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## BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. VI<sup>1</sup>

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### Sylviidæ

#### *Conopoderas æquinocialis æquinocialis* (Latham)

*Sylvia æquinocialis* LATHAM, 1790, 'Index Ornith.,' II, p. 553 (Christmas Island, Pacific Ocean).

*Tatare æquinocialis* SHARPE, 1883, 'Cat. Birds Brit. Mus.,' VII, p. 528.

ADULTS (sexes alike).—Dorsal surface, olivaceous gray, approaching neutral gray on the scapulars and sides of neck, many of the feathers with whitish margins, narrow on the back, but broader on the rump and upper tail-coverts; in some specimens the latter areas are prevailingly pale buffy, perhaps as a result of wear and fading; wing quills, clove brown, the remiges tipped and externally edged with whitish, most broadly on the secondaries and tertials; more or less albinistic wing quills not unusual; under surface of remiges, mouse gray; lining of wing, whitish; coverts, like quills, but still more broadly tipped with grayish white; rectrices, clove brown dorsally, mouse gray ventrally, narrowly edged and more broadly tipped with whitish, in ventral aspect the whitish terminations being more extensive, showing in some specimens as conspicuous light spots on the inner vanes of the quills; an ill-defined whitish supraorbital stripe, which extends forward through the lores to the nostrils; cheeks, olivaceous gray; entire ventral surface, whitish, faintly tinged on flanks, sides of breast and belly with pale neutral gray, and on center of breast and belly with pale yellowish. Iris, brown; bill, blackish on maxilla, horny or flesh color on mandible; lining of mouth, orange; legs and feet, "slaty."

NEOTYPE.—No. 190,543, Amer. Mus. Nat. Hist.; ♂ ad.; Christmas Island, Line Group, Pacific Ocean; February 12, 1921; R. H. Beck.

MEASUREMENTS.—(11 males): wing, 70–76 (73.4); tail, 57–64 (61.2); exposed culmen, 15–16.6 (15.8); bill from nostril, 10.8–11.2 (11); tarsus, 23–24.8 (24); middle toe with claw, 17 mm.

6 females: wing, 70–72 (71.3); tail, 57–61 (58.4); exposed culmen, 15–15.8 (15.3); bill from nostril, 11–11.2 (11); tarsus, 23–24 (23.5); middle toe with claw, 20 mm.

RANGE.—Christmas Island, Line Group.

Specimens from Christmas Island collected February 10–20, 1921.

Although this warbler was named one hundred and forty years ago and has since been collected on two or more occasions, no specimen

<sup>1</sup>Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, and 337.

appears to have found its way into a natural history museum previous to the series obtained by Messrs. Beck and Quayle of the Whitney Expedition. The species proves to be of rather unexpected appearance, being of a gray and white cast and equally different from the yellow representatives of *Conopoderas* of the Marquesas and Society Groups on the one hand, and the brownish races of the Tuamotus on the other.

Most of the nineteen specimens were preparing to breed, according to the opinion of the collectors. Two or more of the skins are characterized by faint grayish lines on the throat and upper breast, which may be indicative of immaturity. In other respects there is nothing to reveal relative age. Variation in the white emargination of the dorsal feathers and in the intensity of the yellowish wash on the ventral surface seem to be determined by the extent of plumage wear.

***Conopoderas æquinoctialis pistor* (Tristram)**

*Acrocephalus pistor* TRISTRAM, 1883, Ibis, p. 44, Pl. II (Fanning Island).

*Tatare pistor*, SHARPE, 1883, 'Cat. Birds Brit. Mus.,' VII, p. 527.

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas æquinoctialis æquinoctialis*, but larger, with more general whitish emargination of the dorsal plumage, and with more pronounced grayish wash on the throat and upper breast.

MEASUREMENTS.—(2 males): wing, 82, 79; tail, 69, 66; exposed culmen, 18, 17.8; bill from nostril, 13, 12.8; tarsus, 29, 28; middle toe with claw, 23 mm.

1 female: wing, 77; tail, 61; exposed culmen, 17.5; bill from nostril, 13; tarsus, 29 mm.

RANGE.—Fanning Island, Line Group.

Two adult males received from the Bishop Museum, Honolulu, and collected at Fanning Island, July 29, 1922, by S. C. Ball; one female lent by the Museum of Vertebrate Zoölogy, Berkeley, Calif., collected at Fanning Island, June 23, 1924, by H. Kirby.

Tristram published an excellent description of this warbler, which proves to be a larger race of the Christmas Island form. Except for size, the two subspecies are of nearly identical appearance, though two of the three specimens of *pistor* are of much lighter aspect on the dorsal surface, owing to the greater extent of the whitish feather edgings. The two males are in full moult and it is possible that the color difference between the two subspecies is one of season rather than one of pattern. In any event, the difference in size is striking.

***Conopoderas æquinoctialis*, subspecies?**

The Museum of Vertebrate Zoölogy of the University of California has kindly lent a male specimen of a warbler of the *æquinoctialis* group, collected at Washington Island during the summer of 1924 by H. Kirby.

The skin is in bad condition, with a broken bill, but the bird seems to have been intermediate in size between the subspecies *æquinoctialis* and *pistor*. It very probably represents a third race, confined to Washington Island, which lies well to the northwestward of Fanning Island in the direction of Palmyra. Further collecting will be necessary before the affinities of the Washington Island bird can be ascertained.

#### THE WARBLERS OF THE TUAMOTUS

About fifty islands of the Tuamotu (Paumotu) Archipelago were investigated during the course of the Whitney Expedition, and examples of *Conopoderas*, mostly in excellent series, were obtained at thirty-seven of them, in addition to specimens from the easterly outliers, Pitcairn and Henderson. It is fair to assume that members of this genus do not inhabit certain other islands in the group, on which Messrs. Beck and Quayle, and their Polynesian assistants, hunted with great thoroughness, but without encountering warblers.

In particular, the southeasterly clusters of the Tuamotus, such as islets of the Actæon and Gambier Groups (some dozen or more bodies of land), yielded no trace of warblers, although some of these support an abundance of other land birds, including fruit pigeons (*Ptilinopus*) and quail doves (*Gallicolumba*). According to our present information, no *Conopoderas* is known from any islet between Tureia (20° 45' S., 138° 30' W.) and Pitcairn (25° S. 130' W.). The latter is perhaps not strictly to be included within the Tuamotu Archipelago; at any rate, the affinities of its endemic warbler are, as will appear, with the form occurring at one of the Austral Islands (Rimitara) rather than with the birds of the central and northwestern Tuamotus.

