# A REVISION OF THE GENUS NYCTALEMON DALMAN (LEPIDOPTERA, URANIIDAE) WITH NOTES ON THE BIOLOGY, DISTRIBUTION, AND EVOLUTION OF ITS SPECIES

by

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## 1. INTRODUCTION

In November 1949 the late Professor Dr. L. J. Toxopeus of Bandung, Java, sent me a specimen of *Nyctalemon* for identification, but neither with the help of our collection, nor with the current literature did I succeed in ascertaining the correct name of this insect. On the contrary it appeared that, though the described forms of this genus clearly were of different value, viz., partly good species, partly geographical subspecies representing these species in restricted areas, no satisfactory division of the genus into species and subspecies had been given. Thus, Seitz' classification of the known forms into four species of which three are polytypic proved to make no sense. Therefore I resolved to study the genus more closely.

In the ensuing correspondence Toxopeus gave me the benefit of his experience by providing references to relevant literature and quotations from his own notes. Because of this help I proposed to publish a joint paper on this genus after having studied the literature and examined a sufficiently large material, which proposal Toxopeus accepted. Though, after all, I doubt whether it would have been possible to carry out this plan, because of the great distance from Bandung to Leiden, the sudden and untimely death of Toxopeus on April 21, 1951, for ever prevented its execution.

Toxopeus' death was a serious loss to science, especially because he had had too little occasion to make his broad views on the systematics and distribution of East Indian Macrolepidoptera crystallize into comprehensive publications. Those who had discussed these topics with him, therefore expected him to publish important papers as soon as he would have retired from official duties.

The present publication, to which Toxopeus contributed indirectly, is dedicated to his memory.

The genus *Nyctalemon* is distributed between the tropics from Assam to the New Hebrides, but is apparently lacking in East Java, South Celebes, the Lesser Sunda Is., and Australia. In modern literature there is full agreement as to which described forms should be included in this genus, but ever since more than one form was described there has been diversity of opinion about their taxonomic status. Seba (1765) was the first to figure two different forms, which in his opinion both came from America. He allotted the first to the Rhopalocera, the second to the Heterocera. Cramer (1779, 1782), however, figuring the same two forms, which he rightly states to come from China and Amboina respectively, considered them varieties of one species.

Since the second half of the 19th century more forms of *Nyctalemon* have been described and named, and the splitters recognised more and more species. So Westwood (1879) distinguished six species, of which he, incomprehensibly, included one in his genus *Chrysiridia*, Kirby (1892) lists eight species, and Dalla Torre (1924) nine species. On the other hand, Butler (1869) and Boisduval (1874) held the view that the forms known in their time belonged to three species, which same view was maintained by Semper in 1901. Aurivillius (1882) and Pagenstecher (1885) recognised only two species, whereas Snellen (1889, 1890, 1895), Hampson (1895), Pagenstecher in his later papers (1895, 1900), and Röber (1927), the extremists among the lumpers, were convinced that the genus contained only one variable species represented by a series of local forms in its enormous area of distribution.

Of all these views on the division of the genus into species that of Semper may have been the best founded. Semper found that in the Philippine Is.

two clearly distinct forms coexist, which he, therefore, considered to be good species. All the described forms occurring West of Celebes were so near these two that he synonymised them either with the one, *N. menoetius*, or with the other, *N. zampa*. The forms occurring in the Moluccas and Eastward, however, appeared to be so much more different from the two western species than from each other that he lumped them in a third species, *N. patroclus*. Though he was aware of the variability of these three species, Semper did not attempt to subdivide them.

The first who tried to divide the genus into a number of polytypic species, and realized that the study of the distribution of the different forms would provide clues for the understanding of their interrelationship, was Pfeiffer (1925). Unfortunately, however, his paper is full of errors. Seitz evidently based his survey of the genus mainly on Pfeiffer's work, and, as already stated above, the result was very unsatisfactory. Forms which have nothing to do with each other are united into one species, while others, which are difficult to distinguish, are allotted to different ones. Seitz' figures, however, remain extremely useful for reference.

