locality, Pelew Islands).

Erythrura trichroa pelewensis Kuroda, Ibis, 1927, p. 692 (Pelew); Mayr. Amer. Mus. Novit., no. 489, 1931, p. 4 (Pelew); Hand-list Japanese Birds, rev., 1932, p. 171 (Palau); Hand-list Japanese Birds, 3d ed., 1942, p. 189 (Babelthuap); Mayr, Birds Southwest Pacific, 1945, p. 301 (Palau).

Chlorumunia trichroa pelewensis Mathews, Syst. Avium Australasianarum, 2, 1930, p. 840 (Pelew).

Geographic range.—Micronesia: Palau Islands—Babelthuap.

Characters.—Kuroda (1922a:27) describes the bird as follows, "Resembles *E. trichroa* (Kittlitz) from Carolines (the type from Kusaie), but distinguishable from it by the bill being much thicker and stouter, by the chin being tinged with blue, by the under-parts being paler throughout and somewhat tinged with bluish, by the rump and upper tail-coverts being bright crimson instead of dull crimson, by the central tail-feathers brownish red instead of dull crimson, by the distinct shafts of central tail-feathers and by longer wing and tail."

Measurements.—The measurements by Kuroda of a single specimen are listed in table 53.

Remarks.—Only one specimen of this subspecies is known. The NAMRU2 party did not obtain any record of it in the southern Palaus in 1945. If still present in the islands, it may be confined to the higher forested areas of Babelthuap.

Evolutionary history of Erythrura trichroa in Micronesia.—The Blue-faced Parrot-finch has been recorded from Kusaie, Ponapé, Truk and Palau, which are all "high" islands of southern Micronesia. This bird belongs to a species which occurs in Melanesia, northern Australia, Celebes, and the Moluccas. Stresemann (1940: 40) points out the interesting observation that this species ranges only east of Wallace's Line. Mayr (1931c:1-10) has reviewed the parrot-finches of the genus *Erythrura* and places *E. trichroa* in the subgenus *Erythrura*, noting that *E. t. cyaneifrons* from Banks and the New Hebrides is similar to the subspecies found in Micronesia. As a group the subspecies of *E. trichroa* are very similar, but the populations in Micronesia appear closest to subspecies from the Solomons, Admiralty Islands and possibly to *E. t. modesta* from the Moluccas, which appears to indicate that Micronesia was invaded from the south or from the southwest via the Moluccas. Whether the little known subspecies at Palau represents an independent invader from the Moluccas is uncertain.

Lonchura nigerrima minor (Yamashina)

Black-breasted Weaver-finch

Munia (Donacola) hunsteini minor Yamashina, in Takatsukasa and Yamashina, Dobutsu. Zasshi, 43, 1931, p. 600. (Type locality, Ponapé.)

Lonchura hunsteini minor Hand-list Japanese Birds, rev., 1932, p. 171 (Ponapé, Truk); Hand-list Japanese Birds, 3d ed., 1942, p. 190 (Ponapé, Truk).

Donacola hunsteini minor Mathews, Ibis, 1933, p. 95 (Ponapé).

Lonchura nigerrima minor Mayr, Birds Southwest Pacific, 1945, p. 301 (Ponapé, ?Truk).

Geographic range.—Micronesia: Caroline Islands—Ponapé, Truk?

Characters.—Yamashina in Takatsukasa and Yamashina (1931c:600) characterizes this subspecies as similar to *M. hunsteini* from New Ireland, but smaller; the wing of the adult of the bird from Ponapé is from 46 to 49 mm, instead of 50-51 mm. as in the New Ireland bird. Moreover the crown and nape are white instead of pearl gray.

Remarks.—Little is known concerning this subspecies named by

Yamashina at Ponapé. No specimens have been seen by me. Richards obtained one male at Ponapé in 1947-1948. He found the birds in large flocks.

Lonchura punctulata cabanisi (Sharpe)

Philippine Nutmeg Mannikin

Munia cabanisi Sharpe, Cat. Birds British Mus., 13, 1890, p. 353. (Type locality, Luzon.)

Munia punctulata cabanisi Kuroda, in Momiyama, Birds Micronesia, 1922, p. 78 (Yap).

Lonchura punctulata cabanisi Yamashina, Tori, 7, 1932, p. 395 (Yap); Hand-list Japanese Birds, rev., 1932, p. 171 (Yap); Hand-list Japanese Birds, 3d ed., 1942, p. 189 (Yap).

Geographic range.—Philippine Islands and Micronesia. In Micronesia. Palau Islands; Caroline Islands—Yap.

Characters.—A small finch with upper parts light grayish-brown, feathers with white shafts producing a streaked appearance; lores, anterior part of auriculars, malar region, and feathers of chin and throat chocolate-brown with faint white shafts;; breast and sides mottled white and dark brown, middle of abdomen and under tail-coverts pale buffy-white, wings brown with lighter edges, under wing dark with lighter coverts; upper tail-coverts and middle tail feathers dark olive, outer tail feathers colored like wings; bill heavy and black; feet dark brown.

Remarks.—The Philippine Nutmeg Mannikin is a resident on the island of Yap. Yamashina (1932a:395) records a nest containing one egg taken there on May 15, 1932. Marshall (1949:221) records this bird at Palau on November 6 and December 2, 1945. Whether this bird was introduced to Yap and Palau by man or whether it reached there by independent invasion is unknown.

SUMMARY AND CONCLUSION

The avifauna of Micronesia consists of 206 kinds of birds belonging to 37 families and 91 genera. Of these, 30 kinds are sea birds, 29 kinds are migratory shore birds, and 146 kinds are land and fresh-water birds. Of the 30 sea birds, 18 kinds are resident; of the 147 land and fresh-water birds, 104 kinds are resident and 6 kinds have been introduced by man. There are no resident shore birds in Micronesia. The following conclusions can be drawn from this study:

1. The islands of Micronesia are oceanic islands and were seemingly formed independently of any present day continental land mass. Terrestrial organisms have reached these islands by "over-water dispersal." The avifauna of Micronesia has been received from the following sources: Polynesia, Melanesia, the Moluccas, Celebes, Phillipines, and Palearctica (see figure 8).

2. Oceanic birds are among the oldest forms of bird life inhabiting

Micronesia. The presence of elevated islands containing phosphate, resulting from the deposition of guano by oceanic birds, is some indication of the length of time during which these birds have been present. In number of individuals, the oceanic birds inhabiting the inshore zone are more numerous than those inhabiting the offshore and pelagic zones, although twelve of the eighteen resident kinds of oceanic birds prefer the offshore and pelagic zones. Most of the species of oceanic birds resident in Micronesia are circumtropical in distribution; no residents are known in Micronesia which have been derived from Palearctica or the North Pacific. Micronesia has no endemic oceanic birds.

3. On the migratory flights, shore birds reach Micronesia along three distinct flyways, which in this report are named the Asiatic-Palauan Flyway, the Japanese-Marianan Flyway, and the Nearctic-Hawaiian Flyway (see figure 7). The shore birds began to utilize the Pacific islands as wintering grounds by gradually spreading from the Eastern Hemisphere rather than from the Western Hemisphere.

4. More than half (52 percent) of the land birds and fresh-water birds in Micronesia were derived directly from ancestral stocks in Melanesia. The areas of the Moluccas and of Celebes (Malaysia) supplied 21 percent of the birds; the Philippines, 10 percent; Polynesia, 9 percent; and Palearctica, 8 percent. Results of this study show that there may have been only 46 actual colonizations of Micronesia by birds from other areas, and that many of the large number of endemics present have been the result of secondary colonizations within the islands of Micronesia. It is concluded that Micronesia, except for the Marshall Islands, has a much closer affinity to Melanesia than to any other area as regards avifauna. The Marshall Islands may be regarded as a part of the Polynesian Subregion from the viewpoint of avian zoogeography.

5. Endemism in the land birds and fresh-water birds of Micronesia is extreme. Of 104 native, resident birds, 97 (93.5 percent) have become differentiated and can be separated taxonomically from related forms. In Micronesia, there are 5 endemic genera, 31 endemic species, and 76 endemic subspecies. The families containing the greatest number of endemic forms are Muscicapidae (14), Zosteropidae (14), Columbidae (13), and Sturnidae (9).

6. It is concluded that some of the more important factors controlling the dispersal of the bird life to Micronesia are the direction and the intensity of the winds, the small size of the islands, the isolation of the islands (especially those "high" islands), and the insular

climates, which appear to favor colonists from tropical homes rather than those from Palearctic homes.

7. The factors most important in the process of differentiation of birds in the islands of Micronesia are isolation, paucity in numbers of individuals, freedom from predation, absence (and presence) of interspecific and intraspecific strife, and nutrition. The importance of the "dilution" factor is discussed, and the possibility of cross-breeding between different kinds of birds is considered. It is concluded that genetic change altering the phenotypic expression of avian characteristics is no more apt to occur in insular populations than in continental populations, but such changes have a greater chance of being perpetuated in insular populations.

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A Quantitative Study of the Nocturnal Migration of Birds

BY

GEORGE H. LOWERY, JR.

University of Kansas Publications
Museum of Natural History

Volume 3, No. 2, pp. 361-472, 47 figures in text
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This series contains contributions from the Museum of Natural History.
Cited as Univ. Kans. Publ., Mus. Nat. Hist.

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PRINTED BY
FERD VOILAND, JR., STATE PRINTER
TOPEKA, KANSAS
1951

23-1020

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INTRODUCTION

The nocturnal migration of birds is a phenomenon that long has intrigued zoologists the world over. Yet, despite this universal interest, most of the fundamental aspects of the problem remain shrouded in uncertainty and conjecture.

Bird migration for the most part, whether it be by day or by night, is an unseen movement. That night migrations occur at all is a conclusion derived from evidence that is more often circumstantial than it is direct. During one day in the field we may discover hundreds of transients, whereas, on the succeeding day, in the same situation, we may find few or none of the same species present. On cloudy nights we hear the call notes of birds, presumably passing overhead in the seasonal direction of migration. And on stormy nights birds strike lighthouses, towers, and other tall obstructions. Facts such as these are indisputable evidences that migration is taking place, but they provide little basis for evaluating the flights in terms of magnitude or direction.

Many of the resulting uncertainties surrounding the nocturnal migration of birds have a quantitative aspect; their resolution hinges on how many birds do one thing and how many do another. If we knew, for instance, how many birds are usually flying between 2 and 3 A. M. and how this number compares with other one-hour intervals in the night, we would be in a position to judge to what extent night flight is sustained from dusk to dawn. If we could measure the number of birds passing selected points of observation, we could find out whether such migration in general proceeds more or less uniformly on a broad front or whether it follows certain favored channels or flyways. This in turn might give us a clearer insight into the nature of the orienting mechanism and the extent to which it depends on visual clues. And, if we had some valid way of estimating the number of birds on the wing under varying weather conditions, we might be able to understand better the nature and development of migration waves so familiar to field ornithologists. These are just random examples suggesting some of the results that may be achieved in a broad field of inquiry that is still virtually untouched—the quantitative study of migratory flights.

This paper is a venture into that field. It seeks to evaluate on a more factual basis the traditional ideas regarding these and similar problems, that have been developed largely from circumstantial criteria. It is primarily, therefore, a study of comparative quantities or volumes of migration—or what may be conveniently called flight densities, if this term be understood to mean simply the number of birds passing through a given space in a given interval of time.

In the present study, the basic data permitting the numerical expression of such migration rates from many localities under many different sets of circumstances were obtained by a simple method. When a small telescope, mounted on a tripod, is focused on the moon, the birds that pass before the moon's disc may be seen and counted, and their apparent pathways recorded in terms of coordinates. In bare outline, this approach to the problem is by no means new. Ornithologists and astronomers alike have recorded the numbers of birds seen against the moon in stated periods of time (Scott, 1881a and 1881b; Chapman, 1888; Libby, 1889; West, 1896; Very, 1897; Winkenwerder, 1902a and 1902b; Stebbins, 1906; Carpenter, 1906). Unfortunately, as interesting as these observations are, they furnish almost no basis for important generalizations. Most of them lack entirely the standardization of method and the continuity that would make meaningful comparisons possible. Of all these men, Winkenwerder appears to have been the only one to follow up an initial one or two nights of observation with anything approaching an organized program, capable of leading to broad conclusions. And even he was content merely to reproduce most of his original data without correlation or comment and without making clear whether he fully grasped the technical difficulties that must be overcome in order to estimate the important flight direction factor accurately.

The present study was begun in 1945, and early results obtained were used briefly in a paper dealing with the trans-Gulf migration of birds (Lowery, 1946). Since that time the volume of field data, as well as the methods by which they can be analyzed, has been greatly expanded. In the spring of 1948, through the cooperation and collaboration of a large number of ornithologists and astronomers, the work was placed on a continent-wide basis. At more than thirty stations (Figure 34, page 437) on the North American continent, from Yucatán to Ontario, and from California to South Carolina, observers trained telescopes simultaneously on the moon and counted the birds they saw passing before its disc.

Most of the stations were in operation for several nights in the full moon periods of March, April, and May, keeping the moon under constant watch from twilight to dawn when conditions permitted. They have provided counts representing more than one thousand hours of observation, at many places in an area of more than a million square miles. But, as impressive as the figures on the record sheets are, they, like the published observations referred to above, have dubious meaning as they stand. Were we to compare them directly, station for station, or hour for hour, we would be almost certain to fall into serious errors. The reasons for this are not simple, and the measures that must be taken to obtain true comparisons are even less so. When I first presented this problem to my colleague, Professor William A. Rense, of the Department of Physics and Astronomy at Louisiana State University, I was told that mathematical means exist for reducing the data and for ascertaining the desired facts. Rense's scholarly insight into the mathematics of the problem resulted in his derivation of formulae that have enabled me to analyze on a comparable basis data obtained from different stations on the same night, and from the same station at different hours and on different nights. Astronomical and technical aspects of the problem are covered by Rense in his paper (1946), but the underlying principles are discussed at somewhat greater length in this paper.

Part I of the present paper, dealing with the means by which the data were obtained and processed, will explore the general nature of the problem and show by specific example how a set of observations is prepared for analysis. Part II will deal with the results obtained and their interpretation.

ACKNOWLEDGMENTS

In the pursuit of this research I have received a tremendous amount of help from my colleagues, students, and other friends. In the first place, in order to obtain much of the data on which the study was based, it was necessary to enlist the aid of many persons in various parts of the country and to draw heavily on their time and patience to get all-night telescopic counts of migrating birds. Secondly, the processing of the primary data and its subsequent analysis demanded that I delve into the fields of astronomy and mathematics. Here, from the outset, I have enjoyed the constant and untiring help of Professor W. A. Rense of the Department of Physics and Astronomy at Louisiana State University. Without his collaboration, I would not have been able to do this work, for he not only supplied formulae whereby I was able to make desired computations, but time and again he maneuvered me through my difficulties in the mathematical procedures. Moreover, Professor Rense has manifested a great interest in the ornithological aspect of the problem, and his trenchant advice has been of inestimable value to me. No less am I indebted to my associate, Robert J. Newman, with whom I have spent untold hours discussing the various aspects of the problem. Indeed, most of the concepts that have evolved in the course of this study have grown out of discussions over a four-year period with both Rense and Newman. Whatever merit this work may have may be attributable in no small part to the help these two men have given me. In the preparation of many of the illustrations, I am further obligated to Newman for his excellent creative ideas as well as draftsmanship, and to Miss Helen Behrnes and A. Lowell Wood for their assistance.

The mathematical computations required in this study have been laborious and time-consuming. It is estimated that more than two thousand man-hours have gone into this phase of the work alone. Whereas I have necessarily done most of this work, I have received a tremendous amount of help from A. Lowell Wood. Further assistance in this regard came from Herman Fox, Donald Norwood, and Lewis Kelly.

The recording of the original field data in the spring of 1948 from the thirty-odd stations in North America involved the participation of more than 200 ornithologists and astronomers. This collaboration attests to the splendid co-operative spirit that exists among scientists. Many of these persons stayed at the telescope, either as observer or as recorder, hours on end in order to get sets of data extending through a whole night.

The following were responsible for much of the field data herein used: J. R. Andrews, S. A. Arny, M. Dale Arvey, H. V. Autrey, Charles C. Ayres, Mr. and Mrs. Roy Bailey, Irwin L. Baird, Maurice F. Baker, Rollin H. Baker, Bedortha and Edna Baldwin, Mrs. A. Marguerite Baumgartner, T. A. Becket, Paul Bellington, Donald Bird, Carl Black, Jr., Lea Black, Lytle Blankenship, Mr. and Mrs. J. Stewart Boswell, Bruce Boudreaux, Frank Bray, Mr. and Mrs. Leonard Brecher, Homer Brewer, Mrs. Harvey Broome, Heyward Brown, Floyd Browning, Cyril Broussard, Paul Buress, Ralph M. Burress, Robert Cain, Don Carlos, Mrs. Reba Campbell, Mr. and Mrs. E. Burnham Chamberlain, Laura Chaney, Van B. Chaney, Jr., Edward Clebsch, Mr. and Mrs. Ben B. Coffey, William Cook, Dr. Jack Craven, Hugh C. and William Davis, Katherine Davis, Richard Davis, Richard DeArment, Robert E. Delphia, J. C. Dickinson, Mr. and Mrs. Otto Dietrich, John Dietrich, Clara Dixon, Nina Driven, John J. Duffy, Mr. and Mrs. R. J. Dunbar, Betty Dupre, Bernard E. Eble, Jr., Robert G. Eble, Dr. and Mrs. William H. Elder, C. C. Emory, Davis Emory, Alice H. Farnsworth, James Fielding, William R. Fish, Mr. and Mrs. Myron Ford, W. G. Fuller, Louis Gainey, Dr. Mary E. Gaulden, Mr. and Mrs. John J. Giudice, Lt. L. E. Goodnight, Earl R. Greene, Max Grilkey, W. W. H. Gunn, Noel Maxwell Hall, Jr., A. J. Hanna, Paul Hansen, Harold W. Harry, Joseph Healy, Dorothy Helmer, Mr. and Mrs. John H. Helmer, Philip E. Hoberecht, William D. Hogan, Dr. and Mrs. Joseph C. Howell, E. J. Huggins, Mrs. Walter Huxford, Hugh Iltis, W. S. Jennings, William M. Johnson, William Kasler, Luther F. Keeton, Lawrence C. Kent, W. H. Kiel, L. P. Kindler, Mr. and Mrs. Joseph E. King, Harriet Kirby, E. J. Koestner, Roy Komarek, Ann Knight, Mr. and Mrs. N. B. Langworthy, Mr. and Mrs. C. F. Lard, Prentiss D. Lewis, Ernest Liner, Dr. and Mrs. R. W. Lockwood, Dr. Harvey B. Lovell, William J. Lueck, Don Luethy, James Major, Mr. and Mrs. Russell L. Mannette, Mrs. John B. Mannix, Donald Mary, Dale E. McCollum, Stewart McConnell, Mr. and Mrs. M. L. McCroe, Robert L. McDaniel, Mr. and Mrs. Frank McGill, Thomas Merimer, Mr. and Mrs. I. S. H. Metcalf, Ann Michener, John Michener, T. H. Milby, D. S. Miller, Burt Monroe, Jr, Burt Monroe, Sr., Mrs. R. A. Monroe, Gordon Montague, Duryea Morton, James Mosimonn, Don L. Moyle, Grant Murphy, John T. Murphy, Mrs. H. F. Murphy, Mrs. Hill Myers, Mr. and Mrs. Robert J. Newman, William Nichols, R. A. Norris, Floyd Oaks, Eugene P. Odum, Mrs. E. E. Overton, Lennie E. Pate, Kenneth Patterson, Ralph Paxton, Louis Peiper, Marie Peiper, Mr. and Mrs. Harold S. Peters, Mary Peters, Mr. and Mrs. D. W. Pfitzer, Betty Plice, Max Plice, Lestar Porter, D. R. Power, Kenneth Price, George Rabb, Marge Reese, Wayne L. Reeve, C. L. Riecke, R. D. Ritchie, V. E. Robinson, Beverly J. Rose, Mary Jane Runyon, Roger Rusk, Bernd Safinsley, Mr. and Mrs. Glen C. Sanderson, Lewis L. Sandidge, John Sather, J. Benton Schaub, Evelyn Schneider, Henry W. Setzer, Mr. and Mrs. Walter Shackleton, Mr. and Mrs. Francis P. Shannon, Mr. and Mrs. Charles Shaw, Paul H. Shepard, Jr., Alan C. Sheppard, Mabel Slack, Alice Smith, R. Demett Smith, Jr., Nat Smith, Major and Mrs. Charles H. Snyder, Albert Springs, Dr. and Mrs. Fred W. Stamm, J. S. Steiner, Mrs. Paul Stephenson, Herbert Stern, Jr., Herbert Stoddard, Mr. and Mrs. F. W. Stomm, Charles Strull, Harold P. Strull, Mrs. Fan B. Tabler, Dr. and Mrs. James T. Tanner, S. M. H. Tate, David Taylor, Hall Tennin, Scott Terry. Mr. and Mrs. S. Charles Thacher, Olive Thomas, G. A. Thompson, Jr., Dr. and Mrs. S. R. Tipton, Robert Tucker, Tom Uzzel, Mr. and Mrs. M. G. Vaiden, Richard Vaught, Edward Violante, Brother I. Vincent. Marilyn L. Walker, Mr. and Mrs. Willis Weaver, Mr. and Mrs. W. L. Webb, Margaret M. L. Wehking, W. A. Welshans, Jr., Mrs. J. F. Wernicke, Francis M. Weston, Miss G. W. Weston, Dr. James W. White, John A. White, A. F. Wicke, Jr., Oren Williams, J. L. Wilson III, W. B. Wilson, Dr. and Mrs. Leonard Wing, Sherry Woo, Rodney Wuthnow, Grace Wyatt, Mr. and Mrs. Malcom Young, Mr. and Mrs. A. J. Zimmerman. To the scores of other people who assisted in making these observations I extend my hearty thanks.

Drs. E. R. Hall, Edward H. Taylor, and H. B. Hungerford of the University of Kansas have read the manuscript and have made valuable suggestions, as have also Dr. W. H. Gates of Louisiana State University and Dr. Donald S. Farner of the State College of Washington. Dr. Farner has also been of great help, together with Drs. Ernst Mayr, J. Van Tyne, and Ernst Schüz, in suggesting source material bearing on the subject in foreign literature. Dr. N. Wyaman Storer, of the University of Kansas, pointed out a short-cut in the method for determining the altitude and azimuth of the moon, which resulted in much time being saved. For supplying climatological data and for guidance in the interpretation thereof, I am grateful to Dr. Richard Joel Russell, Louisiana State University; Commander F. W. Reichelderfer, Chief of the U. S. Weather Bureau, Washington, D. C.; Mr. Merrill Bernard, Chief of the Climatological and Hydrologic Services; and Mr. Ralph Sanders, U. S. Weather Bureau at New Orleans, Louisiana.

Acknowledgment is made to Bausch and Lomb Optical Company for the loan of six telescopes for use in this project. Messrs. G. V. Cutler and George Duff of Smith and Johnson Steamship Company, operators of the Yucatan Line, are to be thanked for granting me free passage on the "S. S. Bertha Brøvig" to Progreso, Yucatán, where I made observations in 1945 and 1948. I am also indebted to the Louisiana State University Committee on Faulty Research for a grant-in-aid.

PART I. FLIGHT DENSITIES AND THEIR DETERMINATION

A. LUNAR OBSERVATIONS OF BIRDS AND THE FLIGHT DENSITY CONCEPT

The subject matter of this paper is wholly ornithological. It is written for the zoologist interested in the activities of birds. But its bases, the principles that make it possible, lie in other fields, including such rather advanced branches of mathematics as analytical geometry, spherical geometry, and differential calculus. No exhaustive exposition of the problem is practicable, that does not take for granted some previous knowledge of these disciplines on the part of all readers.

There are, however, several levels of understanding. It is possible to appreciate *what* is being done without knowing *how* to do it; and it is possible to learn how to carry out the successive steps of a procedure without entirely comprehending *why*. Some familiarity with the concepts underlying the method is essential to a full understanding of the results achieved, and details of procedure must be made generally available if the full possibilities of the telescopic approach are to be realized. Without going into proof of underlying propositions or actual derivation of formulae, I shall accordingly present a discussion of the general nature of the problem, conveyed as much as possible in terms of physical visualization. The development begins with the impressions of the student when he first attempts to investigate the movements of birds by means of the moon.

What the Observer Sees

Watched through a 20-power telescope on a cloudless night, the full moon shines like a giant plaster hemisphere caught in the full glare of a floodlight. Inequalities of surface, the rims of its craters, the tips of its peaks, gleam with an almost incandescent whiteness; and even the darker areas, the so-called lunar seas, pale to a clear, glowing gray.

Against this brilliant background, most birds passing in focus appear as coal-black miniatures, only 1/10 to 1/30 the apparent diameter of the moon. Small as these silhouettes are, details of form are often beautifully defined—the proportions of the body, the shape of the tail, the beat of the wings. Even when the images are so far away that they are pin-pointed as mere flecks of black against the illuminated area, the normal eye can follow their progress easily.

In most cases the birds are invisible until the moment they "enter," or pass opposite, the rim of the moon and vanish the instant they reach the other side. The interval between is likely to be inestimably brief. Some birds seem fairly to flash by; others, to drift; yet seldom can their passing be counted in seconds, or even in measureable fractions of seconds. During these short glimpses, the flight paths tend to lie along straight lines, though occasionally a bird may be seen to undulate or even to veer off course.

Now and again, in contrast to this typical picture, more eerie effects may be noted. Some of them are quite startling—a minute, inanimate-looking object drifting passively by like a corpuscle seen in the field of a microscope; a gigantic wing brushing across half the moon; a ghost-like suggestion of a bird so transparent it seems scarcely more than a product of the imagination; a bird that pauses in mid-flight to hang suspended in the sky; another that beats its way ineffectually forward while it moves steadily to the side; and flight paths that sweep across the vision in astonishingly geometric curves. All of these things have an explanation. The "corpuscle" is possibly a physical entity of some sort floating in the fluid of the observer's eye and projected into visibility against the whiteness of the moon. The winged transparency may be an insect unconsciously picked up by the unemployed eye and transferred by the *camera lucida* principle to the field of the telescope. It may be a bird flying very close, so drastically out of focus that the observer sees right through it, as he would through a pencil held against his nose. The same cause, operating less effectively, gives a characteristic gray appearance with hazy edges to silhouettes passing just beneath the limits of sharp focus. Focal distortions doubtless also account for the precise curvature of some flight paths, for this peculiarity is seldom associated with distinct images. Suspended flight and contradictory directions of drift may sometimes be attributable to head winds or cross winds but more often are simply illusions growing out of a two-dimensional impression of a three-dimensional reality.

Somewhat more commonplace are the changes that accompany clouds. The moon can be seen through a light haze and at times remains so clearly visible that the overcast appears to be behind, instead of in front of, it. Under these circumstances, birds can still be readily discerned. Light reflected from the clouds may cause the silhouettes to fade somewhat, but they retain sufficient definition to distinguish them from out-of-focus images. On occasion, when white cloud banks lie at a favorable level, they themselves provide a backdrop against which birds can be followed all the way across the field of the telescope, whether or not they directly traverse the main area of illumination.

Types of Data Obtained

The nature of the observations just described imposes certain limitations on the studies that can be made by means of the moon. The speed of the birds, for instance, is utterly beyond computation in any manner yet devised. Not only is the interval of visibility extremely short, but the rapidity with which the birds go by depends less on their real rate of motion than on their proximity to the observer. The identification of species taking part in the migration might appear to offer more promise, especially since some of the early students of the problem frequently attempted it, but there are so many deceptive elements to contend with that the results cannot be relied upon in any significant number of cases. Shorn of their bills by the diminution of image, foreshortened into unfamiliar shape by varying angles of perspective, and glimpsed for an instant only, large species at distant heights may closely resemble small species a few hundred feet away. A sandpiper may appear as large as a duck; or a hawk, as small as a sparrow. A goatsucker may be confused with a swallow, and a swallow may pass as a tern. Bats, however, can be consistently recognized, if clearly seen, by their tailless appearance and the forward tilt of their wings, as well as by their erratic flight. And separations of nocturnal migrants into broad categories, such as seabirds and passerine birds, are often both useful and feasible.

It would be a wonderful convenience to be able to clock the speed of night-flying birds accurately and to classify them specifically, but neither of these things is indispensable to the general study of nocturnal migration, nor as important as the three kinds of basic data that *are* provided by telescopes directed at the moon. These concern:—(1) the direction in which the birds are traveling; (2) their altitude above the earth; (3) the number per unit of space passing the observation station.

Unfortunately none of these things can be perceived directly, except in a very haphazard manner. Direction is seen by the observer in terms of the slant of a bird's pathway across the face of the moon, and may be so recorded. But the meaning of every such slant in terms of its corresponding compass direction on the plane of the earth constantly changes with the position of the moon. Altitude is only vaguely revealed through a single telescope by the size and definition of images whose identity and consequent real dimensions are subject to serious misinterpretation, for reasons already explained. The number of birds per unit of space, seemingly the easiest of all the features of migration to ascertain, is actually the most difficult, requiring a prior knowledge of both direction and altitude. To understand why this is so, it will be necessary to consider carefully the true nature of the field of observation.

The Changing Field of Observation

Most of the observations used in this study were made in the week centering on the time of the full moon. During this period the lunar disc progresses from nearly round to round and back again with little change in essential aspect or apparent size. To the man behind the telescope, the passage of birds looks like a performance in two dimensions taking place in this area of seemingly constant diameter—not unlike the movement of insects scooting over a circle of paper on the ground. Actually, as an instant's reflection serves to show, the two situations are not at all the same. The insects are all moving in one plane. The birds only appear to do so. They may be flying at elevations of 500, 1000, or 2000 feet; and, though they give the illusion of crossing the same illuminated area, the actual breadth of the visible space is much greater at the higher, than at the lower, level. For this reason, other things being equal, birds nearby cross the moon much more swiftly than distant ones. The field of observation is not an area in the sky but a volume in space, bounded by the diverging field lines of the observer's vision. Specifically, it is an inverted cone with its base at the moon and its vertex at the telescope.

Since the distance from the moon to the earth does not vary a great deal, the full dimensions of the Great Cone determined by the diameter of the moon and a point on the earth remain at all times fairly constant. Just what they are does not concern us here, except as regards the angle of the apex (roughly 1/2°), because obviously the effective field of observation is limited to that portion of the Great Cone below the maximum ceiling at which birds fly, a much smaller cone, which I shall refer to as the Cone of Observation (Figure 1).

The problem of expressing the number of passing birds in terms of a definite quantity of space is fundamentally one of finding out

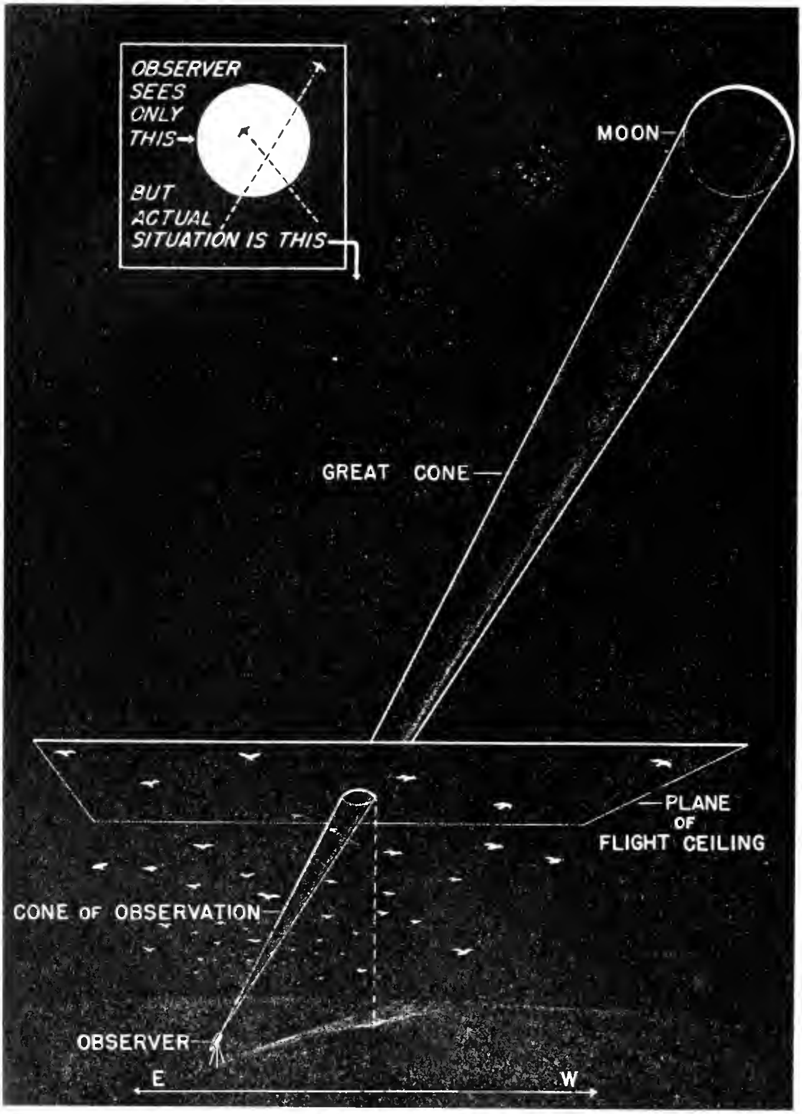


FIG. 1 The field of observation, showing its two-dimensional aspect as it appears to the observer and its three-dimensional actuality. The breadth of the cone is greatly exaggerated.

the critical dimensions of this smaller cone. The diameter at any distance from the observer may be determined with enough accuracy for our purposes simply by multiplying the distance by .009, a convenient approximation of the diameter of the moon, expressed in radians (see Figure 2). One hundred feet away, it is approximately 11 inches; 1000 feet away, nine feet; at one mile, 48 feet; at two miles, 95 feet. Estimating the effective length of the field of observation presents more formidable difficulties, aggravated by the fact that the lunar base of the Great Cone does not remain station-

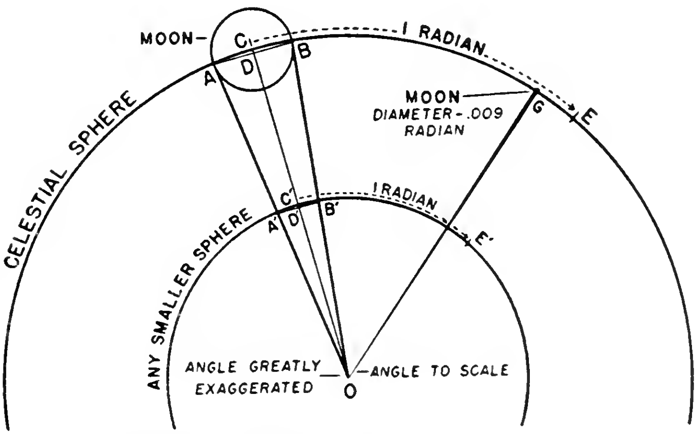


FIG. 2. Method for determining the diameter of the cone at any point. The angular diameter of the moon may be expressed in radians, or, in other words, in terms of lengths of arc equivalent to the radius of a circle. In the diagram, the arc between C and E, being equivalent to the radius CO, represents a radian. If we allow the arc between A and B to be the diameter of the moon, it is by astronomical calculation about .009 radian, or .009 CO. This ratio will hold for any smaller circle inscribed about the center O; that is, the arc between A′B′ equals .009 C′O. Thus the width of the cone of observation at any point, expressed in degrees of arc, is .009 of the axis of the cone up to that point. The cone is so slender that the arc between A and B is essentially equal to the chord AB. Exactly the same consideration holds true for the smaller circle where the chord A′B′ represents part of the flight ceiling.

ary. The moon rises in the general direction of east and sets somewhere in the west, the exact points where it appears and disappears on the horizon varying somewhat throughout the year. As it drifts across the sky it carries the cone of observation with it like the slim beam of an immense searchlight slowly probing space. This situation is ideal for the purpose of obtaining a random sample of the number of birds flying out in the darkness, yet it involves great complications; for the size of the sample is never at two consecutive instants the same. The nearer the ever-moving great cone of the moon moves toward a vertical position, the nearer its intersection with the flight ceiling approaches the observer, shortening, therefore, the cone of observation (Figure 3). The effect on the number of

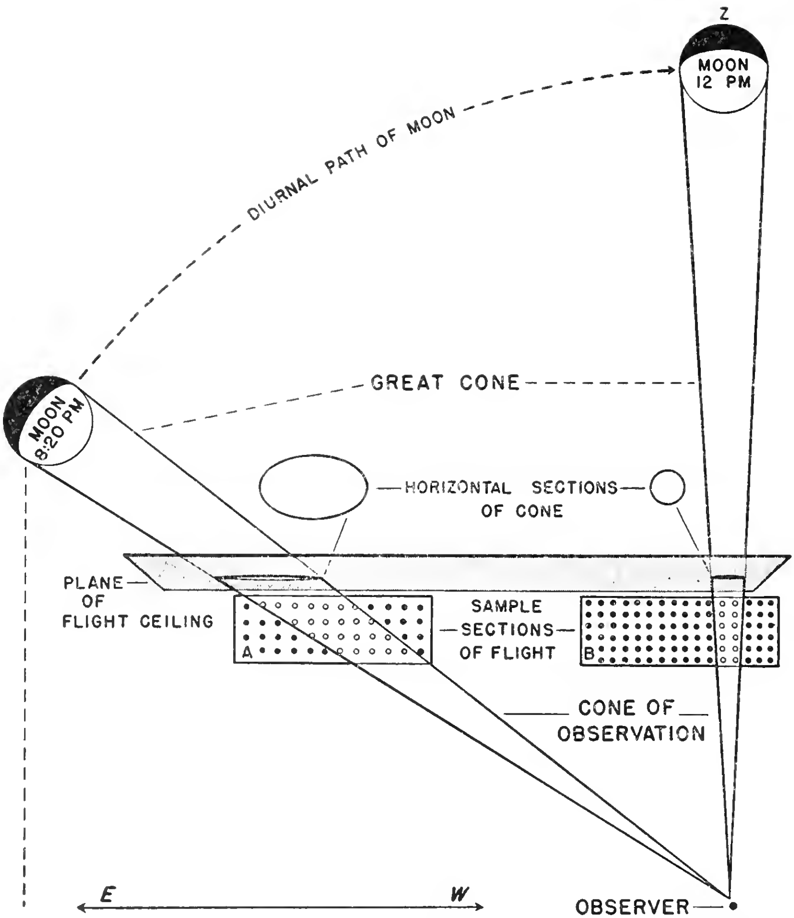


FIG. 3. Temporal change in the effective size of the field of observation. The sample sections, A and B, represent the theoretical densities of flight at 8:20 and 12:00 P. M., respectively. Though twice as many birds are assumed to be in the air at midnight when the moon is on its zenith (Z) as there were at the earlier hour, only half as many are visible because of the decrease in size of the cone of observation.

birds seen is profound. In extreme instances it may completely reverse the meaning of counts. Under the conditions visualized in Figure 3, the field of observation at midnight is only one-fourth as large as the field of observation earlier in the evening. Thus the twenty-four birds seen from 7 to 8 P. M., represent not twice as many birds actually flying per unit of space as the twelve observed from 11:30 to 12:30 A. M., but only half the amount. Figure 4, based on ob-

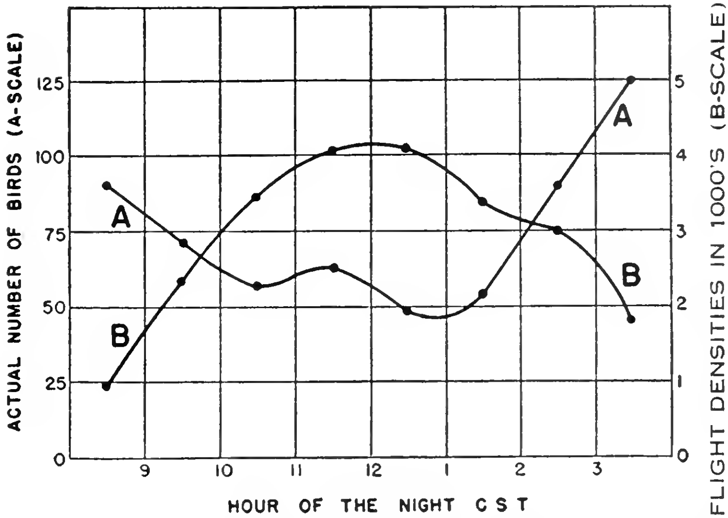


FIG. 4. Migration at Ottumwa, Iowa, on the night of May 22-23, 1948. Curve A is a graphic representation of the actual numbers of birds seen hourly through the telescope. Curve B represents the same figures corrected for the variation in the size of the cone of observation. The dissimilarity in the two curves illustrates the deceptive nature of untreated telescopic counts.

servations at Ottumwa, Iowa, on the night of May 22-23, shows a similar effect graphically. Curve A represents the actual numbers of birds per hour seen; Curve B shows the same figures expressed as flight densities, that is, corrected to take into account the changing size of the field of observation. It will be noted that the trends are almost exactly opposite. While A descends, B rises, and *vice-versa*. In this case, inferences drawn from the unprocessed data lead to a complete misinterpretation of the real situation.

Nor does the moon suit our convenience by behaving night after night in the same way. On one date we may find it high in the sky between 9 and 10 P. M.; on another date, during the same interval of time, it may be near the horizon. Consequently, the size of the cone is different in each case, and the direct comparison of flights in the same hour on different dates is no more dependable than the misleading comparisons discussed in the preceding paragraph.

The changes in the size of the cone have been illustrated in Figure 3 as though the moon were traveling in a plane vertical to the earth's surface, as though it reached a point directly over the observer's head. In practice this least complicated condition seldom obtains in the regions concerned in this study. In most of the northern hemisphere, the path of the moon lies south of the observer so that the cone is tilted away from the vertical plane erected on the parallel of latitude where the observer is standing. In other words it never reaches the zenith, a point directly overhead. The farther north we go, the lower the moon drops toward the horizon and the more, therefore, the cone of observation leans away from us. Hence, at the same moment, stationed on the same meridian, two observers, one in the north and one in the south, will be looking into different effective volumes of space (Figure 5).

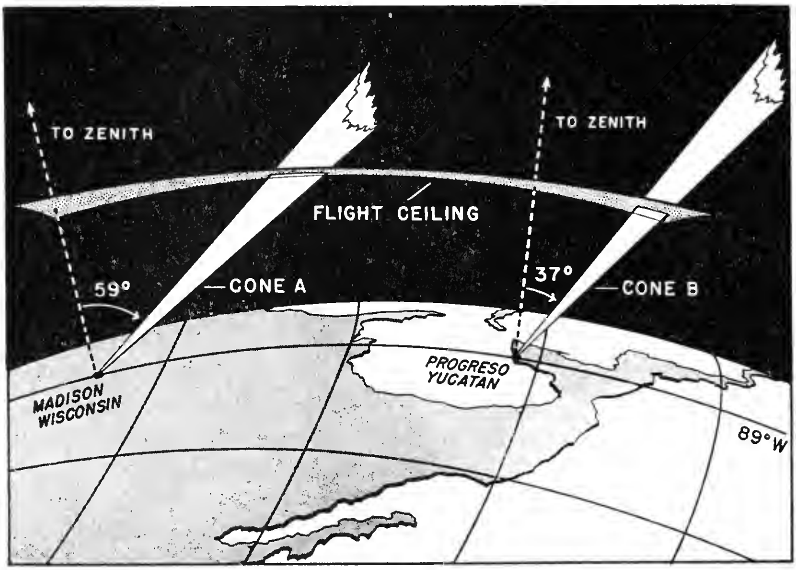


FIG. 5. Geographical variation in the size of the cone of observation. The cones A and B represent the effective fields of observation at two stations situated over 1,200 miles apart. The portions of the great cones included here appear nearly parallel, but if extended far enough would be found to have a common base on the moon. Because of the continental scale of the drawing, the flight ceiling appears as a curved surface, equidistant above each station. The lines to the zenith appear to diverge, but they are both perpendicular to the earth. Although the cones are shown at the same instant in time, and have their origin on the same meridian, the dimensions of B are less than one-half as great as those of A, thus materially decreasing the opportunity to see birds at the former station. This effect results from the different slants at which the zenith distances cause the cones to intersect the flight ceiling. The diagram illustrates the principle that northern stations, on the average, have a better chance to see birds passing in their vicinity than do southern stations.

As a further result of its inclination, the cone of observation, seldom affords an equal opportunity of recording birds that are flying in two different directions. This may be most easily understood by considering what happens on a single flight level. The plane parallel to the earth representing any such flight level intersects the slanting cone, not in a circle, but in an ellipse. The proportions of this ellipse are very variable. When the moon is high, the intersection on the plane is nearly circular; when the moon is low, the ellipse becomes greatly elongated. Often the long axis may be more than twice the length of the short axis. It follows that, if the long axis happens to lie athwart the northward direction of flight and the short axis across the eastward direction, we will get on the average over twice as large a sample of birds flying toward the north as of birds flying toward the east.

In summary, whether we wish to compare different stations, different hours of the night, or different directions during the same hour of the night, no conclusions regarding even the relative numbers of birds migrating are warranted, unless they take into account the ever-varying dimensions of the field of observation. Otherwise we are attempting to measure migration with a unit that is constantly expanding or contracting. Otherwise we may expect the same kind of meaningless results that we might obtain by combining measurements in millimeters with measurements in inches. Some method must be found by which we can reduce all data to a standard basis for comparison.

The Directional Element in Sampling

In seeking this end, we must immediately reject the simple logic of sampling that may be applied to density studies of animals on land. We must not assume that, since the field of observation is a volume in space, the number of birds therein can be directly expressed in terms of some standard volume — a cubic mile, let us say. Four birds counted in a cone of observation computed as 1/500 of a cubic mile are not the equivalent of 500 $\times$ 4, or 2000, birds per cubic mile. Nor do four birds flying over a sample 1/100 of a square mile mathematically represent 400 birds passing over the square mile. The reason is that we are not dealing with static bodies fixed in space but with moving objects, and the objects that pass through a cubic mile are not the sum of the objects moving through each of its 500 parts. If this fact is not immediately apparent, consider the circumstances in Figures 6 and 7, illustrating the principle as it applies to areas. The relative capacity of the sample and the whole to intercept bodies in motion is more closely expressed by the ratio of their perimeters in the case of areas and the ratio of their surface areas in the case of volumes. But even these ratios lead to inaccurate results unless the objects are moving in all directions equally (see Figure 8). Since bird migration exhibits strong directional tendencies, I have come to the conclusion that no sampling procedure that can be applied to it is sufficiently reliable short of handling each directional trend separately.

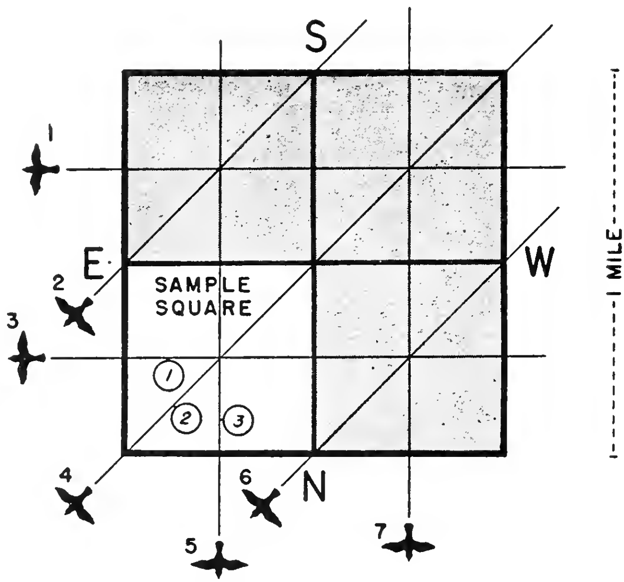


FIG. 6. The problem of sampling migrating birds. The large square in the diagram may be thought of as a square mile on the earth's surface, divided into four equal smaller squares. Birds are crossing over the area in three directions, equally spaced, so that each of the subdivisions is traversed by three of them. We might be tempted to conclude that 4 x 3, or 12, would pass over the large square. Actually there are only seven birds involved all told. Obviously, the interceptive potential of a small square and a larger square do not stand in the same ratio as their areas.

For this reason, the success of the whole quantitative study of migration depends upon our ability to make directional analyses of primary data. As I have already pointed out, the flight directions of birds may be recorded with convenience and a fair degree of objectivity by noting the slant of their apparent pathways across the disc of the moon. But these apparent pathways are seldom the real pathways. Usually they involve the transfer of the flight line from a horizontal plane of flight to a tilted plane represented by the face of the moon, and so take on the nature of a projection. They are clues to directions, but they are not the directions themselves. For each compass direction of birds flying horizontally above the earth, there is one, and only one, slant of the pathway across the moon at a given time. It is possible, therefore, knowing the path of a bird in relation to the lunar disc and the time of the observation, to compute the direction of its path in relation to the earth. The formula employed is not a complicated one, but, since the meaning of the

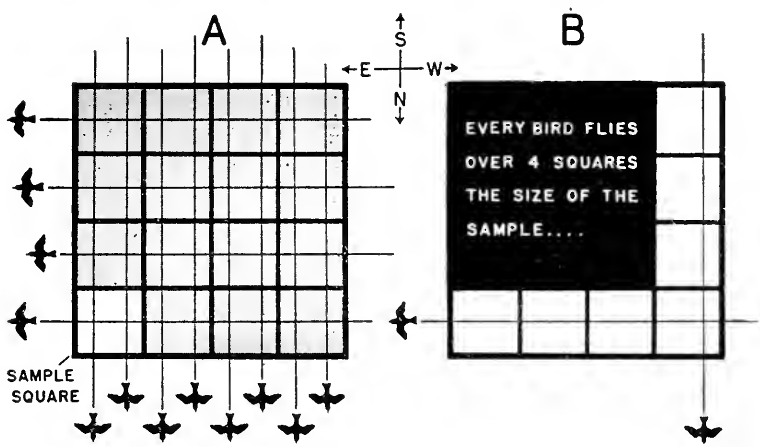


FIG. 7. The sampling effect of a square. In Diagram A eight evenly distributed birds are flying from south to north, and another four are proceeding from east to west. Three appear in each of the smaller squares. Thus, if we were to treat any of these smaller sections as a directly proportionate sample of the whole, we would be assuming that 3 x 16, or 48, birds had traversed the square mile—four times the real total of 12. If we consider the paths separately as in Diagram B, we see quite clearly what is wrong. Every bird crosses four plots the size of the sample and is being computed into the total over and over a corresponding number of times. Patently, just as many south-north birds cross the bottom tier of squares as cross the four tiers comprising the whole area. Just as many west-east birds traverse one side of the large square as cross the whole square. In other words, the inclusion of additional sections *athwart* the direction of flight involves the inclusion of additional birds proceeding in that direction, while the inclusion of additional sections *along* the direction does not. The correct ratio of the sample to the whole would seem to be the ratio of their perimeters, in this case the ratio of one to four. When this factor of four is applied to the problem it proves correct: 4 x 3 (the number of birds that have been seen in the sample square) equals 12 (the exact number of birds that could be seen in the square mile).

lunar coördinates in terms of their corresponding flight paths parallel to the earth is constantly changing with the position of the moon, the calculation of each bird's flight separately would require a tremendous amount of time and effort.

Whatever we do, computed individual flight directions must be frankly recognized as approximations. Their anticipated inaccuracies are not the result of defects in the mathematical procedure employed. This is rigorous. The difficulty lies in the impossibility of reading the slants of the pathways on the moon precisely and in the

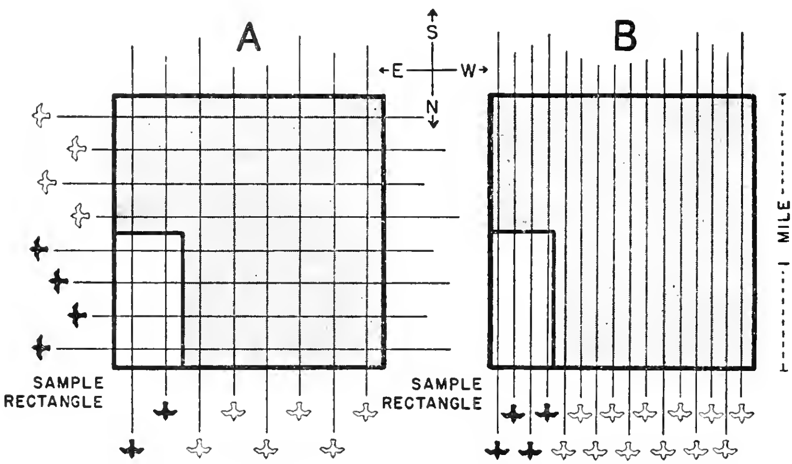


FIG. 8. Rectangular samples of square areas. In Diagram A, where as many birds are flying from west to east as are flying from south to north, the perimeter ratio (three to eight) correctly expresses the number of birds that have traversed the whole area relative to the number that have passed through the sample. But in Diagram B, where all thirty-two birds are flying from south to north, the correct ratio is the ratio of the base of the sample to the base of the total area (one to four), and use of the perimeter ratio would lead to an inaccurate result (forty-three instead of thirty-two birds). Perimeter ratios do not correctly express relative interceptory potential, unless the shape of the sample is the same as the shape of the whole, or unless the birds are flying in all directions equally.

three-dimensional nature of movement through space. The observed coördinates of birds' pathways across the moon are the projected product of two component angles—the compass direction of the flight and its slope off the horizontal, or gradient. These two factors cannot be dissociated by any technique yet developed. All we can do is to compute what a bird's course would be, if it were flying horizontal to the earth during the interval it passes before the moon. We cannot reasonably assume, of course, that all nocturnal migration takes place on level planes, even though the local distractions so often associated with sloping flight during the day are minimized in the case of migrating birds proceeding toward a distant destination in darkness. We may more safely suppose, however, that de-

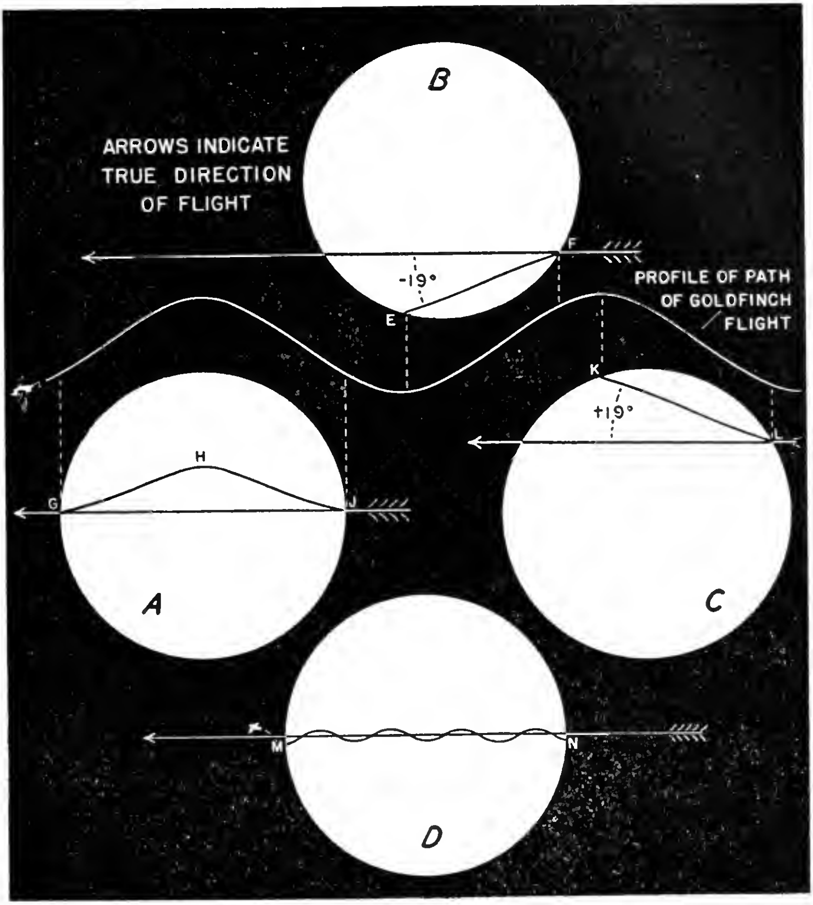


FIG. 9. The effect of vertical components in bird flight. The four diagrams illustrate various effects that might result if a bird with an undulating flight, such as a Goldfinch, flew before a moon 45° above the horizon. In each case the original profile of the pathways, illustrated against the dark background, is flattened considerably as a result of projection. In the situation shown in Diagram A, where the high point of the flight line, GHJ, occurs within the field of the telescope, it is not only obvious that a deviation is involved, but the line GJ drawn between the entry and departure points coincides with the normal coördinates of a bird proceeding on a horizontal plane. In Diagrams B and C, one which catches an upward segment of flight, and the other, a downward segment, the nature of the deviation would not be detectable, and an incorrect direction would be computed from the coördinates. Over a series of observations, including many Goldfinches, one would expect a fairly even distribution of ups and downs. Since the average between the coördinate angles in Diagrams B and C, + 19° and -19°, is the angle of the true coördinate, we have here a situation where the errors tend to compensate. In Diagram D, where the bird is so far away that several undulations are encompassed within the diameter of the field of view, the coördinate readings do not differ materially from those of a straight line.

viations from the horizontal are random in nature, that it is mainly a matter of chance whether the observer happens to see an ascending segment of flight or a descending one. Over a series of observations, we may expect a fairly even distribution of ups and downs. It follows that, although departures from the horizontal may distort individual directions, they tend to average out in the computed trend of the mean. The working of this principle applied to the undulating flight of the Goldfinch (*Spinus*) is illustrated in Figure 9.

Since *individually* computed directions are not very reliable in any event, little is to be lost by treating the observed pathways in groups. Consequently, the courses of all the birds seen in a one-hour period may be computed according to the position of the moon at the middle of the interval and expressed in terms of their general positions on the compass, rather than their exact headings. For this latter purpose, the compass has been divided into twelve fixed sectors, 22½ degrees wide. The trends of the flight paths are identified by the mid-direction of the sector into which they fall. The sectoring method is described in detail in the section on procedures.

The problem remains of converting the number of birds involved in each directional trend to a fixed standard of measurement. Figure 7A contains the partial elements of a solution. All of the west-east flight paths that cross the large square also cross one of its mile-long sides and suggest the practicability of expressing the amount of mi-

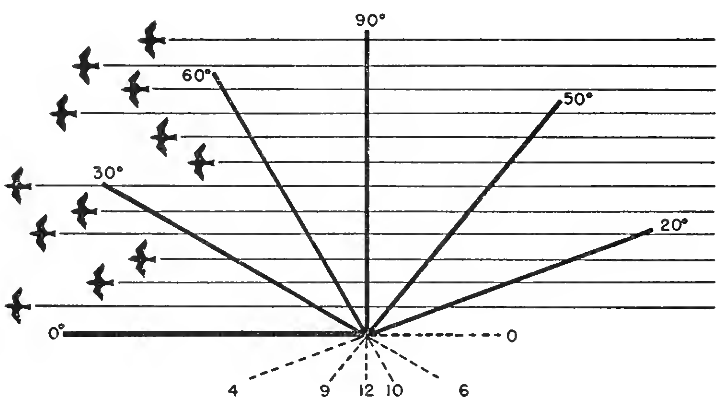


FIG. 10. The interceptory potential of slanting lines. The diagram deals with one direction of flight and its incidence across lines of six different slants, lines of identical length oriented in six different ways. Obviously, the number of birds that cross a line depends not only on the length of the line, but also on its slant with respect to the flight paths.

gration in any certain direction in terms of the assumed quantity passing over a one-mile line in a given interval of time. However, many lines of that length can be included within the same set of flight paths (Figure 10); and the number of birds intercepted depends in part upon the orientation of the line. The 90° line is the only one that fully measures the amount of flight per linear unit of front; and so I have chosen as a standard an imaginary mile on the earth's surface lying at right angles to the direction in which the birds are traveling.

Definitions of Flight Density

When the count of birds in the cone of observation is used as a sample to determine the theoretical number in a sector passing over such a mile line, the resulting quantity represents what I shall call a Sector Density. It is one of several expressions of the more general concept of Flight Density, which may be defined as the passage of migration past an observation station stated in terms of the theoretical number of birds flying over a one-mile line on the earth's surface in a given interval of time. Note that a flight density is primarily a theoretical number, a statistical expression, a *rate* of passage. It states merely that birds were moving through the effective field of observation at the *rate* of so many per mile per unit of time. It may or may not closely express the amount of migration occurring over an actual mile or series of miles. The extent to which it does so is to be decided by other general criteria and by the circumstances surrounding a given instance. Its basic function is to take counts of birds made at different times and at different places, in fields of observation of different sizes, and to put them on the statistically equal footing that is the first requisite of any sound comparison.

The idea of a one-mile line as a standard spacial measurement is an integral part of the basic concept, as herein propounded. But, within these limitations, flight density may be expressed in many different ways, distinguished chiefly by the directions included and the orientation of the one-mile line with respect to them. Three such kinds of density have been found extremely useful in subsequent analyses and are extensively employed in this paper: Sector, Net Trend, and Station Density, or Station Magnitude.

Sector Density has already been referred to. It may be defined as the flight density within a 22½° directional spread, or sector, measured across a one-mile line lying at right angles to the mid-direction of the sector. It is the basic type of density from the point of view of the computer, the others being derived from it. In analysis it provides a means of comparing directional trends at the same station and of studying variation in directional fanning.

Net Trend Density represents the maximum net flow of migration over a one-mile line. It is found by plotting the sector densities directionally as lines of thrust, proportioned according to the density in each sector, and using vector analysis to obtain a vector resultant, representing the density and direction of the net trend. The mile line defining the spacial limits lies at right angles to this vector resultant, but the density figure includes all of the birds crossing the line, not just those that do so at a specified angle. Much of the directional spread exhibited by sector densities undoubtedly has no basis in reality but results from inaccuracies in coördinate readings and from practical difficulties inherent in the method of computation. By reducing all directions to one major trend, net trend density has the advantage of balancing errors one against the other and may often give the truer index to the way in which the birds are actually going. On the other hand, if the basic directions are too widely spread or if the major sector vectors are widely separated with little or no representation between, the net trend density may become an abstraction, expressing the idea of a mean direction but pointing down an avenue along which no migrants are traveling. In such instances, little of importance can be learned from it. In others, it gives an idea of general trends indispensable in comparing station with station to test the existence of flyways and in mapping the continental distribution of flight on a given night to study the influence of weather factors.

Station Density, or Station Magnitude, represents all of the migration activity in an hour in the vicinity of the observation point, regardless of direction. It expresses the sum of all sector densities. It includes, therefore, the birds flying at right angles over several one-mile lines. One way of picturing its physical meaning is to imagine a circle one-mile in diameter lying on the earth with the observation point in the center. Then all of the birds that fly over this circle in an hour's time constitute the hourly station density. While its visualization thus suggests the idea of an area, it is derived from linear expressions of density; and, while it involves no limitation with respect to direction, it could not be computed without taking every component direction into consideration. Station density is adapted to studies involving the total migration activity at various stations. So far it has been the most profitable of all the density concepts, throwing important light on nocturnal rhythm, seasonal increases in migration, and the vexing problem of the distribution of migrating birds in the region of the Gulf of Mexico.

Details of procedure in arriving at these three types of flight density will be explained in Section B of this discussion. For the moment, it will suffice to review and amplify somewhat the general idea involved.

Altitude as a Factor in Flight Density

A flight density, as we have seen, may be defined as the number of birds passing over a line one mile long; and it may be calculated from the number of birds crossing the segment of that line included in an elliptical cross-section of the cone of observation. It may be thought of with equal correctness, without in any way contradicting the accuracy of the original definition, as the number of birds passing through a vertical plane one mile long whose upper limits are its intersection with the flight ceiling and whose base coincides with the one mile line of the previous visualization. From the second point of view, the sample becomes an area bounded by the triangular projection of the cone of observation on the density plane. The dimensions of two triangles thus determined from any two cones of observation stand in the same ratio as the dimensions of their elliptical sections on any one plane; so both approaches lead ultimately to the same result. The advantage of this alternative way of looking at things is that it enables us to consider the vertical aspects of migration—to comprehend the relation of altitude to bird density.

If the field of observation were cylindrical in shape, if it had parallel sides, if its projection were a rectangle or a parallelogram, the height at which birds are flying would not be a factor in finding out their number. Then the sample would be of equal breadth throughout, with an equally wide representation of the flight at all levels. Since the field of observation is actually an inverted cone. triangular in section, with diverging sides, the opportunity to detect birds increases with their distance from the observer. The chances of seeing the birds passing below an elevation midway to the flight ceiling are only one-third as great as of seeing those passing above that elevation, simply because the area of that part of the triangle below the mid-elevation is only one-third as great as the area of that part above the mid-elevation. If we assume that the ratio of the visible number of birds to the number passing through the density plane is the same as the ratio of the triangular section of the cone to the total area of the plane, we are in effect assuming that the density plane is made up of a series of triangles the size of the sample, each intercepting approximately the same number of birds. We are assuming that the same number of birds pass through the inverted triangular sample as through the erect and uninvestigable

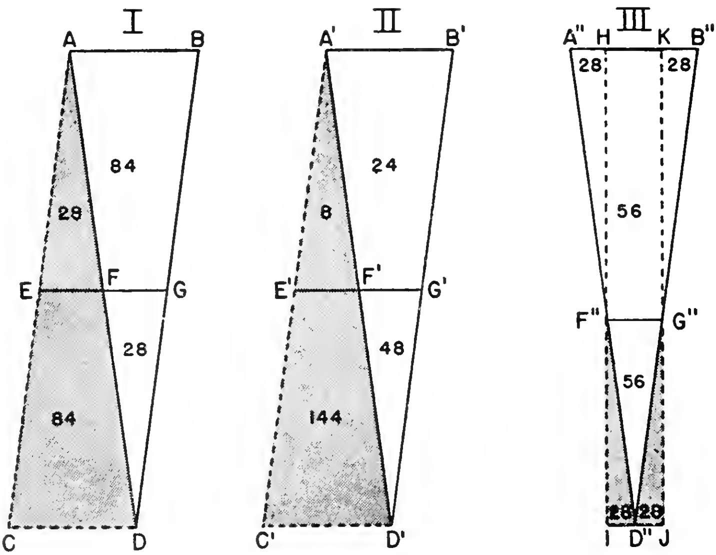


Fig. 11. Theoretical possibilities of vertical distribution. Diagram I shows the effect of a uniform vertical distribution of birds. The figures indicate the number of birds in the respective areas. Here the sample triangle, ABD, contains the same number of birds as the upright triangle, ACD, adjacent to it; the density plane may be conceived of as a series of such alternating triangles, equal in their content of birds. Diagram II portrays, on an exaggerated scale, the situation when many more birds are flying below the median altitude than above it. In contrast to the 152 birds occurring in the triangle A′C′D′, only seventy-two are seen in the triangle A′B′D′. Obviously, the latter triangle does not provide a representative sample of the total number of birds intersecting the density plane. Diagram III illustrates one method by which this difficulty may be overcome. By lowering the line F′G′ to the median altitude of bird density, F″G″ (the elevation above which there are just as many birds as below), we are able to determine a rectangular panel, HIJK, whose content of birds provides a representative sample of the vertical distribution.

triangle beside it (as in Figure 11, Diagram II). In reality, the assumption is sound only if the altitudinal distribution of migrants is uniform.

The definite data on this subject are meagre. Nearly half a century ago, Stebbins worked out a way of measuring the altitude of migrating birds by the principle of parallax. In this method, the distance of a bird from the observers is calculated from its apparent displacement on the moon as seen through two telescopes. Stebbins and his colleague, Carpenter, published the results of two nights of observation at Urbana, Illinois (Stebbins, 1906; Carpenter, 1906); and then the idea was dropped until 1945, when Rense and I briefly applied an adaptation of it to migration studies at Baton Rouge. Results have been inconclusive. This is partly because sufficient work has not been done, partly because of limitations in the method itself. If the two telescopes are widely spaced, few birds are seen by both observers, and hence few parallaxes are obtained. If the instruments are brought close together, the displacement of the images is so reduced that extremely fine readings of their positions are required, and the margin of error is greatly increased. Neither alternative can provide an accurate representative sample of the altitudinal distribution of migrants at a station on a single night. New approaches currently under consideration have not yet been perfected.

Meanwhile the idea of uniform vertical distribution of migrants must be dismissed from serious consideration on logical grounds. We know that bird flight cannot extend endlessly upward into the sky, and the notion that there might be a point to which bird density extends in considerable magnitude and then abruptly drops off to nothing is absurd. It is far more likely that the migrants gradually dwindle in number through the upper limits at which they fly, and the parallax observations we have seem to support this view.

Under these conditions, there would be a lighter incidence of birds in the sample triangle than in the upright triangle beside it (Figure 11, Diagram III). Compensation can be made by deliberately scaling down the computed size of the sample area below its actual size. A procedure for doing this is explained in Figure 11. If it were applied to present altitudinal data, it would place the computational flight ceiling somewhere below 4000 feet. In arriving at the flight densities used in this paper, however, I have used an assumed ceiling of one mile. When the altitude factor is thus assigned a value of 1, it disappears from the formula, simplifying computations. Until the true situation with respect to the vertical distribution of flight is better understood, it seems hardly worthwhile to sacrifice the convenience of this approximation to a rigorous interpretation of scanty data. This particular uncertainty, however, does not necessarily impair the analytical value of the computations. Provided that the vertical pattern of migration is more or less constant, flight densities still afford a sound basis for comparisons, wherever we assume the upper flight limits to be. Raising or lowering the flight ceiling merely increases or reduces all sample cones or triangles proportionately.

A more serious possibility is that the altitudinal pattern may vary according to time or place. This might upset comparisons. If the divergencies were severe enough and frequent enough, they could throw the study of flight densities into utter confusion.

This consideration of possible variation in the altitudinal pattern combines with accidents of sampling and the concessions to perfect accuracy, explained on pages 379-385, to give to small quantities of data an equivocal quality. As large-scale as the present survey is from one point of view, it is only a beginning. Years of intensive work and development leading to a vast accumulation of data must elapse before the preliminary indications yet discernible assume the status of proved principles. As a result, much of the discussion in Part II of this paper is speculative in intent, and most of the conclusions suggested are of a provisional nature. Yet, compared with similar procedures in its field, flight density study is a highly objective method, and a relatively reliable one. In no other type of bird census has there ever been so near a certainty of recording *all* of the individuals in a specified space, so nearly independently of the subjective interpretations of the observer. The best assurance of the essential soundness of the flight density computations lies in the coherent results and the orderly patterns that already emerge from the analyses presented in Part II.

B. Observational Procedure and the Processing of Data

At least two people are required to operate an observation station—one to observe, the other to record the results. They should exchange duties every hour to avoid undue eye fatigue. Additional personnel are desirable so that the night can be divided into shifts.

Essential materials and equipment include: (1) a small telescope; (2) a tripod with pan-tilt or turret head and a mounting cradle; (3) data sheets similar to the one illustrated in Figure 12. Bausch and Lomb or Argus spotting scopes (19.5 x) and astronomical telescopes up to 30- or 40-power are ideal. Instruments of higher magnification are subject to vibration, unless very firmly mounted, and lead to difficulties in following the progress of the moon, unless powered by clockwork. Cradles usually have to be devised. An

ORIGINAL DATA SHEET

DATE ..... 24-25 April 1948 LOCALITY Progreso, Yucatán
OBSERVERS . Harold Harry; George H. Lowery
WEATHER .. Moderate to strong "trade" winds along coast, slightly N of E. Moon emerged above low cloud bank at 8:26.
INSTRUMENT B. & L. 19.5 Spotting Scope; image erect
REMARKS .. Observation station located 1 mile from land, over Gulf of Mexico, at end of new Progreso wharf

TIME	IN	OUT	REMARKS
CST 8:26	—	—	observations begin, H H observing
50	4 30	9	slow, small
56	3	10	medium size
9.00	2	10:30	very small
11	5	9 30	moderately fast
25	5	10	very small, rather slow
26	3	11	" "
36	5	10	medium size
40	3	10	" "
43	5 30	9	" "
46	3 30	10	small
56	4 30	10	medium size
9 58-10 00	—	—	time out to change observers, GL at scope
10.05	4:30	11 30	small
06	3	11	
12	5	8	very small
25	5	12	very fast; small
30	4	10	small
32	4	11	"
32	2	11	"
33	5	11	"
33	4	1	"
33	5:30	11	"
35	4.30	10	swallow-like
36	5	1 30	

FIG. 12. Facsimile of form used to record data in the field. One sheet of the actual observations obtained at Progreso, Yucatán, on April 24-25, 1948, is reproduced here. The remainder of this set of data, which is to be used throughout the demonstration of procedures, is shown in Table 1.

adjustable lawn chair is an important factor in comfort in latitudes where the moon reaches a point high overhead.

As much detail as possible should be entered in the space provided at the top of the data sheet. Information on the weather should include temperature, description of cloud cover, if any, and the direction and apparent speed of surface winds. Care should be taken to specify whether the telescope used has an erect or inverted image. The entry under "Remarks" in the heading should describe the location of the observation station with respect to watercourses, habitations, and prominent terrain features.

The starting time is noted at the top of the "Time" column, and the observer begins the watch for birds. He must keep the disc of the moon under unrelenting scrutiny all the while he is at the telescope. When interruptions do occur as a result of changing positions with the recorder, re-adjustments of the telescope, or the disappearance of the moon behind clouds, the exact duration of the "time out" must be set down.

Whenever a bird is seen, the exact time must be noted, together with its apparent pathway on the moon. These apparent pathways can be designated in a simple manner. The observer envisions the disc of the moon as the face of a clock, with twelve equally spaced points on the circumference marking the hours (Figure 13). He calls the bottommost point 6 o'clock and the topmost, 12. The intervals in between are numbered accordingly. As this lunar clockface moves across the sky, it remains oriented in such a way that 6 o'clock con-

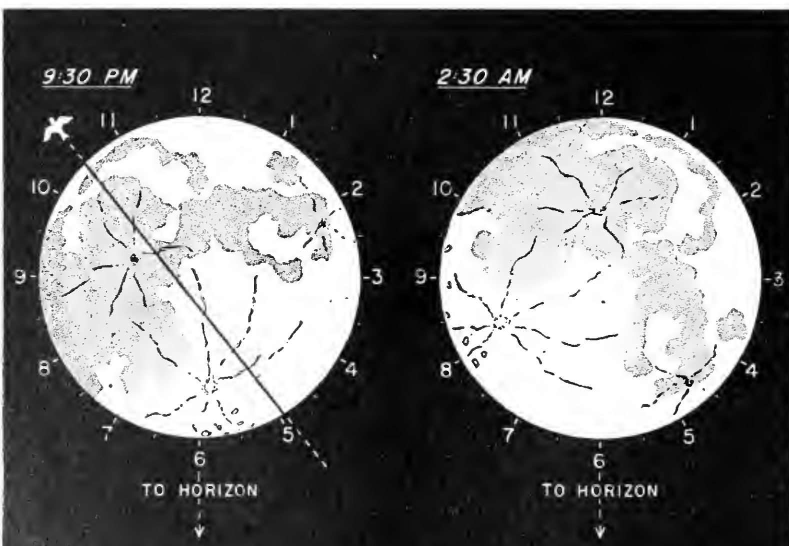


FIG. 13. The identification of coördinates. These diagrams illustrate how the moon may be envisioned as a clockface, constantly oriented with six o'clock nearest the horizon and completely independent of the rotation of the moon's topographic features.

tinues to be the point nearest the horizon, unless the moon reaches a position directly overhead. Then, all points along the circumference are equidistant from the horizon, and the previous definition of clock values ceases to have meaning. This situation is rarely encountered in the northern hemisphere during the seasons of migration, except

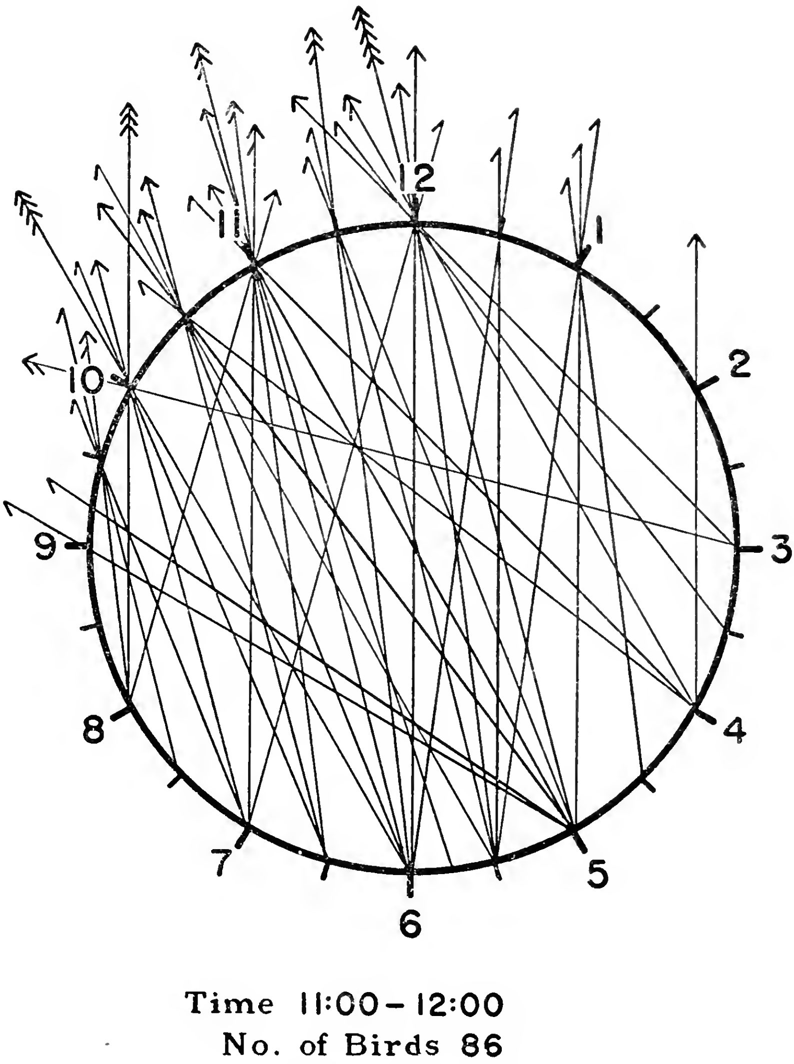


FIG. 14. The apparent pathways of the birds seen in one hour. The observations are those recorded in the 11:00-12:00 P. M. interval on April 24-25, 1948, at Progreso, Yucatán (see Table 1).

in extreme southern latitudes. It is one that has never actually been dealt with in the course of this study. But, should the problem arise, it would probably be feasible to orient the clock during this interval with respect to the points of the compass, calling the south point 6 o'clock.