An alphabetical list of all the Tuamotu Islands represented by warblers in the Whitney Expedition collection is appended, together with their synonyms and their approximate geographical positions. The first name is, in most cases, that preferred by Brigham's 'Index to the Islands of the Pacific' (Mem. B. P. Bishop Museum, Vol. I, No. 2, pp. 87-256, 1900). In the systematic text only the first of the respective names is used.

Ahii, Ahe, Peacock	14° 30' S., 146° 20' W.
Ahunui, Fangataufa, Cockburn, Byam Martin	19° 40' S., 140° 25' W.
Anaa, Chain	17° 30' S., 145° 30' W.
Apataki, Hagemeister,	15° 30' S., 146° 20' W.
Aratika, Carlshov	15° 30' S., 145° 30' W.
Arutua, Rurick	15° 10' S., 146° 50' W.
Faaité, Faite, Miloradowitch	16° 45' S., 145° 10' W.

Fakahina, Fakaina, Akahaina, Predpriatie	16° S., 145° W.
Fakarava, Fakarawa, Wittgenstein	16° 10' S., 145° 35' W.
Hao, Hau, Bow, Harp	18° 15' S., 140° 55' W.
Hiti, Eliza	16° 45' S., 144° 8' W.
Katiu, Saken	16° 25' S., 144° 20' W.
Kauehi, Kawehe, Vincennes	15° 50' S., 145° 10' W.
Kaukura, Aura	15° 45' S., 146° 45' W.
Makatea, Metia, Aurora	15° 50' S., 148° 12' W.
Makemo, Makima, Phillips, Koutousoff	16° 35' S., 143° 40' W.
Manihi, Waterlandt	14° 30' S., 145° 55' W.
Matahiva, Lazareff	14° 55' S., 148° 40' W.
Napuka, Whytoohee	14° 10' S., 141° 15' W.
Niau, Greig	16° 10' S., 146° 20' W.
Nihiru, Niheri, Nigeri	16° 40' S., 142° 50' W.
Paraoa, Hariri, Gloucester	19° 10' S., 140° 55' W.
Rangiroa, Rahiroa, Vliegen, Deans, Nairsa	15° 10' S., 147° 30' W.
Raraka	16° 10' S., 144° 55' W.
Taenga, Holt, Jermaeloff	16° 10' S., 143° 5' W.
Tahanea, Tchitschagof	16° 50' S., 144° 45' W.
Taiaro, King	15° 45' S., 144° 35' W.
Takapoto, Oura	14° 40' S., 145° 10' W.
Takaroa, Tiokea	14° 30' S., 144° 55' W.
Takurea, Takoumé, Wolkonski	15° 50' S., 142° 10' W.
Tepoto, Ofiti	16° 50' S., 144° 10' W.
Tikahau, Tikahao, Krusenstern	15° S., 148° 10' W.
Tikei, Romanzoff	14° 55' S., 144° 30' W.
Toau, Elizabeth	15° 55' S., 146° W.
Tuanaki, Tuanake, Reid	16° 40' S., 144° 15' W.
Tureia, Carysfort, Papakena	20° 45' S., 138° 30' W.
Vanavana, Kurateke, Barrow, Teku	20° 45' S., 139° 10' W.

Wetmore (Bull. Mus. Comp. Zool., LXIII, No. 4, pp. 206-212) has already reported upon Tuamotuan warblers collected during a cruise of the 'Albatross' at ten different islands, of which the following three were not visited by members of the Whitney Expedition:

Akiaki, Thrum Cap, Lanciers	18° 30' S., 139° 15' W.
Pinaki, Nganati, Whitsunday	19° 20' S., 138° 45' W.
Hereheretue, St. Paul, San Pablo	19° 55' S., 144° 55' W.

The American Museum material from the Tuamotus, Pitcairn, Henderson, and from Rimitara of the Austral Group, to southward of the Societies, comprises about fifteen hundred specimens of *Conopoderas* taken at forty islands. The task of sorting, examining, comparing, and measuring these has been a large one, but the result, we hope, will justify the pains.

The Tuamotus, including Makatea, prove to be occupied by six races of a common species, three of which are here described as new.

These six are by no means of equal rank or equivalent range. Three of them (*erema*, *palmarum*, *niauensis*) are each confined to single islands; a fourth, the type form (*atypha*), occurs upon at least twenty-eight more or less contiguous islands; a fifth (*rava*) is found at a similar natural aggregation of seven or more islands in the east-central part of the Tuamotus. The sixth (*flavida*) inhabits one or more islands of the Disappointment Group, to northward of the main archipelago, and seems to have affinities with the warblers of the Marquesas Islands.

The typical subspecies, *Conopoderas atypha atypha*, which was described by Wetmore from Fakarava, ranges throughout most of the atolls between Matahiva on the west and Fakahina on the east. It is a somewhat nondescript and featureless bird, very puzzling because of a wide scope of coloration through brown, buffy, pale yellow, grayish, olive-green, and brownish olive, and, furthermore, because of the presence of two definite color phases which may be described roughly as "grayish" and "reddish." These phases appear in nestling plumage and are found apparently through all stages of the birds' life. Among our specimens are nestlings, juvenals, adults in fresh feathers, others in very worn plumage, and birds of both sexes with enlarged gonads or collected while incubating eggs or feeding young, which represent the respective color phases.

For these reasons, small series, such as have been previously available, would inevitably lead to confusion in a taxonomic study. It would be quite possible, for instance, that six or eight birds of only the brown type might be collected on one island, and as many of the greenish-gray type, with white breasts, on another. Under such circumstances it would be natural to describe the two as distinct races, a procedure which Wetmore, indeed, has followed. Our large series have rectified and balanced any such chance of error. For example, the criterion upon which we have worked out the distribution of *Conopoderas atypha atypha*, and have synonymized three of Wetmore's subspecific names, has been the presence upon any one of twenty-eight islands of birds indistinguishable in dimensions, pattern, and coloration from birds taken at other islands. In some cases the bulk of the specimens from two islands may chance to have different aspects, but there always prove to be certain examples from the respective localities that can be matched exactly, while any remaining discrepancies are blended out, and made to appear inconsequential, by specimens from still other islands. In short, the skins of *Conopoderas atypha atypha*, from the islands listed under the special discussion of that

subspecies, make up a homogeneous series of birds, without a single character upon which to establish a difference or hang a name.

***Conopoderas atypha atypha* Wetmore**

*Conopoderas atypha atypha* WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, p. 207 (Fakarava, Tuamotu Group).

*Conopoderas atypha crypta* WETMORE, idem, p. 209 (Makemo, Tuamotu Group).

*Conopoderas atypha agassizi* WETMORE, idem, p. 210 (Apataki, Tuamotu Group).