At first my studies led me to believe that the old view held by Butler, Boisduval, and Semper was right, and that the genus consisted of three polytypic species. This preliminary result was briefly discussed in a paper read before the Biogeographical Section of the Ninth International Congress of Entomology. Later, however, the view that the forms occurring in the Moluccas and Eastward all belong to one polytypic species proved untenable. These forms have now tentatively been considered as representing five species, of which at least one is polytypic. In total thirteen valid subspecies or monotypic species, of which three are described as new, have been recognised in this paper, and one form of doubtful status is provisionally described as a new variety.

For this study I had about 570 specimens for examination, some 425 of which were measured and compared in detail. Though in my opinion this examination and the perusal of the pertaining literature enabled me to present a more complete and better founded subdivision of the genus than hitherto available, I am well aware of its deficiencies. The examination of a larger material, especially of those forms of which I had few specimens only at my disposal, may easily lead to corrections and amplifications of my results. A better understanding of the interrelationships of the different species and subspecies may, however, be obtained by studying their early stages and biology. Throughout this paper I have tried to stress the most serious gaps in our knowledge of *Nyctalemon*.

My thanks are due to all those who helped me by giving me access to collections, by the loan of specimens, or by procuring useful information; especially to: Dr. J. Bourgogne (Paris), Mr. D. S. Fletcher (London), Dr. Elli Franz (Frankfurt am Main), Dr. G. Kruseman (Amsterdam), Dr. M. A. Lieftinck (Bogor), Mr. H. T. Pagden (Kuala Lumpur), Prof. Dr. W. Roepke (Wageningen). Mr. W. H. Tams (London), Mr. E. Taylor (Oxford), Dr. S. L. Tuxen (Copenhagen), Prof. G. C. Varley (Oxford), Dr. P. E. L. Viette (Paris), Mr. A. M. R. Wegner (Bogor). I am indebted to Mrs. Agnete Volsøe (Copenhagen) for her corrections in the English text of my paper.

## 2. SYSTEMATICS

### a. THE CORRECT NAME OF THE GENUS

The following is a synonymy of the present genus:

*Papilio* Linnaeus, 1758, p. 458 [partim].
*Noctua* Fabricius, 1794, p. 8 [partim].
*Urania* Fabricius in Illiger, 1807, p. 279 [partim].
*Lyssa* Hübner, 1816 [-1826], p. 289 [1823, nomen supprimendum].
*Nyctalemon* Dalman, 1825, p. 406 [nomen conservandum].
*Nyctalaemon* Salvin & Godman, 1877, p. 150.
*Lyssidia* Westwood, 1879, p. 509, 520, 525.
*Chrysiridia* Westwood, 1879, p. 522 [partim].

Of these generic names *Papilio, Noctua, Urania,* and *Chrysiridia* cannot be used for the species dealt with here, because these species are not congeneric with the type species of any of the mentioned genera. The name *Nyctalaemon* is an unnecessary emendation of *Nyctalemon.* Hence *Lyssa, Nyctalemon,* and *Lyssidia* should only be considered here.

The name *Lyssa* was introduced by Hübner as a generic name for two species, which he called *L. Achillaria* and *L. Patroclaria.* The first has a reference to a figure of Cramer (1782, pl. 198 fig. A) representing a species from the Moluccas that had been described earlier as *Papilio patroclus* by Linnaeus 1). The second name is accompanied by two references, of which the first is to Linnaeus' description of *Papilio patroclus.* Evidently the name *patroclaria* is an emendation of *patroclus,* as Hübner changed all the trivial names of the species which he classed in his "Fünfte Horde, Phalanx quinta. Spanner, Geometrae" so that they ended in .... *aria.* Therefore *Lyssa patroclaria* can be considered another synonym of *Papilio patroclus* L., and, if this view is accepted, Linnaeus' species automatically becomes the monotype of the genus *Lyssa.*

The second reference accompanying Hübner's name *Lyssa patroclaria,*

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1) For a discussion of this species see p. 12.

however, is to another figure of Cramer's (1779, pl. 109 figs. A, B) representing a second species of the genus occurring in China. Hübner, therefore, was right when including two species in his new genus, but unfortunately he indicated them by wrong names. He had been led astray by Cramer who called the insect figured in his pl. 198 *"Patroclus"*, and that represented in his pl. 109 *"Patroclus* var.", though the latter is the true *patroclus* L.