When a bird appears in front of the moon, the observer identifies its entry and departure points along the rim of the moon with respect to the nearest half hour on the imaginary clock and informs the recorder. In the case of the bird shown in Figure 13, he would simply call out, "5 to 10:30." The recorder would enter "5" in the "In" column on the data sheet (see Figure 12) and 10:30 in the "Out" column. Other comment, offered by the observer and added in the remarks column, may concern the size of the image, its speed, distinctness, and possible identity. Any deviation of the pathway from a straight line should be described. This information has no bearing on subsequent mathematical procedure, except as it helps to eliminate objects other than birds from computation.

The first step in processing a set of data so obtained is to blue-pencil all entries that, judged by the accompanying remarks, relate to extraneous objects such as insects or bats. Next, horizontal lines are drawn across the data sheets marking the beginning and the end of each even hour of observation, as 8 P. M.-9 P. M., 9 P. M.-10 P. M., etc. The coördinates of the birds in each one-hour interval may now be plotted on separate diagrammatic clockfaces, just as they appeared on the moon. Tick marks are added to each line to indicate the number of birds occurring along the same coördinate. The slant of the tick marks distinguishes the points of departure from the points of entry. Figure 14 shows the plot for the 11 P. M.—12 P. M. observations reproduced in Table 1. The standard form, illustrated in Figure 15, includes four such diargrams.

Applying the self-evident principle that all pathways with the same slant represent the same direction, we may further consolidate the plots by shifting all coördinates to the corresponding lines passing through the center of the circle, as in Figure 15. To illustrate, the 6 to 8, 5 to 9, 3 to 11, and 2 to 12 pathways all combine on the 4 to 10 line. Experienced computers eliminate a step by directly plotting the pathways through center, using a transparent plastic straightedge ruled off in parallel lines.

We now have a concise picture of the apparent pathways of all the birds recorded in each hour of observation. But the coördinates do not have the same meaning as readings of a horizontal clock on

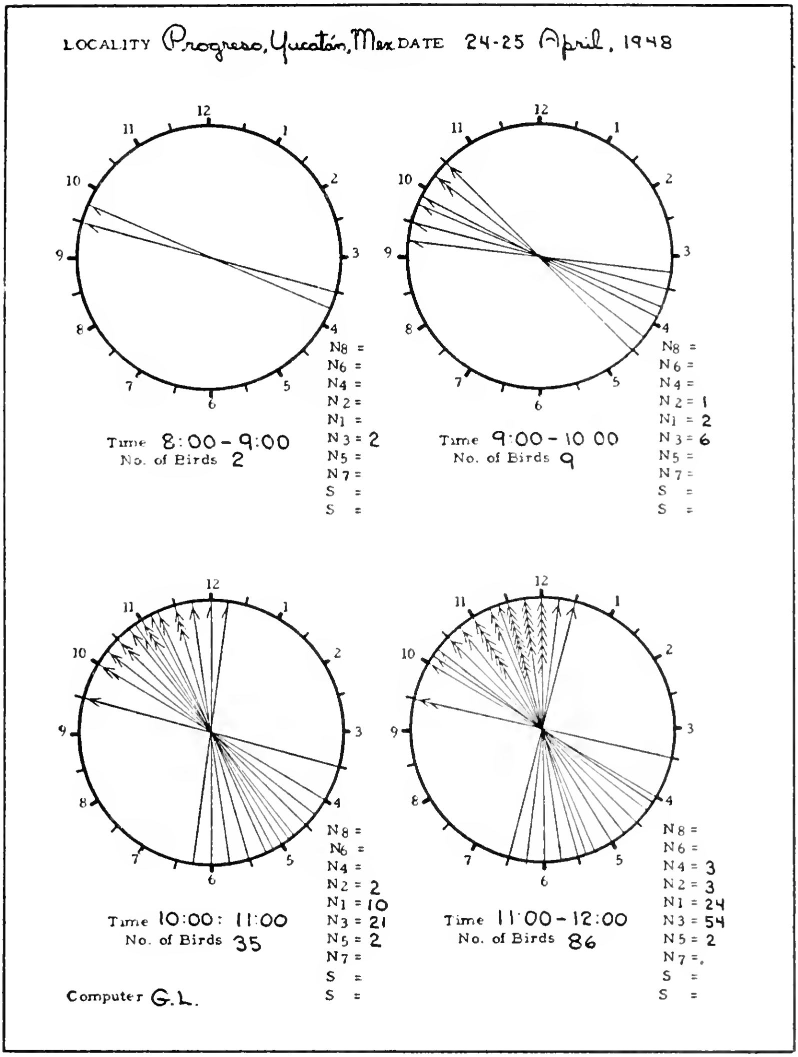


FIG. 15. Standard form for plotting the apparent paths of flight. On these diagrams the original coördinates, exemplified by Figure 14, have been moved to center. In practice the sector boundaries are drawn over the circles in red pencil, as shown by the white lines in Figure 19, making it possible to count the number of birds falling within each zone. These numbers are then tallied in the columns at the lower right of each hourly diagram.

the earth's surface, placed in relation to the points of the compass. They are merely projections of the birds' courses. An equation is available for reversing the effect of projection and discovering the

TABLE 1.—Continuation of Data in Figure 12, Showing Time and Readings of Observations on 24-25 April 1948, Progreso, Yucatán

Time	In	Out	Time	In	Out
10:37-10:41	Time out		11:15	8	9:30
10:45	5:30	10	11:16	4	11
	6	9		5	9
	5:30	10	11:17	5	11:30
10:46	6	8	11:18	5	12
	3:30	11		6	11:30
	5	12	11:19	5:30	11:30
10:47	3:15	1	11:20	6	10
	6	8:30		3	12
	5:45	11:45		5	12
	5	10	11:21	5:45	11
10:48	6	9:45		5	11
10:50	5:30	11	11:23	5	12
10:51	4	11	11:25	5	10:30
10:52	4	2		6	11
	5:30	11		6	12
10:53	5:30	11:30	11:27	6	10
	5	11	11:28	6	11:30
10:55	5	12		5:30	12:30
	5	11	11:29	6	11:30
10:56	6	10		4	12
10:58	4:30	11:30		6:30	10:30
	5:45	11:45		6	11
10:59	6:30	10:30	11:30	3	10
11:00	3:30	12		(2 birds at once)	
	6:30	11	11:31	5	10:30
	(2 birds at once)			5:30	10:30
11:03	6	11	11:32	6	11:30
11:04	3	12	11:33	7:30	9:30
	5	12		4	10:30
11:05	6	10		6	11:30
	5	11		8	9:30
11:06	6	10:30	11:35	7	10
11:07	3	10		4:30	1
11:08	6	11	11:38	6:30	11
11:10	7	9:30	11:40	5:30	12
11:11	5	9:15	11:42	4	2
11:13	5	12		5	12
11:14	6:30	10		6	10
	5:30	1		4	2
	4	12		5	12

TABLE 1.—*Concluded*

Time	In	Out	Time	In	Out
11:44	8	9:30		8	10:15
	7	11	12:16	3:30	1:30
	6	10		8	11
11:45	5	12	12:23	7	1:30
	6	10:30		6	12:30
	5:45	11	12:36	8	11
	4	12	12:37	7:30	1
11:46	7	11	12:38	7	12:30
	6	12	12:40	8	1
11:47	8	10	12:45	7:30	1
11:48	6	10	12:47	5:30	1
11:49	6:30	10:30	12:48	7	1
11:51	8	10	12:52	5:30	1:30
	8	10	12:54-12:55	Time out	
	8	10	12:56	8	10:45
	8	10	12:58	5:30	1:30
	6	10		7	1:30
	8	10		7	2
	6	11	12:59	5	3
	7	12	1:00-1:30	Time out	
11:52	5	1	1:37	8	12
11:54	7	11	1:38	8	12
	6	12:30	1:48	7	1
11:55	5	12		7	1
11:56	7	10	1:51	5:30	11
	5	12	1:57	8	1
11:58	8	11	2:07	7	2
11:59	5:30	12	2:09	9	12
12:00-12:03	Time out		2:10	8	1
12:03	5:30	11:30	2:17	9	12
12:04	8	11	2:21	6	2
12:07	6	12:30	2:30	5:30	3:15
	7:30	1	2:32	8	2
12:08	5	10:30	2:46	7	1
12:09	5:30	1	3:36	9	2
	7:30	2	3:39	8:30	2
12:10	6:30	12:45	3:45	6	4
12:13	8	11	3:55	9	2
12:14	7	1	4:00	8	3
12:15	7	12:30	4:03	9	2
	7:15	1:30	4:30	Closed station	

true directions of flight. This formula, requiring thirty-five separate computations for the pathways reproduced in Figure 12 alone, is far too-consuming for the handling of large quantities of data. A simpler procedure is to divide the compass into sectors and, with the aid of a reverse equation, to draw in the projected boundaries of these divisions on the circular diagrams of the moon. A standard-

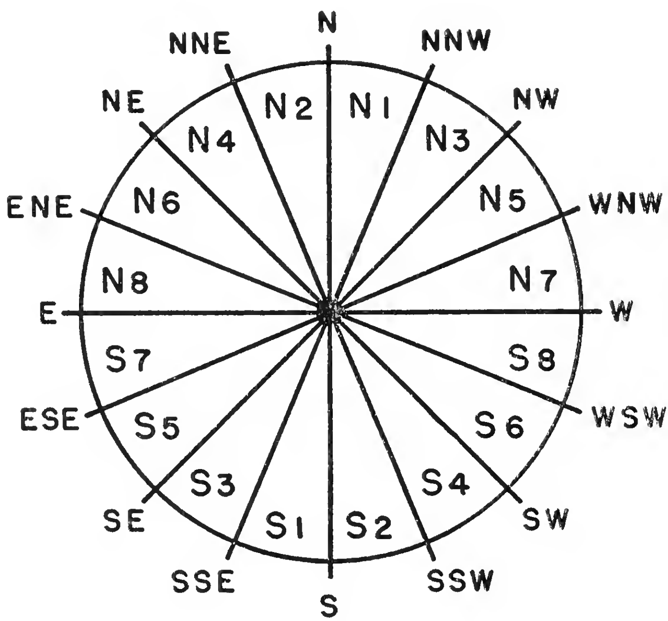


FIG. 16. Standard sectors for designating flight trends. Each zone covers a span of 22½°. The N_6 and N_8, the N_5 and N_7, and their south complements, where usually few birds are represented, can be combined and identified as N_{6-8} and N_{5-7}, etc.

ized set of sectors, each 22½° wide and bounded by points of the compass, has been evolved for this purpose. They are identified as shown in Figure 16. The zones north of the east-west line are known as the North, or N, Sectors, as N_1, N_2, N_3, etc. Each zone south of the east-west line bears the same number as the sector opposite, but is distinguished by the designation S.

Several methods may be used to find the projection of the sector boundaries on the plot diagrams of Figure 15. Time may be saved by reference to graphic tables, too lengthy for reproduction here, showing the projected reading in degrees for every boundary, at every position of the moon; and a mechanical device, designed by

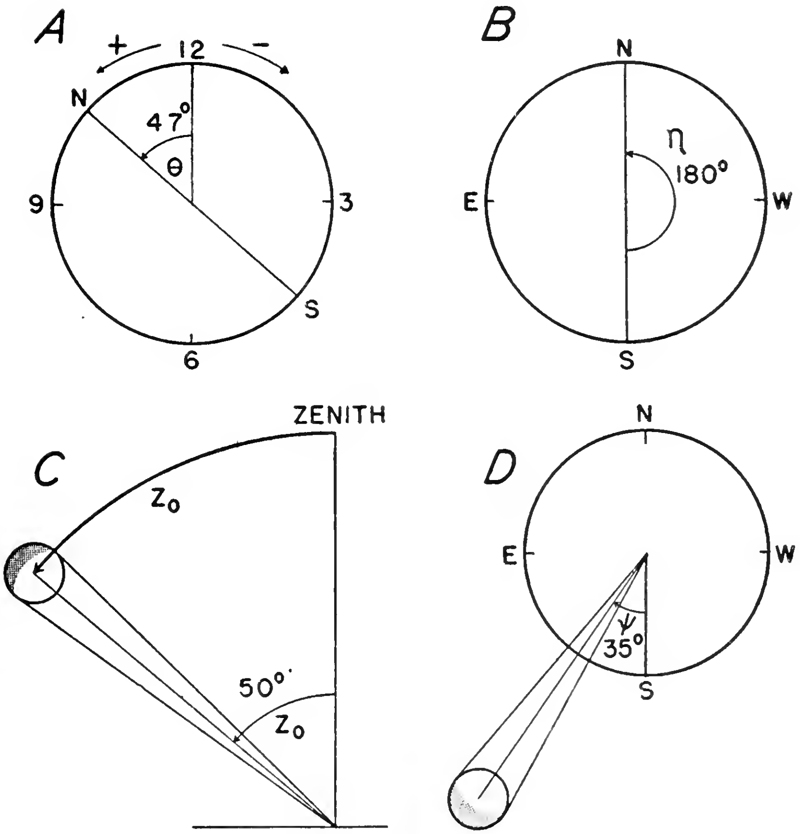


FIG. 17. The meaning of symbols used in the direction formula.

C. M. Arney, duplicating the conditions of the original projection, speeds up the work even further. Both methods are based on the principle of the following formula:

$$\tan\,\theta = \frac{\tan\,(\eta - \psi)}{\cos\,Z_o} \qquad (1)$$

The symbols have these meanings:

θ is the position angle of the sector boundary on the lunar clock, with positive values measured counterclockwise from 12 o'clock, negative angles clockwise (Figure 17A).

η is the compass direction of the sector boundary expressed in degrees reckoned west from the south point (Figure 17B).

Z_o is the zenith distance of the moon's center midway through the hour of observation, that is, at the half hour. It represents the number of degrees of arc between the center of the moon and a point directly over the observer's head (Figure 17C).

ψ is the azimuth of the moon midway through the hour of observation, measured from the south point, positive values to the west, negative values to the east (Figure 17D).

COMPUTATION OF ZENITH DISTANCE AND AZIMUTH OF MOON

DATE 24-25 Apr. 48 LOCALITY Progreso, Yucatán LAT. 21°17'N. LONG. 89°39' W.

Avg. Time 8:30 CST on 24 April = 0230 GCT on 25 April
GHA = 18°43' Declination of Moon = S 19°48'
LHA = GHA — Local Long. = 18°43' — 89°39' = 70° 56'
Altitude = 9°33' ∴ 90° — Alt. = 90° — 9°33' = 80° 27' = Z_o
Azimuth$_n$ = 115°44' Az$_n$ − 180° = 115°44' − 180° = −64°16' = ψ_o

Avg. Time 9:30 CST on 24 April = 0330 GCT on 25 April
GHA = 33°11' Declination of Moon = S 20°00'
LHA = GHA — Local Long. = 33°11' —89°39' = 56°28'
Altitude = 21°05' ∴ 90° — Alt. = 90° — 21°05' = 68°55' = Z_o
Azimuth$_n$ = 122°54' Az$_n$ − 180° = 122°54' − 180° = −57°06' = ψ_o

Avg. Time 10:30 CST on 24 April = 0430 GCT on 25 April
GHA = 47°40' Declination of Moon = S 20°11'
LHA = GHA — Local Long. = 47°40' — 89°39' = 41° 59'
Altitude = 31°39' ∴ 90° — Alt. = 90° — 31°39' = 58°21' = Z_o
Azimuth$_n$ = 132°30' Az$_n$ − 180° = 132°30' − 180° = −47°30' = ψ_o

Avg. Time 11:30 CST on 24 April = 0530 GCT on 25 April
GHA = 62°08' Declination of Moon = S 20°22'
LHA = GHA — Local Long. = 62° 08' — 89°39' = 27°31'
Altitude = 40°25' ∴ 90° — Alt. = 90° — 40°25' = 49°35' = Z_o
Azimuth$_n$ = 145°18' Az$_n$ − 180° = 145°18' − 180° = −34°42' = ψ_o

Avg. Time 12:30 CST on 25 April = 0630 GCT on 25 April
GHA = 76°37' Declination of Moon = S 20°32'
LHA = GHA — Local Long. = 76°37' — 89°39' = 13°02'
Altitude = 46°35' ∴ 90° — Alt. = 90° — 46°35' = 43°25' = Z_o
Azimuth$_n$ = 162°00' Az$_n$ − 180° = 162°00' − 180° = − 18°00' = ψ_o

Avg. Time ST on = GCT on
GHA = Declination of Moon =
LHA = GHA — Local Long. = — =
Altitude = ∴ 90° — Alt. = 90° — = = Z_o
Azimuth$_n$ = Az$_n$ − 180° = — 180° = = ψ_o

If GHA is greater than Local Long., Azimuth (ψ_o) is positive
If GHA is less than Local Long., Azimuth is negative

Computer K.

FIG. 18. Form used in the computation of the zenith distance and azimuth of the moon.

The angle η for any sector boundary can be found immediately by measuring its position in the diagram (Figure 16). The form (Figure 18) for the "Computation of Zenith Distance and Azimuth of the Moon" illustrates the steps in calculating the values of Z_o and ψ_o. From the American Air Almanac (Anonymous, 1945-1948), issued annually by the U. S. Naval Observatory in three volumes, each covering four months of the year, the Greenwich Hour Angle (GHA) and the declination of the moon may be obtained for any ten-minute interval of the date in question. The Local Hour Angle (LHA) of the observation station is determined by subtracting the longitude of the station from the GHA. Reference is then made to the "Tables of Computed Altitude and Azimuth," published by the U. S. Navy Department, Hydrographic Office (Anonymous, 1936-1941), and better known as the "H. O. 214," to locate the altitude and azimuth of the moon at the particular station for the middle of the hour during which the observations were made. The tables employ three variables—the latitude of the locality measured to the nearest degree, the LHA as determined above, and the declination of the moon measured to the nearest 30 minutes of arc. Interpolations can be made, but this exactness is not required. When the latitude of the observation station is in the northern hemisphere, the H. O. 214 tables entitled "Declinations Contrary Name to Latitude" are used with south declinations of the moon, and the tables "Declinations Same Name as Latitude," with north declinations. In the sample shown in Figure 15, the declination of the moon at 11:30 P. M., midway through the 11 to 12 o'clock interval, was S 20° 22′. Since the latitude of Progreso, Yucatán is N 21° 17′, the "Contrary Name" tables apply to this hour

Because the H.O. 214 expresses the vertical position of the moon in terms of its altitude, instead of its zenith distance, a conversion is required. The former is the number of arc degrees from the horizon to the moon's center; therefore Z_o is readily obtained by subtracting the altitude from 90°. Moreover, the azimuth given in the H.O. 214 is measured on a 360° scale from the north point, whereas the azimuth used here (ψ_o) is measured 180° in either direction from the south point, negative values to the east, positive values to the west. I have designated the azimuth of the tables as Az_n and obtained the desired azimuth (ψ_o) by subtracting 180° from Az_n. The sign of ψ_o may be either positive or negative, depending on whether or not the moon has reached its zenith and hence the meridian of the observer. When the GHA is greater than the local longitude (that is, the longitude of the observation station), the azimuth is positive. When the GHA is less than the local longitude, the azimuth is negative.

Locating the position of a particular sector boundary now becomes a mere matter of substituting the values in the equation (1) and reducing. The computation of the north point for 11 to 12 P. M. in the sample set of data will serve as an example. Since the north point reckoned west from the south point is 180°, its η has a value of 180°.

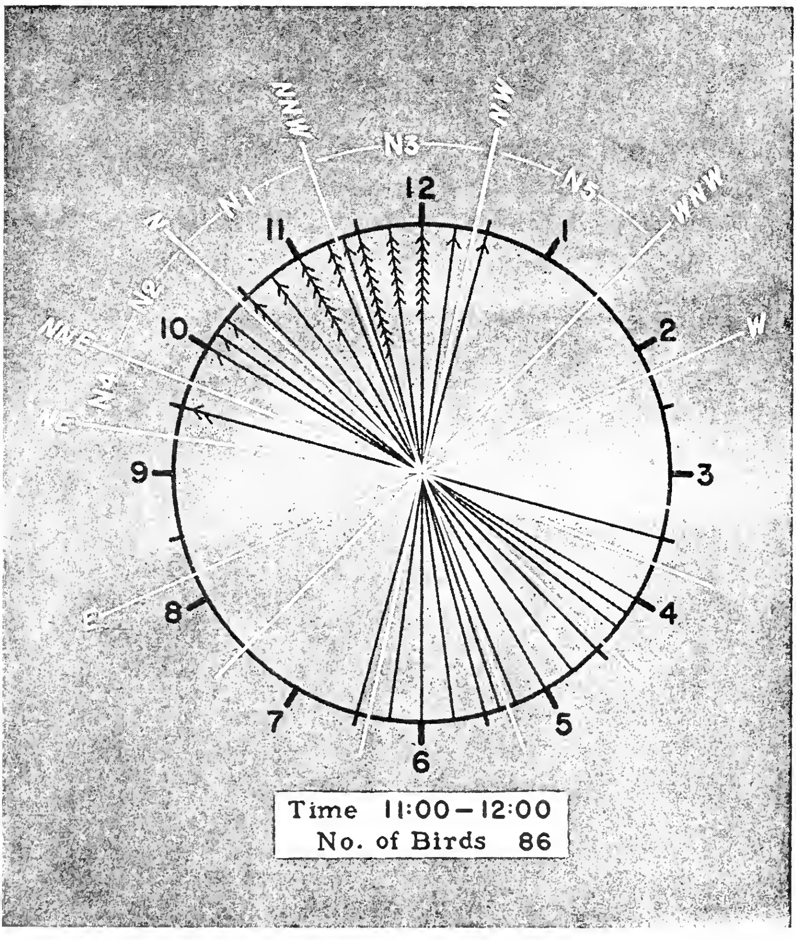


FIG. 19. Method of plotting sector boundaries on the diagrammatic plots. The example employed is the 11:00 to 12:00 P. M. diagram of Figure 15.

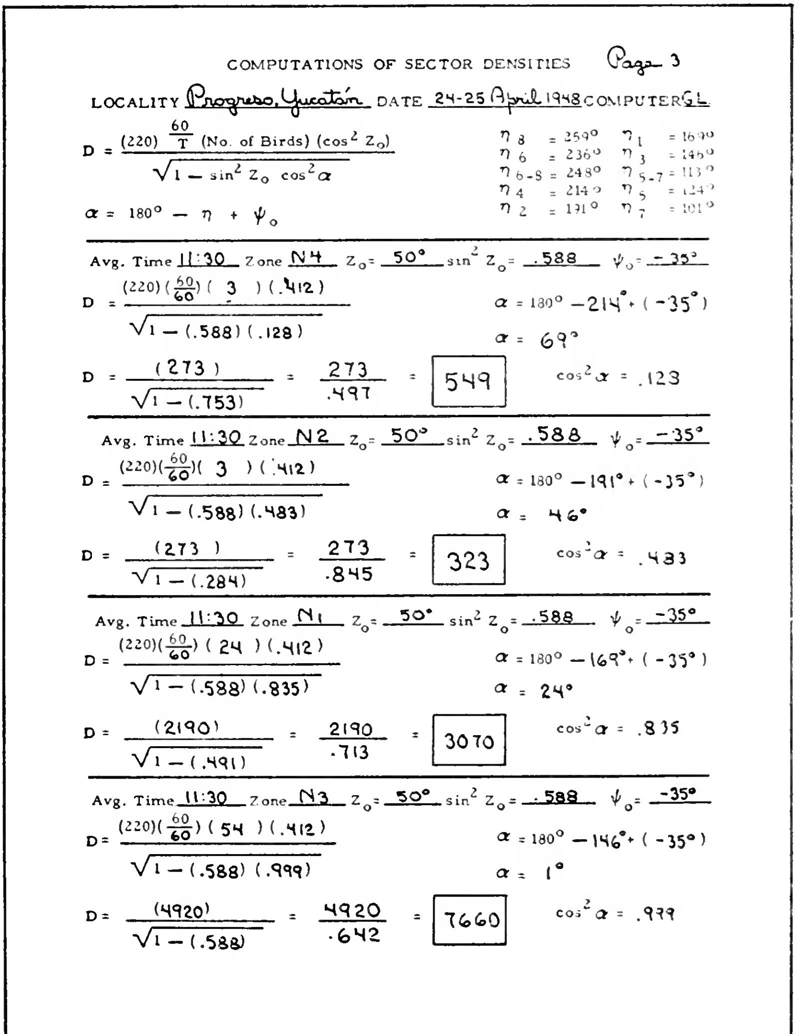
$$\tan \theta_{\text{Npt.}} = \frac{\tan (180^\circ - \psi_o)}{\cos Z_o}$$

Substituting values of ψ_o found on the form (Figure 18):

$$\tan \theta_{\text{Npt.}} = \frac{\tan [180^\circ - (-35^\circ)]}{\cos 50^\circ} = \frac{\tan 215^\circ}{\cos 50^\circ} = \frac{.700}{.643} = 1.09$$

$$\theta_{\text{Npt.}} = 47^\circ 28'$$

Four angles, one in each quadrant, have the same tangent value.



COMPUTATIONS OF SECTOR DENSITIES Page 3

LOCALITY Progreso, Yucatán DATE 24-25 April 1948 COMPUTER GL

$$D = \frac{(220)\,\frac{60}{T}\,(\text{No. of Birds})\,(\cos^2 Z_o)}{\sqrt{1 - \sin^2 Z_o \cos^2 \alpha}}$$

$\alpha = 180^\circ - \eta + \psi_o$

$\eta_8 = 259^\circ$ $\eta_1 = 169^\circ$
$\eta_6 = 236^\circ$ $\eta_3 = 146^\circ$
$\eta_{6-8} = 248^\circ$ $\eta_{5-7} = 113^\circ$
$\eta_4 = 214^\circ$ $\eta_5 = 124^\circ$
$\eta_2 = 191^\circ$ $\eta_7 = 101^\circ$

Avg. Time 11:30 Zone N4 Z_o = 50° $\sin^2 Z_o$ = .588 ψ_o = −35°

$$D = \frac{(220)(\frac{60}{60})(3)(.412)}{\sqrt{1 - (.588)(.128)}} \qquad \alpha = 180^\circ - 214^\circ + (-35^\circ)$$

$\alpha = 69^\circ$

$$D = \frac{(273)}{\sqrt{1 - (.753)}} = \frac{273}{.497} = \boxed{549} \qquad \cos^2 \alpha = .123$$

Avg. Time 11:30 Zone N2 Z_o = 50° $\sin^2 Z_o$ = .588 ψ_o = −35°

$$D = \frac{(220)(\frac{60}{60})(3)(.412)}{\sqrt{1 - (.588)(.483)}} \qquad \alpha = 180^\circ - 191^\circ + (-35^\circ)$$

$\alpha = 46^\circ$

$$D = \frac{(273)}{\sqrt{1 - (.284)}} = \frac{273}{.845} = \boxed{323} \qquad \cos^2 \alpha = .483$$

Avg. Time 11:30 Zone N1 Z_o = 50° $\sin^2 Z_o$ = .588 ψ_o = −35°

$$D = \frac{(220)(\frac{60}{60})(24)(.412)}{\sqrt{1 - (.588)(.835)}} \qquad \alpha = 180^\circ - 169^\circ + (-35^\circ)$$

$\alpha = 24^\circ$

$$D = \frac{(2190)}{\sqrt{1 - (.491)}} = \frac{2190}{.713} = \boxed{3070} \qquad \cos^2 \alpha = .835$$

Avg. Time 11:30 Zone N3 Z_o = 50° $\sin^2 Z_o$ = .588 ψ_o = −35°

$$D = \frac{(220)(\frac{60}{60})(54)(.412)}{\sqrt{1 - (.588)(.999)}} \qquad \alpha = 180^\circ - 146^\circ + (-35^\circ)$$

$\alpha = 1^\circ$

$$D = \frac{(4920)}{\sqrt{1 - (.588)}} = \frac{4920}{.642} = \boxed{7660} \qquad \cos^2 \alpha = .999$$

FIG. 20. Form for computing sector densities.

Since, in processing spring data, we are dealing mainly with north sectors, it is convenient to choose the acute angle, in this instance 47°28′. In doubtful cases, the value of the numerator of the equation (here 215°) applied as an angular measure from 6 o'clock will tell in which quadrant the projected boundary must fall. The fact that projection always draws the boundary closer to the 3-9 line serves as a further check on the computation.

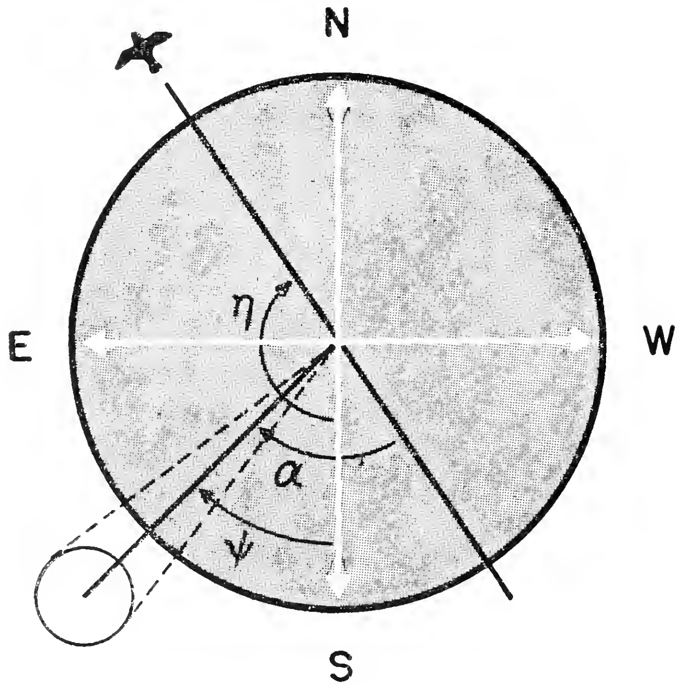


FIG. 21. Determinaton of the angle α

In the same manner, the projected position angles of all the pertinent sector boundaries for a given hour may be calculated and plotted in red pencil with a protractor on the circular diagrams of Figure 15. To avoid confusion in lines, the zones are not portrayed in the black and white reproduction of the sample plot form. They are shown, however, in the shaded enlargement (Figure 19) of the 11 to 12 P. M. diagram. The number of birds recorded for each sector may be ascertained by counting the number of tally marks between each pair of boundary lines and the information may be entered in the columns provided in the plot form (Figure 15).

We are now prepared to turn to the form for "Computations of Sector Densities" (Figure 20), which systematizes the solution of the following equation:

$$D = \frac{(220)\,\frac{60}{T}\,(\text{No. of Birds})\,(\cos^2 Z_2)}{\sqrt{1 - \sin^2 Z_2 \cos^2 a}} \qquad (2)$$

SUMMARY OF SECTOR DENSITIES

LOCALITY Progreso, Yucatán DATE 24-25 April 1948 COMPUTER G.L.

Zone	Average Time of Observation C.S.T.									Total
	8:30	9:30	10:30	11:30	12:30	1:30	2:30	3:30	4:30	
N8 E-ENE										
N6 ENE-NE										
N4 NE-NNE				549						500
N2 NNE-N		31	148	323	259	320				1100
N1 N-NNW		98	900	3070	840	1295	950	100	219	7500
N3 NNW-NW	46	336	2420	7660	4900	287	119	267		16,000
N5 NW-WNW			241	261	1950					2500
N7 WNW-W										
S8 W-WSW										
S6 WSW-SW										
S4 SW-SSW										
S2 SSW-S										
S1 S-SSE										
S3 SSE-SE										
S5 SE-ESE										
S7 ESE-E										
Station Magnitude	0+	500	3700	11,900	7900	1900	1100	400	200	27,600

FIG. 22. Facsimile of form summarizing sector densities. The totals at the bottom of each column give the station densities.

Some of the symbols and factors, appearing here for the first time, require brief explanation. D stands for Sector Density. The constant, 220, is the reciprocal of the quotient of the angular diameter of the moon divided by 2. T is Time In, arrived at by sub-

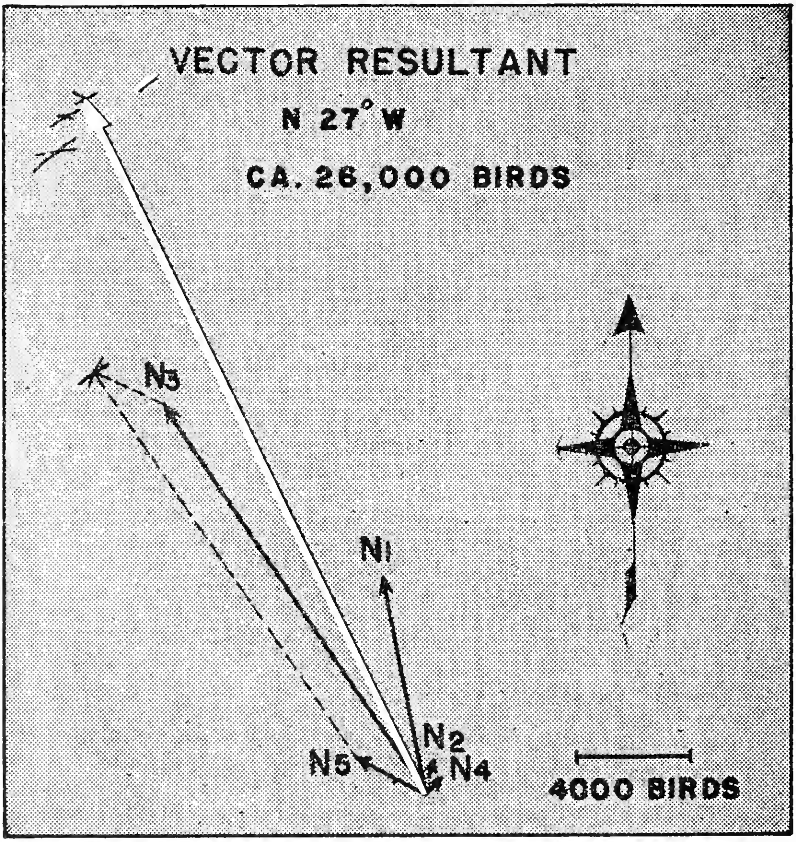


FIG. 23. Determination of Net Trend Density.

tracting the total number of minutes of time out, as noted for each hour on the original data sheets, from 60. "No. of Birds" is the number for the sector and hour in question as just determined on the plot form. The symbol a represents the angle between the mid-line of the sector and the azimuth line of the moon. The quantity is found by the equation:

$$a = 180° - \eta + \varphi_o \qquad (3)$$

The symbol η here represents the position of the mid-line of the sector expressed in terms of its 360° compass reading. This equation is illustrated in Figure 21. The values of η for various zones are given in the upper right-hand corner of the form (Figure 20). The subsequent reductions of the equations, as they appear in the figure for four zones, are self-explanatory. The end result, representing the sector density, is entered in the rectangular box provided.

After all the sector densities have been computed, they are tabulated on a form for the "Summary of Sector Densities" (Figure 22). By totaling each vertical column, sums are obtained, expressing the Station Density or Station Magnitude for each hour.

An informative way of depicting the densities in each zone is to plot them as lines of thrust, as in Figure 23. Each sector is represented by the directional slant of its mid-line drawn to a length expressing the flight density per zone on some chosen scale, such as 100 birds per millimeter. Standard methods of vector analysis are then applied to find the vector resultant. This is done by considering the first two thrust lines as two sides of an imaginary parallelogram and using a drawing compass to draw intersecting arcs locating the position of the missing corner. In the same way, the third vector

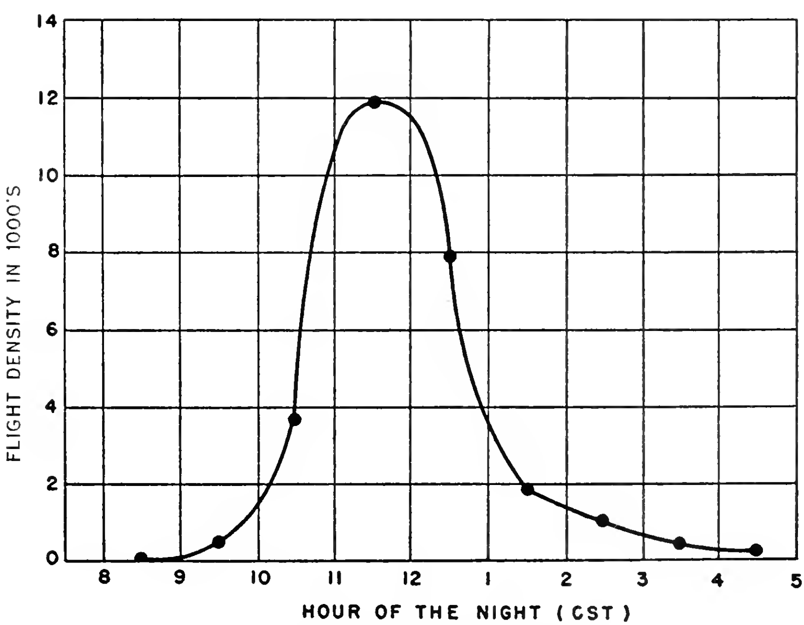


FIG. 24. Nightly station density curve at Progreso, Yucatán, on April 24-25, 1948.

is combined with the invisible resultant whose distal end is represented by the intersection of the first two arcs. The process is repeated successively with each vector until all have been taken into consideration. The final intersection of arcs defines the length and slant of the Vector Resultant, whose magnitude expresses the Net Trend Density in terms of the original scale.

The final step in the processing of a set of observations is to plot on graph paper the nightly station density curve as illustrated by Figure 24.

PART II. THE NATURE OF NOCTURNAL MIGRATION

Present day concepts of the whole broad problem of bird migration are made up of a few facts and many guesses. The evolutionary origin of migration, the modern necessities that preserve its biologic utility, the physiological processes associated with it, the sensory mechanisms that make it possible, the speed at which it is achieved, and the routes followed, all have been the subject of some investigation and much conjecture. All, to a greater or less extent, remain matters of current controversy. All must be considered unknowns in every logical equation into which they enter. Since all aspects of the subject are intimately interrelated, since all have a bearing on the probabilities relating to any one, and since new conjectures must be judged largely in the light of old conjectures rather than against a background of ample facts, the whole field is one in which many alternative explanations of the established phenomena remain equally tenable. Projected into this uncertain atmosphere, any statistical approach such as determinations of flight density will require the accumulation of great masses of data before it is capable of yielding truly definitive answers to those questions that it is suited to solve. Yet, even in their initial applications, density analyses can do much to bring old hypotheses regarding nocturnal migration into sharper definition and to suggest new ones.

The number of birds recorded through the telescope at a particular station at a particular time is the product of many potential variables. Some of these—like the changing size of the field of observation and the elevation of flight—pertain solely to the capacity of the observer to see what is taking place. It is the function of the density and direction formulae to eliminate the influences of these two variables insofar as is possible, so that the realities of the situation take shape in a nearly statistically true form. There remain to be considered those influences potentially responsible for variations in the real volume of migration at different times and places—things like the advance of season, geographic location, disposition of terrain features, hourly activity rhythm, wind currents, and other climatological causes. The situation represented by any set of observations probably is the end result of the interaction of several such factors. It is the task of the discussions that follow to analyze flight densities in the light of the circumstances surrounding them and by statistical insight to isolate the effects of single factors. When this has been done, we shall be brought closer to an understanding of these influences themselves as they apply to the seasonal movements of birds. Out of data that is essentially quantitative, conclusions of a qualitative nature will begin to take form. It should be constantly borne in mind, however, that such conclusions relate to the movement of birds *en masse* and that caution must be used in applying these conclusions to any one species.

Since the dispersal of migrants in the night sky has a fundamental bearing on the sampling procedure itself, and therefore on the reliability of figures on flight density, consideration can well be given first to the horizontal distribution of birds on narrow fronts.

A. HORIZONTAL DISTRIBUTION OF BIRDS ON NARROW FRONTS

Bird migration, as we know it in daytime, is characterized by spurts and uneven spatial patterns. Widely separated V's of geese go honking by. Blackbirds pass in dense recurrent clouds, now on one side of the observer, now on the other. Hawks ride along in narrow file down the thermal currents of the ridges. Herons, in companies of five to fifty, beat their way slowly along the line of the surf. And an unending stream of swallows courses low along the levees. Everywhere the impression is one of birds in bunches, with vast spaces of empty sky between.

Such a situation is ill-suited to the sort of sampling procedure on which flight density computations are based. If birds always traveled in widely separated flocks, many such flocks might pass near the cone of observation and still, by simple chance, fail to enter the sliver of space where they could be seen. Chance would be the dominating factor in the number of birds recorded, obscuring the effects of other influences. Birds would seldom be seen, but, when they did appear, a great many would be observed simultaneously or in rapid succession.

When these telescopic studies were first undertaken at Baton Rouge in 1945, some assurance already existed, however, that night migrants might be so generally dispersed horizontally in the darkness above that the number passing through the small segment of sky where they could be counted would furnish a nearly proportionate sample of the total number passing in the neighborhood of the observation station. This assurance was provided by the very interesting account of Stone (1906: 249-252), who enjoyed the unique experience of viewing a nocturnal flight as a whole. On the night of March 27, 1906, a great conflagration occurred in Philadelphia, illuminating the sky for a great distance and causing the birds overhead to stand out clearly as their bodies reflected the light. Early in the night few birds were seen in the sky, but thereafter they began to come in numbers, passing steadily from the southwest to the northeast. At ten o'clock the flight was at its height. The observer stated that two hundred birds were in sight at any given moment as he faced the direction from which they came. This unparalleled observation is of such great importance that I quote it in part, as follows: "They [the birds] flew in a great scattered, widespread host, never in clusters, each bird advancing in a somewhat zigzag manner . . . Far off in front of me I could see them coming as mere specks . . . gradually growing larger as they approached . . . Over the illuminated area, and doubtless for great distances beyond, they seemed about evenly distributed . . . I am inclined to think that the migrants were not influenced by the fire, so far as their flight was concerned, as those far to the right were not coming toward the blaze but keeping steadily on their way . . . Up to eleven o'clock, when my observations ceased, it [the flight] continued apparently without abatement, and I am informed that it was still in progress at midnight."

Similarly, in rather rare instances in the course of the present study, the combination of special cloud formations and certain atmospheric conditions has made it possible to see birds across the entire field of the telescope, whether they actually passed before the moon or not. In such cases the area of the sky under observation is greatly increased, and a large segment of the migratory movement can be studied. In my own experience of this sort, I have been forcibly impressed by the apparent uniformity and evenness of the procession of migrants passing in review and the infrequence with which birds appeared in close proximity.

As striking as these broader optical views of nocturnal migration are, they have been too few to provide an incontestable basis for generalizations. A better test of the prevailing horizontal distribution of night migrants lies in the analysis of the telescopic data themselves.

The distribution in time of birds seen by a single obsever may be studied profitably in this connection. Since the cone of observation is in constant motion, swinging across the front of birds migrating from south to north, each interval of time actually represents a different position in space. This is evident from the map of the progress of the field of observation across the terrain at Tampico, Tamaulipas, on April 21-22, 1948 (Figure 25). At this station on this night, a total of 259 birds were counted between 7:45 P. M. and 3:45

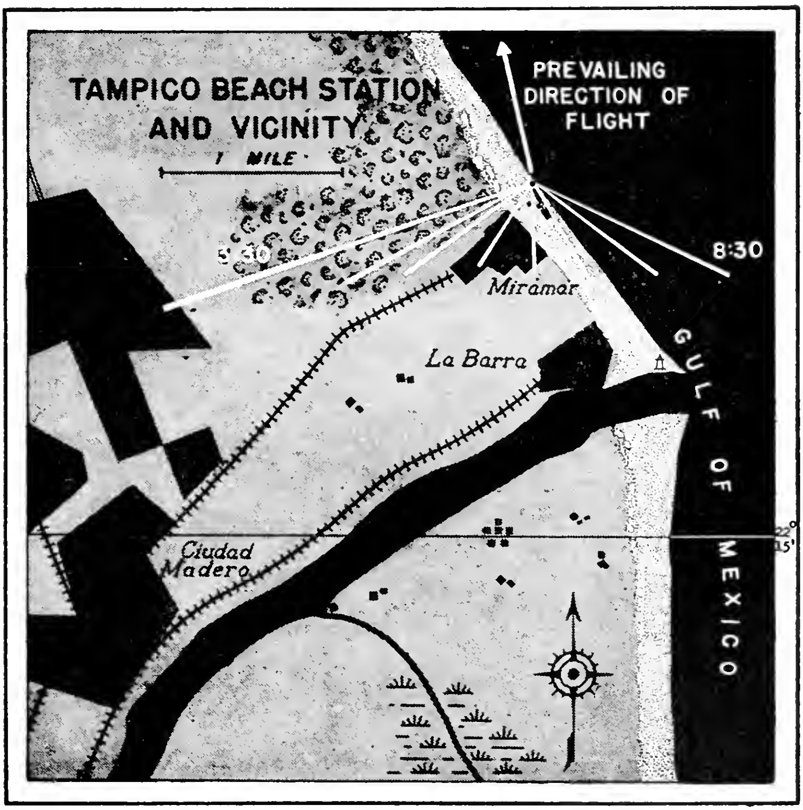


FIG. 25. Positions of the cone of observation at Tampico, Tamps., on April 21-22, 1948. Essential features of this diagrammatic map are drawn to scale, the triangular white lines representing the projections of the cone of observation on the actual terrain at the mid-point of each hour of observation. If the distal ends of the position lines were connected, the portion of the map encompassed would represent the area over which all the birds seen between 8:30 P. M. and 3:30 A. M. must have flown.

A. M. The number seen in a single hour ranged from three to seventy-three, as the density overhead mounted to a peak and then declined. The number of birds seen per minute was not kept with stop watch accuracy; consequently, analysis of the number of birds that passed before the moon in short intervals of time is not justified. It appears significant, however, that in the ninety minutes of heaviest flight, birds were counted at a remarkably uniform rate per fifteen minute interval, notwithstanding the fact that early in the period the flight rate overhead had reached a peak and had begun to decline. The number of birds seen in successive fifteen-minute periods was twenty-six, twenty-five, nineteen, eighteen, fifteen, and fifteen.

Also, despite the heavy volume of migration at this station on this particular night, the flight was sufficiently dispersed horizontally so that only twice in the course of eight hours of continuous observation did more than one bird simultaneously appear before the moon. These were "a flock of six birds in formation" seen at 12:09 A. M. and "a flock of seven, medium-sized and distant," seen at 2:07 A. M. In the latter instance, as generally is the case when more than one bird is seen at a time, the moon had reached a rather low altitude, and consequently the cone of observation was approaching its maximum dimensions.

The comparative frequency with which two or more birds simultaneously cross before the moon would appear to indicate whether or not there is a tendency for migrants to fly in flocks. It is significant, therefore, that in the spring of 1948, when no less than 7,432 observations were made of birds passing before the moon, in only seventy-nine instances, or 1.1 percent of the cases, was more than one seen at a time. In sixty percent of these instances, only two birds were involved. In one instance, however, again when the moon was low and the cone of observation near its maximum size, a flock estimated at twenty-five was recorded.

The soundest approach of all to the study of horizontal distribution at night, and one which may be employed any month, anywhere, permitting the accumulation of statistically significant quantities of data, is to set up two telescopes in close proximity. Provided the flight overhead is evenly dispersed, each observer should count approximately the same number of birds in a given interval of time. Some data of this type are already available. On May 19-20, at Urbana, Illinois, while stationed twenty feet apart making parallax studies with two telescopes to determine the height above the earth of the migratory birds, Carpenter and Stebbins (*loci cit.*) saw seventy-eight birds in two and one-half hours. Eleven were seen by both observers, thirty-three by Stebbins only, and thirty-four by Carpenter only. On October 10, 1905, at the same place, in two hours, fifty-seven birds were counted, eleven being visible through both telescopes. Of the remainder, Stebbins saw seventeen and Carpenter, twenty-nine. On September 12, 1945, at Baton Rouge, Louisiana, in an interval of one hour and forty minutes, two independent observers each counted six birds. Again, on October 17, 1945, two observers each saw eleven birds in twenty-two minutes. On April 10, 1946, in one hour and five minutes, twenty-four birds were seen through one scope and twenty-six through the other. Likewise on May 12, 1946, in a single hour, seventy-three birds were counted by each of two observers. The Baton Rouge observations were made with telescopes six to twelve feet apart. These results show a remarkable conformity, though the exceptional October observation of Carpenter and Stebbins indicates the desirability of continuing these studies, particularly in the fall.

On the whole, the available evidence points to the conclusion that night migration differs materially from the kind of daytime migration with which we are generally familiar. Birds are apparently evenly spread throughout the sky, with little tendency to fly in flocks. It must be remembered, however, that only in the case of night migration have objective and truly quantitative studies been made of horizontal distribution. There is a possibility that our impressions of diurnal migration are unduly influenced by the fact that the species accustomed to flying in flocks are the ones that attract the most attention.

These conclusions relate to the uniformity of migration in terms of short distances only, in the immediate vicinity of an observation station. The extent to which they may be applied to broader fronts is a question that may be more appropriately considered later, in connection with continental aspects of the problem.

B. DENSITY AS FUNCTION OF THE HOUR OF THE NIGHT

There are few aspects of nocturnal migration about which there is less understanding than the matter of when the night flight begins, at what rate it progresses, and for what duration it continues. One would think, however, that this aspect of the problem, above most others, would have been thoroughly explored by some means of objective study. Yet, this is not the case. Indeed, I find not a single paper in the American literature wherein the subject is discussed, although some attention has been given the matter by European ornithologists. Siivonen (1936) recorded in Finland the frequency of call notes of night migrating species of *Turdus* and from these data plotted a time curve showing a peak near midnight. Bergman (1941) and Putkonen (1942), also in Finland, studied the night flights of certain ducks (*Clangula hyemalis* and *Oidemia fusca* and *O. nigra*) and a goose (*Branta bernicla*) and likewise demonstrated a peak near midnight. However, these studies were made at northern latitudes and in seasons characterized by evenings of long twilight, with complete darkness limited to a period of short duration around midnight. Van Oordt (1943: 34) states that in many cases migration lasts all night; yet, according to him, most European investigators are of the opinion that, in general, only a part of the night is used, that is, the evening and early morning hours. The consensus of American ornithologists seems to be that migratory birds begin their flights in twilight or soon thereafter and that they remain on the wing until dawn. Where this idea has been challenged at all, the implication seems to have been that the flights are sustained even longer, often being a continuation far into the night of movements begun in the daytime. The telescopic method fails to support either of these latter concepts.

The Time Pattern

When the nightly curves of density at the various stations are plotted as a function of time, a salient fact emerges—that the flow

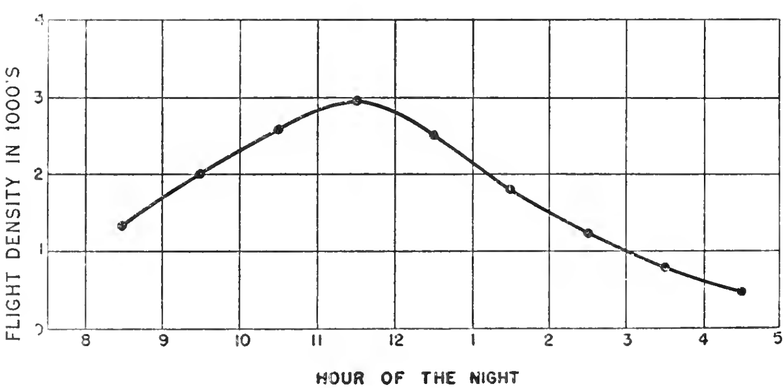


FIG. 26. Average hourly station densities in spring of 1948. This curve represents the arithmetic mean obtained by adding all the station densities for each hour, regardless of date, and dividing the sum by the number of sets of observations at that hour (CST).

of birds is in no instance sustained throughout the night. The majority of the curves rise smoothly from near zero at the time of twilight to a single peak and then decline more or less symmetrically to near the base line before dawn. The high point is reached in or around the eleven to twelve o'clock interval more often than at any other time.

Figure 26, representing the average hourly densities for all stations on all nights of observation, demonstrates the over-all effect of these tendencies. Here the highest density is reached in the hour before midnight with indications of flights of great magnitude also in the hour preceding and the hour following the peak interval. The curve ascends somewhat more rapidly than it declines, which fact may or may not be significant. Since there is a great disproportion in the total volume of migration at different localities, the thought might be entertained that a few high magnitude stations, such as Tampico and Progreso, have imposed their own characteristics on the final graph. Fortunately, this idea may be tested by subjecting the data to a second treatment. If hourly densities are expressed as a percentage of the nightly peak, each set of observations, regardless of the number of birds involved, carries an equal weight in determining the character of the over-all curve. Figure 27 shows that percentage analysis produces a curve almost identical with the preceding one. To be sure, all of the individual curves do not conform with the composite, either in shape or incidence of

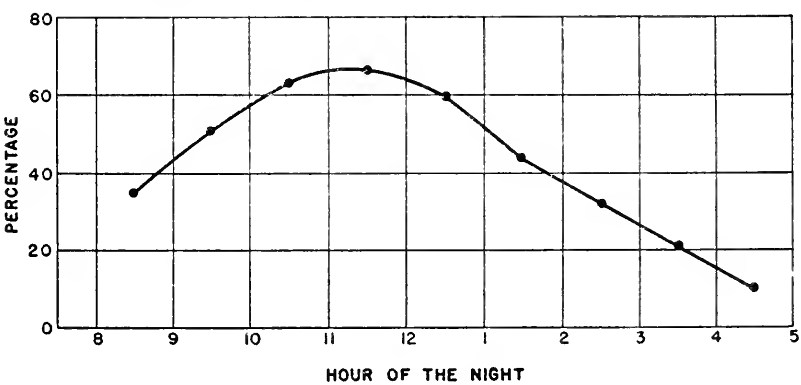


FIG. 27. Hourly station densities plotted as a percentage of peak. The curve is based only on those sets of data where observations were continued long enough to include the nightly peak. In each set of data the station density for each hour has been expressed as a percentage of the peak for the night at the station in question. All percentages for the same hour on all dates have been averaged to obtain the percentile value of the combined station density at each hour (CST).

peak. The extent of this departure in the latter respect is evident from Figure 28, showing the number of individual nightly station curves reaching a maximum peak in each hour interval. Even this graph demonstrates that maximum densities near midnight represent the typical condition.

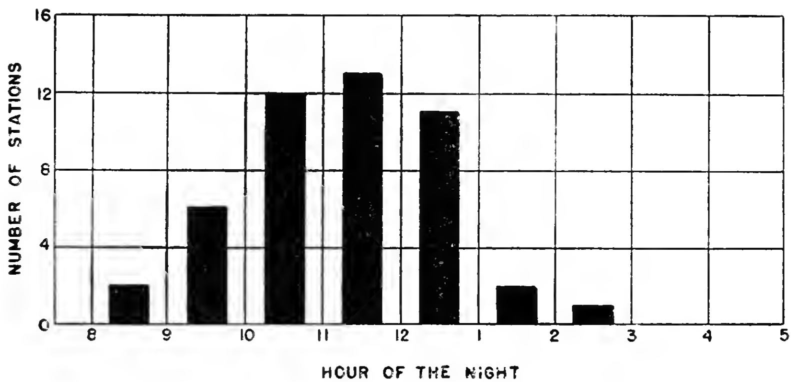


Fig. 28. Incidence of maximum peak at the various hours of the night in 1948. "Number of stations" represents the total for all nights of the numbers of station peaks falling within a given hour.

The remarkable smoothness and consistency of the curves shown in Figures 26 and 27 seem to lead directly to the conclusion that the volume of night migration varies as a function of time. Admittedly other factors are potentially capable of influencing the number of birds passing a given station in a given hour. Among these are weather conditions, ecological patterns, and specific topographical features that might conceivably serve as preferred avenues of flight. However, if any of these considerations were alone responsible for changes in the numbers of birds seen in successive intervals, the distribution of the peak in time could be expected to be haphazard. For example, there is no reason to suppose that the cone of observation would come to lie over favored terrain at precisely the hour between eleven and twelve o'clock at so many widely separated stations. Neither could the topographical hypothesis explain the consistently ascending and descending pattern of the ordinates in Figure 28. This is not to say that other factors are without effect; they no doubt explain the divergencies in the time pattern exhibited by Figure 28. Nevertheless, the underlying circumstances are such that when many sets of data are merged these other influences are subordinated to the rise and fall of an evident time pattern.

Stated in concrete terms, the time frequencies shown in the graphs suggest the following conclusions: first, nocturnal migrations are not a continuation of daytime flights; second, nearly all night migrants come to earth well before dawn; and, third, in each hour of the night up until eleven or twelve o'clock there is typically a progressive increase in the number of birds that have taken wing and in each of the hours thereafter there is a gradual decrease. Taken at its face value, the evidence seems to indicate that birds do not begin their night migrations *en masse* and remain on the wing until dawn and that in all probability most of them utilize less than half of the night.

Interestingly enough, the fact that the plot points in Figure 26 lie nearly in line tempts one to a further conclusion. The curve behaves as an arithmetic progression, indicating that approximately the same number of birds are leaving the ground in each hour interval up to a point and that afterwards approximately the same number are descending within each hour. However, some of the components making up this curve, as later shown, are so aberrant in this regard that serious doubt is cast on the validity of this generalization.

Because the results of these time studies are unexpected and startling, I have sought to explore other alternative explanations and none appears to be tenable. For example, the notion that the varying flight speeds of birds might operate in some way to produce a cumulative effect as the night progresses must be rejected on close analysis. If birds of varying flight speeds are continuously and evenly distributed in space, a continuous and even flow would result all along their line of flight. If they are haphazardly distributed in space, a correspondingly haphazard density pattern would be expected.

Another explanation might be sought in the purely mathematical effects of the method itself. The computational procedure assumes that the effective area of the sample is extremely large when the moon is low, a condition that usually obtains in the early hours of the evening in the days surrounding the full moon. Actually no tests have yet been conducted to ascertain how far away a silhouette of a small bird can be seen as it passes before the moon. Consequently, it is possible that some birds are missed under these conditions and that the effective field of visibility is considerably smaller than the computed field of visibility. The tendency, therefore, may be to minimize the densities in such situations more than is justified.

However, in many, if not most, cases, the plotting of the actual number of birds seen, devoid of any mathematical procedures, results in an ascending and descending curve.

A third hypothesis proposes that all birds take wing at nearly the same time, gradually increase altitude until they reach the mid-point of their night's journey, and then begin a similarly slow descent. Since the field of observation of the telescope is conical, it is assumed that the higher the birds arise into the sky the more they increase their chances of being seen. According to this view, the changes

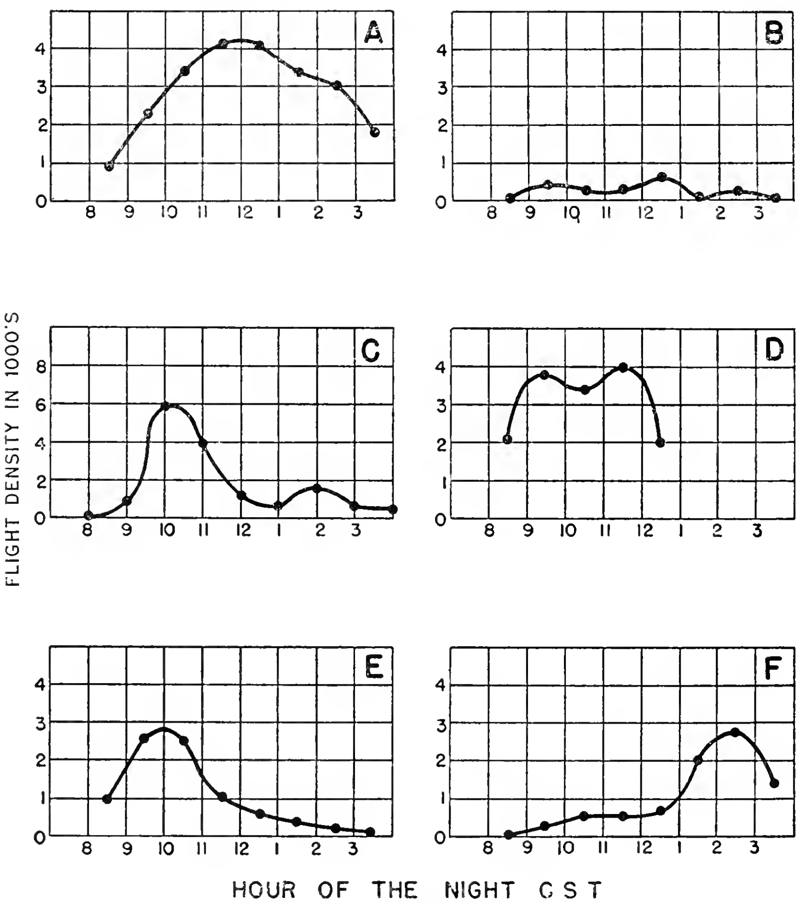


FIG. 29. Various types of density-time curves. (A) Near typical, Ottumwa, April 22-23; (B) random fluctuation, Stillwater, April 23-24; (C) bimodal, Knoxville, April 22-23; (D) sustained peak, Ottumwa, April 21-22; (E) early peak, Oak Grove, May 21-22; (F) late peak, Memphis, April 23-24.

in the density curve represent changes in the opportunity to see birds rather than an increase or decrease in the actual number of migrants in the air. Although measurements of flight altitude at various hours of the night have not been made in sufficient number to subject this idea to direct test, it is hardly worthy of serious consideration. The fallacy in the hypothesis is that the cone of observation itself would be rising with the rising birds so that actually the greatest proportion of birds flying would still be seen when the field of observation is in the supine position of early evening.

It cannot be too strongly emphasized that the over-all time curves just discussed have been derived from a series of individual curves, some of which differ radically from the composite pattern. In Figure 29, six dissimilar types are shown. This variation is not surprising in view of the fact that many other causative factors aside from time operate on the flow of birds from hour to hour. Figure 29A illustrates how closely some individual patterns conform with the average. Figure 29B is an example of a random type of fluctuation with no pronounced time character. It is an effect rarely observed, occurring only in the cases where the number of birds observed is so small that pure chance has a pronounced effect on the computed densities; its vacillations are explicable on that account alone. Errors of sampling may similarly account for some, though not all, of the curves of the bimodal type shown in Figure 29C. Some variation in the curves might be ascribed to the variations in kinds of species comprising the individual flights at different times at different places, provided that it could be demonstrated that different species of birds show dissimilar temporal patterns. The other atypical patterns are not so easily dismissed and will be the subject of inquiry in the discussions that follow. It is significant that in spite of the variety of the curves depicted, which represent every condition encountered, in not a single instance is the density sustained at a high level throughout the night. Morover, these dissident patterns merge into a remarkably harmonious, almost normal, average curve.

When, at some future date, suitable data are available, it would be highly desirable to study the average monthly time patterns to ascertain to what extent they may deviate from the over-all average. At present this is not justifiable because there are not yet enough sets of data in any two months representing the same selection of stations.

Correlations with Other Data

It is especially interesting to note that the data pertaining to this problem derived from other methods of inquiry fit the conclusions adduced by the telescopic method. Overing (1938), who for several years kept records of birds striking the Washington Monument, stated that the record number of 576 individuals killed on the night of September 12, 1937, all came down between 10:30 P. M. and midnight. His report of the mortality on other nights fails to mention the time factor, but I am recently informed by Frederick C. Lincoln (*in litt.*) that it is typical for birds to strike the monument in greatest numbers between ten and twelve o'clock at night. At the latter time the lights illuminating the shaft are extinguished, thus resulting in few or no casualties after midnight. The recent report by Spofford (1949) of over 300 birds killed or incapacitated at the Nashville airport on the night of September 9-10, 1948, after flying into the light beam from a ceilometer, is of interest in this connection even though the cause of the fatality is shrouded in mystery. It may be noted, however, that "most of the birds fell in the first hour," which, according to the account, was between 12:30 A. M. and 1:30 A. M. Furthermore, birds killed at the Empire State Building in New York on the night of September 10-11, 1948, began to strike the tower "shortly after midnight" (Pough, 1948). Also it will be recalled that the observations of Stone (*loc. cit.*), already referred to in this paper (page 410), show a situation where the flight in the early part of the night was negligible but mounted to a peak between ten and eleven o'clock, with continuing activity at least until midnight.

All of these observations are of significance in connection with the conclusions herein advanced, but by far the most striking correlation between these present results and other evidences is found in the highly important work of various European investigators studying the activity of caged migratory birds. This work was recently reviewed and extended by Palmgren (1944) in the most comprehensive treatise on the subject yet published. Palmgren recorded, by an electrically operated apparatus, the seasonal, daily, and hourly activity patterns in caged examples of two typical European migrants, *Turdus ericetorum philomelas* Brehm and *Erithacus rubecula* (Linnaeus). Four rather distinct seasonal phases in activity of the birds were discerned: *winter non-migratory, spring migratory, summer non-migratory,* and *autumn migratory.* The first of these is distinguished by morning and evening maxima of activity, the latter being better developed but the former being more prolonged. Toward the beginning of migration, these two periods of activity decline somewhat. The second, or spring migratory phase, which is of special interest in connection with the present problem, is characterized by what Palmgren describes as nightly migratory restlessness (*Zugunruhe*). The morning maximum, when present, is weaker and the evening maximum often disappears altogether. Although variations are described, the migratory restlessness begins ordinarily after a period of sleep ("sleeping pause") in the evening and reaches a maximum and declines before midnight.

This pattern agrees closely with the rhythm of activity indicated by the time curves emerging from the present research. Combining the two studies, we may postulate that most migrants go to sleep for a period following twilight, thereby accounting for the low densities in the early part of the night. On awakening later, they begin to exhibit migratory restlessness. The first hour finds a certain number of birds sufficiently stimulated so that they rise forthwith into the air. In the next hour still others respond to this urge and they too mount into the air. This continues until the "restlessness" begins to abate, after which fewer and fewer birds take wing. By this time, the birds that began to fly early are commencing to descend, and since their place is not being filled by others leaving the ground, the density curve starts its decline. Farner (1947) has called attention to the basic importance of the work by Palmgren and the many experimental problems it suggests. Of particular interest would be studies comparing the activity of caged American migrant species and the nightly variations in the flight rates.

The Baton Rouge Drop-off

As already stated, the present study was initiated at Baton Rouge, Louisiana, in 1945, and from the outset a very peculiar density time pattern was manifest. I soon found that birds virtually disappeared from the sky after midnight. Within an hour after the termination of twilight, the density would start to ascend toward a peak which was usually reached before ten o'clock, and then would begin, surprisingly enough, a rapid decline, reaching a point where the migratory flow was negligible. In Figure 30 the density curves are shown for five nights that demonstrate this characteristically early decline in the volume of migration at this station. Since, in the early stages of the work, coördinates of apparent pathways of all the birds seen were not recorded, I am unable now to ascertain the direction of flight and thereby arrive at a density figure based on the dimension

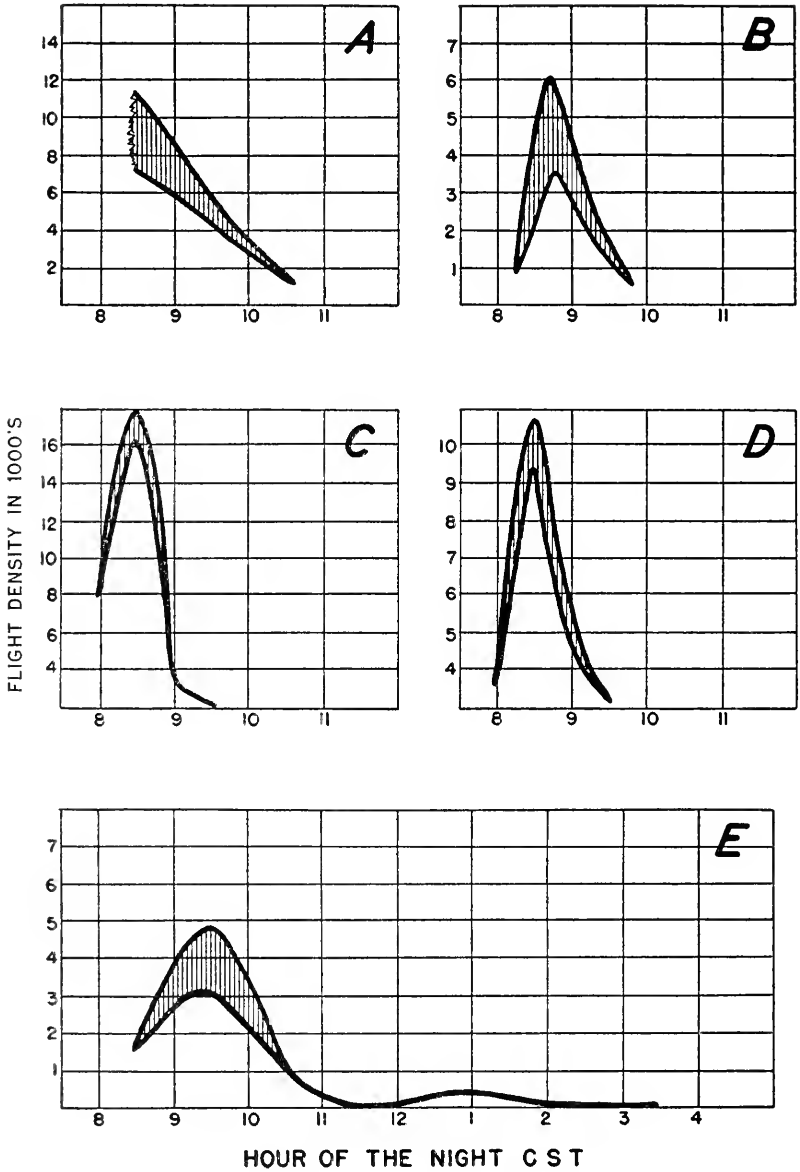


FIG. 30. Density-time curves on various nights at Baton Rouge. (A) April 25, 1945; (B) April 15, 1946; (C) May 10, 1946; (D) May 15, 1946; (E) April 22-23, 1948. These curves are plotted on a "plus or minus" basis as described in the text, with the bottom of the curve representing the minimum density and the top of the curve the maximum.

of the cone and the length of the front presented to birds flying in certain directions. It is feasible, nevertheless, to compute what I have termed a "plus or minus" flight density figure stating the rate of passage of birds in terms of the maximum and minimum corrections which all possible directions of flight would impose. In other words, density is here computed, first, as if all the birds were flying perpendicular to the long axis of the ellipse, and, secondly, as if all the birds were flying across the short axis of the ellipse. Since the actual directions of flight were somewhere between these two extremes, the "plus or minus" density figure is highly useful.

The well-marked decline before midnight in the migration rates at Baton Rouge may be regarded as one of the outstanding results emerging from this study. Many years of ornithological investigation in this general region failed to suggest even remotely that a situation of this sort obtained. Now, in the light of this new fact, it is possible for the first time to rationalize certain previously incongruous data. Ornithologists in this area long have noted that local storms and cold-front phenomena at night in spring sometimes precipitate great numbers of birds, whereupon the woods are filled the following day with migrants. On other occasions, sudden storms at night have produced no visible results in terms of bird densities the following day. For every situation such as described by Gates (1933) in which hordes of birds were forced down at night by inclement weather, there are just as many instances, even at the height of spring migration, when similar weather conditions yielded no birds on the ground. However, the explanation of these facts is simple; for we discover that storms that produced birds occurred before midnight and those that failed to produce birds occurred after that time (the storm described by Gates occurred between 8:30 and 9:00 P. M.).

The early hour decline in density at Baton Rouge at first did not seem surprising in view of the small amount of land area between this station and the Gulf of Mexico. Since the majority of the birds destined to pass Baton Rouge on a certain night come in general from the area to the south of that place, and since the distances to various points on the coast are slight, we inferred that a three-hour flight from even the more remote points would probably take the bulk of the birds northward past Baton Rouge. In short, the coastal plain would be emptied well before midnight of its migrant bird life, or at least that part of the population destined to migrate on any particular night in question. Although data in quantity are not available from stations on the coastal plain other than Baton Rouge, it may be pointed out that such observations as we do have, from Lafayette and New Orleans, Louisiana, and from Thomasville, Georgia, are in agreement with this hypothesis.

A hundred and seventy miles northward in the Mississippi Valley, at Oak Grove, Louisiana, a somewhat more normal density pattern is manifested. There, in four nights of careful observation, a pronounced early peak resulted on the night of May 21-22 (Figure 29E), but on the other three nights significant densities held up until near twelve o'clock, thereby demonstrating the probable effect of the increased amount of land to the south of the station.

Subsequent studies, revealing the evident existence of an underlying density time pattern, cast serious doubt on the explanations just advanced of the early decline in the volume of migration at Baton Rouge. It has as yet been impossible to reconcile the early drop-off at this station with the idea that birds are still mounting into the air at eleven o'clock, as is implied by the ideal time curves.

C. MIGRATION IN RELATION TO TOPOGRAPHY

To this point we have considered the horizontal distribution of birds in the sky only on a very narrow scale and mainly in terms of the chance element in observations. Various considerations have supported the premise that the spread of nocturnal migration is rather even, at least within restricted spacial limits and short intervals of time. This means that in general the flow of birds from hour to hour at a single station exhibits a smooth continuity. It does not mean that it is a uniform flow in the sense that approximately the same numbers of birds are passing at all hours, or at all localities, or even on all one-mile fronts in the same locality. On the contrary, there is evidence of a pronounced but orderly change through the night in the intensity of the flight, corresponding to a basic and definitely timed cycle of activity. Other influences may interfere with the direct expression of this temporal rhythm as it is exhibited by observations at a particular geographical location. Among these, as we have just seen, is the disposition of the areas that offer suitable resting places for transient birds and hence contribute directly and immediately to the flight overhead. A second possible geographical effect is linked with the question of the tendency of night migrants to follow topographical features.

General Aspects of the Topographical Problem

That many diurnal migrants tend to fly along shorelines, rivers, and mountain ridges is well known, but this fact provides no assurance that night migrants do the same thing. Many of the obvious advantages of specialized routes in daylight, such as feeding opportunities, the lift provided by thermal updrafts, and the possible aid of certain landmarks in navigation, assume less importance after night falls. Therefore, it would not be safe to conclude that *all* nocturnal migrants operate as do *some* diurnal migrants. For instance, the passage of great numbers of certain species of birds along the Texas coast in daylight hours cannot be regarded as certain proof that the larger part of the nocturnal flight uses the same route. Neither can we assume that birds follow the Mississippii River at night simply because we frequently find migrants concentrated along its course in the day. Fortunately we shall not need to speculate indefinitely on this problem; for the telescopic method offers a means of study based on what night migrants are doing *at night.* Two lines of attack may be pursued. First we may compare flight densities obtained when the field of the telescope lies over some outstanding topographical feature, such a a river, with the recorded volume of flight when the cone of observation is directed away from that feature. Secondly, we may inquire how the major flight directions at a certain station are oriented with respect to the terrain. If the flight is concentrated along a river, for instance, the flight density curve should climb upward as the cone of observation swings over the river, *regardless of the hour at which it does so.* The effect should be most pronounced if the observer were situated on the river bank, so that the cone would eventually come to a position directly along the watercourse. Though in that event birds coming up the river route would be flying across the short axis of an elliptical section of the cone, the fact that the whole field of observation would be in their path should insure their being seen in maximum proportions. If, on the other hand, the telescope were set up some distance away from the river so that the cone merely moved *across* its course, only a section of the observation field would be interposed on the main flight lane.

The interaction of these possibilities with the activity rhythm should have a variety of effects on the flight density curves. If the cone comes to lie over the favored topographical feature in the hour of greatest migrational activity, the results would be a simple sharp peak of doubtful meaning. However, since the moon rises at a different time each evening, the cone likewise would reach the immediate vicinity of the terrain feature at a different time each night. As a result, the terrain peak would move away from its position of coincidence with the time peak on successive dates, producing first, perhaps, a sustention of peak and later a definitely bimodal curve. Since other hypotheses explain double peaks equally well, their mere existence does not necessarily imply that migrants actually do travel along narrow topographical lanes. Real proof requires that we demonstrate a moving peak, based on properly corrected density computations, corresponding always with the position of the cone over the most favored terrain, and that the flight vectors be consistent with the picture thus engendered.

