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AND OTHER SAMOAN TERRESTRIAL ARTHROPODA

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BUTTERFLIES OF SAMOA AND SOME NEIGHBOURING ISLAND-GROUPS

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WITH ONE TEXT-FIGURE AND FOUR PLATES

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INSECTS OF SAMOA
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Part I. Orthoptera and Dermaptera.
,, II. Hemiptera.
,, III. Lepidoptera.
,, IV. Coleoptera.
,, V. Hymenoptera.
,, VI. Diptera.
,, VII. Other Orders of Insects.
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The work will be published at intervals in the form of numbered fascicles. Although individual fascicles may contain contributions by more than one author, each fascicle will be so arranged as to form an integral portion of one of the Parts specified above.

INSECTS OF SAMOA

Part III. Fasc. 1

BUTTERFLIES OF SAMOA AND SOME NEIGHBOURING ISLAND-GROUPS

By G. H. E. Hopkins, M.A., F.E.S.

With 1 Figure in text, and Plates I to IV.

Introduction

The area dealt with in this paper includes Samoa, Tonga, the Ellice and Tokelau Islands, and Swain's Island. The collection on which it is mainly based was made by Dr. P. A. Buxton and myself during two years (1924 and 1925) spent in Samoa while employed in research work on Filariasis for the London School of Hygiene and Tropical Medicine. During the course of our work we visited all the islands of Western Samoa, and in addition were able to do a little collecting in Tutuila (American Samoa) on several occasions. I have also been greatly helped by records and specimens from Dr. J. S. Armstrong and Dr. A. J. Brass; such records, together with all others not my own, are given below with the recorder's name appended. Most of the Tongan records were obtained during a visit I made to the group during February and March, 1925.* I was in Togatabu † from 14th to 26th February, in Haapai on the 13th and 27th, and in Vavau on the 12th February and from the 28th February to the 13th March; unfortunately a large number of the specimens collected by me in Tonga were destroyed on the way to England. I also owe to Dr. Armstrong a number of Tongan specimens which he collected in the same localities in

* This visit, and one of about a week's duration to American Samoa, were made possible by a grant from the Fund for Promoting the Study of Evolution, presented to the University of Oxford by Prof. J. M. Baldwin, and administered by Prof. E. B. Poulton, F.R.S.

† Spelt "Tongatabu" on most Atlases.

March 1926, and to Dr. T. D. A. Cockerell, of the University of Colorado, the records of a small collection made by Mrs. Cockerell in the same localities in July 1924. I was not able to visit any of the higher (volcanic) islands in the Tongan group, nor can I find in the literature any records from them. The records from the Ellice Islands and neighbouring groups were obtained by Dr. Buxton during September 1924. I am indebted to the Bishop Museum, Honolulu, for the opportunity of examining three small but very interesting collections made by Dr. H. C. Kellers in 1917–1918, Mr. E. H. Bryan in 1924, and by Mr. A. F. Judd in 1926, for the most part in American Samoa. I have no records from a greater elevation than 2,000 feet in Savai'i and Upolu, or 1,000 feet in Tutuila, but Bryan, who reached altitudes of four or five thousand feet in Savai'i on several occasions, did not see any butterflies much above 3,000 feet. Rose Atoll has only four species of plants (*Pisonia grandis*, *Boerhaavea diffusa*, *Portulaca* sp., and the coconut), and, as might be expected, has no butterfly fauna (Mayor, p. 74). The authorities of the British Museum and Professor Poulton have allowed me to make full use of the collections under their charge, and have helped me in many ways. For the identifications of plants I am indebted to the authorities at Kew and at the British Museum. The coloured plate I owe to the skill of Miss O. F. Tassart, and the figures of early stages to my friend Dr. V. B. Wigglesworth, who drew them from specimens in spirit with the aid of photographs from life taken by Dr. Buxton.

The literature on the butterflies of the area (like that on all the other groups of insects) is unfortunately extremely scattered, and much confused by synonymy and misidentifications ; in several instances identical insects are recorded under totally different names (sometimes under two different names in the same list), while in at least one case (that of *Zizera labradus* Godt. and *Z. alsulus* H.S.) two very distinct species have, in several lists, been lumped together as being synonymous. It is hoped, therefore, that this paper will serve a useful purpose in bringing together our knowledge of the subject and clearing up some of the synonymic muddles ; no attempt has been made to make the synonymy exhaustive, but I have tried to ensure that it is as complete as possible for the area under consideration.

It is most unfortunate that few of the Samoan butterflies in collections have more accurate indications of locality than " Samoa " or (as in the case of the Bourke collection) " Apia and Pago-Pago " ; this has entirely obscured

the fact that in several cases the butterflies of Western Samoa (Upolu and Savai'i) show very important differences from their relatives in Tutuila (of which island Pago-Pago is the capital). On the other hand, I have been fortunate enough to capture specimens of several species of butterflies previously unrecorded from Samoa, and to work out a portion of the life-histories (for the most part previously unknown) of many of the species on my list.

Many measurements of expanse are given in the following notes; these were all taken by measuring the distance from centre of thorax to tip of forewing and doubling the figure thus found; many of the measurements given by German authors are approximately half mine, and are evidently the expanse of one forewing only, but the method adopted herein appears to me to be more logical.

The types of all new forms have been presented to the British Museum, paratypes to the Bishop Museum, Honolulu, and to the Hope Department, Oxford.

Natural Enemies and Mimicry

An attempt was made to ascertain the natural enemies of butterflies in Samoa. Ants swarm everywhere, and captive larvae were destroyed by them on several occasions both there and in Tonga, but I am not able to produce any evidence that they attack larvae in nature; they do not appear to interfere with larvae of *Badamia exclamationis*, though the bushes on which these latter occur are always overrun with ants. Birds were never observed to capture butterflies, but that they frequently do so is proved by the fact that specimens of several species (including *Danaida melittula*, *Euploea eleutho bourkei*, *E. schmeltzi*, and *Melanitis leda* in Samoa, and *Euploea eleutho mathewi* and *Hypolimnas antilope* in Tonga) were not uncommonly captured bearing unmistakable beak-marks on their wings (Pl. III, figs, 1, 2, 3). Specimens with what looked like lizard-injuries were quite common (Pl. III, figs. 4–7). Spiders undoubtedly take a toll of butterflies, and specimens of *Danaida archippus*, *Danais melittula*, *Euploea schmeltzi* and *Hypolimnas inconstans*, as well as smaller species, were found in their webs. On one occasion a Pentatomid bug was caught in the act of sucking a larva of *Atella exulans*.

I was not able to find any convincing evidence of mimicry in any of the islands visited: *Hypolimnas errabunda* somewhat resembles *Euploea schmeltzi*, and some forms of *H. pallescens* are not unlike *Euploea e. mathewi* and *E. e. bourkei*,

but these very doubtful cases seem to be the only possible instances of mimicry in the area. *H. lutescens* greatly resembles *E. schmeltzi*, but the two species do not occur in the same islands.

Distribution

With the single exception of the comparatively recent American immigrant, *Danaida archippus*, the butterflies inhabiting Samoa and the neighbouring groups of islands are all Indo-Malayan in origin; most of them call for little note on the subject of distribution, being very wide-spread throughout the islands of Polynesia. The majority of them seem to have reached Samoa by way of Fiji, which is the Eastern limit of quite a number of species, but the cases of *Euploea schmeltzi*, *Hypolimnas errabunda*, and *Atella exulans* are different. The first-named has no close relatives nearer than the Loyalty Isles, the other two both find their closest allies in Papua (and in the case of *H. errabunda* in the Solomons also), and have not been recorded in any form from the islands intervening between these localities and Samoa (a distance of about 1,200 miles). Many of these islands are not very well-known, and, since both *H. errabunda* and *A. exulans* are mountain species, it is possible that they have been overlooked, as they had been in Samoa, and that races of them will turn up in Fiji and perhaps elsewhere; but this argument does not apply to *E. schmeltzi*, which is a coastal species and could not be overlooked in any locality where any collecting at all has been done. A possible explanation of the absence of this species from any locality between the Loyalties and Samoa is that it existed there at one time, but has been worsted in the struggle for existence by the larger and more vigorous *E. eleutho*, which feeds on the same food-plants and would, therefore, come into competition with it. Though both species occur in Samoa, they are confined to separate islands, and strong support to this suggestion would be found if this should prove to be the state of affairs in the Loyalties also. Unfortunately, the fact that the material available from the latter group is insufficiently supplied with data makes the test impossible of application at present. Neither *H. errabunda* nor *E. schmeltzi* is recorded in any form from localities east of Samoa, but *Atella gaberti*, which appears to be fairly closely related to *A. exulans*, occurs in Tahiti, though apparently not in the intervening groups.

The other point of special interest, in the distribution of the butterflies

of the Central Pacific, is the great difference between the fauna of Western and that of American Samoa. I have shown this in tabular form in Table I. In this table I have marked with a query those species which are rare, or which occur only at a considerable altitude, and may therefore yet be met with in the islands from which they have not hitherto been recorded. It will be noted at once that, leaving out of consideration the cases of *H. errabunda* and *A. exulans*, both of which come in this category, there are very interesting differences between Western and American Samoa, and unexpected resemblances in several cases between the latter and Tonga. *Euploea eleutho* occurs in both Tonga and American Samoa but not in Western Samoa, as also does *Hypolimnas antilope ; Euploea schmeltzi*, on the other hand, though abundant at low levels in Western Samoa, is absent from the eastern part of the group and from Tonga. Furthermore, specimens of *Hypolimnas bolina* and of *Precis villida* from American Samoa do not appear to be separable from Tongan ones, while the same species occur in Western Samoa as quite distinct races: of the sixteen species known from American Samoa five do not occur (at least as the same race) in Western Samoa. There appears to be at least *primâ facie* evidence that the fauna of Western Samoa has a slightly different origin from that of the other two localities; the difference is not confined to butterflies, but was observed in other orders also. Even among the birds similar differences are to be found: the king-hunter of Western Samoa is *Todirhamphus recurvirostris*, which in both Tonga and American Samoa is replaced by races of *Halcyon sacra ;* the former is confined to Western Samoa, but other species of the genus are recorded as occurring in the Paumotu and Tahiti groups. It seems possible that, while the faunas of Tonga and American Samoa have been derived from Fiji, that of Western Samoa has come more directly from New Guinea. The intervening islands may give evidence for or against this theory when their insects are better known.

Concerning local distribution in a particular island there is little to note. As a rule the insects of the coast-belt are not found at higher elevations, except where artificial clearings and roads have opened up the country to them. The insects of any particular elevation are, however, usually identical in all parts of the same island, as might be expected on account of the comparatively small size of the latter.

TABLE I

Distribution of Butterflies in Samoa and Tonga

Species.	Western Samoa.	American Samoa.	Tonga.
D. archippus	X	X	X
D. melissa	ssp. *melittula*	ssp. *tutuilae*	ssp. *angustata*
E. eleutho	—	ssp. *bourkei*	ssp. *mathewi*
E. schmeltzi	X	—	—
A. andromacha	ssp. *polynesiaca*	?	ssp. *polynesiaca*
M. leda	ssp. *solandra*	ssp. *solandra*	ssp. *solandra*
D. bisaltide	—	—	ssp. *tonganus*
H. errabunda	X	?	?
H. antilope	—	ssp. *lutescens*	ssp. *lutescens*
H. bolina	ssp. *inconstans*	ssp. *pallescens*	ssp. *pallescens*
P. villida	ssp. *samoensis*	ssp. *villida*	ssp. *villida*
I. sinha	ssp. *bowdenia*	ssp. *bowdenia*	ssp. *bowdenia*
A. exulans	X	?	?
P. godeffroyi	X	X	—
C. jacquinotii	ssp. *manaia*	ssp. *manaia*	ssp. *manaia*
B. java	X	?	ssp. *schmeltzi*
T. hecabe	—	—	ssp. *aprica*
D. epijarbas	ssp. *doris*	?	ssp. *armstrongi*
J. argentina	X	X	—
J. carissima	—	—	X
J. morphoides	—	—	?
C. cnejus	ssp. *samoa*	ssp. *samoa*	ssp. *samoa*
C. lithargyrea	ssp. *pepe*	ssp. *pepe*	X
N. vitiensis	ssp. *samoensis*	ssp. *samoensis*	ssp. *samoensis*
Z. alsulus	X	—	X
Z. labradus	X	X	X
T. fraseri	X	?	?
B. exclamationis	X	X	—

Specific Descriptions

1. Danaida archippus (F.).

Danaida archippus ; Fruhstorfer, 1910, p. 193.
Danais archippus ; Butler, 1874, p. 275.
Rebel, 1910, p. 416.
Schmeltz, p. 177.
Danais plexippus L. ; Fraser, p. 147.
Anosia plexippus ; Butler, 1883, p. 408.
Danaida plexippus ; Walker, p. 187.
Collenette, 1925.
Anosia menippe ; Waterhouse, 1904, p. 491.
Swezey, 1921, p. 601.
Danais erippus ; Semper, 1905, p. 247.

Walker, who gives an excellent summary of the known history of this species in the Pacific, states (p. 187) that it was first noted in Tonga in 1863, in Tutuila in 1867, and in Western Samoa not until 1869. There appear to be no previous records from the Ellice Islands, but on Nui Island in September 1924 Buxton saw a specimen feeding on Iron-tree (*Pemphis acidula*), while he also noticed the butterfly as well as its food-plant on Vaitupu Island ; both islands are in the Ellice group. Collenette's notes on the species tend to show that it is becoming much less common in some parts of the Pacific, probably on account of the decrease in abundance of its food-plant, *Asclepias curassavica* L. This may also be true in Tonga, where I found both the butterfly and its food-plant by no means common, though, so far as my investigations went, generally distributed ; Schmeltz (*l.c.* p. 70), records it from Niuafou also. In Samoa, however, the insect is very abundant, occurring commonly at sea-level throughout the group, and extending up into the hills wherever clearing has allowed the *Asclepias* to become common.

The larvae sometimes entirely defoliate the plant, and are reduced to eating the stalks and seed-capsules ; thus they may be of some slight economic use as a check on this obnoxious weed. The adult frequents the flowers of *Ageratum coryzoides* L. (Compositae), *Lantana camara* L., *Stachytarpheta indica* Vahl. (Verbenaceae), and its own food-plant.

The early stages, which may be found throughout the year, are too well-known to require description.

2 (a). Danaida (Tirumala) melissa melittula (H.S.).

Danais melittula ; Herrich-Schaeffer, 1869, p. 70 (Upolu Island).
Schmeltz, pp. 175–177.
Butler, 1847, p. 275.
Rebel, 1910, p. 415, Pl. XVIII, fig. 4.
Tirumala melittula ; Waterhouse, 1904, p. 492.
Moore, p. 233.
Swezey, 1921, p. 602.
Danaida melissa melittula ; Fruhstorfer, 1910, p. 203.
Poulton, pp. 604–606.
Danais melissa ; Butler, 1870, p. 360.
" Miniature edition of *Tirumala hamata* " ; Fraser, p. 147.

As has been pointed out by several authors, the Samoan record of *D. obscurata* Butler is certainly erroneous. It is due to the fact that the type specimens from the Solomons were unfortunately labelled Upolu as well. The form is quite distinct from any found in Samoa.

D. m. melittula (Pl. II, fig. 3) is found in all the islands of Western Samoa, where it is always common, and frequently very abundant, from sea-level to about 800 feet, and, as a straggler, up to 2,000 feet. In American Samoa it is replaced by the closely-allied *D. melissa tutuilae.* It is found in greatest numbers on the flowers of *Ageratum coryzoides* L., but is also fond of those of *Stachytarpheta indica ;* Rechinger states that it prefers the flowers of *Asclepias curassavica,* but I am not able to confirm this. It flies in mist or light rain, but is not on the wing until after 7 a.m., and does not become fully active even in sunshine until after 8 a.m. ; it remains on the wing until dusk. Among captured specimens males outnumber females by at least five to one.

There does not appear to be any difference in markings or in size between specimens from the various islands of Western Samoa ; in a series of 49 males from Upolu and 43 from Savai'i, the maximum, mean and minimum expanse are 82, 72, and 62 mm. for Upolu, and 78, 72, and 62 mm. for Savai'i ; ignoring one abnormally large specimen from Malololelei, Upolu, the figures for the two islands are identical. Females are very slightly smaller, the corresponding figures for a series of 21 specimens from the two islands being 78, 71, and 62 mm. The race appears to be confined to Western Samoa, but the species has a wide

distribution through the Indo-Malayan region, and occurs in many races in the islands of the Pacific. The present race appears to be the smallest known form of the species.

The *eggs*, which are laid singly on the underside of a leaf of *Tylophora samoensis* A. Gr. (ASCLEPIADACEAE), are creamy white and barrel-shaped, with about 14 longitudinal ribs, each of which is joined to its neighbour by about 19 narrow transverse bars; the height is about 1·35 mm. and the diameter 0·76 mm.

The head of the *larva* (Pl. IV, fig. 1) is black, except two broad transverse bands and the labrum, which are white. The body above the spiracles is white, with one broad and two or three narrow black transverse bands on each segment; below the spiracles the colour is orange-brown. Spiracles, legs and prolegs are black. There is a pair of black fleshy filaments on the mesothorax, and another pair on the eighth abdominal segment. Eggs and larvae were found in June and September.

The *pupa* (Pl. IV, fig. 2) is much more compressed in shape than that of *D. archippus*, and of a beautiful translucent jade-green, totally different from the waxy green of that of *archippus;* the girdle and a few minute dots on the dorsal surface are golden, and the cremaster and two small spots on the ventral surface black.

2 (b). Danaida (Tirumala) melissa tutuilae, ssp. n.

Danais melittula; Schmeltz, p. 175.
Rebel, 1910, p. 415.

Differs from *melittula* in both sexes owing to its much larger size and more extensive blue markings. The latter feature is best seen in the state of development of the hook-shaped marking formed by the coalescence of the blue streak along the inner margin of the forewing with the blue spot external to it, and of this latter with the spot internal to it and anterior to the streak. The extent of this coalescence varies in both the forms, and the hook may be "Complete" (Pl. II, fig. 1), "Incomplete" (Pl. II, fig. 2), or "Absent"; I call it incomplete when the streak is attached to the external spot, but the latter is not joined in turn to the internal one, or when the two spots are joined to one another but not to the streak. In a series of one hundred and twelve specimens of *D. m. melittula* from Upolu and Savai'i, the hook is complete in seventeen males and nine females, incomplete in seventeen males and five females, and

absent in fifty-eight males and six females; in a series of forty-eight specimens of *D. melissa tutuilae*, all from Tutuila, it is complete in eleven males and seven females, incomplete in twelve males and four females, and absent in thirteen males and one female. That is to say, the hook, absent in 63 per cent. of males of *D. m. melittula*, is developed to some extent in 64 per cent. of male *D. melissa tutuilae*; the difference in the females is not so great, and the numbers are rather small. The difference in size between the two races is much more striking than that of markings; the maximum, mean, and minimum expanse of thirty-five males of *D. melissa tutuilae* being 88, 80, and 71 mm. as against 78, 72, and 62 mm. for *D. m. melittula*, and of eleven females 86, 79, and 74 mm. as against 78, 71, and 62 mm. for the same sex of the latter.

As will be seen from the above figures, among captured specimens, males are much commoner than females, though to a less extent than in *D. m. melittula*, outnumbering them by only about three to one instead of by about five to one as in the latter. The difference, although I do not think it probable, may possibly be seasonal, since most of the specimens from Tutuila were captured in August. If not seasonal, it is very interesting in view of the fact that the proportions of the sexes in *Hypolimnas bolina* show an exactly opposite difference in the two parts of Samoa, females being very much commoner in Western Samoa than they are in Tutuila.

D. melissa tutuilae is very common at low elevations in Tutuila, and probably throughout American Samoa. In habits the race exactly resembles *D. m. melittula*, but even in flight is readily separated by its superior size. I have no knowledge of the early stages.

2 (c). Danaida (Tirumala) melissa angustata (Moore).

Tirumala angustata; Butler, 1883, p. 408.
Danaida melissa angustata; Fruhstorfer, 1910, p. 203.
Poulton, pp. 604–609.