Since it is clear that Hübner's genus *Lyssa* virtually is not monotypic, it seems more correct to look for a designation of the type species in the literature after 1823. Westwood (1879, p. 309) explicitly stated that he meant his new name *Lyssidia* to replace *Lyssa* Hübner, and (1879, p. 520) designated *"U. patroclus"* (= *Papilio patroclus* L.) as the type of *Lyssidia.* Thus he indirectly fixed the type of *Lyssa.* Therefore, if one admits that two different species were originally included in the genus by Hübner, *Papilio patroclus* L. must also be considered the type of *Lyssa.*

The name *Nyctalemon* was proposed as a generic name for two species: *"Orontes"*, and *"Patroclus"*, i.e., *Papilio orontes* L., and *Papilio patroclus* L., by Dalman in 1825. Hampson (1895, p. 111) designated *"N. patroclus* L." (= *Papilio patroclus* L.) as the type of Dalman's genus, which consequently became an objective synonym of *Lyssa* Hübner.

A third name, *Lyssidia,* was proposed by Westwood in 1879 to replace *Lyssa* Hübner, because the latter was presumed to be a homonym of *Lissa* Leach, 1815, a genus of Crustacea. By original designation *Papilio patroclus* L. is also the type species of *Lyssidia* Westwood (Westwood, 1879, p. 520), which, therefore, is another objective synonym of *Lyssa* Hübner.

The name *Lyssa* has hardly been used as a generic name for *Papilio patroclus* L. and its near allies, because of its alleged homonymy with *Lissa* Leach, 1815. As there is no reason, however, to suppose that these two are of common derivation (cf. supplement 1 of 1943 of Art 34 of the International Rules of Zoological Nomenclature), according to the law of priority *Lyssa* Hübner is the valid generic name for *Papilio patroclus* L. and its near allies.

A study of the literature, however, reveals that, while the name *Lyssa* is obsolete, having been used since Hübner published it only by Aurivillius (1882), *Nyctalemon* is generally used for these moths. Reverting to the use of *Lyssa,* because of its validity upon the strength of the law of priority, would, therefore, serve no useful purpose, but on the contrary lead to unnecessary confusion. Therefore I prepared a proposal to the International Commission on Zoological Nomenclature to use their plenary powers to suppress the name *Lyssa* Hübner, and to place the name *Nyctalemon* Dalman, type species *Papilio patroclus* L., on the Official List of Generic Names in Zoology. Pending the publication of this proposal, and the subsequent decision of the Commission, I have used the name *Nyctalemon* in my preliminary note as well as in the present paper.

There is no agreement as to the gender of the name *Nyctalemon*. In fact it has been combined with adjectives in the male, female, or neutral form as trivial names. We may presume, as Agassiz (1846. p. 47) did, that the name *Nyctalemon* is derived from νὺξ, night, and ἀλήμων, vagabond. Consequently, I propose to consider the gender of the name *Nyctalemon* to be male.

### b. DIAGNOSTIC CHARACTERS OF THE SPECIES AND SUBSPECIES

The study of the genital organs proved of hardly any value for the discrimination of species in this genus. Both the ♂ and ♀ genitalia are very uniform. I made slides of the genitalia of: *Nyctalemon patroclus* (L.) ♂, ♀; *N. m. macleayi* (Montr.) ♂, ♀; *N. toxopeusi* nov. spec. ♂; *N. mutatus* (Butl.) var. *fletcheri* nov. var. ♂, ♀; *N. curvatus* Skin. ♂ ♀: *N. menoetius celebensis* subsp. nov. ♂, ♀; *N. menoetius adspersus* subsp. nov. ♂; *N. zampa docilis* G., S. & Dr. ♂, ♀; *N. z. zampa* Butl. ♂; *N. z. dilutus* Rbr. ♂. The ♂ as well as the ♀ genitalia of these forms appeared to be distinguished by slight differences in size and proportions only.