The Work of Winkenwerder

To date, none of the evidence in favor of the topographical hypothesis completely fills these requirements. Winkenwerder (*loc. cit.*), in analyzing the results of telescopic counts of birds at Madison and Beloit, Wisconsin, Detroit and Ann Arbor, Michigan, and at Lake Forest, Illinois, between 1898 and 1900, plotted the number of birds seen at fifteen-minute intervals as a function of the time of the night. He believed that the high points in the resulting frequency histograms represented intervals when the field of the telescope was moving over certain topographically determined flight lanes, though he did not specify in all cases just what he assumed the critical physiographic features to be. Especially convincing to him were results obtained at Beloit, where the telescope was situated on the east bank of the Rock River, on the south side of the city. Immediately below Beloit the river turns southwestward and continues in this direction about five miles before turning again to flow in a southeastward course for approximately another five miles. In this setting, on two consecutive nights of observation in May, the number of birds observed increased tremendously in the 2 to 3 a. m. interval, when, according to Winkenwerder's interpretation of the data (he did not make the original observations at Beloit himself), the telescope was pointing directly down the course of the river. This conclusion is weakened, however, by notable inconsistencies. Since the moon rises later each evening, it could not have reached the same position over the Rock River at the same time on both May 12-13 and May 13-14, and therefore, if the peaks in the graph were really due to a greater volume of migration along the watercourse, they should not have so nearly coincided. As a matter of fact the incidence of the peak on May 12-13 should have preceded that of the peak on May 13-14; whereas his figure shows the reverse to have been true. Singularly enough, Winkenwerder recognized this difficulty in his treatment of the data from Madison, Wisconsin. Unable to correlate the peak period with the Madison terrain by the approach used for Beloit, he plotted the observations in terms of hours after moonrise instead of standard time. This procedure was entirely correct; the moon does reach approximately the same position at each hour after its rise on successive nights. The surprising thing is that Winkenwerder did not seem to realize the incompatibility of his two approaches or to realize that he was simply choosing the method to suit the desired results.

Furthermore, as shown in Part I of this paper, the number of birds seen through the telescope often has only an indirect connection with the actual number of birds passing over. My computations reveal that the highest counts of birds at Beloit on May 12-13 were recorded when the moon was at an altitude of only 8° to 15° and, that when appropriate allowance is made for the immense size of the field of observation at this time, the partially corrected flight density for the period is not materially greater than at some other intervals in the night when the telescope was not directed over the course of the Rock River. These allowances do not take the direction factor into consideration. Had the birds been flying at right angles to the short axis of an elliptical section of the cone throughout the night, the flight density in the period Winkenwerder considered the peak would have been about twice as high as in any previous interval. On the other hand, if they had been flying across the long axis at all times, the supposed peak would be decidedly inferior to the flight density at 10 to 11:00 P. M., before the cone came near the river.

Admittedly, these considerations contain a tremendous element of uncertainty. They are of value only because they expose the equal uncertainty in Winkenwerder's basic evidence. Since the coördinates of the birds' apparent pathways at Beloit were given, I at first entertained the hope of computing the flight densities rigorously, by the method herein employed. Unfortunately, Winkenwerder was apparently dealing with telescopes that gave inverted images, and he used a system for recording coördinates so ambiguously described that I am not certain I have deciphered its true meaning. When, however, his birds are plotted according to the instructions as he stated them, the prevailing direction of flight indicated by the projection formula falls close to west-northwest, not along the course of the Rock River, but *at direct right angles to it.*

Interpretation of Recent Data

I am in a position to establish more exact correlations between flight density and terrain features in the case of current sets of observations. Some of these data seem at first glance to fit the idea of narrow topographically-oriented flight lanes rather nicely. At Tampico, where six excellent sets of observations were made in March and April, 1948, the telescope was set up on the beach within a few yards of the Gulf of Mexico. As can be seen from Figure 25 (*ante*), the slant of the coastline at this point is definitely west of north, as is also the general trend of the entire coast from southern Veracruz to southern Tamaulipas (see Figure 34, beyond). The

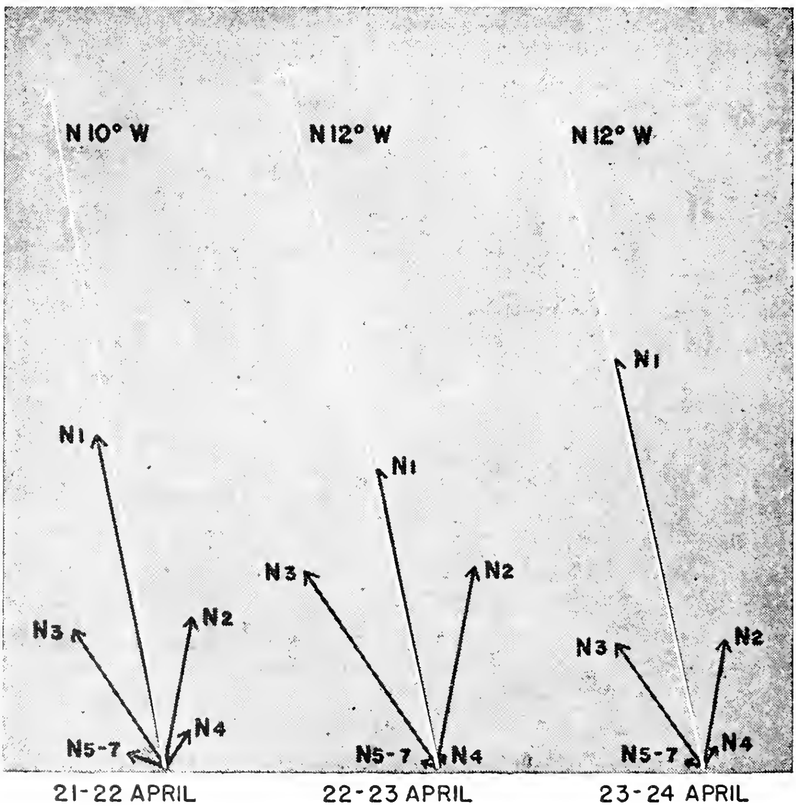


FIG. 31. Directional components in the flight at Tampico on three nights in 1948. The lengths of the sector vectors are determined by their respective densities expressed as a percentage of the station density for that night; the vector resultants are plotted from them by standard procedure. Thus, the nightly diagrams are not on the same scale with respect to the actual number of birds involved.

over-all vector resultant of all bird flights at this station was N 11° W, and, as will be seen from Figure 31, none of the nightly vector resultants in April deviates more than one degree from this average. Thus the prevailing direction of flight, as computed, agrees with the trend of the coast at the precise point of the observations, at least to the extent that both are west of north. To be sure, the individual sector vectors indicate that not all birds were following this course; indeed, some appear to have been flying east of north, heading for a landfall in the region of Brownsville, Texas, and a very few to have been traveling northeastward toward the central Gulf coast. But it must be remembered that a certain amount of computational deviation and of localized zigzagging in flight must be anticipated. Perhaps none of these eastward vectors represents an actual extended flight path. The nightly vector resultants, on the other hand, are so consistent that they have the appearance of remarkable accuracy and tempt one to draw close correlations with the terrain. When this is done, it is found that, while the prevailing flight direction is 11° west of north, the exact slant of the coastline at the location of the station is about 30° west of north, a difference of around 19°. It appears, therefore, that the birds were not following the shoreline precisely but cutting a chord about ten miles long across an indentation of the coast. If it be argued that the method of calculation is not accurate enough to make a 19° difference significant, and that most of the birds might have been traveling along the beach after all, it can be pointed out with equal justification that, if this be so, the 11° divergence from north does not mean anything either and that perhaps the majority of the birds were

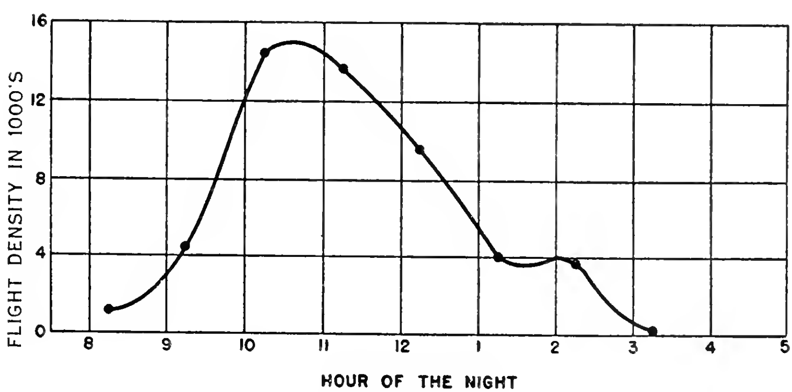


FIG. 32. Hourly station density curve at Tampico, Tamaulipas, on the night of April 21-22, 1948 (CST).

going due north. We are obliged to conclude either that the main avenue of flight paralleled the disposition of the major topographical features only in a general way or that the angle between the line of the coast and true north is not great enough to warrant any inference at all.

Consideration of the Tampico density curves leads to similarly ambiguous results. On the night of April 21-22, as is evident from a comparison of Figures 25 and 32, the highest flight density occurred when the projection of the cone on the terrain was wholly included within the beach. This is very nearly the case on the night of April 23-24 also, the positions of the cone during the peak period of density being only about 16° apart. (On the intervening date, clouds prevented continuous observation during the critical part of the night.) These correlations would seem to be good evidence that most of these night migrants were following the coastline of the Gulf of Mexico. However, the problem is much more complicated. The estimated point of maximum flight density fell at 10:45 P. M. on April 21-22 at 11:00 P. M., on April 23-24, both less than an hour from the peak in the ideal time curve (Figure 26, *ante*). We cannot be sure, therefore, that the increase in density coinciding with the position of the moon over the beach is not an increase which would have occurred anyway. Observations conducted several nights before or after the second quarter, when the moon is not on or near its zenith at the time of the predictable peak in the density curve, would be of considerable value in the study of this particular problem.

The situation at Tampico has been dealt with at length because, among all the locations for which data are available, it is the one that most strongly supports the topographical hypothesis. In none of the other cases have I been able to find a definite relation between the direction of migration and the features of the terrain. Studies of data from some of these stations disclose directional patterns that vary from night to night only slightly more than does the flight at Tampico. In three nights of observation at Lawrence, Kansas, marked by very high densities, the directional trend was north by north-northeast with a variation of less than 8°, yet Lawrence is so situated that there seems to be no feature of the landscape locally or in the whole of eastern Kansas or of western Missouri that coincides with this heading. At Mansfield, Louisiana, in twelve nights of observation, the strong east by northeast trend varied less than 15°, but again there appears to be no correlation over a wide area between this direction and any landmarks. And, at Progreso, Yucatán, where the vector resultants were 21° and 27° on successive nights, most of the birds seen had left the land and were beginning their flight northward over the trackless waters of the Gulf of Mexico. Furthermore, as I have elsewhere pointed out (1946: 205), the whole northern part of the Yucatán Peninsula itself is a flat terrain, unmarked by rivers, mountains, or any other strong physiographic features that conceivably might be followed by birds.

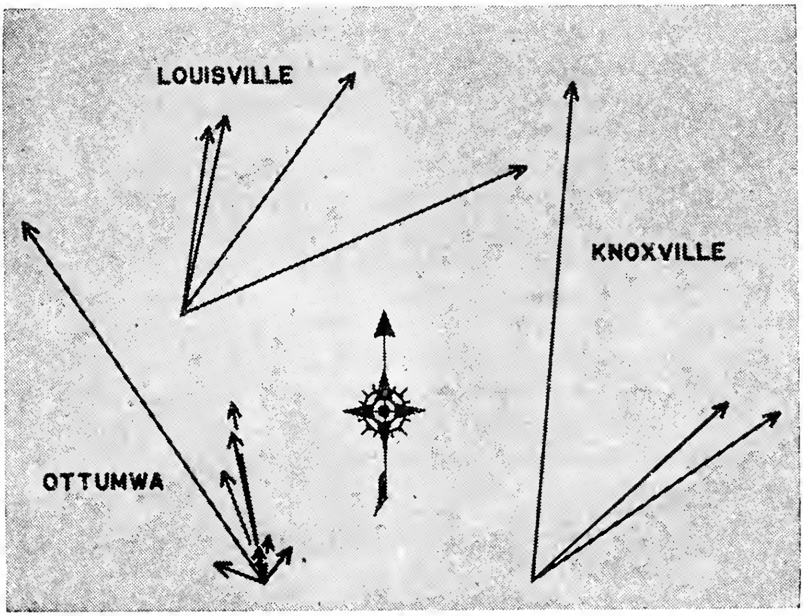


FIG. 33. The nightly net trend of migrations at three stations in 1948. Each arrow is the vector resultant for a particular night, its length expressing the nightly density as a percentage of the total station density for the nights represented. Thus, the various station diagrams are not to the same scale.

In Figure 33 I have shown the directional patterns at certain stations where, unlike the cases noted above, there is considerable change on successive nights. Each vector shown is the vector resultant for one particular night. The lengths of the vectors have been determined by their respective percentages of the total computed density, or total station magnitude, for all the nights in question. In other words, the lengths of the individual vectors denote the percentile rôle that each night played in the total density. From the directional spread at these stations it becomes apparent that if most of the birds were traveling along certain topographic feature on one night, they could not have been traveling along the same feature on other nights.

The possibility should be borne in mind, however, that there may be more than one potential topographic feature for birds to follow at some stations. Moreover, it is conceivable that certain species might follow one feature that would lead them in the direction of their ultimate goal, whereas other species, wishing to go in an entirely different direction, might follow another feature that would lead them toward their respective destination. It would seem unlikely, however, that the species composition of the nocturnal flights would change materially from night to night, although there is a strong likelihood that it might do so from week to week and certainly from month to month.

By amassing such data as records of flight direction along the same coast from points where the local slant of the shoreline is materially different, and comparisons of the volume of migration at night along specialized routes favored during the day with the flight densities at progressive distances from the critical terrain feature involved, we shall eventually be able to decide definitely the rôle topography plays in bird migration. We cannot say on the basis of the present ambiguous evidence that it is not a factor in determining which way birds fly, but, if I had to hazard a guess one way or the other, I would be inclined to discount the likelihood of its proving a major factor.

D. GEOGRAPHICAL FACTORS AND THE CONTINENTAL DENSITY PATTERN

A study of the total nightly or seasonal densities at the various stations brings forth some extremely interesting factors, many of which, however, cannot be fully interpreted at this time. A complete picture of the magnitude of migration at a given station cannot be obtained from the number of birds that pass the station on only a few nights in one spring. Many years of study may be required before hard and fast principles are justifiable. Nevertheless, certain salient features stand out in the continental density pattern in the spring of 1948. (The general results are summarized in Tables 2-5; the location of the stations is shown in Figure 34.) These features will be discussed now on a geographical basis.

TABLE 2.—Extent of Observations and Seasonal Station Densities at Major Stations in 1948

Observation Station	Nights of observation				Hours of observation				Season density
	March	April	May	Total	March	April	May	Total	
CANADA									
Pt. Pelee	......	......	1	1	......	......	6	6	2,500
MEXICO									
S. L. P.: Ebano	1	......	......	1	3	......	......	3	1,300
Tamps.: Tampico	3	3	......	6	20	20	......	40	140,300
Yuc.: Progreso	......	3	......	3	......	18	......	18	60,500
UNITED STATES									
Fla.: Pensacola	......	2	2	4	......	8	7	15	1,500
Winter Park	......	5	6	11	......	39	38	77	21,700
Ga.: Athens	......	2	......	2	......	10	......	10	4,000
Thomasville	......	1	1	2	......	8	8	16	4,700
Iowa: Ottumwa	......	5	5	10	......	16	28	44	134,400
Kans.: Lawrence	2	1	......	3	16	4	......	20	68,700
Ky.: Louisville	......	3	2	5	......	20	14	34	49,300
Murray	......	2	......	2	......	13	......	13	26,200
La.: Baton Rouge	......	3	......	3	......	15	......	15	11,000
Lafayette	......	1	......	1	......	5	......	5	2,800
Mansfield	1	5	4	10	2	16	22	40	22,400
New Orleans	1	1	......	2	5	2	......	7	1,900
Oak Grove	......	2	2	4	......	16	15	31	33,900
Mich.: Albion	......	1	......	1	......	3	......	3	1,100
Minn.: Hopkins	......	......	1	1	......	......	4	4	2,000
Miss.: Rosedale	......	1	1	2	......	6	8	14	12,600
Mo.: Columbia	......	2	1	3	......	8	6	14	13,100
Liberty	......	1	1	2	......	7	7	14	4,800
Okla.: Stillwater	1	2	1	4	5	11	3	19	8,400
S. Car.: Charleston	1	1	1	3	5	8	9	22	3,000
Tenn.: Knoxville	......	2	2	4	......	18	14	32	35,400
Memphis	2	3	2	7	13	20	12	45	29,700
Tex.: College Station	......	3	1	4	......	19	8	27	32,200
Rockport	......	1	......	1	......	4	......	4	6,200

TABLE 3.—Average Hourly Station Densities in 1948

OBSERVATION STATION	March	April	May	Season
CANADA				
Pt. Pelee	....	....	400	400
MEXICO				
S. L. P.: Ebano	400	....	....	400
Tamps.: Tampico	700	6,300	....	3,500
Yuc.: Progreso	....	2,800	....	2,800
UNITED STATES				
Fla.: Pensacola	....	0+	200	100
Winter Park	....	300	200	300
Ga.: Athens	....	400	....	400
Thomasville	....	500	100	300
Iowa: Ottumwa	....	1,700	3,800	3,100
Kans.: Lawrence	4,000	1,400	....	3,400
Ky.: Louisville	....	2,000	700	1,500
Murray	....	2,000	....	2,000
La.: Baton Rouge	....	700	....	700
Lafayette	....	600	....	600
Mansfield	0	700	800	600
New Orleans	60	800	....	300
Oak Grove	....	1,400	800	1,100
Mich.: Albion	....	400	....	400
Minn.: Hopkins	....	....	500	500
Miss.: Rosedale	....	1,100	700	900
Mo.: Columbia	....	400	1,700	900
Liberty	....	500	200	300
Okla.: Stillwater	500	200	1,000	400
S. Car.: Charleston	200	200	0+	100
Tenn.: Knoxville	....	1,300	800	1,100
Memphis	300	800	900	700
Tex.: College Station	....	1,100	1,500	1,200
Rockport	....	1,600	....	1,600

TABLE 4.—Maximum Hourly Station Densities in 1948

Observation Station	March	April	May
CANADA			
Pt. Pelee	....	....	1,400
MEXICO			
S. L. P.: Ebano	600	....	....
Tamps.: Tampico	3,100	21,200	....
Yuc.: Progreso	....	11,900	....
UNITED STATES			
Fla.: Pensacola	....	100	700
Winter Park	....	2,300	1,000
Ga.: Athens	....	900	....
Thomasville	....	1,500	200
Iowa: Ottumwa	....	3,800	12,500
Kans.: Lawrence	14,500	2,200	....
Ky.: Louisville	....	5,000	1,400
Murray	....	3,700	....
La.: Baton Rouge	....	3,400	....
Lafayette	....	1,800	....
Mansfield	....	2,100	1,600
New Orleans	200	1,100	....
Oak Grove	....	2,700	2,500
Mich.: Albion	....	700	....
Minn.: Hopkins	....	....	1,100
Miss.: Rosedale	....	2,200	1,400
Mo.: Columbia	....	800	3,400
Liberty	....	800	800
Okla.: Stillwater	900	700	1,400
S. Car.: Charleston	400	600	200
Tenn.: Knoxville	....	5,800	1,900
Memphis	1,200	3,400	2,100
Tex.: College Station	....	3,400	3,100
Rockport	....	2,400	....

TABLE 5.—Maximum Nightly Densities at Stations with More Than One Night of Observation

OBSERVATION STATION	March	April	May
MEXICO			
Tamps.: Tampico	5,500	63,600	....
Yuc.: Progreso	....	31,600	....
UNITED STATES			
Fla.: Winter Park	....	6,200	....
Ga.: Athens	....	2,600	....
Thomasville	....	3,900	....
Iowa: Ottumwa	....	15,300	54,600
Kans.: Lawrence	51,600	5,400	....
Ky.: Louisville	....	17,000	8,400
Murray	....	16,400	....
La.: Baton Rouge	....	6,200	....
Mansfield	....	4,900	5,200
Oak Grove	....	13,600	5,800
Miss.: Rosedale	....	6,800	5,800
Mo.: Columbia	....	1,400	10,300
Okla.: Stillwater	2,700	1,900	3,000
Tenn.: Knoxville	....	15,200	9,000
Memphis	3,600	7,900	7,000
Tex.: College Station	....	6,200	13,200

FIG. 34. Stations at which telescopic observations were made in 1948.

Gulf Migration: A Review of the Problem

In view of the controversy in recent years pertaining to migration routes in the region of the Gulf of Mexico (Williams, 1945 and 1947; Lowery, 1945 and 1946), the bearing of the new data on the problem is of especial interest. While recent investigations have lent further support to many of the ideas expressed in my previous papers on the subject, they have suggested alternative explanations in the case of others. In the three years that have elapsed since my last paper dealing with Gulf migration, some confusion seems to have arisen regarding the concepts therein set forth. Therefore, I shall briefly re-state them.

It was my opinion that evidence then available proved conclusively that birds traverse the Gulf frequently and intentionally; that the same evidence suggested trans-Gulf flights of sufficient magnitude to come within the meaning of migration; that great numbers of birds move overland around the eastern and western edges of the Gulf; that it was too early to say whether the coastal or trans-Gulf route was the more important, but that enough birds cross the water from Yucatán to account for transient migration in the extreme lower Mississippi Valley; and, that, in fair weather, most trans-Gulf migrants continue on inland for some distance before coming to land, creating an area of "hiatus" that is usually devoid of transient species. I tried to make it emphatically clear that I realized that many birds come into Texas from Mexico overland, that I did not think the hordes of migrants normally seen on the Texas coast in spring were by any means all trans-Gulf migrants. I stated (1946: 206): "Proving that birds migrate in numbers across the Gulf does not prove that others do not make the journey by the coastal routes. But that is exactly the point. No one has ever pretended that it does." Although some ornithologists seem to have gained the impression that I endorse only the trans-Gulf route, this is far from the truth. I have long held that the migrations overland through eastern Mexico and southern Texas on one hand, and the over-water flights on the other, are each part of the broad movement of transients northward into the United States. There are three avenues of approach by which birds making up the tremendous concentrations on the Texas coast may have reached there: by a continental pathway from a wintering ground in eastern and southern Mexico; by the over-water route from Yucatán and points to the southward; and, finally, by an overland route from Central America via the western edge of the Gulf. As a result of Louisiana State University's four-year study of the avifauna in eastern Mexico, I know that migrants reach Texas from the first source. As a consequence of my studies in Yucatán of nocturnal flight densities and their directional trends, I strongly believe that migrants reach Texas from this second source. As for the third source, I have never expressed an opinion. I am not prepared to do so now, for the reason that today, as three years ago, there is no dependable evidence on which to base a judgment one way or another.

Western Gulf Area

Among the present flight density data bearing on the above issues, are the six sets of observations from the vicinity of Tampico, Tamaulipas, already referred to. These were secured in the spring of 1948 by a telescope set up on the Gulf beach just north of the Miramar pavilion and only a hundred feet from the surf (see Figure 25, *ante*). The beach here is approximately 400 feet wide and is backed by scrub-covered dunes, which rapidly give way toward the west to a rather dense growth of low shrubs and trees. One might have expected that station densities at Tampico in March would be rather high. Actually, though they are the second highest recorded for the month, they are not impressive and afford a striking contrast with the record flights there in April (Table 6). Unfortunately, only

TABLE 6.—Computed Hourly Densities at Tampico, Tamps., in Spring of 1948

Date	Average hour of observation								
	8:30	9:30	10:30	11:30	12:30	1:30	2:30	3:30	4:30
22–23 March	600	700	1,000	800	100	100	0	100	......
23–24 March	0	400	1,200	3,100	800	......	......	......	......
24–25 March	300	700	800	1,600	1,100	......	......	......	......
21–22 April	1,100	7,000	14,900	12,900	8,100	3,800	3,500	200	......
22–23 April	700	2,900	7,500	......	......	......	......	......	......
23–24 April	600	4,700	19,100	21,200	5,500	5,900	4,000	2,000	200

a few stations were operating in March and thus adequate comparisons are impossible; but the indications are that, in March, migration activity on the western edges of the Gulf is slight. It fails even to approach the volume that may be observed elsewhere at the same time, as for example, in eastern Kansas where, however, the migration is not necessarily correlated with the migration in the lower Gulf area. Strangely enough, on the night of March 22-23, at Tampico, approximately 85 per cent of the birds were flying from north of an east-west line to south of it, opposite to the normal trend of spring migration. This phenomenon, inexplicable in the present instance, will be discussed below. On the other two nights in March, the directional trend at Tampico was northward with few or no aberrant components. Observations made approximately thirty-five miles inland from the Gulf, at Ebano, San Luis Potosí, on the night of March 25-26, show lower station densities than the poorest night at Tampico, but since they cover only a three-hour watch, they reveal little or nothing concerning the breadth of the so-called coastal flyway.

April flight densities at Tampico are the highest recorded in the course of this study. The maximum hourly density of 21,200 birds is 46 per cent higher than the maximum hourly density anywhere else. The average hourly density of 6,300 in April is more than twice as great as the next highest average for that month. These figures would seem to satisfy certain hypotheses regarding a coastwise flight of birds around the western edge of the Gulf. Other aspects of the observations made at that time do not satisfy these hypotheses. Texas ornithologists have found that in periods of heavy spring migration, great numbers of birds are invariably precipitated by rainy weather. On April 23, in the midst of the record-breaking telescopic studies at Tampico, Mr. Robert J. Newman made a daytime census immediately following four hours of rain. He made an intensive search of a small area of brush and low growth back of the beach for traces of North American migrants. In his best hour, only thirteen individual birds out of seventy-five seen were of species that do not breed there. The transient species were the Ruby-throated Hummingbird (1), Scissor-tailed Flycatcher (1), Western Wood Pewee (1), Black-throated Green Warbler (2) Orchard Oriole (7), and Baltimore Oriole (1), all of which winter extensively in southern Mexico. Perhaps, however, the apparent scarcity of transients on this occasion is not surprising in the light of the analysis of flight density in terms of bird density on the ground which I shall develop beyond. My only point here is to demonstrate that rain along the coast does not always produce birds.

As large as the nocturnal flights at Tampico have so far proved to be, they are not commensurate with the idea that nearly all birds follow a narrow coastwise route around the Gulf. To establish the latter idea, one must be prepared to show that the migrant species returning to the United States pass along two flyways a few miles wide in the immense volume necessary to account for their later abundance on a 1500-mile front extending across eastern North America. One might expect at least ten to twenty fold the number observable at any point in the interior of the United States. In actuality, the highest nightly density of 63,600 birds at Tampico is barely sufficient to account for the highest nightly density of 54,600 at Ottumwa, Iowa, alone.

Of course, there is no way of knowing how closely a ratio of anywhere from ten to one through twenty to one, employed in this comparison, expresses the true situation. It may be too high. It could be too low, particularly considering that preliminary studies of flight density in Florida indicate that the western shores of the Gulf of Mexico must carry the major part of the traffic if migratory flights back to the United States in spring take place only along coastwise routes. Consideration of the data obtained in Florida in 1948 will serve to emphasize the point.

Eastern Gulf Area

At Winter Park, Florida, seventy-seven hours were spent at the telescope in April and May. This was 71 per cent more hours of actual observation than at the next highest station. Nevertheless, the total seasonal density amounted to only 21,700 birds. The average hourly density was only 300 birds, with the maximum for any one hour being 2,300 birds. In contrast, forty-five hours of observation at Tampico, Tamaulipas, in March and April, yielded a total station density of 140,300 birds. At the latter place, on the night of April 23-24, almost as many birds passed *in a single hour* as passed Winter Park in all of its seventy-seven hours of observation.

Should future telescopic studies at Florida stations fail to produce densities appreciably higher than did Winter Park in 1948, the currently-held ideas that the Florida Peninsula is a major flyway will be seriously shaken. But one consideration must be kept in mind regarding the present picture. No observations were made at Winter Park in March, when it is conceivable that densities may have been materially higher. We know, for instance, that many of the early migrants to the southern United States are species whose winter homes are in the West Indies. Numbers of Vireonidae and Parulidae (notably the genera *Vireo, Parula, Protonotaria, Mniotilta, Seiurus, Geothlypis, Setophaga,* and certain *Dendroica* and *Vermivora*) winter extensively in this region and are among the first birds to return to the southern states in the spring. Many of them often reach Louisiana and other states on the Gulf coastal plain by mid-March. In the same connection, it may be mentioned that many of the outstanding instances of birds striking lighthouses in southern Florida occurred in March and early April (Howell, 1932).

Yucatán Area

I have long felt that the answers to many of the questions which beset us in our study of Gulf migration are to be found on the open waters of the Gulf of Mexico itself or on the northern tip of the Yucatán Peninsula. Accordingly, in the spring of 1945 I crossed the Gulf by slow freighter for the purpose of determining how many and what kinds of birds might be seen between the mouth of the Mississippi River and the Yucatán Peninsula in fair weather, when it could not be argued that the birds had been blown there by inclement weather. To my own observations I was able to add those of other ornithologists who likewise had been aboard ship in the Gulf.

The summary of results proved that birds of many species cross the Gulf and do so frequently. It failed to demonstrate beyond all doubt that they do so in large numbers. Nor had I expected it to do so. The concensus of Gulf coast ornithologists seemed to be that transient migration in their respective regions is often performed at too high an elevation to be detected unless the birds are forced to earth by bad weather. I saw no reason to anticipate that the results would be otherwise over the waters of the Gulf of Mexico.

The application of the telescopic method held promise of supplying definite data on the numbers of trans-Gulf migrants, however high their flight levels. The roll and vibration of the ship had prevented me in 1945 from making telescopic observations at sea. Since no immediate solution to the technical difficulties involved presented itself, I undertook to reach one of the small cays in Alacrán Reef, lying seventy-five miles north of Yucatán and in line with the coast of southern Louisiana. Because of transportation difficulties, my plans to place a telescopic station in this strategic location failed. Consequently, I returned in 1948 by freighter to Progreso, Yucatán, where telescopic counts were made for three nights, one of which was rendered almost valueless by the cloud cover.

The observation station at Progreso was situated on the northern end of the new wharf which projects northward from the beach to a point one mile over the Gulf. As will be seen from Figure 35, the entire cone of observation lay at nearly all times over the interven-

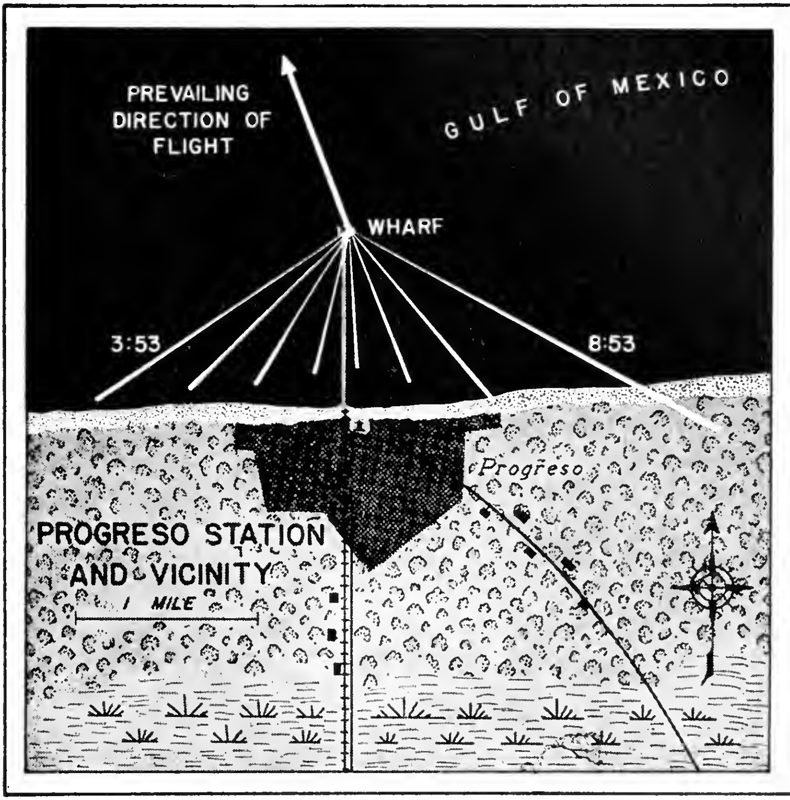


FIG. 35. Positions of the cone of observation at Progreso, Yucatán, on the night of April 23-24, 1948, from 8:53 P.M. to 3:53 A.M. Essential features of this map are drawn to scale. The telescope was set up on the end of a one-mile long wharf that extends northward from the shore over the waters of the Gulf of Mexico. The triangular (white) lines represent the projections of the cone of visibility on the earth at the mid-point of each hour of observation. Only briefly, in the first two hours, did the cone lie even in part over the adjacent mainland. Hence, nearly all of the birds seen in the course of the night had actually left the land behind.

ing water between the telescope on the end of the wharf and the beach. Therefore, nearly all of the birds seen were actually observed leaving the coast and passing out over the open waters of the Gulf. The hourly station densities are shown in Table 7 and Figures 24 and 36. In the seventeen hours of observation on the nights of April 23-24 and April 24-25, a total computed density of 59,200 birds passed within one-half mile of each side of Progreso. This is the third highest density recorded in the course of this study. The

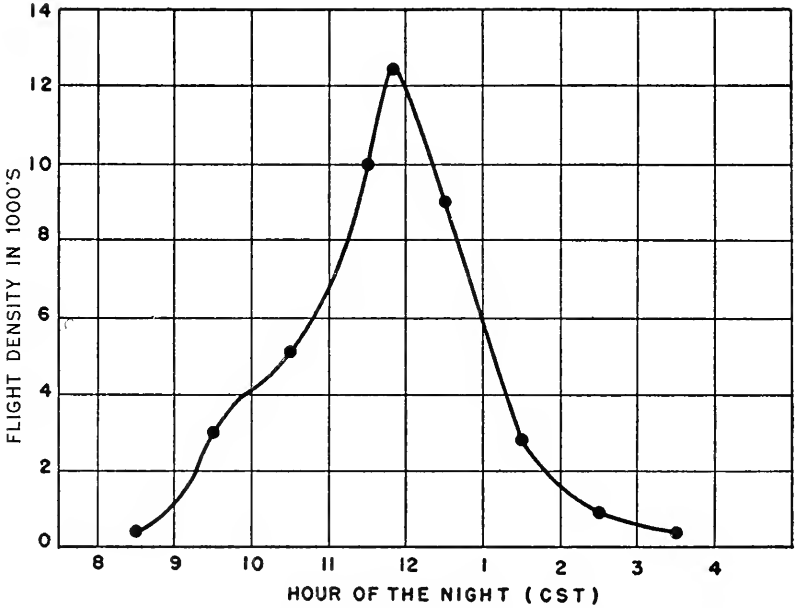


FIG. 36. Hourly station density curve for night of April 23-24, 1948, at Progreso, Yucatán.

TABLE 7.—Computed Hourly Densities at Progreso, Yuc., in Spring of 1948

DATE	Average hour of observation								
	8:30	9:30	10:30	11:30	12:30	1:30	2:30	3:30	4:30
23-24 April	400	3,000	5,100	10,000	9,000	2,800	900	400	......
24-25 April	0	500	3,700	11,900	7,900	1,900	1,100	400	200

maximum for one hour was a computed density of 11,900 birds. This is the fourth highest hourly density recorded in 1948.

It is not my contention that this many birds leave the northern coast of Yucatán every night in spring. Indeed, further studies may show negligible flight densities on some nights and even greater densities on others. As a matter of fact several hours of observation on the night of April 25-26, at Mérida, Yucatán, approximately twenty-five miles inland from Progreso, indicated that on this night the density overhead was notably low, a condition possibly accounted for by a north wind of 10 mph blowing at 2,000 feet. I merely submit that on the nights of April 23-24 and 24-25, birds were leaving the coast of Yucatán *at Progreso* at the rate indicated. But, as I have emphasized in this paper and elsewhere (1946: 205-206), the northern part of the Yucatán Peninsula is notably unmarked by streams or any other physiographic features which birds might follow. The uniformity of the topography for many miles on either side of Progreso, if not indeed for the entire breadth of the Peninsula, makes it probable that Progreso is not a particularly favored spot for observing migration, and that it is not the only point along the northern coast of Yucatán where high flight densities can be recorded. This probability must be considered when comparisons are made between Progreso densities and those at Tampico. The argument could be advanced that the present densities from Tampico do not sufficiently exceed those at Progreso to establish the coastal route as the main avenue of traffic in spring, since there is every reason to suspect topography of exerting some influence to produce a channeling effect in eastern Mexico. Here the coast parallels the directional trend of the migratory movement for more than 600 miles. Likewise the Sierra Madre Oriental of eastern Mexico, situated approximately 100 miles inland (sometimes less), lies roughly parallel to the coast. Because of the slant of the Mexican land mass, many winter residents in southern Mexico, by short northward movements, would sooner or later filter into the coastal plain. Once birds are shunted into this lowland area, it would seem unlikely that they would again ascend to the top of the Sierra Madre to the west. In this way the great north-south cordillera of mountains may act as a western barrier to the horizontal dispersion of transients bound for eastern North America. Similarly, the Gulf itself may serve as an eastern barrier; for, as long as migrants may progress northward in the seasonal direction of migration and still remain over land, I believe they would do so.

To put the matter in a slightly different way, the idea of a very narrow flight lane is inherent in the idea of coastwise migration. For, as soon as we begin to visualize flights of great volume over fronts extending back more than fifty miles from the shore line, we are approaching, if indeed we have not already passed, the point where the phenomenon is no longer coastwise in essence, but merely overland (as indeed my own unprocessed, telescopic data for 1949 indicate may be the case). In actuality, those who have reported on the migration along the western edge of the Gulf of Mexico have never estimated the width of the main flight at more than fifty miles and have intimated that under some circumstances it may be as narrow as two miles. No evidence of such restrictions can be discerned in the case of the trans-Gulf flights. If it cannot be said that they may be assumed to be as wide as the Gulf itself, they at least have the potential breadth of the whole 260-mile northern coast of the Yucatán Peninsula. On these premises, to be merely equal in total magnitude, the coastwise flights must exhibit, depending on the particular situation, from five to 130 times the concentrations observable among trans-Gulf migrants. This point seems almost too elementary to mention, but I have yet to find anyone who, in comparing the two situations, takes it into consideration.

Judged in this light, the average hourly density of 2,800 birds at Progreso in April would appear to be indicative of many more migrants on the entire potential front than the 6,300 birds representing the average hourly density for the same month at Tampico.

That the Progreso birds were actually beginning a trans-Gulf flight seems inevitable. The Yucatán Peninsula projects 200 miles or more northward into the vast open expanses of the Gulf of Mexico and the Caribbean Sea, with wide stretches of water on either side. The great majority of the birds were observed *after* they had proceeded beyond the northern edge of this land mass. Had they later veered either to the east or the west, they would have been obliged to travel several hundred miles before again reaching land, almost as far as the distance straight across the Gulf. Had they turned southward, some individuals should have been detected flying in that direction. As can be seen from Figures 23, 42, and 44, not one bird observed was heading south of east or south of west on either night. No other single piece of evidence so conclusively demonstrates that birds cross the Gulf of Mexico in spring in considerable numbers as do flight density data recorded from Progreso in 1948.

Northern Gulf Area

Unfortunately only a few data on flight density are available from critical localities on the northern shores of the Gulf in spring. As the density curves in Figure 30 demonstrate, several sets of observation, including some phenomenal flights, have been recorded at Baton Rouge. This locality, however, lies sixty-four miles from the closest point on the Gulf coast, and the point due southward on the coast is eighty-four miles distant. Since all of the birds seen at Baton Rouge on any one night may have come from the heavily forested area between Baton Rouge and the coast of the Gulf, we cannot use data from Baton Rouge as certainly representative of incoming trans-Gulf flights. Data from repeated observations at stations on the coast itself are needed to judge the degree of trans-Gulf migration northward. On the few nights of observation at such localities (Cameron and Grand Isle, Louisiana, and Pensacola, Florida), flight densities have been zero or negligible. To be sure, negative results have been obtained at stations in the interior of the United States, and flights of low density have been recorded on occasion at stations where the flight densities are otherwise high. Nevertheless, in view of the volume of migration departing from Progreso, Yucatán, it would appear, upon first consideration, that we should at times record on the coast of Louisiana enough birds arriving in a night of continuous observation to yield a high density figure.

Upon further consideration, however, there are factors mitigating against heavy densities of birds in northern flight on the northern coast of the Gulf. In the first place, presuming the main trans-Gulf flight to originate from northern Yucatán, and that there is a directional fanning to the northward, the birds leave on a 260-mile front, and arrive on a front 400 miles or more wide. Consequently, other factors remaining the same, there would be only approximately half the number of birds on the coast of arrival, at a given time and place, as there was on the coast of departure. Secondly, we may now presume on the basis of the telescopic studies at Progreso, that most migrants leaving northern Yucatán do so in the few hours centering about midnight. The varying speeds of the birds making the 580-mile flight across the Gulf distribute them still more sparsely on the north coast of the Gulf both in time and in space. Also we can see only that segment of the flight, which arrives in that part of a twenty-four hour period when the moon is up. This circumstance further reduces the interceptive potential because the hours after dark, to which the present telescopic studies have been restricted, comprise the period in which the fewest migrants arrive from over the water. To illustrate: it is a mathematical certainty that *none* of the birds leaving Yucatán in the hours of heaviest flight, before 12 P. M., and flying on a straight course at a speed of approximately 33 mph will reach the northern Gulf coast after nightfall; they arrive in the daytime. It will be useful to devise a technique for employing the sun as a background for telescopic observation of birds, thereby making observations possible on a twenty-four hour basis, so as to test these inferences by objective data.

When a whole night's observation (1949 data not yet processed) at Port Aransas, on the southern coast of Texas, on the great overland route from eastern Mexico, yields in one night in April only seven birds, the recording of no birds at a station near the mouth of the Mississippi River becomes less significant.

As I have previously remarked in this paper, the new data obtained since 1946, when I last wrote on the subject of migration in the region of Gulf of Mexico, requires that I alter materially some of my previously held views. As more and more facts come to light, I may be compelled to alter them still further. For one thing, I have come to doubt seriously the rigidity of the coastal hiatus as I envisioned it in 1945. I believe instead that the scarcity of records of transient migrants on the Gulf coastal plain in fair weather is to a very large extent the result of a wide dispersion of birds in the dense cover that characterizes this general region. I now question if appreciable bird densities on the ground ever materialize anywhere except when the sparseness of suitable habitat for resting or feeding tends to concentrate birds in one place, or when certain meteorological conditions erect a barrier in the path of an oncoming migratory flight, precipitating many birds in one place.

This retrenchment of ideas is a direct consequence of the present study, for time and again, as discussed in the case of Tampico densities, maximal nightly flights have failed to produce a visible abundance of transients on land the following day. A simple example may serve to illustrate why. The highest one-hour density recorded in the course of this study is 21,200 birds. That means that this many birds crossed a line one mile long on the earth's surface and at right angles to the direction of flight. Let us further assume that the average flight speed of all birds comprising this flight was 30 mph. Had the entire flight descended simultaneously, it would have been dispersed over an area one mile wide and thirty miles long, and the precipitated density on the ground would have been only 1.1 birds per acre. Moreover, if as many as ten species had been involved in the flight, this would have meant an average per species of less than one bird per nine acres. This would have failed, of course, to show appreciable concentrations to the observer in the field the following day. If, however, on the other hand, the same flight of 21,200 birds had encountered at one point a weather barrier, such as a cold-front storm, all 21,200 birds might have been precipitated in one place and the field observer would have recorded an "inundation of migrants." This would be especially true if the locality were one with a high percentage of open fields or prairies and if the flight were mainly of woodland dwelling species, or conversely, if the locality were densely forested with few open situations and the flight consisted mainly of open-country birds. As explained on page 389, the density formula may be too conservative in its expression of actual bird densities. Even if the densities computed for birds in the air are only half as high as the actual densities in the air, the corresponding ground density of 2.2 birds per acre that results if all the birds descended simultaneously would hardly be any more impressive than the 1.1 bird per acre.

This consideration is doubtless highly modified by local circumstances, but, in general, it seems to suggest a working hypothesis that provides an explanation for many of the facts that we now have. For example, on the coast of Texas there are great expanses of terrain unattractive to such birds as warblers, vireos, tanagers, and thrushes. The precipitation there by bad weather of even a mediocre nightly flight composed of birds of the kinds mentioned would surely produce an overwhelming concentration of birds in the scattered woods and shrubs.

In spite of all that has been written about the great concentrations of transient migrants on the coast of Texas in spring, I am not convinced that they are of a different order of magnitude than those concentrations that sometimes occur along the cheniers and coastal islands of Louisiana and Mississippi. I have read over and over the highly informative accounts of Professor Williams (*loci cit.*) and the seasonal summaries by Davis (1936-1940) and Williams (1941-1945). I have conversed at length with Mrs. Jack Hagar, whom I regard as one of the leading authorities on the bird life of the Texas coast, and she has even permitted me access to her voluminous records covering a period of fifteen years residence at Rockport. Finally, I have spent a limited amount of time myself on the Texas coast studying first-hand the situation that obtains there in order that I might be in a position to compare it with what I have learned from observations elsewhere in the region of the Gulf of Mexico, Louisiana, Florida, Yucatán, and eastern Mexico.

Although the concentrations of birds on some days near the mouth of the Mississippi River are almost incalculable, the fact remains that in Texas the densities of transient species on the ground are more consistently high from day to day. The reason for this may be simple. As birds move up daily from Mexico overland, a certain percentage would be destined to come down at all points along the route but so dispersed in the inland forest that they might pass unnoticed. However, that part of the same flight settling down in coastal areas, where trees are scarce, would produce visible concentrations of woodland species. With the advent of a cold-front storm, two diametrically opposite effects of the same meteorological phenomenon would tend to pile up great concentrations of migrants of two classes—the overland and the trans-Gulf flights. During the prepolar-front weather the strong southerly (from the south) and southeasterly winds would tend to displace much of the trans-Gulf segment to the western part of the Gulf. With the shift of the winds to the north and northwest, which always occurs as the front passes, the overland flight still in the air would tend to be banked up against the coast, and the incoming trans-Gulf flight would be confronted with a barrier, resulting in the precipitation of birds on the first available land.

These postulated conditions are duplicated in part in autumn along the Atlantic coast of the eastern United States. There, as a result of the excellent work of Allen and Peterson (1936) and Stone (1937), a similar effect has been demonstrated when northwest winds shove the south-bound flights up against the coast of New Jersey and concentrate large aggregations of migrants there.

Interior of the United States

Attention has been drawn already to the nature of the nightly flights at stations immediately inland from the Gulf coast, where densities decline abruptly well before midnight. I have suggested that this early drop-off is mainly a result of the small amount of terrain south of these stations from which birds may be contributed to a night's flight. At Oak Grove, Louisiana, the flight exhibited a strong directional trend with no significant aberrant components. Therefore, one may infer that a considerable part of the flight was derived from regions to the south of the station.

At Mansfield, Louisiana, thirty-eight hours of observation in April and May resulted in flight densities that are surprisingly low —much lower, in fact, than at Oak Grove. In eleven of the hours of observation no birds at all were seen. A possible explanation for these low densities lies in the fact that eastern Texas and western Louisiana, where, probably, the Mansfield flights originated, is not an especially attractive region to migrants because of the great amount of deforested and second growth pine land. Oak Grove, in contrast, is in the great Tensas-Mississippi River flood plain, characterized by an almost solid stand of deciduous forest extending over thousands of square miles in the lower Mississippi valley.

In further contrast to the considerable flight densities and pronounced directional trend at Oak Grove, we have the results from Rosedale, Mississippi, only seventy miles to the north and slightly to the east. At Rosedale the densities were mediocre and the flight

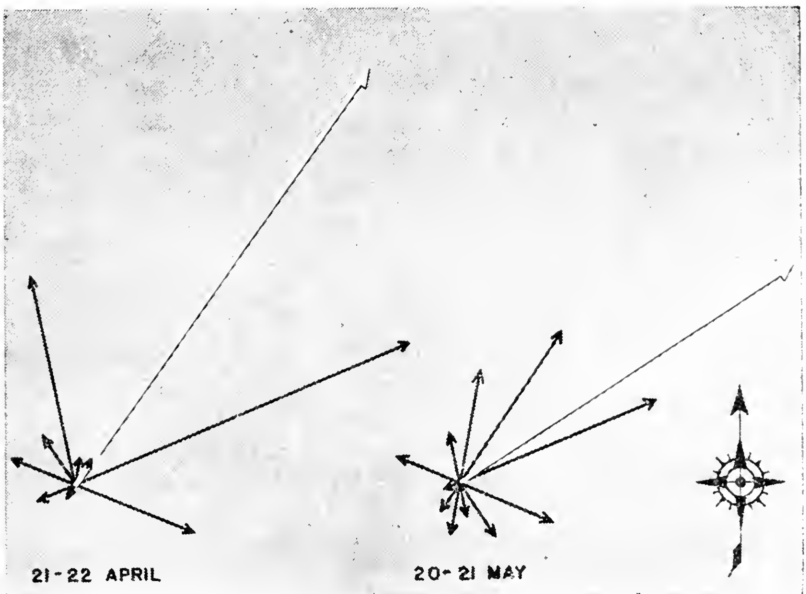


FIG. 37. Sector density representation on two nights at Rosedale, Mississippi, in 1948. The white lines are the vector resultants.

directions were extremely divergent. Many of the nights of observation at this locality were seriously interrupted by clouds, but such counts as were made on those dates indicated little migration taking place. On two nights, however, April 21-22 and May 20-21, visibility was almost continuous and densities were moderately high. In Figure 37 I have shown the flight directions for these two nights. The lengths of the individual sector vectors are plotted as a percentage of the total station density for each of the two nights (5,800 and 6,800 birds, respectively). Although the vector resultants show a net movement of birds to the northeast, there are important divergent components of the flights. This "round-the-compass" pattern is characteristic of stations on the edge of meteorological disturbances, as was Rosedale on April 21-22, but not on the night of May 20-21. If bats are presumed to have played a rôle in these latter observations, their random flights would tend to cancel out and the vector resultant would emerge as a graphic representation of the actual net trend density of the birds and its prevailing direction of flow. Although I do not believe that bats are the real reason for the diverse directional patterns at Rosedale, I can offer no alternative explanation consistent with data from other stations.

Moving northward in the valley of the Mississippi and its tributaries, we find a number of stations that yielded significantly high densities on most nights when weather conditions were favorable for migration. Louisville and Murray, Kentucky, and Knoxville, Tennessee, each show several nights with many birds flying, but only Lawrence, Kansas, and Ottumwa, Iowa, had migrations that approach in magnitude the record station densities at Tampico. Indeed, these were the only two stations in the United States that produced flights exceeding the densities at Progreso, Yucatán. The densities at Lawrence are unique in one respect, in that they were extremely high in the month of March. Since there were very few stations in operation then, these high densities would be of little significance were it not for the fact that at no time in the course of this study from 1945 to the present have comparable densities been obtained this early in the migration period. Examination of the "Remarks" section of the original data sheets from Lawrence show frequent mention of "duck-like" birds passing before the moon. We may infer from these notations that a considerable part of the overhead flight was composed of ducks and other aquatic birds that normally leave the southern United States before the main body of transient species reach there. The heavy flight densities at Lawrence may likewise have contained certain Fringillidae, Motacillidae, Sylviidae, and other passerine birds that winter mainly in the southern United States and which are known to begin their return northward in March or even earlier. Observations in 1948 at Lawrence in April were hindered by clouds, and in May no studies were attempted. However, we do have at hand two excellent sets of data recorded at Lawrence on the nights of May 3-4 and May 5-6, 1947, when the density was also extremely high.

At Ottumwa, Iowa, where a splendid cooperative effort on the part of the local ornithologists resulted in forty-four hours of observation in April and May, densities were near the maximum for all stations. Considering this fact along with results at Lawrence and other mid-western stations where cloud cover did not interfere at the critical periods of observation, we have here evidence supporting the generally held thesis that eastern Kansas, Missouri, and Iowa lie on a principal migratory flyway.

Stations in Minnesota, Illinois, Michigan, Massachusetts, and Ontario were either operated for only parts of one or two nights, or else clouds seriously interfered with observations, resulting in discontinuous counts. It may be hoped that future studies will include an adequate representation of stations in these states and that observations will be extensive enough to permit conclusions regarding the density and direction of migration.

Charleston, South Carolina, which does not conveniently fall in any of the geographic regions so far discussed, had, to me, a surprisingly low flight density; twenty-two hours of observation there in March, April, and May yielded a total flight density of only 3,000 birds. This is less, for example, than the number of birds computed to have passed Lawrence, Kansas, in one hour, or to have passed Progreso, Yucatán, in one twenty-minute interval! Possibly observations at Charleston merely chanced to fall on nights of inexplicably low densities; further observations will be required to clear up this uncertainty.

E. MIGRATION AND METEOROLOGICAL CONDITIONS

The belief that winds affect the migration of birds is an old one. The extent to which winds do so, and the precise manner in which they operate, have not until rather recently been the subject of real investigation. With modern advances in aerodynamics and the development of the pressure-pattern system of flying in aviation, attention of ornithologists has been directed anew to the part that air currents may play in the normal migrations of birds. In America, a brief article by Bagg (1948), correlating the observed abundance of migrants in New England with the pressure pattern obtaining at the time, has been supplemented by the unpublished work of Winnifred Smith. Also Landsberg (1948) has pointed out the close correspondence between the routes of certain long-distance migrants and prevailing wind trajectories. All of this is basis for the hypothesis that most birds travel along definite air currents, riding with the wind. Since the flow of the air moves clockwise around a high pressure area and counterclockwise around a low pressure area, the birds are directed away from the "high" and toward the center of the "low." The arrival of birds in a particular area can be predicted from a study of the surrounding meteorological conditions, and the evidence in support of the hypothesis rests mainly upon the success of these predictions in terms of observations in the field.

From some points of view, this hypothesis is an attractive one. It explains how long distances involved in many migrations may be accomplished with a minimum of effort. But the ways in which winds affect migration need analysis on a broader scale than can be made from purely local vantage points. Studies of the problem must be implemented by data accumulated from a study of the process in action, not merely from evidence inferred from the visible results that follow it. Although several hundred stations operating simultaneously would surely yield more definite results, the telescopic observations in 1948 offer a splendid opportunity to test the theory on a continental scale.

The approach employed has been to plot on maps sector vectors and vector resultants that express the directional trends of migration in the eastern United States and the Gulf region, and to compare the data on these maps with data supplied by the U. S. Weather Bureau regarding the directions and velocities of the winds, the location of high and low pressure areas, the movement of cold and warm fronts, and the disposition of isobars or lines of equal pressure. It should be borne in mind when interpreting these vectors that they are intended to represent the directions of flight only at the proximal ends, or junction points, of the arrows. The tendency of the eye to follow a vector to its distal extremity should not be allowed to create the misapprehension that the actual flight is supposed to have continued on in a straight line to the map location occupied by the arrowhead.

A fundamental difficulty in the pressure-pattern theory of migration has no doubt already suggested itself to the reader. The difficulty to which I refer is made clear by asking two questions. How can the birds ever get where they are going if they are dependent upon the whim of the winds? How can pressure-pattern flying be reconciled with the precision birds are supposed to show in returning year after year to the same nesting area? The answer is, in part, that, if the wind is a major controlling influence on the routes birds follow, there must be a rather stable pattern of air currents prevailing from year to year. Such a situation does in fact exist. There are maps showing wind roses at 750 and 1,500 meters above mean sea level during April and May (Stevens, 1933, figs. 13-14, 17-18). Similarly, the "Airway Meteorological Atlas for the United States" (Anonymous, 1941) gives surface wind roses for April (Chart 6) and upper wind roses at 500 and 1,000 meters above mean sea level for the combined months of March, April, and May (Charts 81 and 82). The same publication shows wind resultants at 500 and 1,000 meters above mean sea level (Charts 108 and 109).

FIG. 38. Over-all sector vectors at major stations in the spring 1948. See text for explanation of system used in determining the length of vectors. For identification of stations, see Figure 34.

FIG. 39. Over-all net trend of flight directions at stations shown in Figure 38. The arrows indicate direction only and their slants were obtained by vector analysis of the over-all sector densities.

Further information permitting a description in general terms of conditions prevailing in April and May is found in the "Monthly Weather Review" covering these months (*cf.* Anonymous, 1948 *a*, Charts 6 and 8; 1948 *b*, Charts 6 and 8).

First, however, it is helpful as a starting point to consider the over-all picture created by the flight trends computed from this study. In Figure 38, the individual sector vectors are mapped for the season for all stations with sufficient data. The length of each sector vector is determined as follows: the over-all seasonal density for the station is regarded as 100 per cent, and the total for the season of the densities in each individual sector is then expressed as a percentage. The results show the directional spread at each station. In Figure 39, the direction of the over-all vector resultant, obtained from the sector vectors on the preceding map, is plotted to show the net trend at each station.

As is evident from the latter figure, the direction of the net trend at Progreso, Yucatán, is decidedly west of north (N 26° W). At Tampico this trend is west of north (N 11° W), but not nearly so much so as at Progreso. In Texas, Louisiana, Georgia, Tennessee, and Kentucky, it is decidedly east of north. In the upper Mississippi Valley and in the eastern part of the Great Plains, the flow appears to be northward or slightly west of north. At Winter Park, Florida, migration follows in general the slant of the Florida Peninsula, but, the meager data from Thomasville, Georgia, do not indicate a continuation of this trend.

It might appear, on the basis of the foregoing data, that birds migrate along or parallel to the southeast-northwest extension of the land masses of Central America and southern Mexico. This would carry many of them west of the meridian of their ultimate goal, obliging them to turn back eastward along the lines of net trend in the Gulf states and beyond. This curved trajectory is undoubtedly one of the factors—but certainly not the only factor—contributing to the effect known as the "coastal hiatus." The question arises as to whether this northwestward trend in the southern part of the hemisphere is a consequence of birds following the land masses or whether instead it is the result of some other natural cause such as a response to prevailing winds. I am inclined to the opinion that both factors are important. Facts pertinent to this opinion are given below.

In April and May a high pressure area prevails over the region of the Gulf of Mexico. As the season progresses, fewer and fewer cold-front storms reach the Gulf area, and as a result the high pressure area over the Gulf is more stable. Since the winds move clockwise around a "high," this gives a general northwesterly trajectory to the air currents in the vicinity of the Yucatán Peninsula. In the western area of the Gulf, the movement of the air mass is in general only slightly west of north, but in the central Gulf states and lower Mississippi Valley the trend is on the average northeasterly. In the eastern part of the Great Plains, however, the average circulation veers again slightly west of north. The over-all vector resultants of bird migration at stations in 1948, as mapped in Figure 39, correspond closely to this general pattern.

Meteorological data are available for drawing a visual comparison between the weather pattern and the flight pattern on individual nights. I have plotted the directional results of four nights of observation on the Daily Weather Maps for those dates, showing surface conditions (Figures 40, 42, 44 and 46). Each sector vector is drawn in proportion to its percentage of the corresponding nightly station density; hence the vectors at each station are on an independent scale. The vector resultants, distinguished by the large arrowheads, are all assigned the same length, but the nightly and average hourly station densities are tabulated in the legends under each figure. For each map showing the directions of flight, there is on the facing page another map showing the directions of winds aloft at 2,000 and 4,000 feet above mean sea level on the same date (see Figures 41-47). The maps of the wind direction show also the velocities.

Unfortunately, since there is no way of analyzing the sector trends in terms of the elevations of the birds involved, we have no certain way of deciding whether to compare a given trend with the winds at 2,000, 1,000, or 0 feet. Nor do we know exactly what wind corresponds to the average or median flight level, which would otherwise be a good altitude at which to study the net trend or vector resultant. Furthermore, the Daily Weather Map illustrates conditions that obtained at 12:30 A. M. (CST); the winds aloft are based on observations made at 10:00 P. M. (CST); and the data on birds covers in most cases the better part of the whole night. Add to all this the fact that the flight vectors, their resultants, and the wind representations themselves are all approximations, and it becomes apparent that only the roughest sort of correlations are to be expected.

However, as will be seen from a study of the accompanying maps (Figures 40-47), the shifts in wind direction from the surface up to 4,000 feet above sea level are not pronounced in most of the instances at issue, and such variations as do occur are usually in a clockwise direction. All in all, except for regions where frontal activity is occurring, the weather maps give a workable approximation to the average meteorological conditions on a given night.

The maps (Figures 40-47) permit, first, study of the number of instances in which the main trend of flight, as shown by the vector resultant, parallels the direction of wind at a reasonable potential mean flight elevation, and, second, comparison of the larger individual sector vectors and the wind currents at any elevation below the tenable flight ceiling—one mile.

On the whole, inspection of the trend of bird-flight and wind direction on specific nights supports the principle that the flow of migration is in general coincident with the flow of air. It might be argued that when the flow of air is toward the north, and when birds in spring are proceeding normally in that direction, no significance can be attached to the agreement of the two trends. However, the same coincidence of wind directions and bird flights seems to be maintained when the wind currents deviate markedly from a northward trajectory. Figures 46 and 47, particularly in regard to the unusual slants of the flight vectors at Ottumwa, Knoxville, and Memphis, illustrate that this coincidence holds even when the wind is proceeding obliquely eastward or westward. On the night of May 22-23, when a high pressure area prevailed from southern Iowa to the Atlantic coast, and the trajectory of the winds was northward, migration activity at Knoxville and Ottumwa was greatly increased and the flow of birds was again northward in the normal seasonal direction of migration.

Further study of the data shows fairly conclusively that maximum migration activity occurs in the regions of high barometric pressure and that the volume of migration is either low or negligible in regions of low pressure. The passage of a cold-front storm may almost halt migration in spring. This was demonstrated first to me by the telescopic method at Baton Rouge, on April 12, 1946, following a strong cold front that pushed southeastward across the Gulf coastal plain and over the eastern Gulf of Mexico. The winds, as usual, shifted and became strong northerly. On this night, following the shift of the wind, only three birds were seen in seven hours of continuous observation. Three nights later, however, on April 15, when the warm air of the Gulf was again flowing from the south, I saw 104 birds through the telescope in two hours. Apropos of this consideration in the 1948 data are the nights of May 21-22 and 22-23.

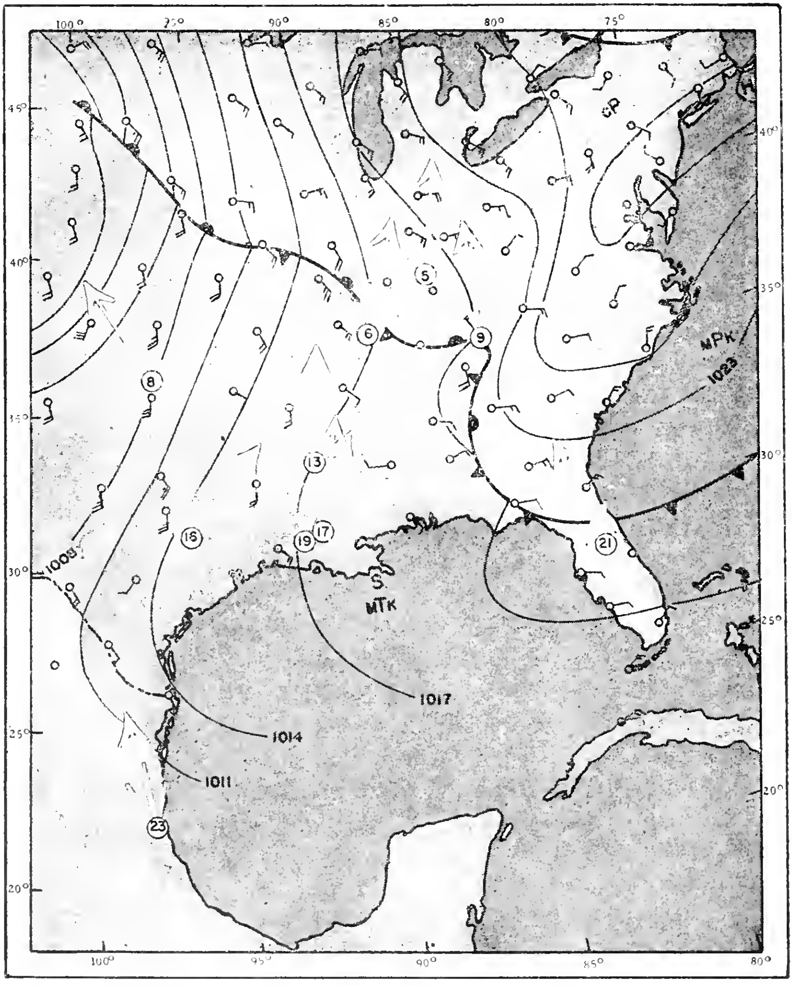


FIG. 40. Comparison of flight trends and surface weather conditions on April 22-23, 1948. The meteorological data were taken from the U. S. Weather Bureau Daily Weather Map for 12:30 A. M. (CST) on April 23. The nightly station densities and the average hourly station density (shown in parentheses) are as follows:

5. Louisville: 9,100 (1,100)
6. Murray: 16,300 (2,700)
8. Stillwater: 1,900 (500)
9. Knoxville: 15,200 (1,700)
13. Oak Grove: 13,600 (1,700)
16. College Station: 13,300 (1,900)
17. Baton Rouge: 6,200 (1,000)
19. Lafayette: 2,800 (600)
21. Winter Park: 6,200 (700)
23. Tampico: 11,100 (3,700)

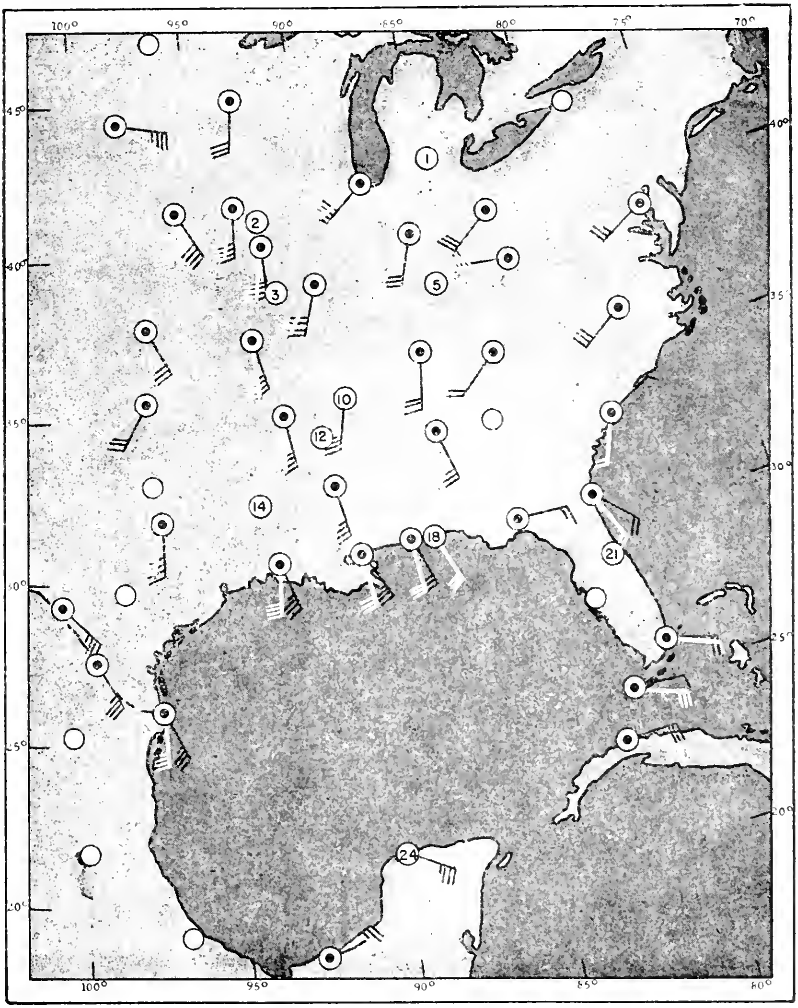


FIG. 41. Winds aloft at 10:00 P. M. on April 22 (CST). Winds at 2,000 feet above mean sea level are shown in black; those at 4,000 feet, in white. Velocities are indicated by standard Beaufort Scale of Wind Force. The numbers in circles refer to the stations shown in Figure 40.

Correction: Figures 41 and 45 were inadvertently transposed.

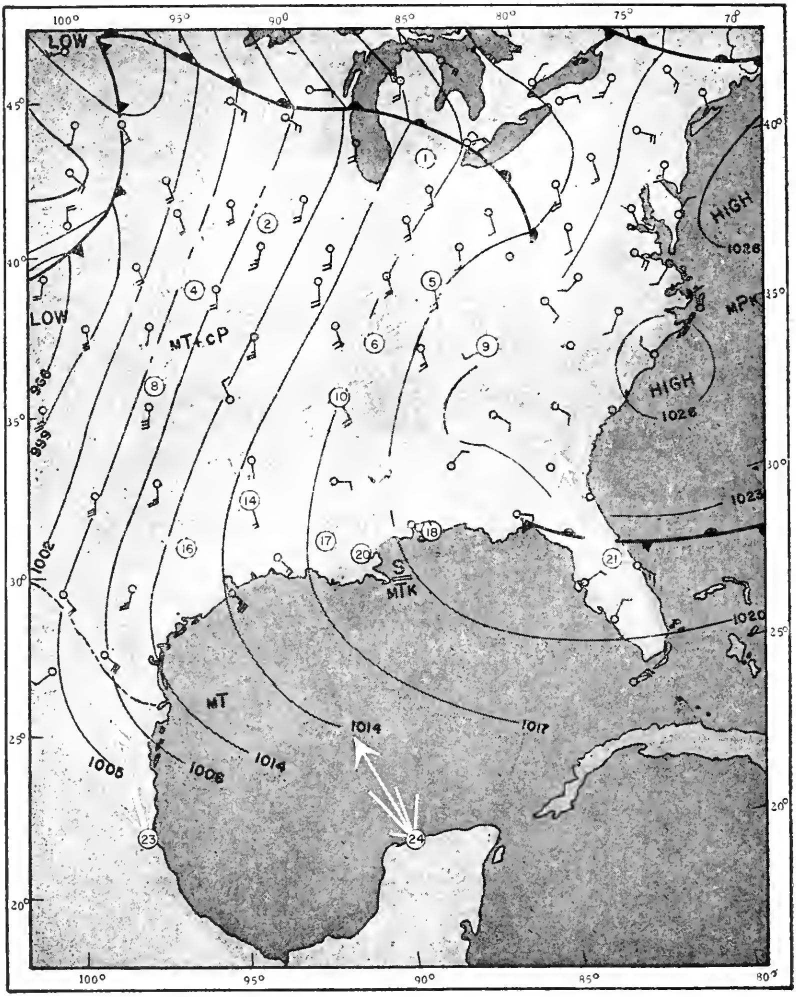


FIG. 42. Comparison of flight trends and surface weather conditions on April 23-24, 1948. The meteorological data were taken from the U. S. Weather Bureau Daily Weather Map for 12:30 A. M. (CST) on April 24. The nightly station densities and the average hourly station density (shown in parentheses) are as follows:

1. Albion: 1,100 (300)
2. Ottumwa: 5,500 (900)
4. Lawrence: 5,400 (1,400)
5. Louisville: 13,300 (2,700)
6. Murray: 9,800 (1,400)
8. Stillwater: 800 (100)
9. Knoxville: 8,000 (900)
10. Memphis: 7,900 (1,000)
14. Mansfield: 4,900 (1,200)
16. College Station: 700 (100)
17. Baton Rouge: 1,700 (400)
18. Pensacola: migration negligible
20. New Orleans: 1,600 (800)
21. Winter Park: 2,700 (300)
23. Tampico: 63,600 (6,300)
24. Progreso: 31,300 (3,900)

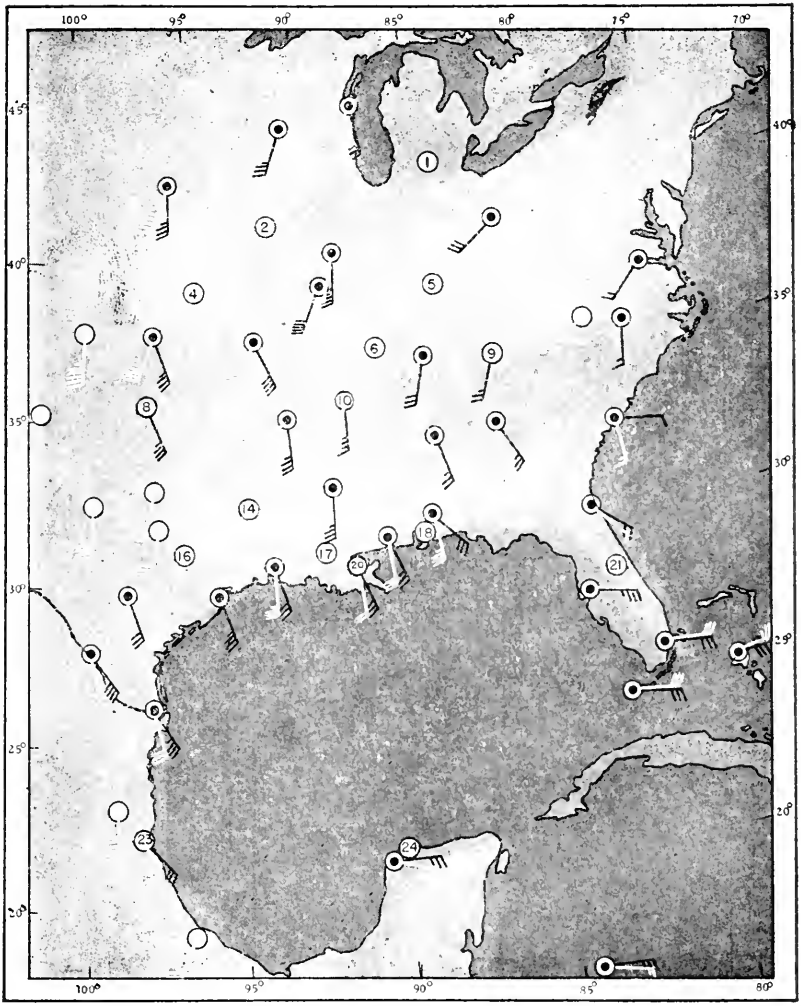


FIG. 43. Winds aloft at 10:00 P. M. on April 23 (CST). Winds at 2,000 feet above mean sea level are shown in black; those at 4,000 feet, in white. Velocities are indicated by standard Beaufort Scale of Wind Force. The numbers in circles refer to the stations shown in Figure 42.

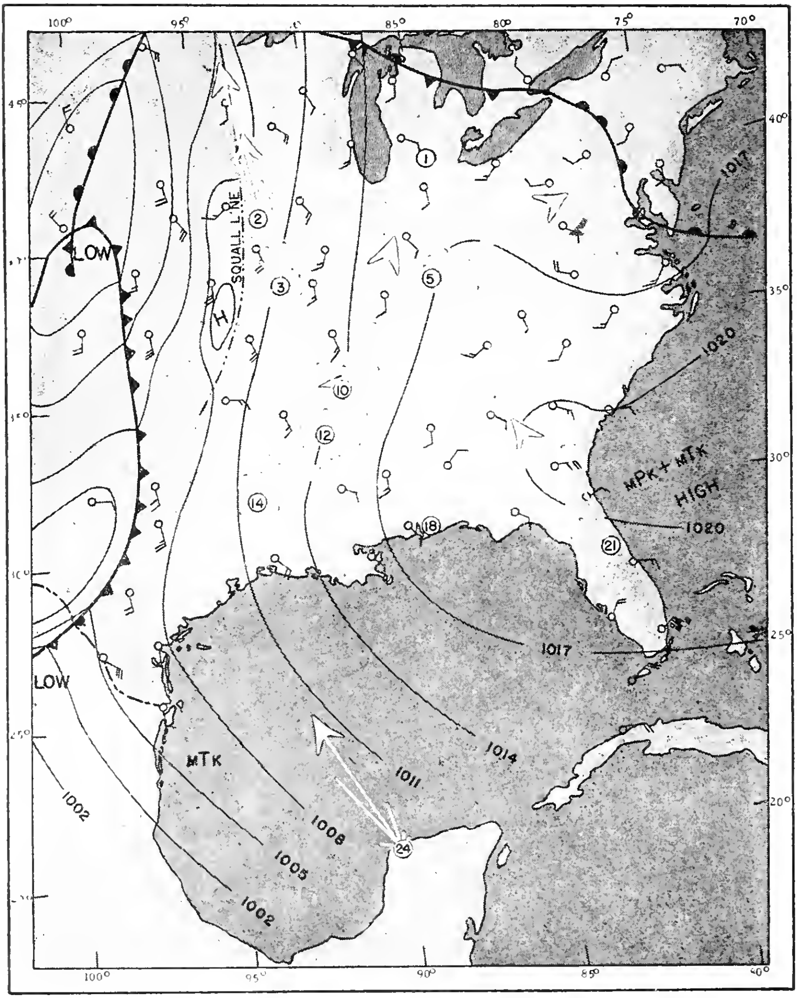


FIG. 44. Comparison of flight trends and surface weather conditions on April 24-25, 1948. The meteorological data were taken from the U. S. Weather Bureau Daily Weather Map for 12:30 A. M. (CST) on April 25. The nightly station densities and the average hourly station density (shown in parentheses) are as follows:

1. Albion: migration negligible
2. Ottumwa: 4,600 (1,500)
3. Columbia: 1,400 (400)
5. Louisville: 1,700 (200)
10 Memphis: 6,600 (900)
12. Rosedale: 1,100 (100)
14. Mansfield: 1,700 (400)
18. Pensacola: migration negligible
21. Winter Park: 600 (100)
24. Progreso: 27,300 (3,000)

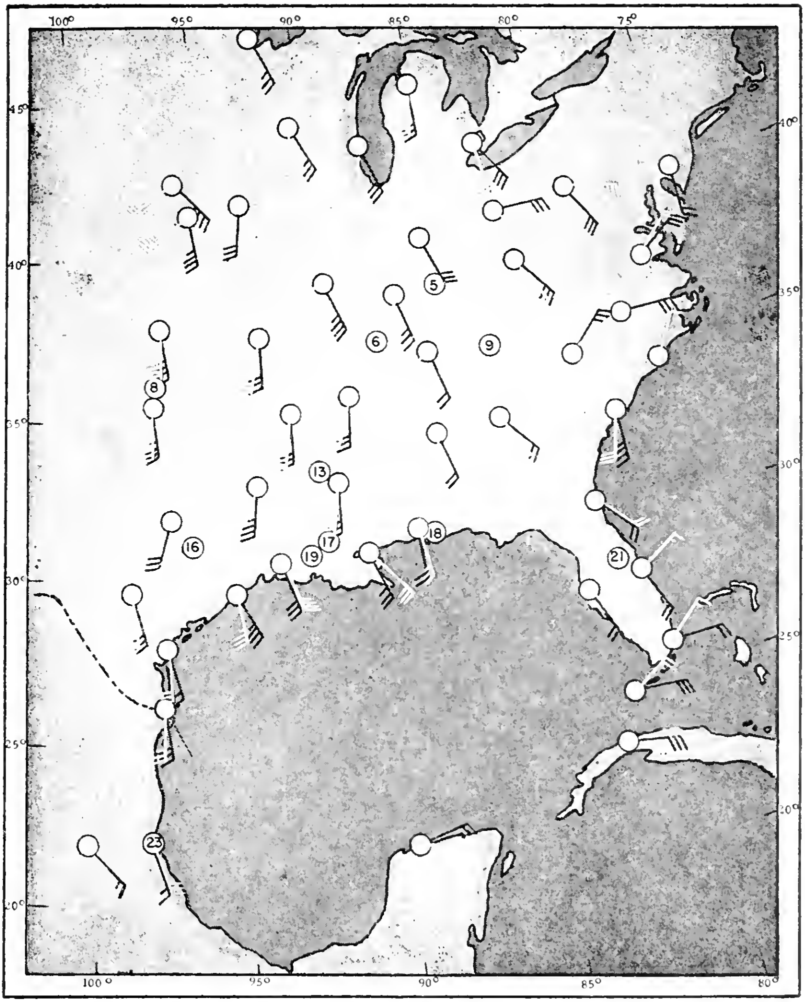


FIG. 45. Winds aloft at 10:00 P. M. on April 24 (CST). Winds at 2,000 feet above mean sea level are shown in black; those at 4,000 feet, in white. Velocities are indicated by standard Beaufort Scale of Wind Force. The numbers in circles refer to the stations shown in Figure 44.