At the time of my visit in February and March, 1925, this appeared to be a very rare insect in Tonga, and only two specimens were seen, both at Nukualofa, Togatabu; Armstrong, in March 1926, did not meet with it, nor did Mrs. Cockerell in July 1924. It was evidently commoner during Mathew's visit in July 1884, since he captured four specimens at Nukualofa during the single day on which he was there; the difference may possibly be seasonal. There do not appear to be any records from the other islands of the Tongan

group, and the form does not occur elsewhere. Schmeltz's records of *D. melittula* and *D. neptunia* from Togatabu (1876, pp. 175 and 177) presumably refer to this race.

Poulton suggests (p. 607) that the somewhat reduced pattern may give the form a superficial resemblance to the much commoner *E. eleutho mathewi* when on the wing; the markings do not seem dissimilar in flight, but *D. melissa angustata* appears quite blue, while *E. eleutho mathewi* looks very white. Possibly the female (which in this group of Danaines is usually of a considerably paler blue than the male) would show more resemblance to the *Euploea*.

3 (a). Euploea eleutho bourkei (Poulton).

Euploea eleutho; Schmeltz, p. 180.
Moore, p. 272.
Nipara helcita; Moore, p. 258.
Euploea eleutho escholtzi; Swezey, 1921, p. 602.
Euploea helcita bourkei; Poulton, p. 585.

Talbot (p. 26) has recently cleared up the confusion between *E.* "*eleutho*," never found east of 150° E. longitude, and *E.* "*helcita*," which does not occur to the west of 160° E.: he has shown that the error is to be traced back to Boisduval, the following of whose mistake by various later authors accounts for the records of *E. eleutho* from Samoa, Tonga, the Ellice Islands, etc., in all of which it has certainly never occurred in its typical form. Talbot also pointed out that the two "species" were probably only geographical races of one, of which the prior name is *eleutho*. The main difference between the two "species" is the presence in *eleutho* of a sexual brand, absent in "*helcita*": that Talbot's view is correct is shown by the specimens of *E. eleutho bourkei* (described below) which had well-developed brands. The existence of specimens of *bourkei*, taken on the same day and within a few yards of each other, some with brands and some without, shows (if further proof were needed) how utterly fallacious is the use of the male brands as generic or sub-generic characters in *Euploea*. The forms of *eleutho* with brands and those without, which were formerly placed in different genera, are now shown to occur, not only in the same species, but in the same geographical race of that species! Felder's *E. eleutho escholtzi* is a Fijian race, and the Samoan record of it is erroneous. *E. aglaina*, a form with much reduced white markings, was described by Fruhstorfer (1908, p. 276, Pl. 86A) as occurring in Tutuila, but, as pointed out by Poulton, this is almost certainly

erroneous. If the label be correct, it must be a very rare aberration, for there are no specimens showing the least approach to it in any of the collections examined, nor in the long series collected by me in Tutuila; on the other hand, judging from Fruhstorfer's figure, which does not agree with his description, it almost exactly resembles specimens from the Cook Islands, which are its probable habitat. As mentioned by Poulton (p. 586), there is in the British Museum a "Male *walkeri*, with the hindwing pattern of *escholtzi*," labelled Navigators' Islands; this has the grey suffusion of the underside typical of *bourkei* and *mathewi*, and is probably correctly labelled, but there are no specimens showing any approach to this pattern in the very long series of other Samoan examples examined by me.

Variation is not extensive, but the spots on the hindwing are slightly more developed in some specimens than in others. Females always have the ground-colour paler than males, but do not seem to exhibit better developed spots. The most interesting point about the race, however, is the occurrence of males with a sexual brand, a feature never recorded before in any race of "*helcita*." Of twenty-six males captured by Buxton and myself in Tutuila, seven have a well-developed brand (Pl. III, figs 9 and 10), and two more show a trace of one, so that more than a third of the specimens have the brand developed to some extent. As might be expected in what is evidently a vestigial and obsolescent structure, the brand varies very much in size, but I have never seen a trace of it in the hundreds of male "*helcita*" from Tonga and other groups in the neighbourhood of Samoa that I have examined.

The maximum, mean and minimum expanse of twenty-six males are 82, 74, and 66 mm., and of fourteen females 76, 70, and 65 mm.

Common in Tutuila Island, American Samoa, at Pago-Pago, Leone, and other localities at or near sea-level, frequenting the flowers of *Ageratum coryzoides* and *Stachytarpheta*; there are also three specimens in the collection from Tau Island, American Samoa. It is very easily distinguished from *E. schmeltzi*, even on the wing, by its much darker colour and larger white spots. This form does not occur in Western Samoa; the types were stated by Poulton to be from "Apia and Tutuila" (E. Bourke) and "Apia and Pago-Pago" (G. F. Mathew), but Mathew, on referring to his note-book, found that all his Samoan specimens of the species were from Pago-Pago, and it is quite certain that Bourke's specimens also came from there, since he lumped the two localities together.

As represented by its several races, this is one of the most widely-distributed butterflies in the Pacific Islands, often occurring on atolls which support no

other butterfly-life except *H. bolina* and *P. villida*. Forms without a brand are found from Tahiti in the east to the New Hebrides and New Caledonia in the west, and (as stated above) are replaced still farther west by the form with a brand (typical *eleutho*).

The *larva* (Pl. IV, fig. 5), in addition to the two pairs of fleshy filaments borne by the caterpillars of *E. schmeltzi* and *D. melittula*, has a pair of these processes on the metathorax and second abdominal segment respectively. In colour it is brown-olive above, with a pair of small diamond-shaped white spots on each segment; the head is black, marked with two white bands; the black spiracles are borne on a broad cream-coloured spiracular line; the legs are black, the first pair much reduced; the filaments plum-coloured. The specimen figured is not quite full-grown. The larva feeds on *Ficus tinctoria* Forst., and doubtless also on other species of the same genus.

3 (b). Euploea eleutho mathewi (Poulton).

Nipara eleutho; Butler, 1883, p. 408.
Euploea helcita mathewi; Poulton, p. 586.

This race, the Tongan representative of *E. eleutho*, was found commonly in all the localities visited in that group. It has a somewhat bolder flight than *E. schmeltzi*, and in the evening, about 5.30 to 6 p.m., may be met with flying low, apparently in preparation for roosting for the night. At these times the butterfly circles round close to the ground, often settling on bushes and trees, or on dead fallen leaves. Mathew records it (Poulton, p. 607) as roosting in flocks, as do many species of the genus. Apparently it is not attracted to *Stachytarpheta* flowers, but is fond of those of *Ageratum;* I suspect that the former only attract butterflies in the absence of more attractive flowers. Like other species of *Euploea* it has a habit of settling on the dead twigs and branches of *Tournefortia* (Buxton, 1926, Hopkins, 1926), but, as in the other cases, this seems to apply only to the males, females not being found at this tree. Males are in general more often captured than females, but I am not able to give exact figures.

Variation is not extensive, but there is an interesting difference between specimens from Togatabu and those from Vavau: in *mathewi* the sub-terminal spots of the hindwing are usually fused in pairs, and in most specimens from Togatabu this is found to be the case; in Vavau specimens, on the other hand, though this form is common, there is a definite tendency for the spots in question to be separate. It would appear that we have here the beginning of the

separation of a new race, which, however, has not yet proceeded far enough to render the forms separable. The maximum, mean, and minimum expanse of seventy-one males from both localities are 84, 77, and 72 mm., and of eleven females 82, 77, and 70 mm. This race, unlike *E. e. bourkei*, has the female more heavily spotted than the male.

The chief food-plant is a large tree, the Tongan sacred fig, the local name for which is Ovava, but I also saw a female ovipositing on *Ficus tinctoria*, so that probably any species of *Ficus* is acceptable.

The black areas of the wings evidently contain a pigment, not present in the white areas, which is distasteful to some other creatures. On the way to England a batch of Tongan butterflies, which included many specimens of the present species, was attacked and partially destroyed by Dipterous larvae; in the case of specimens of *E. eleutho mathewi*, the white markings were eaten away while the black parts were left untouched (Pl. III, fig. 8).

3 (c). Euploea eleutho distincta (Butler).

Nipara distincta; Butler, 1874, p. 278.
Euploea eleutho; Butler, 1878, p. 296.
Moore, p. 272.
Euploea helcita distincta; Fruhstorfer, 1910, p. 235.
Euploea helcita walkeri; Poulton, p. 582.

We obtained this form only in the Ellice group, where Buxton captured a series of thirteen males and nine females on the islands of Nui, Nanomaga, Niutao and Nukulailai; he did not see it on Funafuti, and Rainbow does not record it from there, but it is possible that Whitmee's specimens, referred to below, are from this island, since the name "Ellice Is.," now generally applied to the whole group, was formerly used for Funafuti only. Of the specimens captured by Buxton, all are typical *E. eleutho distincta* except the two males from Nukulailai, both of which have the white pattern much reduced; in one of them the reduction affects both wings equally, but in the other the hind-wing pattern is almost obsolete, the inner row of spots showing more reduction than the outer, while on the forewing the spots, though obscured by dark suffusion, are larger than in the first specimen. Unfortunately these are the only two specimens captured on this island. Of two males and three females in the British Museum, labelled "Ellice Is., Whitmee," both males and two females are typical *E. e. distincta;* the third female is almost identical on the upper-

side with Tutuila specimens, but on the underside there is no trace of the greyish suffusion so characteristic of the latter, so that I see no reason to suppose that it is incorrectly labelled. The form, however, would appear to be uncommon. A large male in the British Museum labelled "Atafu, Union Is., J. J. Lister" (apparently the only record of a *Euploea* from this group), is like the better-marked specimens from the Ellice group in pattern, and *E. e. distincta* also appears to be the common form in Wallis Island (Poulton, p. 584, Pl. XLII, figs. 8–10). Maximum, mean, and minimum expanse of specimens from the Ellice Is. are: male 81, 75·5, and 72 mm.; female 77, 72, and 68 mm.

The larva was found on a species of *Ficus*, which grows either as an independent plant, or as an epiphyte in a tuft of fern on a coconut palm. Unfortunately it was not preserved.

Buxton notes that the flight of the adult in the Ellice Is. is not at all like that of *E. schmeltzi*, being much more soaring, and that the insect makes long flights from tree to tree; this is also true of the races of *E. eleutho* found in Tutuila and in Tonga. The butterfly was fond of sitting on the broad leaves of various trees, and was not common except in Nui.

4. Euploea schmeltzi schmeltzi (H.S.).

Euploea schmeltzi; Herrich-Schaeffer, 1869, p. 70, Pl. II, fig. 8.
Butler, 1874, p. 277.
Fruhstorfer, 1910, p. 241.
Rebel, 1910, p. 416, Pl. XVIII, figs. 2 and 3.
Euploea schmeltzii; Schmeltz, 1876, p. 181.
Pagenstecher, p. 302.
Deragena schmeltzii; Fraser, p. 147.
Moore, p. 272.
Waterhouse, 1904, p. 492.
Deragena schmeltzi; Swezey, 1921, p. 602.
Euploea schmeltzii schmeltzii; Poulton, p. 596.

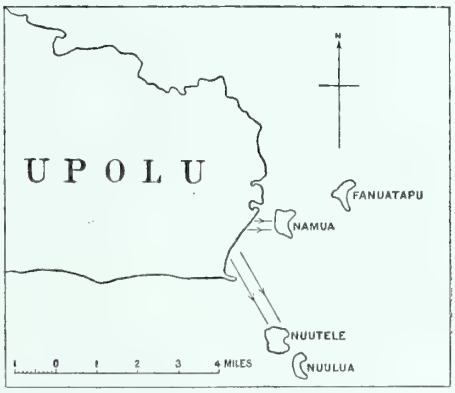
This species occurs very commonly in Western Samoa with *D. m. melittula*, and frequents the same kinds of flowers, but in addition it is found in flocks of many hundreds on *Tournefortia argentea* L. (Boraginaceae), a common strand tree (Buxton, 1926, Hopkins, 1926). All the specimens captured on this tree (several dozen in number) turned out to be males; Armstrong on one occasion saw "About 150 on one dead branch below the tree, all males." Trees of the

same genus are very attractive to *Euploea mathewi* in Tonga, and to several species of *Euploea* in the New Hebrides (Buxton) and the Solomons (Woodford, 1890, p. 94). In all these cases it is noticeable that only males are attracted, though both sexes frequent flowers, and that it is not the flowers but the dead and withering twigs and branches that are attractive. I once saw many hundreds of *Euploea schmeltzi* on the fruit-clusters of *T. argentea* in Savai'i, but even in this case it was the dead and withered clusters that were preferred. The tree does not seem to be attractive to any other butterflies, except moderately so to males of *D. m. melittula*, and it is difficult to imagine in what the attraction lies; no exudation of any sort was observed. Since the attraction is almost confined to males of the genus *Euploea*, it seems not impossible that the scent may resemble that of a virgin female, and that the volume of it is sufficiently great to make up for slight differences, and hence make it attractive, not to one species of *Euploea* only, but to many. It should be noted that this habit is quite distinct from that of roosting in flocks, which is so common in the genera *Euploea* and *Danaida*. In Tonga, in addition to seeing the males of *E. mathewi* on *Tournefortia*, I was able to find both sexes going to roost in the evening about half a mile inland; they did not appear to show a preference for any particular tree, and there were no specimens of *Tournefortia* in the neighbourhood, this tree being entirely confined to the beach. The case seems to some extent parallel with the attraction of isoeugenol and methyleugenol for certain TRYPETIDAE, and of naphtha and kerosene for *Ceratitis captitata*; this also has not yet found a satisfactory explanation, but has been attributed to some form of sex-stimulus, since in this instance also it is the males only that are attracted.

Variation is considerable in both sexes, both in size and markings, but all forms may be taken together at the same time and place. The white markings on the upperside are usually much better developed in the female than in the male; the reduction of pattern, especially in the latter sex, may go so far as to leave no indication of the white markings except the short row of sub-apical spots, while on the other hand all the markings may be well developed. In some specimens the forewing pattern is well developed, and that of the hindwing almost obsolete. My largest specimen is 69 mm. in expanse, and my smallest 60 mm.; both are males.

On the 7th April, 1924, Buxton observed a very interesting flight of this species in the district of Aleipata, Upolu Island. At about 9 a.m. he found the

butterflies in numbers flying out from the mainland towards the small outlying islands of Namua and Nuutele (Text-fig. 1). As there was no perceptible wind, and the directions of the flights to the two islands were nearly at right angles, he concludes that the islands must have been visible to the butterflies from the shore, a distance of more than a mile in the case of Nuutele. There does not appear to be any other possible explanation of the facts.*



TEXT-FIGURE 1.—Coast-line in the Aleipata district of Upolo Island, Samoa, showing lines of flight of *Euploea schmeltzi* from mainland to outlying islands.

The form is found commonly throughout Western Samoa, but we did not meet with it in Tutuila; Schmeltz (p. 181), however, records a specimen from there; Rechinger (Rebel, 1910, p. 417) gives Tutuila as one of the localities where he observed it; and Poulton (p. 606) states that Mathew found "*Euploea* [*helcita bourkei* and *schmeltzi*]" at Pago-Pago. The names in brackets were added by Poulton, who informs me that the original record merely gives the genus and no specific names; there can be no doubt that the species referred to was *E. eleutho bourkei*. Rechinger's record is equally unsatisfactory; all the specimens (twelve in number) brought home by him were from localities in Upolu and Savai'i, nor were any of his specimens of other species of butterflies taken in Tutuila (Rebel gives full particulars of the number captured in each locality and the total number obtained), so that it is obvious that he did not collect in Tutuila at all, but merely saw a species of *Euploea* (which must have been *E. eleutho bourkei*) and assumed that it was *E. s. schmeltzi*. This is further borne out by the fact that he did not capture either *E. e. bourkei* or the male of *Hypolimnas bolina*, although these are the commonest butterflies in Tutuila. There are no specimens from Tutuila in the British Museum, and I think we are justified in ignoring Schmeltz's old record, and stating that *E. e. schmeltzi* is entirely confined to Western Samoa. Outside Samoa its nearest relative is *E. schmeltzi whitmei* (Butl.), which occurs in the Loyalty Islands. These closely related forms are widely separated geographically,

* See p. 46 for a similar habit of *Catophoga jacquinotii manaia*.

and no connecting forms have yet been described; the intervening islands are, however, so little known that it is quite possible that such forms exist on them, but have not yet been met with.

The *egg* is barrel-shaped, 1·6 mm. in height and 1·0 mm. in diameter, pale yellow, with some twenty-four longitudinal and about the same number of transverse ribs dividing the surface up into roughly rectangular areas, which are more irregular towards the apex. The shell is particularly soft, and the egg is easily crushed. The ova are laid singly on the upper or underside of a leaf of the food-plant, *Ficus tinctoria* Forst., a common bush which grows either as an epiphyte in the crowns of *Pandanus* and other trees, or as an independent plant. The butterfly is not strictly confined to this species, but sometimes selects other members of the genus *Ficus*.

The *larva* spins a pad of silk on the leaf to improve its foothold. When young it is green, with a pale yellow sub-spiracular line; head, legs, prolegs and two pairs of fleshy filaments, one on the mesothorax, the other on the eighth abdominal segment, are black. The full-grown larva (Pl. IV, fig. 3) is about 30 mm. long, and varies considerably in colour; the form found invariably in a wild state has the body, legs, and prolegs glaucous-green; the head is pale brown, with two pale green lines; there is a broad pale yellow sub-spiracular line, and the spiracles are black; the fleshy filaments, which are large in proportion to the size of the larva, are purplish-brown in colour. When larvae are reared in captivity, either from eggs or from very young caterpillars, the commonest form when full-grown is very dark, almost black, with a yellow sub-spiracular line and black filaments; a modification of this form has the head black, the body above the yellow sub-spiracular line deep black with one rather broad and three broken and rather narrow white transverse bands on each segment, and spiracles, filaments, legs and prolegs black. Almost all larvae in captivity are of one of these dark forms, unless captured when already half-grown. A parallel case is that of *Macroglossa hirundo samoana* Roths. and Jord. (Sphingidae); here, also, there are two main types of coloration in the larva, one of which is green and the other dark. The dark form varies considerably, but is more or less as follows: brown-red above, under surface dark brown approaching black; head, legs, and prolegs black; blackish mid-dorsal and supraspiracular lines, the space between these lines broken up into square blocks of brown-red by dark brown intersegmental lines; spiracles black; whole of upper part of body thickly covered with small white dots;

horn red, with a black tip. At various times I had about fifty of these larvae reared from eggs, besides some thirty others found when nearly full-grown; all the latter were of the green form, while of the former all but one or two at the most were dark. It is difficult to account for this difference in colour between wild and captive larvae, unless it be an effect of the conditions of higher relative humidity under which the latter are usually kept.

The *pupa* (Pl. IV, fig. 4) is attached by the tail to a pad of silk on the underside of a leaf of the food-plant. It is usually metallic gold in colour; the eyes, antennae, a broad lateral band, a broad transverse band on the fourth abdominal segment, and two narrow dorsolateral lines from this latter to the cremaster are brown; there are also small brown blotches on the wing-cases. The golden colour may or may not show a greenish tinge, and there is also a form of the pupa which is silvery in colour instead of golden. In a few cases dark larvae gave golden pupae, and green larvae silvery ones, but the instances were too few to indicate whether this is usual. The pupal stage usually lasts eight days.

Early stages were found in every month from June to December.

5. Acraea andromacha polynesiaca Rebel.

Acraea andromacha; Schmeltz, p. 186.
Acraea andromache; Pagenstecher, p. 302.
Acraea andromache polynesiaca; Rebel, 1910, p. 417, Pl. XVIII, fig. 1.

Described by Rebel from specimens collected at Tiavi, Upolu Island, Samoa. The author states that it differs from the nomino-typical form as follows: "A little larger, and the yellow spots between the veins in the black marginal band of the hindwing are distinctly larger and more in line. The black spots in the lower part of the transverse branch in cell 4 of the hindwing are generally smaller and obsolescent. Forewings 29–35 mm., against 26–32 mm. in the typical form." In a long series from various parts of Western Samoa there is much variation in size, from a maximum of 71 to a minimum of 50 mm. In other respects the form is very constant, though there is slight variation in the size of the spots in the marginal band of the hindwing.