*Conopoderas atypha nesiarcha* WETMORE, idem, p. 210 (Rangiroa, Tuamotu Group).

MEASUREMENTS.—(134 males,<sup>1</sup> from the twenty-eight islands listed below): wing, 84–93 (88.3); tail, 68–83 (74.6); exposed culmen, 19.6–22 (21); bill from nostril, 14.3–17 (15.8); tarsus, 29–33 (30) mm.

79 females from all of the same islands save Katiu and Nihiru (twenty-six islands): wing, 81–90 (84.6); tail, 66–77 (71.1); exposed culmen, 19–22 (20.6); bill from nostril, 14.8–16.8 (15.6); tarsus, 28–31.5 (29.7) mm.

RANGE.—The northerly and westerly islands of the Tuamotu Archipelago, with the exception of Napuka, Anaa, Niau, and Makatea.

Specimens from the following twenty-eight islands of the Tuamotus: Fakarava, September, 1921, April, 1923; Aratika, December, 1922, May, June, 1923; Toau, April, June, 1923; Apataki, June, 1923; Kaukura, June, 1923; Rangiroa, August, 1922, June, 1923; Arutua, February, 1923; Tikahao, June, 1923; Matahiva, April, June, 1923; Tikei, August, December, 1922 Takapoto, August, 1922, February, March, 1923; Takaroa, February, March, 1923; Manihi, February, 1923; Ahii, August, 1922, February, 1923; Tahanea, March, 1923; Faaité, April, 1923; Kauehi, March, May, 1923; Raraka, March, 1923; Taiaro, May, 1923; Makemo, October, 1921, May, 1923; Katiu, May, 1923; Tuanaki, May, 1923; Hiti, October, 1921, May, 1923; Tepoto, May, 1923; Fakahina, October, 1921; Taenga, May, 1923; Nihiru, October, 1921; Takurea, May, 1923.

Wetmore's description of his specimens from Fakarava, Aratika, and Tikei (*loc. cit.*, p. 207) gives a good record of one phase of this highly variable race. To complete the picture, however, it is necessary to combine with the above his equally full and careful descriptions of specimens exhibiting different plumage variations, which he described under three other names, from the islands of Makemo, Apataki, and Rangiroa, respectively.

The following critical notes are drawn from an examination of twelve hundred specimens.

<sup>1</sup>In this and certain other long series the dimensions of bill and tarsus are based upon slightly fewer specimens than those of wing and tail.

FAKARAVA.—Even the central rectrices are frequently tipped with whitish. There is, moreover, wide latitude in the extent of pale edgings on the dorsal plumage and in the general color tone, both of which are determined only in part by the extent of wear. In examples of the rufescent phase, the back and rump range between tawny-olive and snuff brown, while breast and flanks are often heavily tinged with clay color.

In young birds the rectrices are olive-brown, with only faintly paler edgings. The larger, whitish areas appear on these quills in a later plumage, after which one or two pairs of the outer feathers are often terminally whitish for a fifth or more of their length. Some adults show little more than a whitish speckling in the tail. Irregular albinistic feathers may appear on any part of the body.

ARATIKA.—There is a higher proportion of reddish birds than among those from Fakarava, but no dearth of counterparts among specimens in every plumage, including the grayest. Asymmetrical albinism is shown in the tail of one specimen. One immature male is extraordinarily yellowish, being washed with mustard or amber yellow on the breast; it is mainly tawny-olive on the upper surface, and has an olive-ochre tinge on cheeks and flanks.

TOAU.—The series matches the preceding two, though with more pronounced albinism, particularly of back, wings, and tail. As if to balance this, some adults have tails with absolutely no trace of white.

APATAKI.—Upon the basis of a single specimen Wetmore described the warbler of Apataki as *C. a. agassizi*. He compared his type not with specimens from the neighboring islands of Fakarava and Aratika, but with birds from Makemo, which lies in a southeasterly direction some one hundred and seventy-five geographic miles from Apataki.

Comparison of a large series of Apataki specimens with birds from Fakarava shows that the two are quite indistinguishable. Their variations are exceedingly similar, some birds from each island being very grayish on the back, with paler feather edgings, while others have more pronounced olivaceous and brownish casts. Others in each series show an almost pinkish wash on the breasts. Variation in the tail feathers is likewise of the type described above, and the measurements agree.

KAUKURA AND ARUTUA.—Seventy-five specimens from these two islands agree entirely with Fakarava birds.

RANGIROA.—Dr. Wetmore had six specimens from Rangiroa, upon

the basis of which he described the warbler of that island as *C. a. nesiarcha*, comparing it with birds from Fakarava, etc. The characteristics given relate both to color and to proportions. He states that the Rangiroa form is more buffy below than typical *atypha*, that it averages more brownish above, and that the bill is distinctly shorter. Measurements given for the exposed culmen of his four male specimens are from 18.3 to 18.5 mm.

We can only assume that Wetmore's specimens were all immature birds of the rufescent phase, which, if a fact, might account both for the buffy suffusion and the shortness of the bill. At any rate, the last character is by no means shown in a series of sixty specimens from Rangiroa obtained during the course of the Whitney Expedition. The following figures represent the range in bill length of males from Rangiroa and from Fakarava, the type locality of *C. a. atypha*.

Rangiroa	20-20.8 (average, 20.45 mm.)
Fakarava	20-21 (average, 20.45 mm.)

Furthermore, grayish birds with light breasts, like many from Fakarava, are common in the series. Conversely, the buffiest Rangiroa specimens can be matched from any other island represented by a large series.

**TIKAHAO AND MATAHIVA.**—Warblers from these islands, at the extreme northwesterly end of the long line of the Tuamotus, also agree entirely with typical examples from Fakarava and its neighbors, as well as with those from Rangiroa and other intervening atolls. They include birds which are quite as grayish above and as whitish below as those from the type locality. The variations among both adults and immature harmonize completely, and the measurements offer no criteria for separation.

Nestlings and fledglings were taken during June.

**TIKEI, TAKAPOTO, TAKAROA, MANIHI, AND AHII.**—North of the western end of the Tuamotus lies this small line of somewhat isolated islands. The warblers from all of them agree closely, and a special effort was made, through close comparison and the measurement of a long series, to distinguish between them and the topotypical birds. The attempt was unsuccessful. The majority of specimens are brownish and buffy, but among those from Manihi and Ahii, especially, are some examples that are more than ordinarily "gray and white."

At Tikei, fledglings of the reddish phase were taken in December. Adults of both phases were breeding between August and December. From Takapoto are nestlings taken in March and actively breeding adults



taken in August. At Ahii, a female was collected on her eggs on February 6, and non-breeding adults during August.