Correction: Figures 41 and 45 were inadvertently transposed.

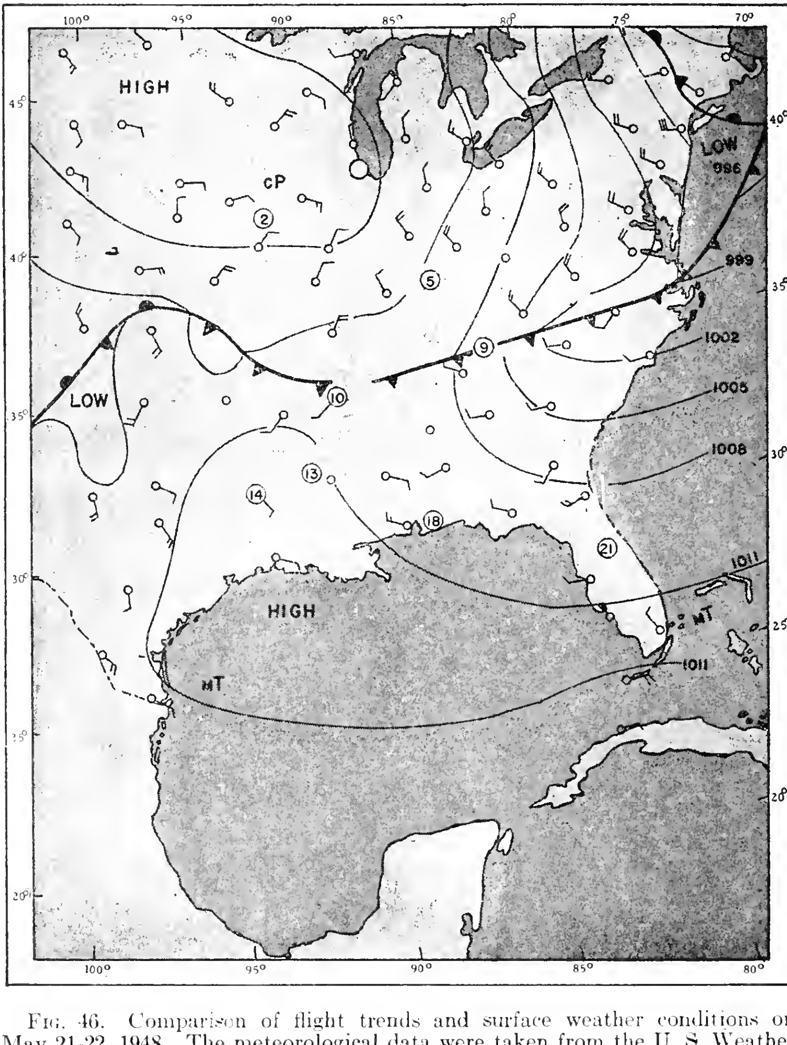


FIG. 46. Comparison of flight trends and surface weather conditions on May 21-22, 1948. The meteorological data were taken from the U. S. Weather Bureau Daily Weather Map for 12:30 A. M. (CST) on May 22. The nightly station densities and the average hourly station density (shown in parentheses) are as follows:

2. Ottumwa: 6,900 (1,400)
5. Louisville: 1,500 (200)
9. Knoxville: 3,200 (500)
10. Memphis: 7,000 (1,200)
13. Oak Grove: 5,800 (800)
14. Mansfield: 2,500 (800)
18. Pensacola: migration negligible
21. Winter Park: 1,200 (200)

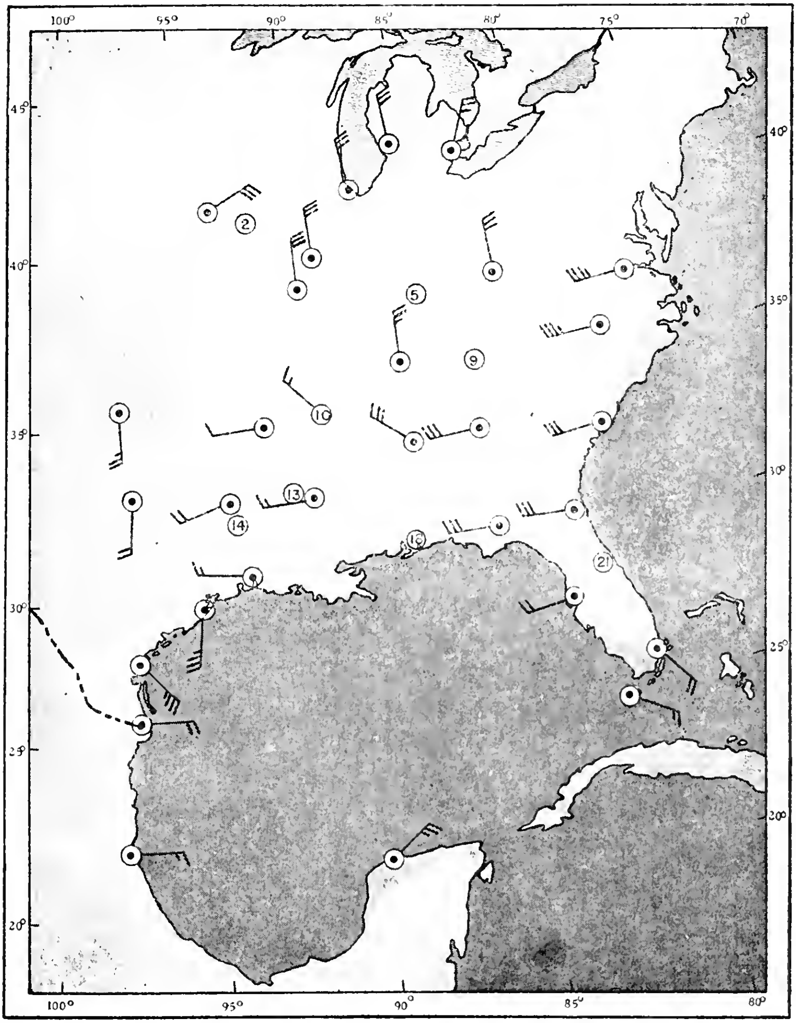


FIG. 47. Winds aloft at 10:00 P. M. on May 21 (CST). Winds at 2,000 feet above mean sea level are shown. Velocities are indicated by standard Beaufort Scale of Wind Force. The numbers in circles refer to the stations shown in Figure 46.

On the first night, following the passage of a cold front, migration at Ottumwa was comparatively low (6,900 birds in five hours). On the following night, when the trajectory of the winds was toward the north, the volume of migration was roughly twice as high (22,300 birds in eight hours). At Louisville, on May 21-22, the nightly station density was only 1,500 birds in seven hours, whereas on the following night, it was 8,400 birds in the same length of time, or about six times greater.

The evidence adduced from the present study gives support to the hypothesis that the continental pattern of spring migration in eastern North America is regulated by the movement of air masses. The clockwise circulation of warm air around an area of high pressure provides, on its western edge, tail winds which are apparently favorable to northward migration. High pressure areas exhibit a centrifugal force outward from the center, which may tend to disperse the migratory flight originating at any given point. In contrast, the circulation of air in the vicinity of a low pressure area is counterclockwise with the force tending to be directed inward toward the center. Since the general movement of the air is from the high pressure area toward a low pressure area, birds starting their migrations with favorable tail winds, are often ultimately carried to a region where conditions are decidedly less favorable. In the vicinity of an area of low pressure the greater turbulence and high wind velocities, combined with the possibly slightly less buoyant property of the air, cause birds to descend. Since low pressure areas in spring generally precede cold fronts, with an attending shift of the wind to the north, an additional barrier to the northward migration of birds is imposed. The extreme manifestation of low pressure conditions and the manner in which they operate against bird flight, are associated with tropical hurricanes. There, the centripetal force of the wind is so great that it appears to draw birds into the "eye" of the hurricane. A classic example of this effect is seen in the case of the birds that came aboard the "West Quechee" when this vessel passed through the "eye" of a hurricane in the Gulf of Mexico in August, 1927. I have already discussed the details of this incident in a previous paper (1946:192). There is also the interesting observation of Mayhew (1949), in which a similar observation was made of large numbers of birds aboard a ship passing through one of these intense low-pressure areas.

Although the forces associated with an ordinary low-pressure area are by no means as intense as those associated with a tropical hurricane, the forces operating are much the same. Consequently birds conceivably might tend to be drawn toward a focal point near the center of the low, where the other factors already mentioned would tend to precipitate the entire overhead flight. Visible evidence of migration would then manifest itself to the field ornithologists.

CONCLUSIONS

1. Telescopic counts of birds passing before the moon may be used to determine reliable statistical expressions of the volume of migration in terms of direction and of definite units of time and space.
2. Night migrants fly singly more often than in flocks, creating a remarkably uniform dispersion on a local scale throughout the sky, quite unlike the scattered distributions observable in the daytime.
3. The nocturnal migration of birds is apparently preceded by a resting or feeding pause during which there are few migrants in the air. It is not to an important degree a non-stop continuation of flights begun in the daylight.
4. Nightly migrational activity in North America varies from hour to hour according to a definite temporal pattern, corresponding to the *Zugunruhe* of caged European birds, and expressed by increasingly heavy flights up until the hour before midnight, followed by a pronounced decline.
5. The visible effects of the time pattern are subject to modification at a particular station by its location with respect to the resting areas from which the night's flight originates.
6. Quantitative and directional studies have so far failed to prove that nocturnal migrants favor narrow, topographically-determined flight lanes to an important degree.
7. Flight densities on the east coast of Mexico, though of first magnitude, have not yet been demonstrated in the volume demanded by the premise that almost all migrants returning to the United States from regions to the south do so by coastal routes.
8. Heavy flights have been recorded from the northern coast of Yucatán under circumstances leading inevitably to the conclusion that birds migrate across the Gulf of Mexico in considerable numbers.
9. There is reason to believe that the importance of the Florida Peninsula as an April and May flyway has been over-estimated, as regards the numbers of birds using it in comparison with the numbers of birds using the Mexican and Gulf routes.

10. The amount of migration is apparently seldom sufficient to produce heavy densities of transient species on the ground without the operation of concentrative factors such as ecological patterns and meteorological forces.
11. The absence or scarcity of transients in some areas in fine weather may be explained by this consideration.
12. A striking correlation exists between air currents and the directional flight trends of birds, suggesting that most night migrants travel by a system of pressure-pattern flying.

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Transmitted June 1, 1949.

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BY

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University of Kansas Publications
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Volume 3, No. 3, pp. 473-530, 49 figures in text, 13 tables
October 10, 1951

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Editors: E. Raymond Hall, Chairman, Edward H. Taylor,
A. Byron Leonard, Robert W. Wilson

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PRINTED BY
FERD VOILAND, JR., STATE PRINTER
TOPEKA, KANSAS
1950

23-1019

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M. DALE ARVEY

CONTENTS

INTRODUCTION

A small family of passerine birds, the Bombycillidae, has been selected for analysis in the present paper. By comparative study of coloration, nesting, food habits, skeleton and soft parts, an attempt is made to determine which of the differences and similarities between species are the result of habits within relatively recent geological time, and which differences are the result of inheritance from ancient ancestral stocks, which were in the distant past morphologically different. On the basis of this information, an attempt is made to ascertain the natural relationships of these birds. Previous workers have assigned waxwings alone to the family Bombycillidae, and a question to be determined in the present study is whether or not additional kinds of birds should be included in the family.

It has generally been assumed that the nomadic waxwings originated under boreal conditions, in their present breeding range, and that they did not undergo much adaptive radiation but remained genetically homogeneous. Also it is assumed that the species were wide ranging and thus did not become isolated geographically to the extent that, say, the Fringillidae did. The assumption that waxwings originated in the northern part of North America or Eurasia may be correct, but it is more probable that the origin was more southerly, perhaps, in northern Mexico, of North America (see p. 519. Subsequent to the differentiation of this stock in the south, there was a northerly movement, while certain populations remained behind and underwent an evolution different from the northern group. Since the fossil record does not permit us to say when in geological time the family originated, we must rely on anatomical evidence and the distributional evidence of present-day species to estimate when the family stock had diverged from some unknown group sufficiently to merit the status of a separate family.

ACKNOWLEDGMENTS

It is with pleasure that I acknowledge the guidance received in this study from Professor E. Raymond Hall of the University of Kansas. I am indebted also to Dr. Herbert Friedmann of the United States National Museum for the loan of certain skins, skeletons, and alcoholic material; to Mr. Alexander Skutch, for notes on certain Central American birds; and to Dr. Henry W. Setzer, Mr. George H. Lowery, Jr., Mr. Victor E. Jones, Mr. Victor Housholder, Mr. Alvaro Wille-Trejos, and Mr. Morton F. Davis, for gifts of specimens that have been used in this work. Suggestions and critical comments from Professors Worthie H. Horr, Charles G. Sibley and Edward H. Taylor are gratefully acknowledged. I wish also to thank Mrs. Virginia Unruh for the preparation of the drawings used in this work.

NOMENCLATURAL HISTORY

The oldest name available for any species of the waxwings is *Lanius garrulus* Linnaeus (1758). *Lanius garrulus* and *Lanius garrulus* variety B *carolinensis* were described as conspecific. The description has been associated with the first of the two names. The latter name is a *nomen nudum* since it was not accompanied by a separate description. The generic name *Lanius* was originally applied to both shrikes and waxwings by Linnaeus. Since that name is applied to the shrikes only, the next available generic name that may be applied to the generically different waxwings must be used. This is *Bombycilla,* a name originally proposed by Brisson (1760) for the Cedar Waxwing. In the 12th Edition of the Systemae Naturae (1766) Gmelin proposed the generic name *Ampelis* for the Bohemian Waxwing, and combined it with the specific name *garrulus,* the Cedar Waxwing being termed variety B. Vieillot (1807) proposed the generic name *Bombycilla* and combined it with a new specific name, *cedrorum,* for the Cedar Waxwing. Vieillot has been cited as the author of *Bombycilla* since that time, although Brisson used *Bombycilla* 33 years before. Oberholser (1917) did not cite Brisson's work in his discussion of the proper generic name for the waxwings, and *Bombycilla* should be ascribed to Brisson and not Vieillot, since Opinion 37, rendered by the International Zoölogical Committee on Nomenclature, states that generic names used by Brisson (1760) are valid under the Code. In consequence, the specific name available for the Cedar Waxwing, since Brisson is ruled not to be a binomialist, is *Bombycilla cedrorum* Vieillot (1807).

Most workers prior to 1900 utilized the family name Ampelidae to include waxwings, silky flycatchers, and palm-chats. Ridgway (1904:113) elevated the silky flycatchers to family rank under the name Ptilogonatidae, and assigned the palm-chats to a separate family, the Dulidae.

MATERIALS

The following specimens, numbering 238, and representing each currently recognized species and subspecies, were used in the study, and were supplemented by observation in 1947 on specimens in the United States National Museum.

SPECIES OR SUBSPECIES	Skin	Skeleton	Alcoholic
Phainoptila melanoxantha melanoxantha	8	1	2
Phainoptila melanoxantha minor	2	....	....
Ptilogonys cinereus cinereus	13	3	4
Ptilogonys cinereus molybdophanes	6	....	....
Ptilogonys caudatus	16	3	4
Phainopepla nitens nitens	....	1	5
Phainopepla nitens lepida	12	5	4
Bombycilla cedrorum	53	27	8
Bombycilla garrula garrula	4	3	....
Bombycilla garrula centralasiae	9	2	....
Bombycilla garrula pallidiceps	7	3	2
Bombycilla japonica	10	....	....
Dulus dominicus dominicus	9	5	2
Dulus dominicus oviedo	4	1	....
Totals	153	54	31

DIAGNOSES

Family Bombycillidae

Diagnosis.—Bill short, flat, somewhat obtuse, minutely notched near tip of each maxilla, flared at base; gape wide and deeply cleft; culmen convex; nasal fossa broad, exposed, or filled with short, erect or antrorse, close-set velvety feathers; nostril narrowly elliptical; rictal vibrissae long, short, or absent; lacrimal bone free, articulating at two points; wings long and pointed, or short and rounded; primaries ten, tenth reduced in some species; tail short, narrow, even, two thirds or less length of wing, or much longer and forked or rounded; feet weak (except in *Dulus* and *Phainoptila*); tarsus generally shorter than middle toe and claw, distinctly scutellate with five or six divisions, the lateral plate subdivided (except in *Phainoptila*); lateral toes of nearly equal length; hallux approximately as long as inner lateral toe, or shorter; basal phalanx of middle toe more or less united to that of outer and inner toes; body stout; head generally conspicuously crested; plumage soft, smooth and silky (except in *Dulus*); eggs spotted; nest in trees; three subfamilies, five genera, eight species.

Subfamily Ptilogonatinae

Diagnosis.—Rictus with conspicuous bristles; nasal fossa almost entirely exposed; tail long and rounded, graduated, or square; caudal muscles and pygostyle well developed; wings rounded and short, first primary a half to a third as long as second; second primary shorter than third; humerus long, with small external condyle; plumage soft and silky, less so in *Phainoptila;* sexes dissimilar, young like adult female; three genera, four species.

Genus **Phainoptila** Salvin

Phainoptila Salvin, Proc. Zoöl. Soc. London, 1877:367, April 17, 1877. Type *Phainoptila melanoxantha* Salvin.

Diagnosis.—Without crest; tarsus longer than middle toe and claw, and booted or very slightly reticulate; tail shorter than wing, rounded; nostril exposed, ovate; rictal bristles distinct; first primary well developed; plumage normal, bill flared slightly at base.

Range.—Costa Rica and Panamá.

Phainoptila melanoxantha melanoxantha Salvin

Phainoptila

Phainoptila melanoxantha melanoxantha Salvin, Proc. Zoöl. Soc. London, 1877:367; April 17, 1877.

Diagnosis.—Coloration of adult males: Pileum, hindneck, back, scapulars, and upper tail coverts Black (capitalized color terms after Ridgway, Color Standards and Color Nomenclature, Washington, D. C., 1912), with Bluish Gray-Green gloss; rump Lemon Yellow tinged with Olive; lower breast and abdomen Gull Gray or Slate Gray; sides and flanks clear Lemon Yellow; lower chest, upper breast, and under tail coverts Yellowish Olive-Green, extending to patch on sides and flanks of same color; bill and feet Black or Blackish Brown. Coloration of adult females: Most of upper parts Olive-Green, with Yellowish Olive on rump; thighs Olive-Gray, as are sides of head; rest of coloration as in male. Coloration of young: As in adult female, but duller throughout.

Measurements.—Wing 99.0, tail 88.5, culmen 15.2, tarsus 28.4.

Range.—Highlands of Costa Rica and extreme western Panamá (Volcán de Chiriquí).

Phainoptila melanoxantha minor Griscom

Phainoptila

Phainoptila melanoxantha minor Griscom, Amer. Mus. Novitates, 141:7, 1924.

Diagnosis.—Coloration as in *P. m. melanoxantha*, but female with hindneck more extensively gray and of slightly darker shade; rump, upper tail coverts, and edgings to tail feathers slightly greener, less yellow; average size smaller than in *P. m. melanoxantha.*

Range.—Highlands of westeran Panamá (Cerro Flores and eastern Chiriquí).

Genus **Ptilogonys** Swainson

Ptilogonys Swainson, Cat. Bullock's Mex. Mus., App. 4, 1824. Type *Ptilogonys cinereus* Swainson.

Diagnosis.— Tail much longer than wing, even or graduated; head with bushy crest; nostril large, rounded and fully exposed, bordered by membrane; rictal bristles well developed; tarsus shorter than middle toe with claw; plumage soft, blended.

Range.—Southwestern United States to Costa Rica.

Ptilogonys cinereus cinereus Swainson

Ashy Ptilogonys

Ptilogonys cinereus cinereus Swainson, Cat. Bullock's Mex. Mus., App. 4, 1824.

Diagnosis.—Coloration of adult male: Frontals, supralorals, malars, and chin White; orbital ring White; auriculars and nape grayish brown; rest of head smoke gray; back, scapulars, wing coverts, rump, and upper tail coverts plain Bluish Black; rectrices (except middle pair) with large patch of White midway between base and tip, rest plain Bluish Black; chest, breast, and anterior parts of sides plain Bluish Gray-Green, much lighter than back, and fading into paler Gray on throat; abdomen and thighs White; flanks and posterior part of sides Olive-Yellow or Yellowish Olive; under tail coverts Lemon Yellow; bill, legs and feet Black. Coloration of adult females: Head plain Smoke Gray, passing into White on frontals, malars, and chin; back, scapulars, wing coverts, and rump Hair Brown; upper tail coverts Dark Gull Gray; remiges and rectrices Black with faint Dusky Green gloss, edged with Gull Gray; chest Dark Grayish Brown lightening to Wood Brown on sides and flanks; abdomen White; under tail coverts Yellow Ocher. Coloration of young: As in adult female, but paler throughout.

Measurements.—In adult male, wing 94.0. and tail 104.2; in adult female, wing 93.3, and tail 94.8; both sexes, culmen 11.1, and tarsus 18.7.

Range.—Mountainous districts of central and southern Mexico, in states of Durango, Zacatecas, Hidalgo, México, Oaxaca, Colima, Morelos, Veracruz, San Luis Potosí, Guerrero and Michoacán.

Ptilogonys cinereus molybdophanes Ridgway

Ashy Ptilogonys

Ptilogonys cinereus molybdophanes Ridgway, Man. N. American Birds, 464 (footnote), 1887.

Diagnosis.—Coloration of adult male: Upper parts darker bluish than in *P. c. cinereus;* venter paler; flanks Olive-Green rather than Olive as in *P. c. cinereus*. Coloration of adult female: Like female of *P. c. cinereus* but colors darker throughout; dorsum more olivaceous.

Measurements.—In adult male, wing 89.4, and tail 97.1; in adult female, wing 89.4, and tail 93.3; both sexes, culmen 11.7, and tarsus 17.3.

Range.—Western Guatemala, in subtropical and temperate zones.

Ptilogonys caudatus Cabanis

Costa Rican Ptilogonys

Ptilogonys caudatus Cabanis, Jour. für Orn., 1866:402, Nov. 1866.

Diagnosis.—Coloration of adult male: Forehead and crown Pale Grayish Blue, slightly paler anteriorly; orbital ring Lemon Yellow; rest of head and neck, including crest, Olive-Yellow; throat paler and tinged with Light Gull Gray; back, scapulars, rump, upper tail coverts and wing coverts uniform Bluish Slate-Black; chest and breast similar but paler; sides and flanks Yellowish Olive-Green; thighs, lower abdomen, and under tail coverts Lemon Yellow; remiges, primary coverts, and tail Black, glossed with Bluish Black and edged with Gull Gray; inner webs of rectrices (except two middle pair) with large middle patch of White; bill, legs, and feet Black. Coloration of adult female: Forehead and crown Pale Gull Gray, becoming paler anteriorly; rest of head, together with neck, back, scapulars, rump, and wing coverts plain Yellowish Olive Green; chest and breast similar but more grayish; lower abdomen and flanks White tinged with Yellowish Olive; under tail coverts Olive-Gray; remiges, primary coverts, and rectrices Black with Gull Gray edges. Coloration of young: Dorsum plain Light Grayish Olive; upper tail coverts Brownish Olive; underparts Grayish Olive anteriorly, becoming more Yellowish Olive on abdomen; under tail coverts pale Yellowish Olive with Grayish Olive base; bill and feet Brownish Drab.

Measureemnts.—In adult male, wing 96.2, and tail 135.7; in adult female, wing 93.9, and tail 113.7; both sexes, culmen 12.6, and tarsus 19.1.

Range.—Highlands of Costa Rica and extreme western Panamá.

Genus **Phainopepla** Sclater

Phainopepla Sclater, Proc. Zoöl. Soc. London, 26:543, 1858. Type *Phainopepla nitens* (Swainson).

Diagnosis.—Tail almost as long as wing; head with pointed crest of narrow, separated feathers; rectrices without white; bill narrow, compressed terminally; conspicuous white patch under wing; nostril small, exposed; rictal bristles distinct; tail slightly rounded.

Phainopepla nitens nitens (Swainson)

Phainopepla

Phainopepla nitens nitens (Swainson), Anim. in Menag., 1838:285, Dec. 31, 1837.

Diagnosis.—Coloration of adult male: Uniform glossy Bluish Black; inner webs of primaries except innermost pair with middle portion White; bill, legs, and feet Black. Coloration of adult female: Plain Olivaceous Black, longer feathers of crest Black, edged with Gull Gray; remiges and rectrices Dusky Drab to Black; rectrices and coverts margined by White; bill and feet Brownish Drab to Dusky Brown. Coloration of young: Like adult female but more Brownish Drab.

Measurements.—No specimens examined; larger than *P. n. lepida* (Van Tyne, 1925).

Range.—Central and southern Mexico, in states of Coahuila, San Luis Potosí, Durango, Guanajuato, México, Puebla, and Veracruz.

Phainopepla nitens lepida Van Tyne

Phainopepla

Phainopepla nitens lepida Van Tyne, Occ. Pap. Bost. Soc. Nat. Hist., 5:149, 1925.

Diagnosis.—Coloration same as *P. n. nitens;* separated by smaller size.

Measurements.—Wing 91.0, tail 90.3, culmen 11.5, tarsus 17.6.

Range.—Southwestern United States, from central California, southern Utah, and central western Texas southward to Cape San Lucas in Baja California, and into northwestern Mexico (Sonora and Chihuahua).

Subfamily **Bombycillinae**

Diagnosis.—Wings long and pointed, reaching almost to tip of tail; first primary spurious; second primary longest; tail short and even; rictal vibrissae few and short; secondaries generally, and sometimes also rectrices, tipped with red, corneous appendages; nasal fossa partly filled with short, antrorse, close-set velvety feathers; plumage soft, silky; tail tipped with yellow band (red in *B. japonica*); sexes alike; humerus short with large external condyle; caudal muscles and pygostyle not well developed; bill flared widely at base; one genus, three species.

Range of subfamily.—Holarctic breeding area; wanders nomadically south in winter to Central America and West Indies, southern Europe and Asia.

Genus **Bombycilla** Brisson

Bombycilla Brisson, Orn. ii, 1760:337. Type *Bombycilla garrula* (Linnaeus).

Diagnosis.—As described for the subfamily.

Bombycilla cedrorum Vieillot

Cedar Waxwing

Bombycilla cedrorum Vieillot, Hist. Nat. Amer., 1:88, Sept. 1, 1807

Diagnosis.—Coloration of adults: Shading from Saccardo's Umber on dorsum to Bister on top of head; upper tail coverts and proximal rectrices Gull Gray; underparts shade through pale Lemon Yellow wash on belly into White on under tail coverts; forehead, lores, and eye-stripe Black; chin same, soon shading into Blackish Mouse Gray and into color of breast; side of under jaw with sharp White line; narrow line bordering forehead, and lores, White; lower eyelid White; quills of remiges Dark Mouse Gray, darkening at tips; inner quills tipped with red horny wax appendages; tail feathers like primaries, but tipped with Lemon Yellow, and occasionally showing also red horny wax appendages; bill and feet Black. Coloration of young: Dorsum as in adult, but lightly streaked with White; head concolor with dorsum; forehead White; lores Black; eye stripe Black anterior to eye and White posterior to eye; throat Light Buff; belly with alternate streaks of Dresden Brown and light Ochraceous Buff but posteriorly White; tail tipped with Lemon Yellow bar; bill black at tip, shading to Sepia at base.

Measurements.—Wing 92.9, tail 55.5, culmen 10.9, tarsus 16.8.

Range.—Breeds from central British Columbia, central Alberta and Manitoba, northern Ontario, southern Quebec and Cape Breton Island south to northwestern California, northern New Mexico, Kansas, northern Arkansas, North Carolina, and northern Georgia. Winters south to Louisiana, Mississippi, Texas, Arizona, Colorado, Florida, Honduras, Costa Rica, Jamaica, Little Cayman Island, Haiti, and Panamá.

Bombycilla garrula (Linnaeus)

Bohemian Waxwing

Bombycilla garrula (Linnaeus), Syst. Nat., 10th Ed., 1758:55.

Diagnosis.—Coloration of adults: General color Olive-Brown, shading insensibly from clear Smoke Gray of upper tail coverts and rump to Cinnamon-Drab anteriorly, heightening on head and forehead to Hazel; narrow frontal line, lores, broader mask through eye, chin, and upper throat, Sooty Black; under tail-coverts Cinnamon-Brown; tail Smoke Gray, deepening to Blackish

Mouse Gray distally, and tipped with Lemon Yellow; wings Blackish Mouse Gray; primaries tipped with sharp spaces of Lemon Yellow or White, or both; secondaries with White spaces at ends of outer web, shafts usually ending with enlarged, horny red appendages; primary coverts tipped with White; bill Blackish Slate and paler at base; feet Black. Coloration of young: Much like adult, but general color duller; some streaking on venter and back; chin, throat, and malar region dull White. Three subspecies.

Bombycilla garrula garrula (Linnaeus)

Bohemian Waxwing

Bombycilla garrula garrula (Linnaeus), Syst. Nat., 10th Ed., 1758:55.

Diagnosis.—Coloration: As described for the species, but darkest of the three subspecies; tending to be more Vinaceous dorsally than either *pallidiceps* or *centralasiae*.

Measurements.—Wing 113.5, tail 63.1, culmen 12.5, tarsus 20.7.

Range.—Europe; breeds north to northern Russia and Norway, south to about 65° N latitude; winters south to England and Ireland, southern France, northern Italy, and Turkey.

Bombycilla garrula centralasiae Poljakov

Bohemian Waxwing

Bombycilla garrula centralasiae Poljakov, Mess. Orn. vi:137, 1915.

Diagnosis.—Coloration: As described for the subspecies *garrula*, but less Vinaceous dorsally, and more Cinnamon; venter lighter gray than *garrula*, and much paler than *pallidiceps*.

Measurements.—Wing 114.7, tail 63.0, culmen 12.2, tarsus 21.0.

Range.—Asia; breeds northern Siberia south to Vladivostok; winters to Turkestan and central eastern China and Japan.

Bombycilla garrula pallidiceps Reichenow

Bohemian Waxwing

Bombycilla garrula pallidiceps Reichenow, Orn. Monats. 16:191, 1908.

Diagnosis.—Coloration: As described for the species, but more grayish above and below than *B. g. garrula;* darker gray than in *centralasiae*.

Measurements.—Wing 115.1, tail 71.7, culmen 12.6, tarsus 21.1.

Range.—Breeds from western Alaska to northern Mackenzie and northwestern Manitoba south to southern British Columbia, southern Alberta, northern Idaho, and possibly Colorado (Bergtold 1924) and Montana (Burleigh 1929); winters east to Nova Scotia and irregularly over much of Canada, and south irregularly to Pennsylvania, Ohio, Michigan, Indiana, Kansas, Colorado, California, Arizona, and Texas.

Bombycilla japonica (Siebold)

Japanese Waxwing

Bombycilla japonica (Siebold), Nat. Hist. Jap., St. No. 2:87, 1824.

Diagnosis.—Coloration: Dorsum generally Brownish Drab shading to Light Brownish Drab on lower back, rump, and upper tail coverts; secondary and tertiary coverts Pale Brownish Drab, washed on outer web with Carmine;

primary coverts Blackish Slate, with White edging; tail feathers Slate-Gray, broadly tipped with Carmine, bordered anteriorly by subterminal Black bar; head crested, forehead Chestnut; lores, frontals, and stripe extending around eye and nape, Black; throat Black, narrowing on lower throat; breast, sides of flanks Light Drab; venter pale Sulphur Yellow; thighs Brownish Drab; under tail coverts Carmine; bill, legs, and feet Black.

Measurements.—Wing 108.3, tail 53.6, culmen 11.2, tarsus 19.4.

Range.—Breeds eastern Siberia, northern China; winters south in China, and to Japan (Hokkaido, Kyushu), Taiwan, and Korea.

Subfamily *Dulinae*

Diagnosis.—Bill deep and compressed, culmen strongly depressed; nostrils circular, wholly exposed; tail even, and shorter than wing; tenth primary less than half length of ninth; under parts streaked; plumage hard and harsh; rictal bristles minute; wing rounded; humerus long and with small external condyle; pygostyle and caudal muscles not well developed; one genus, one species.

Range of subfamily.—Islands of Haiti and Gonave, Greater Antilles.

Genus *Dulus* Vieillot

Dulus Vieillot, Analyse, 1816:42.

Diagnosis.—Like the subfamily.

Dulus dominicus dominicus (Linnaeus)

Palm-chat

Dulus dominicus dominicus (Linnaeus), Syst. Nat., 12th Ed., 1766:316.

Diagnosis.—Coloration: Dorsum Olive, back, scapulars, and wing coverts more Brownish Olive; lower rump and upper tail coverts Olive-Green; pileum and hindneck with indistinct streaks of Brownish Olive; tail Brownish Drab, edged with Light Olive Gray; lores, suborbital region, and auricular regions Dusky Brown; malars Dusky Brown and streaked with Sooty Black, streaks narrower on abdomen, broader and paler on under tail coverts, bill Light Brownish Drab; legs and feet Brownish Drab.

Measurements.—Wing 85.0, tail 68.8, culmen 15.0, tarsus 24.7.

Range.—Island of Haiti, Greater Antilles.

Dulus dominicus oviedo Wetmore

Palm-chat

Dulus dominicus oviedo Wetmore, Proc. Biol. Soc. Wash., 42:117, 1929.

Diagnosis.—Coloration: Like *D. d. dominicus,* but averaging more Grayish Olive; rump and tail coverts with less greenish wash.

Measurements.—Wing 90.1, tail 71.3, culmen 16.2, tarsus 25.1.

Range.—Gonave Island, off Haiti, Greater Antilles.

COLORATION

The general coloration of waxwings is cryptic, that is to say, concealing or blending. The lighter color of the venter, especially of the belly, contrasts with the duller, darker vinaceous color of the dorsum. Several ruptive marks tend to obliterate the outline of the body. The crest of the head, when elevated, tends to elongate the body, making the outline less like that of a normal bird. The facial mask effectively breaks up the outline of the head, and conceals the bright eye, which would otherwise be strikingly distinct. The white spots on the distal ends of the secondaries of *B. garrula* and the yellow color on the distal ends of the rectrices (red in *B. japonica*) are also ruptive. These ruptive marks on an otherwise blending type of plumage might be important to waxwings, and probably are more effective when the birds remain motionless in either a well-lighted area or in one that is partly in shadow, rather than in one that is wholly in shadow.

The red wax tips on the secondaries of the flight feathers, and sometimes found on the ends of the rectrices in *Bombycilla*, are puzzling and no wholly convincing reason has been suggested for their occurrence. Two instances are known of yellow instead of red-colored wax tips in *B. cedrorum* (Farley, 1924). It is well known that many individuals, especially of *B. cedrorum*, do not possess these tips; they are absent in a smaller proportion of individuals of *B. garrula*. Of the 53 skins of *B. cedrorum* available in the University of Kansas Museum of Natural History, which might be taken as a sampling at random of the general population of this species, only 17 possess wax tips. A few specimens are unilateral, and the tips are of varying sizes in different individuals. Of these 17 birds, 6 are female and 7 male, the others being unsexed at the time of skinning. This proportion is, roughly, half and half. Of the seven skins of *B. garrula pallidiceps* in the same Museum, five possess the tips, and two that are females have no trace of the red tips at all. Of the five which do have the tips, two are males, two are females, and one is unsexed. In a series of 13 specimens of the three subspecies of *B. garrula*, loaned by the United States National Museum, all but two individuals possess the tips on the secondaries, and, in addition, four specimens, equally divided between the two sexes, have color on the rachis of some rectrices, and small appendages of pigment extend beyond the feathers. Stevenson (1882) found that among 144 specimens of *B. garrula garrula* killed by storms in England in the winter of 1866-67, 69 individuals had wax tips. Of these, 41 were males and 27 were females; the remaining one was of uncertain sex. Among 38 definitely sexed *B. garrula pallidiceps* in the California Museum of Vertebrate Zoölogy, Swarth (1922:276) lists tips in 22 males and 16 females. These data indicate that the proportion of birds with the wax tips is higher in *B. garrula* than in *B. cedrorum*. The potentiality for wax tips is possibly inherited according to Mendelian ratio.

Bombycilla japonica is of interest in that the adults, at least, seldom have the waxy appendages. Nevertheless, in the specimens observed, the entire distal ends of the feathers normally possessing the tips in other species are suffused with red color. This may be the original condition of all waxwings, or perhaps, instead, this species is in a transitional stage in the development of the tips. Swarth (1922:277) says concerning the probable derivation of the wax tips in *B. garrula* (and in *B. cedrorum*): "the ornamentation, in fact, may well have begun with the coloring of the shaft, spreading later over adjoining feather barbs. The last stage would have been the coalescing of the barbs, forming the waxlike scale as is now seen. Various steps of this hypothetical development are supplied in the wing and tail feathers of different birds of this series." *Bombycilla japonica* thus may be close to the ancestral condition in the waxwing stock in the development of the waxy appendage.

The rectrices of all three species of waxwings seldom possess the wax tips, unless the secondaries have the maximum number of tips. In these individuals, the pigment seems to "spill over" onto the tail feathers. Eight is the maximum number of tips found on the secondaries. Rectrices with wax tips are more frequently found in *B. garrula,* and only occasionally in *B. cedorum*. The pigment in the tip of the tail of *B. japonica* is red rather than yellow as it is in the other two species, and some individuals of the Japanese Waxwing show a slight amount of coalescence of wax in the tail feathers as well as in the secondaries.

If the tips were present in all members of the two species, it could be postulated, in line with recent investigational work by Tinbergen (1947), that the tips are in the nature of species "releasers," facilitating species recognition. Such recognition is now regarded as of prime importance in the formation of species. It is improbable that sex recognition may be aided, as there is no evidence to indicate that the tips are found predominantly in either sex.

The wax tips are not limited to the adult birds in the species *B. garrula*. Swarth (*op. cit.*) mentions the capture of several young

Bohemian Waxwings, and describes them as "possessing all the distinctive markings of the most highly developed adult." This includes wax appendages, and several citations are given (Wolley 1857, Gould 1862) to indicate that this is the rule rather than the exception, not only for the American subspecies *pallidiceps,* but at least for the European subspecies *garrula* as well. On the other hand, the young of *B. cedrorum* lack the wax tips, at least as far as available data show.

Some characteristics of living animals are of the "relict" type; that is to say, they were developed in ancient times when some unknown ecological factor was operative which is no longer demonstrable, and the characteristic is now neutral or at least not detrimental, although of no positive value to the organism. Possibly the wax tips of waxwings are thus to be explained. I am more inclined to the opinion that the wax tips are adaptations to present-day ecological conditions for the birds.

The wax tips are ruptive in effect, since the birds, especially in winter, are habitués of bushes and trees that have berries, and the tips, on the otherwise dull body, suggest berries. The red tips tend further to disrupt the body outline at the midline, or slightly posterior to this. Perhaps the wax tips on the rectrices emphasize the end of the tail, the region of the body that is the least vital and that may be expendable in times of pursuit by an enemy.

Any characteristic is of survival value to an organism if in any way the characteristic enhances the chances of survival up to the time when the organism can successfully raise even a few young to maturity. If that character, as for example, the red wax tips on the secondaries, helps to maintain the individual until it can raise to independence a greater number than merely a few young, such a character can be said to be of greater survival value. The character may be effective for a brief period of time and may be uncommon; it might be effective for a split second in time, and only at a particular stage in the life history.

The winter period probably is the most hazardous for waxwings, in that they then depend at times upon long flights to find food. The food is vegetable, and thus is comparatively low in food value; the birds must ingest large quantities of berries or dried fruits to maintain themselves. In winter, in northern latitudes at least, predators are more apt to prey upon those species which, like waxwings, do not migrate south. The winter months are those in which waxwings frequent berry bushes, and it may well be that in these months, the wax tips that appear like berries, are especially valuable to the birds, and operate selectively.

It is suggested, therefore, that the wax tips are of positive value to waxwings, rather than being relict characters. Coalescence of pigment has taken place in the formation of the wax tips. *B. japonica* is closer to the ancestral stock insofar as wax tips are concerned, and generally lacks the tips. *B. cedrorum* has the tips in approximately half of the adults, and not at all in the young. *B. garrula* has the tips in almost all the adults, and in a like proportion of the young, and probably has evolved further in the development and retention of the wax tips than has either of the other two species.

The streaked plumage of *Dulus* is decidedly generalized, and is probably more nearly like the color of the ancestral stock. In this connection it is notable that young Cedar Waxwings are streaked, and young Bohemian Waxwings are streaked to a lesser degree. This streaking is apparently a recapitulation of the feather color of the stock. Perhaps the color of *Dulus* has not changed, as the streaking would not be a disadvantage to the birds in their environment of light and shadow. In joining together in groups and in the construction of large communal nests, *Dulus* has evidently gained sufficient protection against predators; other birds solve this problem by modifying their coloration.

Ptilogonys is ruptively colored, but in a different fashion than *Bombycilla*. The tail markings, the distinct yellow on the under tail coverts, the sharply marked pileum, are all examples of ruptive coloration. The generally lighter venter (especially under tail coverts), the crest that may be elevated, and the generally drab bluish dorsum, are cryptic and serve to hide the animal insofar as is possible considering its habits. The very conspicuous coloration of the male, in contrast to the more drab color of the female, however, would lead one to believe that in *Ptilogonys*, following the pattern of many passerine birds, the male leads a predator from the nest, leaving the drab female to incubate the eggs, and thus preserve the young.

It is difficult to suggest reasons for the brilliant coloration of the male *Phainopepla*, unless it is for decoying predators away from the nest. Possibly some birds survive not because of, but in spite of, their coloration, and *Phainopepla* may be a case of this sort. Anyone who has observed *Phainopepla* in life will agree, certainly, that the male makes no attempt at concealment, and flaunts his color to all comers.

The coloration of *Phainoptila,* in contrast to *Phainopepla,* is much more plain, and is suited to its habits of brush dwelling; in a brush habitat the drab coloration is difficult to detect. The Yellowish Olive under tail-coverts and the Olivaceous dorsum are all evidences of cryptic coloration, and undoubtedly, this bird depends upon hiding for escape from its enemies, since it is a bird of the dense forest cover.

Coloration, which varies relatively rapidly in response to differing ecological conditions, has become more different in the species of Bombycillidae than is true in many other families of passerine birds. The explanation lies in early geographical isolation of the three subfamilies, with consequent radiation in three directions. Waxwings have become adapted by possessing a thick protective layer of feathers and drab coloration broken by ruptive marks. They still retain the streaked plumage, which is probably ancestral, in the juveniles; this is lost at the first molt in the fall. In its evolution. *Dulus* has developed large feet, heavy decurved beak, and the large communal nest that affords protection from enemies; as a consequence, perhaps *Dulus* did not need a plumage different from the primitive and streaked one. The survival of *Dulus* may not have depended on either ruptive marks or on brilliant and outstanding plumage. The large feet and large bill seem to be responses to particular ecological requirements, as will be shown later.

The Ptilogonatinae, with habits paralleling those of the flycatchers, probably are considerably modified from the ancestral stock; the coloration probably is more brilliant and conspicuous. Perhaps this type of coloration and the habit of capturing insects from a perch are correlated. Some amount of territoriality is characteristic of this subfamily and dimorphism in color—the plumage of the male is outstandingly conspicuous—possibly is of selective value to the race. In a tropical forest community, a duller pattern possibly would be more visible and thus would be selectively disadvantageous.

COURTSHIP

Waxwings are gregarious birds and individuals establish no well-defined territories as do many birds. The nest itself is the only defended territory, and as Crouch (1936) has shown, the Cedar Waxwing will nest in close proximity to others of the same species. Swarth (1932:275) mentions that the Bohemian Waxwing is tolerant of the nests of other pairs near by. The extreme condition is that found in *Dulus,* in which the territory is not limited even to the nest, but to the individual compartment of the community nest. *Phainopepla*, a less gregarious bird than *Dulus* and waxwings, has a much more definite territory, although individuals of *Phainopepla* are tolerant of others of the same species; no feeding territory is established, and small flocks of birds feed together at any time of the year.

In birds whose territories lack well-defined boundaries, it would be expected that elaborate song would not have evolved, and that most of the recognition of kind and sex would be dependent upon the behavior of the birds. This is the fact; song, as such, is lacking in the three subfamilies Bombycillinae, Ptilogonatinae, and Dulinae. Waxwings utter (1) notes that serve to keep the flock together, (2) calls used by the young in begging for food, and (3) some low notes that Crouch (*op. cit.*:2) considered as possibly concerned with courtship. *Phainopepla* has various call notes, and in addition, a succession of notes which are run together. *Ptilogonys* utters a note which Skutch (MS) characterizes as a loud, not unmusical "tu-whip" that is used as the birds "fly in straggling parties which keep in contact by their constant chatter." *Dulus* is described by Wetmore and Swales (1931:349) as having only a variety of rather harsh chattering notes in chorus.

The most notable behavior pattern associated with courtship in Waxwings, in the absence of song, is the so-called "mating dance" described by Crouch (1936), and observed by me in Lawrence, Kansas, in the spring of 1948. This consists of one bird of a pair (presumably the male) hopping along a branch toward the other bird (the female), then away again, repeating the procedure for some little time. The female remains motionless until, as the male approaches, mutual fondling of the head and neck feathers takes place, or the birds may peck at each other's bill. A berry may be passed from bill to bill, although generally the berry is not utilized for food, and this can be interpreted as a nervous reaction of the birds. It may be an instance of "false feeding" as is seen in many birds, in which the female begs for food, as a nestling would beg, as a preliminary to the sexual act. I am of the opinion that these reactions are in the nature of behavioristic patterns that bring the birds into the emotional balance for copulation, as copulation follows the "dance." Sometimes, however, copulation is preceded by a "nuptial flight" around the nesting area, at which time the birds utter loud calls. Armstrong (1924:183) is of the same opinion, citing numerous instances in which nuptial flights and elaborate displays have evolved for just this purpose. The birds are then in the proper physiological balance to initiate the complicated sequence of copulation, nesting, incubation, feeding, and brooding of the young.

It would be valuable to know more concerning the life histories of the other birds considered in this paper, since behavior is inherent, and probably can be cited as evidence of close relationship or the opposite. All that I have been able to learn is that *Phainopepla* has a nuptial flight in which the male chases the female, and that *Dulus* (Wetmore and Swales, 1931:347) seeks the company of others of its kind at all times, and that two birds, presumably paired, will sidle up to one another when they are perched.

NEST BUILDING

There are numerous papers concerning the nesting of waxwings. *B. garrula,* owing to its nesting in the far north, where observers are few, has received less attention than *B. cedrorum.* There is, on the other hand, no literature that deals with the nesting habits of the majority of the Ptilogonatines, with the exception of *Phainopepla,* on which there is considerable literature (Merriam, 1896; Myers, 1907, 1908). No detailed study of the nesting of *Dulus* has been reported, although Wetmore and Swales (1931) have described carefully the large communal nest of this genus.

In *Bombycilla,* both members of a pair apparently aid in the construction of the nest (Crouch, 1936; Swarth, 1932). Although the sexes are alike in plumage and general appearance, most students of the nesting of waxwings agree that one bird, assumed to be the female, does most of the arranging of the material, and does the shaping of the nest, whereas both birds carry materials to the nest site. As is characteristic of many passerine birds, both members of the pair gather materials and fly back to the nest site, where the female takes the more active part in the construction of the nest itself.

Both species of American waxwings build bulky nests, with the base or platform composed of a large amount of twigs and sticks, from which there often trails a mass of sticks and moss or string. Softer materials such as moss, plant fibers, and string, are placed inside the platform; moss is readily available to, and preferred by, *B. garrula* according to Swarth (*op. cit.*:271), and various plant fibers and string are used by *B. cedrorum.* The inner lining consists of soft plant fibers or down, dry grasses, and feathers. The nest is usually unconcealed in a tree either adjacent to a trunk or on a main side branch, but sometimes in a fork. Nest building by both Cedar and Bohemian waxwings is rapid, taking from three to five days, and is followed immediately by egg laying.

Nesting by waxwings is late in the season; June is the month in which the nest is usually started. This is readily explainable in Bohemian Waxwings, since adverse weather would prohibit earlier nesting in the area in which they spend the summer. Crouch (*op. cit.*:1) remarks that *B. cedrorum* possibly evolved in the far north where it was impossible for it to start nesting earlier, and that the habit has been retained. Perhaps, on the other hand, nesting is delayed until the berry crop is ripe, to insure sufficient food for the young.

Desertion of the nest is not uncommon in waxwings, despite the tolerance to other animals that is shown by the birds. A new nest may suddenly be begun before the first one is finished, and all the materials from the first nest may be removed, or the nest may be abandoned before it is completed. The eggs may be left at any time up to hatching, and the young may be deserted, especially in the earlier stages of development.

The very large and bulky communal nest of *Dulus* is not radically different from the nest of waxwings. In the absence of sufficient nesting sites, a pair of gregarious birds such as *Dulus* could combine their nest with those of other pairs, retaining for their own territory only the nest cavity, and in this way communal nests might have evolved. The nest of *Dulus* is communal probably because of the lack of suitable trees for nesting sites, and only incidentally does this type of nest afford better protection from natural marauders. Large numbers of Palm-chats work together in the construction of the nest platform, and both sexes probably take part in the work.

In *Phainopepla* the nest is built mostly by the male (Merriam, 1896; Myers, 1908), although the female does some of the work, especially in the shaping and lining of the nest. In this genus, the nest is usually a compact structure, but exceptional nests are of considerable bulk. The nest is commonly placed in a fork near the main trunk of a tree, in a conspicuous location, and generally is 10 to 20 feet from the ground. In shape and location, the nest closely corresponds to that of *Bombycilla*, but the materials used for a base are stems of annual plants, whereas *Bombycilla* uses more woody twigs. The finer materials used by *Phainopepla* are more readily obtainable in the ecological association inhabited by *Phainopepla* than would be heavier twigs such as *Bombycilla* uses.

FOOD

Waxwings are typically frugivorous; berries are the staple food. The birds are known to catch insects, especially in the spring and summer, and their insect gathering technique has been likened to that of Tyrannid flycatchers. Nice (1941) experimented with a young captive Cedar Waxwing and found that it had a decided preference for red or blue berries, and that meal worms were utilized as food only when the birds became educated by other captive birds of other species as to the food value of the worms. Post (1916) indicates that the food given to the nestlings of Cedar Waxwings is entirely animal for the first three days, and that a mixed diet of berries and insects is subsequently offered.

In feeding of the young, regurgitation of partly digested food does not take place, according to Wheelock (1905). Rather, the adults "store" food in the form of berries in the expanded esophagus or crop, feeding them whole to the young. Digestion is an unusually rapid process, involving merely minutes for the passage of berries and cherries. This is correlated with a short intestinal tract, which is unusual for a frugivorous bird. Nice's (1940) experiments with Cedar Waxwings revealed that cherries would pass through the digestive tract in 20 minutes, blueberries in 28 minutes, and choke-cherries in 40 minutes. Heinroth (1924) states that berries pass through the digestive tract of Bohemian Waxwings in the space of a "few minutes." This rapid digestion is obviously adaptive, since the value of the food is slight and therefore large quantities of it must be ingested; the large seeds would hamper further ingestion until they were eliminated, since they seem not to be regurgitated.

Members of the subfamily Ptilogonatinae are both insectivorous and frugivorous insofar as available data show, although again there is relatively little information available concerning them. Skutch (MS) has found that the Guatemalan *Ptilogonys cinereus* catches insects by repeated sallies into the air from a perch, after the manner of flycatchers. He notes also that the birds feed on berries of *Eurya theoides* and *Monnina xalapensis*. It is well known that *Phainopepla* catches insects when these are available, and its liking for berries is so apparent that in parts of its range, it is known as the "pepper bird," since it frequents pepper trees (*Schinus molle*) and feeds on the small red berries. The preserved specimens of *Ptilogonys* and *Phainoptila* available for this study contain only berries in the digestive tract. *Dulus* feeds mostly, if not wholly, on plant food. According to Wetmore and Swales (1931:349), berries, fruits, and parts of flowers are eaten.

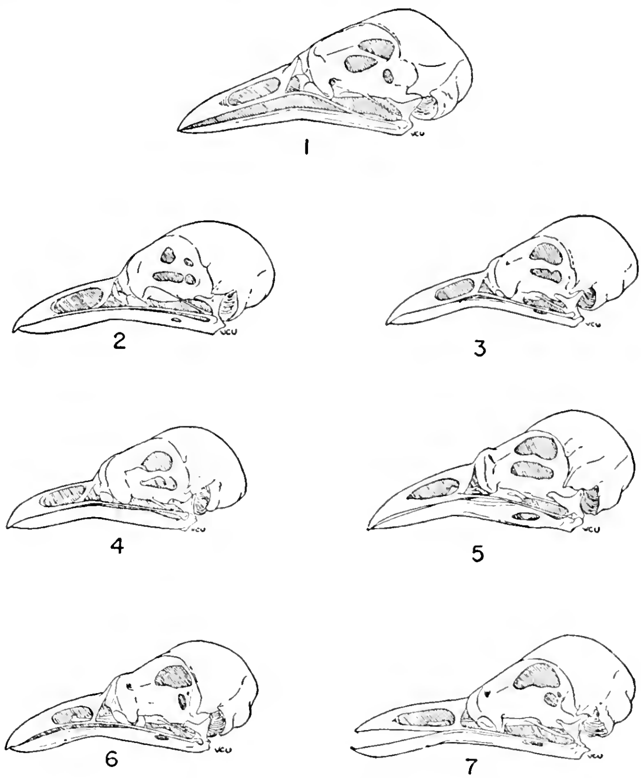
SKELETON

A critical analysis of the skeletons provides evidence that aids the student in estimating which differences are merely the result of habits developed in relatively recent geological time as opposed to those which owe their existence to more ancient heritage. Stresses caused by the action of different sets of muscles can apparently stimulate changes in bones to meet new needs, and the evidence from genetics is that such mutations in wild birds are minute and cumulative, rather than of large degree and of sudden appearance. Once adaptive mutations have occurred, if genetic isolation from one source or another accompanies it, a new population different from the parental stock may become established. Study of the skeleton of any species of living bird may indicate those characters identifiable as modifications fitting it to a particular environment. If no distinguishing characters are discovered that may be attributed to environmental factors, such a species can be spoken of as generalized; the inference then is that such a species is not modified for a single, particular ecological niche.

Some parts of the skeleton, obviously, are more adaptable or plastic than others. The beak seems to be the most adaptable part. Probably this results from its frequent use; it is the part of the bird to capture the food. The long bones, meeting the environment as legs which serve as landing mechanisms or as locomotory appendages, and as wings which provide considerable locomotion for most birds, probably come next in order as regards plasticity. In these parts, then, one may look for the most change in birds, which, within relatively recent geologic times, have been modified to fit a particular set of conditions. From the beak and long bones of a species in which habits are unknown, one can infer the habits and habitat from a comparison with the skeletal features of species of known habits.

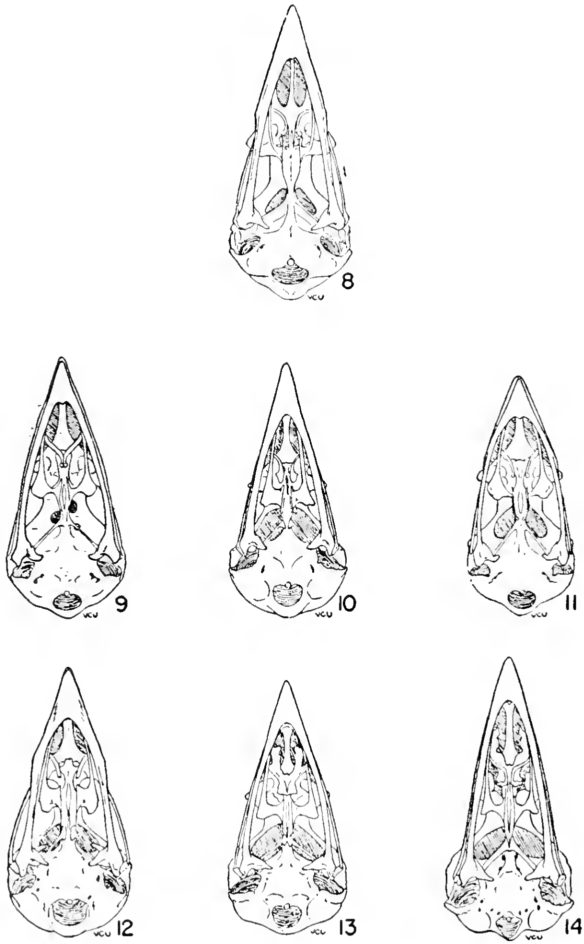
Skull.—The skulls in all three subfamilies have essentially the same general appearance and structure, the most marked differences being, as would be expected, in the bills and associated bones.

The most specialized bill is to be found in *Dulus;* its bill is decurved, and the associated bones are correspondingly changed for support of the bill. For example, the palatines and "vomer" are much wider, the palatines are more concave from below and have longer posterior processes than the corresponding bones in *Bombycilla.* Moreover, the "vomer" in *Dulus* and in *Phainoptila* is larger and heavier than in *Bombycilla,* and the quadrate and pterygoid bones are relatively large for support of the beak. The palatines, however, are weak in *Phainoptila*. In the Ptilogonatinae, with the exception of *Phainoptila,* the wings of the palatines flare more than in *Bombycilla,* but not to the extent that they do in *Dulus,* nor does the palatine bone present a concave appearance in the Ptilogonatinae. The premaxilla is a relatively weak bone in *Bombycilla* and *Phainopepla,* stronger in *Ptilogonys,* and is notably heavy in *Phainoptila* and *Dulus,* and in these latter two genera shows a sharply-ridged tomium. The maxillae connect to somewhat widened nasal and nasolateral processes in all the genera, and the premaxillae narrow abruptly from this point forward. In the family, *Phainopepla* and *Phainoptila* show the least flaring in this region.



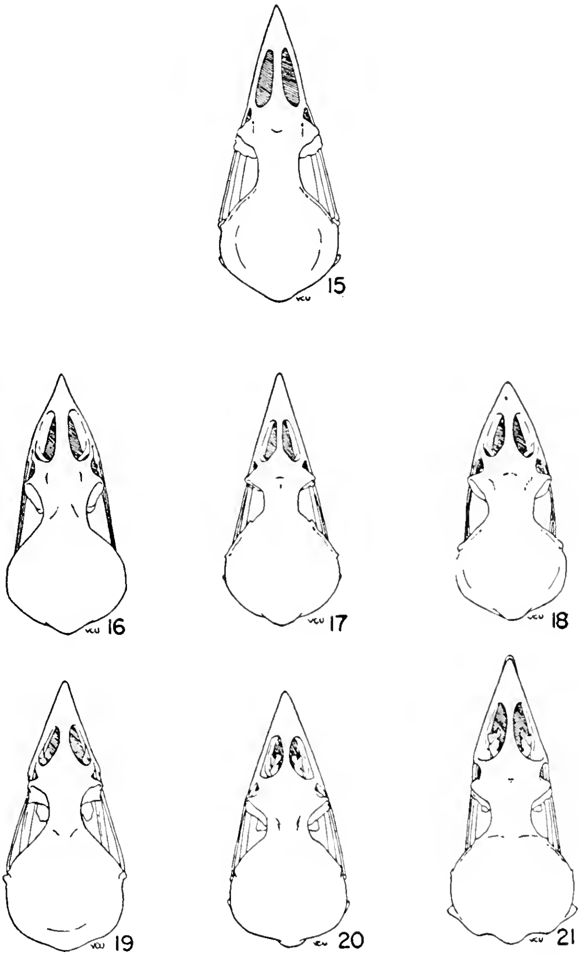
FIGS. 1-7. Skulls in lateral view of five genera of Bombycillidae. Natural size.

1. *Phainoptila m. melanoxantha,* sex?, MNH no. 26493, 15 mi. SE Cartago, Costa Rica.
2. *Ptilogonys caudatus,* male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
3. *Phainopepla nitens,* male, MNH no. 24752, Pima Co., Arizona.
4. *Ptilogonys cinereus,* female, Louisiana State University no. 297, Xilitla Region, San Luís Potosi, Mexico.
5. *Dulus dominicus,* female, USNM no. 292652, Don Don, Haiti.
6. *Bombycilla cedrorum,* male, MNH no. 15331, Bexar Co., Texas.
7. *Bombycilla garrula,* sex?, USNM no. 223895, Bozeman, Montana.



FIGS. 8-14. Skulls in ventral view of five genera of Bombycillidae. Natural size.

8. *Phainoptila m. melanoxantha,* sex?, MNH no. 26492, 15 mi. SE Cartago, Costa Rica.
9. *Ptilogonys caudatus,* male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
10. *Phainopepla nitens,* male, MNH no. 24754, Pima Co., Arizona.
11. *Ptilogonys cinereus,* female, Louisiana State University no 297, Xilitla Region, San Luis Potosi, Mexico.
12. *Dulus dominicus,* female, USNM no. 292652, Don Don, Haiti.
13. *Bombycilla cedrorum,* male, MNH no. 15331, Bexar Co., Texas.
14. *Bombycilla garrula,* sex?, USNM no. 223895, Bozeman, Montana.



FIGS. 15-21. Skulls in dorsal view of five genera of Bombycillidae. Natural size.

15. *Phainoptila m. melanoxantha,* sex?, MNH no. 26493, 15 mi. SE Cartago, Costa Rica.
16. *Ptilogonys caudatus,* male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
17. *Phainopepla nitens,* male, MNH no. 24752, Pima Co., Arizona.
18. *Ptilogonys cinereus,* female, Louisiana State University no. 297, Xilitla Region, San Luís Potosi, Mexico.
19. *Dulus dominicus,* female, USNM no. 292642, Don Don, Haiti.
20. *Bombycilla cedrorum,* male, MNH no. 15331, Bexar Co., Texas.
21. *Bombycilla garrula,* sex?, USNM no. 223895, Bozeman, Montana.

This flaring, immediately lateral to the antorbital plate, is common to all Bombycillids and constitutes a major skeletal characteristic useful for recognition of the members of the family, since the swelling is easily discernible both externally and on the cleaned skulls. In *Phainopepla* there is much variability in this character; some specimens have a narrower antorbital bridge than others. Only one skeleton of *Phainopepla n. nitens* was available. The flaring in the skull of this specimen is identical with that in *Ptilogonys*. Among the skulls of *P. n. lepida* in the University of Kansas Museum of Natural History, is No. 19228, a juvenile, taken 5 miles south of Tucson, Arizona. In this specimen, the flaring in the antorbital region is clearly evident and equal in amount to that in skulls of *P. n. nitens,* but the bird had not attained full skeletal growth. However, the flaring of the antorbital region appears to be common in the nestlings of many species of passerine birds. Other specimens of the subspecies *lepida* show a varying amount of flaring, the least (in the series available) being in No. 24754, MNH, in which the proportion of the skull (length divided by width) closely corresponds to that in *Phainoptila;* the skull of No. 24754 is long and thin, and the base of the bill is only slightly swollen. The skull of *Phainopepla nitens lepida* is more generalized than that of *Phainopepla n. nitens,* having a longer and narrower bill like the generalized *Phainoptila.* In *Phainopepla n. nitens* and in members of the genus *Ptilogonys*, more flaring occurs in the antorbital region.

Phainoptila, as noted above, has no great amount of flaring in the antorbital region. When more specimens of *Phainoptila* are examined, the base of the bill probably will be found to flare more in some individuals than in others; this would be expected if we may judge by the data on *Phainopepla.* The premaxilla and maxilla of *Phainoptila* are similar to the same bones in *Dulus,* and there is a well-marked ridge on the tomium (possibly for cutting flower parts). In *Phainoptila,* the palatines are narrower than in any other genus of the family and abut the lacrimals. The entire skull appears to be modified along different lines from those of the skull of *Dulus;* the skull of *Phainoptila* seems to be modified for a frugivorous rather than an insectivorous diet. The skull of *Phainoptila* probably is more nearly similar to the ancestral skull than is that of any other living species in the family. The wide gape characteristic of some members of the family is undoubtedly a modification for aiding in the capture of insects, and *Phainoptila* has progressed less in this direction than have other species in the family.

The mandibles vary somewhat in the shape and proportionate size of the bones. The mandible is proportionately, as well as actually, highest in *Dulus*. The medial condyle varies to some extent, being slightly flattened mediad in *Bombycilla,* and less so in the other genera. The mandible of *Bombycilla* narrows to the symphysis much more gradually than it does in the other genera.

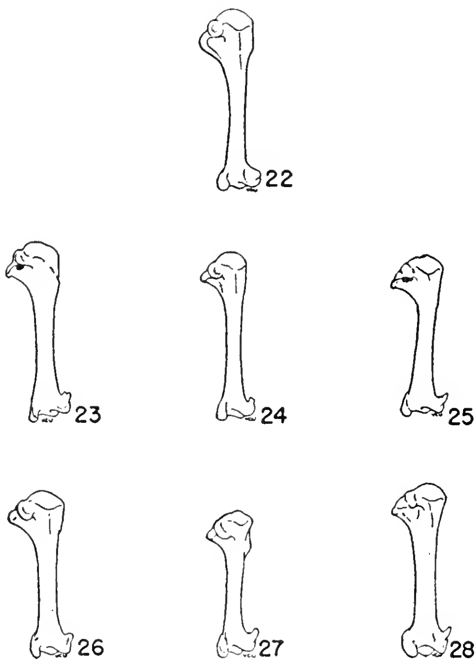
The antorbital plate is large and divides the orbital chamber from the nasal chamber. The small lacrimal bone anterior to the plate articulates with the maxilla and the premaxilla. Shufeldt (1889) states that the free lacrimal ossicle might be of some taxonomic importance in the passerines, since it is found in the generalized Corvids and in nestling Turdids. I find it well developed and identical, with a double articulation and free ends, in all the Bombycillids. There is no significant variability in the family, and this is more evidence of close taxonomic relationship between the members of the family.

The size of the crania is somewhat variable, although the differences seem to be primarily those of proportion. Ptilogonatinae have long crania, whereas the crania of the Bombycillinae and Dulinae are shorter but deeper. I regard the longer cranium as primitive, and it is longest in *Phainoptila.* In order of decreasing relative length of the cranium, *Phainoptila* is followed by *Ptilogonys caudatus, P. cinereus,* and *Phainopepla. Bombycilla garrula* has the deepest cranium in the family.

The measurements of the lengths and widths of the skulls are given in Table 9. The relative length of the bill and relative width of the skull are given in Table 10. These relative measurements are calculated by using the actual measurements in Table 9 as numerators, the length of the skull from the lacrimal bone to the posteriormost end of the skull being used as the denominator. The data indicate that *Phainoptila* has a slightly narrower cranium.

Humerus.—Certain families of passerine birds have a noticeable variation in the characteristics of the humerus; the bone varies in length, in diameter, and in the complexity of the processes at either end. In the Bombycillids, however, the amount of variation is relatively small, and the diaphysis of the bone is somewhat twisted, especially so in *Dulus.* The deltoid tuberosity is variable, being shorter but more elevated in *Bombycilla* than it is in the Ptilogonatinae and in the Dulinae. The tendon from the pectoralis major muscle, which inserts on this process, probably finds better insertion on a higher process than on a lower but longer one.

Distally, the two major condyles and the intercondylar groove or olecranon fossa that make efficient articulation with the ulnar process, are not variable. The external condyle, however, is significantly variable in the family. This condyle is longest and most pronounced in birds in which the humerus is short in relation to the trunk, as for example in *Tachycineta*. In the Bombycillidae the condyle is smallest in *Phainoptila*, where it is a mere suggestion of a process. In the remainder of the Ptilogonatinae, the condyle is larger but rounded, and shows a double process in *Ptilogonys caudatus*, and a slightly pointed process in *P. cinereus*. The external condyle in *Dulus* is not specialized, being low and rounded, but in *Bombycilla*, it is noticeably elongated, indicating a better attachment distally for



FIGS. 22-28. Humeri of five genera of Bombycillidae. Natural size.

22. *Phainoptila m. melanoxantha*, sex?, MNH no. 26493, 15 mi. SE Cartago, Costa Rica.
23. *Ptilogonys caudatus*, male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
24. *Phainopepla nitens*, male, MNH no. 24754, Pima Co., Arizona.
25. *Ptilogonys cinereus*, female, Louisiana State University no. 297, Xilitla Region, San Luís Potosi, Mexico.
26. *Dulus dominicus*, female, USNM no. 292652, Don Don, Haiti.
27. *Bombycilla cedrorum*, male, MNH no. 15331, Bexar Co., Texas.
28. *Bombycilla garrula*, sex?, USNM no. 223895, Bozeman, Montana.

the deltoid muscle. (No measurements are tabulated for this condyle, as the percentage of error in measuring this small structure is great.) Table 1 gives lengths of humeri, and Table 2 gives lengths of the humeri expressed as percentages of the length of the trunk, a standard measurement.

The area of insertion of the deltoid muscle is elongated in those birds with shortened humeri; these birds have also greater flight power than do birds with longer humeri and therefore a shorter external condyle.

TABLE 1. Lengths of Arm Bones in cm.

SPECIES	Humerus	Radius	Ulna	Manus
Ptilogonys caudatus	2.39	2.57	2.79	2.25
Ptilogonys cinereus	2.24	2.48	2.78	2.38
Phainopepla nitens	2.21	2.59	2.82	2.39
Phainoptila melanoxantha	2.40	2.51	2.70	2.25
Dulus dominicus	2.23	2.38	2.63	2.31
Bombycilla garrula	2.35	2.58	2.88	2.67
Bombycilla cedrorum	2.06	2.34	2.60	2.38

TABLE 2. Arm-trunk Ratios (in percent)

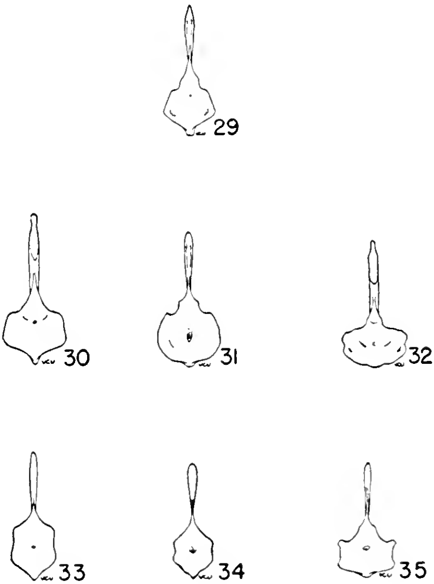
SPECIES	Humerus	Radius	Ulna	Manus	Total
Ptilogonys caudatus	85	92	93	80	2.58
Ptilogonys cinereus	84	90	103	89	2.76
Phainopepla nitens	84	98	107	91	2.82
Phainoptila melanoxantha	73	77	82	69	2.31
Dulus dominicus	78	83	92	81	2.51
Bombycilla garrula	69	75	87	78	2.34
Bombycilla cedrorum	67	76	85	77	2.29

Table 3. Arm-trunk Ratios (in percent)

Species	Humerus	Radius	Ulna	Manus	Total
Corvus brachyrynchos	90	101	111	106	307
Dendroica audubonii	68	82	90	77	237
Setophaga ruticilla	69	82	91	75	235
Myadestes townsendi	71	84	96	81	248
Sialia sialis	72	84	98	86	256
Hylocichla mustelina	75	81	92	80	247
Parus atricapillus	85	90	106	81	272
Tachycineta thalassina	71	95	107	128	306
Myiarchus crinitus	83	105	115	92	290
Dumetella carolinensis	76	75	89	78	243
Polioptila caerulea	85	93	105	71	261
Eremophila alpestris	91	99	110	95	296
Muscivora forficata	85	111	120	108	313

Pygostyle.—This part of the skeletal system is variable in the species dealt with, not so much in size as in complexity. It reflects, of course, the character of the caudal muscles and their size, as well as the length of the rectrices and the corresponding force necessary to hold these feathers upright and in a useful position. Firm attachment is important even in flight, because the tail is used as a rudder, and in the Ptilogonatinae as a brake. The pygostyle is most modified in this subfamily.

In lateral aspect, the pygostyles of the species of the Ptilogonatinae are similar. The crest of the bone is flattened dorsally, and has a broad anterior surface that is thin and bladelike. This is widest in *Ptilogonys caudatus*, and narrowest in *Phainoptila*, in which genus, however, the entire bone is of small size. The centrum is widest in *Ptilogonys caudatus*, and is progressively narrower in *P. cinereus*, *Phainopepla*, and *Phainoptila*. Greater width provides a larger area of attachment for the larger rectrices and also more area for insertion of the lateralis caudae muscle, the size of which varies more than that of the other caudal muscles in the different species of the Bombycillidae.



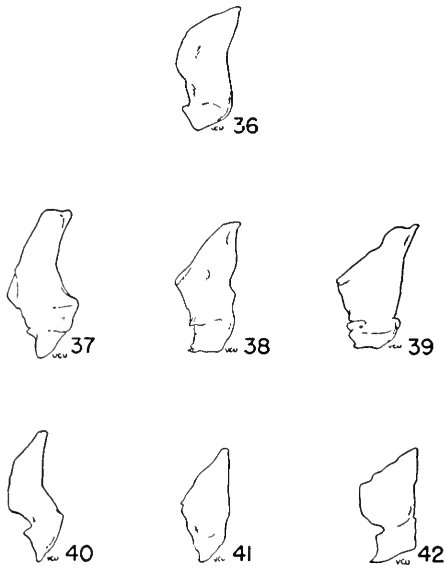
FIGS. 29-35. Pygostyles in posterior view of five genera of Bombycillidae. X 2.

29. *Phainoptila m. melanoxantha*, sex?, MNH no. 26493, 15 mi. SE Cartago, Costa Rica.
30. *Ptilogonys caudatus*, male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
31. *Phainopepla nitens*, male, MNH no. 24754, Pima Co., Arizona.
32. *Ptilogonys cinereus*, female, Louisiana State University no. 297, Xilitla Region, San Luís Potosi, Mexico.
33. *Dulus dominicus*, female, USNM no. 292652. Don Don, Haiti.
34. *Bombycilla cedrorum*, male, MNH no. 15331, Bexar Co., Texas.
35. *Bombycilla garrula*, sex?, USNM no. 223895, Bozeman, Montana.

In proportionate size (see Table 7), the pygostyle of *Bombycilla* is the smallest in the family. The dorsal spinous portion is acutely pointed instead of flattened as in the Ptilogonatinae. In *Dulus*, the spinous portion is extremely thin, and shows a decided curve dorsad from the centrum, and there is no flattened area anterior to the spinous portion as is seen in *Ptilogonys*.

The centrum in cross section varies considerably. In *Bombycilla* the walls are indented, with definite terminal knobs; both knobs and indentations are more pronounced in *B. garrula* than in *cedrorum*, however. The spinous portion is enlarged in both species, and the rest of the neck region is constricted (Figs. 29-35).