Usually rare in Samoa, though found throughout the year, but not at all uncommon in May, June and July, 1924, at various localities between 1,000 and 2,000 feet in Upolu (Vailima and Malololelei) and in Savai'i, where it was common locally at 1,500–1,800 feet. It also occurs as a straggler right down to sea-level (Apia and Lalomanu), but is never common there. I have no records

of the species from Tutuila, but it might easily be overlooked. There is a specimen in the British Museum labelled Togatabu (apparently the only record of the species from Tonga), and it also occurs in Fiji.

The flight is lazy and floating, resembling that of a *Danaida*, but much weaker. The insect has, however, a habit of keeping fifteen to twenty feet above the ground, which renders it much less easy to catch than it otherwise would be.

The *eggs* are laid in batches of about 80 on the upperside of a leaf of *Passiflora samoensis* Exell, and are barrel-shaped and cream-coloured, with about 20 inconspicuous longitudinal ridges broken by numerous shallow transverse lines; diameter 0·77 mm., height 0·87 mm. The egg stage lasts at least five days.

The *larvae* (Pl. IV, fig. 10) are blackish, with head, legs and spines black; spines long, slightly branched, one pair on thorax, penultimate and last segments, three pairs on all the other segments. They feed in companies, and the pupae are often found together in fair numbers. Before starting to devour the leaf, the young larvae eat a large part of the egg-shell; they then begin on the leaf, eating either surface. The larval stage lasts about a fortnight.

The *pupae* (Pl. IV, fig. 11) are placed in rows on a stem of the creeper; they are creamy-white in colour, with mid-ventral and paired dorsolateral and spiracular broad broken black bands; these bands are composed of a rounded blotch, enclosing a yellow spot, on each segment of the abdomen; eye, leg and proboscis-sheaths black, wing-sheaths white, striped longitudinally with black; on the thorax the dorsolateral black bands are replaced by a pair of narrow black lines placed mid-dorsally, and fused together posteriorly. The duration of the pupal stage is ten days.

Early stages were found in May, June and July.

6. Melanitis leda solandra (F.)

Papilio solandra Fabricius, 1775, Syst. Ent. p. 500 (taken "in Insula Otaheity"=Tahiti).

Melanitis leda var. *solandra;* Butler, 1874, p. 279.

Melanitis leda; Fraser, p. 148.
Waterhouse, 1904, p. 494.
Swezey, 1921, p. 604.

Melanitis taitensis; Butler, 1883, p. 409.

Melanitis leda taitensis; Schmeltz, p. 183.
Rebel, 1910, p. 419.

Specimens of this species from Samoa and Tonga do not appear separable from each other, or from the Tahitian form. All that I have seen from both groups are of the wet-season form, but two males and a female from Tonga in the British Museum, and five males taken by me in Togatabu in March 1925, are somewhat transitional towards the dry-season form. There is much variation both in size and markings in specimens from all localities, but I have not been able to find any racial or seasonal relation in the variation, and as the numbers are small I do not give the figures. The largest and smallest specimens that I have seen from the area are both males, and were taken by Whitmee in Samoa, but the exact locality is not given. One male in the British Museum from Tutuila, 23.iv.03 (*M. J. Nicoll*), is entirely without markings on the upperside, except a faint patch of yellowish suffusion in the position usually occupied by the yellow sub-apical blotch.

Never a common species in the neighbourhood of Apia, but rather common in neglected coconut plantations in the Aleipata district of Upolu, in several localities in Savai'i, and in Tutuila, it also occurs in Tau and probably throughout the Samoan group. It is also common in Tonga at Nukualofa, and doubtless many other localities ; there are in the British Museum several specimens from Vavau, taken by the Eclipse Expedition, in April 1911. Outside our area the species is widely distributed in the Pacific, but does not seem to be recorded from any of the groups to the north or north-west of Samoa. It is not strictly confined to sea-level, but occurs commonly in some places up to 1,000 feet or more. It is mainly crepuscular in its habits, but odd specimens are often found flying by day, especially in shady places.

Egg.—A female was seen ovipositing (7.vi.25, Apia district) on the underside of a blade of grass ; only two eggs were laid. These were of a very pale green colour, and to the naked eye appeared perfectly smooth, but under a microscope proved to be covered with reticulation in very low relief ; they were hemispherical in shape, and 1·2 mm. in diameter. Larvae emerged four days later, but refused to feed.

The newly-hatched *larva* is almost white, with a black head. Swezey records finding the larvae of this species twice on sugar-cane in Samoa ; this, however, is evidently not the usual food-plant there, for the butterfly is found commonly in districts where no sugar-cane is grown. Schmeltz (p. 191) states that " The larva lives on Cyperaceae, and is green with two horn-like processes on the head."

7. Doleschallia bisaltide tongana, nom. nov.

Papilio drusius Fabricius, 1781, Sp. Ins., p. 61, no. 272.

This form was described by Fabricius from two males taken at Rotterdam Island (=Namuka in the Tongan group), but this name is preoccupied by *Papilio drusius* Cramer, described in 1779.

It is closely related to the Fijian *D. b. vomana* Fruhst., from which it differs as follows: *Male* (Pl. II, fig. 4), upperside ground-colour brighter tawny, the fifth of the small white spots forming the sub-apical series on forewing always completely obscured by a large tawny spot, which is united to the short sub-apical tawny band; hindwings much paler than in *D. b. vomana*, with little dark suffusion and with all the dark markings reduced. Underside as in *D. b. vomana*, but in all the specimens I have seen the ground-colour is a reddish-brown, without any trace of the green sometimes found in Fijian specimens. Five males from Neiafu, Vavau group, Tonga, March 1925, agree well with the types.

The *female* is undescribed: it is similar to the male, but ground-colour paler and all dark markings less extensive. Type female from Tonga (*G. F. Mathew*), Godman and Salvin collection, in B.M.; one paratype from Neiafu, March 1925.

Both sexes are smaller than Fijian specimens (expanse of male 63–71 mm., mean of seven specimens 68 mm., and of female 74 mm.). Variation is slight, affecting chiefly the proportions of the tawny band on the forewings; in four of my males and both the females this extends from the costa to join the ground-colour as in the types; in only one is the fifth spot of the sub-apical series not connected with the tawny band.

This insect was rather common on Talau Hill, Neiafu, during February and March 1925, and Armstrong saw a single specimen there in March 1926. It patrols back and forth over a chosen stretch of open ground, such as a path, with a strong and rapid flight, usually keeping at a height of ten to fifteen feet from the ground, and occasionally settling on leaves, though usually fairly high. It did not seem to be attracted to flowers. On one occasion I saw one give chase to a large hornet (*Polistes macaënsis* F.), and they constantly flew at other specimens of their own species as if to drive them off the chosen territory. One of the captured specimens had a large symmetrical injury to the hindwings, which must have been caused by the bite of either a bird or a lizard.

The early stages are unknown.

8. Hypolimnas errabunda, sp. n.

Male (Pl. II, fig. 5). Upperside very dark brown, apical third of forewing and a broad terminal border strongly suffused with red-brown; a series of three very small preapical white dots in interspaces 5–7; hindwing with a broad ochreous-brown sub-terminal border. Underside brown, apical third of forewing and a very broad postdiscal band on hindwing paler; preapical white dots larger than on upperside, and continued as a postdiscal series of dark-ringed bluish-white spots on both wings; sub-terminal and terminal narrow dark lines; in cell of forewing a triangular white spot, followed by three rather irregular white lines. Cilia white, alternated with black.

Female (Pl. II, fig. 6) similar, but paler; on upperside preapical dots much larger than in male, and continued as a postdiscal series of white spots in all the interspaces of forewing, and very faintly in interspaces 5–7 of hindwing; on underside markings as in male, but postdiscal white spots much larger and not bluish. Cilia as in male.

Type male from Malololelei, Upolu Island, 2,000 feet, 27.iv.24, allotype female from same locality 4.v.24; 9 male and 4 female paratypes from same locality, various dates. Maximum, mean and minimum expanse of males (excluding two bred specimens) 77, 72, and 66 mm., of females 92, 87, and 82 mm.

Variation is very slight; in the male the postdiscal series of white dots is sometimes very faintly developed on the upperside in some of the interspaces of both wings, and there is slight variation in the width of the ochreous-brown subterminal border of the hindwing, and in the development of the red-brown suffusion of the forewing; in the female the spots in interspaces 2 and 3 of the hindwing upperside (never very distinct) are sometimes almost obsolete. The underside is almost invariable in both sexes.

An uncommon species and never seen below 2,000 feet, although the food-plant occurs down to 1,000 feet and probably below. Only found in Upolu Island at Malololelei, Lake Lanuto'o, and probably other localities at high elevations, though the food-plant is common in Tutuila. Both sexes frequent the flowers of *Lantana*. The colour and markings give this insect a distinct resemblance to *Euploea schmeltzi*, but the female is very much too large to be mistaken for that species. In the male, however, owing to its much smaller size, the resemblance is much greater, and it is quite possible to mistake one species for the other on the wing. Odd specimens (sometimes only one) were

seen in every month from January to July, but not on visits paid to the same locality in August, September, October and December; it is not at all improbable, however, that *H. errabunda* occurs in these latter months also, for our visits were not very frequent and the species is never common. A specimen was captured bearing a very large symmetrical injury, involving both fore and hindwings, and obviously inflicted while the butterfly was at rest; about a third of the total wing-area is missing. The injury was presumably the work of a lizard.

Eggs.—A female was observed on 22.vi.24 ovipositing on the underside of a leaf of *Cudrania* sp. near *javanensis* Trec., a rather common epiphyte belonging to the URTICACEAE, and known locally as "Samoan strawberry." The eggs were green, with fourteen longitudinal ridges, and the batch consisted of five; as the plant is not large enough to support many larvae this is probably about the normal number of eggs in a batch. Unfortunately it was not possible to measure these eggs, but I subsequently obtained oviducal eggs, of which the diameter was 0·96 mm. and the height 1·02 mm. The first larva hatched eight days later.

The newly-hatched *larva* is grey with a black head. When full-grown (Pl. IV, fig. 12) it is deep velvety black, with numerous minute white spots; the legs and prolegs are black, the spiracles white. There is a pair of very large and stout black spines on the head, and a short pair on the prothorax; the spines on all the other segments are stout and orange-coloured; there are seven spines on each segment behind the prothorax except the penultimate and last segments, which bear only three and two respectively. The larvae were about 60 mm. long when full-fed. In captivity the larval stage lasted thirty-eight days, but may have been prolonged by the fact that the food-supply was very limited; the two males bred were very small.

Pupa.—Very like that of *H. bolina* but larger, with tubercles much less prominent; dark brown with lighter brown mottling, especially on the dorsal surface. Two males each remained in the pupa eight days.

This form will probably prove to be a race of *H. pithoeka* Kirsch., which occurs in several races in Papua and the Solomons. As, however, it differs markedly from any known race of *H. pithoeka*, and is so widely separated from it geographically, I prefer to keep it separate provisionally. The larva differs from that of *H. pithoeka* in the absence of the two broad ochre-yellow lateral lines mentioned by Fruhstorfer (1912, p. 544).

9. Hypolimnas antilope lutescens (Butler).

Diadema lutescens ; Butler, 1874, p. 283, Pl. XLIV, fig. 3.
Swezey, 1921, p. 603.
Diadema antilope lutescens ; Schmeltz, 1875, p. 185.
Hypolimnas antilope lutescens ; Rebel, 1910, p. 418.

All the Samoan and Tongan specimens of this species that I have seen are referable to the forms *lutescens* Butler and *sila* Fruhst, the difference between which in these islands appears to be sexual, all the lighter specimens being males and the darker ones (form *sila*) females.

The species is not found in Western Samoa, but Swezey recorded it from Tutuila, and I found eggs, larvae, and imagines there at Pago-Pago and other localities on the south coast of the island, at sea-level, in August 1925 ; it probably occurs all round the coast. In Tonga it was not uncommon near Neiafu, Vavau, in February and March 1925, especially at an elevation of about 200 feet on Talau Hill, but I did not see it elsewhere in the group.

In striking contrast to its relatives *H. bolina* and *H. errabunda*, this is a very unwary insect ; its flight is lazy and floating, and it does not seem to frequent flowers ; it is fond of settling on a leaf at some distance from the ground, and is then easily captured.

The *eggs* are laid in batches of several hundred on the underside of a leaf of *Pipturus incanus* Wedd. (URTICACEAE), and are very small in proportion to the size of the butterfly (diameter 0·77 mm., height 0·9 mm.).

The *larva* is black, with spines arranged like those of *H. errabunda*, but pale brown in colour ; the pair on the head are much larger than the rest, and are black. The larvae feed in companies at least until the last moult, and remain on the food-plant by day. I did not find early stages in Tonga. Unfortunately I was not able to obtain the food-plant in Upolu, and in consequence all my larvae died. Subsequently I found the tree not uncommon there at an elevation of about 1,000 feet ; in Tutuila it occurs very commonly at sea-level, and also up to an elevation of at least 1,500 feet.

In our area the butterfly appears to be confined to Tonga and American Samoa, but it has a wide range in the Pacific, occurring in Fiji, Papua, the Cook Islands, the New Hebrides, and elsewhere. Butler's types are from Ovalau, Fiji.

10 (a). Hypolimnas bolina inconstans Fruhst.

Hypolimnas bolina inconstans ; Fruhstorfer, 1912, p. 552.
Hypolimnas bolina var. *otaheitae ;* Fraser, p. 147.
Hudson, p. 105.
Hypolimnas bolina ; Waterhouse, 1904, p. 493.
Swezey, 1921, p. 603.
Diadema montrouzieri ; Schmeltz, p. 185.
Swezey, 1921, p. 602.
Hypolimnas bolina montrouzieri ; Rebel, 1910, p. 418.

Fruhstorfer records this form as *inconstans* Butler, and quotes part of Rebel's description of female specimens from near Apia ; Butler, however, used the name *inconstans* for an Australian form of *Argynnis hyperbius* (the type of which is in the British Museum), and not for any form of *H. bolina*, so that the present race becomes *H. bolina inconstans* Fruhst., with no type.

Rebel's full description is as follows : " The Samoan race appears to constitute a well-differentiated local form, which is at once separated from the very variable Fijian form (*octocula* Butl.) by the smaller size and constant dark coloration. The white semi-fascia of the forewings and the white sub-apical spots, together with the wavy line of dots which joins them, always remain conspicuous. The longitudinal orange patch in cell 1*b* varies somewhat in extent, but never reaches the base nor the middle of the wing, and only seldom extends back to the line of dots. In two specimens this orange mark on the inner border is much obscured. The hindwings show a bluish-white round blotch in the centre, which sometimes narrows band-like and appears pure white on the inner side. Forewings 29–34 mm." Fruhstorfer's description of the form omits mention of the orange patch ; it appears to be the smallest known form of *H. bolina*. The female illustrated (Pl. I, fig. 2) is from the type locality, Apia.

The male (Pl. I, fig. 1) is undescribed ; it differs from that of other races chiefly in its smaller size ; the white discal spots on the upperside are small and much obscured by blue scaling, and the white discal band of the hindwing underside is much reduced, but the other underside markings are clear and well-defined. In a series of six males the maximum, mean, and minimum expanse are 68, 62, and 56 mm. Neallotype male from Apia, November 1924 ; paratypes from Mulifanua, April 1924, Apia neighbourhood,

April and May 1925, and Lalomanu, Aleipata district, September and October 1924. All these localities are in Upolu.

Variation on the upperside is slight, for a race of *H. bolina*, and in the female extends at most to the loss of the orange patch on the forewing. Out of 122 females from Western Samoa, only 10 have no trace of this "*nerina*-red"; this is certainly more than the true proportion, for the form was noted as being rare, and specimens of it were often collected when those possessing the orange patch were passed over. There is also a little variation in the other direction, the orange colour extending to cover the greater part of the disc of the forewing, but such specimens are not common. The white marks on the forewing are never obscured. There are sometimes traces of orange on the outer side of the white discal spot of the hindwings (in about a third of the females), and rarely this also becomes more extensive, but never produces a form at all like *pallescens*. On the underside there is a good deal of variation in the width of the white band on the hindwing, which may be well developed or much reduced. An entry in Mathew's diary ("Apia, Samoa, June 20, 1884 . . . many *bolina*, the females varied a good deal") may perhaps indicate that the race was formerly more variable than is now the case.

The female is very common everywhere in the coastal belt of all the islands of Western Samoa, and occurs as a straggler in open spaces up to 2,000 feet, but the male is extremely rare, much less than one per cent. of the specimens observed; only eighteen males were seen during the whole two years, while females were common in every month. Of the specimens captured (about 150), only six were males, and this is much above the true proportion, as a special watch was kept for them. The rarity of the male is so marked as to lead inevitably to a suspicion that parthenogenesis must occur in this race, but unfortunately I was never able to prove this by breeding; a series of six females, neither very fresh nor very worn and all containing eggs, which were dissected in December 1925, had no spermatozoa in the spermatheca, but much more of this negative evidence would be required before we could consider the existence of parthenogenesis in the form proved. Simmonds has been unable to obtain larvae from unfertilised eggs in Fiji, but I do not know of any other race of *H. bolina* in which the discrepancy between the sexes is so great as in *inconstans*. The combined observations of Armstrong and myself show that this discrepancy has been constant over a period of at least four years, while the fact that Rechinger, collecting in 1905, was not able to capture a single male suggests that it is of

much longer standing. In this connection an observation made by Simmonds on *H. bolina pallescens* in the neighbourhood of Suva, on the island of Viti Levu, Fiji, is of very great interest. He had noted over a period of several years that females always outnumbered males in this district, though the discrepancy was not nearly so great as in Western Samoa ; in March 1926, however, on his return after an absence of about a year, he found that the proportions were reversed, and that males now outnumbered females, as is usual in the species. This was also my own experience during a few days spent in the Suva neighbourhood in December 1925, when I found males outnumbering females by at least three to one.

The insect is a strong and rapid flier, and visits the flowers of *Stachytarpheta* and *Lantana ;* it has a habit of flying in under the overhanging branches of bushes, and settling there on a branch or the underside of a leaf, usually head downwards, but ready to fly off at the least alarm. The female carries the male during copulation.

Specimens from Upolu and Savai'i do not differ in any way from each other ; this is well shown in the size, maximum, mean, and minimum expanse of ninety-five females from Upolu being 80, 70, and 52 mm., and of ten females from Savai'i, 78, 70, and 62 mm. Specimens from Tutuila, on the other hand, are extremely different, and are provisionally referred to the form *pallescens* Butler (*q.v.*).

The *eggs* are always green, instead of being sometimes green and sometimes yellow as in the Fijian race of *H. bolina ;* they have eleven very prominent longitudinal ridges, and are laid in a batch of about six on the underside of a leaf of *Sida rhombifolia* (MALVACEAE). The diameter is 0·79 mm., and the height 0·86 mm. Eggs hatch three days after being laid.

Walker (Poulton, p. 649) describes the larva of the Marquesan race as follows : " General aspect that of a *Vanessa* or *Argynnis* larva. Length from $1\frac{3}{4}$ to more than 2 inches ; cylindrical, rather stout, a little attenuated in front. Head a little larger than 2nd segment, deeply bifid at top, and bearing, on each lobe, a long blackish spine pointing upwards and a little forwards ; colour light reddish-brown or burnt-sienna. Body deep brownish-black, with a rather well-defined, irregular, sub-spiracular, longitudinal stripe on each side, light burnt-sienna colour ; legs and prolegs the same tint. Segments 3–12 bear eight ochreous-orange, slightly branched spines about $\frac{1}{6}$ inch long, rigid and somewhat irritating when handled ; segment 2 has only two short spines on

either side. Spiracles black, surrounded with ochreous-yellow." Larvae from Upolu differ as follows: Smaller (about 37 mm. $=1\frac{1}{2}$ inches when full grown); head light reddish-brown, with a large oval black mark at the base of each of the two long spines; body black, with a thin dusting of very minute yellow spots; sub-spiracular line light brown, very indistinct and almost obsolete; legs, prolegs, and spines on body-segments light cinnamon-brown, with no trace of orange. The larvae are unaccountably hard to find, and apparently do not frequent the food-plant by day. Collenette states (1926, p. 26) that at Rapa, in the Austral Islands, the larvae of *H. bolina* were very conspicuous by day on *Sida;* it would appear that the habits of the larva, and to some extent those of the imago also, differ considerably in different localities.