FAAITE AND TAHANEA.—These atolls lie southeast of Fakarava, close to the latter and to each other. The birds of all are counterparts in appearance and measurements.

At Faaite, half-grown nestlings which are perfect examples of the reddish and the grayish phases, respectively, were taken on the same date in April. The distinction is as independent of sex and age as of locality, and is thus demonstrated to be a purely individual variation. The genetic significance, if it could be worked out, would be exceedingly interesting.

KAUEHI, RARAKA, AND TAIARO.—Birds from these islands, which lie northeast of Fakarava, are true to type. The Raraka series includes a male taken on March 10, 1923, which has six asymmetrically placed albinistic rectrices, several partially albino quills in each wing, and a rump and upper tail-coverts which are Isabella color. The last is an expression of a strong underlying character in the genus (Cf. *Conopoderas atypha flavida*, *Conopoderas caffra fatuhivæ*, etc.).

Among the Kauehi birds are March fledglings of the two phases already described. In the Taiaro series, also, are both gray and rufescent female chicks, taken from nests on May 28 and 29. The hue of the reddish example is close to the snuff brown of Ridgway's 'Color Standards.' Several May adults from Taiaro are in full moult, tail-less, and with only pin-feathers on the head and throat.

MAKEMO.—Wetmore described the warbler of Makemo, in the central part of the Tuamotu Archipelago, as *C. a. crypta*, stating that it differed from the typical form in being "distinctly grayer above, and whiter, less buffy, below."

We can only conclude, again, that the observed difference depended on the smallness of his series. The Whitney Expedition collection includes a large number of skins from Makemo, and in measurements, coloration, and range of variation they are quite indistinguishable from birds of Fakarava. Five characteristically gray adults from each island were carefully examined by several members of the Department of Birds in the American Museum, and absolutely no racial differences, however slight, could be discriminated. Dr. Wetmore also speaks of strongly rufescent examples in the Makemo series. These, are likewise present among our birds, but they can be matched, skin for skin, among the warblers from Fakarava and from many of the other islands already considered.

Fledglings of the grayish phase are dated May 21. Both grayish and rufescent adults were breeding during the same month, while still other adults were undergoing heavy moult.

KATIU, TUANAKI, HITI, AND TEPOTO.—These four islands make up the so-called Sea Gull or Raeffsky Cluster of the Tuamotus, lying between Makemo on the east and Raraka and Tahanea on the west. Tepoto is not to be confused with the more northerly island of Tetopoto or Otooho, in the Disappointment Group, which is incorrectly labelled "Tepoto" on many hydrographic charts.

The warblers, as might be expected, agree with those of the surrounding islands. A male from Hiti is the most thoroughly albinistic example yet mentioned, with the head and a large part of the back creamy white, speckled with a few dark feathers, and with an isabelline patch on the left side of the neck. The quills are irregularly spotted with white, but no more so than among many otherwise normal specimens. One example from Tuanaki, a male collected on May 3, is the yellowest noted throughout the entire subspecies. The under surface of this bird, from throat to belly, is washed with Naples yellow, and the flanks and crissum with a color ranging from cream-buff to chamois.

Breeding adults were collected at Katiu, Tuanaki, and Hiti during May, and at the last-named island during October as well.

FAKAHINA.—This is an isolated island, lying one hundred and twenty-five miles east of Takurea and one hundred and fifty or more miles northeast of Hao. It is the eastern outpost of a natural chain extending from Matahiva through the line of islands previously discussed, and its warblers are absolutely indistinguishable from Fakarava birds. The Fakahina series comprises only five specimens, and these all of the gray phase. Four of them have white under-surfaces and one shows a faint yellowish tinge. Albinism is conspicuous in two specimens. It so happens that our entire series from Takurea, the nearest island to Fakahina, is made up of six birds in the rufescent or buffy phase. It is easy to understand, therefore, how a systematist with only these two series to compare might justifiably describe them as distinct subspecies. Only when we find birds of both types present in large numbers from neighboring islands do we realize the pitfalls.

TAENGA.—Specimens from Taenga are absolutely typical of the subspecies, agreeing equally with those from such remote localities as Fakarava to westward and Fakahina to eastward. Non-breeding adults, many undergoing complete moult, were taken during May.

NIHIRU AND TAKUREA.—Nihiru is represented by but one skin, an adult male taken in October, and in breeding condition. From Takurea we have an excellent series of May birds, mostly with inactive gonads, although at least one was nesting.

We have grouped the specimens from these two islands under *Conopoderas atypha atypha*, with the characters of which most of them substantially agree, but it must be confessed that some of the birds would be hard to distinguish from the subspecies *rava*, which inhabits the group of islands lying to southeastward. Such apparent evidence of intergradation is quite in harmony with the theory of subspecies, and the geographic proximity of the areas of uncertainty is interesting, not to say gratifying. The same degree of doubt applies to the warblers of Hao, which we have aligned with *Conopoderas atypha rava*, but which occupy the island of the other assemblage that lies nearest Nihiru and Takurea.

The habitats of the races *atypha* and *rava* differ somewhat in quality as well as in geographic position. Most of the islands occupied by the former are large, well-wooded atolls. The islands inhabited by *rava*, on the contrary, are very small, Hao being the only exception. When the bird life of the whole region is better known, through further study of the Whitney Expedition material, an interpretation of such relationships may become possible.

It has not been thought worth while to give detailed measurements of specimens from the separate islands considered above. Suffice it to say that these were all made and carefully compared by the senior author, and that the sums from which averages were derived were reckoned on a computing machine by his assistant, Miss Dorothy Taylor. The fact that the incomparable collection of Tuamotuan warblers were prepared by the same field workers during a recent and relatively short period of time, and that the skins are all of the same "make," has been of great advantage in working out the relationships and variations of these puzzling birds.

From notations on the labels of *Conopoderas atypha atypha*, one is forced to the conclusion that the birds breed throughout the year. At any rate, a tabulation of the condition of the gonads, in warblers from practically all islands within the range, proves insufficient to give a clue to any relation between season and the height of the breeding period. Adults in all sexual stages, as well as nestling birds, are noted for the following months: February, March, April, May, June, August, October, and December. Change of plumage likewise seems to have no reference

to time of year. Many specimens noted as still caring for their young were actively moulting. Not infrequently the feathers undergo extraordinary wear before the beginning of the moult. Among our series are a number of pitifully bleached and threadbare birds, with body feathers and quills abraded almost to shreds.

Males heavily outnumber females among specimens from all but one of the twenty-eight islands listed. The ratio of sexed birds for all of these localities is 804 males to 404 females, or a proportion of two to one. This may be partly explained by greater conspicuousness of the males because of their singing and their greater freedom during the period of incubation. It is probable, however, that males do actually outnumber females.