Except differences in size the ♂ genitalia show some variation in the proportions of the valve only. *N. zampa* (pl. I fig. 3) presents the relatively shortest valves, whereas in *N. menoetius* (pl. I fig. 2) these are more protracted and somewhat more pointed. The valves of the species of the *patroclus*-group (pl. I fig. 1) are intermediate, though nearer to those of *N. zampa*. Other parts of the ♂ genitalia are remarkably constant throughout the genus.

No important differences were found between the ♀ genitalia of different species of *Nyctalemon*. In pl. I fig. 4 the habitus of the ♀ genitalia is shown. The ovipositor with two postapophyses and the eighth segment with the anapophyses are clearly visible. At the anterior ventral side of the ostium genitale an oblong plate occurs which probably is homologous with the instita in geometrids (Pierce, 1914, p. XXIV), and the limen in tortricids (Diakonoff, 1939, p. 123). A rather long and gradually widening ductus leads to the bursa. A paired cestum (Diakonoff, 1939, p. 123) is found in the funnel-shaped connection of the ductus and the bursa. These cesta are long sclerotized bands, tapering to both sides, and provided with numerous small spines on their inner surface. These spines are visible at a magnification of 30 ×, and it appears that some sparse similar spines occur on the inner surface of the wall of the ductus between the cesta. The wall of the bursa is wrinkled throughout. A pair of signa occurs, which at a magnification of 30 × proves to be scobinate. In the bursa of some specimens I found a spermatophore accompanied by a great number of loose spines, which must be the cornuti of the ♂ partner.

As far as I have been able to ascertain Mehta (1933, p. 237) only studied the genitalia in *Nyctalemon*. He examined the ♂ genitalia of "*Lyssidia achillari* Hubn." (sic), but gives no description or figure.

The size of specimens of the same population shows considerable variation. As the proportions are practically similar in small and large specimens, the length of the fore wing (wl) has been used for comparing the size of specimens, and the mean values to compare the populations of certain areas. Considerable variation in size even in specimens from the same locality and date appears, e. g., from the values for wl of two ♀♀ from Babat, S. Sumatra, June 20, 1919, viz., 57 and 72 mm.

Although the mean values give no proof of conformities or differences, they provide useful indications. Only in those cases in which the existence of an expected difference was corroborated by Wilcoxon's test (cf. p. 31) the wl was used without restriction as a differential character in the key to the species and subspecies.

There is some variation in the shape of the wings. The outer edge of the fore wing may be somewhat convex, or slightly sigmoid to practically straight. In the latter case the fore wings have a more pointed appearance. Probably the shape of the hind wings, especially the length and the width of the tails, is also to some extent characteristic of certain forms. Since this part of the specimens is, however, often more or less damaged, I refrained from measuring tails.

Although the general wing pattern is remarkably constant throughout the genus, the details of this pattern furnish the most important characters. They comprise the form and number of dark markings on both sides of the wings, the shape and direction of the light bands in both wings, and the width of these bands in the fore wings.

The direction of the light band in the fore wing is indicated by the smallest angle ($\alpha$) between this band and a plane perpendicular to the main axis of the animal. In some cases it proved useful to measure the relative length of that part of vein 1 which is situated proximal of the crossing of the light band and that vein in the fore wing (100a/b).

In the *patroclus*-group the width of the light band in the fore wing was measured in mm, along vein 5 (bw5). This may seem a more exact figure than it really is, because sometimes these bands are vaguely delimited. In such cases the width had to some extent to be estimated. In the *menoetius*-group, however, and especially in *N. zampa* the light band in the fore wing is too narrow for its variation to be measured in mm. Therefore I examined all the specimens by means of a binocular microscope (7.5 ×), and counted the number of rows of light scales between veins 3 and 4. This is a partially subjective figure too, as the bands have more or less vague edges, and rows of partially dark, partially light scales sometimes occur.

For the values of the band width (bw5 and bw3/4) the means were computed in the same way as for the fore wing length. Just as for the wing length a difference in band width was used without restriction as a differential character in the key only in case the existence of an expected difference was corroborated by Wilcoxon's test.

Unless this wing was damaged, all measurements were taken from the right fore wing.

When comparing series of specimens of one species it appears that the variation in colour is often connected with geographical distribution and, therefore, can be used as a character for distinguishing geographical subspecies. One should, however, be very careful when using the colour of museum specimens of *Nyctalemon* as a diagnostic character, because there is evidence that discolouring occurs in dry specimens kept in collections.