Walker's description of the *pupa* is as follows: "Not very unlike that of *Vanessa io*, but larger and stouter; palpi-cases rather distinct, front of thorax very convex, with a strong, toothed, lateral crest. Abdomen very stout and rather abruptly truncated, bearing 5 longitudinal rows of sharp-pointed tubercles, the outer ones only distinct on the anterior segments. Anal appendages rather short and stout. Colour dark, dull, umber-brown, irregularly blotched with a lighter and more ochreous tint, especially on the wing-cases." Pupae from Upolu agree perfectly with the above description. The pupal period is about ten days. Eggs or larvae were obtained in June, July, and August.

There are in the British Museum five males and two females of *H. bolina* labelled Swain's Island (*J. J. Lister*); of these females one is typical *inconstans*, but the other a rather remarkable form with the yellow markings very pale, and so extensive as to cover the greater part of both wings on the upperside. All the specimens agree with *inconstans* in size (males 62–73 mm., mean 67 mm., females 70 and 74 mm.), and are best referred to that race until we know whether the peculiar female is a normal form, or merely an uncommon aberration.

10 (b). Hypolimnas bolina pallescens (Butl.).

The forms of *H. bolina* found in the Tongan group and in American Samoa, unlike those from Western Samoa and from the Ellices, do not seem separable at present either from each other or from the Fijian race (of which *pallescens* appears to be the earliest name), except possibly by the varying proportions of the different forms of the female (the forms with orange or yellow ground-colour, for instance, seem to be entirely absent in Tutuila). I prefer, therefore, to treat them all as belonging to the Fijian race, while keeping separate

the records of the forms found in each group, and the synonyms that have been used.

(i) Forms occurring in Tonga

Hypolimnas thomsoni Butler, 1883, p. 414 (male only, the female is from Kandavu, Fiji).
Fruhstorfer, 1912, p. 553.
Hypolimnas naresi Butler, *l.c.*
Hypolimnas moselyi Butler, *l.c.*
Hypolimnas bolina morseleyi ; Fruhstorfer, 1912, p. 553.

These three "species" of Butler are very similar; all are of the male-like form, and they are not worth separating in such a variable species as *H. bolina ;* the female f. *murrayi* Butler, described from a specimen from Kandavu, Fiji, is similar, but differs in the fact that the postdiscal white band on the forewing is obscured by dark suffusion and blue iridescence. Unfortunately the long series of *H. bolina* females which I collected in Tonga were almost all accidentally destroyed on the way home. Of the few survivors and those in the British Museum, nine females are of the *thomsoni* form, and fifteen of the pale form, *pallescens,* or modifications of it. These, however, do not truly represent the forms occurring in Tonga, nor the proportions in which they were to be found at the time of my visit. Fortunately I kept notes of the proportions between the sexes, and between the different female forms observed. Both f. *murrayi* and a *nerina*-form (*i.e.* a form not unlike *H. b. inconstans* but much larger) were captured, but both were rare; except where the specimens were captured, I did not distinguish between f. *thomsoni* and f. *murrayi,* both being recorded as male-like, while all forms with a light ground-colour (i.e. f. *pallescens* and modifications) were called pale.

In Vavau some dozens of males were seen, but only two females; these were both of the *nerina*-form, but both pale forms and f. *thomsoni* from this locality are in the British Museum. Only males were observed in Haapai, and I have seen no females from that locality in collections. In Togatabu both sexes were common; of sixty-eight females, either captured or seen sufficiently close for their character to be noted beyond doubt, forty-four were male-like, of which only two or three were f. *murrayi,* twenty-three were pale, and only one was of the *nerina*-form. About two hundred males were seen, so that the proportion of males to females at the time of my visit would be about 3 : 1.

Probably this is less than the true disproportion between the sexes at that time, for a special watch was kept for females, and I hunted by preference in the shady places where these were to be found, rather than in the more open and sunny localities were the males were more common. Armstrong, in March 1925, saw males only, and of four specimens collected by Mrs. Cockerell at Nukualofa, in July, three are males, the only female being f. *thomsoni*.

The maximum, mean and minimum expanse of twenty-four females from various Tongan localities are 96, 83, and 72 mm.

An interesting point in the habits of this species in Tonga (true also in Tutuila) is that the female, unlike that of *H. bolina inconstans*, is of rather shy and retiring habits. Specimens of this sex were never to be seen sitting high up on a bush like the males, but always close to the ground and often quite in the interior of the bush; on several occasions one was seen to fly into the interior of a patch of bushes, and emerge several yards away from its point of entry, but males were never observed to do this.

I failed to see much evidence of protective resemblance in Tonga; the male-like form can sometimes be mistaken in flight for *E. eleutho*, but the resemblance is greatest in old, worn specimens, whose value to the species is presumably little or none; moreover, the difference is usually readily seen on account of the different manner of flight, and it is only very occasionally that it is possible to mistake the two. At least one female was captured bearing an obvious beak-mark on one wing; this was of the right size and shape to have been made by the large king-hunter (*Halcyon sacra*), which is common in Tonga, and I do not know of any other Tongan insectivorous bird with a beak large enough to have made the mark.

A pale female was watched ovipositing on *Sida*; the *eggs* were green.

(ii) Forms occurring in American Samoa

Of fifteen female specimens from Tutuila, which I have been able to examine (not including those in the Kellers collection, which are dealt with separately), eleven (one Dec. 1924, five Aug. 1925, and two Dec. 1925, *Buxton* and *Hopkins*; one Nov. or Dec. 1892, *Bourke*, and two April 1903, *M. J. Nicholl*) are of the *thomsoni* form, the remaining four (all Aug. 1925) are of the form with dark-suffused postdiscal band (*murrayi*). The maximum, mean, and minimum expanse of these females are 89, 81, and 75 mm. A single female from Tau Island, Feb. 1926 (*A. F. Judd*), is of the *thomsoni* form, and is 83 mm. in expanse.

The eight females in the Kellers collection, all labelled Tutuila, April 1918 (which are accompanied by fourteen males), and one labelled Pago-Pago, Tutuila, Sept. 1923 (*Swezey* and *Wilder*), form a remarkable contrast with all the above. All have more or less "*nerina*-red" (absent in every other specimen from American Samoa which I have seen), and the last-mentioned is typical *H. bolina inconstans* both in markings and size. Of the eight females collected by Kellers, three have a distinct pale apical area on the forewing, as in some specimens from the Cook Islands, but differ from these latter in their much smaller size. There is much variation in the extent of the orange area on the forewing and also in the white discal patch on the hindwing; in three of the specimens this white patch is quite absent, and in two of these even the metallic blue suffusion, which usually surrounds it, has almost entirely disappeared; but the postdiscal white band on the forewing is clearly-defined and unsuffused in all of them. They vary in size from 96 to 74 mm., with a mean of 81 mm., whereas other specimens from Tutuila are much more uniform in size, only varying from 89 to 75 mm., with the same mean; in many respects they strongly resemble specimens from Wallis and Fotuna Islands. I am unable to account for the extreme difference between these specimens and all others from American Samoa that I have seen; the existence of the two females of the *thomsoni* form captured by Nicoll in April 1903, seems to preclude the possibility that the difference is seasonal.

The species is common at low elevations in Tutuila, but, as in Tonga, males greatly outnumber females; a captured series consists of forty-five males and twelve females, in spite of a special effort having been made to secure specimens of the latter sex.

Samoan records of *H. bolina* have usually been under the name *montrouzieri* Butler, but this is certainly a mistake; the type male of this form was obtained in the New Hebrides, but the female (in the British Museum) is labelled "Navigators' Is." (=Samoa). It is a very large specimen, 96 mm. in expanse, while females from Tutuila only average 81 mm., and is of a form that I have not seen from any part of Samoa. It agrees very well both in size and markings with females from the Cook Islands, and almost certainly came from that group. The unreliability of old labels is well shown by the fact that there is, in the same series, another female of the form (which is entirely confined in all its modifications to Australia and the islands of the Pacific) labelled "Nepaul" (with, of course, a note that the locality is erroneous).

The difference in the proportions of the sexes of *H. bolina* in Western and in American Samoa is extremely interesting; in almost all the Pacific Islands males are much commoner than females. Tonga and Tutuila conform to this general rule, while Simmonds has shown that in certain parts of Fiji the females preponderate. In no part of its range, however, does the disproportion between the sexes seem to be so great as in Western Samoa, where the males are much less than 1 per cent. of the total; this is the more remarkable, in that there do not appear to be any differences in conditions between the two parts of Samoa to account for this disparity in sex-proportions. At the nearest point Upolu and Tutuila are only about 40 miles apart, and the climates seem to be as nearly as possible identical. Although I did not find the early stages in Tutuila, *Sida* (which it is safe to assume is, as in Fiji, Tonga and Western Samoa, the food-plant) is common. Nor does the lack of males in Western Samoa appear to be in any way disadvantageous to the species, for here, as in the other islands, *H. bolina* is one of the commonest insects. Another apparently inexplicable point is the cause of the difference in size of *H. bolina* in the two parts of Samoa; the average expanse of females in Tutuila is 81 mm., and of the same sex in Upolu or Savai'i only 70 mm. The small size of *H. bolina* in Western Samoa finds a parallel in the case of several other species of butterflies, including *D. melissa melittula* and *P. villida samoensis*, and it has been suggested by Poulton that this general feature of small size in Western Samoan butterflies may be correlated with the occurrence of hurricanes. In Tonga, however, where the butterflies are not noticeably small, hurricanes are far more frequent than in Samoa, and most of the islands, being low, are much more exposed to the force of the wind than are the mountainous islands of Samoa. Moreover, as pointed out above, the small size of the butterflies of Upolu and Savai'i is not shared by the same species in Tutuila, where conditions as regards hurricanes are identical. This latter point has been entirely obscured by the fact that hardly any of the older Samoan records give exact localities, so that specimens from all the islands in the group are mixed in collections.

10 (c). Hypolimnas bolina rarik (Esch.).

Apatura rarik Escholtz, 1821, Kotzeb. Reise, p. 203, t. 5, f. 10.
Hypolimnas rarik ; Woodford, 1895, p. 348.
Diadema otaheitae ; Butler, 1878, p. 297.
Hypolimnas bolina elliceana Fruhstorfer, 1912, p. 553.

The type locality of this race is the Gilbert Islands, but it appears to be the dominant form in the Ellice group also.

Fruhstorfer's description of *H. bolina elliceana* is as follows : "In the Ellice Is., to the N.W. of Samoa, we encounter a very small melanotic form ; *elliceana* subsp. nov., represented in the British Museum." Of the two females from the Ellice Islands in the British Museum, one is quite typical *H. bolina rarik,* the other, labelled as Fruhstorfer's type, is of the *nerina* form, and is 88 mm. in expanse. A form resembling it is figured by Poulton, Pl. LIII, fig. 3 ; it is probably the specimen recorded by Butler (1878, p. 297) as *D. nerina.* These females are accompanied by three males. Of the specimens collected by Buxton, four are males, and five females ; four of the latter are typical *H. bolina rarik ;* the fifth (the only female from Nui) has the white postdiscal band on the upperside of the forewing much obscured by dark suffusion, the orange somewhat restricted, and the white blotch on the hindwing strongly suffused with yellow. The maximum, mean, and minimum expanse of seven males from the Ellice group are 82, 73, and 66 mm., of six females (excluding the type of *H. bolina elliceana*) 86, 82, and 75 mm.

Specimens of the species were observed in Nanumea, Nui, Nukulailai, Nukufetau and Niutao ; males and females were about equally common at the time of Buxton's visit. Mathew (Poulton, p. 647) records it from Funafuti, and it doubtless occurs throughout the group. The form *rarik* appears to be a fairly constant one, which does not occur in our area except in the Ellices, unless a male 94 mm. in expanse, taken by J. J. Lister in Fakaofu, Tokelau group, and now in the British Museum, belongs thereto ; this seems to be the only record of *H. bolina* from the Tokelaus.

The adults are fond of sitting head downwards on a tree-trunk like a *Vanessa,* and the larva eats *Pipturus propinquus* Wedd., *Sida* (the usual food-plant elsewhere) being apparently absent from the Ellices. Woodford (1895, p. 349) states that in the Gilberts the larva feeds upon a species of *Abutilon.*

11 (a). Precis villida villida (F.).

Papilio villida Fabricius, Mant. Ins., 1787, p. 35, no. 366.
Junonia villida ; Butler, 1878, p. 297, 1883, p. 415, 1895, p. 238.
Swezey, 1921, p. 603.
Junonia vellida ; Rainbow, p. 95.
Woodford, 1895, p. 349.

This form was described by Fabricius from specimens from " Amsterdam Island " (Togatabu), and the types are in the Banks Collection in the British Museum. It seems to be widespread in our area, and I am unable to separate specimens from the various groups except those from Western Samoa, which Rebel has described under the name *P. villida samoënsis*. There is considerable variation in size, as is shown by the figures in Table II. The numbers examined from each locality are as follows: Tonga, six males, four females; Tutuila, eleven males, seven females; Ellice group, three males, three females; Olosega (Swain's Island) three males, two females; Western Samoa (ssp. *samoënsis*), forty-three males, seventeen females. It should be noted that the figures given for the Ellices and for Olosega are not means; from the former locality the measurements given are those of all specimens available, from the latter island three males measured 46 mm. and the fourth 45 mm., two females measured 54 and 45 mm. There is considerable variation in other respects besides size, but it does not appear to be constant in any one locality. Both this and the next race can readily be separated from specimens of the Australian race (*calybe* Godt.) by the underside of the hindwing, which in the island specimens is of a much yellower shade of grey and always bears well-developed eye-spots.

In Samoa, the form is common in Tutuila, and I have one specimen from Tau Island. In the Ellices, Buxton obtained specimens in Nui, Nanumea, and Nukufetau, and Rainbow records it as occurring in Funafuti. Woodford states that in this group the larva eats *Scaevola koenigii* Vahl. (Goodeniaceae), and Buxton found the larvae feeding singly on the same plant; in Olosega (Swain's Island) a single specimen of this species was the only butterfly he saw, but there are other specimens from this island in the British Museum (*J. J. Lister*). Buxton also saw it on Atafu, Tokelau Islands. I did not meet with the species in Tonga, but there are specimens in the British Museum from both Vavau and Togatabu; no doubt, like *P. villida samoënsis* in Western Samoa, it has strictly defined seasons, but the only dated specimens from Tonga are those taken by the Eclipse Expedition in Vavau, in April or May.

In several geographical races this species is one of the most widespread butterflies in the South and Central Pacific; its range extends from Australia in the west to Tahiti in the east, and it is found on many atolls that support no other butterfly-life except the still more widely-distributed *H. bolina* and perhaps *Euploea eleutho.*

TABLE II

Size in millimetres of specimens of Precis villida *from various localities*

Locality.	Race.	Male.			Female.		
		Max.	Mean.	Min.	Max.	Mean.	Min.
Tonga . . .	*villida*	52	49	48	54	52	50
Tutuila . . .	,,	50	47·5	46	56	53	50
Ellice group . .	,,	50	(49)	45	58	54	46
Olosega . . .	,,	46	(46)	45	54	—	45
Western Samoa . .	*samoënsis*	47	42·5	38	52	45	39

11 (b). Precis villida samoënis Rebel.

Junonia velleda; Semper, 1866, p. 251.
Schmeltz, p. 183.
Fruhstorfer, 1902, p. 353.
Junonia villida; Butler, 1874, p. 281.
Waterhouse, 1904, p. 493.
Pagenstecher, p. 302.
Junonia vellida; Fraser, p. 149.
Junonia villida samoënsis Rebel, 1910, p. 418, Pl. XVIII, fig. 9.
Precis villida samoënsis; Fruhstorfer, 1912, p. 522.

Rebel's description of this race is as follows: "Distinguished from the Australian parent form by its smaller size (male 19–22, female 24–27 mm., length of forewing), but above all by the bright orange setting of the beautiful blue-centred eye-spots, which is completely confluent and appears as a broad border on all the wings. Also the ground-colour is a little darker, and extends down on the hindwings in cell 3 as a blunt tooth. On the underside all the wings are pale yellowish-grey, with very broad rich orange colouring in the

border of all the wings, and in the whole region of the inner margin of the fore-wings." The form differs from *P. villida villida* chiefly in its smaller size (Table II), the mean expanse of males being 5 mm., and that of females 8 mm., less in specimens of this race from Upolu than in those of the type form from Tutuila. Specimens from Savai'i do not differ in any way from those from Upolu, but, as I have only a few examples from the former island, I do not quote the numbers; the means quoted for specimens from Upolu and from Tutuila are based on forty-three males and seventeen females from the former island, and eleven males and seven females from the latter. In addition to the difference in size, however, a form occurs in this race, more particularly in the female, which is not mentioned by Rebel and has not been seen by me from any locality outside Western Samoa; in this form the ground-colour is strongly suffused with orange-tawny scales of the same colour as the broad sub-terminal band, so that in extreme specimens of the form the contrast between band and ground-colour is almost entirely lost, and the two merge into one another. Nearly all females from Western Samoa show some tendency towards this form, but in the males it is less common and less well-developed. The orange sub-terminal band of the hindwing, usually broken in *P. villida villida*, is generally complete in the race *samoënsis*.

This insect provides the best example of seasonal prevalence that I was able to observe in a Samoan butterfly; it was very uncommon in the Apia district in 1924, except from September to December, when it was rather common; it was abundant in the Aleipata district and in several localities in Savai'i at the same time. It remained common in the Apia district until towards the end of January, after which only odd specimens were seen there until August, when it became common (sometimes abundant) in many localities in this and other districts, and remained so until our departure in December. It was never seen much above 1,000 feet, and only at that height where there were large cleared spaces. It is attracted to the flowers of *Lantana*, *Stachytarpheta*, *Mimosa pudica*, etc., but much more commonly is seen basking in the sun on a road or other open space, frequently flying up to chase a passing rival. On the two or three occasions when pairs were seen flying *in copulâ*, the female carried the male.

I was not able to obtain any of the earlier stages. Oviducal *eggs*, however, were green and marked with twelve prominent longitudinal ridges; their height was about 0·70 mm., and the diameter about 0·68 mm. *Scaevola*,

the food-plant of the species in the Ellices, occurs commonly in Samoa, but, since Fruhstorfer states (1912, p. 521) that the larva (presumably of the Australian race) eats *Plantago*, *Antirrhinum* and *Daphne*, it is probable that other races also are more or less polyphagous.

12. Issoria sinha bowdenia (Butler).

Atella bowdenia Butler (M. R.), 1873, p. 687.
Schmeltz, p. 186.
Waterhouse, 1904, p. 493.
Rebel, 1910, p. 419, Pl. XVIII, figs. 7 and 8.
Swezey, 1921, p. 603.
Atella bodenia ; Butler (A. G.), 1874, p. 283.
Fraser, p. 149.
Atella korodenia ; Pagenstecher, p. 302.
Atella egista ; Herrich-Schaeffer, 1869, p. 71.
Issoria sinha bowdenia ; Fruhstorfer, 1912, p. 475.
Issoria sinha samoana Fruhstorfer, 1912, p. 475.

Fruhstorfer described his *I. sinha samoana* from a single male from Samoa ; judging from his description it was merely a variety of *I. bowdenia*, the type locality of which is Tonga, and it seems very unfortunate that he should have described it on such inadequate material. I have examined a long series of this species both in the material brought home by me and in that in the British Museum, and can find no constant difference between specimens from Samoa and from Tonga. The only distinction which appears to be of any value is that of size ; the maximum, mean, and minimum expanse of the forewings are as follows : Tonga (nine specimens) 66, 63, and 60 mm., Western Samoa (thirty-five specimens) 64, 58, and 46 mm., Tutuila (thirteen specimens) 68, 64, and 56 mm. ; two males from Tau, American Samoa, measure 56 and 60 mm. respectively. The difference does not appear sufficiently great to be significant. In Fiji the species is represented by *I. sinha vitiensis* Waterh.