The centrum of *Dulus* in posterior aspect presents the appearance of a simple shield; little of the indentation seen in *Bombycilla* is



FIGS. 36-42. Pygostyles in lateral view of five genera of Bombycillidae. X 2.
36. *Phainoptila m. melanoxantha,* sex?, MNH no. 26493, 15 mi. SE Cartago, Costa Rica.
37. *Ptilogonys caudatus,* male, MNH no. 24492, 15 mi. SE Cartago, Costa Rica.
38. *Phainoptila nitens,* male, MNH no. 24754, Pima Co., Arizona.
39 *Ptilogonys cinereus,* female, Louisiana State University no. 297, Xilitla Region, San Luís Potosi, Mexico.
40. *Dulus dominicus,* female, USNM no. 292652, Don Don, Haiti.
41. *Bombycilla cedrorum,* male, MNH no. 15331, Bexar Co., Texas.
42. *Bombycilla garrula,* sex?, USNM no. 223895, Bozeman, Montana.

present. The spinous portion is plain, with no constriction nor terminal enlargement in the neck. The centrum in *Phainopepla* is similar to that in *Dulus,* but has a small expansion at the base of the spine, the entire centrum being wider in proportion to its over-all size than in any of the other species mentioned previously. The centrum in *Ptilogonys* shows great width, and the spine is in a large expanded tip as in *Bombycilla.* The lateral edges of the centrum in P. *cinereus* are "winged" and in two separate halves; whereas the centrum of *P. caudatus* is fairly plain, its specialization being reflected primarily in breadth and flatness. In cross section of the centrum, *Phainoptila* is similar to *Phainopepla,* although, in the former, the bone is smaller in proportion to the size of the animal, and the lateral wings are more angular than in *Phainopepla.*

In specialization for muscle attachment, the centra of the pygostyles of the Ptilogonatinae have more area for muscle attachment than do the centra in the Bombycillinae and Dulinae; the centrum is wide, the spinous portion is long, and the bone is flattened anteriorly. The most generalized pygostyle is in *Phainoptila,* and that of *Dulus* differs only slightly. In *Bombycilla* the pygostyle is proportionately small, but is complex in shape; there is seemingly not the need for greatly expanded areas since the caudal muscles are less specialized in this genus.

Sternum.—The sternum in Bombycillids is typically passerine in general shape and in having a long and deep carina or sternal crest. The caudal process of the bone is broad, with the terminal ends flattened, forming dorsally a graceful V-shaped outline, whereas the outline of the posterior end of the sternum is broad and convex.

In lateral aspect, the carina is deeper in *Bombycilla* than in other genera of the family, and is deepest in *B. garrula.* In this species, the manubrium is more extended and comparatively larger than in the other species of the family. The anterior edge of the keel forms the sharpest angle in *B. cedrorum.* In *Dulus,* the keel is moderately deep, the manubrium short, and there is a distinct indented curve between the manubrium and the anterior angle of the keel.

In ventral aspect the lateral processes of the sternum tend to flare outwards in adult Ptilogonatines on almost the same plane as the rest of the bone, whereas in *Bombycilla* and *Dulus* the same process is closer to the body of the sternum. In *Bombycilla* the xiphoid process is more dorsal in position than in other species in the family, and in *Dulus* an upward curve is very noticeable. The process in these two genera is narrower than in the Ptilogonatinae, and lacks the heavy distal terminal enlargement which is apparent in *Ptilogonys.*

Relative Lengths of Bones.—In instances where the animals being compared are obviously different in over-all size, it is useful to express the size of a given part in relation to some other part of the same individual organism if the aim is to obtain clues as to differences in functions of the parts being compared. Differences in actual lengths of corresponding bones in two kinds of animals often, of course, reflect only the difference in over-all size of the animals. Consequently, the relative size of the part is expressed as a percentage in this paper. In computing a percentage it is well, of course, to select some relatively stable part of the animal to use as a denominator in the mathematical expression that yields the percentage. The thoracic region of the vertebral column is thought to be such a part. For example, the length of the humerus divided by the length of the thoracic region yields, in *Phainopepla* and *Ptilogonys,* respective percentages of .84 and .85. These are roughly the same, whereas the actual lengths of the humeri are 2.21 and 2.39 cm.

TABLE 4. Lengths of Leg Bones in cm.

SPECIES	Femur	Tibiotarsus	Tarsometatarsus
Ptilogonys caudatus	2.04	3.10	1.94
Ptilogonys cinereus	1.89	2.90	1.77
Phainopepla nitens	1.76	2.78	1.72
Phainoptila melanoxantha	2.43	3.77	2.58
Dulus dominicus	2.09	3.34	2.09
Bombycilla garrula	2.32	3.46	1.99
Bombycilla cedrorum	1.92	2.95	1.64

TABLE 5. Leg-trunk Ratios (in percent)

SPECIES	Femur	Tibiotarsus	Tarsometatarsus	Total
Ptilogonys caudatus	73	110	69	252
Ptilogonys cinereus	71	109	66	246
Phainopepla nitens	69	106	65	240
Phainoptila melanoxantha	74	115	60	249
Dulus dominicus	73	119	73	265
Bombycilla garrula	68	101	59	228
Bombycilla cedrorum	63	96	53	212

TABLE 6. Leg-trunk Ratios (in percent)

SPECIES	Femur	Tibio-tarsus	Tarso-meta-tarsus	Total
Corvus brachyrynchos	71	120	77	268
Corvus corax	73	139	78	290
Dendroica audubonii	62	109	81	252
Setophaga ruticilla	66	127	94	287
Myadestes townsendi	61	99	60	220
Sialia sialis	66	111	72	249
Hylocichla mustelina	75	133	97	305
Parus atricapillus	78	138	99	315
Tachycineta thalassina	61	97	56	214
Myiarchus crinitus	68	106	74	248
Dumetella carolinensis	73	136	94	303
Polioptila caerulea	75	144	113	332
Eremophila alpestris	73	113	115	301
Muscivora forficata	62	98	61	221

TABLE 7. Actual Length and Width in mm. of Pygostyle and Proportionate Length and Width of Pygostyle in percent of Lacrimal Length

SPECIES	Length	Width	Length, percent	Width, percent
Ptilogonys caudatus	9.8	3.9	45	18
Ptilogonys cinereus	8.8	4.1	41	19
Phainopepla nitens	8.4	3.9	41	19
Phainoptila melanoxantha	8.5	3.5	35	14
Dulus dominicus	8.5	2.9	38	13
Bombycilla garrula	7.0	3.5	31	15
Bombycilla cedrorum	7.1	2.9	35	14

TABLE 8. Length of Sternum and Depth of Carina expressed as percentages of the Length of the Trunk

SPECIES	Sternum	Carina
Ptilogonys caudatus	85	28
Ptilogonys cinereus	91	32
Phainopepla nitens	81	26
Phainoptila melanoxantha	76	25
Dulus dominicus	107	28
Bombycilla garrula	88	33
Bombycilla cedrorum	82	31

TABLE 9. Skull and Sternum, Length and Width in mm.

SPECIES	Length of Skull	Width of Skull	Length of Sternum	Width of Sternum
Ptilogonys caudatus	34.9	15.6	23.9	7.8
Ptilogonys cinereus	33.4	14.7	24.3	8.5
Phainopepla nitens	33.3	15.1	21.3	6.9
Phainoptila melanoxantha	39 7	16.0	24.8	8.2
Dulus dominicus	36.4	16.6	30.5	8.0
Bombycilla garrula	37.0	16.8	30.0	11.2
Bombycilla cedrorum	34.0	15.5	25.3	9.6

The length of the trunk was taken as the distance from the anterior tip of the neural crest of the last cervical vertebra to the anterior edge of an acetabulum. The number of free thoracic vertebra was five in each specimen; consequently, there was no error from this source. In the cranium, a measurement was taken from the anterior edge of the lacrimal bone to the posteriormost end of the cranium, and the resultant figure was employed for a constant in cases in which small bones were compared.

Table 10. Relative Length and Width of Skull (in percent)

Species	Length of Skull	Width of Skull
Ptilogonys caudatus	160	72
Ptilogonys cinereus	158	69
Phainopepla nitens	162	73
Phainoptila melanoxantha	161	65
Dulus dominicus	164	75
Bombycilla garrula	164	74
Bombycilla cedrorum	162	74

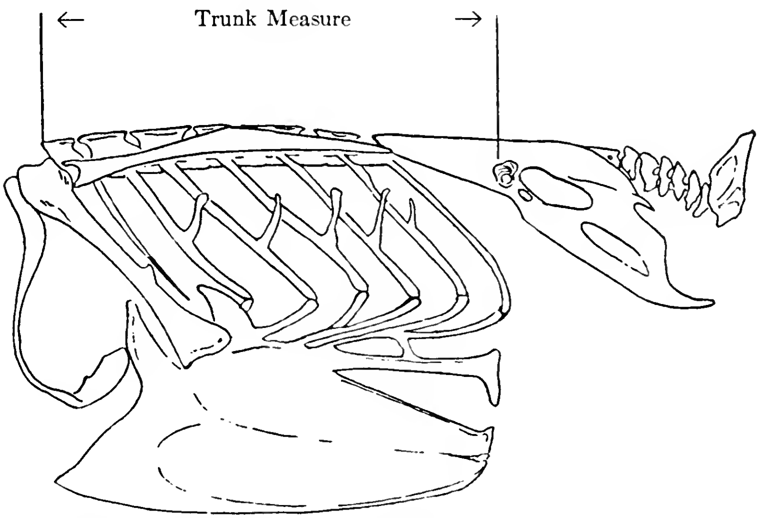


Fig. 43. Part of skeleton of *Bombycilla cedrorum* showing method of measuring the length of the trunk. Natural size.

Leg-trunk Percentages.—Table 4 shows the relative lengths of the legs and of the separate bones in the legs of the different species of the Bombycillids. Table 5 shows corresponding lengths for other passerine birds. The total length of the leg was computed by adding the figures obtained for the lengths of the femur, tibiotarsus and tarsometatarsus. The lengths of the toes were disregarded. Length of leg was recorded in this same way by Richardson (1942:333), who thought that only in swimming and running birds do the toes contribute to the functional length of the hind limb.

Table 4 shows that of the birds compared in this paper, *Dulus* has the longest legs. In order of decreasing length the others are the Ptilogonatinae, and finally the Bombycillinae, which have the shortest legs of all. In Waxwings the length of the legs, expressed as percentages of the body-lengths, are identical with those birds that are similar in habits, that is to say, birds which do not use the hind limb except in perching. It can be noted by reference to Table 5 that *Tachycineta* and *Myadestes* fall into this category. This shortness of limb is obviously adaptive, and each of the segments of the limb has been correspondingly shortened, with no element reduced at the expense of the other two. The short leg can be more easily folded against the body while the bird is in flight, than can a long leg which is more unwieldy. It may be noted from tables 4 and 5 that birds which spend much time on the ground, or that hop a great deal in the underbrush, have longer legs than do birds which spend much time in flight. Two birds with noticeably long legs are *Hylocichla mustelina,* a typical ground dweller, and *Parus atricapillus,* which hops about in the trees and underbrush.

Insofar as the lengths of the legs show, *Dulus* and *Phainoptila* are the most generalized of the Bombycillidae, since the relative length of leg is approximately the same as that of more generalized birds such as warblers, crows and thrushes of similar locomotory habits. In other words, *Dulus* and *Phainoptila* have remained unspecialized, in contrast to the waxwings in which adaptive changes fitting them for a perching habit have taken place. *Ptilogonys* and *Phainopepla* are intermediate in length of leg between *Phainoptila* and *Bombycilla,* and *Ptilogonys* and *Phainopepla* have progressed from life on the ground toward the perching habit. *Bombycilla cedrorum* is more specialized than is *B. garrula* in shortness of leg, and the reduction is comparable, as is noted above, to that in the legs of *Tachycineta.*

In birds which have the legs much modified for walking or for hopping in the brush, such as *Polioptila* and *Eremophila,* it is noteworthy that the distal segment, the tarsometatarsus, is the longest, whereas in birds such as *Myiarchus* and *Tachycineta,* that do not utilize the limbs in this manner, the tibiotarsus, the middle segment, is the longest. Mammals much modified for walking or hopping likewise

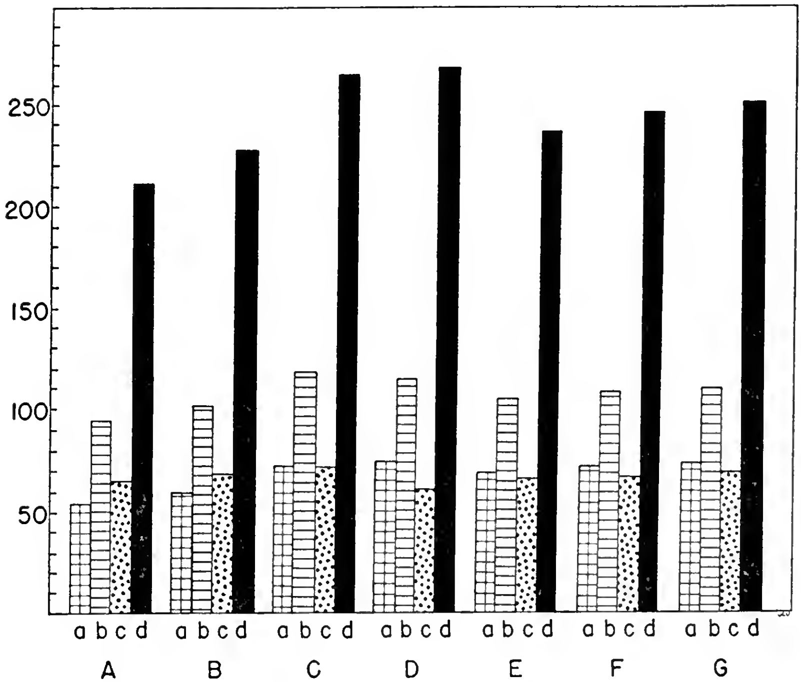
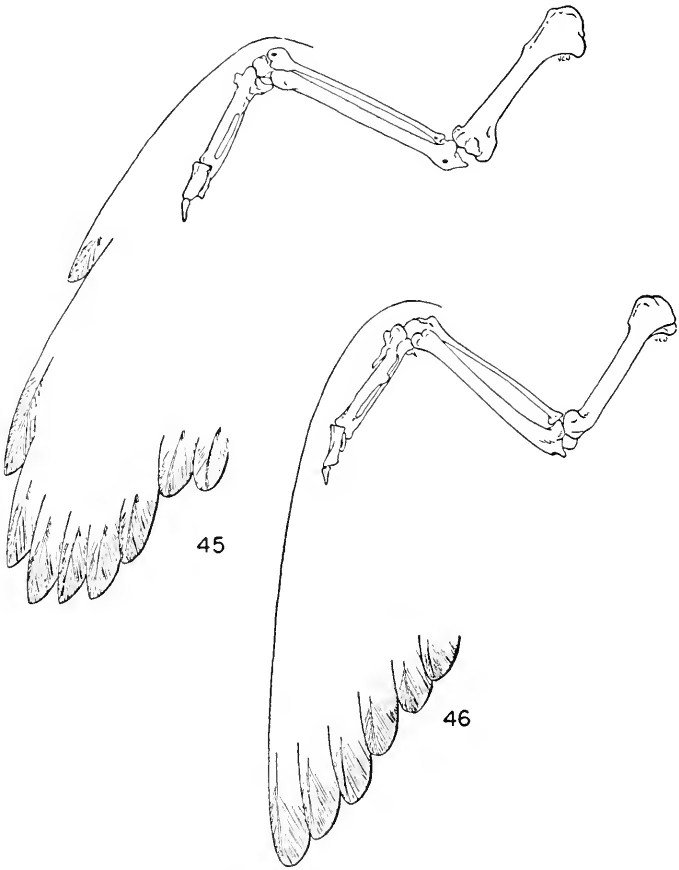


FIG. 44. Graph showing relative lengths of bones of the leg. The percentage values are shown on the axis of the ordinates.
A. *Bombycilla cedrorum;* B. *Bombycilla garrula;* C. *Dulus dominicus;* D. *Phainoptila melanoxantha;* E. *Phainopepla nitens;* F. *Ptilogonys cinereus;* G. *Ptilogonys caudatus.* a. femur; b. tibiotarsus; c. tarsometatarsus; d. total.

have the proximal segment, the femur, short, and the distal segment long (Howell, 1944). The waxwings have all of the segments short; these birds are modified for strong and sustained flight. Their hind limbs are used principally for landing devices and for perching. No one element of the leg has been shortened much, if any, more than any other.

Arm-trunk Percentages.—Tables 1 and 2 show the total length of the arm, and lengths of the separate arm elements, relative to the trunk. Table 3 gives the corresponding lengths for birds other than the Bombycillidae. Total length of arm was obtained by adding together the lengths of the humerus, ulna, and manus, and by dividing the figure thus obtained by the length of the trunk as was done for leg lengths in tables 4 and 5. The method of adding together the component parts does not give the entire length of the wing, since the length of the feathers, which add effectively to the total length, as well as do the lengths of the small carpal elements, is lacking.

It may be noted that *Phainoptila* and *Bombycilla* have the shortest arm in the family Bombycillidae. The humerus, radius and ulna



FIGS. 45-46. Outlines of wings. X ½
45. *Ptilogonys caudatus,* showing relation of outline of wing to bones of arm.
46. *Bombycilla cedrorum,* showing relation of outline of wing to bones of arm.

are comparable to the same elements in thrushes and the catbird, and it is only the extremely short manus in *Phainoptila* that affects the total. The manus in *Phainoptila* is comparatively smaller than in any other genus of the family Bombycillidae, and this indicates poor flight power. *Bombycilla* has a total length corresponding closely to that in warblers, but the lengths of the distal elements correspond closely to those in the catbird and thrushes. Of the three segments, the humerus is, relatively, the most shortened. Next in order of increasing length of arm is *Dulus;* measurements for it are roughly the same as those of *Myadestes.* The wing bones of the Ptilogonatinae, other than *Phainoptila,* are the longest in this series, and they most nearly resemble the same bones in flycatchers, Parids, and gnatcatchers.

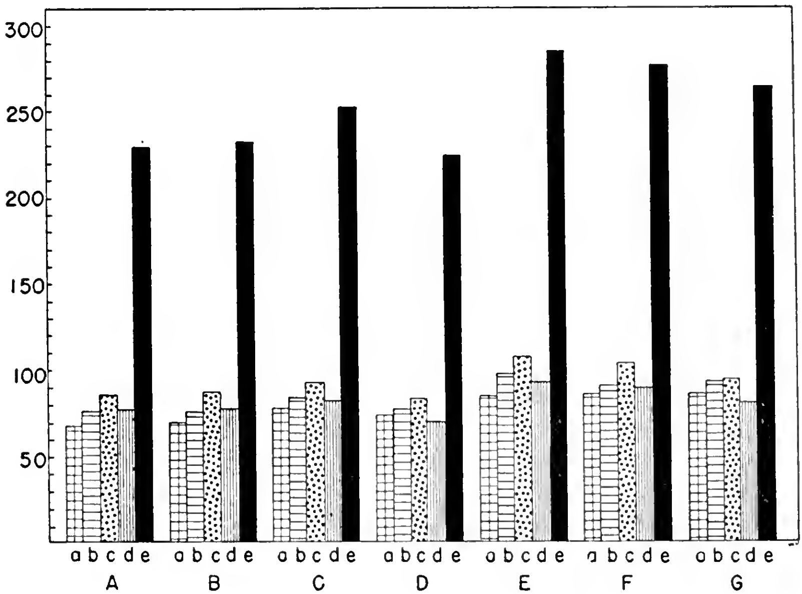


FIG. 47. Graph showing relative lengths of bones of the arm. The percentage values are shown on the axis of the ordinates.
A. *Bombycilla cedrorum;* B. *Bombycilla garrula;* C. *Dulus dominicus;* D. *Phainoptila melanoxantha;* E. *Phainopepla nitens;* F. *Ptilogonys cinereus;* G. *Ptilogonys caudatus.* a. humerus; b. radius; c. ulna; d. manus; e. total.

It is notable that, in general, birds with long and narrow wings appear to have relatively the shortest humeri, with the distal bones, especially the manus, variable in length and seemingly correlated with the manner of feather attachment. Those birds with rounded and short wings have the longest humeri. In swallows, for example, the humerus is short, whereas the other arm bones are long, and the manus is unusually large and heavy. A short humerus gives better lever action in the flight stroke than a long humerus does.

MUSCULATURE

Dissections showed the same muscles to be present in all genera of the Bombycillidae. There are, nevertheless, differences in the size of the muscles in the various species, and these differences have been investigated primarily as a check on differences noted in the structure of the bones. Even slight differences in mass can be important functionally, but the difficulty in accurately measuring the mass prevents wholly reliable conclusions. The method first used in the attempt to determine the mass of a given muscle was that of immersing the muscle in a liquid-filled graduated tube, and then measuring the amount of liquid displaced. This method, although adequate for large muscles, was subject to a great amount of error in the case of small muscles, and consequently was abandoned. The technique eventually used was that previously employed by Richardson (1942). It consisted of dissecting out the muscle, placing it in embalming solution, leaving it there until a later period, and finally, weighing the muscle on scales, accurate to a milligram, after the muscle had been out of the liquid for a period of one minute. After being weighed, the muscle was measured by the displacement method in a graduated tube, as a check. The results indicate that, although the two methods give the same general results, weighing is accurate to one-hundredth of a gram, whereas the displacement method was accurate to only a tenth of a gram.

In determining the percentage of the weight of a muscle in relation to the total weight of the bird, the weight of the muscle was used as the numerator, and the weight of the preserved specimen was used as the denominator. Before weights were taken, all specimens were plucked in identical fashion.

Caudal Muscles.—The muscles of the caudal area that were used for comparison were the levator caudae and the lateralis caudae. These muscles are used by the living bird to maintain the position of the pygostyle and therefore the rectrices; these muscles are especially important to those birds that utilize the tail as a rudder in flight and as a brake. As may be seen by reference to Table 11, the two muscles are largest in proportion to body weight in the Ptilogonatinae, in which subfamily the species have long rectrices and must have correspondingly well-developed muscles in order to utilize the rectrices to best advantage in flight. The lateralis caudae differs more according to species than does the levator caudae, showing that rudder action of the tail is of primary importance in the adaptation for capturing insects. It will be remembered that the pygostyle in this subfamily has a flattened lateral surface for attachment of the levator caudae muscle, and it is therefore to be expected that this muscle will be larger in the Ptilogonatinae than it is in either the Bombycillinae or the Dulinae. The levator coccygis, together with the two muscles mentioned above, is responsible for elevation of the tail. The levator coccygis is less altered in different

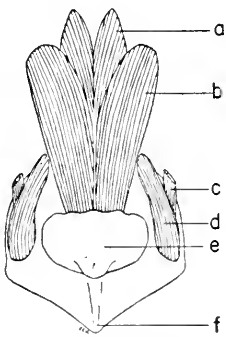


FIG. 48. Caudal musculature, of *Phainopepla nitens lepida,* in dorsal view. × 2. a. Levator coccygis; b. Levator caudae; c. Lateralis caudae; d. Lateralis coccygis; e. oil gland; f. dorsal tip of pygostyle.

species of the family than is the lateralis caudae. It may be noted that the caudal muscles of *Dulus* and *Bombycilla* constitute a smaller percentage of the total weight of the bird than in any of the genera in the subfamily Ptilogonatinae.

TABLE 11. Caudal Muscles (Actual and Relative Weights)

SPECIES	Levator	Lateralis
Ptilogonys caudatus	.145g. .092%	.022g. .045%
Ptilogonys cinereus	.030g. .076%	.010g. .026%
Phainopepla nitens	.025g. .096%	.008g. .029%
Phainoptila melanoxantha	.040g. .063%	.015g. .014%
Dulus dominicus	.028g. .063%	.006g. .014%
Bombycilla garrula	.034g. .048%	.010g. .014%
Bombycilla cedrorum	.026g. .050%	.008g. .014%

TABLE 12. Weights of Muscles (These percentages expressed in terms of weights of the body)

SPECIES	P. major	P. minor	Deltoid
Ptilogonys caudatus	2.42g. 4.94%	.29g. .59%	.55g. 1.12%
Ptilogonys cinereus	2.19g. 5.57%	.28g. .71%	.53g. 1.35%
Phainopepla nitens	1.30g. 4.99%	.20g. .77%	.30g. 1.15%
Phainoptila melanoxantha	3.93g. 6.18%	.44g. .69%	.92g. 1.45%
Dulus dominicus	2.09g. 4.81%	.22g. .50%	.50g. 1.15%
Bombycilla garrula	3.85g. 5.31%	.45g. .62%	.55g. .76%
Bombycilla cedrorum	2.58g. 5.00%	.35g. .68%	.50g. .97%
	Thigh	Peroneus	Gatrocnemius
Ptilogonys caudatus	.43g. .88%	.15g. .31%	.96%
Ptilogonys cinereus	.30g. .71%	.08g. .21%	1.02%
Phainopepla nitens	.28g. 1.12%	.10g. .40%	1.42%
Phainoptila melanoxantha	1.09g. 1.61%	.48g. .75%	2.97%
Dulus dominicus	.73g. 1.68%	.18g. .41%	1.01%
Bombycilla garrula	.50g. .69%	.15g. .18%	.59%
Bombycilla cedrorum	.37g. .73%	.10g. .19%	.83%

Pectoral Muscles.—The pectoral set of muscles varies but little in the family; flight power is seemingly not dependent upon size of either the pectoralis major or pectoralis minor. The data indicate that the insertion on the humerus, with consequent changes in the relative length of that bone, is more significant in type of flight and over-all flight power than is the actual size of the muscle mass. The deltoid muscle, for example, is smaller in *Bombycilla* than in members of the other two subfamilies. The humerus in *Bombycilla* is shortened, and the muscle therefore does not need to be large to accomplish the same powerful stroke that would be accomplished by a longer humerus and a larger, more powerful deltoid muscle. In the case of the deltoid, the shortening of the humerus and the more complex arrangement of the points of insertion have obviated the necessity of enlarging the muscle.

Leg Musculature.—The muscles of the thigh are noticeably larger in birds that have long leg bones. (See Table 12 for size of muscles.) On the tibiotarsus, the peroneus and gastrocnemius muscles were measured. When expressed as a percentage of the weight of the bird, the peroneus has much the same relative weight in all but one of the species, whereas the gastrocnemius varies much. The peroneus is proportionately large only in *Phainoptila,* in which genus all the leg muscles are well developed, but the gastrocnemius is larger in all the Ptilogonatinae and in *Dulus* than it is in the specialized *Bombycilla,* in which it has probably been reduced as the leg bones and other muscles have been reduced.

The volume of the muscles of the hind limb changes more readily in response to saltation and running than do the muscles of the forelimb to flying.

DIGESTIVE TRACT

The digestive tract is relatively uniform in all genera of the family; there are only slight differences between the species. The degree of compactness of the visceral mass varies, *Phainoptila* and *Ptilogonys caudatus* having the folds of the digestive tract loosely arranged, whereas *Ptilogonys cinereus* and *Phainopepla* have folds which adhere more tightly to the ventriculus and liver. In *Dulus* and *Bombycilla,* as compared with the Ptilogonatinae, the visceral mass (primarily liver and ventriculus) is situated more posteriorly in the body cavity, and is more compact, and the intestine is more tightly coiled.

The coiling of the intestine, if its degree of compactness is disregarded, is nearly identical in the birds of the family; there are four major loops between the ventriculus and the anus. The length of this section of the tract is, however, somewhat variable, as can be seen by reference to Table 13, in which the actual and relative lengths of the intestine are given. It may be seen that in *Bombycilla* and in *Phainopepla*, the tracts are much shortened. This is notable, since these are frugivorous birds, and in many frugivorous birds, the tract is lengthened for better extraction of edible portions of the food. Possibly the action of the digestive juices is correspondingly more rapid in *Bombycilla* and *Phainopepla*, thereby permitting the necessary nutriment to be extracted by a short digestive tract.

In a migratory bird, or one that depends on flight power to find food and escape capture by predators, as in the case of the waxwings, the compacted and shortened visceral mass would seem to be advantageous, because of the consequent reduction in weight. I consider the longer intestine to be the ancestral condition, and that the intestine has become shorter to meet new environmental conditions.

Beddard (1898:30) states that caecae in the tract may be highly variable in a single family of birds. The Bombycillidae is no exception in this regard. At the junction of the cloaca and the large intestine, there are two small caecae, the function of which is unknown to me. The caecae are largest in the Ptilogonatinae, smaller in the Bombycillinae, and smallest in the Dulinae. There may be a

TABLE 13. Digestive Tract: Actual Length, and Length Relative to Thoracic Length

SPECIES	Length in mm.	Relative length (in percent)
Ptilogonys caudatus	134	476.9
Ptilogonys cinereus	111	415.6
Phainopepla nitens	94	357.5
Phainoptila melanoxantha	150	457.1
Dulus dominicus	130	451.0
Bombycilla garrula	102	298.2
Bombycilla cedrorum	95	309.5

correlation between large caecae and more insectivorous diet and small caecae and frugivorous diet; however, the data are not conclusive in this regard.

ORIGIN OF THE SPECIES

It is here postulated that the center of origin for the ancestral stock of the Bombycillidae was in a region of North America, which at the time concerned was temperate or possibly even semi-tropical in climate. Probably Northern Mexico was the place and probably the climate was temperate. It is reasonably certain, because of the distribution of the species of the family, that they originated in the Americas. In the absence of paleontological data (*Bombycilla* alone is reported, in essentially its modern form, from the late Pleistocene —Wetmore, 1940a), the place and time of origin cannot certainly be determined.

The distribution of the family is such that the more primitive groups are in the south. These are the Ptilogonatinae in Central America and Mexico, and the isolated Dulinae in Haiti and the Dominican Republic. This distribution would support the view that the origin was in the south. However, the Holarctic Bombycillinae are so typically birds of northern latitudes that, were it not for such close relatives south of their range, it would appear logical to infer a northerly origin with a subsequent shifting of populations both southward and northward. The phyletic age of the family is probably great, however, as evidenced by the spotty distribution of the birds.

In the evolution of this family, population pressure possibly played the initial role in forcing members of the primitive, southern stock to seek habitable areas on the periphery of the range. Some birds also, being possessed of the "adventuresome spirit", aided the northerly movement, thus effecting an extension of the breeding ranges to the north. So far as is now known, this family did not seek living space in South America. By extending its range, a species might find more abundant food and nesting sites. This process of extending the range probably would be costly to the species concerned, because only those individuals best able to adapt themselves to the new environmental conditions would be able to survive long enough to reproduce their kind.

The return flight to the south could, in time, be dispensed with, except in the coldest weather or when the local berry- and fruit-crop failed. Birds such as waxwings are, of course, able to subsist on dried fruits and berries in the critical winter season when strictly insectivorous birds, not so catholic in their food habits, must return south. It appears that waxwings are descendants of migratory birds that have adjusted themselves to a life in the north; and they are judged not to have evolved from year-round residents of the north.

Even a short migratory journey in spring by part of a population of birds, while the other part remained in the original range, would quickly isolate one breeding population from the other, resulting in the formation of different genetic strains that lead to subspecies, species, and finally to genera and families. Any variation away from the ancestral, "sedentary" stock would become established more quickly because of such isolation at the breeding period. By the same token, the parental stock can, and no doubt does, become modified to suit its environment more perfectly, thus accelerating the tempo of this type of divergent evolution.

The original "split" of the Bombycillines is thought then to have been the result of migration on the part of some of the ancestral stock, with subsequent loss of regular migration because the need to return south was lost. Early in development, and before the migrational tendency was entirely lost, an isolated population, which later became sedentary, as it was an island population, diverged to give rise to the Dulinae. The Dulinae are a homogeneous group since on the islands now inhabited by the birds, they have not been isolated sufficiently long to produce even well-marked subspecies.

The present day *Phainoptila* is most nearly like the ancestral group, and the remainder of the Ptilogonatinae have diverged to

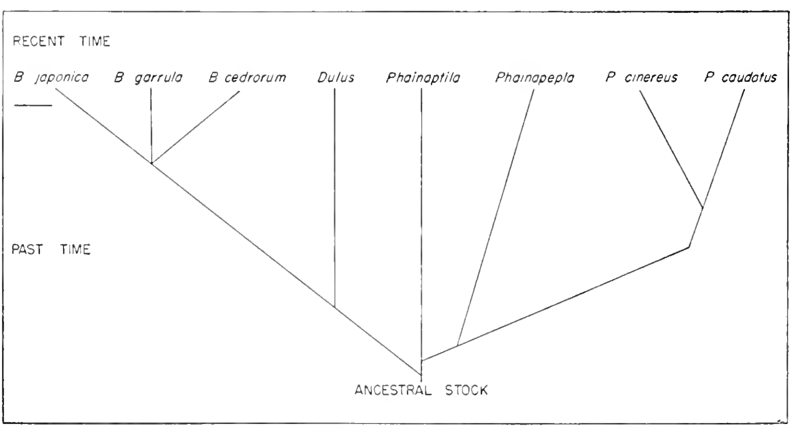


FIG. 49. Hypothetical family tree of the Bombycillidae.

fit conditions similar to those to which the Tyrannid flycatchers, which parallel them, are also fitted.

In comparatively recent geological time, two basic lines developed from the Bombycilline stock, the future *B. garrula* and *B. cedrorum*. Possibly *garrula* originally was isolated in Europe and Asia, and later came into contact with *B. cedrorum,* following the time at which the two species were genetically well differentiated. It appears certain that *B. japonica* was an offshoot of the Bombycilline stock at an early time, since it has characteristics that seem relatively unspecialized. It possibly was isolated in the Orient.

Structural affinities of *Dulus* and *Bombycilla* are more pronounced than are those of *Dulus* and *Ptilogonys*, for example. Many of the structural features of *Dulus* parallel those of *Phainoptila,* and it seems likely that the Dulinae were separated early in the history of the family, perhaps as an isolated offshoot of the early migratory Bombycillinae.

CONCLUSIONS

Nomenclature, as used by a taxonomist, should of course indicate affinities as well as apply a name, and the rank of the family should be applied to a structural unit based on common anatomical characters that are more fundamental than, in my opinion, are those used by Ridgway (1904) in proposing family status for the silky flycatchers and the palm-chats. The characters in the diagnosis (page 478) of the family Bombycillidae are common features regarded as warranting a single family unit for the waxwings, silky flycatchers, and palm-chats. The differences in morphology used by previous workers to characterize each of these groups: (1) the silky flycatchers; (2) waxwings and; (3) palm-chats are regarded as more properly characters of only subfamily rank.

The existing coloration of the species of the Bombycillidae appears to have been acquired relatively late, geologically speaking. The three subfamilies responded to ecological stimuli in three different ways, and the resulting color patterns are unlike in the three groups. Dulinae to this day have a color pattern that is most like the ancestral color pattern, and this is recapitulated in the juvenal plumage of the Bombycillinae before they attain their adult plumage.

Consideration of the geographic distribution of the species of the family indicates that the center of origin of the family Bombycillidae was south of the present range of the waxwings (subfamily Bombycillinae). Waxwings probably are the descendants of a migratory population that diverged from the primitive population at an early time in the history of the family. Owing to their adaptations to survive in the north, waxwings no longer return south in the autumn. Palm-chats (subfamily Dulinae) are descendants of an isolated population of the family stock that developed communal living habits as one specialization. Silky Flycatchers (subfamily Ptilogonatinae) became modified to catch insects, and have specializations that roughly parallel those of the Tyrannid flycatchers.

Osteologically, the various species of the Bombycillidae are remarkably similar. Small variations do exist, but these are primarily differences in relative size. The modifications of the beak enable palm-chats to feed on parts of plants, and the beak of *Phainoptila* shows some similarity in this respect. Rounded wings, which cause a bird to fly by means of short, relatively weak strokes, are correlated with a comparatively long humerus, whereas long and pointed wings, which enable a bird to fly with more powerful strokes of the wing, are correlated with a relatively short humerus. There is a positive correlation between a short humerus and a long external condyle, and between a long humerus and the absence or smallness of the external condyle.

In the Bombycillidae short bones of the leg are adaptive, and long bones of the leg are the generalized condition. Although all passerine birds were differentiated relatively late in geologic time, long hind limbs still could have been present in the immediate ancestors of passerine birds. As adaptive radiation took place in the class Aves, some birds, the Bombycillidae included, became more and more adapted for an arboreal, and eventually an aerial habitat, with consequent loss of saltatorial and running ability.

Birds, like mammals, have a short femur, the most proximal element in the leg, if the species is adapted to run fast. If the species is not adapted to run fast, birds, unlike mammals, have the tibiotarsus longer than any of the other elements; in mammals that are not adapted to run fast, the femur and tibia are approximately the same length. In non-running birds as compared with running birds, the leg element distal to the tibiotarsus, and the one proximal to it, are considerably shortened. In waxwings, all three elements of the hind limb are shortened, indicating that the reduction in length has been, evolutionarily speaking, a rapid process, in order to reduce the limbs to a convenient size as soon as possible.

The shape of the pygostyle varies in the Bombycillidae, but the simple shieldlike bone of *Phainoptila* is judged to resemble closely the ancestral type. In *Ptilogonys* there is a tall dorsal spine, coupled with a wide and heavy centrum and flattened lateral areas, for support of the long rectrices. In *Bombycilla* the bone is small with knobs on the centrum that have been developed for muscle attachment.

The muscles were carefully dissected in each genus and in most of the species. The same homologous muscles are present in all species. Significant differences were found only in the relative size of certain muscles. No satisfactorily accurate method of measuring these differences was found. Consequently, less use was made of the results of the dissections than was originally planned.

The set of pectoral muscles varies but slightly in relative mass, and the variation is not considered significant. The deltoid muscle was selected for measurement since its point of insertion is unusually variable, while the mass of the muscle varies little. We can conclude that the extent of the area of insertion of the tendon of a muscle can determine that muscle's relative efficiency, while the muscle itself remains the same in bulk.

The muscles of the hind limb are notably larger in species that have long legs, and a good index of the hopping ability may be gained by study of certain of these muscles. In the Bombycillidae, and in those Ptilogonatinae that do not use the hind limbs for hopping, the bones are shortened, and the associated muscles are correspondingly smaller.

The gross anatomy of the digestive tract is practically identical in the members of the family. The variability noted is mainly in the degree of compactness of the visceral mass in *Bombycilla* and in *Phainopepla*. Also there is a tendency for the Bombycillinae and the Dulinae to have the mass situated more posteriorly than it is in the Ptilogonatinae. Moreover, *Bombycilla* has a shorter intestine than do the other genera. All of this indicates that the waxwings (Bombycillinae) have the center of gravity situated more advantageously for flight than do the birds of the two other subfamilies.

SUMMARY

1. The silky flycatchers, waxwings, and palm-chats are included in the family Bombycillidae; the Ptilogonatidae and Dulidae are reduced to subfamily rank.
2. The coloration of the birds of each subfamily is different because the ecological needs are different.
3. Waxwings were at one time regularly migratory, but are now nomadic, since they are adapted to live in northern latitudes for the entire year.
4. The corresponding bones in different members of the family closely resemble one another, and the differences which do exist are the results of responses within relatively recent times to changes in habits.
5. In the Bombycillidae a rounded wing is judged to be the primitive condition. As the wing becomes more pointed, the humerus becomes shorter and its external condyle longer.
6. The hind limbs are short in birds that depend most on flight power, but are longer and the distal elements are disproportionately longer in birds that depend on saltation or on running.
7. The pygostyle varies in shape and size between genera and even between some species.
8. The pectoral muscles differ in size only slightly in the different members of the family, but the insertions are more extensive for these muscles in birds that fly a great deal.
9. The muscles of the hind limb vary in mass, but not in kind, in the members of the family Bombycillidae.
10. In the Bombycillidae that depend on flight power, rather than on saltation or on running power, there is a tendency for the digestive tract to become shorter and for the whole visceral mass to become more compact.

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Transmitted July 29, 1949.

Mention should be made here of an important paper by Jean Delacour and Dean Amadon (1949). The Relationships of *Hypocolius*. Ibis, 91:427-429, plates 19 and 20) which appeared after the present paper by Arvey was written. Delacour and Amadon stated that *Hypocolius*, a monotypic Persian genus, should be assigned to the Bombycillidae. Their conclusions (*op. cit.*: 429) were as follows: "It might be advisable to set up three subfamilies in the Bombycillidae, one for *Bombycilla*, one for *Hypocolius*, and a third for the silky flycatchers, *Ptilogonys*, *Phainopepla* and *Phainoptila*. Further study may show that *Dulus* can be added as a fourth subfamily.

"Previously the Bombycillidae appeared to be an American group of which one genus (*Bombycilla*) had reached the Old World. Inclusion of *Hypocolius* in the family makes this theory uncertain. Without obvious affinities to other families, and consisting of a small number of scattered and rather divergent genera, the Bombycillidae would seem to be a declining group whose origin cannot safely be deduced from the distribution of the few existing species."

—Eds.

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26. A synopsis of the American bats of the genus Pipistrellus. By E. Raymond Hall and Walter W. Dalquest. Pp. 591-602, 1 figure in text. January 20, 1950.

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14. A new pocket gopher (Thomomys) and a new spiny pocket mouse (Liomys) from Michoacán, Mexico. By E. Raymond Hall and Bernardo Villa-R. Pp. 249-256, 6 figures in text. July 26, 1948.

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University of Kansas Publications
Museum of Natural History

Volume 3, No. 4, pp. 531-649, 7 figures in text, 2 tables
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UNIVERSITY OF KANSAS
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Volume 3, No. 4, pp. 531-649, 7 figures in text, 2 tables
October 10, 1951

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PRINTED BY
FERD VOILAND, JR., STATE PRINTER
TOPEKA, KANSAS
1951

23-3247

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By

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From the arid tropics in the north to the lush, steaming jungles in the south, and from the sand dunes and mangrove swamps of its Gulf shores to the top of its snow-capped, volcanic peak, Orizaba, the 400-mile length of Veracruz embraces a wide variety of habitats and diversity of life conditions. As a result no other state in the Republic of Mexico exceeds Veracruz in the richness of its avifauna. But, despite this fact, the only comprehensive treatment of the birds of this state is still an unpublished manuscript, "Ornithology of the Mexican State of Veracruz with an Annotated List of Birds," by Frederick W. Loetscher, Jr. (Thesis, Cornell University, 1941). In this voluminous manuscript, the author brings together records published up to 1940, as well as references to specimens in the major museums. Supplementing these data are Loetscher's notes on five months of intensive personal observation of the birds of the state in which time he covered much ground and visited many localities not studied ornithologically since the days of Sallé, Sumichrast, de Oca, and others. Loetscher listed 586 species as definitely occurring in Veracruz, and this was a treatment based on an ultra-conservative point of view as to what constitutes a valid state record. A number of species recorded in the literature as occurring in Veracruz were rejected from his faunal list.

Loetscher's manuscript, which we have been permitted to examine through the courtesy of the author and the Laboratory of Ornithology at Cornell University, has provided a very helpful background against which to evaluate certain of our own records. Reference has been made also to several excellent papers published since the completion of Loetscher's manuscript. These include publications by Brodkorb (1943 and 1948), Davis (1945), Traylor (1949), and Wetmore (1943).

The large number of discoveries and important distributional data brought to light by these papers show that Veracruz still is one of the richest fields in North America for avifaunal discoveries. The present work is primarily a report on three collections coming from widely scattered localities and represents neither a comprehensive survey of the avifauna of the state nor an exhaustive study of any one locality. It contains, however, a considerable amount of new distributional data.

In late 1945 Dalquest entered Mexico to collect zoölogical specimens for the University of Kansas Museum of Natural History. Headquarters were established at Potrero Viejo, Veracruz, in February, 1946, and work continued from that date, with interruptions of two to three months each year in the rainy season, until July, 1949. Although the time was spent principally in studying the mammals, collections were made also of fishes, amphibians, reptiles, and birds. A total of 1007 specimens of birds, including a large number of skeletons, was secured in the four seasons of field work. Also, in addition to the collection made by Dalquest, which is deposited at the University of Kansas Museum of Natural History, we have had at our disposal for study certain material from Veracruz that reposes in the Louisiana State University Museum of Zoölogy. This includes approximately 200 specimens collected in Veracruz in 1937 and 1938 by Mr. Dyfrig McHattie Forbes of Potrero Viejo, and 87 specimens taken by Lowery and Robert J. Newman, in 1937 and 1949, respectively.

These combined collections and accompanying field notes have provided distributional data relating to 297 species or 312 species and subspecies. For eighteen of these kinds of birds we have been able to find no previously published records for Veracruz. Other specimens were of species reported from Veracruz only many years ago, and the validity of some of these old records was in question. The specimens listed in the following accounts of species and subspecies, unless otherwise stated, are in the collection of the University of Kansas Museum of Natural History.

The nomenclature employed, except where explanations are made to the contrary, follows the 4th edition of the American Ornithologists' Union "Check-list" (1931) or its various Supplements (1944-1949), Peters' "Birds of the World" (1931-1948), or Cory, Hellmayr, and Conover's "Birds of the Americas" (1918-1949).

In this paper, Lowery is responsible for the identification of the specimens, the general organization of the material, and the nomenclatural and taxonomic comments. Dalquest is responsible for the information dealing with the actual field work, such as natural history notes and most of the distributional facts, including the discussion of life-zones and their application in the individual species accounts.

ACKNOWLEDGMENTS

We are grateful to Mr. and Mrs. Dyfrig McHattie Forbes of Potrero Viejo, Veracruz, whose interest in the fauna of this state has continued over many years. Mr. Forbes personally collected nearly 200 specimens of birds in Veracruz for the Louisiana State University in 1937 and 1938. Lowery was the guest of Mr. Forbes for several days in August, 1937, and Dalquest lived with Mr. Forbes and his family for four seasons of field work in Veracruz. It is a pleasure to name in the present report a new race of owl in honor of Mr. Forbes.

For assistance in various ways and for the loan of comparative material we are indebted to the following: John W. Aldrich, Allen J. Duvall, and the United States Fish and Wildlife Service; Emmet R. Blake, Melvin A. Traylor, and the Chicago Natural History Museum; John Davis; Frederick W. Loetscher, Jr.; Robert J. Newman; Kenneth C. Parkes and the Laboratory of Ornithology of Cornell University; James L. Peters and the Museum of Comparative Zoölogy; Charles G. Sibley; George M. Sutton; J. Van Tyne and the University of Michigan Museum of Zoology; Alexander Wetmore, Herbert Friedmann, and the United States National Museum. The University of Kansas Endowment Association sponsored the major part of the field work. Finally, we are indebted to Professor E. Raymond Hall and Mr. Harrison B. Tordoff for permission to report upon the collections from Veracruz in their care, and for suggestions pertaining to the manuscript.

LIFE-ZONES OF VERACRUZ

The life-zone classification employed in this paper represents Dalquest's concepts entirely and is based largely on his observations of the mammals of Veracruz.

Merriam (1892) dealt only superficially with the life-zones as they pertain to areas south of the United States. He did not subdivide the Tropical Region, but other authors applying Merriam's principles have done so. Goldman (1920) separated Panamá into the Lower Tropical Life-zone, with arid and humid divisions, the Upper Tropical Life-zone, and the Temperate Life-zone. The latter is an inclusive term to cover the small, isolated areas that are higher than the Tropical life-zones but that are not identifiable in detail with the life-zones of the temperate region farther north. Dickey and van Rossem (1938) divided the Tropical Region of El Salvador into four parts: the Humid Upper Tropical, the Arid Upper Tropical, the Humid Lower Tropical, and the Arid Lower Tropical life-zones. Other authors have applied somewhat different terminology to the divisions of the Tropical Region. There is general agreement, however, that the Tropical Region is divisible into at least two major life-zones, and that locally the life-zones in turn may each be divisible into humid and arid parts. Where mountains or highlands rise above the Tropical Region they present conditions somewhat comparable to those found in the Austral and Boreal regions, and they have been grouped together by some authors under the name of the Temperate Zone.

Central Mexico consists of a plateau which, in those parts that adjoin Veracruz, is elevated six to nine thousand feet above sea level. This plateau is an arid region, and was mapped by Merriam, *et al.* (1910) as lying in the Upper and the Lower Sonoran life-zones. At the eastern edge of the tableland, the lip or rim of the plateau is raised in a series of hills or mountains, of which the Pico de Orizaba and Cofre de Perote are two. From the elevated crest of the rim, the land plunges down abruptly to the tropics. The drop from the Pico de Orizaba to the Lower Tropical Life-zone has an average ratio of one foot in six feet, or a drop of 4,200 meters in twenty-three kilometers. The average distance from the Lower Sonoran Life-zone of the Mexican Plateau to the Lower Tropical Life-zone, in central Veracruz, is approximately nine miles. Where the crest is low, the life conditions are essentially like those of the Transition Life-zone of the United States. Where mountains are encountered, the land may rise to levels where Canadian, Hudsonian, or Arctic-Alpine conditions are simulated. But these minor zonal areas are so anomalous, so compressed, so isolated, and of such minor geographic extent that the identification of any one life-zone in any area, save where the land is level for a short distance, is scarcely possible.

West of the main crest of the rim of the Mexican Plateau, the land drops less abruptly on the average, but the slope is still steep. Where the geographic limits of Veracruz extend westward past the western base of the mountains or hills that form the rim of the plateau, the extensive Lower Sonoran Life-zone of the Mexican plateau is reached. This occurs in two small areas only, one of which is north and west of the Cofre de Perote. The other is north of Tulancingo, Hidalgo, where a long arm of Veracruz projects westward across the plateau for some distance.

Approximately ninety per cent of Veracruz lies in the Tropical

Region. It is with this region, and its bird fauna, that this paper is primarily concerned. The Tropical Region is clearly divided into two parts. One of these, the Upper Tropical Life-zone, includes the eastern slopes of the mountains forming the rim of the Mexican Plateau from an approximate upper average elevation of 5,500 feet to an approximate lower average elevation of 1,700 feet. The Upper Tropical Life-zone in Veracruz, because it exists principally on the eastern face of the abruptly dropping face of the Mexican Plateau, is a narrow belt separating the extensive Lower Tropical Life-zone from the higher zones of these same mountains. Also included mainly in this life-zone are the Tuxtla Mountains of southern Veracruz. The highlands of the Tuxtla Mountains and the Mexican Plateau both intercept the moisture-laden winds from the Gulf of Mexico, after their passage over the low, comparatively level Lower Tropical Life-zone.

The Upper Tropical Life-zone in Veracruz is not divisible into humid and arid parts. If further study of the Upper Tropical Life-zone of the Americas should show that the recognition of humid and arid divisions is practicable, the Upper Tropical Life-zone of Veracruz would probably be considered as belonging entirely to the humid division. The Upper Tropical Life-zone includes the cloud-hung upland forests and lower mountain slopes, where there is an abundance of water from springs as well as from mountain snows to the west, and where precipitation is great and humidity is high. Streams are clear, cold, and swift. Exposed outcrops of rock are numerous. The forest is high and lush with saprophytes and epiphytes. The ground is usually well drained and covered with an understory vegetation.

At the lower edge of the Upper Tropical Life-zone, at an approximate average elevation of 1,700 feet, the land levels off and descends gently to sea level at the Gulf of Mexico. This area in Veracruz is the Lower Tropical Life-zone. Division of this extensive lowland into humid and arid divisions is practicable. It should be pointed out that the divisions of the Lower Tropical Life-zone in Veracruz may not correspond to the same divisions of this zone used by other authors for areas farther south. In Veracruz the arid and humid divisions are easily discerned, but in their faunas there is little qualitative difference. The arid division of the Lower Tropical Life-zone consists of an extensive grassy plain, usually spoken of herein as the coastal plain, where the conditions are arid over a long, dry season. The plain is fairly level, with no exposed outcrops of country rock. Vegetation on the grass lands consists of thorny thickets and flat-topped trees with lacy foliage. Streams are deep and sluggish with muddy banks. Near the streams and rivers there are jungles, with typical jungle birds and mammals. The arid division of the Lower Tropical Life-zone extends southward (from the arm of mountains that reaches eastward from the Mexican Plateau, north of Jalapa), nearly to the Isthmus of Tehuantepec, skirting about the base of the Tuxtla Mountains. It exists as a nearly continuous unit, except where cut by a network of narrow bands of jungle along the major streams.

The humid division of the Lower Tropical Life-zone consists of the lowland jungles lying, in Veracruz, mostly under 500 feet in elevation. A considerable part of the northern third of Veracruz, north of the twenty-degree parallel, lies in this division, as does extreme southern Veracruz, south of the coastal plain and the Tuxtla Mountains. Little collecting of birds was done in the northern part of this area.

GAZETTEER OF LOCALITIES

The following place names and geographical features are those to which reference is made in this paper. The spellings employed are based principally on the American Geographical Society's "Map of Hispanic America on the Scale of 1:1,000,000 (Millionth Map)" and its accompanying Index (1944). A few place names, however, were found only by consulting the "Coördenadas geográficas y alturas en metros sobre el nivel del mar, de las cabeceras municipales de la República [de México]," a publication issued by the Secretaría de la Economía Nacional (1944). Numbers in brackets identify the position of a locality on the accompanying map (Fig. 1).

Acultzingo.—Lat. 18° 42′; long. 97° 18′. Village on road from Puebla to Córdoba [47].

Altotonga.—Lat. 19° 46′; long. 97° 13′. Village on road from Perote to Tlapacoyan, Puebla [18].

Alvarado.—Lat. 18° 47′; long. 95° 45′. Village on coast [51].

Arroyo de la Piedra.—Lat. 18° 59′; long. 96° 20′. Arroyo on road from Córboda to Veracruz [37].

Boca del Río.—Lat. 19° 07′; long. 96° 07′. Village beside Río Jamapa on road from Córdoba to Veracruz [36].

Buena Vista.—Lat. 17° 38′; long. 95° 13′. Village on headwaters of Río San Juan in southern Veracruz [63].

Cañada Blanca.—Same as Ojo de Agua.

Cerro Gordo.—Lat. 19° 25′; long. 96° 42′. Village on road from Jalapa to Veracruz [28].

Coatzacoalcos.—Lat. 18° 09′; long. 94° 25′. Also known as Puerto México. A city at mouth of the Río Coatzacoalcos in southern Veracruz [59].

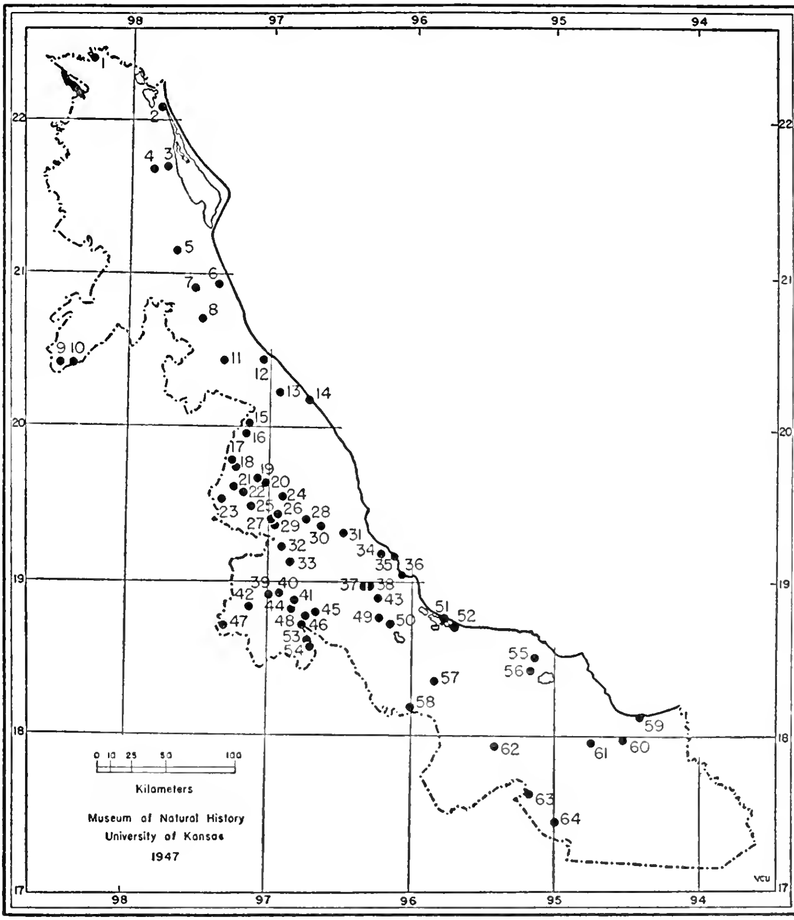

FIG. 1. Map of Veracruz showing the localities that are numbered in the Gazetteer (pp. 538-543). The numerical sequence of localities is an arrangement whereby north takes precedence over south and west over east. 1. Laguna Cerro Pez. 2. Tampico Alto. 3. El Cepillo. 4. Ozuluama. 5. Potrero Llano. 6. Tuxpan. 7. San Isidro. 8. Tehuatlán. 9. Jacales. 10. Zacualpilla. 11. Papantla. 12. Gutiérrez Zamora. 13. San Marcos. 14. Nautla. 15. El Jobo. 16. Tlapacoyan. 17. Jalacingo. 18. Altotonga. 19. Las Vigas. 20. La Joya. 21. Perote. 22. Valsequilla. 23. Limón. 24. Jalapa. 25. Cofre de Perote. 26. Coatepec. 27. Jico. 28. Cerro Gordo. 29. Teocelo. 30. Plan del Río. 31. Puenta Nacional. 32. Mirador. 33. Tlacotepec. 34. Paso de San Juan. 35. Veracruz. 36. Boca del Río. 37. Arroyo de la Piedra. 38. La Capilla. 39. Fortín. 40. Córdoba. 41. Potrero Viejo. 42. Orizaba. 43. Mecayucan. 44. Yanga. 45. Cuitláhuac. 46. San Juan de la Punta. 47. Acultzingo. 48. Omealco. 49. El Faro. 50. Piedras Negras. 51. Alvarado. 52. El Conejo. 53. Presidio. 54. Motzorongo. 55. Volcán San Martín Tuxtla. 56. San Andrés Tuxtla. 57. Cosamaloapán. 58. Otatitlán. 59. Coatzacoalcos. 60. Minatitlán. 61. Jáltipan. 62. Jimba. 63. Buena Vista. 64. Jesús Carranza. For the location of localities mentioned in the text but not shown on the map, see Gazetteer of Localities.

Coatepec.—Lat. 19° 27′; long. 96° 57′. Town south of Jalapa [26].

Cofre de Perote.—Lat. 19° 30′; long. 97° 09′. A volcanic peak approximately fifteen miles west of Jalapa. [25].

Córdoba.—Lat. 18° 54′; long. 96° 56′. City in central Veracruz. [40].

Cosamaloapán.—Lat. 18° 22′; long. 95° 48′. A town on Río Papaloapan [57].

Cuitláhuac.—Lat. 18° 49′; long. 96° 43′. Also known as San Juan de la Punta. Town on road from Córdoba to Veracruz [45].

El Cepillo.—Lat. 21° 42′; long. 97° 45′. Village approximately forty-eight miles south of Tampico, Tamaulipas [3].

El Faro.—Lat. 18° 45′; long. 96° 14′. Not on maps. A few houses beside the Río Blanco [49].

El Jobo.—Lat. 20° 01′; long. 97° 10′. Village on road from Teziutlán, Puebla, to the Gulf of Mexico [15].

El Conejo.—Lat. 18° 43′; long. 95° 37′. A Wetmore locality (1943:217) [52].

Fortín.—Lat. 18° 54′; long. 97° 00′. Town on road from Orizaba to Córdoba [39].

Gutiérrez Zamora.—Lat. 20° 28′; long. 97° 06′. Town on road south of Papantla [12].

Hacienda Mirador.—See Mirador.

Hacienda Potrero.—Same as Potrero Viejo [41].

Isla.—Lat. 18° 03′; long. 95° 28′. A Loetscher locality situated on the railroad between Córdoba and Jesús Carranza, at a point approximately 8.4 miles northwest of Jimba.

Jacales.—Lat. 20° 26′; long. 98° 27′. Village in the arm of Veracruz that extends westward, north of Tulancingo, Hidalgo [9].

Jalacingo.—Lat. 19° 49′; long. 97° 19′. Village on road from Perote to Teziutlán, Puebla [17].

Jalapa.—Lat. 19° 32′; long. 96° 55′. City in central Veracruz, and capital of the state. [24].

Jáltipan.—Lat. 17° 58′; long. 94° 43′. A town on railroad from Jesús Carranza to Coatzacoalcos [61].

Jesús Carranza.—Lat. 17° 26′; long. 95° 01′. Also known as Santa Lucrecia. Town and railroad division point in central part of Isthmus of Tehuantepec in southern Veracruz [64].

Jico.—Lat. 19° 25′; long. 97° 00′. Village south of Jalapa [27].

Jimba.—Lat. 17° 56′; long. 95° 23′. Village on railroad from Córdoba to Jesús Carranza [62].

La Capilla.—Lat. 18° 58′; long. 96° 19′. Village on road from Córdoba to Veracruz [38].

La Cieba.—Lat. 18° 52′; long. 96° 51′. Area in cane field immediately west of Potrero Viejo.

La Joya.—Lat. 19° 36′; long. 97° 03′. Village on road from Perote to Jalapa; not on maps. Approximately 3 miles south and 2 miles east of Las Vigas.

La Pesca.—Lat. 18° 53′; long. 96° 49′. Village one mile northeast of Potrero Viejo.

Las Vigas.—Lat. 19° 39′; long. 97° 05′. Town on road from Perote to Jalapa [19].

Laguna Cerro Pez.—Lat. 22° 10′; long. 98° 22′. Lake on boundary between Veracruz and San Luis Potosí [1].

Limón.—Lat. 19° 30′; long. 97° 21′. Also known as San Antonio Limón. Village on Veracruz boundary west of Perote [23].

Matacabresto.—Forbes locality; not on maps. Said to be below (east of) Cuitláhuac.

Mecayucan.—Lat. 18° 53′; long 96° 15′. Village on road from Córdoba to Veracruz [43].

Metlac.—Not on maps; a power house and canyon approximately three kilometers in a northerly direction from Fortín, near road from Córdoba to Orizaba.

Minatitlán.—Lat. 17° 59′; long. 94° 32′. Town in southern Veracruz, on railroad from Jesús Carranza to Coatzacoalcos [60].

Mirador.—Lat. 19° 17′; long. 96° 54′. Hacienda on road from Fortín to highway between Jalapa and Veracruz [32].

Motzorongo.—Lat. 18° 39′; long. 96° 44′. Village on railroad from Córdoba to Jesús Carranza [54].

Nautla.—Lat. 20° 13′; long. 96° 46′. Village on Gulf of Mexico on road leading easterly from Teziutlán, Puebla [14].

Ojo de Agua.—Lat. 18° 56′; long. 96° 54′. Village, cave, and spring 6 miles northwest of Potrero Viejo.

Omealco.—Lat. 18° 45′; long. 96° 47′. Town on railroad from Córdoba to Jesús Carranza [48].

Orizaba.—Lat. 18° 51′; long. 97° 06′. City in central Veracruz [42].

Otatitlán.—Lat. 18° 11′; long. 96° 02′. Village beside Río Papaloapan in southern Veracruz. Also called Otatlán [58].

Ozuluama.—Lat. 21° 40′; long. 97° 51′. Town in northern Veracruz, forty-eight miles south of Tampico, Tamaulipas [4].

Palma Sola.—Same as Arroyo de la Piedra.

Palo Gacho.—Lat. 18° 43′; long. 96° 20′. Not on maps. Situated above (west of) Piedras Negras.

Papantla.—Lat. 20° 27′; long. 97° 19′. City in northern Veracruz [11].

Paraje Nuevo.—Lat. 18° 52′; long. 96° 52′. Village on railroad from Córdoba to Veracruz, 2 miles north of Potrero Viejo.

Paso del Macho.—Lat. 18° 59′; long. 96° 45′. Village on railroad from Córdoba to Veracruz, 9 miles approximately northeast of Potrero Viejo.

Paso de San Juan.—19° 12′; long. 96° 12′. Village on road from Fortín to highway between Jalapa and Veracruz [34].

Paso del Toro.—Lat. 19° 03′; long. 96° 09′. Village on road from Córdoba to Veracruz, approximately 4 miles south and 2 miles west of Boca del Río.

Pasa Nueva.—This locality was not found by us on any map; Allen (1904: 29) writes concerning a collection of mammals made in 1901 by E. A. Colburn that "Pasa Nueva" is "situated a short distance from Tlacotalpan, about sixty miles south of the city of Vera Cruz, in the low tropical coastal belt." Wetmore (1943: 216-217) refers to collections of birds made in part by the same collector in the same year as from "Paso Nuevo" and shows this place as being located on the Río San Juan at latitude 17° 59′ and longitude 95° 11′. This is fifty-three air-line miles from Tlacotalpan and eighty-three miles south and east of Veracruz. We wonder if Allen may not have been more nearly correct than Wetmore, because there is a "Paso Nuevo" listed by Nava (Direccion General Correos y Telegrafos de los Estados Unidos Méxicanos, 1892: 203) as a rancho near Cosamaloapan. Presumably this Paso Nuevo is on or near the Río Papaloapan instead of on the Río San Juan. Cosamaloapan is only nineteen and a half miles in an air-line from Tlacotalpan and fifty-six and a half miles south-southeast of Veracruz.

Perote.—Lat. 19° 34′; long. 97° 14′. Town on the road extending from Jalapa westward to Puebla boundary [21].

Piedras Negras.—Lat. 18° 46′; long. 96° 11′. Village on railroad from Veracruz to Jesús Carranza [50].

Plan del Río.—Lat. 19° 23′; long. 96° 36′. Village on road from Jalapa to Veracruz [30].

Potrero.—Lat. 18° 53′; long. 96° 47′. Also known as Potrero Nuevo. Village on railroad from Córdoba to Veracruz, approximately 1 mile north and 3 miles east of Potrero Viejo.

Potrero Llano.—Lat. 21° 10′; long. 97° 43′. Village on road from Papantla to Tampico, Tamaulipas [5].

Potrero Viejo.—Lat. 18° 52′; long. 96° 50′. Village on railroad from Córdoba to Veracruz [41].

Presidio.—Lat. 18° 39′; long. 96° 46′. Village on railroad from Córdoba to Jesús Carranza [53].

Puenta Nacional.—Lat. 19° 19′; long. 96° 29′. Village on road from Jalapa to Veracruz [31].

Rincón Area.—Peninsula-like area west of Jimba, in southern Veracruz.

Río Atoyac.—From lat. 18° 58′; long. 96° 54′, SE to junction with Río Jamapa at lat. 18° 50′; long. 96° 40′. Some maps give the name Río Atoyac to the lower part of the river, to which the name Río Jamapa is applied in this account.

Río Banderilla.—From lat. 19° 35′; long. 96° 55′, draining eastward into the Río Actópam.

Río Blanco.—From lat. 18° 43′; long. 97° 18′, east into Laguna Tlalixcoyan (a part of Laguna de Alvarado), at lat. 18° 45′; long. 95° 50′.

Río Chalchijapa. River flowing across Oaxacan boundary at latitude 94° 46′ (where it is called the Río Alegro) and continuing northerly to Boca Chalchijapa (lat. 17° 26′; long. 94° 50′), at confluence with Río Coatzacoalcos.

Río Coatzacoalcos. River flowing across Oaxacan boundary at lat. 17° 20′; long. 94° 59′, and northeastward into the Gulf of Mexico at the city of Coatzacoalcos (lat. 18° 09′; long. 94° 25′).

Río Jamapa.—See Río Atoyac.

Río Metlac.—Tributary of Río Blanco with junction at lat. 18° 50′; long. 96° 58′.

Río Solosuchi.—Also written Río Solosuchil. A river flowing from boundary of state at lat. 17° 14′; long. 94° 28′, northwestward into Río Chalchijapa at lat. 17° 22′; long. 94° 47′.

Sala de Agua.—Lat. 18° 50′; long. 96° 43′. A cave and village 2 miles south and 7 miles east of Potrero Viejo.

San Andrés Tuxtla.—Lat. 18° 27′; long. 95° 13′. City at terminus of railroad spur running eastward to Tuxtla Mountains from the Córdoba-Jesús Carranza main line [56].

San Francisco de las Mesillas. Same as Yanga and San Lorenzo.

San Isidro.—Lat. 20° 56′; long. 97° 33′. Village west of Tuxpam, in northern Veracruz [7].

San Juan de la Punta.—Lat. 18° 45′; long. 96° 43′. Town on road from Córdoba to Veracruz [46].

San Marcos.—Lat. 20° 12′; long. 96° 57′. Village on road from Teziutlán, Puebla, eastward to Gulf of Mexico [13].

Tampico Alto.—Lat. 22° 07′; long. 97° 48′. Village south of Tampico, Tamaulipas [2].

Tehuatlán.—Lat. 20° 43′; long. 97° 32′. Tihuatlán on maps. Village on road from Papantla to Tampico, Tamaulipas [8].

Teocelo.—Lat. 19° 23′; long. 96° 58′. Village south of Jalapa [29].

Tlacotepec.—Lat. 19° 11′; long. 96° 50′. Village on road from Fortín to highway from Jalapa to Veracruz [33].

Tlapacoyan.—Lat. 19° 58′; long. 97° 13′. Village on road from Teziutlán, Puebla, eastward to the Gulf of Mexico [16].

Tuxpam.—Lat. 20° 57′; long. 97° 24′. City in northwestern Veracruz, beside Gulf of Mexico [6].

Valsequilla.—Lat. 19° 37′; long. 97° 11′. Village on road from Perote to Jalapa; not on maps [22].

Veracruz.—Lat. 19° 12′; long. 96° 08′. Large city on coast of the Gulf of Mexico [35].

Volcán San Martín Tuxtla.—Lat. 18° 33′; long. 95° 13′. Volcanic peak in Tuxtla Mountains [55].

Yanga.—Lat. 18° 50′; long. 96° 47′. Also known as San Lorenzo. A village on road from Córdoba to Veracruz [44].

Zacualpilla.—Lat. 20° 25′; long. 98° 22′. Village in the arm of Veracruz that extends westward, north of Tulancingo, Hidalgo [10].

Family TINAMIDAE

Tinamus major robustus Parker

Great Tinamou

Tinamus robustus Parker, Trans. Zoöl. Soc. London, 5, 1866: 205-232, pl. 34, fig. 8, pl. 39, pl. 40, figs. 1-7, pl. 41, figs. 1-3 (San Gerónimo, Baja Verapaz, Guatemala.) *Cf.* Brodkorb, Misc. Publ. Mus. Zoöl., Univ. Michigan, 55, January 30, 1943, pp. 20-21.

One ♀, 20 km. E Jesús Carranza, 300 ft., April 14, 1948; 1 ♀, 25 km. SE Jesús Carranza, March 30, 1949; 1 ♂, 35 km. SW Jesús Carranza, February 18, 1948.

Perdiz grande, Perdiz real. This large tinamou was not found north of the Río Coatzacoalcos, on the Isthmus of Tehuantepec, but it was abundant in the dense jungles south of the Coatzacoalcos. The species prefers the deep shade of the high forest where the dense crowns of the trees overhead so completely block the light that there is little understory vegetation. The ground in such habitat is covered with dry leaves and shadows, and the gray colors of the tinamous blend with the dull surroundings. So well protected by their color are they that, in searching for them, one must look for the slight bobbing movement of the birds' heads rather than for the birds themselves. This species flushes far more readily than the smaller species of tinamous and, taking off with a roar of wings similar to that of the Ruffed Grouse, usually flies about 200 feet. On the three occasions that birds were seen to alight, they turned, just before landing, to face the direction from which they had come.

A nest of this species was found on April 4, 1949. Three violet eggs, almost round in shape (59x49 mm.) were placed at the base of one of the tall, sinuous, narrow roots of a wild fig tree in the jungle. This site was 100 feet from the shore of the Río Solosuchi, thirty-five kilometers southeast of Jesús Carranza, at 350 feet elevation.

The nest consisted of a scarcely perceptible hollow in the dry leaves, about ten inches from the root. At this particular place there was a thin grove of slender, thorny ground palms, about twelve feet in height, surrounding the fig tree. Two birds were flushed here.

Their presence in such relatively dense cover led to the investigation that disclosed the nest. The eggs were in an advanced state of incubation.

The mournful cry of this bird is heard most often in the late afternoon, but is commonly heard at any hour of the day or night. The natives say that the bird lives entirely on fireflys, a belief possibly originating from its habit of calling at night.

The pale green flesh of this tinamou is tender and has a delicate flavor and, in the uninhabited southern jungles, formed one of the principal table meats of our field party. The birds were usually fat, and were more tender than the Guans and Curassows.

Crypturellus boucardi boucardi (P. L. Sclater)

Boucard Tinamou

Tinamus boucardi P. L. Sclater, Proc. Zool. Soc. London, 1859: 391. (Teotalcingo, Oaxaca, México.)

Two ♀, 35 km. SW Jesús Carranza, 350-400 ft., February 18, 1948, and April 9, 1949; 1 ♂, 20 km. SE Jesús Carranza, 250 ft., May 5, 1949.

Perdiz chica. This smaller species was found in the same localities and habitat as *Tinamus major*, and nowhere else in Veracruz. It appeared to be less common than the larger species. Its mournful whistles were usually heard in the early morning and late afternoon. Rarely did it call at night. Except when chased by dogs, this bird refused to flush. When approached by man, it usually "freezes," and allows an approach to within ten to fifteen feet before dashing off into the jungle. The birds taken were seen only when attention was called to them by the rustling of leaves when the birds ran off, almost from beneath the collector's feet.

Twenty-five kilometers southeast of Jesús Carranza, on March 30, 1949, a nest containing two rounded (50 x 40 mm.) cream-colored eggs was found. The nest was a shallow depression in dry leaves beneath the dense, tangled branches of a large fallen tree, in a small clearing in the jungle. The eggs were in an advanced state of incubation.

The flesh of this species, like that of the other tinamous, is a fine table meat.

One of these birds was found sleeping near midnight, fourteen kilometers southwest of Coatzacoalcos. Its retreat consisted of three or four dead *coyole* palm fronds that lay in a tangled mass on the ground.

Crypturellus cinnamomeus sallaei (Bonaparte)
Cinnamoneous Tinamou

Nothocernus [sic] *sallaei* Bonaparte, Compt. Rend. Acad Sci. Paris, 42, May, 1856: 954. (Córdoba, Veracruz, México.)

One ♂, Río Atoyac, 8 km. NW Potrero, March 3, 1946; 1 ♀, 2 km. N Motzorongo, 1500 ft., December 8, 1946.

Perdiz. This tinamou is common in central Veracruz, both on the coastal plain and in the humid upland jungles. It prefers a far denser growth of plants for cover than the other tinamous in Veracruz. It was found most commonly in dense thickets, overgrown corn *milpas,* dense jungle along water-courses on the coastal plain, and in poorly-kept coffee groves. Although locally abundant, and highly desired as game, this species is so difficult to take that even the native hunters do not attempt it. When a hunter does obtain a shot at a *perdiz,* it is usually at very close range, and the shot charge is directed at the bird's legs in order to preserve the body flesh.

Family COLYMBIDAE

Colymbus dominicus brachypterus Chapman
Least Grebe

Colymbus dominicus brachypterus Chapman, Bull. Amer. Mus. Nat. Hist., 12, 1899: 256. (Lomita Ranch, Texas.)

One ♂, 5 km. N Jalapa, 4500 ft., October 19, 1946; 1 ♂, 7 km. NW Potrero, 1700 ft., January 10, 1947; 1 ♀, 3 km. N Presidio, 1500 ft., December 2, 1946.

This is the commoner grebe in the central part of the state. It was not noted on the rivers in the southern part of Veracruz, such as the Río Coatzacoalcos, but was common on ponds and such rivers as the Río Atoyac and Río Blanco, even in their upper reaches where the water is cold and clear.

Podilymbus podiceps podiceps (Linnaeus)
Pied-billed Grebe

Colymbus Podiceps Linnaeus, Syst. Nat., ed. 10, 1, 1758: 136. Based on the Pie-Bill Dapchick, *Podiceps minor, rostro vario* Catesby, Carolina, 1, p. 91. (In America septentrionali = South Carolina.)

One ♀, 15 km. W Piedras Negras, 300 ft., January 18, 1947.

The specimen listed seems to be the first taken in Veracruz, though Loetscher (MS) saw the species on two consecutive dates at Isla.

Family ANHINGIDAE

Anhinga anhinga leucogaster (Vieillot)

Water-turkey

Plotus leucogaster Vieillot, Nouv. Dict. Hist. Nat., nouv. ed., 1, 1816: 545. (Florida.)

One ♂, 22 km. SSW Jesús Carranza, 300 ft., March 24, 1948.

Pato buzo. The Water-turkey is common on the broad lower reaches of the larger rivers of Veracruz. They were often seen sitting on dead stubs along the river banks or on driftwood, or swimming in pairs or small groups. In extreme southern Veracruz they were found far up the rivers, where the streams were swift, cold, and clear.

Family ARDEIDAE

Butorides virescens virescens (Linnaeus)

Green Heron

Ardea virescens Linnaeus, Syst. Nat., ed. 10, 1, 1758: 144 (America; restricted to coast of South Carolina by H. C. Oberholser, Proc. U. S. Nat. Mus., 42, 1912, p. 534.)

One ♀ and 1 ♂ (LSUMZ), Potrero Viejo, 1,700 ft., January 25 and April 20, 1938; 1 ♀ (skel.), Potrero Viejo, 1,700 ft., October 21, 1947; 1 ♂ (skel.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 6, 1946.

Garcita. Green Herons are fairly common in the lowlands of Veracruz.

Butorides virescens anthonyi (Mearns)

Green Heron

Ardea virescens anthonyi Mearns, Auk, 12, July, 1895: 257. (Seven Wells, Salton River, on the Colorado Desert, Baja California.)

One ♀ (LSUMZ), Piedras Negras, December 19, 1937.

This speciman appears to be a typical example of the race *anthonyi,* the first to be recorded in Veracruz. The wing measures 195 mm., the under parts are pale, and the neck is decidedly fulvescent.

Florida caerulea (Linnaeus)

Little Blue Heron

Ardea caerulea Linnaeus, Syst. Nat., ed. 10, 1, 1758: 143. Based mainly on the Blew Heron, *Ardea caerulea* Catesby, Carolina, 1, p. 76. (In America septentrionali = South Carolina.)

Four ♂, Río Atoyac, 8 km. NW Potrero, March 2 and 15, 1946; 1 ♀, 1 ♂ (skels.), Río Blanco, 20 km. W Piedras Negras, October 3 and 6, 1946; 1 ♀ (LSUMZ), Matacabresto, Río Blanco above Piedras Negras, December 18, 1937.