In this, and all other forms of *Conopoderas* examined, males average consistently larger than females, particularly in the length of wing and tail. Notes on the labels of this and the three following subspecies record the iris as brown, bill blackish above, horn-color on the mandible, feet and legs "gray."

#### ***Conopoderas atypha palmarum*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas atypha atypha*, but distinguishable by its slightly smaller size.

TYPE.—No. 190,439, Amer. Mus. Nat. Hist.; ♂ ad.; Anaa Island, Tuamotus; October 21, 1921; R. H. Beck.

MEASUREMENTS.—(5 males): wing, 85–89 (86.8); tail, 68.6–73.3 (71.6); exposed culmen, 18.5–19.7 (19.2); bill from nostril, 14.2–14.7 (14.5); tarsus, 28.3–29.3 (28.9) mm.

5 females: wing, 79.6–82.5 (80.8); tail, 60–68 (63.2); exposed culmen, 16.5–18.5 (17.5); bill from nostril, 12.5–13.8 (13); tarsus, 27–29 (28.3) mm.

RANGE.—Known only from Anaa Island.

Specimens from Anaa, collected during October, 1921.

Only eleven examples of the resident warbler of Anaa were obtained, five males, six females, but these comprise adults with large gonads and two or more nesting birds. The series includes both gray and rufescent phases, and the specimens present no feature of plumage to distinguish them from the typical form. The fact that none of the Anaa skins has any entirely white tail quills is probably due only to chance, and the smallness of the representation.

The size difference is, however, perfectly constant, even though slight. It shows in every dimension, but particularly in the bill; the maximum length of culmen among five males of *palmarum* is about the same as the minimum length among 134 males of *atypha*. To put the

matter another way, the size range in MALES of *palmarum* is lower than that in FEMALES of *atypha*.

Anaa lies in a somewhat isolated position, about forty geographic miles south of the nearest points of Tahanea and Faaite. It is a much-broken atoll, which doubtless accounts for its other name, Chain Island. The axis lies in the trade-wind direction. In 1874 the islets on the reef supported seven million coconut palms.

The fact that the endemic warbler of Anaa is so much less distinct a geographic race than the bird of Niau, which lies much closer to atolls inhabited by the typical form, is one of the puzzling problems that continually challenge the taxonomist and zoögeographer.

### **Conopoderas atypha niauensis, new subspecies**

SUBSPECIFIC CHARACTERS.—Distinguishable from *Conopoderas atypha atypha* by its much smaller size (distinctly smaller than even the subspecies *palmarum*, especially in size of bill); and from both *atypha* and *palmarum* by the absence of appreciable whitish tips and borders on the quills and coverts, the great reduction of pale emargination on the back, the obsolescence of the loreal-superciliary stripe, and the apparent absence of albinism.

TYPE.—No. 199,952, Amer. Mus. Nat. Hist.; ♂ ad.; Niau Island, Tuamotus; September 13, 1921; R. H. Beck.

MEASUREMENTS.—(17 males): wing, 82–87 (85.7); tail, 70–74 (71.4); exposed culmen, 18–18.8 (18.4); bill from nostril, 13–14.6 (13.7); tarsus, 27–28.5 (28) mm.

3 females: wing, 79–80 (79.3); tail, 62–69 (65); exposed culmen, 18–18.8 (18.4); bill from nostril, 13; tarsus, 28.5–29 (28.7) mm.

RANGE.—Known only from Niau Island.

Specimens from Niau, collected during September, 1921, and August, 1922.

Most of the examples are breeding adults, with enlarged gonads. Small size is undoubtedly the certain character for the recognition of this race, but the nearly unicolor aspect of the dorsal surface among the whole series of twenty-three specimens, the absence of the familiar albinistic quills and scattered white body feathers, and the suppression of most other light or whitish markings, are probably also significant. The general feathering of the back, moreover, is of an olive-buff cast which is subtly different from the color of the two preceding subspecies, and is rarely matched in the large and highly variable series of *atypha*. In ventral aspect none of the Niau birds approaches the whiteness of *atypha* in "gray" phase, all of our specimens being tinged on the breast, belly, and flanks with cream color and tones of buff.

Niau is a small, continuous, heavily wooded atoll, lying about equally close to each of the larger chain-atolls of Fakarava, Toau, and

Kaukura. The three latter share the subspecies *Conopoderas atypha atypha*, and it was, naturally, surprising to find a distinct and smaller race occupying Niau. It should be recalled that Niau is also the home of an endemic kingfisher (*Todirhamphus gertrudæ*), the only member of its family thus far known from the Tuamotus. Perhaps this small island has more faunistic peculiarities than have hitherto been suspected.

***Conopoderas atypha rava* Wetmore**

*Conopoderas atypha rava* WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, p. 208 (Pinaki or Whitsunday Island, Tuamotu Group).

MEASUREMENTS.—(39 males, from Pinaki, Akiaki, and the five other islands listed below): wing, 84–93 (89.3); tail, 71–80 (76.2); exposed culmen, 20–22 (21); bill from nostril, 15–16.8 (16); tarsus, 30–31.8 (30.9) mm.

23 females, from six of the same islands: wing, 82–88 (85.2); tail, 67–77 (71.3); exposed culmen, 19.2–21.6 (20.4); bill from nostril, 15–16.6 (15.9); tarsus, 28.5–30.8 (29.5) mm.

RANGE.—Seven or more islands in the southeastern part of the Tuamotu Archipelago.

Specimens from Vanavana, Tureia, Ahunui, and Paraoa, June, 1922, and Hao, October, 1921.

The type and its associated specimens have been kindly lent by Dr. Wetmore. They prove to be indistinguishable from our birds taken at a half circle of islands which lie from south to northwest of Pinaki, at distances ranging between eighty and about one hundred and forty geographic miles. The type is, fortunately, a “typical” and average specimen, with the following dimensions, according to our own measurements: wing, 89; tail, 74; exposed culmen, 21.3; bill from nostril, 15.5; tarsus, 30.8 mm.