This species was common in every month throughout the coastal region in Western Samoa, and in Tutuila whenever visited, but was never very abundant ; it also occurs, as noted above, in Tau. Though seen in February and March 1925, at both Nukualofa and Neiafu in Tonga, it was not common at either locality. It frequents the flowers of *Morinda citrifolia* (Rubiaceae) and sometimes those of *Lantana*, but does not seem to care much for any other

blooms; both sexes are more frequently seen flying round the food-plant than in any other circumstances. It is commonest at the edge of forest, and is never found (in Samoa) much above 1,000 feet, though the food-plant, a small tree, *Xylosma suaveolens* Forst., (FLACOURTIACEAE) occurs up to at least 2,000 feet. My notes on the early stages were made from Samoan material.

The *egg* is yellow and almost spherical, 0·67 mm. in height and 0·77 mm. in diameter, the surface marked with about twelve longitudinal and thirteen transverse ribs. The eggs are laid singly on the underside of a leaf, and the egg-laying habits of the female are very curious. The insect settles on the upperside of the leaf, and bends her abdomen underneath to attach the egg; when possible she chooses a leaf with a hole in it, in which case she inserts the tip of her abdomen through the hole. She is not at all particular about laying on the food-plant, for eggs are frequently to be found on any other plant that happens to be near by. The egg-stage lasts two days.

The *larva* (Pl. IV, fig. 6) is coloured as follows: Head pale red-brown; body above spiracular line light brown, with an interrupted paler dorsal line; spiracular line white; prolegs, and body below spiracular line greenish. There is a pair of long, branched, blackish, spines on the prothorax, and three pairs of shorter pale brown spines on each of the other body-segments. Length about 26 mm. when full-grown. The larva feeds either exposed on the upperside of a leaf, or hidden on the underside, and when disturbed drops by a thread to the ground.

The *pupa* (Pl. IV, fig. 7) is attached to a vein on the underside of a leaf of the food-plant. There is a pair of short dorsolateral spines on the head, another short pair on the thorax, and a pair of long dorsal spines on segments 2, 4, and 6 of the abdomen. The colour is pale green; there is a short streak of metallic silver on the dorsum of the wing-cases, and the two spines of each pair on the abdomen are joined dorsally by a patch of silver. The imago hatches after seven days. Larvae were found in June, August, November and December.

13. Atella exulans, sp. n.

Male (Pl. II, fig. 13). Upperside bright tawny-yellow with slight purple iridescence, black markings as follows: Forewing, four sinuous lines in the cell and a bar along the discocellular veins, beyond this a somewhat triangular oblique bar extending from the costa to vein 4, where it almost touches a small triangular spot in interspace 3; a transverse series of small postdiscal spots,

followed by a lunular line and narrow terminal and sub-terminal borders, fused anteriorly; a small angular line basally in interspace 1. Hindwing, a transverse series of small postdiscal spots, absent in interspaces 1 and 6, and obsolescent in interspace 4, followed by a lunular line and narrow terminal and sub-terminal lines. Underside much paler, apex of forewing pale purplish-brown; markings more or less as on upperside, but very faint except the postdiscal spot in interspace 1 of the forewing, which is large and black, and the postdiscal spots in interspaces 2 to 6 of the hindwing; the latter are ringed with deeper tawny and placed on a pearly-white band, beyond which is a line of pearly lunules.

Female (Pl. II, fig. 14). Similar to male, ground-colour paler and all black markings more extensive. The purple iridescence is absent.

Maximum, mean, and minimum expanse of twenty-two males 50, 47, and 42 mm., of six females 53, 51, and 48 mm.

Type male from Malololelei, Upolu Island, 2,000 feet, 11.x.25, female from same locality, 10.vii.24; paratypes from same locality, various dates, and one female from Mata Vanu, Savai'i, 1,500 feet.

Variation is very slight and specimens from Savai'i do not differ from those from Upolu. A short series of bred specimens are very small, and are not taken into consideration in the above figures of the expanse.

This very distinct form will possibly prove to be a race of *A. alcippe* (described from a specimen from Amboina), but is widely separated from it geographically. The only *Atella* hitherto known to occur in Polynesia is *A. gaberti* (not very closely related to the present form), of Tahiti, so that this record is a notable extension of the known range of the genus. A species is also known to exist in Papua.

Unlike *Issoria bowdenia*, this species is strictly confined to the upper parts of the islands; it does not occur below about 1,000 feet, and is commonest at about 2,000 feet, so that the two species have quite separate ranges, which, however, overlap slightly at an elevation of about 1,000 feet. Common at Malololelei throughout the year, and at an elevation of about 2,000 feet in Savai'i (*E. J. Bryan*); I also took it in Savai'i at 1,500 feet, on Mata Vanu. There are no records from Tutuila or from any localities outside Samoa.

In habits it much resembles *I. bowdenia*, being generally found round the food-plant, a small tree, *Melicytus sp.*, probably *M. ramiflorus* Forst. (VIOLACEAE); it also frequents the flowers of *Lantana* and of *Micania scandens* (COMPOSITAE).

The *egg*, which is cream-coloured and nearly hemispherical, is laid singly on the underside of a leaf of *Melicytus*. The sculpturing is shallow, consisting of about forty longitudinal ridges, occasionally coalescing and connected by very inconspicuous transverse ridges. Micropylar area flat, sculptured like the rest of the egg. Height 0·47 mm., diameter 0·56 mm.

Larva (Pl. IV, fig. 8). Head mainly black, anteriorly pale green; body pale yellowish-green, with a broad blackish middorsal line and an interrupted white spiracular one; legs and prolegs pale yellowish-green; spines as in *I. bowdenia* but much shorter, pale grey. Length when full-grown about 20 mm. Like that of *I. bowdenia*, the larva drops by a thread when disturbed, but even more readily. It is sometimes attacked and sucked by a Pentatomid bug (*Platynopus melacanthus* Boisd.).

Pupa (Pl. IV, fig. 9) dimorphic, one form pale green with the following markings on the dorsal surface: a double small dark-brown spot on the head, and another on the thorax; a short streak of the same colour on the inner margin of the wing-case, and a rather large blotch of it on segments 2, 4, and 6 of the abdomen; on the head and each segment of the thorax and abdomen, except the last, there is a minute metallic gold spine. The second form is similar, but paler green, the dorsal surface much marked and suffused with purplish-brown, the metallic markings more extensive and more coppery in tint, and the dark brown areas paler and less well-defined. The two forms are quite distinct, and intermediates do not seem to occur. The pupa is attached to a pad of silk on the underside of a leaf of the food-plant; the cremaster is relatively exceptionally large, and extends ventrally for a considerable distance; accordingly the pupa does not hang down vertically like most Nymphalid pupae, but lies with its whole ventral surface almost touching the leaf. The pupal stage lasts six days. Larvae and eggs were found in March and July.

14. Papilio godeffroyi Semper.

Papilio godeffroyi Semper, 1866, p. 469, Pl. XXIV.
Herrich-Schaeffer, p. 78.
Butler, 1874, p. 289.
Schmeltz, p. 191.
Mathew, 1885, p. 361, Pl. X (larva and pupa).
Fraser, p. 148.

Papillo godeffroyi ; Rebel, 1910, p. 419.
Swezey, 1921, p. 605.
Papilio godefroyi ; Woodford, 1890, p. 69.
Pagenstecher, p. 302.

Semper's types came from Upolu ; in a short series from Upolu, Savai'i and Tutuila there is almost no variation, and the specimens from the different islands are inseparable.

The species is never very common, but is found throughout the year in many localities, from sea-level to at least 2,000 feet, in all parts of Western Samoa and in Tutuila. Woodford states that he once took a specimen on one of the eastern islands of Fiji ; this is probably the specimen recorded by Herrich-Schaeffer (p. 79) from Ovalau, Fiji. The record has been discredited by later writers, but, as Woodford was quite familiar both with this species and with the Fijian *P. schmeltzi*, I see no reason to doubt his statement ; it seems, however, to be the only record of the species from any locality outside Samoa. It is least uncommon on the outskirts of thick forest, where it frequents the flowers of *Lantana* and of *Carica papaya* (paw-paw or mummy-apple). A very large proportion of the specimens seen are damaged, apparently by contact with twigs in flight. This, when the insect is not alarmed, is rather slow but powerful, and the butterfly frequently keeps high up round the upper parts of large trees ; the females are more easily captured than the males, since they often fly only a few feet above the ground, apparently seeking a suitable place for oviposition. They appear to be somewhat scarcer than the opposite sex, my series including eleven of the latter and only six females. Schmeltz (p. 191) states that Graeffe found specimens from the mountains in Upolu larger than those from the coast ; I am not able to confirm this.

A single *egg* was laid in my hand by a captured female ; this was almost spherical, uniform pale brown above and dull yellowish beneath, the two colours sharply separated ; there was no sculpturing, but the surface was slightly rough. Diameter 0·75 mm., height 0·68 mm. The larva subsequently hatched, but died.

According to Mathew, the *larvae* "Fed perfectly exposed upon young stunted plants of *Aralia** growing in shady and sheltered places." "The full-

* Rechinger (Bot. und Zool. Ergebnisse einer wiss. Forschungsreise nach den Samoainseln, etc. *Denkschr. K. Akad. Wissenschaft*, Vienna, vol. 85, p. 323) does not record any species of this genus from Samoa. He records several genera of the Araliaceae.

grown larva is from 50 mm. to 55 mm. long, rather plump, tapering slightly towards the anal extremity, and with the 4th, 5th, and 6th, segments considerably thickened; whole colour a beautiful golden green; oblique darker green stripes pointing backwards; a darker narrow dorsal line widening out to a diamond-shaped longitudinal spot at the segmental divisions; a double stripe between this and the oblique stripes; from the 2nd segment, in a line with the mouth, a somewhat triangular blotch of a deep velvety madder-brown runs obliquely upwards through 3rd and 4th to base of 5th segment, and connects over the back with a similar marking on the other side; this stripe is continued through the 6th segment, where it meets the broad shining white stripe, which runs above claspers to vent; the triangular blotch is bordered above by a pale golden-green line; on 8th and 10th segments a somewhat triangular madder-purple blotch, bordered above by a narrow white stripe; head shining brownish-green, with a narrow white line down centre of face, and a V-shaped mark over mouth; legs pale reddish-brown; ventral and anal claspers smoky black; two bluntish orange-coloured spines upon the 2nd segment, just behind the head, and at the base of each of these a minute orange tubercle, between which, and a little to the rear of the spines, is the nuchal valve, through which, when the larva is irritated, the usual tentacles are emitted; the tentacles are of a deep carmine, and give off the accustomed pungent odour; on 3rd and 4th segments a pair of subdorsal blunt spines; on 5th, and from 9th to 13th segments, a single subdorsal spine on each side; all the spines orange, faintly tipped with black. These larvae varied a good deal; in some the oblique stripes and triangular blotches were entirely absent, the whole surface, above the white spiracular stripe, being of a beautiful green, more or less marbled or streaked with darker and golden greens; while one or two larvae I took had the markings upon one side only."

The description of the *pupa* by the same author is as follows: "The chrysalis is from 30 mm. to 35 mm. long, angulated; head very strongly bifid, the extreme points tipped with black; back gradually arched; sheath of haustellum prominent; costal edge of wing-case ridged; body pinched in at centre; whole surface a beautiful golden apple-green; spiracles well-marked, darker; segmental divisions clearly defined, pale yellowish-brown. The chrysalis is invariably attached to the midrib of a leaf, while those of *Papilio schmeltzi* are just as invariably attached to a stem." He notes that pupae in captivity vary in colour with the colour of the background.

15. Catophaga jacquinotii manaia, ssp. n.

Catophaga athama; Butler Ann. & Mag. Nat. Hist., 1898, p. 398.
Rebel, 1910, p. 420.

Female (Pl. II, fig. 11). Upperside pale creamy-yellow, darker on the hindwing. Forewing; costa thickly sprinkled with black scales; apical third of wing and a broad terminal band black, black area somewhat deeply excavated in interspace 2 and bearing a series of 3 large and 2 small and diffuse sub-apical spots of the ground-colour; hindwing with a broad black subterminal border, between which and the termen is a series of small triangular areas of the ground-colour. Underside: forewing with a broad irregular black postdiscal band dividing the wing into two areas, a very pale yellow basal area in which the cell is strongly suffused with chrome-yellow, and an apical area which appears to be black in reality, but is so strongly suffused with white scales as to seem pearly-white; the subapical spots appear pure white on this pearly-white ground; hindwing greenish-white, a narrow strip along the costa and a small area at the anal angle chrome-yellow; a broad subterminal band as on the upperside, but so strongly suffused with white as to appear pearly.

Male (Pl. II, fig. 9). Upperside white, costa, apex, and termen of forewing very narrowly edged with black; underside white, black markings as on upperside, apex of forewing and whole of hindwing yellowish-buff, deepening to canary-yellow along the costa and at the anal angle of the hindwing. There is an opaque area in the disc of the upperside of the hindwing, which is apparently a patch of scent-scales.

Types from Lalomanu, Aleipata district, Upolu Island, female 20.xi.24, male 23.x.24; a series of more than forty paratypes from the above locality and others, in Western Samoa. Maximum, mean, and minimum expanse of female (twenty-three specimens) 66, 61, and 54 mm., of male (twenty-three specimens) 69, 64, and 58 mm. I have made the female the holotype on account of the difficulty of separating males of the different forms in this subgenus. The name means " beautiful " in Samoan.

The above race is apparently very closely allied to *C. jacquinotii* Lucas (=*C. athama* Lucas), but is distinguished in the female by the paler ground-colour, the deeper indentation of the black area of the forewing in interspace 2, and the presence of more than three subapical spots; the above differences are taken from Lucas' figure (Blanchard, Voyage au Pole Sud, Zoologie IV,

p. 381, Pl. I, figs. 10 and 11); the form figured (*C. athama*) is, as pointed out by Dixey, the female of *C. jacquinotii* Lucas, which has page-priority; Dixey also points out that Butler's description of a male from Samoa as that of *C. athama* was quite unjustified. Both the sexes of Lucas' species were taken in "Balaou, New Guinea," a locality which has been variously identified as the Pelew (Palau) Islands or as Vanua Ubalavu in the Exploring group (the Lau group of Fiji), though the latter are nowhere in the neighbourhood of New Guinea. I have not seen specimens from either the Pelew group or the Philippines, but examples from other groups in the Western Pacific (*e.g.* the New Hebrides and New Caledonia) differ markedly from Samoan and Tongan females in their much yellower ground-colour, and appear much more like Lucas's figure. A female from "Vanua Valava, Fiji," figured by Herrich-Schaeffer (Stett. ent. Zeit., 1869, Pl. I, fig. 2) is apparently of the present form; but the only specimen from Fiji that I have seen is a male.

Variation in the male of *C. jacquinotii manaia* is slight, and almost confined to the underside of the hindwing and apex of forewing, the colour of which is sometimes much paler than in the type. The female varies very considerably, and there are two main forms. In one of these (Pl. II, fig. 10) the ground-colour on the upperside is somewhat darker than in the type, and becomes deep cream, the subapical spots are enlarged and there may be a small extra one posteriorly; the black band on the hindwing is narrower than in the type; on the underside the suffusion of white scales is so dense that the apex of the forewing and terminal area of hindwing appear almost pure white. In the other form (Pl. II, fig. 12) the ground-colour is paler, approaching pure white in some specimens, the black areas are increased in size and the subapical spots of the forewing small, that in interspace 4 being sometimes hardly visible; on the underside the markings are as on the upperside, the white suffusion of the dark areas on both forewing and hindwing being so poorly developed that these are sooty-black. In some specimens of this form the subterminal band of the hindwing is entirely without suffusion, but I have not seen any in which there is not a little suffusion of the apical area of the forewing. The two forms are not sharply divided and they do not appear to be seasonal, both forms occurring at the same time and place. Intermediates (like the type female) are much commoner than the extreme forms, and the form with dark markings on the underside as on the upperside appears to be rare. Tongan specimens do not seem to differ in any respect from Samoan ones; six Tongan males have

a maximum, mean, and minimum expanse of 69, 64, and 58 mm., and two females measure 62 and 66 mm. respectively.

A very uncommon species in the Apia district, but a few specimens were seen in every month ; sometimes common in other Samoan localities : Rechinger found it abundant on Apolima in June (Rebel, *l.c.*), and it was very abundant there in March 1924, and also at Lalomanu from September to December, 1924 ; it occurs commonly in several localities in Savai'i (Fagamalo, Tuasivi, etc.) and in Tutuila (Pago-Pago). In Tonga I saw a single male at Neiafu, Vavau, and Armstrong found it very common at the same locality in March 1925, especially on the top of Talau Hill, where, however, all the specimens seemed to be males. He states that they showed a marked preference for a species of wild pepper very similar to the kava plant ; both sexes were driven out of this by beating, and it seems possible that it is the food-plant, but unfortunately he was not able to find eggs or larvae. Both sexes are very fond of the flowers of *Morinda citrifolia*, and occasionally visit those of *Lantana*, but I have never seen them at any other flowers.

This species is a very swift and strong flyer, and extremely difficult to catch on the wing. In the Laomanu district is a long and narrow promontory (Text-fig. 1) running in an easterly direction, and along this both sexes delighted to fly out to sea in the teeth of the strong south-easterly wind ; few were seen to return, and some at least reached the outlying islets of Nuutele and Nuulua ; they were accompanied in their flight by smaller numbers of *E. schmeltzi* and *D. m. melittula*.

An *egg*, which was laid in my hand by a captive female, was yellow and of the skittle-shape common among Pierines ; unfortunately it was lost before it could be measured. The other early stages are unknown.

16. Belenois java schmeltzi, ssp. nov.

Belenois teutonia ; Schmeltz, p. 190.
Pagenstecher, p. 301.
Anaphaeis micronesia ; Cockerell, p. 168.

The forms of *Belenois* occurring in Fiji, and other groups of islands in the Pacific, have long been considered races of *B. teutonia* Fab. of " New Holland " (Australia) ; this in turn, however, is conspecific with *B. java* Sparrm. (an older name), and is therefore placed as a race of the latter both in the British Museum collection and in Seitz. The species is very widespread in the Pacific, but does

not seem to occur north of Samoa. The Tongan form appears to differ constantly from other races, and may be described thus :

Male (Pl. I, fig. 5). Upperside white. On forewing a rounded black spot at apex of cell, apical area and termen black, with a subterminal series of seven white spots, the first three of which are elongate and the four posterior rounded, the second spot (that at the apex) being very small and narrow. Hindwing ; a black terminal band, narrowing posteriorly and bearing a series of spots of the ground-colour, which appear yellowish by transparency ; the black along the veins of the underside also shows through. Underside as upperside, but all the black markings more extensive. Forewing with costa and discocellulars black. Hindwing, all the veins broadly edged with black, the areas of ground-colour along the costa and inner margin, and the subterminal series of spots all strongly tinged with chrome-yellow, a small area of the same colour in the cell.

Female (Pl. I, fig. 6). Similar to male, but all black markings more extensive, and sooty-black instead of jet-black as in the male. Upperside creamy white ; forewing costa edged with dusky black, and a broad curved streak of black along the discocellulars ; hindwing, veins narrowly (discocellulars broadly) edged with dusky black. Underside as in male, but ground-colour yellowish-white, subterminal spots of forewing yellowish, and black markings more extensive.

Maximum, mean, and minimum expanse of ten males 66, 62, and 58 mm., of six females 68, 63, and 59 mm. Types and six paratypes (five male and one female) from Neiafu, Vavau, Tonga, 7.iii.26 (*J. S. Armstrong*) ; I have also two very poor males, captured at the same locality on 12.ii.25 by myself, and have taken into consideration two males and two females from Vavau, collected by the Eclipse Expedition in April or May 1911, and two females from Tonga (exact locality not given), 1889 (*J. J. Lister*). I have named the race after Schmeltz, who was the first to record it and point out some of the distinctions between it and the Fijian race.