The specimens of *Nyctalemon zampa docilis* that I received from Java and Sumatra after the second world war, have a darker, more greyish colour than the rather brown specimens preserved before 1940. In two species, *N. patroclus* and *N. toxopeusi,* however, the colour of recently killed specimens appeared hardly to differ from that of museum specimens. I found that in two cases the dark colour was wrongly taken for a character of a newly described form, presumably because fresh specimens of the new form were compared with museum specimens of others, or with a coloured figure of an already known form. The first is to be found in the description of "*Nyctalemon najabula*" by Moore (1877, p. 620), the second in that of "*Nyctalemon menoetius deliensis*" by Van der Meer Mohr (1933, p. 60).

It proved impossible not to take into account the colour when distinguishing subspecies of *Nyctalemon,* but certainly a far more subtle analysis of the geographical variation in this genus could be made if fresh specimens from various localities were available for comparison. Unless otherwise stated all colour descriptions have been taken from specimens kept for at least a decade, and generally during a much longer time, in collections. It is a drawback that most colour descriptions in this paper had to be given in comparative terms, such as "lighter than ..." or "more brownish than ...".

I failed, however, to apply Ridgway's terms for describing the colours, and especially for pointing out the slight but clearcut differences that appear to exist between some closely allied subspecies.

### c. ABBREVIATIONS

The following abbreviations have been used to indicate certain measurements in the next sections (cf. fig. 1).

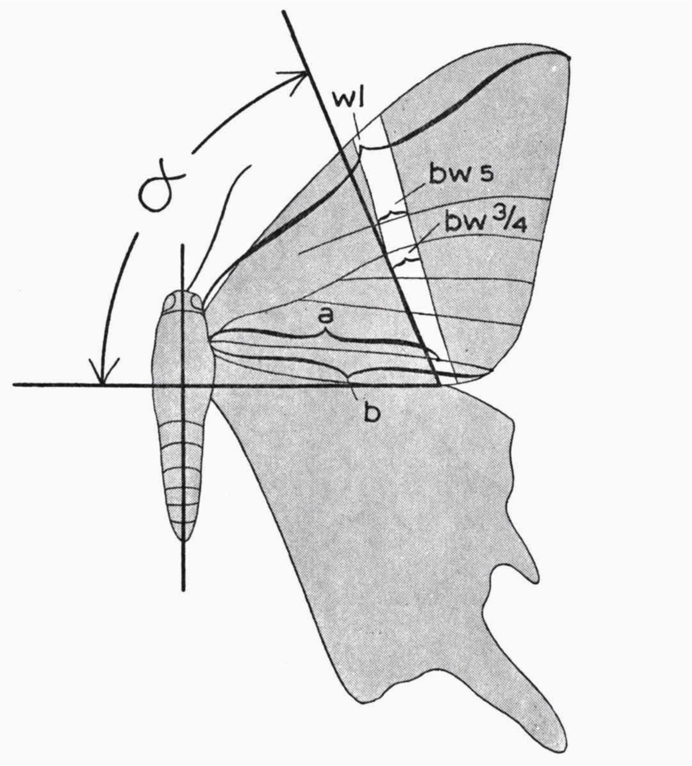

Fig. 1. Diagram of a *Nyctalemon* showing the way in which the measurements $\alpha$, a, b, bw3/4, bw5, and wl have been taken.

$\alpha$: smallest angle between the light band of the fore wing and the plane perpendicular to the main axis of the animal in correctly set specimens.
100a/b: index for the position of the crossing of the light band and vein 1 in the fore wing; a and b are measured to within 1 mm.
bw3/4: width of the light band of the fore wing expressed by the number of rows of light scales between veins 3 and 4.
bw5: width of the light band in the fore wing in mm measured along vein 5, to within 0.5 mm.
wl: length of the fore wing in mm, to within 1 mm.

The following abbreviations indicate the collections from which specimens were examined. or in which examined specimens will be deposited.