Wetmore states that this race is “similar to *Conopoderas atypha atypha*, but under surface washed with massicot yellow, under tail coverts averaging paler, less buffy, and superciliary stripe massicot yellow, most obscure anteriorly.” The above is substantiated by our series of seventy-five specimens, except that the under tail coverts are not paler or less buffy than in typical *atypha*. On the contrary, they are rather consistently darker and buffier throughout the series of *rava* than is usual in the subspecies *atypha*. Moreover, the statement that “the under surface is washed with massicot yellow” is distinctly true of only the more brightly colored examples, perhaps one third of the entire series, for variation is very great, and it runs through much the same gamut with reference to color phases, albinism, etc., as in the race of the western Tuamotus. Certainly, however, the birds from the southeastern islands

are on the whole both browner on the dorsal surface and yellower or buffier beneath than any equal number of specimens of *C. a. atypha*. There is not a single example of the definitely gray and whitish birds, such as can be picked out among specimens from Fakarava, or from almost any one of the other northerly islands lying between Matahiva on the west and Fakahina on the east. In short, *C. a. rava* is a "weak" but perfectly acceptable geographic subspecies, with a definite suggestion of intergradation apparent among examples from Hao, which, appropriately enough, is the island of the southeastern group lying nearest to Nihiru, Makemo, Taenga and other islands occupied by the race *atypha*. Hao, furthermore, is a huge, elongate atoll, with a lagoon more than a hundred square miles in extent. It is similar to a majority of the islands inhabited by *atypha*, but very different from the others within the range of *rava*.

Wetmore's detailed description of this form is excellent. Several of our brightest specimens show a deeper yellow on the breast than that of his birds (close to straw or Naples yellow), but the individual variation is of wide range in this as in other characters.

No great numerical discrepancy between the sexes appears in the series of *C. a. rava*. Of 68 labels bearing positive sex determinations, 38 are marked male and 30 female. Birds from Paraoa, Tureia, Ahunui, and Vanavana had small gonads in June, with a few at the last-named island still caring for nestling young. Birds taken at Hao during October had enlarged testes and ovaries.

#### ***Conopoderas atypha erema* Wetmore**

*Conopoderas atypha erema* WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, p. 211 (Makatea, Tuamotu Group).

MEASUREMENTS.—(10 males): wing 88–95 (92.3); tail, 75–84 (80.6); exposed culmen, 22.6–25 (24); bill from nostril, 17.5–18.6 (18); tarsus, 31–32 (31.5) mm.

8 females: wing, 85–92 (88.9); tail, 74–79 (76.6); exposed culmen, 23.5–24 (23.8); bill from nostril, 16.8–17.2 (17); tarsus, 29.5–30 (29.8) mm.

RANGE.—Restricted to Makatea Island.

Specimens from Makatea, collected during August, 1922.

This very distinct form is admirably treated by Wetmore, whose description and comments are indispensable. Thirty specimens, of which eighteen were definitely sexed as males and eight as females, were taken by members of the Whitney Expedition. The gonads were in various stages, from inactive to large, during August, and several apparently juvenal specimens had attained full growth.

The Makatea bird differs from typical *atypha* not only in its larger size but also in the consistently more cinnamonaceous hue of the entire

plumage. When large series are compared, the distinction is very striking; even the most rufescent examples among the subspecies *atypha* and *rava* are slightly less richly colored on the ventral surface, and decidedly less in dorsal aspect, than average specimens of *erema*. Moreover, the bill of *erema* is not only longer than that of all the subspecies previously treated, but it is also slightly more decurved. The familiar type of variation in the color of the rectrices is, however, apparent in the Makatea form, some specimens showing quills almost entirely olive-brown, while in others the outer feathers are white-tipped, and in still others all but a few central rectrices are entirely white. Albinistic feathers frequently crop out in other parts of the plumage.

Wetmore calls attention to the manner in which *erema* approaches *C. caffra* of Tahiti, etc. We agree with him, however, in aligning *erema* with the Tuamotuan birds rather than with those of the Society Group. Wetmore speaks, furthermore, of the isolated position of Makatea with reference to the bathymetric curve of the ocean bottom. We might add that Makatea, being an uplifted coral, and forested, island, is also topographically set apart from the remaining Tuamotus, and has rather close faunal affinities with the Societies. For example, it shares a large pigeon (*Globicera auroræ*) with Tahiti, while its small fruit pigeon (*Ptilinopus chalcurus*) is endemic, and is quite distinct from the form widely distributed among the atolls of the Tuamotus (Cf. Murphy, Amer. Mus. Novit., No. 124, p. 1). It may be questioned whether Makatea should be included within the Tuamotu Group, despite the fact that it lies so close to Rangiroa.

#### ***Conopoderas atypha flvida*, new subspecies**

**SUBSPECIFIC CHARACTERS.**—A large and very distinct form, differing from typical *atypha* in its longer wing and much longer bill, and from all the Tuamotuan forms thus far described in the strongly yellow tone of the entire ventral surface from chin to tail coverts.

**ADULT MALE.**—Pileum, nape, back, and scapulars brownish olive, darkest on the crown, the feathers from neck to lower back faintly margined with yellowish olive, giving a greenish cast to fresh plumage; rump and upper tail coverts, dark olive-buff, making a decided contrast with the back; quills of wing and tail, mummy brown, tipped and externally margined with whitish or cream color; on the wing, the borders increase in width inwardly to the tertials and greater coverts; outer rectrices with irregular whitish terminations, in some specimens covering most of the inner web of the outermost quills; supraorbital stripe, pale yellow, extending forward through lores to nostril; cheeks and entire under surface, barium yellow, invaded slightly at the sides of the neck by olivaceous feathers; lining and bend of wing, barium yellow. Iris, brown; bill, brown above, flesh color on mandible; legs and feet, gray.



TYPE.—No. 195,802, Amer. Mus. Nat.Hist.; ♂ ad.; Napuka Island, Tuamotus; December 11, 1922; R. H. Beck.

MEASUREMENTS.—(3 males, 1 sex undetermined): wing, 92–95 (93); tail, 73–78.5 (75.2); exposed culmen, 23.8–24 (24); bill from nostril, 17.7–18 (17.9); tarsus, 30–31.7 (31) mm.

RANGE.—Known only from Napuka Island in the Disappointment Group of the Tuamotus.

Specimens from Napuka collected during December, 1922.

Three of the specimens seem to be less mature than the type. One is browner on the back, with a buffy wash along the flanks and sides of breast, and with a darker rump than fully adult birds. The yellow of the breast is also paler in this specimen. All four skins, however, are marked as "breeding" or "nesting."

In dorsal aspect, this race has the characteristic "brown" appearance which is so common among other Tuamotuan warblers. It can be matched by examples of typical *atypha*. The hue of the quills, however, is richer than in most birds of the latter race, while the yellow of the under surface, the great length of the bill, and the conspicuously light rump recall some of the subspecies of *Conopoderas caffra* which inhabit the Marquesas Islands, about three hundred miles to northward. In fact, *flavida* resembles especially the race of Fatuhiva, the nearest of the Marquesas.