This race is evidently very closely related to *B. j. micronesia* Fruhst., of Fiji, but almost all Fijian specimens (as pointed out by Schmeltz) have the submarginal spots on the underside of a greenish-yellow, totally different from the deep chrome-yellow of *B. java schmeltzi ;* a few Fijian specimens have the underside spots yellow instead of greenish, but never of the deep colour typical of Tongan specimens ; the area of the colour is also less than in Tongan

specimens, filling only about half the area of each spot, the rest of which is white, while in Tongan specimens the yellow quite fills the spot.

Variation is not very extensive in this form: one male in the series captured by Armstrong has the black subterminal band of the hindwing very well-defined on the upperside, but in all the rest the inner part of it is very indistinct, and merges into the white ground-colour; the specimen referred to has the submarginal white spots of both wings on the upperside smaller than usual, and the apical spot on the forewing is missing. The chrome-yellow on the underside is more extensive in some specimens than in the type, and several of the females have the underside of the forewing strongly suffused with chrome-yellow, from the base to beyond the middle.

Two specimens of *B. java* from Samoa, the male from "Apia or Pago-Pago," Nov. or Dec. 1892 (*E. Bourke*), and the female from Lalomanu, Aleipata district, Upolu Island, 24.ix.24, taken by myself, differ markedly from the Tongan specimens and perhaps do not belong to the same race; further examples would be of very great interest. The male (Pl. I, fig. 3) has the black markings much reduced, the subterminal band of the hindwing underside being represented by a narrow terminal edging, so that the yellow subterminal spots are not bordered on the inner side with black; the black apical area of the forewing is also much reduced, so that the white subterminal spots become almost continuous with the ground-colour. The specimen is 56 mm. in expanse.

The female (Pl. I, fig. 4) has no black band along the discocellulars of the hindwing upperside, as in Tongan specimens, but all the other black markings are unusually extensive; the upperside of the hindwing has all the veins outlined in black, and much black suffusion, and on the underside the black is so extensive that the whole discal area of the wing becomes black, with an elongate yellowish-white spot, strongly suffused with black, in the cell, and a postdiscal series of similarly-coloured, somewhat triangular spots. Expanse 60 mm.

The difference between these two specimens is very remarkable, the male being much paler than Tongan specimens and the female much darker; this difference can hardly be seasonal, as both were taken in the wet season. It may possibly be geographical, and it is most unfortunate that the male has not more exact data; it is quite possible that it comes from Tutuila, and that there are separate races of the species in that island and in Western Samoa (as in several other cases), but we have no evidence on the point at present.

The species is common in Tonga in the neighbourhood of Neiafu, where both Armstrong and I saw it in plenty; Schmeltz records it from Liku in Togatabu. On my second visit to Vavau, a fortnight after the first, I did not see a single specimen, so that it appears to have sharply-defined seasons and to fly only for a very short period. It is apparently a very rare insect in Samoa, or possibly only very local. The only certain record I have is that of the female described above, but Brass thought he saw two or three others in the same district in November 1925; unfortunately he was not able to capture any of them. It is possible that the species is seasonally common in Tutuila, but we failed to find it on any of our visits, and it is not mentioned in Swezey's list.

Schmeltz says of the larva: "Resembles, according to Dr. Graeffe, that of our Cabbage White; is brown, with yellow tubercles on which stand a few hairs, and lives on CUCURBITACEAE." He does not say with which race he was dealing, but it appears to have been the Tongan one.

17. Terias hecabe aprica (Butler).

Terias aprica Butler, 1883, p. 420.
Terias hecabe; Schmeltz, 1876, p. 188.
Rebel, 1910, p. 421.
Terias hecabe aprica; Rebel, 1915, p. 123.
Terias sulphurata Butler; Cockerell, p. 169.

Rather common in the Nukualofa district, Tonga; I did not take it elsewhere, but there are in the British Museum collection two specimens from the Vavau group, taken by the Eclipse expedition in April or May 1911. Schmeltz recorded the form as occurring in Samoa as well as in Tonga and Fiji, and his record is repeated (with a query) by Rebel; the record has, however, never been confirmed, and it is very doubtful whether the specimen came from Samoa. Certainly no form of *T. hecabe* occurs in Upolu now, and we did not see it or obtain records of it from any other part of Samoa.

Variation in this form appears confined to the black marginal border of the upperside of the hindwing, which is almost obsolete in some specimens (including the type), but quite well-developed in others.

18 (a). Deudorix epijarbas doris, ssp. n.

Closely allied to *D. epijarbas diorella* Waterh., of Fiji, from which it differs as follows: *Male.*—Upperside, fiery-red colour on forewings (almost confined

to interspace 1 in *D. epijarbas diorella*) extending into interspace 2, the basal two-thirds of which it fills. Underside like that of *D. epijarbas diorella*, except that the orange lunule defining outwardly the subterminal black spot in interspace 2 of the hindwing is absent. Maximum, mean, and minimum expanse 43, 39, and 35 mm. (Pl. I, fig. 7.)

Female.—Differs on the upperside from that of *D. epijarbas diorella* in the absence of the orange lunule on the inner side of the anal lobe, and on the underside in the absence of that in interspace 2 of the hindwing. Otherwise the two races are indistinguishable in the female. Maximum, mean, and minimum expanse 44, 41, and 38 mm. (Pl. I, fig. 9.)

Male type and eight paratypes from Malololelei, and one paratype from Apia; female allotype and five paratypes from Malololelei. All are from Upolu Island, Samoa.

The male may immediately be separated from that of *D. epijarbas diorella* by the much greater extent of the red on the forewing; from that of *D. diovis* Hew., of Queensland, which it greatly resembles, it may readily be distinguished by the much more fiery tinge of the red, the greater extent of this colour on the hindwing, and the absence on the latter of the narrow black subterminal border found in *D. diovis*.

Variation is slight; in two males (the type and another) the red colour extends a short distance into interspace 3 on the forewing, and it may also spread slightly into interspace 1*a*. On the underside the fasciae vary a little in width, and in some males the orange lunule in interspace 2 of the hindwing is present but very indistinct.

This species was common at Malololelei (2,000 feet) at *Lantana* blossom, in February 1924, males being much commoner than females. Half a dozen were seen at the same locality in March, and odd specimens in April and May, while a single male was captured on the outskirts of Apia (almost at sea-level) in the latter month. In spite of numerous further visits to the original locality (not, however, in February or March) no more specimens were seen, and I have no records from any localities outside Upolu. Both sexes settle on leaves and twigs as well as on flowers, darting off now and then to chase a companion in typical "Hairstreak" fashion; they also occasionally alight on the ground. The flight is very rapid and powerful.

18 (b). Deudorix epijarbas armstrongi, ssp. n.

This is the Tongan representative of *D. epijarbas*, and is closely allied to *D. epijarbas doris*, from which the female (Pl. I, fig. 8) differs as follows: the pale area of the forewing (diffuse, small and sometimes almost absent in both *D. epijarbas doris* and *diorella*) is a clearly-defined triangular patch, filling the base of interspace 2 and nearly the whole of the basal two-thirds of interspace 1, and extending also into interspace 1*a*. The form resembles *D. epijarbas diorella* in the possession of the orange lunules on the inner side of the anal lobe on the upperside, and in interspace 2 of the hindwing on the underside. The black spot in interspace 2 of the hindwing is slightly developed on the upperside in all three females of *D. epijarbas armstrongi* but not in any of the females of *D. epijarbas doris* or *D. epijarbas diorella* that I have seen. Type and two paratypes (48, 42, and 38 mm. in expanse) from Neiafu, Vavau, Tonga, 7.iii.26 (*J. S. Armstrong*). Male and early stages unknown.

Armstrong found this subspecies not uncommon on the shore at Neiafu on *Morinda citrifolia*, and states that it was not feeding on the flowers but settling on the leaves; most were out of reach, and he was only able to capture the three females mentioned. I met with both sexes rather sparingly at Nukualofa on *Lantana* and at Neiafu, but all my specimens were destroyed on the journey home.

19. Jamides argentina (Prittw.).

Acrophthalmia ? argentina Prittwitz, p. 274.
Lycaena argentina ; Schmeltz, p. 186.
Pagenstecher, p. 302.
Lampides argentina ; Butler, 1874, p. 283.
Swezey, 1921, p. 605.
Jamides bochus argentina ; Fruhstorfer, 1923, p. 902.
Jamides carissima ; Druce (part), p. 443.
Rebel, 1910, p. 421, Pl. XVIII, figs. 10, 11, and 12.
Swezey, 1921, p. 605.
Lycaena woodfordi ; Fraser, p. 148.
Jamides woodfordi ; Swezey, 1921, p. 604.

Although this form varies considerably, more particularly in the width of the terminal black band on the upperside of the forewing in the male, it can readily be distinguished from *Jamides carissima* (described by Butler from a specimen from Erromango Island, New Hebrides) by the greater width of this

band; I have not seen an example from the New Hebrides in which it is as broad as in the Samoan specimens. Moreover, the ground-colour in the male of the present form is of a much brighter and more metallic blue, and the specimens are on the average considerably smaller. Druce states that there are in the British Museum specimens of *J. carissima* from Samoa, but the only *Jamides* from this locality in the collection are *J. argentina;* his figure (Pl. XVII, fig. 17) appears to be true *J. carissima;* Butler (1875, p. 615) records *J. argentina* from the New Hebrides, but there are no specimens of the form in the British Museum except from Samoa. There is considerable variation in all the Pacific *Jamides*, and this has led to many of the species being recorded from localities where they do not occur, but in the main the geographical forms are fairly well-defined and constant. Their synonymy is, however, in a most unfortunate state owing to misidentifications and incorrect localities, and much further material from all localities is required to clear up the confusion. Fruhstorfer is possibly correct in treating them all as races of the Indo-Malayan *J. bochus* Cr., but this cannot be satisfactorily proved until further material, with exact data, is available from all groups.

The maximum, mean, and minimum expanse of thirty-three males from Western Samoa are 29, 25·5, and 22 mm., and of fifteen females 29, 26, and 20 mm.; the corresponding figures for five males and seven females from Tutuila are 28, 26, and 24 mm., and 30, 27, and 24 mm. A single much-worn female from Tau, which appears to be of this form, measures 28 mm. in expanse.

Abundant in Samoa throughout the year, at many localities at sea-level in all the islands visited, and found wherever the food-plant, *Vigna lutea* A. Gr. (Leguminosae), a common yellow-flowered creeper, occurs. The male is commoner than the female. The insect seems little attracted to flowers, and is seldom seen far away from the food-plant.

The *egg* is white, of the "bun-shape" common in the Lycaenidae, and 0·54 mm. in diameter; the surface is covered with very fine sculpturing and the whole egg is surrounded by a zone of transparent bubble-like material which is presumably solidified froth. The eggs are laid singly on the base of a bud, or the stem of a flower.

The *larva* is pale green, the head and spiracles pale brown; when young it has a conspicuous blackish spot on the prothorax, but this is absent when the larva is full-grown. Length of full-grown larva about 11 mm. It eats only the flowers, and feeds concealed within them.

Pupa very pale brown, with a considerable amount of dark brown freckling on the dorsal surface. The imago hatches after eight days.

20. Jamides carissima Butler.

Jamides carissima Butler, 1883, p. 417.
Druce, p. 443.
Jamides woodfordi ; Druce, p. 442.
Pagenstecher, p. 302.

A series collected in Tonga by Armstrong and myself differs considerably from the specimens in the British Museum, owing to the more leaden ground-colour of the males ; but Captain N. D. Riley, who has kindly examined them for me, informs me that in his opinion they are all *J. carissima*, and that the colour of some of them has possibly been altered by damp. This is confirmed by the fact that the metallic scales seem to lie much flatter and more evenly in the older specimens, than in those collected by us. The blue colour in the two females of the latter is somewhat more restricted than in the older ones ; this may perhaps be seasonal, but the numbers are quite insufficient to prove anything. In size, the two series do not appear to differ ; the maximum, mean, and minimum expanse of my ten males are 30, 26, and 23 mm., while two females measure 27 and 25 mm. respectively. All seem somewhat smaller than specimens from the type-locality (the New Hebrides), and in all probability a new racial name will be required for them when more material is available.

The early stages are unknown, but the food-plant is probably a Leguminous creeper with rather large pink flowers, round which the butterflies were usually seen.

Rather common at sea-level in Vavau, Haapai, and Togatabu at the time of my visit ; Armstrong also found it common in March 1926. Schmeltz's record of *L. argentina* from Niuafou probably refers to this species ; with the exception of *Danaida archippus*, it appears to be the only butterfly yet recorded from this exceedingly isolated outlier of the Tongan group.

21. Jamides morphoides (Butler).

Jamides morphoides Butler, 1884, p. 347.
Druce, p. 442.

There is in the British Museum a single male of this species from the Godman-Salvin collection, labelled Tonga (*G. F. Mathew*). As pointed out by

Druce, it differs in some respects from the Type, but, especially in view of the possibility of a mistake in labelling, I prefer not to describe a single specimen. The type locality of the species is Montague Island (Nguna in the New Hebrides), and all the other records except that of this male are from localities in the New Hebrides. Since Mathew collected in both groups, it seems very probable that Tonga is a mistake for either Tongoa, or Tangoa, or Tanna, all in the New Hebrides, but our knowledge of the butterflies of Tonga is still very incomplete.

22. Catochrysops cnejus samoa (H.S.).

Lycaena samoa Herrich-Schaeffer, p. 73, Pl. IV, fig. 18.
Lycaena cnejus ; Schmeltz, p. 187.
Catochrysops cnejus ; Rebel, 1910, p. 422.
Swezey, 1921, p. 605.
Catochrysops cnejus samoa ; Fruhstorfer, 1923, p. 922.
Euchrysops cnejus samoa ; Waterhouse, 1904, p. 495.

As pointed out by Waterhouse, this form is much smaller than the Australian one ; it also differs from most other races of the species in the absence of the black spot near the costa of the hindwing on the underside, and the obsolescence of the two similar spots near the base : the former is absent in all the Samoan males that I have seen, and likewise wanting or poorly developed in all the females. The tail is considerably shorter than in most races of the species. Maximum, mean, and minimum expanse of ten males and five females from Samoa are 32, 27, and 24 mm. Variation in this series is very slight.

Never a very common species in Samoa, and rather local, it occurs during most months in many localities in the coastal zone of all the islands visited. Both sexes fly about the low herbage on the seashore, and hardly penetrate inland. I did not see it in Tonga, but Schmeltz records it as occurring there ; it does not seem to exist in any of the other groups under consideration. Strangely enough, in view of the name, the type locality of this subspecies is Vanua Valava (Vanua Mbalavu in Fiji).

The *larva* is recorded in Fiji as eating the inflorescences of *Crotalaria striata* D. C. (Leguminosae) ; I did not find early stages in Samoa, but the adults were usually seen in the neighbourhood of *Vigna lutea* A. Gr., which is perhaps the food-plant.

23. Catochrysops lithargyrea pepe, ssp. n.

Lycaena platissa ; Schmeltz, p. 187.
Catochrysops platissa ; Druce, p. 444.
Rebel, 1910, p. 422.
Swezey, 1921, p. 605.

Very closely related to *Catochrysops caledonica* (*Lycaena kandarpa* var. *caledonica* Felder), from which it differs in the male (Pl. II, fig. 7) in the complete absence of the orange lunule which, in *C. caledonica*, borders internally the large black spot at the anal angle of the hindwing on the underside, and in the absence or poor development of the corresponding black spot on the upperside. The female (Pl. II, fig. 8) greatly resembles that of *C. caledonica*, from which it differs only in the reduction of the orange lunule at the anal angle. Maximum, mean, and minimum expanse of male 31, 27, and 24 mm., of female 27, 26, and 24 mm. Type male from Vailutai, near Apia, Upolu Island, Samoa, 9.vi.24, female same place and date ; paratypes twenty-four males and nine females from various localities in Western Samoa, various dates ; a series of three males and one female from Tutuila agrees with those from Western Samoa. Both *caledonica* and *pepe* appear to be races of *C. lithargyrea*, described by Moore from a specimen from Ceylon ; the Australian *C. platissa* represents another race of the same species. The name " pepe " is the Samoan word for butterfly.

Variation is very slight in both sexes ; the orange lunule of the male is absent in all the specimens that I have examined, including three in the British Museum, but the black spot on the upperside, though often absent, is faintly developed in most specimens and fairly distinct in one. The orange lunules on the upperside of the hindwing in the female vary slightly in development.

I refer to the above form with much doubt a single male and two females from Togatabu Island, Tonga, March 1926. The females do not differ from those of *C. lithargyrea pepe*, but the male has the black spot at the anal angle of the hindwing well-developed on the upperside, while the apical and subterminal areas of the forewing, and subterminal area of the hindwing are strongly suffused with dark brown. In both these respects this form differs from any specimen of *C. lithargyrea pepe* that I have seen, and, when more material is available, it will probably prove to be a distinct race.

The form described above has been recorded by all previous authors as

L. platissa H. S., but the latter race was described from a specimen from Rockhampton, Queensland, and differs in many respects from both *C. caledonica* and the present race.

Very common on the coast of all the islands of Western Samoa, and in Tutuila, wherever the food-plant occurs; not found inland, and never very far from the food-plant. The species was not common in Tonga at the time of my visit, and the only specimens seen were in Togatabu. Buxton saw a specimen of what he believed to be this species on Nukufetau, Ellice group, but did not succeed in catching it. It is widespread in the Pacific outside our area, and the local races are usually not very distinct.

The *larva* is green, with a white lateral line, and interrupted white lines on each side of the brown mid-dorsal line; head brown, legs and prolegs very pale brown. It feeds on *Desmodium umbellatum* D. C. (LEGUMINOSAE), a common bush with white flowers, and eats only the flowers, refusing leaves even when starving.

Pupa buff, with pale brown freckling, very like that of *Z. labradus;* it is fastened by a silken thread to a leaf of the food-plant.

24. Nacaduba vitiensis samoensis (Druce).

Nacaduba samoensis Druce, p. 437, Pl. XXVII, figs. 5 and 6.
Waterhouse, 1904, p. 494.
Rebel, 1910, p. 421.
Nacaduba samoaensis; Swezey, 1921, p. 604.
Nacaduba berenice samoensis; Fruhstorfer, 1923, p. 919.

In a very long series of this insect, chiefly from Upolu Island, variation is considerable, and several of the distinctions between it and typical *N. v. vitiensis* break down; the upperside of the male is usually of a darker blue than in the latter form, but varies much in shade, as also does the blue marking of the female, which is sometimes quite as extensive as in *N. v. vitiensis.* The best point of distinction between the two forms is in the ocelli at the anal angle of the hindwing on the underside, which are never so large in *N. vitiensis samoensis* as in *N. v. vitiensis;* moreover, in the former the metallic scaling around the ocelli is usually blue, though occasionally greenish as in *N. v. vitiensis,* and the yellow ring which always surrounds them in *N. v. vitiensis* is obsolete or nearly so in all but four of the sixty-three specimens of *N. vitiensis samoensis* that I

have examined. One of these four (which are all males) is from Apia; of the others one is from Pago-Pago, Tutuila, one from Tau Island, and the other (in the Bourke collection) from "Pago-Pago or Apia"; these last three have the ocelli larger than the average, but the metallic ring round them is blue.

A short series of this species caught on Talau Hill, Vavau, Tonga, in March 1925, and March 1926, may possibly represent a new race, but for the present I prefer to refer them to the above form; the four males have the ocelli small and with blue scaling round them, but the yellow ring is present, though poorly developed, in all of them; the single female also has the ocelli small, but the metallic scaling is greenish, and the yellow ring is fairly well-developed.

The maximum, mean, and minimum expanse of twenty-nine males and twelve females from Western Samoa are: males 30, 27, and 23 mm., females 29, 28, and 23 mm.; in the four Tongan males the average expanse is 24 mm.; specimens from Savai'i do not differ in any respect from those from Upolu.