A: Zoölogisch Museum van de Gemeentelijke Universiteit, Amsterdam.
B: Museum Zoologicum, Bogor, Java.
BM: British Museum (Natural History), London.
G: Zoölogisch Laboratorium der Rijksuniversiteit, Groningen (this collection is deposited in the Leiden Museum).
J: Jurriaanse collection of the Leiden Museum.
L: Rijksmuseum van Natuurlijke Historie, Leiden.
NY: American Museum of Natural History, New York.
P: Laboratoire d'Entomologie du Muséum National d'Histoire Naturelle, Paris.
S: Natur-Museum Senckenberg, Frankfurt am Main.
W: Entomologisch Laboratorium der Landbouwhogeschool, Wageningen.

## d. Key to the Species and Subspecies

In this key those subspecies are considered to be of medium size of which I found the mean wl of the ♂♂ to be between 61 and 65 mm, and of the ♀♀ between 65 and 71 mm.

1 (10) Light band fore wing ending near tornus, strongly curved with outer convexity, or straight to somewhat sigmoid with $\alpha < 70°$; $100a/b = 75$ or more. Eastern species; Moluccas to New Hebrides . . . . . . . . *patroclus*-group

2 (9) Light band fore wing straight or somewhat sigmoid.

3 (8) Light bands both wings in normal position, in hind wings curved inward near tornus.

4 (5) ♂♂ light band fore wing yellowish brown, ground colour brown in fresh condition with slight purple gloss; ♀♀ light band fore wing yellowish brown, or suffused white, or white with vague edges, ground colour brown, lighter at apex and submarginally. Moluccas, Bismarck Archipelago . . . 1. *N. patroclus*

5 (4) Light band fore wing clearly white in both sexes.

6 (7) Proximal area upperside fore wing with few linear dark dots; light band fore wing practically straight; light band underside hind wing generally reduced in front of vein 7 or even 6 in the ♂♂; in both sexes the dark brown colour distally bordering this band gradually merges into the ground colour; this light band is generally crossed by a series of dark dots between veins 4 and 5. Tenimber Is. to Louisiade Archipelago . . . . . . . . . . . . . . . . 2. *N. macleayi*
(a) Medium size. Kei Is. to Woodlark Is. . . . . . . . . 2a. *N. m. macleayi*
(b) Larger; with wider band fore wing. Tenimber Is. . . 2b. *N. m. kotzenbergi*
N.B. Specimens from Vulcan Is. and from the Louisiade Archipelago are of doubtful status.

7 (6) Proximal area upperside fore wing with more linear dark dots than in *patroclus* and *macleayi*, this dotted area is consequently more conspicuous; light band fore wing more or less sigmoid; light band underside hind wing never reduced anteriorly, bordered on both sides by dark brown bands which are in strong contrast to the ground colour; at most some sparse dots cross this band between veins 2 and 7. Moluccas, NW. New Guinea, Bismarck Archipelago . . . . . . 3. *N. toxopeusi*

8 (3) Light band both wings more proximal than in other species of this group; that of the hind wing straight or curved with outer concavity, not or hardly curved inward at tornus; light band fore wing somewhat sigmoid in both sexes. Solomon Is. 4. *N. mutatus*

(a) Dark dots in proximal area of both wings coarse; light band hind wing generally with outer concavity; on the underside there are at most some sparse dark dots in the area crossed by this band between veins 4 and 5; upperside with peculiar purple gloss, especially obvious in the ♂♂ . . . 4a. *N. m.* typical form

(b) Dark dots in proximal area both wings fine; light band hind wing practically straight; on the underside this band is generally crossed by a series of dark dots between veins 4 and 5; no obvious purple gloss . . . . . 4b. *N. m.* var. *fletcheri*

9 (2) Light band fore wing strongly curved with outer convexity. New Hebrides . . 5. *N. curvatus*

10 (1) Light band fore wing ending in dorsum, straight or gently curved, with $\alpha = 80^\circ$ or more; 100a/b = 80 or less. Western species; Celebes to Assam . . . *menoetius*-group

11 (12) Apex of hind wing with heavy dark spots; costal margin fore wing checkered black and white; marginal area underside fore wing without dots or faintly dotted (mostly near tornus only, exceptionally in interspaces 1-9); outer margin fore wing slightly convex. Celebes, Philippine Is., Borneo . , . . . 6. *N. menoetius*