Napuka lies in an isolated position north of the central Tuamotus, about one hundred and fifteen geographic miles from Takurea and more than that from Fakahina. It is a well-wooded island, with human inhabitants said by the older authorities to be a "distinct race" from the people of the other Tuamotus. In its endemic *Conopoderas* we have, possibly, a clue of much zoölogical significance, for while the warblers of the western Tuamotus are so distinct from *caffra* of the Societies, we find at Napuka a form suggestive of *caffra* of the Marquesas. Perhaps all the races of these three great insular groups should be recognized as a single Formenkreis. In view of our inadequate series from Napuka, and because of our lack of knowledge of the warblers of Tetopoto and Pukapuka, the question may be reserved for future consideration.

#### THE WARBLERS OF PITCAIRN AND HENDERSON ISLANDS, AND THE AUSTRAL GROUP

Thorough ornithological investigation of the Austral Islands, which lie well to southward of the Societies, and near the Tropic of Capricorn, was undertaken during the Whitney Expedition, but a warbler was found only at the island of Rimitara. Curiously enough, this bird, which is

new to science, has its affinities neither with the species of the Society Islands, nor with that of the Tuamotus, but proves to be very closely akin to the warbler of Pitcairn Island, which is situated twenty-two degrees of longitude to eastward and two and a half degrees farther southward. The latitudinal relationship in the ranges of these two birds is of extraordinary geographic interest.

The species *Conopoderas vauhani* is set well apart from other Polynesian members of the genus by at least one structural characteristic, namely, the greater proportionate length of the tarso-metatarsus. When arbitrary graphs, illustrating the average ratios of bill, tarsus, tail, and wing, are plotted for the various races of *æquinoctialis*, *caffa*, and *atypha*, they prove to resemble one another very closely; the size range is large among these several forms, but proportions remain substantially the same. Similar data based on each of the three subspecies of *vauhani* give a curve of different contour, owing to the relative elongation of the tarsus.

For example, the bill length in males of *Conopoderas vauhani vauhani* averages about 11.5 per cent greater than that in males of *Conopoderas æquinoctialis æquinoctialis*, while the disproportion in length of tarsus amounts to 25 per cent. Again, the wing and bill in males of *Conopoderas atypha atypha* average, respectively, 8 per cent and 19 per cent longer than the same members of *Conopoderas vauhani vauhani*, while the tarsus in these two forms is of the same absolute length.

The color characters of the races of *vauhani* are curious, for while the warblers of Pitcairn and Rimitara are almost facsimiles of each other, that of Henderson Island, which is only one-tenth as far from Pitcairn, differs markedly from the other two. All three subspecies are chronically albinistic, no adult specimens of the Henderson bird being without a fair sprinkling of white feathers on the head and back, whereas in the other two the albinism tends to concentrate in the wings and tail.

The Henderson Island warbler was described in 1913 as a new species, *Acrocephalus taiti*. Its genetic relation to its neighbor on Pitcairn Island has not, however, been pointed out. The Henderson bird is a perfect example of what Duncker has termed an "alipochrome," which means that the activator for yellow pigment is lacking from its germ plasm. In effect, the Henderson warbler is the Pitcairn warbler deprived, through saltation, of its lipochrome, and segregated as a pure strain on another island, with no further opportunity of back-crossing. The whole subject of color inheritance in canaries, including many examples of inheritable characters that appear as mutants in wild birds,

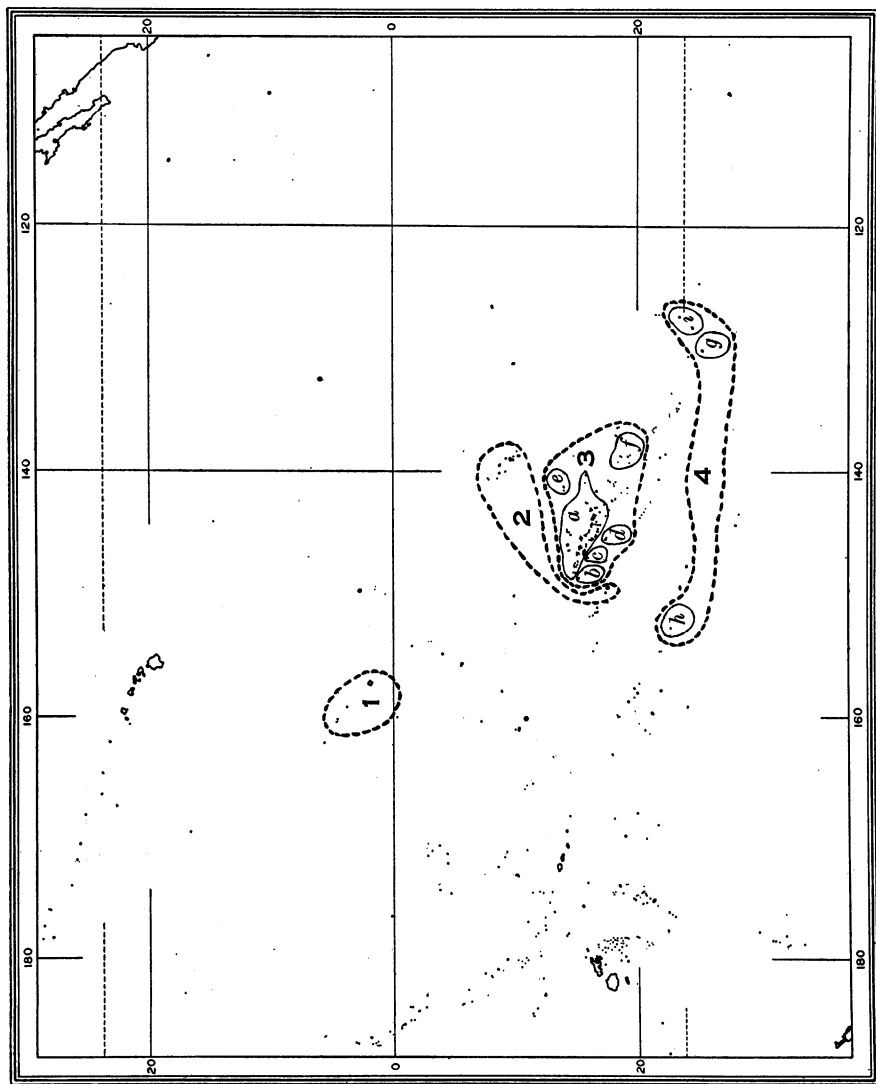


Fig. 1. Distribution of four species of *Conopoderas* in Polynesia.