In Samoa this form is found throughout the year, often abundantly at Malololelei and other localities at high elevations; also in the coastal region, but never so commonly. I have specimens from Upolu, Savai'i, Manono, Tutuila, and Tau; it presumably occurs throughout the group. The specimens from Vavau referred to above seem to be the only ones recorded from outside Samoa. The adults, especially the males, frequent *Lantana* and other flowers. On the 4th May, 1925, they were extremely abundant at Malololelei, migrating from east to west, the wind being negligible, but in the direction of the flight; all the specimens captured (eight or nine) were females. At the same time the species was very abundant at the flowers of *Lantana* and *Mikania scandens* Willd. (Compositae), about half a mile farther up the hill in an easterly direction, but here nearly all the specimens were male. What may have been part of a similar flight was observed at the crater of Mata Vanu in Savai'i, at an altitude of about 1,500 feet, on the 22nd November 1925, when many specimens of this species were seen flying over the old lava from east to west; only two specimens were captured, both of which were females.

The early stages are unknown.

25. Zizera alsulus (H.S.).

Lycaena alsulus ; Herrich-Schaeffer, p. 75.
Schmeltz, p. 187.
Butler, 1874, p. 289.
Pagenstecher, p. 302.
Waterhouse, 1903, p. 212, Pl. II, fig. 10.
Zizera alsulus ; Rebel, 1910, p. 421.
Waterhouse, 1904, p. 494.
Lycaena lulu Mathew, 1889, p. 312.
Zizera lulu ; Druce, p. 436, Pl. VII, fig. 2.
Zizera labradus ; Swezey, 1921, p. 604.
Zizera labradus alsulus ; Fruhstorfer, 1923, p. 926, Pl. CLIII.

A most unfortunate confusion has arisen between this species and *Z. labradus*, originating in the fact that a specimen of the latter was sent by the Godeffroy Museum to the British Museum as *Z. alsulus*, so that most English writers have followed Druce in supposing that the latter was merely a poorly-marked form of *Z. labradus*. A translation of the original description is as follows : " Size and form of *L. alsus*, the upperside with dull violet iridescence, the underside brownish ash-grey, towards the base of the hindwings silver-green. A few specimens without any markings : then a black dot before the edge of interspace 2 of the hindwings, defined basally by a white angular marking, in interspace 3 a white dot, subsequently white angular markings in all the interspaces. From Rockhampton [Queensland] and Upolu."

The mention of a black dot makes it certain that the description cannot refer to any form of *Z. labradus*, and Waterhouse is obviously right in using *alsulus* as the earliest name of this species. Fruhstorfer's treatment of it as a race of *Z. labradus* is quite unjustified ; the two species are very distinct, and are frequently found flying together ; his figures are unrecognisable.

Mathew's types of *L. lulu* were from Togatabu, Tonga, and there are very remarkable differences between his type series and specimens from Upolu and Savai'i ; in the former the maximum, mean, and minimum expanse in a series of sixteen specimens are 27, 25, and 24 mm. ; all the females (seven in number) have extensive blue markings on the forewing, and at least some blue on the hindwing also, and in six of the nine males there is no black spot at the anal angle of the underside of the hindwing. In a series of twenty-nine males and fourteen females from Upolu and Savai'i, the corresponding figures are 24,

21·5, and 17 mm. ; all except three of the females have no blue markings at all (these three have no more than a slight powdering of blue on the forewing, and none on the hindwing), and the black spot at the anal angle is present in all except two of the males (in both series it is always present in the female). These differences do not appear, however, to be geographical, for a series of seven males and one female taken in Togatabu, Haapai, and Vavau, in 1925 and 1926, exactly resembles the Samoan specimens, the maximum, mean, and minimum expanse being 24, 21·5, and 18 mm., while the black spots are present in all ; the single female is of the Samoan form, with no blue markings. In both series the sexes are alike in size.

Never a very common species in Samoa, but found sparingly in Upolu wherever the food-plant, *Indigofera anil* L. (Leguminosae) occurs ; Waterhouse records it also from Satupaitea in Savai'i. The food-plant is a common pink-flowered shrub, which is confined to the coastal region ; I did not see it in Tutuila, and have no records of *Z. alsulus* from there. It is not much attracted to flowers, and never found away from the immediate neighbourhood of the food-plant. In Tonga it was not uncommon at Nukualofa, and I also took it in Haapai and Vavau.

Egg placed very carefully in between the crowded buds of an inflorescence ; bright green when laid, rapidly fading to very pale green approaching white ; covered with rather coarse sculpturing of the "honeycomb" type usual in Lycaenid eggs ; diameter 0·45 mm., height 0·27 mm.

Larva slug-shaped, pale green, head pale brown ; there is a rather distinct dark brown mid-dorsal line, and a yellow spiracular line ; spiracles brown, legs and prolegs green.

Pupa green, dorsal surface thickly sprinkled with small blotches of brownish-olive ; attached by means of a silken girdle and tail-pad to either surface of a leaf. The imago hatches after six or seven days. Several of the pupae were parasitised by a Chalcid. Early stages were found in September, November, and December, and would probably have been found in every month if properly sought for.

Mathew gives a detailed description of the larva and pupa, which differs in some respects from mine ; he does not state their provenance, but it appears to have been Tonga ; my notes are from material collected in Upolu.

26. Zizera labradus (Godt.).

Polyommatus labradus Godt., Enc. Méth., 1819, IX, p. 680.
Zizera labradus ; Druce, p. 435, Pl. XXVII, fig. 1.
Waterhouse, 1904, p. 494.
Rebel, 1910, p. 421.
Pagenstecher, p. 302.
Fruhstorfer, 1923, p. 926, Pl. CLIII.
Lycaena communis (Koch M. S.) ; Schmeltz, p. 188.
Fraser, p. 148.
Lycaena phoebe ; Butler, 1874, p. 285.

In a long series of this insect from various localities in Samoa and Tonga, there is considerable variation ; in the male this chiefly affects the width of the dark border on the upperside, and in the female the extent of the blue on the upperside. This latter is present and usually well-developed in twenty-six Samoan females, and absent or obsolescent in five Tongan ones, but the numbers from Tonga are insufficient in such a variable species to show whether the difference is a constant one. The spots on the underside vary considerably in development. There is also much variation in size, my largest and smallest males (both from Upolu, Samoa) measuring 30 and 20 mm. respectively. My series from Samoa includes fifty-two males and twenty-six females.

Very common in the coastal belt of all the islands of Western Samoa, and also of Tutuila, Vavau, Haapai and Nukualofa. Buxton captured a single male on Nanumea, Ellice Islands, in September 1924, but did not see it on any other islands of the group. The butterfly, unlike *Z. alsulus*, may be found some way inland where there are clearings ; this is probably due to the fact that it has several food-plants. In Samoa I usually found the larvae on *Indigofera anil*, but also on *Desmodium umbellatum*, while in Fiji it is recorded as eating *Phaseolus adenanthus* Mey., and *Vigna catiang* Walp.

The *larva* is olive-green in colour, with a dark green mid-dorsal line and an interrupted narrow yellow lateral line, connected by short yellowish oblique stripes in each segment ; head brown ; legs and prolegs green. Whatever the food-plant, only the flowers are eaten.

Pupa pale buff, with dark brown freckling, mid-dorsal line, and dorsolateral line ; length about 7 mm. ; attached to either side of a leaf of the food-plant.

27. Telicota fraseri, sp. n.

Male (Pl. I, fig. 10).—Upperside bright tawny, with the following black markings: on the forewing a broad subterminal border, traversed by very narrow streaks of the ground-colour along the veins, and becoming wider posteriorly; a narrow stripe from base to rather more than one-third length of wing in interspace 1; at apex of cell, a wedge-shaped mark extending nearly to the subterminal border; the veins are also mainly black. On the hindwing the costa is edged with black, broadening gradually from base to about half-way to termen, then narrowing sharply; termen and dorsum bordered with black, broadest at the anal angle. Underside, ground-colour similar; the black basal streak and the posterior portion of the subterminal border are present (the latter ill-developed), and the dorsum is bordered with black, but the rest of the black markings, including all those of the hindwing, are absent. Cilia bright tawny. There are conspicuous small transparent areas just external to the cell in interspaces 2, 3, and 4 of the hindwing, and similar but much less well-developed areas at the distal end of the cell in both fore and hindwing, and in interspaces 2, 3, and 4 of the forewing; these latter are not very obvious, and are best seen by holding the insect up to the light. Expanse 34 mm. Type and one paratype from Vaisigano Valley; two other paratypes from Vailima and Vailutai, Upolu Island, Samoa. Female and early stages unknown.

This species is apparently closely allied to the Indian *T. palmarum* Moore, but differs from any form of that species that I have seen in the presence of the transparent areas, and in its less extensive black markings; it very closely resembles *Telicota augustula* H. S., of Fiji, but can immediately be distinguished by the absence of the sexual brand in the male. Rechinger's record of the latter species from Samoa (Rebel, 1910, p. 422) almost certainly refers to *T. fraseri*, since he did not capture the only specimen he saw; the only other record of *T. augustula* from Samoa is that of Schmeltz (p. 191), repeated by Pagenstecher (p. 302), and probably also refers to the present species. In all probability this is also the species mentioned by Fraser as a fawn-coloured skipper, seen settling on leaves far from the ground in a clearing in forest, at about 800 feet elevation, and I have accordingly named it after her.

The species appears to be rare in Upolu, but occurred in several localities at different altitudes. In 1924 specimens were seen as follows: one at Malololelei (2,000 feet) on *Lantana* flowers, and one at Vailima (600 feet), both

in May ; one at Vailutai (sea-level), and one at Malololelei, both in June ; one at Vailima in December ; in 1925 Armstrong saw four at *Lantana* blossom, at an elevation of about 1,000 feet up the valley of the Vaisigano, and I saw three at about the same elevation between Vailima and Malololelei in October ; Rechinger's specimen was seen in June. All these localities are in Upolu, and we have no records of the species from elsewhere.

28. Badamia exclamationis (F.).

Samoan specimens of this species do not seem to be separable from the Indian typical form ; possibly they indicate a recent arrival, since the species does not seem to have been recorded from Samoa by previous authors. I did not see it in Tonga, and can find no records of its occurrence there.

It is common throughout the year in Upolu, Savai'i and Tutuila, wherever its food-plant (never found far from the coast) occurs. The larvae are sometimes so abundant as to defoliate the trees completely, but the imago is never found in very great numbers. It is very fond of settling on a bare twig or other vantage-point, from which it darts off at frequent intervals to chase á rival, generally returning to the same twig at the end of its flight.

The *egg* is hemispherical, cream-coloured when first laid, but changing to salmon-pink before hatching ; decorated with from twelve to fifteen longitudinal lines of beading ; laid, usually singly, but sometimes two or three together, on the underside of a leaf of *Terminalia catappa* L. (Combretaceae), usually near the midrib and almost invariably on the young, partially unfolded leaves at the apex of the shoot ; sometimes on the stem near the base of the young leaves. Large trees appear to be neglected for oviposition in favour of small trees and bushes.

The young *larva* is pale green, with a black ring between each pair of segments ; head yellowish-green, marked with black. When full-grown, the head is pale orange-yellow marked with black, body pale yellow-green with a narrow black dorsal stripe, a black transverse ring, which fades into dull red a little above the spiracles, between each pair of segments, and between each pair of these black rings four very narrow red-brown rings ; spiracles black, legs dark brown. The larva turns over the edge of a leaf and spins the two sides together with silk ; it usually remains in this shelter when feeding, only putting its head out, but may also be found feeding fully-exposed, especially when the tree is badly infested and the food-supply short.

The *pupa* is brown, covered with a powdery white deposit, which is easily rubbed off, and placed between two leaves of the food-plant, which are spun together. The pupal stage lasts nine days.

Early stages of this species were observed throughout the year, whenever the food-plant was examined; the bushes on which they were found were overrun by ants, which seemed to ignore healthy larvae and pupae completely, though they readily devoured dead ones.

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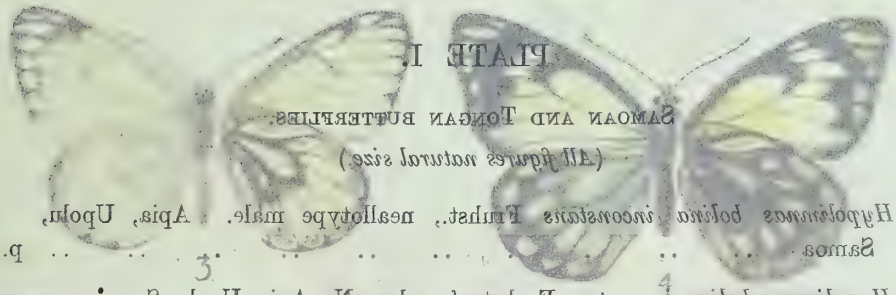
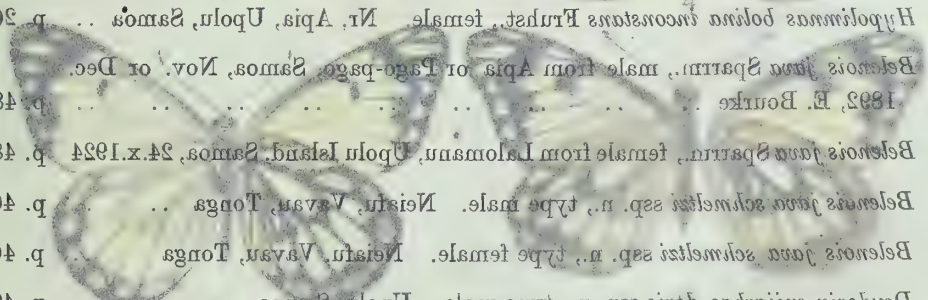
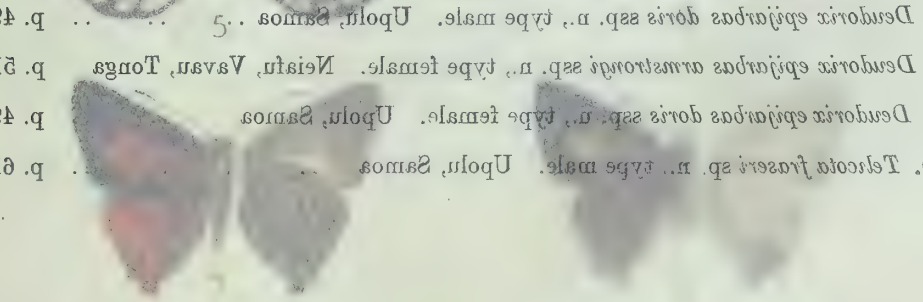
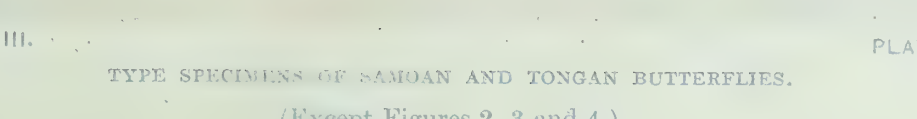








TYPE SPECIMENS OF SAMOAN AND TONGAN BUTTERFLIES.

(Except Figures 2, 3 and 4.)

PLATE I.

Samoan and Tongan butterflies.

(*All figures natural size.*)

Fig. 1. *Hypolimnas bolina inconstans* Fruhst., neallotype male. Apia, Upolu, Samoa .. .. p. 26

Fig. 2. *Hypolimnas bolina inconstans* Fruhst., female. Nr. Apia, Upolu, Samoa .. p. 26

Fig. 3. *Belenois java* Sparrm., male from Apia or Pago-pago, Samoa, Nov. or Dec. 1892, E. Bourke .. .. p. 48

Fig. 4. *Belenois java* Sparrm., female from Lalomanu, Upolu Island, Samoa, 24.x.1924 p. 48

Fig. 5. *Belenois java schmeltzi* ssp. n., type male. Neiafu, Vavau, Tonga .. .. p. 46

Fig. 6. *Belenois java schmeltzi* ssp. n., type female. Neiafu, Vavau, Tonga .. p. 46

Fig. 7. *Deudorix epijarbas doris* ssp. n., type male. Upolu, Samoa .. .. .. p. 49

Fig. 8. *Deudorix epijarbas armstrongi* ssp. n., type female. Neiafu, Vavau, Tonga p. 51

Fig. 9. *Deudorix epijarbas doris* ssp. n., type female. Upolu, Samoa .. .. p. 49

Fig. 10. *Telicota fraseri* sp. n., type male. Upolu, Samoa .. .. p. 61

PART III. PLATE I.

TYPE SPECIMENS OF SAMOAN AND TONGAN BUTTERFLIES.

(Except Figures 2, 3 and 4.)

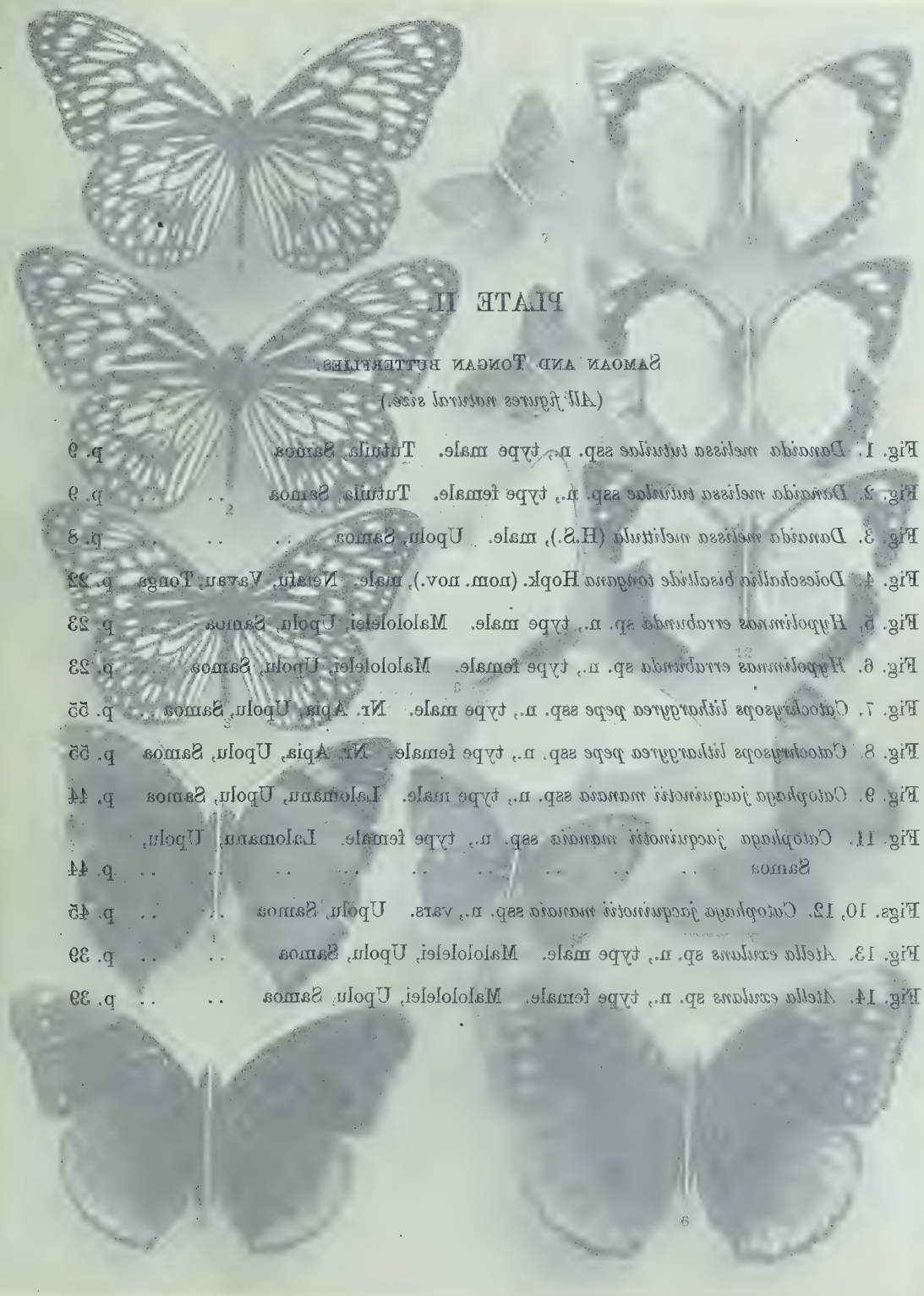


PLATE II.