Garza blanca. This seems to be the commonest heron in Veracruz. It occurs along the larger rivers, even in their upper reaches where the water is cold, clear, and swift, as well as near ponds and lakes. They are often seen singly, but more often are found in small groups. Three kilometers west of Boca del Río, in February, 1946, these herons congregated in the evening to roost in the tall trees bordering the Río Jamapa. The birds began to arrive at the roost about one hour before sundown, and the last individuals did not arrive until almost complete darkness had set in. Blue birds and white birds were about equal in numbers.

Natives commonly confuse white immatures of this species with the Snowy Egret. The Little Blue Heron is occasionally shot for food by hunters who fail to find more acceptable game, especially when an opportunity is presented to kill several birds with one shot. For the most part, however, they are scorned as game.

Casmerodius albus egretta (Gmelin)

American Egret

Ardea Egretta Gmelin, Syst. Nat., 1, pt. 2, 1789: 629. (In insula S. Dominici insulus Falkland et America australi ad Louisianam usque = Cayenne.)

One ♂ (LSUMZ), Potrero Viejo, February 27, 1938; 1 ♂, Matacabresto, NW Piedras Negras, December 19, 1937.

Garza blanca, garza real. The American Egret was found to be fairly common in marshes and along the larger rivers near their mouths. Occasional birds visited the temporary ponds that formed following heavy rains.

This egret is still shot occasionally for its plumes, though there is no market for these feathers. In several native houses plumes were tacked on the walls as ornaments. These never seemed to be from more than one bird; possibly they came from an individual shot primarily for food.

Nyctanassa violacea violacea (Linnaeus)

Yellow-crowned Night Heron

Ardea violaceea Linnaeus, Syst. Nat., ed. 10, 1, 1758: 143. Based on the Crested Bittern, *Ardea stellaris cristata americana* Catesby, Carolina, 1, p. 79. (In America septentrionali = South Carolina.)

One ♂, 5 km. SW Boca del Río, 25 ft., October 12, 1946; 1 ♂, 2 km. N Motzorongo, 1500 ft., December 10, 1946.

Candil. Fairly common along the lower reaches of the rivers. As many as three or four birds were seen on some piles of drift, but usually the species was solitary. The night heron is an important food species in Veracruz, usually hunted from dugout canoes in the evening.

Heterocnus mexicanus mexicanus (Swainson)

Tiger Bittern

Tigrisoma mexicana Swainson, in Murray's Encl. Geog., 1834: 1383 [Amer. ed., 3, 1839, p. 315, fig. 1034]. (Real del Monte, Hidalgo, México.)

One ♀, Puenta Nacional, 500 ft., October 22, 1946; 1 ♂, 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 28, 1946.

Cerrador. This species was common along the rivers of extreme southern Veracruz and less common along streams on the coastal plain of central Veracruz. On the ground these birds are difficult to see in the marsh grasses and dense streamside vegetation where they customarily stay. Along the rivers in southern Veracruz, however, they were found perched in trees along the river banks at midday. At the approach of our canoe, they would become alarmed and fly to another perch a few hundred yards farther along the river, to repeat this process when we again drew near. The birds were always solitary in their roosts, and we found about one bird to each mile of river bank. Occasionally several would be herded along ahead of the canoe. This was a source of great amusement to the Indian guides.

Family COCHLEARIDAE

Cochlearius cochlearius zeledoni (Ridgway)

Boat-billed Heron

Cancroma zeledoni Ridgway, Proc. U. S. Nat. Mus., 8, 1885: 93. (Mazatlán, México.)

One unsexed, 20 km. S Jesús Carranza, January 6, 1948.

Candil. Common along the sluggish rivers of the southern part of the state. These birds were usually found in dense vegetation along the shores of the rivers, about fifteen feet from the ground. From one to five birds were usually seen. They could be found because the branches below the roost would be white with excreta. The species roosts in the daytime but is seen commonly along the shallows of the rivers in the evening. It is hunted regularly for food, and has the same local name as the night heron.

Family CICONIIDAE

Mycteria americana Linnaeus

Wood Ibis

Mycteria americana Linnaeus, Syst. Nat., ed. 10, 1, 1758: 140. (In America calidiore = Brazil.)

Galembou. A flock of approximately 300 individuals was seen on several occasions in the large march west of Boca del Río. Small flocks were noted several times along the Río Atoyac. All were perched in the tops of tall trees. This bird is much desired by natives as food, but is shy and wary. On several occasions hunters were seen trying to stalk them but never with success.

Family THRESKIORNITHIDAE

Guara alba (Linnaeus)

White Ibis

Scolopax alba Linnaeus, Syst. Nat., ed. 10, 1, 1758: 145. (In America = South Carolina.)

One ♂ (skel.), 60 km. ESE Jesús Carranza, 450 ft., March 29, 1948.

Pato coco. This species was found only once in the course of this field work.

Ajaia ajaja (Linnaeus)

Roseate Spoonbill

Platalea Ajaja Linnaeus, Syst. Nat., ed. 10, 1, 1758: 140. (In America australi = Jamaica, from first citation.)

The Spoonbill was found only once, February 8, 1947, fourteen kilometers southwest of Coatzacoalcos.

Family PHOENICOPTERIDAE

Phoenicopterus ruber Linnaeus

Flamingo

Phoenicopterus ruber Linnaeus, Syst. Nat., ed. 10, 1, 1758: 139. (Africa, America, rarius in Europe = West Indies.)

One flock of approximately fifty birds was seen along the shore of a small lake between Jesús Carranza and Jimba on March 22, 1947.

Family ANATIDAE

Anas discors Linnaeus

Blue-winged Teal

Anas discors Linnaeus, Syst. Nat., ed. 12, 1, 1766: 205. (South Carolina.)

One ♂, 25 km. ESE Jesús Carranza, 200 ft., March 27, 1949.

Canati. Migrant ducks and geese bear local names in southern Veracruz. The only species called *pato,* or duck, is the resident Muscovy.

Family CATHARTIDAE

Sarcoramphus papa (Linnaeus)

King Vulture

Vultur Papa Linnaeus, Syst. Nat., ed. 10, 1, 1758: 86. (India occidentalis = Surinam.)

One ♂, 63 km. ESE Jesús Carranza, 500 ft., April 12, 1948; 1 unsexed (skel.), 60 km. ESE Jesús Carranza, 450 ft., March 29, 1948.

Rey nopo. The King Vulture seems not to occur north of the latitude of the Tuxtla Mountains, save perhaps as an accidental wanderer. Along the Río Coatzacoalcos it is fairly common. One was seen near the town of Coatzacoalcos, feeding on the partially submerged carcass of a cow. Another was feeding on a dead gar on the riverbank, five kilometers northeast of Jesús Carranza. South of the Río Coatzacoalcos, this is the commonest vulture, far outnumbering the Black Vulture in the deep jungles of the Isthmus of Tehuantepec. One to ten are in sight, soaring over the jungle, at almost all times of the day. A tapir, killed for a specimen, drew fifty or more of these birds to our camp. One King Vulture had its crop distended with the remains of a tree snake (*Spilotes pullatus mexicanus*). These birds have a strong and unpleasant odor that does not seem to emanate solely from the carrion upon which they feed.

Coragyps atratus (Bechstein)

Black Vulture

Vultur atratus Bechstein, Latham, Allg. Uebers, Vögel, 1, 1793: 655. St. Johns River, Florida, *ex* Bartram.)

Nopo, zopilote. The Black Vulture is abundant everywhere. In the cities and towns, these birds may be seen on the streets and in the markets much as domestic pigeons are seen in the United States. The vultures live principally on the carrion of large animals, and are rarely seen with the Turkey Vulture, but on one occasion two Turkey Vultures were seen to drive three Black Vultures from the carcass of an opossum. The Turkey Vultures soon left without eating much of the opossum, and the carcass was quickly cleaned by the Black Vultures. When carcasses of skinned animals were placed out in tall grass, Black Vultures began to arrive in a short time. The body of a monkey or coyote would be finished in an hour, and the sated birds would then retire to nearby trees to rest. Commonly their weight broke the branches on which they perched. The grass for five feet around the carcass was often flattened to the earth by the beating of the birds' wings. Twice this species was found feeding on the fruit of the *coyole* palm, eating the thin layer of pulp between the tough rind and the rock-hard seed.

These birds may kill other animals; twenty kilometers east of Jesús Carranza, Black Vultures were said to have killed and partly eaten a new-born calf.

Vultures that die are not eaten by other vultures or by mammals, thus leading the Indians to say that their flesh is poisonous. Dead vultures are eaten by insects, such as ants and fly maggots. In central Veracruz, it is said that the flesh of this vulture, especially the liver, is a cure for tuberculosis.

Cathartes aura (Linnaeus)

Turkey Vulture

Vultur Aura Linneaus, Syst. Nat., ed. 10, 1, 1758: 86. (America calidiore; Veracruz, México, substituted by Nelson, Proc. Biol. Soc. Washington, 18, 1905, p. 124.)

Aura, zopilote real. The Turkey Vulture is common in the Upper Tropical Life-zone. It was often caught in traps baited with meat and set for carnivorous mammals. Some were taken in traps set beneath logs or in hollows at the bases of trees, where the baits were completely invisible from the air above.

This species was noted only once on the costal plain, where two were seen about the carcass of an iguana. The Turkey Vulture is never so domestic as the Black Vulture, and does not visit the cities and town in search of food as does the latter species.

Family ACCIPITRIIDAE

Elanus leucurus majusculus Banks and Penard

White-tailed Kite

Elanus leucurus majusculus Bangs and Penard, Proc. New England Zoöl. Cl., 7. 1920: 46. (San Rafael, California.)

One ♂, Mirador, 3,500 ft., December 8, 1947.

Odontriorchis palliatus (Temminck)

Brazilian Kite

Falco palliatus "P. Max." Temminck, Pl. Col., livr. 23, 1822: pl. 204. (Brazil and Guiana = Río Peruhype, southern Bahía.)

One ♂, 20 km. S Jesús Carranza, 300 ft., February 12, 1948.

Our single speciman has the wing 313 mm. in length (unflattened) and the under wing coverts are plain black, characters which uphold Brodkorb's contention (1943:26-27) that *O. p. mexicanus* Swann (Syn. Accipitres, ed. 2, 1922, p. 159; type locality, Tampico, Tamaulipas, México) is a valid race. An adult male from Venezuela in the Louisiana State University Museum of Zoölogy has the wing only 312 mm., but the under wing coverts are noticeably barred.

Chrondrohierax uncinatus aquilonis Friedmann

Hooked-billed Kite

Chrondrohierax uncinatus aquilonis Friedmann, Jour. Washington Acad. Sci. 24, 1934: 314. (Tamaulipas, México.)

One ♀, Río Blanco, 20 km. W Piedras Negras, October 2, 1946.

Buteo albonotatus albonotatus Kaup

Zone-tailed Hawk

Buteo albonotatus Kaup, Isis, col. 329, 1847: 17. (México.)

One ♀, 5 km. SW Boca del Río, October 11, 1946.

So far as can be determined, this is the first record for the Zone-tailed Hawk in Veracruz.

Buteo platypterus platypterus (Vieillot)

Broad-winged Hawk

Sparvius Platypterus Vieillot, Tabl. Encld. Méth., 3, 1823: 1273. (Pennsylvania = Schuylkill River, *ex* Wilson.)

One ♀ Río Atoyac, 8 km. NW Potrero, March 3, 1946.

Buteo magnitrostris griseocauda (Ridgway)

Gray-tailed Hawk

Rupornis magnirostris var. *griseocauda* Ridgway, Proc. Boston Soc. Nat. Hist., 16, 1873-1874 [= December, 1873]: p. 87 (in key), p. 88. (México.)

One ♀, Mirador, 3,500 ft., December 8, 1947; 1 ♂, Río Atoyac, 8 km. NW Potrero, March 2, 1946; 2 ♀ and 2 ♂ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 16, 19, 29, and 31, 1946; 1 ♀ and 2 ♂ (skels.), Río Blanco, 20 km. W Piedras Negras, September 30 and October 1 and 3, 1946; 1 ♀, 15 km., W Piedras Negras, 300 ft., January 13, 1947; 1 ♀ (skel.), 15 km. ESE San Juan de la Punta, 400 ft., September 27, 1946.

Gavilán. This is the commonest hawk on the coastal plain of Veracruz. It is common also in the Upper Tropical Life-zone. Individuals are usually seen perched in isolated trees, from which they swoop down to catch the lizards upon which they feed. Usually they select a perch ten to thirty feet from the ground, and at intervals give their piercing, plaintive cry. The stomachs of several specimens were examined, and held only the remains of the common lizards, *Ameiva* sp. and *Sceloporus variabilis*.

Buteo nitidus plagiatus (Schlegel)

Mexican Goshawk

Asturina plagiata Schlegel, Mus. Pays-Bas, 2, Asturinae, 1862: 1, note. (Veracruz, México.)

Two ♂ (LSUMZ), Palma Sola, November 15 and December 18, 1937; 1 ♂, Río Atoyac, 8 km. NW Potrero, February 25, 1946; 2 ♂, 2 ♀, 1 unsexed (4 skels.), Río Blanco, 20 km. WNW Piedras Negras, May 10, 14, 26, and 30. 1946; 2 ♀, Rio Blanco, 20 km. W Piedras Negras, October 1 and 3, 1946.

Gavilán. This hawk is abundant in central Veracruz. It is only slightly less common than the preceding species on the coastal plain. It was not seen in the southern part of the state.

The Mexican Goshawk, like *B. magnirostris,* feeds principally on lizards, and the stomachs of specimens examined contained many *Ameiva,* slender lizards about eight inches in length. This hawk commonly hunts from a low perch, like *B. magirostris,* but is seen soaring over clearings, apparently hunting on the wing.

Leucopternis albicollis ghiesbreghti (Du Bus)

White Snake Hawk

Buteo ghiesbreghti Du Bus, Esq. Orni., livr. 1, 1845: pl. 1. (Hacienda Mirador, Veracruz.)

Two ♂, 20 km. ENE Jesús Carranza, 200 ft., March 22 and April 28, 1949.

Gavilán blanco. This beautiful white hawk was found only in extreme southern Veracruz. It was not common, and was seen only in the deep, uninhabited jungles to the south of the Río Coatzacoalcos. The species spends much of its time soaring in circles 200 or 300 feet in diameter and 100 feet or so above the tops of the jungle trees. The hawks seem to avoid passing over open places, such as rivers and sand bars. Only twice were individuals seen perched. Both were in open trees, approximately fifty feet from the ground. The stomach of one specimen held several lizards (*Anolis* and *Ameiva*) and another held a small snake (*Drymobius margaritiferus*). The species has a strong, unpleasant, skunk-like odor.

Hypomorphnus urubitinga ridgwayi (Gurney)

Ridgway Black Hawk

Urubitinga ridgwayi Gurney, List Diurn. Birds Prey, 1884: 148. (Guatemala.)

One ♂ Rio Blanco, 20 km. WNW Piedras Negras, May 19, 1946; 1 ♂ (skel.), 3 km. SW Boca del Río, 10 ft., December 18, 1947; 1 ♀ (skel.), 25 km. SE Jesús Carranza, 250 ft., March 29, 1949; 1 ♂ (skel.), SSE Jesús Carranza, 300 ft., May 8, 1949.

Aguila. The Ridgway Black Hawk seems to be rather uncommon in Veracruz; it was seen only a few times on the coastal plain.

Concerning the specimen from three kilometers southwest of Boca del Río field notes for December 18, 1947, read in part: "For the past two evenings, this hawk roosted in a large strangler fig tree, on an angular limb about thirty-five feet from the ground. Beneath the roost, on the ground, were many droppings composed of the remains of the exoskeletons of land crabs, especially a small, hard orange-colored variety. In one such pile of over 100 droppings only this particular land crab was detected. The stomach of the hawk also contained only these land crabs. Since this crab hides in burrows or under logs or rocks by day, the question arises as to how the hawk catches them."

Buteogallus anthracinus anthracinus (Lichtenstein)

Mexican Black Hawk

Falco anthracinus Lichtenstein, Preis-Verz. Vögel Mex., 1830: 3 (Mexico.)

One ♀ (skel.), Río Blanco, 20 km. W Piedras Negras, October 2, 1946; 1 ♀ (skel.), 32 km. ESE Jesús Carranza, 350 ft., March 25, 1948.

Harpia harpyja (Linnaeus)

Harpy Eagle

Vultur Harpyja Linnaeus, Syst. Nat., ed. 10, 1, 1758: 86. (México, *ex* Hernandez.)

One unsexed, 38 km. SE Jesús Carranza, 450 ft., April 9, 1948.

Faisanero, águila real. Although there are only two previous records from Veracruz for this species, both in the nineteenth century and both in the central part of the state (Loetscher MS), the Harpy Eagle is actually not uncommon in extreme southern Veracruz. On one occasion a band of spider monkeys showed some alarm when one of these eagles passed over the tree in which they were feeding. Other than this, there was no evidence of their preying on monkeys, although both the spider monkey (*Ateles pan*) and the black howler monkey (*Alouatta palliata*) were common in the habitat of the Harpy Eagle. Those observed were feeding on large iguanas, and several were seen perched twenty or thirty feet from the ground with the body of a five- or six-foot iguana hanging over the limb beside them and securely held in one foot. Local Indians stated that the Harpy Eagle feeds at times on Guans and Curassows, and for that reason were called *faisaneros*.

Geranospiza nigra nigra (Du Bus)

Blackish Crane Hawk

Ischnosceles niger Du Bus, Bull. Acad. Roy. Belg., 14, pt. 2, 1847: 102. (México.)

One ♂ (skel.), 20 km. ENE Jesús Carranza, March 21, 1949.

Family FALCONIDAE

Herpetotheres cachinnans chapmani Bangs and Penard

Laughing Falcon

Herpetotheres cachinnans chapmani Bangs and Penard, Bull. Mus. Comp. Zoöl., 62, 1918: 37. (Santa Luci, Río Hondo, Quintana Roo.)

One ♂ and 1 ♀ (skels.), Boca del Río, 400 ft., October 11, 1946, and December 8, 1948; 2 ♀, Río Blanco, 20 km. WNW Piedras Negras, 400 ft., May 19 and 26, 1946; 1 ♂ (skel.), 1 ♀, 1 unsexed, 20 km. W Piedras Negras, 400 ft., September 24, October 6 and 11, 1946.

Pájaro vaquero. This beautiful hawk is very common on the coastal plain and also in the dense jungle of the humid division of the Lower Tropical Life-zone of the southern part of the state. It was never seen nor heard in the Upper Tropical Life-zone. Its distinctive call is emitted in the morning and afternoon, frequently on moonlit nights, and less often at midday. Local people say that when the *pájaro vaquero* calls from a dead tree, the next day will be clear; if it calls from a green tree, it will rain.

Three skins from Piedras Negras, listed above, have wings measuring 270, 271, and 273 mm., respectively. Brodkorb (1948a: 406-410) regards populations of this species in Veracruz as intermediate between *H. c. chapmani* and *H. c. excubitor*. But Wetmore (1944: 37) does not recognize *excubitor;* instead he considers Mexican populations as highly variable in size without definite geographic correlation. Since our three specimens are nearly uniform and also well within the measurements assigned to the race *chapmani,* we are therefore using this name. Neither the opinions advanced by Brodkorb nor Wetmore appear conclusive, and the problem will have to be studied further with more material.

Micrastur semitorquatus naso (Lesson)

Collared Micrastur

Carnifex naso Lesson, Echo du Monde Savant, (6), 2, 1842: col. 1085. (Realejo, Nicaragua.)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 26, 1946; 1 ♂ im., 25 km. SE Jesús Carranza, 250 ft., March 29, 1949.

Juan de pe. Collared Micrasturs were found only in deep jungle, usually perched about twenty feet from the ground in leafy trees. They frequently allowed the hunter to approach within twenty feet or less before darting away. They were skillful in maneuvering in the dense, shaded jungle. Both of the specimens taken were shot in flight, while dodging through dense, low vegetation.

Native hunters state that they often shoot this hawk, which they mistake for a perched Chachalaca. The micrastur's dark colors and long tail could easily lead to such an error. The local Indians consider it to be a kind of owl because of its large eyes and shade-haunting habits.

Daptrius americanus guatemalensis (Swann)

Red-throated Caracara

Ibycter americanus guatemalensis Swann, Syn. Accip., ed. 2, 1921: 14. (Guatemala.)

One ♂, 15 km. SW Jimba, 750 ft., March 5, 1947.

This appears to be the first record for this species from Mexico. The specimen taken was one of several seen in high, dense jungle in the Rincón area of southern and western Veracruz. The birds were quite active, flying from tree to tree and soaring for short intervals just over the tree tops. They gave voice to a piercing scream that was most irritating to human ears. The specimen taken had many lizards (*Anolis* and *Ameiva*) in its stomach. The natives in the party stated that the bluish dust on the bird's feathers was a deadly poison, and refused to carry the specimen on the same horse with a Guan (*Penelope*) intended for food. The Red-throated Caracara was not seen in extreme southern Veracruz, but natives recognized the bird's description, and especially the imitation of its call.

Polyborus cheriway audubonii Cassin

Audubon Caracara

Polyborus Audubonii Cassin, Proc. Acad. Nat. Sci. Philadelphia, 17, 1865: 2. (Florida.)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 24, 1946; 1 ♂, 20 km. S Jesús Carranza, 300 ft., February 14, 1948.

The Audubon Caracara is widespread on the coastal plain, but not very common. They usually occur in pairs and often feed with the vultures on carcasses of dead animals. A few were seen in the extensive sugar cane fields near Potrero, at the lower edge of the Upper Tropical Life-zone.

Falco peregrinus anatum Bonaparte

Duck Hawk

Falco Anatum Bonaparte, Geogr. and Comp. List, 1838: 4. (Great Egg Harbor, New Jersey, *ex* Wilson, Amer. Orni., 9, 1814, p. 120, pl. 76.)

One [♀] (LSUMZ), Palma Sola, below Cuitlahuac, November 15, 1937.

This specimen, taken by Mr. Dyfrig Forbes at Palma Sola, seems to be the first record of the Duck Hawk in Veracruz.

Falco femoralis septentrionalis Todd

Aplomado Falcon

Falco femoralis septentrionalis Todd, Proc. Biol. Soc. Washington, 29, June 6, 1916: 98. (Fort Huachuca, Arizona.)

One ♂, 3 km. E San Andrés Tuxtla, 1000 ft., January 18, 1948.

This species seems to be rare. A few were seen and only one was shot.

Falco sparverius sparverius Linnaeus

Sparrow Hawk

Falco sparverius Linnaeus, Syst. Nat., ed. 10, 1, 1758: 90. Based on the Little Hawk, *Accipiter minor* Catesby, Carolina, 1, p. 5. (In America = South Carolina.)

One ♀, 5 km. N Jalapa, 4500 ft., October 19, 1946; 1 ♂, Río Atoyac, 8 km. NW Potrero, February 27, 1946; 1 ♀, 7 km. NW Potrero, 1700 ft., January 7, 1947; 1 ♂, 1 ♀, 1 [♀], (all LSUMZ), Potrero Viejo, 1700 ft., March 3 and 10, 1938.

The Sparrow Hawk was common about open land wherever observations were made. In the state of Veracruz, this little hawk seems to be principally predaceous on birds. In the Upper Tropical Life-zone, Sparrow Hawks were observed chasing warblers and other small birds on several occasions. Two stomachs were examined and each held only the remains of small birds.

Falco sparverius paulus (Howe and King)

Sparrow Hawk

Cerchneis sparverius paulus Howe and King, Contri. N. Amer. Orni., 1, 1902: 28. (Miami, Florida.)

One ♂, 5 km. N Jalapa, 4500 ft., October 19, 1946.

This male specimen with wing measuring 179 mm. and tail 114 mm., can hardly be regarded as anything other than *paulus*, a subspecies not previously recorded outside of the United States.

Family CRACIDAE

Crax rubra rubra Linnaeus

Mexican Curassow

Crax ruber Linnaeus, Syst. Nat., ed. 10, 1, 1758: 157. (Western Ecuador; *cf.* Hellmayr and Conover, Publ. Field Mus. Nat. Hist., zoöl. ser., 13, pt. 1, no. 1, April 30, 1942, p. 130.)

Two ♀, 32 km. SSW Jesús Carranza, 350 ft., March 26, 1948; 1 ♂, 1 ♀ (skel.), 55 km. SW Jesús Carranza, 400 ft., March 26, 1948; 1 ♂, 60 km. SW Jesús Carranza, 450 ft., March 27, 1948.

Faisán real. The Curassow is much hunted for food in Veracruz. North of the Tuxtla Mountains, in the northern three-fourths of the state, it has been almost exterminated. Even in southern Veracruz, wherever roads have been built into the previously inaccessible forests, for hauling out mahogany logs, this fine game bird is rapidly disappearing. It forms one of the principal game species wherever found. In the Rincón area, west of Jimba, great piles of feathers of Curassows and Guans were seen along the newly-built roads where previously few hunters had even been able to penetrate.

South of the Río Coatzacoalcos, in the uninhabited jungles of extreme southern Veracruz, Curassows are abundant. On collecting trips up the Río Solosuchi and Río Chalchijapa, this species was observed daily. The birds were seen in pairs moving slowly along the open floor of the jungle, stopping often to look for possible enemies. When undisturbed, both males and females gave a low, hooting grunt at intervals of one minute or less. When frightened, they dashed off along the ground and only when closely pressed would they take wing. When flushed, they flew only to a nearby, low tree, and usually remained peering at their pursuer. The crops of specimens taken were never full. Stomachs contained principally berries and small fruits, many of which were green, hard, and seemingly unripe.

No nests were found in Veracruz, but a downy chick was discovered on June 5, 1949. This chick, which later escaped, had a loud, piping call, which it uttered almost constantly. In spite of its loud call, it was extremely difficult to find, even by sharp-eyed Indians, so well did its warm, brown colors blend with that of the background of dead leaves.

Penelope purpurascens purpurascens Wagler

Purplish Guan

Penelope purpurascens Wagler, Isis, 23, 1830: col. 1110. (México).

One ♀, 15 km. SW Jimba, 750 ft., March 5, 1947; 2 ♂, 35 km. SW Jesús Carranza, 400 ft., February 17, 1948; 1 ♂, 1 ♀ (skels.), 63 km. ESE Jesús Carranza, 500 ft., March 30, 1948.

Faisán gritón. The Purplish Guan has, like the Curassow, been hunted extensively throughout much of Veracruz. Where both birds are sought as game, the Guan seems slightly better able to survive than the Curassow. At least, in the Tuxtla Mountains and the Rincón area, Guans are more common than Curassows, although in southern Veracruz, where they are little hunted, the two species seem to be about equally common.

The Guan is more arboreal than the Curassow. Although Guans were seen on the ground on a few occasions, they were far more often found in trees. They were not slow to fly, if in danger, but preferred to run off along the larger branches.

Ortalis vetula vetula (Wagler)

Gray-headed Chachalaca

Penelope vetula Wagler, Isis, 23, 1830: col. 1112, (México; Tamico, Tamaulipas, México, designated as type locality by Miller and Griscom, Auk, 38, January, 1921, p. 46; corrected to "neighborhood of the City of Veracruz, Mexico," by Miller and Griscom, Auk, 38, July, 1921, p. 455.)

Two ♂, Río Atoyac, 8 km. NW Potrero, February 24 and March 5, 1946; 1 ♂ (LSUMZ), Potrero Viejo, January 25, 1938; 2 ♂ (one skel.), 2 ♀, Río Blanco, 20 km. WNW Piedras Negras, March 17 and May 11, 18, and 28, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 16, 1946; 1 ♀, Jimba, 350 ft., March 2, 1947; 1 ♂, 25 km. ESE Jesús Carranza, 200 ft., March 27, 1949.

Chachalaca. This game bird is found throughout the tropical parts of Veracruz. It seems to be most abundant in the thicket-covered lowlands of northern Veracruz, and in the low, open, thorny woods of the coastal plain. It is slightly less common in the tall forests of the Upper Tropical Life-zone; and in the deep jungles of the south, it was found only near streams.

In places where it is much hunted, the chachalaca becomes extremely shy, slinking off at the least sign of human presence. Although the species is quite common near Potrero, the few specimens from this locality were obtained with great difficulty.

In the thorny woods of the coastal plain, the resident peoples hunt this bird by driving. Two or three hunters are stationed in comparatively open woods, while others circle out and away to a distance of a kilometer, and then return slowly to their starting point, driving the birds ahead of them. The hunters stop at intervals, to chop on trees with machetes. The Chachalacas move ahead of the hunters by flying from tree to tree, but do not become frightened. The birds pause in almost every tree along the way, and when they pass the concealed hunters, they are shot. Several drives were observed, and one to three birds were killed on each drive.

In southern Veracruz, Chachalacas are usually hunted from canoes, the birds being shot from trees and bushes along the bank. In the state of Veracruz as a whole, this bird is probably the most important single game species. Like the cottontail rabbit, it seems to hold its own in spite of steady, around-the-year, hunting. The birds are not sold to any great extent. The meat brings about one-half the price of a chicken, or three times the cost of a shotgun shell.

The Chachalaca usually calls from a perch considerable higher than the elevations otherwise visited. They call regularly in the early morning, shortly after dawn, throughout the year, and less regularly in the late afternoon or evening. Occasionally they are heard on bright, moonlit nights. The natives consider this a sign that bad weather is approaching.

Our material substantiates the conclusions of Wetmore (1943: 245-246) in that examples of this species from the Upper Tropical Life-zone of central Veracruz are intermediate between *vetula* and *mccalli*. In our three specimens from near Potrero, one has the tips of the lateral rectrices nearly white, whereas the other two have the tips brown as in examples from farther south in Veracruz.

Family PHASIANIDAE

Colinus virginianus pectoralis (Gould)

Bob-white

Ortyx pectoralis Gould, Proc. Zool. Soc. London, 1842 [= 1843]: 182. (México.)

One ♂ (LSUMZ), Potrero Viejo, 1700 ft., March 6, 1948.

Colinus virginianus godmani Nelson

Bob-white

Colinus godmani Nelson, Auk, 14, 1897: 45. (Jáltipan, Veracruz, México.)

Two ♂, 2 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 11, 14, and 15, 1946; 2 ♂, 15 km. W Piedras Negras, 300 ft., January 15, 1947.

Cholina. The Bob-white is only fairly common on the coastal plain of Veracruz. Only rarely were its call-notes heard. Local people recognize this bird as a game species, but seemingly it is rarely hunted for food. The cost of ammunition is greater than the value of the meat of such a small bird. Probably Bob-whites are shot only when opportunity is offered to kill several with a single shell.

Odontophorus guttatus (Gould)

Spotted Wood Quail

Ortyx guttata Gould, Proc. Zool. Soc. London, 1837 [=1838]: 79. ("Bay of Honduras.")

One ♂, 35 km. SE Jesús Carranza, 400 ft., April 30, 1948; 1 ♂ (skel.), 38 km. SE Jesús Carranza, 400 ft., April 30, 1948.

Totoloschóco. This jungle quail is locally common in extreme southern Veracruz. It was found only where there was open ground in the deep shade at the foot of limestone cliffs. In the early morning its call notes, from which the native name is derived, may be heard from numerous points along the cliffs. It was not heard at other times of the day.

This species was found only singly or in groups of four or less, and was always located by dogs. On every occasion the birds flew to low perches, ten to fifteen feet from the ground, and blinked their eyes stupidly. The natives captured our specimens by making a small vine into a noose and, with the aid of a slim pole, slipping the loop over the birds' heads. On some occasions, the quail ducked their heads out of the noose. If this occurred, and the birds seemed about to fly, the Indians barked like dogs, and the quail again settled down. The natives seemed more anxious to obtain the birds for pets than for food.

Family ARAMIDAE

Aramus guarauna dolosus Peters

Limpkin

Aramus pictus dolosus Peters, Occas. Papers Boston Soc. Nat. Hist., 5, 1925: 144. (Bolsón, Costa Rica.)

One ♂ (skel.), 20 km. ENE Jesús Carranza, 200 ft., May 16, 1949.

Pájaro taniche. The Limkin is fairly common along the rivers in the jungles of southern Veracruz. Whenever these birds were seen the natives in the party usually laughed, and repeated the name given above. Presumably there is some amusing, but undisclosed, legend connected with this bird. Apparently the species is never eaten, but the Indians had no compunctions against shooting a bird for a specimen.

The amount of white on the secondaries and the larger size are the critical characters distinguishing *dolosus* from *pictus.* Unfortunately, our single specimen, when examined as a carcass prior to being made into a skeleton, had all the primaries intact on the mani, but only two secondaries remained on one wing and none on the other. These, however, show much less white than is accredited to *dolosus* (in *pictus* the secondaries are virtually without white, save at their extreme base). The wing of our specimen measures 316 mm.; exposed culmen, 119; tarsus, 119. In size these measurements are somewhat intermediate between those of *dolosus* and *pictus*. Brodkord (1943:33) points out the same situation with respect to specimens from Tabasco and Campeche examined by him.

Family RALLIDAE

Rallus limicola limicola Vieillot

Virginia Rail

Rallus limicola Vieillot, Nouv. Dict. Hist. Nat., 28, 1819: 558. (Pennsylvania.)

One ♀, Potrero Viejo, 1700 ft., November 26, 1948.

This seems to be the second locality record for this species in Veracruz. Chapman (1898:36) records four specimens taken by him near Jalapa.

Aramides cajanea mexicana Bangs

Wood Rail

Aramides albiventris mexicanus Bangs, Amer. Nat., 41, 1907: 178 (in key) and 185. (Buena Vista, Veracruz, México.)

One ♂, 6 km. W Boca del Río, 10 ft., February 23, 1946; 1 ♂, 2 ♀ (one skel.), 20 km. E Jesús Carranza, 300 ft., February 21, 1948.

Poposcala, poposcela. The Wood Rail is not common in central Veracruz. The specimen taken at Boca del Río was seen to alight in a slim, dense-crowned tree, beside the Río Jamapa at dusk. It perched in the top of the tree, fifteen feet from the ground, and could not be seen. Shouting and throwing sticks into the tree failed to make it fly. A tough vine hung down from the tree, but even shaking this did not cause the bird to take wing. The vine was then pulled down several feet, bending the tree, and when the vine was released, the rail was catapulted into the air where it was shot.

In southern Veracruz this bird is abundant in marshy places and along rivers. In the early morning and late evening their loud calls, from which the native name is derived, drown out most other bird notes. The chorus is of short duration, usually about ten minutes. The alarm note is more rarely heard, and consists of a deep, menacing growl, similar to that of a large carnivore.

The Wood Rail is not much hunted for food in Veracruz, save in a few localities, as for example, near the city of Coatzacoalcos.

Porzana carolina (Linnaeus)

Sora

Rallus carolinus Linnaeus, Syst. Nat., ed. 10, 1, 1758: 153. (Hudson Bay, Canada.)

One ♀, 7 km. W Potrero Viejo, 1700 ft., October 26, 1946.

Sumichrast (1881:229) lists this species from Orizaba without citing any definite record. The specimen taken at Potrero appears to be the only other record for the species in Veracruz.

Family HELIORNITHIDAE

Heliornis fulica (Boddaert)

Finfoot

Colymbus fulica Boddaert, Tabl. Pl. Enl., 1783: 54. (Cayenne; based on *Le Grebifoulque, de Cayenne* Daubenton, Pl. Enl., ix, pl. 893.)

One ♀, 35 km. SW Jesús Carranza, 400 ft., February 16, 1948; 1 ♂ (skel.), 22 km. ESE Jesús Carranza, 300 ft., March 23, 1948; 1 ♂ (skel.), 2 ♀, 20-25 km. SE Jesús Carranza, March 28 and May 2, 1949.

Viudita. The Finfoot or Sun Grebe is common on the rivers of southern Veracruz, and slightly less so in central Veracruz, as, for example, on the Río Atoyac. The natives say that it is called "Little Widow," because it is always alone. Indeed, the solitary habits of this species are worthy of mention. Never were more than one seen at a time. The Sun Grebes were surprisingly wary, as compared with other tropical birds. They rarely allowed a canoe to approach within fifty yards without showing evidence of alarm. They spent considerable time on land, and several were seen sitting on river banks or logs beside the rivers. These usually took to the water when alarmed, but if approached by a canoe or wounded, they swam to shore and were lost in the thickets fringing the rivers.

Family JACANIDAE

Jacana spinosa spinosa (Linnaeus)

Mexican Jacana

Fulica spinosa Linnaeus, Syst. Nat., ed. 10, 1, 1758: 152. (South America, *ex* Edwards, Nat. Hist. Bds., p. 48, pl. 48 = Panamá, suggested by Todd, Ann. Carnegie Mus., 10, 1916, p. 219. See also Brodkorb Misc. Publ. Mus. Zoöl. Univ. Michigan, no. 55, Jan. 30, 1943, p. 36.)

One ♀, 3 km. N Presidio, 1500 ft., November 30, 1946; 1 ♀, 20 km. S Jesús Carranza, 300 ft., February 10, 1948.

Jacanas were rarely seen in central Veracruz but were abundant on ponds and lakes in southern Veracruz. They were usually seen walking on floating vegetation, and rarely came near shore.

Family CHARADRIIDAE

Charadrius vociferus vociferus Linnaeus

Killdeer

Charadrius vociferus Linnaeus Syst. Nat., ed. 10, 1758: 150. (North America = South Carolina, *ex* Catesby.)

Two ♂ (LSUMZ), Potrero Viejo, 1700 ft., November 20, 1938, and December 20, 1937.

Family SCOLOPACIDAE

Actitis macularia (Linnaeus)

Spotted Sandpiper

Tringa macularia Linnaeus, Syst. Nat., ed. 12, 1, 1766: 249. (Pennsylvania.)

One ♂, 4 km. WNW Fortín, 3200 ft., April 5, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 24, 1946.

Limnodromus scolopaceus (Say)

Long-billed Dowitcher

Limosa scolopacea Say in Long, Exped. Rocky Mts., 1, 1823: 170. (Near Boyer Creek = Council Bluffs, Iowa.)

One ♂, 1 ♀, 20 km. S Jesús Carranza, 300 ft., March 21, 1948; 1 ♂, 2 ♀, all skels., 20 km. E Jesús Carranza, 200 ft., March 20, 1948.

The Dowitcher was present in flocks of hundreds on the banks of small ponds along the Río Coatzacoalcos in April.

Capella gallinago delicata (Ord)

Wilson Snipe

Scolopax delicata Ord, in reprint of Wilson, Amer. Orni., 9, 1825: CCXVIII. (Pennsylvania.)

One ♂ and 1 unsexed (LSUMZ), Potrero Viejo, 1700 ft., January 25 and March 10, 1938.

Erolia minutilla (Vieillot)

Least Sandpiper

Tringa minutilla Vieillot, Nouv. Dict. Hist. Nat., nouv. ed., 34, 1819; 466. (Amérique jusq'au delà du Canada = Halifax, Nova Scotia.)

One ♀ (LSUMZ), Potrero Viejo, 1700 ft., May 25, 1938.

Family BURHINIDAE

Burhinus bistriatus bistriatus (Wagler)

Thick-knee

Charadrius bistriatus Wagler, Isis, 22, 1829: col. 648. (México.)

One ♂, Río Blanco, 20 km. W Piedras Negras, 400 ft., October 3, 1946.

A pair of these birds was seen on the open grasslands of the coastal plain. They were found in a low swale, and when first noticed were running swiftly along the ground. When one was shot, the other flushed with a whirr of wings. Two local natives who were present at the time stated that the species, for which they had a name that was not recorded, is a regular but rare visitant in the area, and is not a food species.

Family LARIDAE

Larus delawarensis Ord

Ring-billed Gull

Larus Delawarensis Ord, in Guthrie, Geog., 2d Amer. ed., 2, 1815: 319. (Delaware River, below Philadelphia.)

Strange to say there are no published records for the Ring-billed Gull in Veracruz. It occurs rather regularly in winter, however, on Laguna Cerro Pez, a small lake on the boundary line lying partly in the state of San Luis Potosí and partly in the state of Veracruz. Members of the Louisiana State University field party working in the state of San Luis Potosí have observed it there on numerous occasions, as for example, on February 25, 1948, flying back and forth across the lake.

Hydroprogne caspia (Pallas)

Caspian Tern

Sterna caspia Pallas, Novi Comm. Acad. Petr., 14, 1770: p. 582, pl. 22. (Caspian Sea, South Russia.)

This species also has apparently not been recorded previously from Veracruz. On February 25, 1948, Robert J. Newman and Prentiss D. Lewis found two individuals, one of which they shot, on the Laguna Cerro Pez. These birds were flying up and down the lake and were seen on occasions to cross over landmarks known to lie in Veracruz.

Family COLUMBIDAE

Columba flavirostris flavirostris Wagler

Red-billed Pigeon

Columba flavirostris Wagler, Isis, 1831: col. 519. (México; restricted to state of Veracruz by van Rossem, Trans. San Diego Soc. Nat. Hist., 6, August 30, 1930, p. 198.)

One ♂, Río Atoyac, 8 km. NW Potrero, February 28, 1946; 2 ♀, 1 ♂ (all skels.), Río Blanco, 20 km. W Piedras Negras, October 1 and 6, 1946.

Paloma mora. The Red-billed Pigeon is fairly common throughout the Tropical Region of Veracruz. It is an arboreal species, usually seen in flight or perched in the tops of tall trees, in flocks of five to twenty-five birds. It regularly visits certain sand bars along rivers to drink and obtain gravel for its crop. When certain favored fruits, such as the *nanchi,* are ripe, these pigeons gather in large numbers. Near Piedras Negras, fully a thousand birds were seen in one afternoon, as single individuals and as flocks ranging up to one hundred individuals.

The *paloma mora* is shot for food whenever a hunter can be reasonably sure of killing several birds with a single shell. For the most part, however, single birds are not shot, for the value of the meat of one bird is less than the cost of the ammunition to kill it.

Columba speciosa Gmelin

Scaled Pigeon

Columba speciosa Gmelin, Syst. Nat., 1, 1789: 783. (Cayenne, *ex* Daubenton, Pl. Enl., pl. 213.)

One ♂, 10 km. NW Minatitlán, 100 ft., February 4, 1947; 1 ♀, 20 km. ENE Jesús Carranza, March 22, 1949.

Paloma real. This apparently rare pigeon may be more common than is generally believed. The two specimens were taken almost by accident. The one from near Minititlán was in a tall tree, fully seventy-five feet from the ground. A Chachalaca had been heard in the vicinity, and was being hunted. A small branch was seen to move in the leafy crown of the tree, and a shot, supposedly at a Chachalaca, brought down the pigeon that had been hitherto unseen and unsuspected. Another pigeon flew from the same tree. The specimen from near Jesús Carranza was in the lower part of a dense tree, perched about fifty feet from the ground. Attention was called to the tree by slight movements of twigs and leaves, but no bird was seen, even after considerable peering. When the motion again started, a shot was fired into the branch and one of these pigeons fell to the ground. Again, another flew from the same tree.

From this evidence, it would seem that *speciosa* is a rather sedentary species, having a preference for dense trees and a reluctance to fly. Its color blends with the background so well that the bird is easily overlooked.

Columba nigrirostris Sclater

Short-billed Pigeon

Columba nigrirostris Sclater, Proc. Zool. Soc. London, 1859 [= 1860]: 390. (Oaxaca, México.)

Two ♂ (one skel.), 20 km. S Jesús Carranza, 300 ft., February 22 and 23, 1948; 1 ♂ (skel.), 30 km. SSE Jesús Carranza, 300 ft., May 8, 1949; 2 ♀ (skels.), 35 km. SE Jesús Carranza, 350 ft., April 4 and 8, 1949.

Bust-a-huei. This small, dark pigeon is abundant in extreme southern Veracruz. Save in the late morning and afternoon, it lives deep in the jungle, staying in the tops of tall trees. It is sedentary and rarely seen. The jungle may seem completely empty of pigeons until, suddenly, one bird will call a soft, rather mournful, "boost, boost-a-way." Abruptly the jungle seems to come alive with pigeons, as though one were calling from every tree. If the birds are close, a short, rather harsh "chirr" note is heard, following the call. In spite of the abundance of calling birds, it is almost impossible to see them in the tall trees where they are perched, unless they flutter to another branch. Specimens shot were usually killed seventy-five or one hundred feet from the ground, so that the fall caused them to split open.

In the late morning and afternoon, the Short-billed Pigeons are seen along the shores of rivers, where they probably go to drink. At such times they are seen perched on low branches or in low trees beside the water. They choose places where the rivers are deep and still, where the low, fringing vegetation grows down to the water level and permits them to drink without alighting on the ground. None was ever seen on a sand or gravel bar.

Zenaidura macroura carolinensis (Linnaeus)

Mourning Dove

Columba carolinensis Linnaeus, Syst. Nat., ed. 12, 1, 1766: 286 (America = Carolina, *ex* Catesby).

One ♂, Río Blanco, 20 km. WNW Piedras Negras, March 17, 1947; 1 ♂ (LSUMZ), Matacabresto, above Piedras Negras, December 17, 1938.

Paloma. The Mourning Dove is an abundant winter resident on the coastal plain.

Zenaida asiatica (Linnaeus)

White-winged Dove

Columba asiatica Linnaeus, Syst. Nat., ed. 10, 1, 1758: 163. Based mainly on *The Brown Indian Dove* Edwards, Nat. Hist. Birds, 2, p. 76. (In Indiis = Jamaica.)

Three ♂, 1 ♀, all skels., Río Blanco, 20 km. W Piedras Negras, October 5 and 6, 1946.

Paloma con alas blancas. The White-winged Dove is an abundant winter resident on the coastal plain, rarely hunted by natives for food unless opportunity is offered to kill several with one shot. Subspecific identification of the skeletons listed above was not practicable.

Scardafella squammata inca (Lesson)

Inca Dove

Chamaepelia inca Lesson, Compl. Oeuvres Buffon, 20, 1847: 211. (México [probably west coast].)

One ♂ (skel.), 4 km. W Paso de San Juan, 250 ft., December 15, 1947; 1 ♀ (skel.), 5 km. W Potrero, March 24, 1946; 1 ♀, Río Atoyac, 8 km. NW Potrero, February 21, 1946; 2 ♂ (skels.), 15 km. ESE San Juan de la Punta, September 28, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 17, 1946.

Palomita. Fairly common in the extensive sugar cane fields about Potrero, and far more common on the coastal plain, these little doves are one of the few birds of the arid coastal plain that remain active in the intense heat of midday.

Columbigallina passerina pallescens (Baird)

Ground Dove

Chamaepelia passerina? var. *pallescens* Baird, Proc. Acad. Nat., Sci., Philadelphia, [11], sig. 21-23, Oct.-Nov., 1859 [= Jan. 12, 1860]: 305. (Cape San Lucas, Baja California.)

One ♂ (skel.), 15 km. ESE San Juan de la Punta, September 28, 1946; 2 ♂ (skels.), 3 km. W Plan del Río, 1000 ft., October 20, 1946; 2 ♀, 2 ♂, Río Blanco, 20 km. WNW Piedras Negras, March 17, 1946; 1 ♂ (skel.), 35 km. SE Jesús Carranza, 400 ft., February 17, 1948.

Palomita. This tiny dove is but slightly less common on the coastal plain than the Inca Dove.

Columbigallina talpacoti rufipennis (Bonaparte)

Ruddy Ground Dove

Chamaepelia rufipennis "Gray" Bonaparte, Compt. Rend. Acad. Sci. Paris, 40, 1855: 22. (Martagena, Columbia.)

One ♂, Río Atoyac, 8 km. NW Potrero, February 22, 1946; 1 ♀, 5 km. W Potrero, 1700 ft., March 23, 1946; 1 ♂, 20 km. S Jesús Carranza, 300 ft., March 20, 1948.

Palomita. The Ruddy Ground Dove is not uncommon in shady places and clearings near water in the Upper Tropical Life-zone.

Columbigallina minuta interrupta (Griscom)

Plain-breasted Ground Dove

Chaemepelia minuta interrupta Griscom, Amer. Mus. Novit., no. 379, 1929; 4. (Secanquim, Guatemala.)

One ♀ (LSUMZ), Potrero Viejo, July 1, 1938; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 18, 1946.

Claravis pretiosa (Ferrari-Perez)

Blue Ground Dove

Peristera pretiosa Ferrari-Perez, Proc. U. S. Nat. Mus., 9, 1886: 175. New name for *Columba cinerea* Temminck, 1811. (Brazil.)

Two ♂, 2 ♀, 20 km. E Jesús Carranza, 300 ft., February 6, 1948.

Tortolito. This dove was noted about houses and clearings along the Río Coatzacoalcos, and on sandbars and islands in the Río Solosuchi and Río Chalchijapa.

Leptotila verreauxi fulviventris (Lawrence)

Verreaux Dove

Leptoptila fulviventris Lawrence, Ann. New York Acad. Sci., 2, 1882: 287. (Yucatán.)

Four ♂, 1 ♀, Río Atoyac, 8 km. NW Potrero, February 20 and 25, March 1, 3, and 10, 1946; 1 ♀ (skel.), Potrero Viejo, 1700 ft., December 16, 1948; 1 ♂ (LSUMZ), Paraje Nuevo, 1700 ft., February 2, 1938; 2 ♂ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 11 and 18, 1946; 1 ♀, 15 km. W Piedras Negras, 300 ft., January 15, 1947; 1 ♂ (skel.), 20 km. ENE Jesús Carranza, 350 ft., April 5, 1949; 2 ♀ (skels.), 20 km. E Jesús Carranza, 300 ft., February 10 and March 20, 1948.

Paloma. In the Upper Tropical Life-zone we found this common species of dove shy and difficult to obtain. They remained in dense cover on the hillsides, calling continually from concealed perches near the ground. As the hunters approached they would flush with much fluttering and move to another concealed perch. On the coastal plain they were confined to the brushy areas and dense jungle fringing arroyos and streams. Here the species was less shy and could easily be obtained by walking along the sandy beds of the arroyos and shooting the doves that flushed from the banks.

The specimens from central Veracruz are mostly intermediate between *fulviventris* and *angelica,* with some examples being indistinguishable from one or the other subspecies. The series as a whole, however, is so nearly intermediate that its assignment to *fulviventris* is arbitrary. Whether the population at Jesús Carranza is more nearly typical of this subspecies than of *angelica* cannot be ascertained from the material available to us.

Leptotila plumbeiceps plumbeiceps (Sclater and Salvin)

Plumbeous-headed Dove

Leptoptila plumbeiceps Sclater and Salvin, Proc. Zool. Soc. London, 1868: 59. ([Choctum], Vera Paz, Guatemala.)

One ♀ (LSUMZ), Potrero Viejo, August 22, 1938; 1 ♂ (LSUMZ), Paraje Nuevo, 1700 ft., February 2, 1938; 1 ♂, Río Atoyac, 8 km. NW Potrero. March 12, 1946.

Paloma. This dove seems to be rare in Veracruz. Its habits seem much like those of *L. verreauxi,* but *L. plumbeiceps* was found in denser vegetation, such as deep thickets, in the Upper Tropical Life-zone near Potrero.

Family PSITTACIDAE

Ara macao (Linnaeus)

Red and Blue Macaw

Psittacus Macao Linnaeus, Syst. Nat., ed. 10, 1, 1758: 96. (South America.)

One ♂, 1 ♀, 35 km. ENE Jesús Carranza, 350 ft., March 18, 1947.

Guacamayo. This red, yellow, and blue macaw was found only in extreme southern Veracruz. It seems to be irregular in its occurrence. In March and April, 1948, one to three pairs were seen almost daily in trips that one of us (Dalquest) made up the Río Chalchijapa and Río Solosuchi. In the same area in March and April of 1949 only one pair was heard and none was seen.

A nest of this species was found in deep jungle south of the Río Coatzacoalcos on March 18, 1947. It was in a cavity in the stub of a dead tree. The opening of the cavity, as seen from below, was approximately two feet in diameter and thirty-five feet from the ground. Eggs or young birds were present, for the parents returned to the nest after being frightened away, even when the hunters were at the foot of the nest stub.

In its native habitat, the deep jungles, this bird is indescribably attractive. As viewed against a background of green jungle, bromeliads, and vines, its bright colors seem softened and natural. In captivity, the colors of the birds seem so gaudy as to be in bad taste.

The Macaw in Veracruz is shot for food. The flesh is tender and well flavored. The birds are ordinarily so shy, however, that probably very few are ever obtained by native hunters.

Aratinga holochlora holochlora (Sclater)

Green Parakeet

Conurus holochlorus Sclater, Ann. and Mag. Nat. Hist., (3), 4, 1859: 224. (Jalapa, Veracruz, México.)

One ♀, 4 km. WNW Fortín, 3200 ft., April 6, 1946; 1 ♂, Río Atoyac, 8 km. NW Potrero, February 18, 1946; 1 ♂ (skel.), 1 ♀, Río Blanco, 20 km. W Piedras Negras, 400 ft., October 6, 1946.

Pariko. This is the only parakeet that was found in the Upper Tropical Life-zone.

Aratinga astec astec (Souancé)

Aztec Parakeet

Conurus astec Souancé, Rev. et Mag. Zool., (2), 9, 1857: 97. (México.)

One ♂, 4 km. E Papantla, 400 ft., November 9, 1947; 2 ♂ (one skel.), 1 ♀, 15 km. ESE San Juan de la Punta, 400 ft., September 27, 1946; 1 ♂, 2 ♀ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 26 and 27, 1946; 2 ♂, 1 ♀, all skels., Río Blanco, 20 km. W Piedras Negras, October 4 and 6, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 14, 1947; 1 ♂ (LSUMZ), El Faro, above Piedras Negras, November 18, 1938; 1 ♂ and 1 ♀ (LSUMZ), Palo Gacho, above Piedras Negras, 350 ft., December 19, 1937; 1 ♀, 20 km. E Jesús Carranza, 300 ft., February 21, 1948.

Pariko. This species was not noted in the Upper Tropical Life-zone, but is common in the arid division of the Lower Tropical Life-zone. When the *nanchi* fruit is ripe, both this parakeet and *Aratinga holochlora* gather in great flocks, although the Aztec Parakeet is by far the more numerous. This season is known as the "time of the *nanchi*," or the "time of the parakeets." At other seasons of the year they were found feeding on the pods of the tamarind tree, which were eaten when very green. Young birds of this species are often offered for sale in the markets.

Pionus senilis senilis (Spix)

White-crowned Parrot

Psittacus senilis Spix, Aves Brazil, 1, 1824: p. 42, pl. 31, fig. 1. (No locality; Veracruz, México, designated by Griscom, Amer. Mus. Novit., no. 379, 1929, p. 6.)

One ♀, 5 km. S Tehuatlán, 700 ft., November 12, 1947; 1 ♂, 35 km. SW Jesús Carranza, 400 ft., February 16, 1948.

Pariko real. The White-crowned Parrot was found to be rather uncommon in Veracruz. In the southern part of the state, a few pairs were noted in low trees along the banks of the Río Coatzacoalcos, and one flock of about ten birds was seen in a *zapote mamay* tree. In northern Veracruz, as at Tehuatlán, the species is more common, and a number of flocks of six to ten birds was seen. The species is less noisy than most other parrots. There seems to be no commercial traffic in the young of this species.

Amazona viridigenalis (Cassin)

Red-crowned Parrot

Chrysotis viridigenalis Cassin, Proc. Acad. Nat. Sci. Philadelphia, 6, 1853: 371. (South America = northeastern México.)

One ♂, 9 km. NW Nautla, 10 ft., November 6, 1947; 1 ♀, Potrero Llano, 350 ft., February 15, 1949.

Catorro. The Red-crowned parrot is the least abundant of the three common, large parrots of the genus *Amazona* found in central and southern Veracruz (*viridigenalis*, *autumnalis*, and *ochrocephala*). Unlike the other species, *viridigenalis* gathers in large flocks, of from twenty to one hundred birds in which pairing is not always evident. The large flocks are active throughout the day, usually resting or feeding in the tops of two or three adjoining trees, for varying lengths of time, before taking flight and wheeling about in a compact mass, to settle shortly on other trees, meanwhile screaming.

The Red-crowned Parrot was most often seen in northern Veracruz, where the jungle is low and dense. It was never seen in the Upper Tropical Life-zone, and was noted only a few times on the coastal plain of central Veracruz.

Amazona autumnalis autumnalis (Linnaeus)

Golden-cheeked Parrot

[*Psittacus*] *autumnalis* Linnaeus, Syst. Nat., ed. 10, 1, 1758: 102. (West Indies = southern México.)

One ♂, 1 ♀, Río Atoyac, 8 km. NW Potrero, February 28 and March 14, 1946; 1 ♂ (LSUMZ), Matacabresto, above Piedras Negras, December 17, 1937.

Loro. This is the common parrot in the Upper Tropical Life-zone. Golden-cheeked Parrots were active in the morning and evening and to a lesser extent on dull or rainy days. They were usually found in pairs and were observed feeding in the tops of the taller trees. They were shy and difficult to obtain. One common food item is the fruit locally called "bull's testicles." Their call, when in flight, is a characteristic "clankety-clank-clank," distinctly more metallic in quality than the call of the Yellow-headed Parrot.

Amazona ochrocephala oratrix Ridgway

Yellow-headed Parrot

Amazona oratrix Ridgway, Man. No. Amer. Birds, 1887: 587. (Petapa, Oaxaca, México.)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 24, 1946; 1 ♂, 1 ♀ (skel.), 20 km. E Jesús Carranza, 300 ft., February 14, 1948.

Catorro, Loro. This species is common in the arid division of the Lower Tropical Life-zone. It is usually seen in pairs and is commonly found feeding in trees thirty-five feet or less in height. The mango is a favored food. Damage is done to bananas when the fruit is green.

On March 4, 1947, on the coastal plain about ten kilometers southwest of Jimba, literally hundreds of Yellow-headed Parrots were flying from their feeding grounds in the jungles of the humid division of the Lower Tropical Life-zone, to their roosting grounds on the coastal plain. For an hour before dusk, from a few to a hundred parrots were in sight at all times, in pairs and small flocks, all flying to the eastward.

Amazona farinosa guatemalae (Sclater)

Blue-crowned Parrot

Chrysotis guatemalae "Hartlaub" Sclater, Ibis, 1860: 44. (Guatemala and Honduras.)

One ♀, 20 km. S Jesús Carranza, 300 ft., February 10, 1948.

This species was found but once. In the jungle along the Río Coatzacoalcos, an Indian guide showed the collector two parrots in a tall tree in deep forest. The birds were motionless, and remained so for more than ten minutes before the collector could discern them in the green vegetation. One was shot. The Indians had not seen this species before. Also, the species was not recorded by Wetmore or Brodkorb in the course of their work in the state.

Family CUCULIDAE

Cóccyzus americanus americanus (Linnaeus)

Yellow-billed Cuckoo

Cuculus americanus Linnaeus, Syst. Nat., ed. 10, 1, 1758: 111. (In Carolina = South Carolina, *ex* Catesby.)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 13, 1946.

The wing of this specimen measures 141 mm., and makes it referable, therefore, to the nominate subspecies.

Piaya cayana thermophila P. L. Sclater

Central American Squirrel Cuckoo

Piaya thermophila P. L. Sclater, Proc. Zool. Soc. London, 1859: 368 (Jalapa, Veracruz, México.)

One ♂ (LSUMZ), 3.5 mi. S Jalapa, May 28, 1949; 1 ♀ (skel.), Puenta Nacional, 500 ft., October 21, 1946; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, January 3, 1938; 1 ♂ and 1 ♀ (LSUMZ), Paraje Nuevo, August 4, 1938, and November 2, 1937; 1 ♀ (skel.) Río Atoyac, 8 km. NW Potrero, March 3, 1946; 5 ♂, 3 ♀, Río Atoyac, 8 km. NW Potrero, February 26—March 10, 1946; 1 ♂, 2 ♀ (skels.), Río Blanco, 20 km. WNW Piedras Negras, May 12-31, 1946; 1 ♀ (skel.), Río Blanco, 20 km. W Piedras Negras, October 1, 1946; 1 ♀, 10 km. NW Potrero, February 16, 1946; 1 ♀, 2 km. N Motzorongo, 1500 ft., December 10, 1946.

Canela. This is a common species in the Upper Tropical Life-zone. It is far less common in the arid division of the Lower Tropical Life-zone.

Crotophaga sulcirostris sulcirostris Swainson

Groove-billed Ani

Crotophaga sulcirostris Swainson, Philos. Mag. (n. s.), 1827: 440. (México.)

One ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, March 11 and 21, 1946; 1 ♂, 10 km. NW Potrero, February 16, 1946; 1 ♂ (skel.), 15 km. ESE San Juan de la Punta, 400 ft., September 27, 1946; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, 1700 ft., August 20 and December 28, 1937; 4 ♂, 3 ♀, all skels., Río Blanco, 20 km. WNW Piedras Negras, May 25, 27, and 28, 1946.

Pijul, garrapatero. The Groove-billed Ani is abundant throughout the Tropical Region of Veracruz. It was absent only in the deep jungles of the extreme southern part of the state. The species prefers an open habitat, with dense, low brush for protection. The native name, *pijul,* is derived from its call, *"pee-hool."* The name *garrapatero* is derived from its habit of associating closely with cattle, and riding about on the backs of cows, presumably in search of engorged ticks. At night, the anis retire to dense bushes or low trees to roost. On a number of occasions, they were found roosting in low orange trees.

Tapera naevia excellens (Sclater)

Striped Cuckoo

Diplopterus excellens Sclater, Proc. Zool. Soc. London, 1857 [= 1858]: 229. (Southern México.)

Two ♂, 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946.

This cuckoo is probably fairly common, but it is so secretive that it is rarely seen. The few individuals observed were found in dense brush on the coastal plain.

Family TYTONIDAE

Tyto alba pratincola (Bonaparte)

American Barn Owl

Strix Pratincola Bonaparte, Geog. and Comp. List, 1938: 7. (Northern parts [of America] = Pennsylvania.)

One ♂ (LSUMZ), Potrero Viejo, 1700 ft., April 5, 1938.

This specimen is virtually indistinguishable from light-phased examples from the United States, thereby excluding the possibility of its being referable to *Tyto alba guatemalae*.

Family STRIGIDAE

Pulsatrix perspicillata saturata Ridgway

Spectacled Owl

Pulsatrix perspicillata saturata Ridgway, Bull. U. S. Nat. Mus., 50, pt. 6, 1914: 758. (Santo Domingo, Oaxaca, México.)

One ♀, 2 km. N Motzorongo, 1500 ft., December 6, 1946.

Only two individuals of this large owl were seen in Veracruz in the course of this study. One was shot at night by the light of the moon, when it perched forty feet from the ground in a tree. The other was seen at midday, in a dim, shadowed, marshy place in deep jungle southwest of Jimba. It was sitting about thirty-five feet from the ground, on a moss-covered limb, about six inches in diameter and slanted at a forty-five degree angle. The owl held its body vertical, seemingly a difficult stance for it to maintain. The position of the owl so close to the limb, however, made it difficult to see.

Glaucidium brasilianum ridgwayi Sharpe

Ferruginous Pygmy Owl

Glaucidium ridgwayi Sharpe, Ibis, ser. 3, 5, January, 1875: 55. (Central America = México.)

One ♀, 8 km. NW Potrero, 1500 ft., February 13, 1946; 2 ♂, 3 ♀, Río Atoyac, 8 km. NW Potrero, February 21—March 15, 1946; 1 ♀ (LSUMZ), Paraje Nuevo, December 15, 1937; 2 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 11 and 12, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 15, 1947; 1 ♀ (skel.) Río Blanco, 20 km. W Piedras Negras, October 6, 1946, 1 ♂, 20 km. ENE Jesús Carranza, 200 ft., March 26, 1949.

Tincalero. These tiny owls are common throughout the Tropical Region of Veracruz. Their monotonous whistle is heard regularly in the early morning, just at dawn, and in the evening, and may be noted occasionally at almost any hour of the day. Their call was never heard at night. In fact, the first call of the Wood Owl usually silenced all Pygmy Owls in the vicinity, and they were not heard again until the following morning. The species must be present in Veracruz in great numbers. At almost any thicket or the edge of almost any jungle, at any time of day, an imitation of their almost interminable short, whistled notes would cause one or more birds to answer. The stomachs of most of the specimens listed above were examined, and found to contain remains of scorpions and insects, principally Orthoptera.

Speotyto cunicularia hypugaea (Bonaparte)

Burrowing Owl

Strix hypugaea Bonaparte, Amer. Orni., 1, 1825: 72, note. (Western United States = Plains of the River Platte.)

One ♀ (LSUMZ), Paraje Nuevo, 1800 ft., May 17, 1938; 1 ♀, 15 km. W Piedras Negras, 300 ft., January 18, 1947.

The specimen taken by Dalquest, on January 18, 1947, was the only one seen by him.

Ciccaba virgata centralis Griscom

Wood Owl

Ciccaba virgata centralis Griscom, Bull. Mus. Comp. Zoöl., 69, 1929: 159. (Chivela, Oaxaca. México.)

One ♀ (skel.), 4 km. W Tlapacoyan, 1700 ft., November 22, 1947; 4 ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, February 24-March 15, 1946; 2 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 18, 1946; 1 ♂, 7 km. NW Potrero, 1700 ft., January 9, 1947; 2 ♂ (LSUMZ), Potrero Viejo, 1700 ft., December 16, 1937, and January 28, 1938; 1 ♂ (LSUMZ), Paraje Nuevo, February 4, 1938; 1 ♀, 3 km. E San Andrés Tuztla, 1000 ft., January 15, 1948.

Tecolote. A common resident of both the Upper Tropical Life-zone and the arid division of the Lower Tropical Life-zone, this owl rests by day in dense jungle, usually in the branches of trees about ten feet from the ground. A few were found in hollow trees. They begin to call shortly after dark. Most of the specimens taken were shot at night with the aid of a headlight. Two specimens from Piedras Negras are lighter and have more white spotting above than the light-phased examples from Potrero.

Rhinoptynx clamator forbesi new subspecies

Striped Owl

Type.—Adult male; no. 233824, Museum of Comparative Zoölogy; Presidio, Veracruz, México; May 3, 1925; collected by W. W. Brown.

Characters.—Similar to *Rhinoptynx clamator clamator* (Vieillot) of northern South America, but black streaks of upper parts and under parts, especially the latter, decidedly reduced in breadth. Resembles *R. c. midas* (Schlegel)

TABLE 1.—MEASUREMENTS IN MILLIMETERS OF THE RACES OF RHINOPTYNX CLAMATOR

R. c forbesi	*Wing*	*Tail*	*Culmen from cere*
2 males from Presidio and Río Blanco, Veracruz	222–230 (229)	126–128 (127)	20.2–20.3 (20.2)
1 female from Río Blanco, Veracruz	230	140	20.3
3 females from Chiapas	242–257 (247.7)	131–141 (135.7)	19.5–21.5 (20.6)
1 male from Costa Rica	231	127	20.7
3 females from Panamá and Canal Zone	233–234 (233.5)	127–142 (133.6)	20.7–23.1 (21.7)
Avg. of all females from México and Central America	239	135.4	21.3
R. c. clamator			
2 males from Colombia and Venezuela	230–241 (235.5)	129	20.0–21.3 (20.7)
2 females from Venezuela	245–256 (250.5)	142–150 (146)	21.8–22.7 (22.3)
R. c. midas			
1 male from Argentina	267	139	22.2
3 females from Argentina and southern Brazil	269–282 (272.7)	145–159 (152)	20.6–23.2 (22.2)
R. c. oberi (unique type) unsexed, Tobago	276	151	....

in general coloration, but size much smaller. Differs likewise from the unique type of *Rhinoptynx clamator oberi* E. H. Kelso by its much smaller size.

Measurements.—Type: wing, 230 mm.; tail, 128; culmen from cere, 20.2. For comparative measurements see Table I.

Distribution.—Southern México (Veracruz and Chiapas) southward through Central America to Panamá.

Remarks.—The name [*Asio*] *mexicana* Gmelin, 1788 (based on the *Mexican Eared Owl* Latham, Synop. Birds, 1, pt. 1, 123) is indeterminate and cannot justifiably be applied to any of the eared owls of México. If it represents a *Rhinoptynx,* it is an earlier name than *clamator;* if it represents a *Bubo,* it is an earlier name than *mayensis;* if it represents an *Asio,* it is an earlier name than either *wilsonianus* or *stygius*. Since there is no way of ascertaining to which owl Gmelin's name applies, we believe that it should continue to be regarded as unidentifiable.

This new geographical race of the Striped Owl is named for Mr. Dyfrig McH. Forbes, of Potrero Viejo, Veracruz, who, along with his family, has contributed greatly to scientific knowledge by making extensive collections of natural history objects and by assisting personnel connected with various museum expeditions. In the latter regard, the Hacienda Potrero has served as headquarters or temporary abode for numerous field parties of diverse zoological interest. There are indeed few zoologists who have worked in Veracruz in the last two decades who have not enjoyed the hospitality and helpful assistance of Mr. and Mrs. Forbes.

Specimens examined.—Total number, 13, as follows:

México: *Veracruz:* 1 ♂ (MCZ 233824), Presidio; 1 ♂ and 1 ♀ (UKNHM 24519 and 24520), 20 km. WNW Piedras Negras. *Chiapas:* 2 ♀ (U. Mich. 94983 and 107656), Finca Esperanza; 1 ♀ (U. Mich. 101967), El Corozal.
Costa Rica: *San José:* 1 ♂ (MCZ 117501), San José. *Guanacoste:* 1 juv. ♀ (MCZ 148164), Puntarenas, 1 unsexed, locality unspecified (USNM 90395).
Panamá: *Santos:* 1 ♀ (USNM 400261), Parita. *Panamá:* 1 juv. ♂ and 1 ♀ (USNM 409353 and 409354), Cerro Azul. *Canal Zone:* 1 ♀ (U. Mich. 56266), Ancón.

Comparative material.—

RHINOPTYNX CLAMATOR CLAMATOR:

Venezuela: *Anzoátegui:* 1 ♂ (USNM 406473), Cantaura. *Monagas:* 2 ♀ (USNM 406474 and 406475), Caicara.
Colombia: *Santander del Norte:* 1 ♂ (USNM 372657), Petrolea.

RHINOPTYNX CLAMATOR MIDAS:

Argentina: *Tucumán:* 1 ♂ (USNM 400051), Tucumán; 1 ♀ (USNM 400050), San Pedro de Colalao. *Buenos Aires:* 1 ♀ (USNM 55877), Buenos Aires.
Brazil: *Bahia:* 1 ♀ (USNM 25841), locality unspecified.

RHINOPTYNX CLAMATOR OBERI (the type):

Brazil: Tobago Island (USNM 75112).

Family NYCTIIBIDAE

Nyctibeus griseus mexicanus Nelson

Potoo

Nyctibeus jamaicensis mexicanus Nelson, Auk, 17, 1900: 260. (Metlaltoyuca, Puebla, México.)

One ♂, 14 km. SW Coatzacoalcos, 100 ft., February 3, 1947; 1 ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., February 5, 1948: 1 ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 21, 1949.

Lechusa. Although this species has not been recorded from Veracruz in recent years, it is fairly common in the arid division of the Lower Tropical Life-zone, at least as far north as Piedras Negras. In the humid division of the Lower Tropical Life-zone, of extreme southern Veracruz, the Potoo is more abundant. Several individuals are usually seen each hour in a night's hunt. The bird's large, brilliant red eyes have a tremendous reflecting power, and can be seen for more than 200 yards, in the beam of a hunting light. Unlike most goatsuckers, the Potoo usually looks at the source of light with both of its eyes. It is not shy, and by keeping the light in the bird's eyes, one can usually be approached to within fifty feet. The eyes of the bird, when it flies, can be easily kept in the light. When thus blinded in flight, it becomes entangled in branches and strikes other objects. None was seen to strike hard enough to be knocked to the ground, but several almost did so.

The Potoo was never seen on the ground; birds were usually perched twenty-five to fifty feet high, in trees that were isolated or that were on the edges of clearings. In the beam of a flashlight, at close range, the body of this species appears gray, and stands out distinctly. When perched, the body is held across the limb and at almost a sixty-degree angle from the horizontal, its position resembling that of a hawk. There is little in the posture of the body to suggest a goatsucker.

In some areas the *lechusa* is considered a bird of ill omen. According to one superstition, the gun of a person shooting one of these birds will burst, unless two sticks are held under the gun, in the form of a cross, when the gun is fired. Even this, it is agreed by most natives, is dangerous, and bad luck in other forms may visit the shooter.

Family CAPRIMULGIDAE

Chordeiles acutipennis texensis Lawrence

Texas Nighthawk

Chordeiles texensis Lawrence, Ann. Lyc. Nat. Hist. New York, 6, 1856: 167. (Texas = Río Grande Valley.)

One ♂, 4 km. WNW Fortín, 3200 ft., March 28, 1946.

Nighthawks were seldom seen in Veracruz. This specimen has a wing and tail measurement of 184 mm. and 115 mm., respectively.

Nyctidromus albicollis merrilli Sennett

Pauraque

Nyctidromus albicollis merrilli Sennett, Auk, 5, 1888: 44. (Nueces River, Nueces County, Texas.)

One ♂, 3 km. N Presidio, 1500 ft., December 2, 1946.

This specimen has the wing 171 mm. and the tail 174 mm. It may be regarded, therefore, as a migrant from farther north where the race *merrilli* occurs.

Nyctidromus albicollis yucatanensis Nelson

Pauraque

Nyctidromus albicollis yucatanensis Nelson, Proc. Biol. Soc. Washington, 14, Sept. 25, 1901: 171. (Tunkas, Yucatán.)

One ♂ (skel.), 5 km. N Jalapa, 4500 ft., October 19, 1946; 1 ♂ (skel.), 5 km. S Tehuatlán, 700 ft., November 14, 1947; 2 ♂, 1 ♀, all skels., Teocelo, 4000 ft., January 3 and 29, 1949; 2 ♂, 1 unsexed, (all LSUMZ), Potrero Viejo, August 20, 1937, and February 25, 1938; 4 ♂ (two skels.), 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, March 17-May 11, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 13, 1947; 1 ♂, 1 ♀ (skel.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 1, 1946; 3 ♀ (skels.), 25-30 km. SE Jesús Carranza, 350 ft., April 3 and 5, and May 31, 1949.

Tapacamino. The call of the Pauraque is one of the most characteristic sounds of the night in the lowlands of Veracruz. The species is somewhat less common in the Upper Tropical Life-zone than in the Lower Tropical Life-zone. In the daytime Pauraques hide on the open ground beneath dense bushes, especially thorny species. Shortly after dusk they emerge and fly to favored hunting places. In most cases the birds rest upon the ground in the open; such situations as the dusting place of a Chachalaca, a road, a trail, a ploughed field, or a closely grazed field are favored stations. Occasionally, and strangely enough, only in certain limited localities, such as near Piedras Negras, the birds seem to prefer to rest on logs or low, horizontal branches. From their stations, they fly up, with a hopping motion and a few wing strokes, to intercept passing insects. Their mournful call is given intermittently. It consists of a somewhat catlike note, that might be translated as "where-are-you." The natives of southern Veracruz translate the call as "pavo-real," in reference to a legend in which the peacock refused to lend its plumage to the *tapacamino.* There is also a children's song concerning this bird.

The varied degrees of shyness of the Pauraque seems to depend on the brilliance of the moon. On moonlit nights, it rarely allows one to approach to within fifty feet. On dark nights, if the hunting light is kept on the brilliant glow of the bird's eye (a single eye is usually seen in the light) it can usually be approached so closely as to be captured in the hand. Most of the specimens listed above were taken in this manner.

Several nests of the Pauraque were found in southern Veracruz in June. Each consisted of a scarcely perceptible depression in the leaf-littered sand beside a river. In every case, the nest was somewhat sheltered above by open, low trees, and on a slight slope. Two nests that were carefully examined each held two eggs.

Phalaenoptilus nuttallii centralis Moore

Poor-will

Phalaenoptilus nuttallii centralis Moore, Proc. Biol. Soc. Washington, 60, 1947: 146. (Puerto de Guadalupe, 5 miles west of Ibarra, Guanajuato, México.)

One ♂, 2 km. W Limón, 7500 ft., September 26, 1948.

Although this specimen has not been compared with the unique type of Moore's new race, *centralis,* it appears to agree with the description in most particulars. Moreover, it differs from material in the United States National Museum in the same way that Moore distinguishes *centralis* from the various named races. This appears to be the first record for this species in Veracruz. The specimen was shot at night on sandy soil in a corn field.

Caprimulgus serico-caudatus salvini Hartert

Salvin Whip-poor-will

Caprimulgus salvini Hartert, Ibis, 1892: 287. New name for *Caprimulgus macromystax* of American authors but not of Wagler and other European authors. (Mirador, Veracruz, México, accepted as type locality, *cf.* Peters, Birds World, 1940, p 198.)

One ♂ (LSUMZ), Potrero Viejo, 1700 ft., December 12, 1938.

The specimen supposedly taken by Sartorius probably at Mirador (Baird, *et al.*, 1874:409) seems to be the only other record for this species in Veracruz.

Caprimulgus vociferus vociferus Wilson

American Whip-poor-will

Caprimulgus vociferus Wilson, Amer. Orni., 5, 1812: 71, pl. 41, figs. 1-3. (Pennsylvania.)

One ♂, 2 km. N Motzorongo, 1500 ft., December 7, 1946.

Caprimulgus vociferus setosus van Rossem

American Whip-poor-will

Caprimulgus vociferus setosus van Rossem, Bull. Mus. Comp. Zoöl., 77, 1934: 408. (Galindo, Tamaulipas, México.)

One ♂, 6 km. SSE Altotonga, 9000 ft., November 10, 1946; 1 ♂ (skel.), 7 km. NW Potrero, 1700 ft., January 9, 1947.

The specimen from Altotonga was shot from the limb of a pine tree, where it was calling approximately an hour after dusk. Both the presence of the bird on a limb thirty-five feet from the ground and the fact that it was calling in November are worthy of note.