1. *Conopoderas equinoctialis* (2, or 3, subspecies, Line Islands). 2. *Conopoderas cafra* (2 subspecies at the Society Islands, 8 at the Marquesas Islands). 3. *Conopoderas atypica* (6 subspecies at the Tuamotu Islands: a, *atypica*; b, *erema*; c, *ritanensis*; d, *ulnam*; e, *flavida*; f, *rara*). 4. *Conopoderas vaughani* (g, *vaughani*; h, *remiare*; Pitcairn Island; i, *tati*; Henderson Island). For distributional and systematic data on *Conopoderas cafra*, see Murphy and Mathews, 1928, Amer. Mus. Novit., No. 337, pp. 9-18.

is reviewed by Duncker (1928, 'Genetik der Kanarienvögel,' Bibliographia Genetica, IV, pp. 37-140).

***Conopoderas vaughani vaughani* (Sharpe)**

*Tatare vaughani* SHARPE, 1900, Bull. Brit. Ornith. Club, XI, No. LXXIV, p. 2 (Pitcairn Island, South Pacific).

ADULTS (sexes alike).—Pileum, dark olive, each feather distally margined with cream-buff, producing a scaled appearance; back, scapulars, and sides of neck, olive, the feathers bordered like those of the crown, but more finely; on the rump, the cream-buff terminations are very broad, covering most of the exposed part of each feather; upper tail-coverts, chiefly Isabella color, with darker shafts, but varying sporadically toward hair brown and toward an albinistic condition; rectrices, when and where dark, approximately fuscous, tipped with white, but in most specimens the tail is from one-half to entirely albinistic, in which case the shafts are white and the vanes vary from white to naphthalene yellow; no distinct supraorbital stripe, but a few feathers of colonial-buff hue on the upper eyelid; wings, irregularly but prevalently albinistic, like tail, the white quills being tinged on their outer webs with naphthalene yellow; when dark, the remiges and their coverts are fuscous, bordered externally with cinnamon-buff, cream-buff, or whitish; lining of wing, whitish or creamy, mottled with dark feathers; cheeks, olive, with lighter feather-edgings; ventral surface, from throat to belly, yellow (straw yellow at points of maximum intensity) but usually mottled by the effect of the concealed, dark mouse gray portions of the feathers; flanks, faintly tinged with cream-buff; feathering of thighs, Isabella color; under tail-coverts, cream-buff. Iris, brown; bill, blackish, flesh color on mandible; legs and feet, "grayish."

MEASUREMENTS.—(7 males): wing, 80-84.8 (82); tail, 68-73 (70); exposed culmen, 17-18 (17.6); bill from nostril, 13-13.3 (13.1); tarsus, 29-30.8 (30) mm.

4 females: wing, 74-78 (75.3); tail, 64-66 (65); exposed culmen, 16.8-17.6, (17.2); bill from nostril 12.7; tarsus, 28.6 mm.

RANGE.—Pitcairn Island (25° 3' S., 130° 8' W.).

Specimens from Pitcairn Island, March, 1922.

Birds in juvenal plumage are browner above, buffy (cinnamon-buff to honey-yellow) on the ventral surface, and with practically no trace of albinism. Adults, on the other hand, are universally albinistic, if that is the proper term to apply to the condition. Only one adult in the series has a full complement of dark rectrices with narrow whitish tips.

No specimen was in breeding condition on the dates of capture.

***Conopoderas vaughani rimitaræ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar in all stages of *Conopoderas vaughani vaughani*, but larger, slightly greener on the dorsal surface (between deep olive and dark olive), and, apparently, characterized by still more extensive albinism, which frequently involves the back, sides, and head, as well as the wings and tail. Even juvenals sometimes exhibit albinism of the rectrices.

TYPE.—No. 190,503, Amer. Mus. Nat. Hist.; ♂ ad.; Rimitara Island, Austral Group; March 29, 1921; E. H. Quayle.

MEASUREMENTS.—(6 males): wing, 81–88 (84.3); tail, 65–76 (71.6); exposed culmen, 17.8–20 (18.6); bill from nostril, 13–14.6 (13.5); tarsus, 29.2–32 (30.6) mm.

6 females: wing, 79.5–84 (82); tail, 67.5–74 (71.1); exposed culmen, 17–19 (18.2); bill from nostril, 13–14.3 (13.7); tarsus, 29 mm.

RANGE.—Rimitara Island, Austral Group (22° 40' S., 152° 45' W.).

Specimens from Rimitara, collected during March and April, 1921.

The birds are very nearly counterparts of the Pitcairn form, except for their slightly but consistently larger size and greater albinism. They were mostly in non-breeding condition, but a few are marked as having swelling gonads. Flesh colors are as in the type form.

Other islands of the Austral Group were thoroughly scoured by the Whitney Expedition collectors, but warblers were found only at Rimitara.

While it is hopeless to speculate on the distributional relationships of these two barely separable races, the possibility of the transfer of the ancestors of one of them through human (Polynesian) agency can hardly be ruled out.

#### **Conopoderas vaughani taiti** (Ogilvie-Grant)

*Acrocephalus taiti* OGILVIE-GRANT, 1913, Bull. Brit. Ornith. Club, XXXI, No. 185, p. 59 (Henderson Island, South Pacific); *Ibis*, 1913, p. 345.

SUBSPECIFIC CHARACTERS.—Differs from *Conopoderas vaughani vaughani* in the practical suppression of olivaceous color in the dorsal plumage, and of yellow in the ventral plumage; *taiti* is a little darker than hair brown on crown and back, and whitish, faintly tinged with buff, below. Moreover, albinism is more thoroughly disseminated throughout the dark body plumage, and rather less general in the quills, than in either of the preceding races.

MEASUREMENTS.—(6 males): wing, 80–84 (82.1); tail, 69–73 (71); exposed culmen, 16.5–17.8 (17); bill from nostril 12–13.5 (12.3); tarsus, 28–30 (29.5) mm.

4 females: wing, 77.5–82 (79.6); tail, 67–73 (70); exposed culmen, 16.8–18 (17.5); bill from nostril, 12.7–14.7 (13.3); tarsus, 28–28.6 (28.3) mm.

RANGE.—Henderson, or Elizabeth, Island (24° 21' S., 128° 19' W.).

Specimens from Henderson Island, collected during March and April, 1922.

The describer, Ogilvie-Grant, gave a good account of this interesting warbler, which differs from the Pitcairn bird chiefly in the absence of color. Juvenals of the two resemble each other very closely indeed, those of the Henderson form being only slightly paler than the young of the other subspecies. Albinism in *taiti* centers about the anterior, rather than the posterior, end of the body, the back and head being shot through with white feathers. Many adults are, in fact, prevailingly white-headed, while the quills of wing and tail are often mostly dark.

The adults were not in breeding condition on the dates collected. Flesh colors were as in the other two forms. Ogilvie-Grant reported that the iris of the female is "red," which sounds like a solecism and does not agree with Beck's notes.