(a) Smaller than b and c; light band fore wing suffused in ♂♂, white in ♀♀, crossing vein 1 nearer its distal end than in b and c; ground colour dark brown. Celebes . . . . . . . . . . . . . . . . . . . . . . 6a. *N. m. celebensis*

(b) At least medium size; light band fore wing white in both sexes; ground colour brown to greyish brown. Philippine Is., Sangir Is., N. Borneo 6b. *N. m. menoetius*

(c) Medium size; light band fore wing suffused in ♂♂, white in ♀♀; ground colour dark greyish brown. E. Borneo . . . . . . . . 6c. *N. m. adspersus*

12 (11) Apex of hind wing with small dark dots; costal margin fore wing checkered black and light brown; marginal area underside fore wing dotted at least in interspaces 4, 8, 9; mostly 2-9, sometimes 1-9; outer margin fore wing straight or slightly sigmoid. Celebes to Assam . . . . . . . . . 7. *N. zampa*

(a) Medium size; light band fore wing generally white, bw3/4 larger than in (c). Sumatra to W. Borneo . . . . . . . . . . . . . . 7a. *N. z. docilis*

N. b. The mean wl in *N. zampa docilis* from Engano was found to be smaller than in other populations of the same subspecies, especially in the ♂♂.

(b) At least medium size; light band fore wing generally somewhat suffused, bw3/4 smaller than in (a). India to Indo China and S. China 7c. *N. z. zampa*

(c) Resembling (b), but the few specimens examined are smaller and have the light band of the fore wing narrower. Probably a good subspecies. Andaman Is. . . . 7d. *N. zampa najabula*

(d) Medium size; light band underside both wings ♀♀ not merging distally into ground colour. Probably a good subspecies. Philippine Is. 7b. *N. z.* subsp. ?

(e) Smaller than (b) and probably also than (a). Light band fore wing narrow and more suffused than in other subspecies; ♀♀ lighter than in other subspecies, possibly with the exception of the form from the Philippine Is. Celebes . . . . 7e. *N. z. dilutus*

## e. Survey of the Species and Supspecies

### 1. **Nyctalemon patroclus** (Linnaeus, 1758)

Plate I fig. 1 (♂ genitalia); fig. 4 on p. 43 (distribution).

*Papilio Patroclus* Linnaeus, 1758, p. 462 (Habitat in Indiis); 1764, p. 204; Herbst, 1790, p. III, 14 [partim], pl. 55 fig. 1 [♀, a copy of Cramer's fig.].

*Patroclus* 23 Clerck, 1764, pl. 37 [♀, probably Moluccas].

........... Seba, 1765, pl. 47 figs. 15, 16 ("America") [♀].

*Patroclus* Cramer, 1782, p. 9, pl. 198 fig. A (Amboina) [♀].

*Lyssa Achillaria* Hübner, 1816 [-1826], p. 289 [1823].

*Lyssa Patroclaria* Hübner, 1816 [-1826], p. 289 [1823] [partim].

*Nyctalemon Achillaria* Guenée, 1857, p, 15.

*Nyctalemon Patroclus* Hopffer, 1856, p. 3; Boisduval, 1874, p. 44; Pagenstecher, 1884, p. 102 (Amboina).

*Lyssidia patroclus* Westwood, 1879, p. 526 [Amboina tantum].

*Lyssa Patroclus* Aurivillius, 1882, p. 26.

*Nyctalaemon patroclus* Salvin & Godman, 1877, p. 150 (Duke-of-York Is., or New Ireland, or New Britain).

*Nyctalemon patroclus* Butler, 1879b, p. 165 (New Ireland); Swinhoe, 1892, p. 149 [partim: Bachian, Ternate, Ceram, Amboina tantum]; Pagenstecher, 1900, p. 123 [partim: New Ireland, New Britain tantum]; Seitz [1926], pl. 69a (♂, ♀) [good].

*Nyctalemon [patroclus] achillaria* Seitz [1926], pl. 69b (♀) [light band of the fore wing extremely wide].

*Nyctalemon patroclus velutinus* Röber, 1927, p. 430 (♂, Goram).