SAMOAN AND TONGAN BUTTERFLIES.

(All figures natural size.)

Fig. 1. Danaida melissa tutuilae ssp. n., type male. Tutuila, Samoa .. .. p. 9

Fig. 2. Danaida melissa tutuilae ssp. n., type female. Tutuila, Samoa .. .. p. 9

Fig. 3. Danaida melissa melittula (H.S.), male. Upolu, Samoa .. .. .. p. 8

Fig. 4. Dolescholliia bisaltide tongana Hopk. (nom. nov.), male. Niafu, Vavau, Tonga p. 22

Fig. 5. Hypolimnas errabunda sp. n., type male. Malololelei, Upolu, Samoa .. p. 23

Fig. 6. Hypolimnas errabunda sp. n., type female. Malololelei, Upolu, Samoa .. p. 23

Fig. 7. Catochrysops lithargyrea pepe ssp. n., type male. Nr. Apia, Upolu, Samoa .. p. 55

Fig. 8. Catochrysops lithargyrea pepe ssp. n., type female. Nr. Apia, Upolu, Samoa p. 55

Fig. 9. Catopsilia florella mamoa ssp. n., type male. Lalomanu, Upolu, Samoa p. 44

Fig. 11. Catopsilia florella mamoa ssp. n., type female. Lalomanu, Upolu, Samoa .. .. p. 44

Figs. 10, 12. Catopsilia florella mamoa ssp. n., vars. Upolu, Samoa .. .. p. 45

Fig. 13. Atella eculeus sp. n., type male. Malololelei, Upolu, Samoa .. .. p. 39

Fig. 14. Atella eculeus sp. n., type female. Malololelei, Upolu, Samoa .. .. p. 39

TYPE SPECIMENS OF SAMOAN AND TONGAN BUTTERFLIES.

(Except Figure 3.)

A. Robinson, photo.]

PLATE II.

SAMOAN AND TONGAN BUTTERFLIES.

(*All figures natural size.*)

Fig. 1. *Danaida melissa tutuilae* ssp. n., type male. Tutuila, Samoa .. .. p. 9

Fig. 2. *Dañaida melissa tutuilae* ssp. n., type female. Tutuila, Samoa .. .. p. 9

Fig. 3. *Danaida melissa melittula* (H.S.), male. Upolu, Samoa .. .. .. p. 8

Fig. 4. *Doleschallia bisaltide tongana* Hopk. (nom. nov.), male. Neiafu, Vavau, Tonga p. 22

Fig. 5. *Hypolimnas errabunda* sp. n., type male. Malololelei, Upolu, Samoa .. p. 23

Fig. 6. *Hypolimnas errabunda* sp. n., type female. Malololelei, Upolu, Samoa .. p. 23

Fig. 7. *Catochrysops lithargyrea pepe* ssp. n., type male. Nr. Apia, Upolu, Samoa .. p. 55

Fig. 8. *Catochrysops lithargyrea pepe* ssp. n., type female. Nr. Apia, Upolu, Samoa p. 55

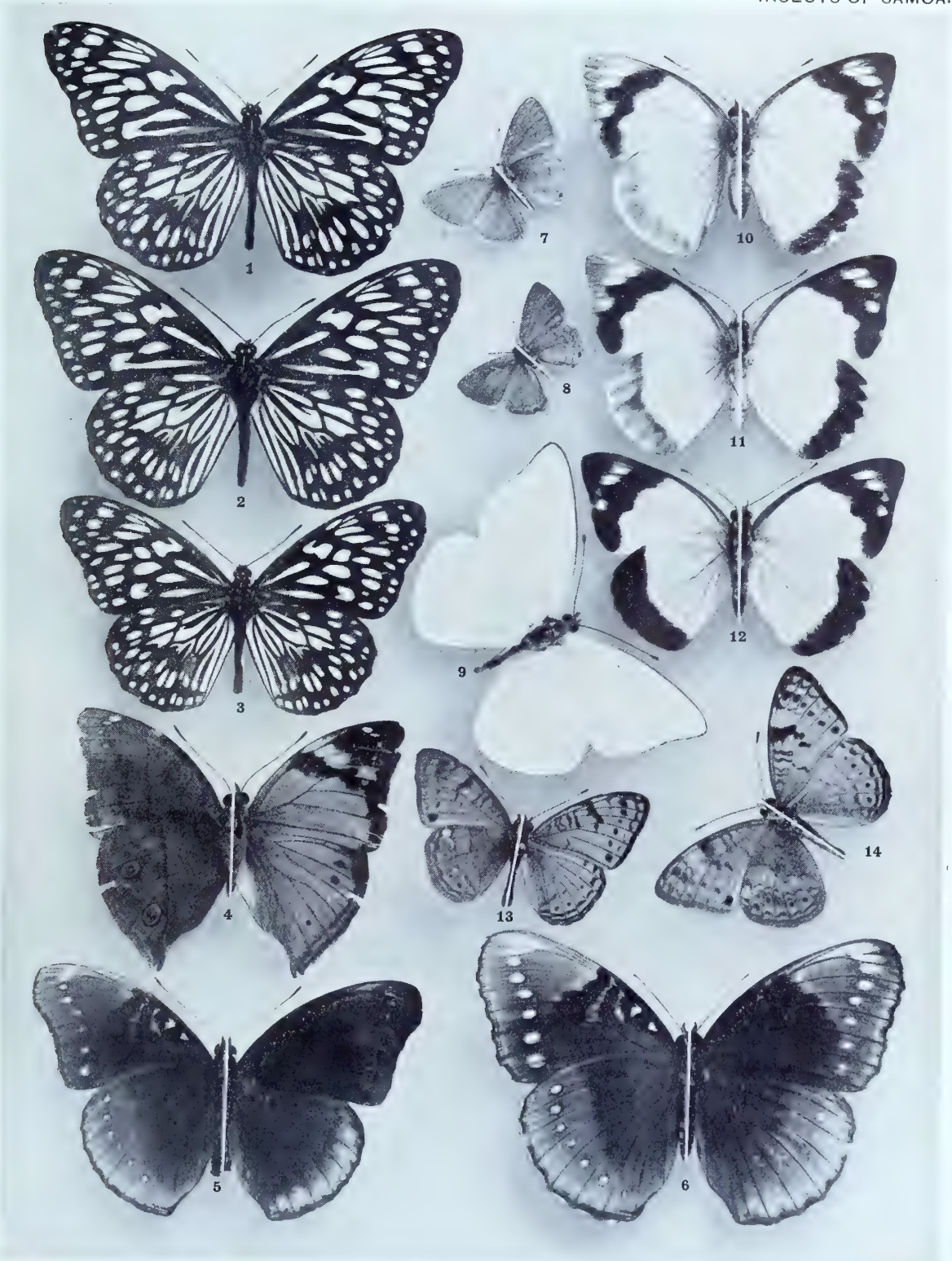
Fig. 9. *Catophaga jacquinotii manaia* ssp. n., type male. Lalomanu, Upolu, Samoa p. 44

Fig. 11. *Catophaga jacquinotii manaia* ssp. n., type female. Lalomanu, Upolu, Samoa .. .. p. 44

Figs. 10, 12. *Catophaga jacquinotii manaia* ssp. n., vars. Upolu, Samoa .. .. p. 45

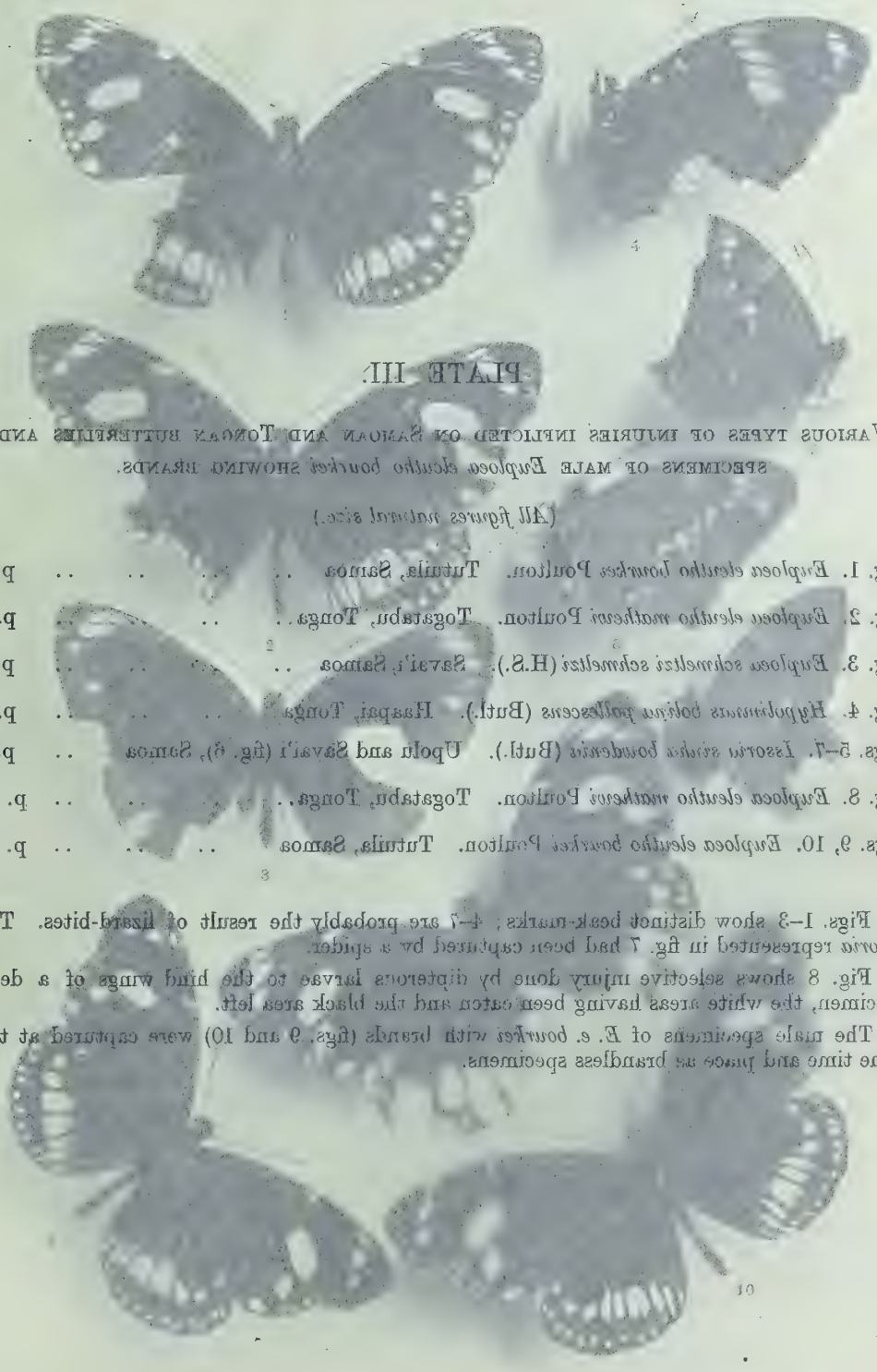
Fig. 13. *Atella exulans* sp. n., type male. Malololelei, Upolu, Samoa .. .. p. 39

Fig. 14. *Atella exulans* sp. n., type female. Malololelei, Upolu, Samoa .. .. p. 39



TYPE SPECIMENS OF SAMOAN AND TONGAN BUTTERFLIES.

A. Robinson, photo.] (Except Figure 3.)



PART III.

SAMOAN AND TONGAN BUTTERFLIES SHOWING VARIOUS TYPES OF INJURY, ETC.

A. Robinson, photo.]

PLATE III.

VARIOUS TYPES OF INJURIES INFLICTED ON SAMOAN AND TONGAN BUTTERFLIES AND SPECIMENS OF MALE *Euploea eleutho bourkei* SHOWING BRANDS.

(*All figures natural size.*)

Fig. 1.	*Euploea eleutho bourkei* Poulton. Tutuila, Samoa	p. 3
Fig. 2.	*Euploea eleutho mathewi* Poulton. Togatabu, Tonga..	p. 3
Fig. 3.	*Euploea schmeltzi schmeltzi* (H.S.). Savai'i, Samoa	p. 3
Fig. 4.	*Hypolimnas bolina pallescens* (Butl.). Haapai, Tonga	p. 3
Figs. 5–7.	*Issoria sinha bowdenia* (Butl.). Upolu and Savai'i (fig. 6), Samoa ..	p. 3
Fig. 8.	*Euploea eleutho mathewi* Poulton. Togatabu, Tonga..	p. 14
Figs. 9, 10.	*Euploea eleutho bourkei* Poulton. Tutuila, Samoa	p. 12

Figs. 1–3 show distinct beak-marks; 4–7 are probably the result of lizard-bites. The *Issoria* represented in fig. 7 had been captured by a spider.

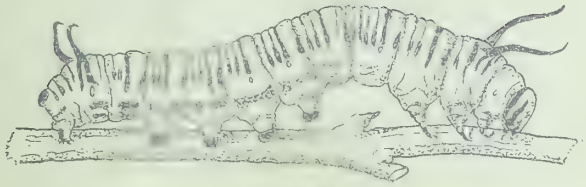
Fig. 8 shows selective injury done by dipterous larvae to the hind wings of a dead specimen, the white areas having been eaten and the black area left.

The male specimens of *E. e. bourkei* with brands (figs. 9 and 10) were captured at the same time and place as brandless specimens.

PART III. PLATE III.

SAMOAN AND TONGAN BUTTERFLIES SHOWING VARIOUS TYPES OF INJURY, ETC.

A. Robinson, photo.]



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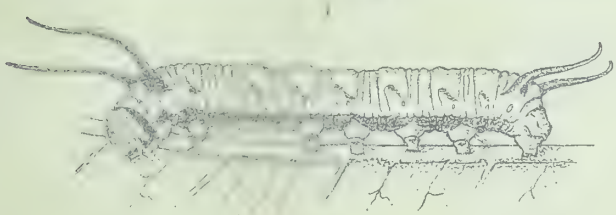

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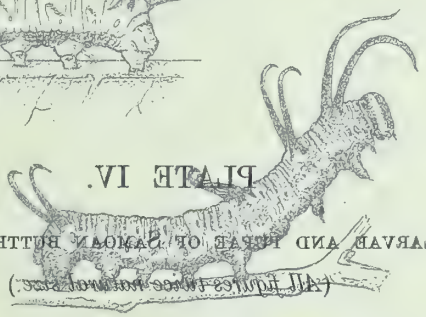

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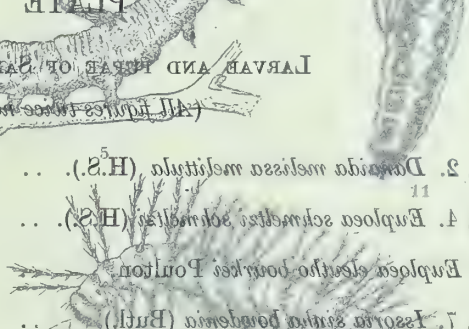

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PLATE IV.

LARVAE AND PUPAE OF SAMOAN BUTTERFLIES.

(All figures twice nat. size.)

Figs. 1, 2. *Danaida melissa melittula* (H.S.). .. .. p. 8

Figs. 3, 4. *Euploea schmeltzi solmalis* (H.S.). .. .. p. 19

Fig. 5. *Euploea electra boerlesi* Poulton .. .. p. 11

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Figs. 8, 9. *Atella erulans* sp. n. .. .. p. 39

Figs. 10, 11. *Acræa andromacha polymnestra* Rebel. .. .. p. 19

Fig. 12. *Hypolimnas errabunda* sp. n. .. .. p. 23

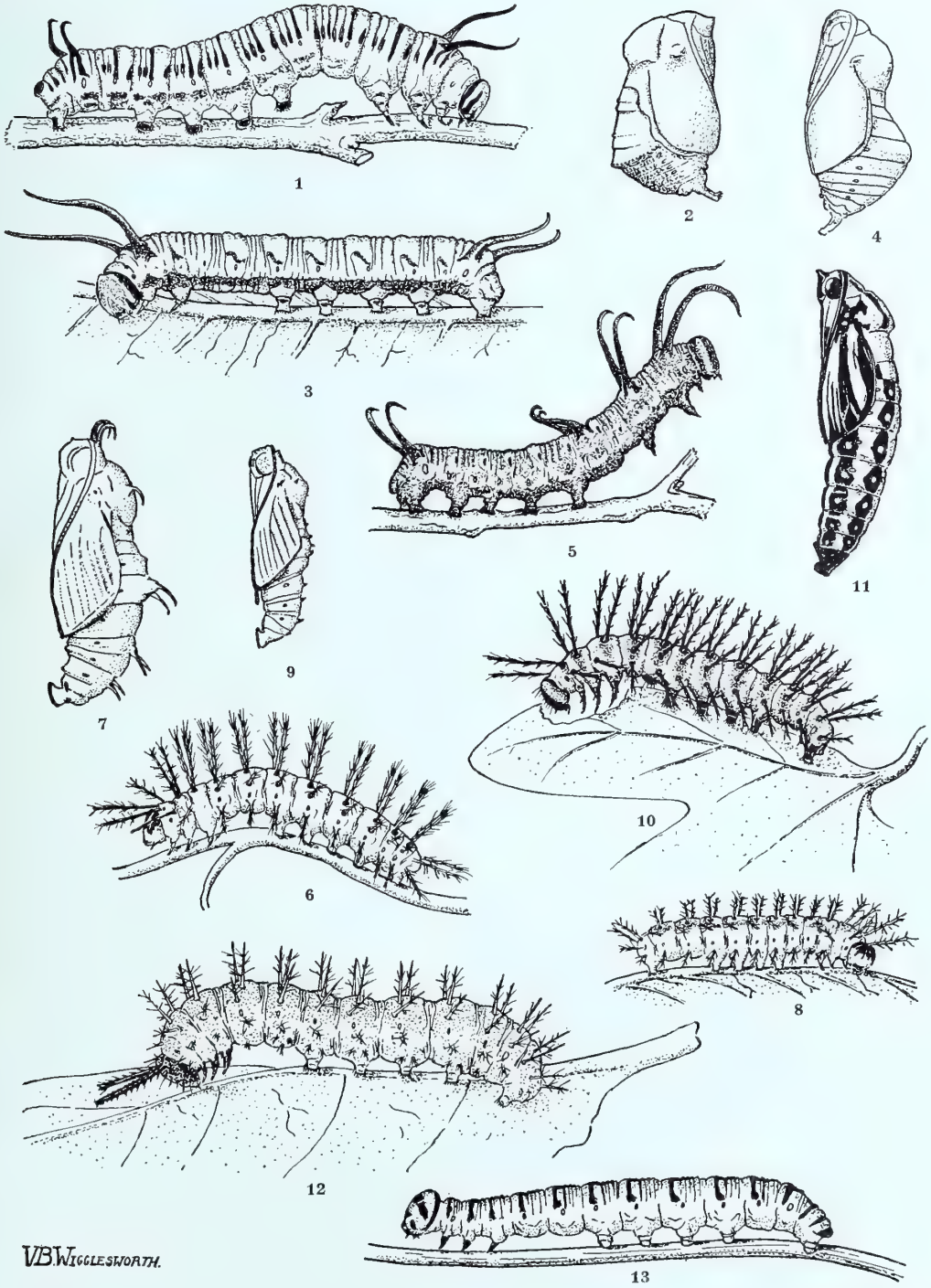
Fig. 13. *Badamia exclamationis* (F.). .. .. p. 62

VBWiggleswortn

PLATE IV.

LARVAE AND PUPAE OF SAMOAN BUTTERFLIES.

(*All figures twice natural size.*)



LARVAE AND PUPAE OF SAMOAN BUTTERFLIES.