Family APODIDAE

Chaetura pelagica (Linnaeus)

Chimney Swift

Hirundo Pelagica Linnaeus, Syst. Nat., ed. 10, 1, 1758: 192. (America = South Carolina.)

One ♂, 20 km. ENE Jesús Carranza, 200 ft., April 10, 1949.

Chaetura vauxi richmondi Ridgway

Vaux Swift

Chaetura richmondi Ridgway, Proc. Biol. Soc. Washington, 23, 1910: 53. (Guayabo, Costa Rica.)

One ♀, 35 km. SE Jesús Carranza, 350 ft., April 7, 1949.

Golondrina. On the Río Solosuchi and Río Chilchijapa in April, 1949, flocks of fifty to one hundred swifts were seen flying over the surface of the water. Both the specimen of *vauxi* and the specimen of *pelagica* were collected from these flocks.

Chaetura rutila brunnitorques Lafresnaye

Chestnut-collared Swift

Chaetura brunnitorques Lafresnaye, Rev. Zool., 1844: 81. (Colombia.)

One ♂, 1 ♀, 5 km. N Jalapa, 4500 ft. October 18, 1946.

The only two specimens taken were captured at night in a small cave behind a waterfall in the Upper Tropical Life-zone.

Family TROCHILIDAE

Phaethornis superciliosus veraecrucis Ridgway

White-browed Hermit

Phaethornis longirostris veraecrucis Ridgway, Proc. Biol. Soc. Washington, 23, 1910: 54. (Buena Vista, Veracruz, México.)

One ♀, 35 km. SW Jesús Carranza, 400 ft., February 17, 1948; 1 ♀, 30 km. SSE Jesús Carranza, 300 ft., May 10, 1949.

These dull-colored hummers seem somewhat restricted in their feeding habits. They are primarily birds of the deep jungle, and do not gather with other species of hummingbirds at the flowering trees along the river banks. Usually they are solitary, moving about in the deep shade, and pausing at bromiliads, vines, and wild banana plants. One gathering of hummingbirds of this species was noted in the jungle near Jesús Carranza, where, in a limited area, there were many brilliant red flowers of a honeysuckle type. This was the only species of hummingbird noted feeding on the flower. Probably 100 of these birds were seen in one afternoon, and often there were ten or more in sight at once. They seemed to be less quarrelsome than most other species of hummingbirds. All trochilids in Veracruz are called *chupa rosa* or *chupa miel* by the natives.

Phaethornis longuemareus adolphi Gould

Boucard Hermit

Phaëthornis adolphi Gould, Monogr. Trochil., pt. 14, 1857: pl. [15] and [text = 1, pl. 35 of volume]. (Córdoba, Veracruz, México.)

One ♀, Río Atoyac, 8 km. NW Potrero, March 5, 1946; 1 ♀ (LSUMZ), Potrero, 1700 ft., January 4, 1938; 1 ♂ (skel.), Potrero Viejo, 1700 ft., December 16, 1948; 1 ♂ (skel.), 13 km. ENE Potrero, 1700 ft., April 24, 1949; 2 ♀ (one skel.), 20 km. SE Jesús Carranza, 250 ft., May 2, 1949.

The body of this tiny hummingbird is so plump that it appears nearly spherical. It is an inconspicuous species, usually found at the edges of patches of jungle, especially along small water-courses. One of its favored haunts is the small, still-surfaced pools of tiny streams in the forest. It spends considerable time skimming the surface of the pools and plunging into the water. The species is noteworthy in that it remains close to the ground. Probably most of its activities are carried on at a distance of three to five feet from the ground, and rarely does it go higher. Although not social, and rarely seen with other species of hummers, individuals of this species rarely fight as do most other kinds of hummers when they meet others of their kind. They feed in flowers of small size, in bromiliads, and in crevices in twigs and vines.

Campylopterus curvipennis curvipennis (Lichtenstein)

Curved-winged Saber-wing

Trochilus curvipennis Lichtenstein, Preis-Verz. Vögel Mexico, 1830: 1. (México.)

One ♂ (skel.), 5 km. ENE El Jobo, 600 ft., October 19, 1947; 3 ♂ (one skel.), 1 ♀, 4 km. W Tlapacoyan, 1700 ft., October 13 and 14, and November 22, 1947; 1 ♀, 4 km. WNW Fortín, 3200 ft., March 27, 1946.

This large hummer is not common. It was usually solitary and found in dense jungle. Several specimens were shot that could not be found in the dense vegetation. On several occasions, individuals ceased the humming flight and flew in the normal, birdlike fashion. This was usually when they were about to perch, and the non-humming flight was only for a distance of six to eight feet.

Campylopterus excellens (Wetmore)

Long-tailed Saber-wing

Pampa pampa excellens Wetmore, Proc. Biol. Soc. Washington, 54, 1941: 207. (Volcán San Martín, Sierra de Tuxtla, Veracruz, México.)

Four ♂ (one skel.), 1 ♀, 30 km. SSE Jesús Carranza, 300 ft., May 8-14, 1949.

When Wetmore described *excellens* he believed that the form was confined to the Sierra de Tuxtla and that it was subspecifically related to *Campylopterus curvipennis* despite its highly trenchant yet

TABLE 2.—COMPARATIVE MEASUREMENTS IN MILLIMETERS OF CAMPYLOPTERUS C. CURVIPENNIS AND CAMPYLOPTERUS EXCELLENS

	C. c. curvipennis: 16 males from San Luis Potosí and Central Veracruz.	7 females from San Luis Potosí and Central Veracruz.	*C. excellens:* 3 males from 30 km. SSE Jesús Carranza, Veracruz.	1 female from same locality.	4 males from Tuxtla Mts. (type and 3 paratypes.)	Avg. of all males of *excellens.*
Wing	62.9–69.1 (66.5)	58.4–62.8 (60.6)	67.1–69.8 (68.1)	66.6	67.5–73.2 (70.3)	69.4
Tail	48.7–53.3 (50.6)	42.6–46.2 (43.8)	59.5–62.6 (60.7)	49.6	60.3–63.5 (61.4)	61.1
Exposed culmen	24.1–27.5 (25.4)	23.2–26.3 (24.3)	28.8–29.4 (28.6)	26.9	26.9–29.2 (27.7)	27.9
Width of bill at posterior edge of nostril	3.5–5.9 (4.8)	4.0–4.6 (4.3)	5.0–6.0 (5.4)	4.0	....	......

subtle characteristics. Superficially, *excellens* is virtually a replica of *curvipennis;* the skins of *excellens*, as Wetmore points out, appear to be nothing more than overstuffed examples of *curvipennis*. In color the two are almost identical. On close inspection, however, one discovers that the tail feathers of *excellens* are decidedly longer and broader and that the head appears to be larger, even though the bill itself is only slightly longer and only slightly broader basally (see Table 2).

In the material recently acquired by Dalquest there are four skins and one skeleton of *Campylopterus* from a locality thirty kilometers SSE of Jesús Carranza. Somewhat surprising is the fact that these specimens are referable to *excellens*, even though they were taken approximately 140 kilometers from the Volcán San Martín in the Sierra de Tuxtla, at an elevation of only 300 feet. Since all were collected between May 8 and 14, there can be little doubt that they represent breeding birds at the Jesús Carranza locality and not altitudinal migrants from the higher elevations in the Sierra de Tuxtla.

Figs. 2-7. Skulls of *Campylopterus curvipennis curvipennis* and *Campylopterus excellens*, to show difference in size and proportion. × 1.

Figs. 2, 4, and 6. *Campylopterus excellens* (Wetmore), ♂, UKNHM 28954, 30 km. SSE Jesús Carranza, Veracruz, May 14, 1949.

Figs. 3, 5, and 7. *Campylopterus c. curvipennis* (Lichtenstein), ♂, LSUMZ 13794, Xilitla, San Luis Potosí, México, February 10, 1947.

TABLE 3.—SKELETAL MEASUREMENTS IN MILLIMETERS OF CAMPYLOPTERUS C. CURVIPENNIS AND CAMPYLOPTERUS EXCELLENS

	Campylopterus c. curvipennis LSUMZ 13794, ♂, Xilitla, San Luis Potosí.	LSUMZ 14206, ♂, 2 mi. SE Xilitla, San Luis Potosí.	UKNHM 24929, ♂, 5 km. ENE El Jobo, Veracruz.	UKNHM 24930, ♂, 4 km. W Tlapocoyan, Veracruz.	*Campylopterus excellens* UKNHM 28954, ♂, 30 km. SSE Jesús Carranza, Veracruz.
Greatest Length of Skull	44.3	44.4	45.5	44.9	48.3
Greatest Width of Skull	11.7	11.6	11.8	11.8	12.7
Interorbital Breadth	6.1	6.1	6.6	6.5	7.3
Maxillary Breadth	5.0	4.8	5.0	5.0	5.1
Quadrato-jugal Breadth	9.7	9.6	9.6	9.6	10.5
Interlacrymal Breadth	6.1	6.1	6.6	6.5	7.3
Length of Palatines	5.9	6.1	6.0	5.9	6.8
Coracoid	8.7	8.5	8.6	8.6	9.5
Humerus	6.6	6.5	6.6	6.4	7.4
Ulna	6.4	6.3	6.4	6.3	7.3
3rd Metacarpal	8.1	8.1	8.1	8.1	8.7
Femur	9.8	9.8	....	9.6	11.2
Tibio-tarsus	14.0	14.0	14.1	14.1	15.4
Tarso-metatarsus	6.2	6.2	6.2	5.9	7.0
Length of mandibular ramus	38.4	37.9	39.3	38.4	42.3

At present there is no material on hand showing that *excellens* occurs sympatrically with *curvipennis,* but it almost certainly does so since the latter is known from localities in the humid division of the Lower Tropical Life-zone from Veracruz to Guatemala. Jesús Carranza, where our recent examples of *excellens* were taken, lies in this same zone.

The really interesting point brought to light by these specimens, however, is found in our study of the one male skeleton. The allegedly greater head-size of *excellens,* which Wetmore discerned entirely by his comparison of skins, is a fact that can be expressed by actual measurements (Figures 2-7 and Table 3). The skull of *excellens* is actually markedly larger than that of *curvipennis.* Also, many of the skeletal elements in the two forms differ significantly in size. The larger over all size of the cranium, and the body skeleton of *excellens,* however, is not the result of an increase in size of all the component parts, for certain dimensions do not vary appreciably from those of *curvipennis* (see Table 3). Even though the tail length of *excellens* shows an absolute difference, the variation in wing length between the two forms is only an average difference.

The question arises as to whether *excellens* should be regarded as specifically distinct from *curvipennis.* In the first place, the fact that *curvipennis* is already polytypic is highly pertinent. The species ranges southward from San Luis Potosí through Veracruz and southern México to Yucatán and Guatemala. Birds from the two last-named places are smaller than those from San Luis Potosí and central Veracruz and are currently recognized under the name *C. c. pampa* (Lesson). Intergradation occurs between the two in Campeche (Ridgway, 1911:356). Superimposed, in southern Veracruz, on this geographically variable and continuous population of *curvipennis,* is the large form, *excellens,* which seems to be reproductively isolated. These facts, coupled with the cranial and other differences in size noted above, point to the conclusion that *excellens* is a sibling species. We propose that it be so regarded until facts are adduced to the contrary.

Campylpoterus hemileucurus (Lichtenstein)

Delattre Saber-wing

Trochilus hemileucurus Lichtenstein, Preis-Verz. Vögel Mexico, 1830: 1. (México.)

Two ♂, 20 km. SE Jesús Carranza, May 1, 1939; 2 ♂ (one skel.), 1 ♀, 30 km. SSE Jesús Carranza, May 12, 1949.

This species seems to be rather rare. In April, May, and June, in extreme southern Veracruz along the Río Chalchijapa and Río Solosuchi, certain species of trees that are confined to sandy river banks come into bloom. The flowers draw swarms of hummers of several species, and usually a dozen or more are present at each tree. Perhaps one in 500 hummers seen at such trees is of this large, purple species. In the field, *C. hemileucurus* appears to be black with the white markings of the tail abrupt and distinct. Its large size separates it from other species with which it is usually seen.

Florisuga mellivora mellivora (Linnaeus)
Jacobin Hummingbird

Trochilus mellivorus Linnaeus, Syst. Nat., ed. 10, 1, 1758: 121. (India, error = Surinam, *ex* Edwards.)

Four ♀ (one skel.), 20 km. SE Jesús Carranza, 250 ft., May 1 and 2, 1949; 1 ♂, 30 km. SSE Jesús Carranza, 300 ft., May 12, 1949.

Florisuga mellivora was noted only in extreme southern Veracruz, where it was found in the same flowering trees with *Campylopterus hemileucurus* and other species of hummers. In the field, this form closely resembles *Campylopterus hemileucurus*, appearing black with abrupt white markings on the tail. It is, however, much smaller than the latter species. *Florisuga* was more common than *Camplyopterus hemileucurus* and was noted in an approximate ratio of four to one. It was, nevertheless, one of the less common species at the flowering trees, being outnumbered many times by the species of *Amazilia*.

Loetscher (MS) doubts the validity of the one previous record for this species in Veracruz, at Orizaba (Sumichrast, 1881:250), and therefore includes it in his list of species of hypothetical occurrence.

Anthracothorax prevostii prevostii (Lesson)
Prévost Mango

Trochilus prevostii Lesson, Hist. Nat. Colibris, Suppl, [1832]: p. 87, pl. 24. (South America.)

Two ♂, Potrero Viejo, February 12 and March 23, 1946; 1 ♂, 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 10 and 28, 1946; 5 ♂, 1 ♀, 20 km. ENE Jesús Carranza, 200 ft., March 26, 1949.

This large and beautiful hummingbird seems to be rather local in its distribution. It was not uncommon at Potrero Viejo, where two were shot from the same twig a few weeks apart, and others were seen. This was the only locality in the Upper Tropical Life-zone where the species was noted. Strangely enough, only males were seen at Potrero Viejo. The two specimens taken near Piedras Negras were the only ones seen in that locality. On the banks of the Río Coatzacoalcos, this was one of the more numerous hummers.

It was common about certain species of flowering trees, at thirty to forty feet from the ground, where it was associated with species of *Amazilia*. It was not present with other hummers in the deep jungles twenty-five kilometers to the southeast, where such species as *Florisuga mellivora* and *Campylopterus hemileucurus*, not seen on the Río Coatzacoalcos, were found.

Chlorostilbon canivetii canivetii (Lesson)

Canivet Emerald

Ornismya canivetii Lesson, Hist. Nat. Colibris, Suppl., [1832]: pp. 174 and 177, pls. 37 and 38. (Brazil, error = Jalapa, Veracruz, México, *ex* Rev. Zool., 1839, p. 15.)

One ♀, 9 km. E Papantla, 300 ft., November 16, 1947; 1 ♂ (LSUMZ), Potrero, 1700 ft., January 6, 1938; 1 ♂, Río Blanco, 20 km. W Piedras Negras, 400 ft., October 1, 1946.

This tiny, brilliant green hummer is rare and inconspicuous. One individual was feeding in a bull's-horn acacia tree after a rainfall, seemingly on small insects floating out from the leaf bases of small bromeliads by the rain.

Amazilia candida genini (Meise)

White-bellied Emerald

Agyrtrina versicolor genini Meise, Bull Mus. Roy. Hist. Nat. Belg., 14, 1938: 2. (El Asterillo, Veracruz, México.)

One ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, February 19 and 25, and March 21, 1946; 1 ♂, 4 km. WNW Fortín, 3200 ft., April 5, 1946; 5 ♂ (one skel.), 20 km. ENE Jesús Carranza, March 23-26, and May 16, 1949; 5 ♂ (three skels.), 30 km. SSE Jesús Carranza, May 9, 12, and 14, 1949; 1 ♀, 60 km. SW Jesús Carranza, 450 ft., March 27, 1948.

This small species is probably the most common hummingbird in the state of Veracruz. In the extreme southern part of the state, when the flowering trees along the river banks were in bloom, literally thousands were seen daily.

Amazilia cyanocephala cyanocephala (Lesson)

Red-billed Azure-crown

Ornismya cyanocephalus Lesson, Hist. Nat. Ois.-Mouches, [1829]: xlv. (Brazil = Veracruz, México.)

One ♀, 4 km. W Tlapacoyan, 1700 ft., October 15, 1947; 1 ♀ (LSUMZ), Jalapa, May 27, 1949; 1 ♂, Teocelo, 4000 ft., January 30, 1949; 1 ♂, 4 km. WNW Fortín, 3200 ft., April 5, 1946; 1 ♂, 20 km. SE Jesús Carranza, 250 ft., May 2, 1949.

This species seems not to be common, although it might easily be overlooked and mistaken for the preceding form. It was often found with *Campylopterus curvipennis*, which it resembles except in its much smaller size.

Amazilia beryllina beryllina (Lichtenstein)

Berylline Hummingbird

Trochilus beryllinus Lichtenstein, Preis-Verz. Vögel Mex., 1830: 1. (México.)

One ♂, 4 km. N Jalapa, 4500 ft., October 13, 1946; 1 ♂, 2 ♀, (all LSUMZ), Jalapa, May 27 and 29, 1949; 1 ♂, 1 ♀, Atoyac, 8 km. NW Potrero, March 5 and 20, 1946; 1 ♂, Ojo de Agua, 8 km. NW Paraje Nuevo, February 12, 1946; 1 ♂, 4 km. WNW Fortín, 3200 ft., March 25, 1946.

Amazilia yucatanensis cerviniventris (Gould)

Buff-bellied Hummingbird

Amazilius cerviniventris Gould, Proc. Zool. Soc. London, pt. 24, 1856: 150. (Córdoba, Veracruz, México.)

One ♀ (LSUMZ), Potrero, 1700 ft., January 4. 1938; 1 ♂, Potrero Viejo, 1700 ft., October 23, 1946; 2 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 12 and 13, 1947; 1 ♂, 20 km. W Piedras Negras, October 1, 1946.

This and the two following species sometimes occur in the same areas and are so similar that they cannot always be separated with certainty from one another in the field.

Amazilia tzacatl tzacatl (De la Llave)

Rieffer Hummingbird

Trochilus Tzacatl De la Llave, Registro Trimestre, 2, no. 5, 1833: 48. (México.)

One ♂ (LSUMZ), Paraje Nuevo, February 12, 1938; 1 ♂ and 2 ♀ (one skel.), 20 km. ENE Jesús Carranza, March 24-26, and April 12, 1949; 1 ♂, 20 km. SE Jesús Carranza, 250 ft., May 2, 1949; 2 ♂ (one skel.), 3 ♀ (two skels.), 30 km. SSE Jesús Carranza, 300 ft., March 28 and May 9 and 12, 1949; 1 ♂ (skel.), 35 km. SE Jesús Carranza, 400 ft., February 19, 1948.

Eupherusa eximia nelsoni Ridgway

Striped-tailed Hummingbird

Eupherusa eximia nelsoni Ridgway, Proc. Biol. Soc. Washington, 23, 1910: 54. (Motzorongo, Veracruz.)

One ♂ (skel.), Potrero Viejo, 1700 ft., March 13, 1949; 1 ♂, 35 km. SE Jesús Carranza, 350 ft., April 5, 1949.

Heliomaster longirostris pallidiceps Gould

Pale-crowned Star-throat

Heliomaster pallidiceps Gould, Intro. Trochil., 1861: 139 (México and Guatemala = Jalapa, Veracruz, México.)

One ♂, 7 km. W Potrero, 1700 ft., December 26, 1946.

Our only specimen was taken by a Mexican girl, and was brought to us by Miss Loni Forbes.

Calothorax lucifer (Swainson)

Lucifer Hummingbird

Cynanthus Lucifer Swainson, Philos. Mag. (n. s.), 1, 1827:442 (Temas-scaltepec.)

One unsexed [= ♂] (skel.), Potrero Viejo, 1700 ft., December 16, 1948.

The specimen listed was found dead on the window sill in a house, where it had seemingly become exhausted and died in attempting to escape from a room that it had entered by accident.

Archilochus colubris (Linnaeus)

Ruby-throated Hummingbird

Trochilus Colubris Linnaeus, Syst. Nat., ed. 10, 1, 1758: 120. Based on The Hummingbird, *Mellivora avis carolinensis* Catesby, Carolina, 1, p. 65. (In America imprimis septentrionali = South Carolina.)

One ♂, 5 km. ENE El Jobo, 600 ft., October 18, 1947; 5 ♂ (two skels.), 3 ♀, 5 km. N Jalapa, 4500 ft., October 13-16, 1946; 1 ♂, Río Atoyac, 8 km. NW Potrero, February 26, 1946; 1 ♂, Río Blanco, 20 km. W Piedras Negras, October 1, 1946.

This familiar North American migrant is abundant in the Upper Tropical Life-zone. It appears to be less common in the Lower Tropical Life-zone.

Atthis heloisa heloisa (Lesson and Delattre)

Heloise Hummingbird

Orismya Helosia Lesson and De Lattre, Rev. Zool., 2, 1839; 15. (Jalapa and Quatepu [= Coatepec], Veracruz, México.)

Two ♂, 5 km. N Jalapa, 4500 ft., October 14, 1946.

Trogon massena massena Gould

Massena Trogon

Trogon massena Gould, Monogr. Trogonidae, pt. 3, 1838: pl. [4] and text [= pl. 16 of volume]. (México.)

Three ♂ (one skel.), 2 ♀ (one skel.), 20 km. ENE Jesús Carranza, 300 ft., March 20 and 23, 1949; 1 ♂ (skel.), 35 km. SE Jesús Carranza, 400 ft., February 19, 1948.

This large trogon was found only in extreme southern Veracruz. South of the Río Coatzacoalcos, it was common in the deep, uninhabited jungles. Birds of this species are rather inactive, sitting almost motionless on vines or branches for long periods, where in spite of their brilliant colors, they are inconspicuous. Usually they are found singly or in pairs, but two flocks of six to ten birds were seen. Possibly there was a fruit-laden tree in the vicinity that brought separate birds together from some distance. In Veracruz, trogons are called *mira-el-sol* by the natives.

Trogon citreolus melanocephalus Gould

Citreoline Trogon

Trogon melancephala Gould, Monogr. Trogonidae, pt. 2, 1835: pl. [6] [and text = pl. 12 of volume.] (State of Tamaulipas, México.)

Two ♂ (one skel.), 2 ♀ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 11 and 18, and September 30, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 15, 1947; 1 ♀, Jimba, 350 ft., March 2, 1947; 1 ♂ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 23, 1949; 1 ♂, 20 km. S Jesús Carranza, 300 ft., February 12, 1948.

This comparatively dull-colored trogon is common in the arid division of the Lower Tropical Life-zone. In the low jungle and thorny brushlands of the coastal plain, it lives closer to the ground than the trogons occupying the higher forests. It was never seen in the Upper Tropical Life-zone, where the other yellow-breasted species, *Trogon violaceus*, is common. Only a few Citreoline Trogons were seen in the jungles of extreme southern Veracruz. Like other trogons, *citreolus* is a rather sedentary species, and spends most of the day perched on some twig or vine.

Trogon collaris puella Gould

Jalapa Trogon

Trogon puella Gould, Proc. Zool. Soc. London, pt. 13, 1845: 18. (Escuintla, South America [probably Escuintla, Guatemala].)

One ♀, Cañada Blanca, 7 km. NW Paraje Nuevo, February 12, 1946; 1 ♀, 4 km. W Tlapocoyan, 1700 ft., October 15, 1947; 2 ♂, Río Atoyac, 8 km. NW Potrero, March 3 and 10, 1946; 1 ♀, 1 ♂, 7 km. NW Potrero, 1700 ft., December 28, 1946, and January 10, 1947; 1 ♂, 3 ♀, 3 km. N Presidio, 1500 ft., December 3-12, 1946; 2 ♀ (one skel.), 35 km. SE Jesús Carranza, 400 ft., February 16, 1948.

The Jalapa Trogon is most common in the Upper Tropical Life-zone, but is far less numerous there than the Gartered Trogon. It was seen only a few times in extreme southern Veracruz, and never on the coastal plain.

Near Presidio, trogons of this species and the following were watched while they are feeding in a low tree in the jungle. The tree bore an abundance of small, berrylike fruit, upon which other birds, especially thrushes and tanagers, were feeding. The Jalapa Trogons confined their attentions to the berries near the top of the tree, about ten feet from the ground. They did not perch in the fruit tree itself, but instead in nearby trees, at a slightly higher elevation. The fruit tree was approached with a silent glide and an upward swoop, so that the bird leaving its perch, dropped well below the level of the fruit and came up to it from below. They hovered a moment with a loud whirring and fluttering of wings in front of the berries as they snipped them from the cluster. The fruit seemed to be swallowed while the trogon was on the wing.

Near Potrero, a trogon of this species was seen to make two flycatcherlike flights outward away from its perch on a horizontal vine approximately fifty feet from the ground. After seeming to catch an insect, the bird returned to the vine. A Mexican assistant who retrieved a wounded trogon of this kind received a severe bite from the bird's powerful bill.

Trogon violaceus braccatus (Cabanis and Heine)

Gartered Trogon

Aganus braccatus Cabanis and Heine, Mus. Hein., Th. 4, Heft 1, 1862-63 [= 1863]: 184. (México; *cf.* Peters, Birds World, 5, 1945, p. 158 (note), and Carriker and de Schauensee, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 424.)

One ♀, 7 km. NW Potrero, 1700 ft., December 29, 1946; 6 ♂, 3 ♀ (one skel.), Río Atoyac, 8 km. NW Potrero, February 17-21, and March 10-20, 1946; 2 ♂ (LSUMZ), Potrero Viejo, January 23, 1938, and August 22, 1937.

The trim, little Gartered Trogon is abundant in the Upper Tropical Life-zone of Veracruz. Its small size and sedentary habits make it easy to overlook in the tall forest. Even when the birds are calling steadily, it is difficult to make out their plump forms in the leafy vegetation near the tops of the tall trees. Often, however, they feed in low trees, with thrushes and tanagers, on ripe berries and other fruit.

Family ALCEDINIDAE

Megaceryle torquata torquata (Linnaeus)

Ringed Kingfisher

Alcedo torquata Linnaeus, Syst. Nat., 1, ed. 12, 1766: 180. (México.)

One ♂, Puente Nacional, 500 ft., October 22, 1946; 1 ♂ (LSUMZ), Río Blanco, Matacabresto, 20 mi. NE Piedras Negras, December 19, 1937; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 15, 1946; 1 ♂, 20 km. ENE Jesús Carranza, 200 ft., April 28, 1949; 1 ♀ (skel.), 35 km. SE Jesús Carranza, 400 ft., February 19, 1948.

Martín pescador. The Ringed Kingfisher seems to be confined to the larger rivers. It is not uncommon on such rivers as the Antiguo, Jamapa, and Blanco in central Veracruz, and is abundant on the rivers Coatzacoalcos, Solosuchi, and Chalchijapa in southern Veracruz. When one travels by canoe on these rivers, the large kingfishers are almost constantly in sight, flying along the rivers or from perch to perch along the shores. Their rattling call is usually made when the bird is flying. When it plunges into the water after a fish, the splash caused by the kingfisher's large body can be heard for some distance. Several nests were seen in vertical banks of sand or claylike soil beside the rivers. Birds were entering and leaving the holes in May.

Chloroceryle amazona mexicana Brodkorb

Amazon Kingfisher

Chloroceryle amazona mexicana Brodkorb, Auk, 57, 1940: 543. (Barra de Cahuacán, Chiapas, México.)

One ♂, Puente Nacional, 500 ft., October 21, 1946; 1 ♀, 5 km. SE Boca del Río, October 10, 1946.

This is the least common of the four species of kingfisher found in the course of this study. It occurs, like *Megaceryle torquata,* most commonly at the lower elevations where the rivers are broad and sluggish.

Chloroceryle americana septentrionalis (Sharpe)

Green Kingfisher

Ceryle septentrionalis Sharpe, Cat. Birds Brit. Mus., 17, 1892: 134. (Teapa, Tabasco, México.)

One ♂ (skel.), Puente Nacional, 500 ft., October 21, 1948; 1 ♂, 5 km. SW Boca del Río, October 11, 1946; 1 ♀, Río Atoyac, 8 km. NW Potrero, February 19, 1946; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, Río Atoyac, October 25, 1938; 1 ♂ (LSUMZ), Paraje Nuevo, January 25, 1938; 1 ♂, 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 16 and 17, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 15, 1946; 1 ♀, 1 ♂, (skels.), Río Blanco, 20 km. W Piedras Negras, September 29 and October 1, 1946; 1 ♀ (skel.), 35 km. SE Jesús Carranza, 350 ft., April 6, 1949.

Martín del río. This is the commonest kingfisher found in Veracruz. It occurs throughout the Tropical Region, from the cold, crystal-clear streams at higher elevations to the broad, brown, sluggish rivers of the lowlands. It was seen also at ponds and lakes, and even at some temporary pools of rain water. It feeds principally on small fish, but may eat also insects, for occasionally it was seen to dive into the pools of rainwater where there could hardly have been any fish.

Chloroceryle aenea stictoptera (Ridgway)

Least Kingfisher

Ceryle superciliosa stictoptera Ridgway, Proc. Biol. Soc. Washington, 2, 1884: 95. (Sisal, Yucatán.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, May 16, 1946; 1 ♂, 30 km. ESE Jesús Carranza, 300 ft., May 10, 1949; 1 ♀, 35 km. SE Jesús Carranza, 350 ft., April 7, 1949; 2 ♀ (skels.), 30 km. SSE Jesús Carranza, 300 ft., May 12-13, 1949.

Martín del arroyo. This tiny species of kingfisher is rare in central Veracruz, and not common elsewhere. Only in the small, sluggish streams leading into tributaries of the Río Coatzacoalcos near its mouth, was it found to be even fairly common. Along the Río Chalchijapa and Río Solosuchi, a few birds were seen perched over pools left by the river as it receded during the dry season. As the water in the pools diminished, tiny fish and fish fry concentrated in great numbers, and dead and dying fish formed a skum over the surface. These probably served as food for the tiny kingfishers. Never was the species seen over the open water of the rivers. This, the natives stated, was because they feared the large fish. Certainly the abundant gars and other carnivorous fish could swallow *C. aenea* in a single gulp, but the same could be said for *C. americana,* which customarily fishes in the open rivers.

Family MOMOTIDAE

Hylomanes momotula momotula Lichtenstein

Tody-motmot

Hylomanes Momotula Lichtenstein, Abh. Akad. Wiss. Berlin for 1838 [= 1839]: p. 449, pl. 4. (Valley Real, México.)

One ♂, 2 ♀, 35 km. SE Jesús Carranza, 300 ft., February 12, 1948, and April 7 and 9, 1949.

The Tody-motmot was found only in extreme southern Veracruz. It is probably fairly common, but is a species that may be easily overlooked. It is, like most motmots, a sedentary bird. In addition it lives in the deepest, most shaded part of the jungle, and its disproportionately large head gives it a profile so unlike a bird that the collector is likely to overlook the species. Two of the three specimens listed were discovered almost by accident; one in a thicket of thorny ground palms beneath tall, dense jungle, and another in a gloomy gulch in the forest. Both birds were seen as they sat motionless on their perches, about six feet from the ground and approximately the same distance from the collector's eye. The third specimen was taken at night in a brushgrown, sandy delta of a dry arroyo beside the Río Solosuchi. The bird was roosting on a twig at about shoulder height, and looked pale in the beam of the hunting light. It was captured in the hand.

Electron carinatum (Du Bus)

Keel-billed Motmot

Prionites carinatus Du Bus, Bull. Acad. Roy. Sci. Belg., 14, 1847: 108. (Guatemala.)

One ♂, 30 km. SSE Jesús Carranza, 300 ft., May 12, 1949.

Gallina. While the party was traveling on the Río Chalchijapa and Río Solosuchi in 1948, a bird was heard on a number of occasions that the natives called "chicken." The call was a loud, far-reaching "cut-cut-cadack," strikingly like the cackle of a hen. It usually seemed to emanate from tall jungle trees on hillsides near the river. One native thought the bird was a kind of pigeon; another, a kind of pheasant. On several occasions, the canoe was beached and a hasty path slashed out in the direction of the sound. Each time, the calling would cease when we came near, and an hour of hard work would have been spent in vain. Throughout that season's work in the south, in spite of many efforts, the identity of the *gallina* remained a mystery. Early in 1949, the same kind of bird was once heard calling, but attempts to find it again ended in failure. Finally, on May 12, the field party was resting after a hurried scramble up a steep hillside after a *gallina* that ceased to call as soon as the top of the hill was reached. The hunters paused for about five minutes, to rest and to smoke cigarettes, and the bird was given up as lost; for past attempts to wait out the callers had always failed. Suddenly the *gallina* called from a tree overhead, perhaps forty feet from the ground. The sharp eyes of the native guide detected the bird, and a shot brought it down. The mysterious *gallina* was thus found to be this strange motmot, with its enormous serrated bill.

Momotus momota lessonii Lesson

Lesson Motmot

Momotus Lessonii Lesson, Rev. Zool., 1842: 174. (Realejo, Nicaragua.)

One ♂ (LSUMZ), Paraje Nuevo, Ojo de Agua, November 2, 1937; 2 ♂, Cañada Blanco, 7 km. NW Paraje Nuevo, February 12, 1946, and January 7, 1947; 2 ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, February 17—March 12, 1946; 2 unsexed (one skel.), Sala de Agua, 1500 ft., 8 km. S Potrero, February 10, 1946; 1 ♂, 3 km. N Presidio, 1500 ft., December 4, 1946; 4 ♂, Rio Blanco, 20 km. WNW Piedras Negras, March 17 and May 11, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 12, 1947; 2 ♀, Río Blanco, 20 km. W Piedras Negras, October 1, 1946; 1 ♀, 20 km. S Jesús Carranza, 300 ft., February 13, 1948.

Pájaro azul; pájaro coo; barrancaña. The Lesson Motmot is abundant throughout the Tropical Region of Veracruz. It is found in cool, shaded places in the jungle. Favored haunts include bases of cliffs, rocks, arroyos, dimly-lighted gulches, and deep forest. It is a sedentary bird and is by no means shy. It calls regularly in the morning and, less regularly, throughout the day. Its note is reminiscent of the call of a pigeon or owl, a hollow "hoot-hoot, hoot-

hoot-hoot." The sound is difficult to locate. Calling birds are usually well concealed in densely-leaved trees.

There is a rather long and involved Indian legend concerning the motmot, of which several versions were heard. According to the legend, the feathers of the motmot were contributed by all the other birds of the jungle, and were put in place on the motmot by the owl. In the light of the dawn the owl became blinded and the last feathers used included by mistake two worn-out feathers from the macaw, which went into the tail, and a pinch of feathers from the blackbird, which were inserted on the breast. The two anomalies in the feathering of the motmot are thus accounted for!

We follow Wetmore (1943: 268) in not recognizing *goldmani*. Two of the three specimens from Piedras Negras have no black on the crown, and in the third specimen only a trace is evident. None of the specimens shows an approach toward *coeruliceps*.

Family GALBULIDAE

Galbula melanogenia Sclater

Black-chinned Jacamar

Galbula melanogenia Sclater, Jardine's Contr. Orni., 1852: p. 61, pl. 90. (No locality given = Vera Paz, Guatemala; *cf.* Sclater, Mon. Jacamars and Puffbirds, 1879, p. 19.)

One ♂, 35 km. SE Jesús Carranza, 400 ft., February 18, 1948; 1 ♂ (skel.), 25 km. ESE Jesús Carranza, 400 ft., March 24, 1948.

The Jacamar was seen only in extreme southern Veracruz, near rivers and clearings in the jungle, where there was an abundance of low and unusually dense brush. In flight, the brilliant, iridescent green plumage of this bird is striking, but at rest the bird is almost impossible to see. Four individuals of this species were shot, but only two were recovered, so dense and thorny is the habitat where they customarily live. Probably less than ten others were seen.

Family RAMPHASTIDAE

Aulacorhynchus prasinus prasinus (Gould)

Emerald Toucanet

Pteroglossus prasinus Gould, Proc. Zool. Soc. London, 1834: 78. (México.)

One ♀, Río Atoyac, 8 km. NW Potrero, March 3, 1946; 1 ♀, 7 km. NW Potrero, 1700 ft., December 29, 1946; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, December 28, 1937; 1 ♂ (LSUMZ), El Faro, NW of Piedras Negras, May 4, 1938.

Pico verde. Toucanets are probably common in the forest of the Upper Tropical Life-zone. They occur in small groups, six to eight birds usually being seen together. The brilliant green color of this species matches closely the green of the tropical vegetation, and unless the birds are moving about, they are difficult to see. Those observed were usually only about thirty feet from the ground. The specimen shot by Forbes at El Faro was taken in the arid division of the Lower Tropical Life-zone, but this is the only record known to us from that area.

Pteroglossus torquatus torquatus (Gmelin)

Collared Araçari

Ramphastos torquatus Gmelin, Syst. Nat., 1, pt. 1, 1788: 354. (Central America.)

Four ♂, 3 ♀ (one skel.), Río Atoyac, 8 km. NW Potrero, February 20—March 12, 1946; 1 ♀, 8 km. NW Potrero, 1500 ft., February 13, 1946; 2 ♂, 1 ♀ (all LSUMZ), Potrero Viejo, March 7, 1938; 1 ♂ Río Blanco, 20 km. WNW Piedras Negras, May 12, 1946; 1 ♂, 3 km. N Presidio, 1500 ft., December 4, 1946; 1 ♀ (skel.), 20 km. E Jesús Carranza, February 14, 1948.

Pico real. The Collared Araçari is common in the Upper Tropical Life-zone; is fairly common in the humid division of the Lower Tropical Life-zone; and was seen but once in the arid division of the Lower Tropical Life-zone. The species usually occurs in small flocks of five to fifteen birds. The birds are usually conspicuous, and follow each other from tree to tree at short intervals. Most of their activities take place fifty feet or more above the ground. Rarely were birds of this species seen at less than thirty feet above the ground.

Ramphastos sulfuratus sulfuratus Lesson

Keel-billed Toucan

Ramphastos sulfuratus Lesson, Traité Orni., livr. 3, 1830: 173. (México.)

One unsexed (skel.), 3 km. W San Marcos, 200 ft., November 4, 1947; 3 ♂ (one skel.), 1 ♀ (skel.), 4 km. W Tlapacoyan, 1700 ft., October 16 and 17, 1947; 1 ♂, Río Blanco, 15 km. W Piedras Negras, 300 ft., November 20, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, 300 ft., November 25, 1946; 1 ♂ (LSUMZ), Piedras Negras, El Faro, 550 ft., December 18, 1937; 1 ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., March 19, 1948; 1 ♀ (skel.), 25 km. SE Jesús Carranza, 250 ft., April 1, 1949.

Pico canoa. The big toucan is not now found near Potrero Viejo, but there are old records from that general area, and several flocks were seen in the Upper Tropical Life-zone near Tlapacoyan. These birds were fairly common along the Río Blanco, and were abundant in southern Veracruz. Only near Tlapacoyan were they seen in flocks. Elsewhere only pairs and single birds were seen, although, it is true, most of the observations in southern Veracruz and on the coastal plain were made in April, May, and early June, when, perhaps, the species is paired for the breeding season. These toucans are rather inactive, and spend considerable time perched prominently on high limbs in the treetops, occasionally swinging their big bills from side to side. Their call, a low "croak-croak-croak," is given throughout the day. Toucans were found roosting at night on several occasions. They were not high in the trees as might be expected, but instead were on isolated branches of jungle trees, only twenty to twenty-five feet from the ground. In southern Veracruz the Keel-billed Toucan is considered a game species, and is shot for food on occasions.

Family PICIDAE

Centurus aurifrons veraecrucis (Nelson)

Golden-fronted Woodpecker

Melanerpes dubius veraecrucis Nelson, Auk, 27, 1900: 259. (Coatzacoalcos, Veracruz, México.)

One ♀ (skel.), Teocelo, 4500 ft., January 2, 1949; 1 ♂ (skel.), 5 km. ENE El Jobo, 600 ft., October 19, 1947; 1 ♀ (skel.), Potrero Viejo, 1700 ft., October 23, 1947; 2 ♂ (LSUMZ), Paraje Nuevo, 1700 ft., April 4, 1938; 2 ♂ (one skel.), 1 ♀, Río Atoyac, 8 km. NW Potrero, February 21—March 20, 1946; 1 ♀, 2 ♂ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 13 and 14, and September 29, 1946; 2 ♂ (one skel.), 3 km. E San Andrés Tuxtla, 1000 ft., January 19, 1948; 1 ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 26, 1949.

Chíncheri. The Golden-fronted Woodpecker occurs throughout the Tropical Life-zones of Veracruz, and is usually the commonest woodpecker found in any locality. Although other races are known to occur in the state, only *veraecrucis* is represented among the skins available in the present collections; the skeletal material was not determined subspecifically.

Balanosphyra formicivora formicivora (Swainson)

Ant-eating Woodpecker

Picus formicivorus Swainson, Philos. Mag., n. s., 1, no. 6, June, 1827: 439. (Temascaltepec, México.)

Two ♂ (skels.), 15 km. ENE Tlacotepec, 1500 ft., December 10 and 12, 1947.

This wide-ranging species is fairly common in the low-lying oak forest between the Upper Tropical Life-zone and the arid division of the Lower Tropical Life-zone. The oak belt is now much reduced in area both because it is the most fertile part of the level land, and consequently is much utilized for agriculture, and because the oak makes a superior grade of charcoal that has resulted in processing most of the trees.

Piculus rubiginosus aeruginosus (Malherbe)

Lichtenstein Woodpecker

Chrysopicus aeruginosus Malherbe, Mon. Picidae, 2, 1862: 171. (México.)

One ♂ (LSUMZ), Potrero Viejo, August 20, 1937.

This specimen from Potrero Viejo shows no approach to *Piculus rubiginosus yucatanensis,* which is known to occur in southern Veracruz, at least as far north as Presidio and Montzorongo, and possibly as far as Orizaba (Ridgway, 1914: 132). If *P. rubiginosus* does occur at Orizaba, only twenty miles east of Potrero Viejo, the two forms may be sympatric and further investigation may show that *rubiginosus* and *aeruginosus* are not conspecific.

Celeus castaneus (Wagler)

Chestnut-colored Woodpecker

Picus castaneus Wagler, Isis, 1829: 515. (No locality given; restricted to Veracruz, México, by Cory, Publ. Field Mus. Nat. Hist., zoöl. ser., 13, pt. 2, Dec. 31, 1919, p. 453.)

One ♂, 3 km. ESE Jesús Carranza, 300 ft., May 10, 1949; 1 ♀, 35 km. SE Jesús Carranza, 400 ft., April 30, 1948.

This woodpecker was found only in the deep jungles of extreme southern Veracruz. A few individuals were seen each day spent along the Río Solosuchi and Río Chalchijapa, in April, May, and June, in 1948 and 1949.

Dryocopus lineatus similis (Lesson)

Lineated Woodpecker

Picus similis Lesson, Oeuvres complétes de Buffon, 20, April, 1847: 204. (San Carlos, El Salvador.)

Two ♂, Río Atoyac, 8 km. NW Potrero, March 9 and 13, 1946; 3 ♂ (skels.) 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 11-26; 1946; 1 ♀, Río Blanco, 20 km. W Piedras Negras, October 1, 1946.

Carpintero. This large species is found throughout the Tropical Region of Veracruz and, next to the Golden-fronted Woodpecker, is the most common woodpecker found in the state. The wing measurements of our skins are 172, 172, 175, 181 mm.

Phloeoceastes guatemalensis regius (Reichenbach)

Guatemalan Ivory-billed Woodpecker

Campephilus regius Reichenbach, Handb. Spec. Orni., Scansores, Picinae, 1854: p. 393, pl. 649, figs. 4331-4332. (Papantla, Veracruz.)

One ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 21, 1949.

Veniliornis fumigatus oleaginus (Lichtenstein)

Oleaginous Woodpecker

Picus oleaginus Lichenstein, Preis-Verz. Vögel. Mex., 1830: 1. (México.)

One ♂, Río Atoyac, 8 km. NW Potrero, March 3, 1946.

This interesting woodpecker was seen only once, on a dead tree trunk, about six feet from the ground in the dense forest of a hill-side in the Upper Tropical Life-zone.

Dendrocopos villosus jardinii (Malherbe)

Hairy Woodpecker

Picus (Leuconotopicus) jardinii Malherbe, Rev. Zool. 1845: 374. (Veracruz, México; *cf.* Cory, Field Mus. Nat. Hist., zool. ser., 13, pt. 2, Dec. 31, 1919, p. 488.)

One ♂, 3 km. E Las Vigas, 8000 ft., November 1, 1946.

The Hairy Woodpecker is not uncommon in the pine forest near Las Vigas. It was not seen elsewhere.

Dendrocopos scalaris ridgwayi (Oberholser)

Ladder-backed Woodpecker

Dryobates scalaris ridgwayi Oberholser, Proc. U. S. Nat. Mus., 41, 1911: p. 140, in key, p. 143. (Jáltipan, Veracruz, México.)

One ♀, 4 km. W Paso de San Juan, 250 ft., December 15, 1948; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 27, 1946; 1 ♀ (skel.), Río Blanco, 20 km. W Piedras Negras, October 6, 1946; 1 ♀ (LSUMZ), Matacabresto, above Piedras Negras, 500 ft., November 4, 1937.

The Ladder-backed Woodpecker was noted on only a few occasions, in the jungle at low elevations.

Family DENDROCOLAPTIDAE

Xiphorhynchus flavigaster saltuarius Wetmore

Ivory-billed Woodhewer

Xiphorhynchus flavigaster saltuarius Wetmore, Auk, 59, 1942: 266. (Altamira, Tamaulipas, México.)

One ♀, 4 km. E Papantla, 400 ft., November 10, 1947.

This specimen is definitely paler on the under parts than specimens from farther south in Veracruz, and is therefore assignable to *saltuarius* instead of *eburneirostris*. In this regard the examples taken in the Potrero region are somewhat intermediate, but they are closer to the latter, to which they are here provisionally referred.

Xiphorhynchus flavigaster eburneirostris (Des Murs)

Ivory-billed Woodhewer

Dryocopus eburneirostris Des Murs, Iconog. Orni., livr. 9, 1847: pl. 52, with text. (Realejo, Nicaragua.)

One ♂ (skel.) 5 km. ENE El Jobo, 600 ft., October 19, 1947; 1 ♀, Río Atoyac, 8 km. NW Potrero, February 19, 1946; 1 ♂, 7 km. NW Potrero, 1700 ft., January 10, 1947; 1 ♂, 2 km. N Motzorongo, 1500 ft., December 7, 1946, 1 ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., February 10, 1948.

Lepidocolaptes souleyetii insignis (Nelson)

Streaked-headed Woodhewer

Picolaptes compressus insignis Nelson, Auk, 14, 1897: 54. (Otatitlán, Veracruz, México.)

One ♂, 2 km. N Motzorongo, 1500 ft., December 10, 1946; 1 ♀, 20 km. S Jesús Carranza, 300 ft., March 20, 1948; 1 ♂, 1 ♀, skels., 20 km. ENE Jesús Carranza, 200 ft., March 20-21, 1949.

This species seems to be far less common than *Xiphorhynchus flavigaster* and was not detected north of the vicinity of Motzorongo.

Glyphorynchus spirurus pectoralis Sclater and Salvin

Wedgebill

Glyphorhynchus pectoralis Sclater and Salvin, Proc. Zool. Soc. London. 28, 1860: 299. (Vera Paz, Guatemala.)

One ♀, 35 km. SW Jesús Carranza, 400 ft., February 19, 1948.

The specimen taken was working up the side of a tree in the deep jungle, in much the manner of a Brown Creeper.

Sittasomus griseicapillus sylviodes Lafresnaye

Mexican Sittasomus

Sittasomus sylviodes Lafresnaye, Rev. et Mag. Zool., (2), 2, 1850: 590. (Mexique; restricted to Veracruz, México, by Bangs and Peters, Bull. Mus. Comp. Zoöl., 68, 1928, p. 392.)

One unsexed (LSUMZ), Potrero Viejo, August 22, 1938; 1 ♂, Río Atoyac, 8 km. NW Potrero, March 3, 1947.

This little dendrocolaptid was seen several times, always near the bases of tall trees in dense forest in the Upper Tropical Life-zone.

Family FURNARIDAE

Synallaxis erythrothorax furtiva Bangs and Peters

Rufous-breasted Synallaxis

Synallaxis erthrothorax furtiva Bangs and Peters, Bull. Mus. Comp. Zoöl., 67, Jan., 1927: 476. (Presidio, Veracruz, México.)

One ♂, Río Atoyac, 8 km. NW Potrero, March 11, 1947; 1 ♀ (LSUMZ) and 1 ♂, 1 unsexed, (skels.), Potrero Viejo, August 22, 1938, and April 24, 1949; 1 ♀, 20 km. ENE Jesús Carranza, 200 ft., April 10, 1949; 1 ♀, 1 ♂ (skel.), 20 km. ENE Jesús Carranza, 300 ft., February 23 and March 20, 1948.

These little birds are fairly common in the Upper Tropical Life-zone and in the humid division of the Lower Tropical Life-zone. They are inconspicuous, living in thickets and brushy places. Their actions are much like those of wrens, which they resemble also in appearance and the display of curiosity. One specimen was taken on the ground, in a banana-baited mouse trap set beneath a bush. One nest was placed in a mass of dense vines beside a stump, about three feet from the ground. Another was about six feet from the ground in a dense bush, which was one of six or eight bushes growing as an isolated thicket, twenty-five feet from a spring. A third nest was placed on the horizontal dead limb that jutted out about three feet over the water of a river. The shore was covered with dense brush that enveloped the base of the limb. This nest was about six feet from the surface of the water. All three of the nests were found in April and May. All were crude, unlined structures, composed of small twigs with numerous openings extending completely through the nest. The one on the horizontal limb, perhaps unfinished, was in the form of a cup, about four inches in diameter by three inches in height. The other two nests were nearly spherical, and about five inches in diameter.

Our Veracruz specimens, as well as the large series in Washington, fail to demonstrate clearly the alleged characters of this race. Indeed, nearly all of the specimens examined by us are indistinguishable from examples of *erythrothorax* taken in Guatemala.

Automolus ochrolaemus cervinigularis (Sclater)

Buff-throated Automolus

Anabates cervinigularis P. L. Sclater, Proc. Zool. Soc. London, 24, 1856 [= 1857]: 288. (Córdoba, Veracruz, México.)

One ♀, 30 km. SSE Jesús Carranza, 300 ft., May 11, 1949.

Sclerurus mexicanus mexicanus Sclater

Mexican Sclerurus

Sclerurus mexicanus P. L. Sclater, Proc. Zool. Soc. London, 24, 1856 [= 1857]: 290. (Córdoba, Veracruz, México.)

One ♀ (LSUMZ), Potrero Viejo, August 22, 1938.

Sclerurus guatemalensis guatemalensis (Hartlaub)

Guatemalan Sclerurus

Tinactor guatemalensis Hartlaub, Rev. Zool., 7, 1844: 370. (Guatemala.)

One ♀, 30 km. SSE Jesús Carranza, 300 ft., May 12, 1949.

This species has been recorded only from Jico, on such an uncertain basis that Loetscher (MS) hesitated to include it in the state list. The above specimen may, therefore, be regarded as the first indubitable record.

Family FORMICARIDAE

Thamnophilus doliatus intermedius Ridgway
Mexican Antshrike

Thamnophilus doliatus intermedius Ridgway, Proc. U. S. Nat. Mus., 10, Aug., 1888: 581. (Trujillo, Honduras; *cf.* Peters, Bull. Mus. Comp. Zoöl., 69, 1929, p. 439.)

One ♂, 15 km. W Piedras Negras, 300 ft., January 12, 1946; 1 ♂, 20 km. ENE Jesús Carranza, 200 ft., March 23, 1949.

This species seems to be uncommon in Veracruz. Perhaps a dozen individuals were seen, always in dense, thorny brush of less than five feet in height.

Microrhopias quixensis boucardi (Sclater)
Boucard Antwren

Formicivora boucardi P. L. Sclater, Proc. Zool. Soc. London, 26, 1858: 300. (Acatepec, Oaxaca, México.)

One ♂, 25 km. SE Jesús Carranza, 250 ft., April 1, 1949.

This antwren was noted only a few times, in extreme southern Veracruz. It resembles a small warbler or flycatcher in its actions.

Formicarius analis moniliger Sclater
Mexican Antthrush

Formicarius moniliger P. L. Sclater, Proc. Zool. Soc. London, 24, 1856 [= Jan., 1857]: 294. (Córdoba, Veracruz, México.)

One ♀, 1 [♂], 35 and 60 km. SE Jesús Carranza, 350 and 450 ft., April 9, 1949, and March 20, 1948.

The Mexican Antthrush is a common species in the jungles of extreme southern Veracruz. It is a ground-inhabiting species, quick to run when alarmed, but taking flight only when surprised. When running, antthrushes resemble tiny tinamous. They are inconspicuous birds, and can be seen only by sitting motionless in the forest for some time.

Grallaria guatimalensis guatimalensis Prévost and Des Murs
Guatemalan Antpitta

Grallaria guatimalensis Prévost and Des Murs, Voyage autour du Monde sur . . . la *Vénus,* Zool., Atlas, 1, 1846 [= 1842]: pl. 4. (Guatemala.)

One ♀, 30 km. SSE Jesús Carranza, 300 ft., May 7, 1949.

The only specimen taken was shot in a thicket beside a river, deep in the jungle. The observer was sitting motionless, with his back against a tree, when the bird came from behind with a swish of wings and perched on a twig six feet away. It resembled a large thrush that had lost its tail.

Family COTINGIDAE

Rhytipterna holerythra holerythra (Sclater and Salvin)

Rufous Mourner

Lipaugus holerythrus Sclater and Salvin, Proc. Zool. Soc. London, 28, 1860: 300. (Choctum, Vera Paz, Guatemala.)

One ♀, 35 km. SE Jesús Carranza, 400 ft., February 18, 1948; 1 ♂, 20 km. SE Jesús Carranza, 250 ft., May 2, 1949.

Aside from a single Verreaux specimen in the United States National Museum labeled "Mexique," and Salvin and Godman's noncommittal ascription of the species to Mexico (1891: 131) based probably on a skin in the British Museum also labeled simply "Mexico," there seem to have been no other records for the Republic until its recent collection in Oaxaca (Blake, 1949: 2) and in Veracruz in the course of the present study, when it was observed in numbers in the jungles of extreme southern Veracruz. There, beside the Río Chalchijapa and Río Solosuchi, it was one of the more common birds. It was usually seen on or near the ground, and in the shade. It resembles somewhat an ant tanager in its actions. Birds in copulation were noted in early May, 1949.

Platypsaris aglaiae sumichrasti Nelson

Rose-throated Becard

Platypsaris aglaiae sumichrasti Nelson, Auk, 1897: 52. (Otatitlán, Veracruz, México.)

One ♂, 5 km. N Jalapa, 4500 ft., October 18, 1946; 1 ♂ (skel.), 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 17 and 25, 1946.

Copetón. This bird is common in the arid division of the Lower Tropical Life-zone. It was seen only once in the Upper Tropical Life-zone.

The Jalapa specimen is immature and cannot be subspecifically identified with certainty. It is, however, somewhat darker throughout than immature examples of *gravis* and is therefore assigned to the southern race.

Tityra semifasciata personata Jardine and Selby

Mexican Tityra

Tityra personata Jardine and Selby, Illust. Orni., 1, pt. 2, June, 1827: pl. 24. (Real del Monte, Hidalgo, México.)

One ♂ (skel.), Potrero Llano, 350 ft., February 11, 1949; 2 ♂ (one skel.), 1 ♀, Río Atoyac, 8 km. NW Potrero, February 18—March 3, 1946; 1 ♂, Ojo de Agua, 8 km. NW Paraje Nuevo, February 12, 1946; 3 ♂, 2 ♀ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 16—25, 1946; 1 ♂ (LSUMZ), below Yanga toward Cuitlahuac, January 12, 1938; 1 ♂ (LSUMZ), San Francisco de las Mesillas near Yanga, January 12, 1938.

Goyo. This tityra was one of the most common and prominent birds noted in the forests and jungles of Veracruz. It was found throughout the Tropical Region, wherever there were tall trees. Most of its activities were carried on at fifty feet or more above the ground, but occasionally, where there were low trees or high bushes laden with fruit, it descended to feed with the ant tanagers and thrushes. It is not a shy species, but is relatively inactive save when feeding.

Erator inquisitor fraserii (Kaup)

Inquisitive Tityra

Psaris fraserii Kaup, Proc. Zool. Soc. London, 19, 1851 [= Oct., 1852]: p. 47, pls. 37 and 38. (Locality unknown = Veracruz, México; *cf.* Hellmayr, Publ. Field Mus. Nat. Hist., zoöl. ser., 13, pt. 6, 1929, p. 223.)

One ♀ (LSUMZ), Paraje Nuevo, 1700 ft., March 6, 1938.

Family PIPRIDAE

Pipra mentalis mentalis Sclater

Yellow-thighed Manakin

Pipra mentalis Sclater, Proc. Zool. Soc. London, 24, 1856 [= January, 1857]: p. 299, pl. 121. (Córdoba, Veracruz, México.)

Two ♂, 15 km. SW Jimba, 750 ft., March 5, 1947; 3 ♂, 35 km. SE Jesús Carranza, 350 ft., April 7, 1949.

A few small bands of these little birds were seen in extreme southern Veracruz, near Jesús Carranza. They seem to buzz, almost crackle, when they fly. The sound is much sharper than that of a hummingbird.

Manacus candei (Parzudaki)

Candé Manakin

Pipra candei Parzudaki, Rev. Zool., 4, 1841: 306. (Trujillo, Honduras.)

One ♂, 20 km. ENE Jesús Carranza, 200 ft., March 22, 1949.

On the Río Coatzacoalcos, the Indians stated that a very pretty little bird lived by a small spring in the jungle. They commonly watered their horses at this spring, and the bird always flew up and perched on a twig to chirp at them. When the spring was visited in search of the bird, the Indian guide swung off his horse, walked down the slight declivity to the spring, looked about for a moment, lifted his gun, fired, and brought down the handsome little manakin listed above. The purpose of an hour's ride was achieved in about two minutes. The species seems to be solitary and confined to a small home range. No others were seen, nor were others known to the natives.

Family TYRANNIDAE

Sayornis nigricans nigricans (Swainson)

Black Phoebe

Tyrannula nigricans Swainson, Philos. Mag. (n. s.), 1, May, 1827: 367. (Tableland of México.)

One ♀, 4 km. WNW Fortín, 3200 ft., April 5, 1946; 1 ♂ (skel.), Río Blanco, 20 km. WNW Piedras Negras, May 27, 1946.

In Veracruz, Black Phoebes are restricted to the vicinity of water. They perch on stones, logs, and twigs, usually over the surface of streams and ponds. Nests of the species were found in niches in limestone cliffs and clay banks beside the Río Solosuchi and Río Chalchijapa in April and May, 1948 and 1949.

In *S. n. semiatra* the under tail coverts are pure white, whereas in *S. n. nigricans* the under tail coverts are well marked with shaft streaks of black (never pure white). The latter condition obtains in our specimens that are listed above. Also, since in these specimens the under tail coverts are not solid black and since the white of the abdominal patch is not restricted, there is no basis for considering them to be *S. n. aquaticus*, a race recently recorded from Chiapas by Blake (1949: 2).

Sayornis saya saya (Bonaparte)

Say Phoebe

Muscicapa saya Bonaparte, Amer. Orni., 1, 1825: p. 20, pl. 11, fig. 3. (Arkansas River, twenty miles from the Rocky Mountains.)

One ♀, 2 km. W Limón, 7500 ft., September 26, 1948.

The Say Phoebe is common on the desert near Limón and Perote in October and November.

Pyrocephalus rubinus blatteus Bangs

Vermilion Flycatcher

Pyrocephalus rubinus blatteus Bangs, Proc. Biol. Soc. Washington, 24, 1911: 189. (Sabune District, British Honduras.)

One ♂ (skel.), 5 km. W Tehuatlán, 700 ft., November 15, 1947; 1 ♀, 5 km. ENE El Jobo, 600 ft., October 18, 1947; 1 ♀ (LSUMZ), Potrero Viejo, February 10, 1938; 2 ♀, 1 ♂, all LSUMZ, Paraje Nuevo, January 6 and February 5 and 10, 1938; 1 ♂, 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946; 3 ♂ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 12 and 13, 1946; 1 ♂, Río Blanco, 20 km. W Piedras Negras, 400 ft., October 3, 1946; 1 ♂, 15 km. W Piedras Negras, 300 ft., January 12, 1947.

Lagunita. This species is uncommon in the Upper Tropical Life-zone. On the coastal plain, however, with its grasslands and scattered trees, it is abundant. On the basis of the material listed above, as well as on the basis of that which was examined in the United States National Museum, it is apparent that size (notably wing length) diminishes from north to south in the state of Veracruz. Wetmore (1943: 284) has already shown that material from San Andrés Tuxtla is definitely referable to *blatteus,* as evidenced by wing measurements in his material ranging from 74 to 77 mm. in males, and 72.7 to 73.4 mm. in females. In the present material, the wings of males from Piedras Negras range from 73.4 to 76.3, and hence may be regarded also as *blatteus.* Farther north, however, in the region of Potrero, males average considerably larger—77.6 to 81.9 mm. A single female from El Jobo has the wing exceptionally long (84.0 mm.) and is possibly a migrant from still farther north in Mexico where birds of this size occur and are known under the name of *mexicanus.*

Muscivora forficata (Gmelin)

Scissor-tailed Flycatcher

Muscicapa forficata Gmelin, Syst. Nat., 1, pt. 2, 1789: 931. (In nova Hispania = México.)

One ♂, 1 ♀ (skel.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 3, 1946; 1 ♂ (LSUMZ), Piedras Negras, below El Faro, 450 ft., October 20, 1937; 2 ♂ (LSUMZ), Piedras Negras, below El Faro, 500 ft., October 20, 1937, and December 17, 1938.

Tijereta. In the first week of October these birds were abundant on the coastal plain near Piedras Negras. Flocks of ten to 100 were perched on weed stalks, bushes, and other low vegetation. A few individuals of *Muscivora tyrannus* were with them. The December 17 specimen listed above probably constitutes the first winter record for the species in the state.

Muscivora tyrannus monachus (Hartlaub)

Forked-tailed Flycatcher

Tyrannus (Milvulus) monachus Hartlaub, Rev. Zool., 7, 1844: 214. (Guatemala.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, May 27, 1946; 1 ♂ (skel.), Río Blanco, 20 km. W Piedras Negras, October 3, 1946.

Tijereta. This species is an uncommon resident on the coastal plain. One pair that lived near Piedras Negras in May, 1946, fed almost entirely over water. A few were noted there with large flocks of *Muscivora forficata* in October, 1946.

Tyrannus melancholicus chloronotus Berlepsch

Melancholy Kingbird

Tyrannus chloronotus Berlepsch, Ornis, 14, 1907: 474. (Temax, Yucatán.)

One ♂, 2 ♀ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, May 27-30, 1946; 1 ♀, 15 km. W Piedras Negras, January 15, 1947; 1 ♀ (LSUMZ), Piedras Negras, 450 ft., May 2, 1938.

This species was found only in the arid division of the Lower Tropical Life-zone.

Legatus leucophaius variegatus (Sclater)

Striped Flycatcher

Elaenia variegata P. L. Sclater, Proc. Zool. Soc. London, 1856 [= 1857]: 297. (Córdoba, Veracruz, México.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, May 13, 1946.

Myiodynastes luteiventris luteiventris Sclater

Sulphur-bellied Flycatcher

Myiodynastes luteiventris P. L. Sclater, Proc. Zool. Soc. London, 1859: 42. (Orizaba, Veracruz, México.)

Four ♂ (three skels.), 3 ♀ (skels.), Río Blanco, 20 km. WNW Piedras Negras, May 13-27, 1946.

Coptón. This species is common on the coastal plain. It is aggressive, chasing even large birds from the vicinity of its perch.

Megarhynchus pitangua mexicanus (Lafresnaye)

Boat-billed Flycatcher

Scaphorhynchus mexicanus Lafresnaye, Rev. et Mag. Zool., 3, 1851: 473. (México.)

One ♀ (skel.), 5 km. ENE El Jobo, 600 ft., October 18, 1947; 2 ♂ (one skel.), 1 ♀, Río Atoyac, 8 km. NW Potrero, February 17—March 13, 1946; 1 ♂ (LSUMZ), Potrero, August 20, 1937; 1 ♂ (LSUMZ), Piedras Negras, N El Faro, May 2, 1938.

Peche amarillo. This flycatcher is common in the Upper Tropical

Life-zone. The Forbes specimen from Piedras Negras, on the coastal plain, shows the presence of the species in the arid division of the Lower Tropical Life-zone, although it seems to be rare there.

Myiozetetes similis texensis (Giraud)

Social Flycatcher

Muscicapa texensis Giraud, Desc. Sixteen New Species Birds, 1841: pl. 1. (Texas = [probably] Veracruz, México.)

One ♂ (LSUMZ), Potrero Viejo, February 24, 1938; 2 ♀ (one skel.), Potrero Viejo, 5 km. W Potrero, May 23, 1946, and September 30, 1947; 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 25, 1946.

Pitangus sulfuratus texanus van Rossem

Derby Flycatcher

Pitangus sulfuratus texanus van Rossem, Trans. San Diego Soc. Nat. Hist., 9, April 30, 1940: 82. (Brownsville, Texas.)

One ♀ (skel.), 3 km. W Boco del Río, 25 ft., September 28, 1947; 1 ♀, Río Atoyac, 8 km. NW Potrero, March 8, 1946; 1 ♀ (skel.), Potrero Viejo, 1700 ft., October 23, 1947; 1 ♂ (skel.), 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946; 2 ♀, Río Blanco, 20 km. WNW Piedras Negras, March 17 and May 25, 1946.

Peche amarillo. This species is probably the commonest and most prominent flycatcher in the arid division of the Lower Tropical Life-zone; it is slightly less common in the Upper Tropical Life-zone than *Megarhynchus pitangua,* which it closely resembles in life.

As stated by van Rossem (1940: 82), central Veracruz lies in the region of intergradation between *texanus* and *guatimalensis.* The skins listed above bear out this statement. One female from near Piedras Negras has as much white on the frontal area as most specimens of *texanus* examined in the present connection, whereas the Río Atoyac female, actually taken farther north, is almost identical with certain specimens of *guatimalensis* that we have studied. Our three specimens from Río Atoyac and Piedras Negras measure as follows: wing, 111, 119, 124 mm.; tail, 88, 89, 97 mm., respectively. This again indicates the variability of the species in central Veracruz.

Myiarchus tyrannulus cooperi Baird

Mexican Crested Flycatcher

Myiarchus cooperi Baird, in Baird, Cassin, and Lawrence, Rept. Expl. R. R. Pac., 9, 1858: 180. (México; *cf.* Deignan, Condor, 51, 1949, p. 270.)

One ♂ (skel.), 4 km. W Paso de San Juan, 250 ft., December 16, 1947; 1 ♂, 15 km. ESE San Juan de la Punta, 400 ft., September 27, 1946.

The Paso de San Juan specimen listed above appears to constitute the first winter record for this species in Veracruz.

Myiarchus tuberculifer lawrenceii (Giraud)

Dusky-capped Flycatcher

Muscicapa lawrenceii Giraud, Desc. Sixteen New Species Birds, 1841: p. [9], pl. [2], fig. 1. (Texas = Nuevo León, México.)

One ♀, Río Atoyac, 8 km. NW Potrero, March 5, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 27, 1946.

Nuttallornis borealis (Swainson)

Olive-sided Flycatcher

Tyrannus borealis Swainson, Fauna Bor.-Amer., 2, 1831 [= Feb., 1832]: p. 141, pl. 35. (Cumberland House [= Carelton House], Saskatchewan.)

One ♂ (LSUMZ), Potrero Viejo, January 23, 1938.

The specimen taken by Forbes at Potrero Viejo on January 23 appears to be the first known instance of the occurrence of this species in Veracruz in winter.

Contopus richardsonii sordidulus Sclater

Western Wood Pewee

Contopus sordidulus Sclater, Proc. Zool. Soc. London, 27, June, 1859: 43. (Southern México and Guatemala; the marked type in British Museum is from Orizaba.)

One unsexed (skel.), 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946.

This specimen is a skeleton. Before being cleaned, however, the wing (with primaries intact) was carefully measured, as was also the tail. These measurements fell within the limits assigned by Ridgway (1907: 525) to this resident race.

Contopus pertinax pertinax Cabanis and Heine

Swainson Pewee

Contopus pertinax Cabanis and Heine, Mus. Hein., 2, 1859: 72. (Jalapa, Veracruz, México.)

One ♂, 4 ♀, all LSUMZ, Jalapa, May 27 and 29, 1949.

Empidonax flaviventris (Baird and Baird)

Yellow-bellied Flycatcher

Tyrannula flaviventris W. M. and S. F. Baird, Proc. Acad. Nat. Sci. Philadelphia, 1, July—Aug. [Sept. 18], 1843: 283. (Carlisle, Pennsylvania.)

One ♂, 4 km. W Tlapacoyan, 1700 ft., October 15, 1947; 1 ♀ (LSUMZ), 3.5 mi. S Jalapa, May 28, 1949; 1 ♀, Río Atoyac, 8 km. NW Potrero, March 21, 1946; 1 ♂, Potrero Viejo, 1700 ft., October 24, 1948; 1 ♂ (LSUMZ), 1 mi. W Fortín, 3200 ft., May 25, 1949; 2 unsexed (skels.), 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 18, 1946.

Empidonax traillii brewsteri Oberholser

Alder Flycatcher

Empidonax traillii brewsteri Oberholser, Ohio Journ. Sci., 18, 1918: 93. (Cloverdale, Nye County, Nevada.)

One ♂ (LSUMZ), Jalapa, May 27, 1949.

The specimen taken at El Conejo on May 15, 1940, and identified by Wetmore (1943: 290) as *E. t. traillii* appears to be the only previous example of the Alder Flycatcher from Veracruz. The individual listed above, shot by Robert J. Newman at Jalapa on the late date of May 29, is apparently, therefore, only the second of its species to be collected in the state, and the first of the race *brewsteri*, to which it is definitely assignable. Previous to either of these records, however, Loetscher (MS) had included the Alder Flycatcher in the Veracruz list on the basis of a bird seen and heard by him at Coatepec on May 5, 1939.

Empidonax minimus (Baird and Baird)

Least Flycatcher

Tyrannula minima W. M. and S. F. Baird, Proc. Acad. Nat. Sci. Philadelphia, 1, July-Aug. [Sept. 18], 1843: 284. (Cumberland County, Pa. = Carlisle, Pennsylvania.)

Two ♂, Río Atoyac, 8 km. NW Potrero, March 8 and 11, 1946; 1 ♀, 15 km. ESE San Juan de la Punta, 400 ft., September 27, 1946; 1 ♀, 3 km. E San Andrés Tuxtla, 1000 ft., January 19, 1948.

Empidonax albigularis axillaris Ridgway

White-throated Flycatcher

Empidonax axillaris Ridgway, in Baird, Brewer, and Ridgway, Hist. N. Amer. Birds, 2, 1874: 363. (Orizaba, Veracruz.)

One ♀ (LSUMZ), Jalapa, May 27, 1949.

Empidonax fulvifrons rubicundus Cabanis and Heine

Fulvous Flycatcher

Empidonax rubicundus Cabanis and Heine, Mus. Hein., 2, 1859: 70, footnote. (México.)

One ♀ (LSUMZ), Las Vigas, 7800 ft., May 30, 1949.

Since, as is well known, Giraud's type of *Muscicapa fulvifrons* (1841) in all probability did not come from Texas as stated, but instead was taken somewhere in Mexico, it would be desirable to restrict the type locality by referring the type specimen to some definite population in that Republic. One reason why this has not been done already is the fact that the type of *fulvifrons* long has been considered unique in respect to length of wing and tail. The wing measures 66.5 mm., the tail, 57 mm. (Ridgway, 1907, p. 588, gives the wing as 68 mm.), whereas other examples of this species from Mexico and the United States are much smaller. Since all of the birds described by Giraud are of the sort that could have been taken on one of the two roads existing in his time that lead from Veracruz to Mexico City, it would seem desirable on first consideration to restrict the type locality of each of Giraud's new birds to some place located on either of these routes. This has been done in some cases. However, there is actually no sound basis for assuming that all sixteen of the "new" birds were of common origin. Indeed, Giraud possessed a number of collections that obviously came from diverse sources. Moreover, to assume that this type of *Muscicapa fulvifrons* came from Veracruz imposes serious difficulties, since examples of the species from that general area are assignable to *E. f. rubicundus*. Recently we have examined a specimen of *fulvifrons* belonging to the Museum of Comparative Zoölogy, which was taken by W. W. Brown at Miquiahuana, Tamaulipas. The measurements of this specimen meet fairly satisfactorily the specifications of the type in that the wing is 64.1 mm. in length and the worn tail is 51.4 mm. If populations from northeastern Mexico are given the name *fulvifrons*, the argument might, nevertheless, be advanced that Giraud's type was a migrant, for instance, from Tamaulipas, that in winter had moved down to that part of the state of Veracruz that was transected by one of the two highways which then extended from the east coast to Mexico City; in other words the type of *fulvifrons* still might have come from Veracruz. Since the subspecies *rubicundus* also has an indefinite type locality (that is to say, "Mexico"), and since, as noted above, breeding populations from central Veracruz are referable to this subspecies, it would be logical, eventually, to restrict the type locality of *rubicundus* to some locality outside of that state so as to avoid placing the type locality of both *fulvifrons* and *rubicundus* in the same area. The best course, however, would seem to be to restrict *fulvifrons* to Miquiahuana, Tamaulipas, the only locality from which there is a specimen that agrees closely with the type.

If the name *fulvifrons* is applied to the populations of the species occupying northeastern Mexico, a re-characterization of this population is necessary since Ridgway's description (*loc. cit.*) was based on Giraud's greatly faded type, which was at one time a mounted specimen. We now have for study a male and female specimen from Miquiahuana, Tamaulipas (M. C. Z.), and one male and three females, in unworn plumage, from Pendencia, San Luis Potosí (LSUMZ). Both of these two population samples average larger (four females: wing, 59.1-60.7, avg. 60.1 mm.; tail, 48.9-53.3, avg. 50.5 mm.) than populations of *rubicundus* (four females from Morelia, Las Vigas, and Río Frio: wing, 56.6-59.2, avg. 57.9 mm.; tail, 47.0-50.2, avg. 48.3 mm.). The San Luis Potosí material comes from a locality only sixty-five miles from Miquiahuana and from the same range of mountains, agrees closely in color with the Miquiahuana material, even though the latter is somewhat worn, and the two lots of material seem to represent the same geographic race.

Notes made in Washington, D. C., by Robert J. Newman and Lowery in the course of identifying their material from the Mexican state of San Luis Potosí, are as follows: "The San Luis Potosí series (*fulvifrons*) is darker above than either *pygmaeus* or *rubicundus* as each is represented in the United States National Museum collections. The greenish brown of the back is between Olive and Buffy Olive, the color less uniform, being more or less broken by spaces of grayish, and contrasting with the Medal Bronze and Buffy Citrine in *pygmaeus*. The top of the head is more dusky (less brownish) than in either *pygmaeus* or *rubicundus*. Beneath they are nearest to *rubicundus*, with the color of the breast ochraceous tawny, as in *rubicundus*, but the flanks and abdomen are nearly as pale as in *pygmaeus*."

Mitrephanes phaeocercus hidalgensis Sutton and Burleigh
Tufted Flycatcher

Mitrephanes phaeocercus hidalgensis Sutton and Burleigh, Wilson Bull. 52, 1940: 30. (Along main highway, 6 mi. S Jacala, at elev. 6000 ft., at La Placita, Hidalgo.)

One ♂, 4 km. W Tlapacoyan, 1700 ft., October 16, 1947; 1 ♀ (LSUMZ), 3.5 mi. S Jalapa, May 28, 1949; 1 ♂, Ojo de Agua, 8 km. NW Paraje Nuevo, February 12, 1946.

The Tufted Flycatcher is not uncommon in the Upper Tropical Life-zone. The specimens from Tlapacoyan and Ojo de Agua might be *M. p. hidalgensis*, since they are decidedly green-backed; the backs are even greener than in near-topotypical specimens of *hidalgensis* from San Luis Potosí examined in the present connection. The type of *M. p. phaeocercus* came from Córdoba, a place only nine kilometers northeast of Ojo de Agua. The specimen from Ojo de Agua, therefore, might be a near-topotype of *phaeocercus*. In San Luis Potosí, however, the species seems to be migratory, since members of field parties from Louisiana State University have not found it there in winter. Consequently, the specimen taken at Ojo de Agua, Veracruz, might be a migrant from farther north. A small series of breeding birds from San Luis Potosí in the Louisiana State University Museum of Zoology demonstrates a considerable degree of progressive fading in which worn June-specimens are decidedly more brownish and hence not unlike certain examples of *phaeocercus* taken at a comparable season in Veracruz and Guatemala. If the examples referred to above from Tlapocoyan and Ojo de Agua are not migrants, then *hidalgensis* possibly is nothing more than the fresh unfaded plumage of *phaeocercus*. This possibility is further strengthened by the fact that specimens of this species that have been in museums for a long time obviously have undergone postmortem fading.

Myiobius sulphureipygius sulphureipygius (Sclater)

Sulphur-rumped Flycatcher

Tyrannula sulphureipygia P. L. Sclater, Proc. Zool. Soc. London, 1857: 296. (Córdoba, Veracruz.)

One ♀, 20 km. ENE Jesús Carranza, 200 ft., March 20, 1949; 1 ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., April 2, 1949.

A common species in the deep jungles of southern Veracruz, this flycatcher is seen perched on twigs of bushes and vines, usually about three feet from the ground.

Platyrinchus cancrominus Sclater and Salvin

Mexican Flat-bill

Platyrhynchus cancrominus Sclater and Salvin, Proc. Zool. Soc. London, 1860: 299. (Choctum, Vera Paz, Guatemala.)

One ♀, 30 km. SSE Jesús Carranza, 300 ft., May 11, 1949.

This is an uncommon species which is usually found in the same localities and habitats as *Myiobius sulphureipygius*. Like that species, it was seen near the ground, and was rather sedentary.

Rhynchocyclus brevirostris brevirostris (Cabanis)

Short-billed Flat-bill

Cyclorhynchus brevirostris Cabanis, Arch. Naturg., 13, 1848: 249. (Jalapa, Veracruz, México.)

One ♂ (LSUMZ), Potrero Viejo, August 22, 1938.

This appears to be the northernmost record for this apparently rare flycatcher in recent years.

Elaenia flavogaster subpagana (Sclater and Salvin)

Yellow-bellied Elaenia

Elainia subpagana Sclater and Salvin, Ibis, 2, 1860: 36. (Dueñas, Guatemala.)

One ♂ (LSUMZ), Boca del Río, May 26, 1949.

The male listed above weighed 26 grams (no fat).

Elaenia viridicata placens (Sclater)
Placid Elaenia

Elainia placens Sclater, Proc. Zool. Soc. London, 27, 1859: 46. (Córdoba, Veracruz, México.)

One ♀ (LSUMZ), Jalapa, just E of city, 4500 ft., May 27, 1949.

Although there are old records of the species from Jalapa, in recent years it was thought that the species was confined to much lower altitudes. This specimen was taken by Newman immediately east of the city and at approximately the same elevation as Jalapa. The weight was 13.6 grams.

Camptostoma imberbe imberbe Sclater
Beardless Flycatcher

Camptostoma imberbe Sclater, Proc. Zool. Soc. London, 25, no. 339, 1857 [Nov. 16]: 203. (In vicinitate urbis S. Andres Tuxtla, in rep. Mexicana [Veracruz].)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 17, 1946.

This specimen appears to be the third record of occurrence for the species in Veracruz.

Family ALAUDIDAE

Eremophila alpestris chrysolaema (Wagler)
Horned Lark

Alauda chrysolaema Wagler, Isis, 1831: 530. (México.)

One ♂ (LSUMZ), 1 mi. E Perote, May 30, 1949.

This specimen, taken from a small flock feeding beside the highway, weighed 25.7 grams (no fat) and the testes were greatly enlarged.

Family HIRUNDINIDAE

Stelgidopteryx ruficollis fulvipennis (Sclater)
Rough-winged Swallow

Cotyle fulvipennis Sclater, Proc. Zool. Soc. London, 27, 1859 [= 1860]: 364. (Vicinity of Jalapa, Veracruz, México.)

One ♂, 3 km. SE Orizaba, 5500 ft., December 20, 1946; 1 ♂, Río Atoyac, 8 km. NW Potrero, February 17, 1946; 1 ♂, 2 ♀, all LSUMZ, Jalapa, May 28, 1949.

We have assigned our specimens of the Rough-winged Swallow to *fulvipennis* after considerable hesitation, for we seriously question if the race can be maintained. The topotypical material from Jalapa can be matched by specimens in a large series of *serripennis* from the eastern United States. The wing of the male measures only

110 mm., which corresponds almost exactly with the average for populations in the United States (Ridgway, 1904: 59; Brodkorb, 1942: 215). The wing measures in the two females, 114 and 115 mm., respectively. This is more than the average for females of *serripennis*, but is within the range of variation exhibited by the species. The throat of *fulvipennis* is allegedly strongly tinged with cinnamon. However, even though the plumage of our three specimens from Jalapa is not excessively worn, one of them has no cinnamon on the throat, and two show only the barest trace of this color; many examples of *serripennis* have as much. None of the three topotypes is darker than most specimens of *serripennis*. The terminal spotting on the under tail-coverts is also lacking. The naming by Brodkorb (*op. cit.*, 217) of an additional race of this species, *S. r. stuarti*, from Central America with a range extending into Veracruz as far north as Motzorongo, further complicates the problem. Accordingly, we have tentatively referred our material to *fulvipennis* until the geographical variation in Mexican populations of the species can be reviewed in its entirety.

Hirundo rustica erythrogaster Boddaert

Barn Swallow

Hirundo erythrogaster Boddaert, Tabl. Pl. Enl., 1783: 45. Based on *Hirondelle a ventre de Cayenne* Daubenton, Pl. Enl., pl. 724, fig. 1. (Cayenne.)

One ♂, Potrero Viejo, 7 km. W Potrero, September 24, 1946; 2 ♀ (LSUMZ), Cuitláhuac, 1300 ft., April 30, 1938.

The above-listed specimens appear to be the first examples taken in the state, although Loetscher (MS) observed the species as an abundant migrant in both spring and fall.

Iridoprocne albilinea albilinea (Lawrence)

Mangrove Swallow

Petrochelidon albilinea Lawrence, Ann. Lyc. Nat. Hist. New York, 8, 1863: 2. (Panamá.)

One ♂, 20 km. ENE Jesús Carranza, 200 ft., April 10, 1949.

This swallow is abundant in extreme southern Veracruz, where it is confined to the vicinity of water. Nests are placed in cavities in logs that project above the water. The nests are composed of dry grass, in a rough mass within the cavity, and have a deep lining of feathers. Birds were nesting in late May and early April, 1949, when a flash flood on the Río Chalchijapa washed away most of the nests. As soon as the water receded and the cavities became dry, nests were rebuilt.

Family CORVIDAE

Psilorhinus morio morio (Wagler)

Northern Brown Jay

Pica morio Wagler, Isis, 1829: 751. (Jalapa, Veracruz, México; *cf.* van Rossem, Bull. Mus. Comp. Zoöl., 77, 1934, p. 414-416.)

One ♀ (LSUMZ), 3 mi. S Jalapa, May 29, 1949, 1 ♀ (skel.), 10 km. NW Potrero, February 16, 1946; 2 ♂, 1♀, Río Atoyac, 8 km. NW Potrero, March 8 and 12, 1946; 1 ♀ (LSUMZ), Potrero Viejo, August 20, 1937; 2 ♂ (LSUMZ), Palma Sola, SE of Cuitláhuac, October 30 and December 11, 1937; 2 ♀ (skels.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 5, 1946.

Psilorhinus mexicanus mexicanus Rüppell

Southern Brown Jay

Psilorhinus mexicanus Rüppell, Museum Senckenbergianum, 2, pt. 2, 1837: p. 189, pl. 11, fig. 2. (Tamaulipas, México.)

One ♂ (LSUMZ), Arroyo de Piedra, 1.7 mi NE La Capilla, 175 ft., May 25, 1949; 2 ♂ (one skel.), 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 12-30, 1946; 1 ♀, 3 km. W Boca del Río, 10 ft., December 17, 1947; 1 ♂ (skel.), 1 km. E Mecayucan, 200 ft., December 19, 1947; 1 ♂ (skel.), 5 km. ENE El Jobo, 600 ft., October 19, 1947; 1 ♀ (skel.), 20 km. ESE Jesús Carranza, 400 ft., March 23, 1948; 3 ♂ (LSUMZ), Palma Sola, November 15-30, 1937.

Pepe. The two kinds of Brown Jays are together one of the most prominent features of the avifauna of Veracruz. They are absent from the Tropical Region only in the deep jungles of extreme southern Veracruz. Their screams and "popping" notes are among the first bird calls heard in the morning and the last heard in the evening. Brown Jays are quick to take alarm, and any unusual occurrence starts them screaming. They are most annoying to hunters, whom they will follow through the forest, and whose presence they announce to all the game in the jungle. Often they are shot by angry hunters, but seemingly are never used as food. In the vicinity of a fruit tree where these birds are feeding, they are relatively quiet, and seem anxious not to draw the attention of other birds to their feeding place. In the vicinity of their nests, which are placed in densely-leaved trees, such as sour orange trees, they are completely silent. At feeding-trees, they do not quarrel with small species of birds, such as thrushes, tanagers, and trogons, but they do fight with parakeets. Sometimes a jay will select one particular parakeet, from a feeding flock, and attack it, forcing the parakeet to move along the branch on which it is perched, and eventually causing it to fly. The jay will pursue the parakeet for a short distance, and then return to the tree to annoy another feeding parakeet. The first parakeet will immediately return to the tree and resume its interrupted feeding. In the "time of the *nanchi* fruit" on the coastal plain, this procedure is repeated throughout the day. The parakeets seem to accept the jays as a mere annoyance that only interrupts momentarily their serious business of feeding.

It is our opinion that *Psilhorinus morio* and *P. mexicanus* should be considered as full species. In the Upper Tropical Life-zone, only *morio* was found. On the arid coastal plain, both forms were observed, often in the same flock. In the breeding season, however, when the birds were mated, the pairs that were observed closely, consisted always of individuals of the same type only.

There is no detectable difference in the call notes of the two species, but each is distinctively colored. Possibly there is some hybridization between the two forms on the coastal plain of Veracruz, where the two species come together. Since, in the Upper Tropical Life-zone only *morio* was found, and since, along the Río Coatzacoalcos, in southern Veracruz, only *mexicanus* was found, and since, in the intermediate area, the coastal plain, the two forms occur together but retain their specific distinctions, the two jays seem to be full species, instead of only subspecies of a single species, as some authors have suggested. That they are very closely related is nevertheless certain.

The female example of *P. morio* taken near Jalapa on May 29, 1949, weighed 277.5 grams (no fat), whereas the female of this species, taken at Arroyo de Piedra, on May 25, 1949, weighed only 224 grams (no fat).

Xanthoura yncas vivida Ridgway

Green Jay

Xanthoura luxuosa vivida Ridgway, Auk, 17, 1900: 28. (Pluma, Oaxaca, México.)

One ♂, 1 ♀, 4 km. WNW Fortín, 3200 ft., March 26, and April 2, 1946; 2 ♀ (LSUMZ), Potrero Viejo, La Cieba, 1400 ft., March 25, 1938.

Esmeralda. The Green Jay is rather uncommon in most of Veracruz. It was noted regularly in Metlac Canyon, near Fortín, and casually in a few other localities in the Upper Tropical Life-zone.

Family CINCLIDAE

Cinclus mexicanus mexicanus Swainson

Mexican Dipper

Cinclus mexicanus Swainson, Philos. Mag., (n. s.), 1, 1827: 368. (Temascaltepec, México.)

One ♂, 4 km. WNW Fortín, 3200 ft., March 30, 1946.

The Dipper was noted only along the clear, cold streams of the

Upper Tropical Life-zone, and then not commonly. It was seen along the Río Banderilla, near Jalapa, and the Río Metlac, near Fortín.

Family TROGLODYTIDAE

Campylorhynchus zonatus zonatus (Lesson)

Banded Cactus Wren

Picolaptes zonatus Lesson, Cent. Zool., 1832: p. 210, pl. 70. (Californie = Orizaba, Veracruz, México, *fide* Brodkorb, Condor, 49, p. 242.)

One ♂, 1 ♀, 4 km. WNW Fortín, 3200 ft., March 26 and April 5, 1946; 2 ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, February 23, and March 15-21, 1946; 1 ♂, 3 km. W Boca del Río, 10 ft., December 17, 1947; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, 1700 ft., March 5 and April 27, 1938; 1 ♀ (LSUMZ), 8.8 mi. SW Paso del Toro, 350 ft., May 25, 1949; 1 ♂ (LSUMZ), 3.9 mi. S Coatepec, May 28, 1949.

This large wren is particularly abundant in the dense thickets and brush of the Upper Tropical Life-zone. It lives in such dense cover that it would be an inconspicuous species were it not so inquisitive and noisy. A male and a female weighed, respectively, 35.8 and 36.5 grams (no fat).

Campylorhynchus rufinucha rufinucha (Lesson)

Rufous-naped Cactus Wren

Picolaptes rufinucha Lesson, Ann. Sci. Nat., (2), Zool., 9, 1838: 168. (Veracruz, México.)

One ♂ (LSUMZ), Boca del Río, May 26, 1949, 1 ♀ (LSUMZ), 11 mi. SW Paso del Toro, May 25, 1949; 1 ♂ (LSUMZ), 24 mi. E Córdoba, May 25, 1949; 1 ♂, 1 ♀ (skel.), Río Blanco, 20 km. WNW Piedras Negras, May 14 and 28, 1946; 1 unsexed (skel.), 15 km. ESE San Juan de la Punta, 400 ft., September 28, 1946.

This cactus wren is fairly common in the arid division of the Lower Tropical Life-zone. The three Louisiana State University Museum of Zoology specimens listed above weighed, respectively, 30.8, 28.2, and 30.7 grams.

Thryomanes bewickii bairdi (Salvin and Godman)

Bewick Wren

Thryothorus bairdi Salvin and Godman, Biol. Centr.—Amer., Aves, 1, 1880: 95. (Oaxaca, México.)

One ♂, 10 km. SW Jacales, 6500 ft., November 6, 1948.

This specimen is darker than examples of *bairdi* that we have examined, but this difference may be the result of either dichromatism, or postmortem change in the comparative material. In size it is closer to *bairdi* than to *murinus*. The measurements are as follows: wing, 54.8; tail, 53.2; exposed culmen, 15.3 mm.

Troglodytes aëdon parkmanii Audubon

House Wren

Troglodytes Parkmanii Audubon, Orni. Biog., 5, 1839: 310. (Columbia River [= near Fort Vancouver, Washington].)

One ♂, Las Vigas, 8500 ft., October 9, 1948; 1 ♀, 1 km. E Jalacingo, 6500 ft., November 13, 1948; 1 ♂ (skel.), 1 km. E Mecayucan, 200 ft., December 20, 1947; 1 ♂, 7 km. NW Potrero, 1700 ft., April 2, 1946.

Also examined were seven skeletons (5 ♂ and 2 ♀) of the House Wren collected on dates between October 9, 1938, and February 12, 1949, at Tampico Alto, Potrero Llano, Teocelo, and Las Vigas. These specimens are not identifiable with certainty to the subspecies.

Troglodytes brunneicollis brunneicollis Sclater

Brown-throated Wren

Troglodytes brunneicollis Sclater, Proc. Zool. Soc. London, 26, 1858: 297. (La Parada, six leagues from Oaxaca, México.)

Two ♂, Las Vigas, 8000 and 8500 ft., October 15 and 17, 1948.

Henicorhina leucosticta prostheleuca (Sclater)

White-breasted Wood Wren

Scytalopus prostheleucus P. L. Sclater, Proc. Zool. Soc. London, 1856 [= 1857]: 290. (Córdoba, Veracruz, México.)

One ♂, 4 km. WNW Fortín, 3200 ft., April 2, 1946; 1 ♀, 35 km. SE Jesús Carranza, 350 ft., April 9, 1949.

This wren is an inconspicuous resident on the ground in deep, shaded forest or jungle.

Henicorhina leucophrys mexicana Nelson

Gray-breasted Wood Wren

Henicorhina mexicana Nelson, Auk, 14, 1897: 73. (Jico, Veracruz, México.)

One ♂ (skel.), Teocelo, 4500 ft., January 30, 1949; 1 ♂ (LSUMZ), 3.5 mi. S Jalapa, May 28, 1949.

The specimen from Teocelo was taken in a mouse trap.

Salpinctes obsoletus (Say)

Common Rock Wren

Troglodytes obsoleta Say, in Long, Exped. Rocky Mts., 2, 1823: 4. (Douglas County, Colorado.)

One ♀ (skel.), 6 km. WSW Zacualpilla, 6500 ft., November 9, 1948.

Our specimen is not identifiable to subspecies.

Catherpes mexicanus mexicanus (Swainson)

Canyon Wren

Thryothorus mexicanus Swainson, Zool. Ill., (2), 1, 1829: pl. 11. (Real del Monte, Hidalgo, México.)

One ♂ (skel.), 3 km. W Acultzingo, 7000 ft., October 6, 1947.

The specimen taken was shot on a cliff where there is a distinct break between the faunas of the Sonoran and Tropical Life-zones.

Family MIMIDAE

Melanotis caerulescens caerulescens (Swainson)

Blue Mockingbird

Orpheus caerulescens Swainson, Philos. Mag., n. s., 1, May, 1827: 369. (México.)

One ♂, 5 km. N Jalapa, 4500 ft., October 19, 1946; 1 ♂ (skel.), 3 km. W Acultzingo, 7000 ft., October 8, 1947.

The Blue Mockingbird is a fairly common resident of the higher parts of the Upper Tropical Life-zone.

Dumetella carolinensis (Linnaeus)

Catbird

Muscicapa carolinensis Linnaeus, Syst. Nat., ed. 12, 1, 1766: 328. (In Carolina = Virginia.)

One ♂, 1 ♀, skels., Teocelo, 4000 ft., January 8 and 9, 1949; 2 ♀ (one skel.), Río Atoyac, 8 km. NW Potrero, February 18 and March 12, 1946; 2 ♂ (one skel.), 3 km. W Gutiérrez Zamora, 300 ft., November 7, 1947.

The Catbird is a common winter visitor in Veracruz, where it frequents more open situations than it does in its summer range in the United States.

Mimus polyglottos leucopterus (Vigors)

Common Mockingbird

Orpheus leucopterus Vigors, in Zool. Beechey's Voy., 1839: 17. (West coast of America = Monterey, California.)

One ♀, 15 km. W Piedras Negras, 300 ft., January 12, 1947.

This species is rare in Veracruz. The specimen listed was the only individual noted during the present field work in that state.

Family TURDIDAE

Turdus migratorius phillipsi Bangs

American Robin

Turdus migratorius phillipsi Bangs, Proc. Biol. Soc. Washington, 37, 1915: 125. (Las Vigas, Veracruz, México.)

One ♂ (LSUMZ), Valsequillo, 15 km. W Las Vigas, May 30, 1949; 1 ♀ (LSUMZ), La Joya, 6 km. SE Las Vigas, 7000 ft., May 30, 1949.

The male listed above weighed 66.6 grams, the female, 78.2. The latter had a conspicuous brood patch and had a small amount of body fat, whereas the male showed no fat.

Turdus assimilis assimilis Cabanis

Jalapa Robin

Turdus assimilis Cabanis, Mus. Hein., 1, 1850 [= October, 1851]: 4. (Jalapa, México.)

One ♂, Río Atoyac, 8 km. NW Potrero, February 18, 1946; 1 ♂ (skel.), 1 ♀, 4 km. W Tlapocoyan, 1700 ft., October 14, 1947.

Primavera. The Jalapa Robin is a shy, retiring species, which was usually seen in dense forest on hill-sides. It was found only in the Upper Tropical Life-zone. The specimen from Potrero is considerably darker above than examples of *assimilis* from San Luis Potosí. In this respect it shows a tendency toward *T. a. leucauchen* Sclater, which Wetmore discovered to be the race occurring in the Tuxtla Mountains of southern Veracruz. Unfortunately, we have seen no fresh, topotypical examples of *assimilis* from Jalapa with which to compare our extensive series from San Luis Potosí; consequently this latter material may not represent typical *assimilis*.

Turdus grayi grayi Bonaparte

Gray Robin

Turdus grayi Bonaparte, Proc. Zool. Soc. London, 1837 [June 14, 1838]: 118. (Alta Vera Paz, Guatemala; *cf.* Griscom, Amer. Mus. Novit., no. 438, 1930, p. 6.)

One ♂ (LSUMZ), Córdoba, January 6, 1938; 1 ♀ (skel.), 10 km. NW Potrero, February 16, 1946; 4 ♂, 1 ♀ (skel.), Río Atoyac, 8 km. NW Potrero, February 17-March 20, 1946; 1 ♂ (LSUMZ), 1 mi. W Fortín, 3000 ft., May 25, 1949; 1 ♀, 4 km. WNW Fortín, 3200 ft., March 28, 1946; 1 ♀, 10 km. NW Potrero, February 16, 1946; 2 ♂, 5 km. N Jalapa, 4500 ft., October 17 and 18, 1946; 1 ♂, 4 km. W Tlapacoyan, 1700 ft., October 16, 1947.

Primavera. This thrush is abundant in the forests of the Upper Tropical Life-zone. It makes much noise when it flushes. Near Potrero, in the quarter hour before dark, the bushes in which a roost was situated resounded with a dull roar, caused by these thrushes. Seemingly each new arrival startled the entire flock, causing each bird to fly with much fluttering, to another twig or branch. The birds roosted approximately three feet from the ground. About thirty birds were present, as far as could be determined.

Hylocichla mustelina (Gmelin)

Wood Thrush

Turdus mustelinus Gmelin, Syst. Nat., 1, pt. 2, 1789: 817. (New York.)

One ♂, 25 km. SE Jesús Carranza, 250 ft., April 3, 1949; 1 ♂, 35 km. SE Jesús Carranza, 200 ft., April 2, 1949.

On the nights of April 2 and 3, 1949, several of these birds were found roosting on branches of jungle trees, ten to twenty feet from the ground. These two nights were the only occasions on which this species was noted in Veracruz.

Hylocichla ustulata ustulata (Nuttall)

Russet-backed Thrush

Turdus cestulatus [= *ustulatus*] Nuttall, Man. Orni. U. S. and Canada, 1, ed. 2, 1840: 400 and 830 and errata, p. vi. (Forests of Oregon = Fort Vancouver, Washington.)

One ♀, Río Atoyac, 8 km. NW Potrero, February 25, 1946; 1 ♂ (LSUMZ), Potrero Viejo, May 15, 1938.

Although Veracruz has been included in the winter range of the Russet-backed Thrush, Loetscher (MS) failed to find any record of the subspecies from the state. The two examples mentioned above may constitute the first definite record of this bird in Veracruz.

Catharus aurantiirostris melpomene (Cabanis)

Orange-billed Nightingale Thrush

Turdus melpomene Cabanis, Mus. Hein., 1, Oct., 1851: 5. (Jalapa, Veracruz, México.)

One ♂, 5 km. N Jalapa, 4500 ft., October 19, 1946; 2 ♂ (LSUMZ), Jalapa, May 27, 1949; 1 ♂ (LSUMZ), 3 mi. S Jalapa, May 28, 1949; 2 ♂ (skels.), 3 ♀ (two skels.), Teocelo, 4500 ft., January 2-10, 1949.

The Orange-billed Nightingale Thrush was found only in the higher part of the Upper Tropical Life-zone. It is an inconspicuous species, found in dense brush and thickets. The specimens from Teocelo were taken in mouse traps set in thickets beside tiny, cold streams.

Sialia sialis guatemalae Ridgway

Common Bluebird

Sialia sialis guatemalae Ridgway, Proc. U. S. Nat. Mus., 5, 1882: 13. (Guatemala.)

One ♂ (LSUMZ), Piedras Negras, El Faro, December 17, 1938.

The Bluebird is fairly common in high country. It was found in small flocks at the upper edge of the Upper Tropical Life-zone, and in the pine forests on the mountains.

Sialia sialis episcopus Oberholser

Common Bluebird

Sialia sialis episcopus Oberholser, Proc. Biol. Soc. Washington, 30, 1917: 27. (Santa Engracia, Tamaulipas, México.)

One ♂, 5 km. N Jalapa, 4500 ft., October 18, 1946.

Although the breeding population at Jalapa is probably *guatemalae,* the only specimen obtained there in the course of this study proves to be an example of *episcopus.*

Family SYLVIIDAE

Polioptila caerulea caerulea (Linnaeus)

Blue-gray Gnatcatcher

Motacilla caerulea Linnaeus, Syst. Nat., ed. 12, 1, 1766: 337. (Philadelphia, Pennsylvania.)

One ♂, Río Atoyac, 8 km. NW Potrero, March 5, 1946; 1 ♂ (skel.), Río Blanco, 20 km. W Piedras Negras, October 1, 1946; 1 ♂ (skel.), 1 ♀, 5 km. ENE El Jobo, 600 ft., October 18 and 19, 1947; 2 ♂, 5 km. S Tehuatlán, 700 ft., November 12 and 14, 1947.

Polioptila caerulea deppei van Rossem

Blue-gray Gnatcatcher

Polioptila deppei van Rossem, Bull. Mus. Comp. Zoöl., 77, December, 1934: 402. (Río Lagartos, Yucatán, México.)

One ♂, Potrero Viejo, 5 km. W Potrero, Febraury 12, 1946.

Family PTILOGONATIDAE

Ptilogonys cinereus cinereus Swainson

Mexican Ptilogonys

Ptilogonys cinereus Swainson, Cat. Exhib. called Modern Mexico, App., 1824: 4. (México.)

One ♂, 5 km. N Jalapa, 4500 ft., October 18, 1946; 2 nestlings in alcohol (LSUMZ), 7.8 mi. NW Acultzingo, 7700 ft., May 24, 1949.

This species was found at the very edge of the Upper Tropical Life-zone and at the lower level of the conifers. The finding of a nest of this species near Acultzingo on May 24, 1949, by a field party from the Louisiana State University Museum of Zoology, was a fortunate ornithological discovery. The description of the nest and its location will be published elsewhere.

Family LANIIDAE

Lanius ludovicianus mexicanus Brehm

Loggerhead Shrike

Lanius mexicanus Brehm, Jour. f. Orni., 2, 1854: 145, 148. (México = probably highlands of Veracruz whence came most of Deppe's birds.)

One ♂ (skel.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 3, 1946.

Shrikes were noted on few occasions, and then only on the arid coastal plain.

Family VIREONIDAE

Vireo griseus noveboracensis (Gmelin)

White-eyed Vireo

Muscicapa noveboracensis Gmelin, Syst. Nat., 1, pt. 2, 1789: 947. (New York.)

One ♂, 5 km. S Tehuatlán, 700 ft., November 15, 1947; 1 ♀, 9 km. E Papantla, 300 ft., November 16, 1947; 1 ♀ (skel.), Teocelo, 4000 ft., January 6, 1949.

Vireo solitarius solitarius (Wilson)

Blue-headed Vireo

Muscicapa solitaria Wilson, Amer. Orni., 2, 1810: p. 143, pl. 17, fig. 6. (Philadelphia, Pennsylvania.)

Two ♀, Río Atoyac, 8 km. NW Potrero, March 13 and 21, 1946.

Vireo olivaceus flavoviridis (Cassin)

Red-eyed Vireo

Vireosylvia flavoviridis Cassin, Proc. Acad. Nat. Sci. Philadelphia, 5, 1851: 152. (San Juan de Nicaragua, Nicaragua.)

One ♂ (skel.), 5 km. ENE El Jobo, 600 ft., October 18, 1947.

This is an exceptionally late date for this vireo, which is not known to be a winter resident in Veracruz.

Vireo gilvus amauronotus Salvin and Godman

Warbling Vireo

Vireo amauronotus Salvin and Godman, Biol. Centr.—Amer., Aves, 1, 1881: 193. (Orizaba, Veracruz, México.)

One ♂ and 1 ♀ (LSUMZ), 3.5 mi. S Jalapa, May 28 and 29, 1949.

The two specimens listed above weighed, respectively, 12.2 and 13.5 grams (no fat).

Family COEREBIDAE

Cyanerpes cyaneus carneipes (Sclater)

Blue Honey-creeper

Coereba carneipes P. L. Sclater, Proc. Zool. Soc. London, 27, 1859 [= February, 1860]: 376. (Playa Vicente, Oaxaca, México.)

One ♀, 30 km. SE Jesús Carranza, 500 ft., April 10, 1948.

The Blue Honey-creeper seems to be surprisingly rare in Veracruz. In the extreme southern part of the state, one of a pair, perched on a twig overhanging a stream, was shot. Another was seen in the same general area in May, 1949.

Family PARULIDAE

Mniotilta varia (Linnaeus)

Black and White Warbler

Motacilla varia Linnaeus, Syst. Nat., ed. 12, 1, 1766: 333. (Jamaica, Dominica = Santo Domingo.)

One ♀ (skel.), Potrero Llano, 350 ft., February 10, 1949: 1 ♀ (LSUMZ), Potrero Viejo, August 22, 1937; 1 ♂ (LSUMZ), Río Atoyac, March 12, 1938; 1 ♂, 5 km. ENE El Jobo, 600 ft., October 18, 1947; 1 ♀, 9 km. E Papantla, 300 ft., November 18, 1947; 1 ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 29, 1949.

Peucedramus olivaceus olivaceus (Giraud)

Olive Warbler

Sylvia olivacea Giraud, Desc. Sixteen New Species Birds, 1841: [p. 16, pl. 7, fig. 2]. ("Texas," error; Las Vigas, Veracruz, México, suggested as type locality by Miller and Griscom.)

One ♀ (LSUMZ), Valsequillo, 15 km. W Las Vigas, May 30, 1949; 1 ♀ (LSUMZ), La Joya, 6 km. SE Las Vigas, 7000 ft., May 30, 1949.

Dendroica petechia aestiva (Gmelin)

Yellow Warbler

Motacilla aestiva Gmelin, Syst. Nat., 1, pt. 2, 1789: 996. (In Gujana, aestate in Canada = Canada.)

One ♂ (LSUMZ), Boca del Río, May 26, 1949.

This belated migrant weighed 10.0 grams and was notably fat.

Dendroica petechia amnicola Batchelder

Yellow Warbler

Dendroica aestiva amnicola Batchelder, Proc. New England Zoöl. Club., 6, 1918: 82. (Curslet, Newfoundland.)

One ♂ (LSUMZ), Paso del Macho, 1200 ft., April 5, 1938; 1 ♂ (LSUMZ), Potrero Viejo, 1650 ft., May 3, 1938.

Dendroica magnolia (Wilson)

Magnolia Warbler

Sylvia magnolia Wilson, Amer. Orni., 3, 1811: p. 65, pl. 23, fig. 2. (Fort Adams, Mississippi.)

Two ♂ (skels.), Teocelo, 4000 ft., January 9 and February 1, 1949; 1 ♂, 5 km. ENE El Jobo, 600 ft., October 18, 1947; 1 ♂, 9 km. E Papantla, 300 ft., November 16, 1947; 1 ♂ (skel.), 5 km. ENE El Jobo, 600 ft., October 19, 1947; 1 ♂ (skel.), Boca del Río, 10 ft., December 8, 1948: 1 ♂ (skel.), Potrero Viejo, 1700 ft., October 23, 1947; 1 ♂ (LSUMZ), Paso del Macho, April 5, 1938.

Dendroica virens virens (Gmelin)

Black-throated Green Warbler

Motacilla virens Gmelin, Syst. Nat., 1, pt. 2, 1789: 985. (In Pennsylvania = Philadelphia, Pennsylvania)

One ♂ (skel.), Teocelo, 4000 ft., January 30, 1949; 1 ♂, 1 ♀, Río Atoyac, 8 km. NW Potrero, March 4 and March 21, 1946.

Dendroica occidentalis (Townsend)

Hermit Warbler

Sylvia occidentalis J. K. Townsend, Jour. Acad. Nat. Sci. Philadelphia, 7, pt. ii [November 21, 1837]: 190. (Forests of the Columbia River = Fort Vancouver, Washington.)

One ♂ (skel.), 3 km. E Las Vigas, 8000 ft., November 4, 1946; 1 ♂ (LSUMZ), Las Vigas, April 2, 1939.

Dendroica dominica albilora Ridgway

Yellow-throated Warbler

Dendroica dominica var. *albilora* (Baird MS) Ridgway, Amer. Natur., 7, October, 1873: 606. (Belize, British Honduras.)

One ♂, Potrero Viejo, 1700 ft., October 21, 1947.

Dendroica pensylvanica (Linnaeus)

Chestnut-sided Warbler

Motacilla pensylvanica Linnaeus, Syst. Nat., ed. 12, 1, 1766: 333. (Pennsylvania.)

One ♂, 20 km. SE Jesús Carranza, 250 ft., May 4, 1949.

Seiurus aurocapillus aurocapillus (Linnaeus)

Oven-bird

Motacilla aurocapilla Linnaeus, Syst. Nat., ed. 12, 1, 1766: 334. (Pennsylvania = at sea approximately 30 miles off Haiti.)

One ♀, 5 km. N Jalapa, 4500 ft., October 17, 1946; 1 ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., March 30, 1949.

Seiurus motacilla (Vieillot)

Louisiana Water-thrush

Turdus motacilla Vieillot, Oiseaux Amér., September, 1807 [= 1808]: p. 9, pl. 65. (Kentucky.)

One ♂, Río Atoyac, 8 km. NW Potrero, February 24, 1946.

Oporornis formosus (Wilson)

Kentucky Warbler

Sylvia formosa Wilson, Amer. Orni., 3, 1811: p. 85, pl. 25; fig. 3. (Kentucky.)

One ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., March 30, 1949.

Oporornis tolmiei austinsmithi Phillips

Macgillivray Warbler

Oporornis tolmiei austinsmithi Phillips, Auk, 64, 1947: 298. (Emigrant Gulch, 6500 ft., 3 mi. SE Chico, Montana.)

One ♂ (LSUMZ), Jalapa, May 29, 1949.

The subspecific allocation of our single specimen to one of the races described by Phillips is provisional, since the differences exhibited by the various races are both minute and subject to considerable individual variation. In our specimen the wing measures 60 mm. and the tail, 53.5 mm. It weighed 11.7 grams and possessed only a small amount of body fat. This seems to be the latest spring record for the species in the state; Loetscher (MS) did not find it present after May 10.

Geothlypis trichas trichas (Linnaeus)

Common Yellow-throat

Turdus trichas Linnaeus, Syst. Nat., ed. 12, 1, 1766: 293. (In America septentrionali = Maryland.)

One ♂, 4 km. WNW Fortín, 3200 ft., March 23, 1946.

Geothlypis trichas typhicola Burleigh

Common Yellow-throat

Geothlypis trichas typhicola Burleigh, Proc. Biol. Soc. Washington, 47, 1945: 21. (Athens, Georgia.)

One ♂ (LSUMZ), Boca del Río, May 26, 1949.

The specimen from Boca del Río is referred with some reluctance to the race *typhicola*, even though it agrees closely with a large series of examples of this race studied in the present connection. The specimen was exceedingly fat, as might be expected of a migrant, and it weighed 11.4 grams. The puzzling fact is that on May 26 yellow-throats within the breeding range of *typhicola*, in the southeastern United States, are well advanced in their nesting activities; yet here is evidence of an example of that race loitering far to the south when apparently it should have been on its breeding ground. Since the sex organs, according to the information on the label, showed only slight development, we can rationalize its belated occurrence in the tropics on the basis of a delayed migratory urge, a phenomenon that may be far more common in passerines than the present available facts would indicate.

Geothlypis trichas occidentalis Brewster

Common Yellow-throat

Geothlypis trichas occidentalis Brewster, Bull. Nuttall Orni. Club, 8, 1883: 159. (Truckee River, Nevada.)

One ♂, 20 km. ENE Jesús Carranza, 200 ft., March 23, 1949; 1 ♀, 20 km. E Jesús Carranza, May 3, 1938.

Geothlypis nelsoni nelsoni Richmond

Nelson Yellow-throat

Geothlypis nelsoni Richmond, Auk, 17, 1900: 197. (Cofre de Perote, Veracruz, México.)

One ♂, Las Vigas, 8500 ft., October 9, 1948.

Icteria virens auricollis (Lichtenstein)

Yellow-breasted Chat

Tanagra auricollis Lichtenstein, Preis-Verz. Vögel Mexico, September 1, 1830: 2. (México = City of Mexico.)

One ♂, 1 ♀ (skels.), 4 km. WNW Fortín, 3200 ft., March 31, 1946; 1 ♂, 10 km. NW Potrero, February 16, 1946; 1 ♂ (skel.), Río Blanco, 20 km. W Piedras Negras, 400 ft., October 3, 1946; 1 ♂ (skel.), 5 km. S Tehuatlán, 700 ft., November 14, 1947; 1 ♂ (skel.), Potrero Viejo, 1700 ft., December 3, 1947. Also examined but not identified to subspecies: 1 ♂ (skel.), Tampico Alto, 50 ft., February 8, 1949; 1 ♂ (skel.), Potrero Llano, 350 ft., February 12, 1949; 1 ♂, 1 ♀, skels., San Isidro, 100 ft., February 4, 1949; 1 ♂ (skel.), Puenta Nacional, 500 ft., December 12, 1948.

This species is a common winter resident in the Upper Tropical Life-zone. It is fully as retiring and shy in Veracruz as it is in the United States. Individuals were commonly taken in mouse traps set for small mammals. In brushy cover, they were sometimes caught at an average of approximately one to each 100 traps set. All examples of this species from previous collections from Veracruz have been identified as *I. v. virens*. Ratio of length of wing to length of tail is the most reliable basis for distinguishing *I. v. auricollis* from *I. v. virens*. On some of our specimens the feathers were so broken that the critical ratio could not be ascertained. Consequently, some of our specimens may actually be *I. v. virens*.

Wilsonia citrina (Boddaert)

Hooded Warbler

Muscicapa Citrina Boddaert, Table Pl. Enl., 1783: 41. Based on the *Gobe-mouche, de la Louisiane* Daubenton, Pl. Enl., pl. 666, fig. 2. (Louisiana.)

One ♂, 2 km. N Motzorongo, 1500 ft., December 9, 1946.

Wilsonia pusilla pusilla (Wilson)

Wilson Warbler

Muscicapa pusilla Wilson, Amer. Orni., 3, 1811: 103. pl. 26, fig. 4. (Southern States, and lower parts of the states of New Jersey and Delaware = southern New Jersey.)

One ♀, 4 km. WNW Fortín, 3200 ft., March 26, 1946; 1 ♀ (skel.), Teocelo, 4000 ft., February 5, 1949; 1 ♂ (skel.), Potrero Viejo, 1700 ft., October 21, 1947; 1 ♂ (skel.), 4 km. W Tlapocoyan, 1700 ft., October 16, 1947; 1 ♂, Río Atoyac, 8 km. NW Potrero, March 5, 1946; 1 ♂ Potrero Viejo, 1700 ft., September 30, 1947.

Wilsonia pusilla pileolata (Pallas)

Wilson Warbler

Motacilla pileolata Pallas, Zoogr. Rosso-Asiatica, 1, 1811: 497. (In insula Kadiak = Kodiak Island, Alaska.)

One ♂ (skel.), 1 ♀, 4 km. W Tlapacoyan, 1700 ft., October 16, 1947; 1 ♂

(skel.), 5 km. ENE El Jobo, 600 ft., October 19, 1947; 1 ♂, 9 km. E Papantla, 300 ft., November 16, 1947; 1 ♂, 2 km. W Perote, 7500 ft., September 24, 1948; 1 ♂ (skel.), Teocelo, 4000 ft., February 1, 1949.

Wilsonia canadensis (Linnaeus)

Canada Warbler

Muscicapa canadensis Linnaeus, Syst. Nat., ed. 12, 1, 1766: 327. (Canada.)

One ♀ (LSUMZ), 3.5 mi. S Jalapa, May 28, 1949; 1 ♀, Río Atoyac, 8 km. NW Potrero, March 8, 1946.

The May 28 specimen listed above represents an unusually late date for the occurrence of the species in Veracruz.

Setophaga ruticilla tricolora (Müller)

American Redstart

Motacilla tricolora Müller, Natursyst., Suppl., 1776: 175 (Cayenne.)

One ♀, Río Atoyac, 8 km. NW Potrero, March 8, 1946.

Alexander Wetmore kindly studied this specimen and identified it as an example of the northern race.

Myioborus miniatus miniatus (Swainson)

Red-bellied Redstart

Setophaga miniata Swainson, Philos. Mag., (n. s.), 1, May, 1827: 368. (Woods of Valladolid [Michoacán], Tableland of Mexico.)

One ♂ (LSUMZ), La Joya, 6 km. SE Las Vigas, 7000 ft., May 30, 1949; 2 ♂, 5 km. N Jalapa, 4500 ft., October 16 and 19, 1946; 1 ♂ (skel.), 3 km. SE Orizaba, 5500 ft., December 22, 1946.

The Red-bellied Redstart was found mainly in low, dense trees at the upper edge of the Upper Tropical Life-zone. Sometimes birds were separate or in pairs, but usually they were in flocks of from six to ten.

Myioborus miniatus molochinus Wetmore

Red-bellied Redstart

Myioborus miniatus molochinus Wetmore, Proc. Biol. Soc. Washington, 55, August 13, 1942: 105. (Between 3,000 and 4,000 feet elevation on Volcán San Martín, Sierra de Tuxtla, Veracruz, México.)

One ♂, 7 km. SE Volcán San Martín, Tuxtla Mts., 3000 ft., January 16, 1948.

Ergaticus ruber (Swainson)

Red Warbler

Setophaga rubra Swainson, Philos. Mag., (n. s.), 1, May, 1827: 368. (Valladolid, Michoacán, México.)

Two ♂ (one skel.), 1 ♀, 3 km. E Las Vigas, 8000 ft., November 1 and 2, 1946, and October 2, 1948; 1 ♂ (skel.), 6 km. SSE Altotonga, 9000 ft., November 11, 1946.

This species is fairly common in the pine forests on the mountains. Its call note is somewhat reminiscent of the call of the Golden-crowned Kinglet. One of the specimens from Las Vigas was brought in by a domestic cat.

Basileuterus culicivorus culicivorus (Lichtenstein)

Lichtenstein Warbler

Sylvia culicivora Lichtenstein, Preis-Verz. Vögel Mexico, 1830: 2. (Jalapa, Veracruz, México.)

One ♀, 4 km. E Tlapacoyan, 1700 ft., October 16, 1947; 1 ♀ (LSUMZ), 3 mi. S Jalapa, May 29, 1949; 2 ♀ (skels.), Teocelo, 4000 ft., January 6 and 8, 1949; 1 ♂ (skel.), 3 km. E San Andrés Tuxtla, 1000 ft., January 10, 1948.

The specimen taken near Jalapa on May 29 weighed 13 grams and held an egg about ready to be laid.

Basiletuterus rufifrons rufifrons (Swainson)

Rufous-capped Warbler

Setophaga rufifrons Swainson, Anim. Menag., 1837: 294. (México; restricted to Real Ariba, Veracruz, by Todd, Proc. U. S. Nat. Mus., 74, 1929, p. 92.)

Two ♂ (LSUMZ), Jalapa, May 27 and 29, 1949.

These two specimens weighed, respectively, 10.6 and 10.4 grams and possessed no body fat.

Family PLOCEIDAE

Passer domesticus (Linnaeus)

English Sparrow

Fringilla domestica Linnaeus, Syst. Nat., ed. 10, 1, 1758: 183. (In Europa = Sweden.)

Although there seems to be no previous published record of its occurrence in the state, the English Sparrow is abundant about human habitations in central Veracruz. A large flock lived about the stables at Potrero Viejo and built nests in the roofs of sheds nearby.

Family ICTERIDAE

Gymnostinops montezuma (Lesson)

Montezuma Oropendola

Cacicus montezuma Lesson, Cent. Zool., livr. 2, October, 1830: p. 33, pl. 7. (México.)

One ♂ (skel.), Teocelo, 4000 ft., February 1, 1949; 2 ♂, 2 ♀, Río Atoyac, 8 km. NW Potrero, February 21-March 12, 1946; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, 400 ft., October 2, 1946; 2 ♀ (skels.), Río Blanco, 20 km. W Piedras Negras, October 2, 1946; 2 ♀ (LSUMZ), Piedras Negras near El Faro, December 18, 1937, and December 18, 1938.

Sakhua. The Oropendola is fairly common throughout the Tropical Region, where it is usually seen in pairs, but sometimes in large flocks numbering up to fifty birds. In June, colonies of this species were nesting along the Río Solosuchi. The long, pendulous nests were abundant, and usually were placed in two or three adjacent trees. From ten to twenty nests were seen in a colony. Isolated trees were utilized, especially those near rivers.

Amblycercus holosericeus holosericeus (Litchtenstein)

Prévost Cacique

Sturnus holosericeus Lichtenstein, Pries-Verz. Vögel Mexico, 1830: 1. (Mexico = Alvarado, Veracruz, México.)

One ♀ (LSUMZ), Potrero Viejo, 1700 ft., March 5, 1938; 1 ♂, Río Atoyac, 8 km. NW Potrero, March 2, 1946; 1 ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., February 12, 1948; 1 ♀, 30 km. ESE Jesús Carranza, 300 ft., May 10, 1949.

The Prévost Cacique is not a common bird in Veracruz. It was found in the Upper Tropical Life-zone and in the humid division of the Lower Tropical Life-zone. The species was usually observed near the ground, in dense thickets from which it flushed with a loud whirr of wings. Twenty kilometers east of Jesús Carranza, a flock of these birds was seen in the same locality almost daily, but elsewhere only single birds were noted.

Psomocolax oryzivorus impacifus Peters

Mexican Rice Grackle

Psomocolax oryzivorus impacifus Peters, Proc. Biol. Soc. Washington, 42, 1929: 123. (Pasa Nueva, Veracruz, México.)

One ♀ (LSUMZ), Potrero Viejo, 1700 ft., February 15, 1938.

Neither Dalquest nor Loetscher found this icterid which seems to be rare in Veracuz. Our only record is the specimen obtained by Forbes at Potrero Viejo.

Tangavius aeneus aeneus (Wagler)

Red-eyed Cowbird

Psarocolius aeneus Wagler, Isis, 22, Heft 7, July, 1829: col. 758. (Laguna, Veracruz, México.)

Eleven ♂ (seven skels.), 4 ♀, Potrero Viejo, 6 km. W Potrero, February 13 and 14, 1946; 3 ♂, 5 km. W Potrero, February 12, 1946; 1 ♂ (LSUMZ), Potrero Viejo, October 14, 1938; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 13, 1946; 1 ♂ (skel.), 3 km. W Boca del Río, 25 ft., September 28, 1947.

Tongonito. The Red-eyed Cowbird is abundant about clearings in the Upper Tropical Life-zone; it is less common on the coastal plain. Like *Cassidix mexicanus,* this bird does some damage to crops, especially corn and rice.

Cassidix mexicanus mexicanus (Gmelin)

Great-tailed Grackle

Corvus mexicanus Gmelin, Syst. Nat., 1, pt. 1, 1788: 375. (México; restricted to Veracruz, México by Lowery, Occas. Papers Mus. Zool. Louisiana State University, 1, May 4, 1938, p. 4.)

Fifteen ♂, 16 ♀ (21 skels. in all), Teocelo, Potrero and environs, and 20 km. E Jesús Carranza, on numerous dates (LSUMZ and UKNHM).

Tordo. This species is abundant about clearings, villages, and water in the Upper Tropical Life-zone. It is less common in the arid division of the Lower Tropical Life-zone. This bird does some damage, especially to seedling corn. The nest is usually placed at the bases of palm fronds. Nesting is in full swing by late February.

Dives dives dives (Lichtenstein)

Sumichrast Blackbird

Icterus dives Lichtenstein, Preis-Verz. Vögel Mexico, 1830: 1. (Mexico.)

One ♂ (skel.), Río Blanco, 20 km. WNW Piedras Negras, May 28, 1946; 1 ♂ (skel.), Río Atoyac, 8 km. NW Potrero, March 2, 1946.

Tongonito. This sweet-voiced icterid is common about water and open places in both the Upper Tropical Life-zone and the arid divisions of the Lower Tropical Life-zone. It is inconspicuous, but its clear call is one of the most typical notes of the bird chorus in the forests and jungles of Veracruz.

Icterus galbula (Linnaeus)

Baltimore Oriole

Coracias Galbula Linnaeus, Syst. Nat., ed. 10, 1, 1758: 108. (America = Virginia.)

One ♀ (skel.), Potrero Viejo, 1700 ft., September 30, 1948; 2 ♂, 1 ♀ (all LSUMZ), 20 mi. SE of Cuitláhuac, 800 ft., May 1, 1938; 1 ♂, 3 km. E San Andrés Tuxtla, 100 ft., January 12, 1948; 1 ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., April 28, 1949.

The specimen taken on May 1 provides a date that seems to be unusually late for this species in Veracruz.

Icterus spurius (Linnaeus)

Orchard Oriole

Oriolus spurius Linnaeus, Syst. Nat., ed. 12, 1, 1766: 162. (America septentrionali = South Carolina.)

One ♂, 5 km. W Potrero, March 18, 1946; 1 ♀ (LSUMZ), Paso del Macho, April 5, 1938; 1 ♂ (LSUMZ), Omealca, May 15, 1938; 1 ♂, 20 km. ENE Jesús Carranza, 200 ft., April 13, 1949; 1 ♀ (skel.), 20 km. E Jesús Carranza, 300 ft., March 20, 1948; 1 ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., April 2, 1949.

This species was not often seen. A flock of approximately fifty birds, however, was observed at Cosamaloapan on April 1, 1947.

Icterus mesomelas mesomelas (Wagler)

Yellow-tailed Oriole

Psarocolius mesomelas Wagler, Isis, 1829: col. 755. (México.)

One ♀ (LSUMZ), Palma Sola, 1750 ft., May 1, 1938; 1 ♀ (LSUMZ), Paraje Nuevo, May 1, 1938; 1 ♂ (skel.), 20 km. E Jesús Carranza 300 ft., February 21, 1948; 1 ♂, 1 ♀, 30 km. SSE Jesús Carranza, 300 ft., May 11, 1949.

Calandria. This oriole is common in thickets near water, usually in bushes that actually overhang the water. It is a noisy bird.

Icterus gularis tamaulipensis Ridgway

Lichtenstein Oriole

Icterus gularis tamaulipensis Ridgway, Proc. Washington Acad. Sci., 3, 1901: 152. (Alta Mira, Tamaulipas, México.)

One ♂, 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 11 and 26, 1946; 1 ♂ (LSUMZ), Piedras Negras, March 12, 1938; 1 ♂ (LSUMZ), El Faro near Río Blanco, March 12, 1938; 1 ♂ (LSUMZ), 15 mi. SE Palma Sola, 800 ft., May 1, 1938; 1 ♂ (LSUMZ), 20 mi. SE Cuitláhuac, 800 ft., May 1, 1938; 1 ♂ (skel.), Potrero Llano, 350 ft., February 15, 1949; 1 ♂ (skel.), 1 km. W Mecayucan, 200 ft., December 19, 1947.

Calandria. The Lichtenstein Oriole is a common species, both in the Upper Tropical Life-zone and in the arid division of the Lower Tropical Life-zone.

Sturnella magna mexicana Sclater

Eastern Meadowlark

Sturnella mexicana Sclater, Ibis, 3, 1861: 179. (Jalapa, Veracruz, México.)

One ♂, 2 ♀ (one skel.), Río Blanco, 20 km. WNW Piedras Negras, March 17 and May 26 and 27, 1946; 1 ♂ (skel.), 20 km. W Piedras Negras, October 1, 1946; 1 ♂ (LSUMZ), Yanga, November 14, 1938.

Tortilla con chile. Meadowlarks were fairly common on the extensive grasslands of the coastal plain. They were not found in the Upper Tropical Life-zone.

Specimens of this species from Veracruz are difficult to place subspecifically. Wetmore refers his material from Tres Zapotes, without comment, to *mexicanus* instead of *inexpectata,* the subspecies to which we might have assigned our specimens because of their small size. Those listed above from Veracruz, and those recorded by Wetmore from Tres Zapotes, average small (wing of males, 100.3-104.0, average, 101.8 mm.; females, 91.2-97.2, average, 94.9). But, the subspecies *mexicanus,* as a population, is probably no more than a stage in the cline between the large birds of the southern end of the Mexican plateau, named *auropectoralis,* and the small birds of Central America, named *inexpectata.* Therefore, no advantage is to be gained redefining the geographical limits of the three races in advance of a thorough revision of Mexican representatives of the species. Unfortunately, the name first proposed was *mexicanus,* with type locality at Jalapa, and this name must be preserved, even though it may be shown to apply to an intermediate population. The alleged difference between these two races in the color of the rectrices (Griscom, 1934:404) seems not to hold up in the materials examined by us.

Family THRAUPIDAE

Chlorophonia occipitalis occipitalis (Du Bus)
Mexican Chlorophonia

Euphonia occipitalis Du Bus, Esq. Orni., livr. 3, 1847:pl. 14. (México.)

One ♂, 1 ♀, 3 km. E San Andrés Tuxtla, 1900 ft., January 18, 1948.

This species seems to be rare in Veracruz, having been recorded previously only from Jalapa and Orizaba, more than a half century ago. Our two specimens of this brilliant-green tanager were shot with a pistol in the top of an "*amate copulene*" tree. The collector (Dalquest) had perched himself near the top of this tree to select desirable birds that were needed for specimens. The Mexican Chlorophonias were feeding with a large aggregation of euphonias, ant tanagers, and (especially) Abbot Tanagers. In the same tree, three wooly opossums *(Caluromys),* two tree-porcupines *(Coendou),* a climbing rat *(Tylomys),* and numerous squirrels and common opossums were obtained. The berry-like fruit in this tree was visited day and night by scores of birds and mammals and was a continuing source of valuable specimens.

Tanagra affinis Lesson
Lesson Euphonia

Tanagra [*Euphonia*] *affinis* Lesson, Rev. Zool., 5, 1842: 175. (Realejo, Nicaragua.)

One ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., February 23, 1948.

Tanagra lauta lauta Bangs and Penard
Bonaparte Euphonia

Tanagra lauta lauta Bangs and Penard, Bull. Mus. Comp. Zoöl., 63, 1919: 35. (Guatemala.)

Three ♂ (one skel.), 1 ♀ (skel.), 3 km. E San Andrés Tuxtla, 1000 ft., January 19, 1948; 1 ♂, 20 km. ENE Jesús Carranza, 200 ft., March 26, 1949.

These little tanagers, which are usually seen in flocks, were observed infrequently in the course of this field work. The species was found feeding on the fruit of the "*amate copulene*" tree.

Thraupis episcopus diaconus (Lesson)

Bishop Tanager

Tanagra (*Aglaia*) *diaconus* Lesson, Rev. Zool., June, 1842: 175. (Realejo, Nicaragua.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, May 14, 1946; 1 ♂ (skel.), 5 km. SW Boca del Río, October 11, 1946; 1 ♂ and 1 ♀ (skels.), Potrero Viejo, 1700 ft., October 21-22, 1947; 1 ♂ and 1 ♀ (LSUMZ), Potrero Viejo, October 18, 1938; 1 ♀ (skel.), 20 km. ENE Jesús Carranza, 200 ft., March 26, 1949.

The Bishop Tanager was not uncommon, either in the Upper Tropical Life-zone or in the arid division of the Lower Tropical Life-zone. The bills of this species are sometimes so thickly covered with the dried juice and pulp of the mango fruit as to be ball-shaped.

Thraupis abbas (Lichtenstein)

Abbot Tanager

Tanagra abbas Lichtenstein, Preis-Verz. Vögel Mexico, 1830: 2. (Mexico = Oaxaca, México; *cf.* van Rossem, Bull. Mus. Comp. Zoöl., 77, 1934, p. 419.)

One ♂ (skel.), 4 km. W Tlapacoyan, October 15, 1947; 1 ♂ (skel.), Boca del Río, 10 ft., December 17, 1947; 1 ♂, 1 ♀, 5 km. N Potrero, 1500 ft., February 11, 1946; 3 ♂ (two LSUMZ), Potrero Viejo, January 12 and November 12, 1938, and October 23, 1947; 1 ♂, Río Blanco, 20 km. WNW Piedras Negras, May 17, 1946; 2 ♂ (skels.), 3 km. E San Andrés Tuxtla, 1000 ft., January 19, 1948; 1 ♂ (skel.), 20 km. E Jesús Carranza, February 14, 1948.

Médlo. This tanager is a common and prominent bird wherever there are tall trees.

Phlogothraupis sanguinolenta sanguinolenta (Lesson)

Crimson-collared Tanager

Tanagra (*Tachyphonus*) *sanguinolentus* Lesson, Cent. Zool., March, 1831: p. 107, pl. 39. (México.)

One ♂ (skel.), 20 km. ENE Jesús Carranza, 200 ft., April 28, 1949; 1 ♀, 35 km. SE Jesús Carranza, 400 ft., February 15, 1948.

This brilliantly-colored tanager was found only in extreme southern Veracruz. It was not a common species, and was noted only along watercourses. In the early mornings, these birds fed in bushes and low trees, but later in the day they were seen only in higher trees. They were shy and difficult to approach.

Piranga rubra rubra (Linnaeus)

Summer Tanager

Fringilla rubra Linnaeus, Syst. Nat., ed. 10, 1, 1758: 181. (Carolina and Virginia = South Carolina.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, March 17, 1946; 1 ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., March 31, 1949; 1 ♂, 35 km. SE Jesús Carranza, 350 ft., April 7, 1949.

On the three or four occasions when these North American migrants were observed, they were in tamarind trees, on the coastal plain.

Piranga leucoptera leucoptera (Trudeau)

White-winged Tanager

Pyranga leucoptera Trudeau, Jour. Acad. Nat. Sci. Philadelphia, 8, 1839: 160. (México.)

One ♂ (skel.), 4 km. W Tlapacoyan, 1700 ft., November 21, 1948; 1 ♂, Río Atoyac, 8 km. NW Potrero, March 3, 1946.

The White-winged Tanager was observed only in the Upper Tropical Life-zone, where it does not appear to be common.

Habia rubica rubicoides (Lafresnaye)

Red Ant Tanager

Saltator rubicoïdes Lafresnaye, Rev. Zool., 7, 1844: 41. (México.)

Two ♀, 3 km. E San Andrés Tuxtla, 1000 ft., January 12 and 19, 1948.

Habia gutturalis salvini (Berlepsch)

Sclater Ant Tanager

Phoenicothraupis salvini Berlepsch, Ibis, 1883: 487. (Vera Paz, Guatemala.)

Two ♂ (one skel.), 9 km. E Papantla, 300 ft., November 17, 1947; 2 ♂, 1 ♀ (two LSUMZ), Río Atoyac, 8 km. NW Potrero, March 10 and 12, 1946; 1 ♀ (skel.), Potrero, 1700 ft., October 27, 1947; 2 ♀ (LSUMZ), Potrero Viejo, December 30, 1937, and February 15, 1938; 1 ♂, 4 km. WNW Fortín, March 28, 1946; 1 ♂ (skel.), 1 ♀, San Andrés Tuxtla, January 18 and 19, 1948; 1 ♂ (skel.), 20 km. E Jesús Carranza, 300 ft., March 20, 1948.

This ant tanager is abundant in brushy areas and low forest throughout most of the Tropical Region. Neither the male specimens nor the skeletons listed above can be identified subspecifically with certainty. Better material from Papantla and Jesús Carranza probably will show that the birds there are assignable to *H. g. littoralis,* the lowland subspecies of this species in Veracruz.

Cholorospingus ophthalmicus ophthalmicus (Du Bus)

Brown-headed Chlorospingus

Arremon opthalmicus Du Bus, Bull. Acad. Roy. Sci. Lettres et Beaux-Arts Belgique, 14, 1847: 106. (México; restricted by Lowery and Newman to Jalapa, Veracruz, México, Occas. Papers Mus. Zool., Louisiana State Univ., 22, 1949, p. 8.)

Three ♂ (one skel.) 1 ♀, 4 km. W Tlapacoyan, 1700 ft., October 13—November 21, 1947; 1 ♂, 2 ♀ (all LSUMZ), 3—5.4 mi. S Jalapa, May 28, 1949; 1 ♂, 1 ♀, 4 km. WNW Fortín, 3200 ft., April 5, 1946.

In the brush and thickets of the arroyos at the upper edge of the Upper Tropical Life-zone, the chlorospingus is fairly common. The male from near Jalapa weighed 18.4 grams (no fat); the two females from the same place weighed 18.9 and 17.2 grams (no fat).

Family FRINGILLIDAE

Saltator atriceps atriceps (Lesson)

Black-headed Saltator

Tanagra (*Saltator*) *atriceps* Lesson, Cent. Zool., 1832: p. 208, pl. 69. (México; restricted to Veracruz, Griscom, Auk, 54, April 8, 1937, p. 198.)

One ♂, 10 km. NW Potrero, February 16, 1946; 1 ♀, 7 km. NW Potrero, 1700 ft., January 9, 1947; 2 ♂, 3 ♀ (one LSUMZ), Río Atoyac, 8 km. NW Potrero, March 28, 1938, and March 1-15, 1946; 3 ♂, 1 ♀, (all LSUMZ), Paraje Nuevo, 1700 ft., January 24 and May 20, 1938; 1 ♀ (LSUMZ), Paraje Nuevo, May 20, 1938; 2 ♂ (one skel.), 1 ♀ (skel.), Río Blanco, 20 km. WNW Piedras Negras, May 16 and October 1, 1946.

This species is abundant and prominent in the Upper Tropical Life-zone, especially where there are many thickets and much low vegetation. It is less common in tall forest. Along the arroyos of the arid division of the Lower Tropical Life-zone of the coastal plain, it is uncommon.

Saltator coerulescens grandis (Lichtenstein)

Grayish Saltator

Tanagra grandis Lichenstein, Preis-Verz. Vögel Mexico, 1830: 2. (Jalapa, Veracruz, México.)

One ♂, 1 ♀ skels., Potrero Viejo, 1700 ft., October 21 and 22, 1947; 1 ♂, 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 27, 1946.

The Grayish Saltator was noted twice near Potrero, along the edges of sugar cane fields. It was more common in brushy places on the coastal plain. This species is more shy than *Saltator atriceps*, and less noisy. The two species of saltators are sometimes called "primavera" in Veracruz.

Caryothraustes poliogaster poliogaster (Du Bus)
Bishop Grosbeak

Pitylus poliogaster Du Bus, Bull. Acad. Roy. Sci. Belgique, 14, 1847: 105. (Guatemala.)

One ♂, 1 ♀, Río Atoyac, 8 km. NW Potrero, March 10, 1946.

The two specimens listed were shot on the same day but in different parts of the forest. They were in small flocks in the tops of tall trees. The species was not seen again.

Richmondena cardinalis coccinea (Ridgway)
Cardinal

Cardinalis virginianus var. *coccineus* Ridgway, Amer. Jour. Sci. (3), 5, no. 25, January, 1873: 39. (Mexico; probably Playa Vicente.)

One ♀ (skel.), Mirador, 3500 ft., December 9, 1947; 4 ♂ (one skel.), 1 ♀, Río Blanco, 20 km. WNW Piedras Negras, May 11-31, 1946; 1 ♂, 15 km. W Piedras Negras, January 12, 1947.

Cardinal. This wide-spread species is common on the coastal plain.

Pheucticus ludovicianus (Linnaeus)
Rose-breasted Grosbeak

Loxia ludoviciana Linnaeus, Syst. Nat., ed. 12, 1, 1766: 306. (Louisiana.)

One ♂, 15 km. W Piedras Negras, 300 ft., January 14, 1947.

The Rose-breasted Grosbeak was seen but once in the course of our field work in Veracruz.

Passerina cyanea (Linnaeus)
Indigo Bunting

Tanagra cyanea Linneaus, Syst. Nat., ed. 12, 1, 1766: 315. (Carolina = South Carolina.)

Two ♀, Río Atoyac, 8 km. NW Potrero, March 11, 1946; 1 ♀, 4 km. WNW Fortín, 3200 ft., April 1, 1946.

This migrant species is common in open fields in spring, usually in flocks of ten to fifty individuals. Sparrow Hawks were seen hunting this species on several occasions.

Passerina versicolor versicolor (Bonaparte)
Varied Bunting

Spiza versicolor Bonaparte, Proc. Zool. Soc. London, 5, 1837 [= June 14, 1838]: 120. (Near Temascaltepec, México.)

One ♀, Río Blanco, 20 km. WNW Piedras Negras, May 30, 1946.

The specimen taken was the only one seen. It was shot from a bush on the coastal plain.

Passerina ciris ciris (Linnaeus)

Painted Bunting

Emberiza Ciris Linnaeus, Syst., Nat., ed. 10, 1, 1758: 179. (South Carolina.)

Two ♂, Río Atoyac, 8 km. NW Potrero, February 19 and March 4, 1946; 2 ♂ (LSUMZ), El Faro, above Piedras Negras, May 2, 1938; 1 ♂ (skel.), 25 km. SE Jesús Carranza, 250 ft., April 2, 1949.

The Painted Bunting is a fairly common winter resident in thickets near water in the Upper Tropical Life-zone. The specimen taken on March 4, 1946, suggests *P. c. pallidor,* but the head is too dark.

Tiaris olivacea pusilla Swainson

Yellow-faced Grassquit

Tiaris pusillus Swainson, Philos. Mag., (n. s.), 1, no. 6, June, 1827: 438. (Temascaltepec and Real del Monte, México.)

One ♀ (skel.), 15 km. E Tlacotepec, 1500 ft., December 12, 1947.

Carpodacus mexicanus mexicanus (P. L. S. Müller)

House Finch

Fringilla mexicana P. L. S. Müller, Natursyst., Suppl., 1766: 165. (México.)

One ♀ (LSUMZ), Las Vigas, 7800 ft., May 30, 1949; 1 ♂, 2 km. E Perote, 7000 ft., October 12, 1947.

This species was noted on the spines of the *maguey* plants on the desert near Perote. The specimen taken at Las Vigas weighed 23.6 grams.

Sporophila torqueola morelleti (Bonaparte)

Cinnamon-rumped Seed-eater

Spermophila morelleti Bonaparte, Consp. Gen. Aves, 1, 1850 [near end]: 497. (Guatimala [sic] = Petén, Guatemala.)

One ♂ (skel.), 4 km. E Papantla, 400 ft., November 9, 1947; 1 ♀, 7 km., NNW Cerro Gordo, October 28, 1947; 2 ♀, Hacienda Potrero, 5 km. W Potrero, March 24, 1946; 1 ♀, 3 km. W Acultzingo, October 7, 1947; 1 ♂, 1 ♀ (skels.), 20 km. E Jesús Carranza, 300 ft., February 12 and 14, 1948.

This tiny bird is abundant in the Tropical Region where there are grassy fields, weedy places, and bushes along the edges of clearings. The overgrown *milpas,* or corn fields, furnish suitable habitat, as do the weeds and grasses growing along the railroad right of ways.

Volatinia jacarina splendens (Vieillot)
Blue-black Grassquit

Fringilla splendens Vieillot, Nouv. Dict. Hist. Nat., nouv. éd., 12, 1817: 173. (Cayenne = French Guiana.)

One ♂, 3 km. SW San Marcos, 200 ft., November 3, 1947; 3 ♂ (two skels.), 1 ♀ (skel.), Río Blanco, 20 km. WNW Piedras Negras, May 14-30, 1946; 1 ♂ (LSUMZ), Paraje Nuevo, February 21, 1938.

The Blue-black Grassquit is abundant in weedy places on the coastal plain. Its habits closely resemble those of *Passerina cyanea.*

Spinus psaltria psaltria (Say)
Arkansas Goldfinch

Fringilla psaltria Say, in Long, Exped. Rocky Mts., 2, 1823: 40 (note). (Arkansas River near the mountains = near Pueblo, Colorado.)

One ♂, 4 km. WNW Fortín, 3200 ft., March 31, 1946; 2 ♂ (skels.), Potrero Viejo, 1700 ft., October 22, 1947.

This goldfinch was noted several times in orange trees near Potrero and Fortín.

Loxia curvirostra stricklandi Ridgway
Red Crossbill

Loxia curvirostra stricklandi Ridgway, Proc. U. S. Nat. Mus., 8, September 2, 1885: 354. (México.)

One ♂, 4 km. SE Las Vigas, 9500 ft., November 5, 1946.

The specimen listed was shot from a flock of approximately six birds. The locality is in the arid pine forest on the northeastern slope of the Cofre de Perote.

Atlapetes pileatus pileatus Wagler
Rufous-capped Atlapetes

Atlapetes pileatus Wagler, Isis, 1831: 526. (Mexico = Valley of Mexico.)

One ♀ 4 km. W Acultzingo. 7500 ft., June 8, 1946.

This interesting sparrow was found only at high altitude in the dense brushland that caps the lip of the Mexican plateau between the states of Veracruz and Puebla.

Atlapetes **brunnei-nucha brunnei-nucha** (Lafresnaye)
Chestnut-capped Atlapetes

Embernagra brunnei-nucha Lafresnaye, Rev. Zool., 2, 1839: 97. (México.)

One ♂, 1 km. E Jalacingo, 6500 ft., November 13, 1948; 2 ♂ (skels.), Teocelo, 4000 ft., December 31, 1948, and January 6, 1949; 1 ♀, 5 km. N Jalapa, 4500 ft., October 18, 1946; 1 ♂, 3 km. SE Orizaba, 5500 ft., December 21, 1946.

The Chestnut-capped Atlapetes is a very shy and retiring species. The specimens were all taken in mouse traps. It was found only in the Upper Tropical Life-zone.

Arremonops rufivirgatus crassirostris (Ridgway)

Texas Sparrow

[*Embernagra rufivirgata*] β *crassirostris* Ridgway, Proc. U. S. Nat. Mus. 1, 1878: 248. (Córdoba and Orizaba, Veracruz, México.)

One unsexed (LSUMZ), Cuitláhuac, January 12, 1939; 1 ♀, 5 km. S Tehuatlán, 700 ft., November 14, 1947.

Arremonops rufivirgatus rufivirgatus (Lawrence)

Texas Sparrow

Embernaga rufivirgata Lawrence, Ann. Lyc. Nat. Hist. New York, 5, May, 1851: p. 112, pl. 5, fig. 2. (Rio Grande in Texas = Brownsville, Texas.)

One ♀ (skel.), Tampico Alto, 50 ft., January 2, 1949; 1 ♀, El Cepillo, 20 ft., February 7, 1949; 1 ♂ (skel.), Ozuluama, 500 ft., February 9, 1949; 1 ♀ (skel.), Potrero Llano, 350 ft., February 15, 1949.

The specimen from El Cepillo, in northern Veracruz, is definitely assignable to *rufivirgatus* instead of either *ridgwayi* or *crassirostris*. As acknowledged by the describers, *ridgwayi* is nothing more than an intermediate population between the green-backed, large-billed birds from southern Veracruz, and adjoining areas, and the grayish, small-billed birds of southern Texas and contiguous areas. Indeed, in material from the state of San Luis Potosí, we find it difficult to distinguish most examples of *ridgwayi* on the basis of color, although the bills of these birds do average somewhat less massive than do the bills in examples of *crassirostris*. Extreme caution must be exercised in a study of geographic variation in this species because of the high degree of postmortem change that occurs in museum material. One of the most striking instances of this phenomenon that we have seen is displayed by the series of *crassirostris* in the United States National Museum. The splendid new series taken by Wetmore and Carriker in the Tres Zapotes area differs markedly from the older material from that general area. The upper parts of the older specimens are much more olivaceous (less grayish) and the flanks are decidedly browner.

Pipilo ocai ocai (Lawrence)

Collared Towhee

Buarremon ocai Lawrence, Ann. Lyc. Nat. Hist. New York, 8, May, 1865: 126. (Jalapa, México.)

One ♂ (LSUMZ), 7.8 mi. by highway NW Acultzingo, May 24, 1949.

Charles Sibley, who recently has made an extensive study of geographic variation and speciation in certain Mexican populations of the genus *Pipilo,* has kindly examined this specimen and identified it as a typical example of *P. o. ocai.* He was somewhat surprised to learn that the species occurs at this locality and at the comparatively low elevation of 7,500 feet. This specimen was taken by Newman and was found by him to be in breeding condition and to weigh 58 grams (no fat).

Pipilo maculatus maculatus Swainson

Spotted Towhee

Pipilo maculata Swainson, Philos. Mag., n. s., 1, June, 1827: 434. (Real del Monte [Hidalgo], México.)

One ♂ (LSUMZ), 7.8 mi. by highway NW Acultzingo, May 24, 1949.

This specimen also was identified by Sibley. In referring it to the race *maculatus,* he points out that it shows, nevertheless, a heavy admixture of brown dorsally which indicates a trend toward a character of populations occurring farther south in México. This specimen, also taken by Newman, was obtained not more than 100 feet from the place where the example of *P. o. ocai* was shot. The latter specimen was in a tree on the periphery of an oak wood; the specimen of *P. m. maculatus* was in a thicket outside of the forest. It, like the example of *ocai,* was in full breeding condition. The individual weighed 45.6 grams (no fat).

Pipilo fuscus Swainson

Brown Towhee

Pipilo fuscus Swainson, Phil. Mag., (n. s.), 1, 1827: 434. (Temascaltepec, México.)

One ♂, 6 km. WSW Zacualpilla, 6500 ft., November 6, 1948; 1 ♂, 3 km. W Limón, 7500 ft., September 30, 1948.

Since the Brown Towhees are now being revised by John Davis at the Museum of Vertebrate Zoology, we sent our two specimens to him for critical study. He finds the specimen that came from six kilometers west-southwest of Zacualpilla to be a first-year male, almost through its post-juvenal molt, and showing characters of both *P. f. fuscus* and *P. f. potosinus.* He regards the specimen from three kilometers west of Limón as showing characters of both *P. f. potosinus* and *P. f. tori.* It seems, therefore, that better material than our two specimens will be required to permit subspecific identifications of the two populations represented.

Plagiospiza superciliosa (Swainson)

Striped Sparrow

Aimophila superciliosa Swainson, Anim. Menag., 1837: 314. (México.)

One ♂ (LSUMZ), 15 km. W Las Vigas, May 30, 1949.

The specimen listed above weighed 38.7 grams and was only moderately fat.

Passerculus sandwichensis savanna (Wilson)

Savannah Sparrow

Fringilla savanna Wilson, Amer. Orni., 3, 1811: p. 55, pl. 22, fig. 3. (Savannah, and Great Egg Harbor, New Jersey = Savannah, Georgia.)

One ♀, 5 km. S Tehuatlán, 700 ft., November 14, 1947.

The specimen agrees closely with examples of *P. s. savanna* in the United States National Museum and the Louisiana State University Museum of Zoology.

Ammodramus savannarum perpallidus (Coues)

Grasshopper Sparrow

[*Coturniculus passerinus*] var. *perpallidus* "Ridgway" Coues, Key N. Amer. Bds., October, 1872: 137, in text. ("dry western regions" = Antelope Island, Great Salt Lake, Utah.)

One ♂, Mirador, 3500 ft., December 8, 1947.

The wing of this specimen measures 62 mm., the tail, 45.5 mm.

Pooecetes gramineus confinus (Baird)

Vesper Sparrow

[*Poocaetes gramineus*] var. *confinus* Baird, in Baird, Cassin, and Lawrence, Rep. Expl. Surv. R. R. Pac., 9, 1858: 448. (Western U. S. = Loup Fork of the Platte River, Nebraska.)

One ♂ (skel.), 1 ♀, 6 km. WSW Zacualpilla, 6500 ft., November 9, 1949.

The skeleton was not identified to the subspecies. The skin of the specimen taken at the same time is, however, clearly referable to *P. g. confinus*.

Aimophila rufescens rufescens (Swainson)

Rusty Sparrow

Pipilo rufescens Swainson, Philos. Mag. (n. s.), 1, no. 6, June, 1827: 434. (Temiscaltipec [= Temascaltepec], México.)

One ♂ (LSUMZ), Jalapa, May 27, 1949; 1 ♀ (LSUMZ), Potrero Viejo, 1700 ft., August 20, 1937; 1 ♂, 1 ♀, Río Atoyac, 8 km. NW Potrero, March 20, 1946; 1 ♂ (skel.), 5 km. N Jalapa, 4500 ft., October 19, 1946; 1 ♂ (skel.), 7 km. SE Volcán San Martín, 3000 ft., January 16, 1948.

This shy species was usually seen in pairs, along the edges of fields in the Upper Tropical Life-zone. It was generally found on or near the ground, and was quick to retire to dense brush at the slightest alarm. The specimen taken by Newman at Jalapa weighed 40 grams (no fat).

Aimophila ruficeps boucardi (Sclater)
Rock Sparrow

Zonotrichia boucardi Sclater, Proc. Zool. Soc. London, 1867: p. 1, pl. 1. (Orizaba, Veracruz, and La Puebla, Puebla, México.)

One ♀, 6 km. WSW Zacualpilla, 6500 ft., November 9, 1948.

Aimophila petenica petenica (Salvin)
Petén Sparrow

Ammodromus petenicus Salvin, Proc. Zool. Soc. London, 1863: 189. (Plains of Petén, n. e. Guatemala.)

One ♂, Río Blanco, 20 km. WNW Piedras Negras, May 30, 1946.

Junco phaeonotus phaeonotus Wagler
Red-backed Junco

Junco phaeonotus Wagler, Isis, 1831: col. 526. (México.)

Three ♂ (one skel.), Las Vigas, 8500 ft., October 10, 11, and 19, 1948.

This species is abundant in the pine forests near Las Vigas.

Spizella passerina mexicana Nelson
Chipping Sparrow

Spizella socialis mexicana Nelson, Auk, 16, 1899: 30. (San Cristóbal, Chiapas, México.)

Two ♂ (LSUMZ), Jalapa, May 27, 1949.

These two specimens weighed 14.1 and 13.1 grams, and neither possessed fat.

Spizella pusilla wortheni Ridgway
Field Sparrow

Spizella wortheni Ridgway, Proc. U. S. Nat. Must., 7, 1884: 259. (Silver City, New Mexico.)

One unsexed, 2 km. W Limón, 7500 ft., September 24, 1948.

Both in color and size, this specimen fulfills all the specifications of *wortheni* (*cf.* Burleigh and Lowery, 1942: 209-211). This is apparently the first record of the occurrence of either the species or the subspecies in the state of Veracruz.

Melospiza lincolnii lincolnii (Audubon)

Lincoln Sparrow

Fringilla Lincolnii Audubon, Birds Amer. [folio], 2, 1834: pl. 193. (Labrador [= near mouth of the Natashquan River, Quebec].)

One ♂ (skel.), Teocelo, 4500 ft., January 2, 1949; 1 ♀, Hacienda Potrero, 5 km. W Potrero, March 24, 1946; 1 ♀, 4 km. WNW Fortín, 3200 ft., April 5, 1946; 1 ♀ (skel.), 7 km. NNW Cerro Gordo, 1500 ft., November 27, 1947.

This species was exceedingly common in the winter months and was often seen feeding in open clearings near human dwellings.

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Transmitted by authors, December 22, 1949.

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PRINTED BY
FERD VOILAND, JR., STATE PRINTER
TOPEKA, KANSAS
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