*Nyctalemon patroclus* subsp. Roepke, 1935a, p. 80, fig. 6 (♀, Bachian) [light band of the fore wing extremely wide].

## Type material and synonyms

Neither the description nor the locality, "Habitat in Indiis", given by Linné in 1758 provides any clue as to which species of *Nyctalemon* was originally named *Papilio patroclus*. There is no type in the Linnean collection in London, as appears from the following information kindly forwarded by Mr. D. S. Fletcher: "The type of *Papilio patroclus* Linn. is not in the collection at the Linnean Society in London. The collection contains only one specimen of the genus *Lyssa* and that is not regarded as the type. It does not bear a label in Linnaeus' handwriting, nor is there any other evidence to suggest that it might be the type of *patroclus*."

We should therefore look for the oldest publication in which the name *patroclus* was more exactly defined. This appears to be Linnaeus' "Museum Ludovicae Ulricae", in which the description of *Papilio patroclus* is accompanied by a reference to a figure of Clerck's. Dr. B. Petersen, Uppsala, was so kind as to inform me that the specimen of *Papilio patroclus* is at present missing from the collection of the Museum Ludovicae Ulricae at Uppsala. Fortunately, however, Aurivillius (1882, p. 26) compared the specimen with the original coloured figure of Clerck, which belongs to the library of the Royal Swedish Academy of Sciences, and found them to agree perfectly. On my request Dr. A. Holmberg, Director of this library, was so kind as to procure a colour photograph of Clerck's original pl. 37. The two figures of "*Patroclus*" are fairly rough, but they rather represent a ♀ of the common species from the Moluccas than of any other species of the genus.

Unfortunately, Cramer and other authors used the name *patroclus* to indicate one of the western species of *Nyctalemon*. Although this error was noticed as early as 1856 by Hopffer, and by several authors after him, it has caused confusion in the literature.

The ♀ figured by Cramer is to be considered the type of *Lyssa achillaria* Hübner; it is probably lost. If the name *Lyssa patroclaria* is considered a synonym of *Nyctalemon patroclus* (cf. p. 4), it is based on the same type specimen, viz., the ♀ figured by Clerck.

Judging from the description *Nyctalemon patroclus velutinus* is based on a normal fresh ♂ of this species. Dr. Elli Franz kindly informed me that Röber's types may be in the Dresden Museum.

Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Morotai | A, L | 1 | 63 | 63 | 2 | 2 | 2 | 71-73 | 72.0 | 2.5 | 2.5 |
| Halmahera | A, J, L | 14 | 59-68 | 64.6 | 1.5-2.5 | 2.1 | 8 | 67-74 | 69.4 | 1.5-4 | 2.7 |
| Ternate | J | 1 | 65 | 65 | 1.5 | 1.5 | 1 | 69 | 69 | 4 | 4 |
| Obi | L | | | | | | 1 | 70 | 70 | 4 | 4 |
| Bachian | A, L | 27 | 57-68 | 63.2 | 1.5-3 | 1.8 | 10 | 68-74 | 70.2 | 3-4.5 | 3.4 |
| Gebeh | L | 1 | 64 | 64 | 1.5 | 1.5 | | | | | |
| Buru | A, BM | 2 | 63-65 | 64.0 | 2-2.5 | 2.3 | 2 | 70-75 | 72.5 | 2.5-4 | 3.3 |
| Ceram | A, BM | 4 | 57-69 | 64.5 | 1.5-2.5 | 2.0 | 1 | 77 | 77 | 5.5 | 5.5 |
| Amboina | J, L | 2 | 65-66 | 65.5 | 1.5-2 | 1.8 | 1 | 68 | 68 | 3.5 | 3.5 |
| Saparua | L | 4 | 68-70 | 68.8 | 2-2.5 | 2.3 | 1 | 76 | 76 | 3.5 | 3.5 |
| Kei Is. | L | 1 | 69 | 69 | 1.5 | 1.5 | | | | | |
| Moluccas, all together | A, BM, J, L | 57 | 57-70 | 64.3 | 1.5-3 | 1.9 | 27 | 67-77 | 70.7 | 1.5-5.5 | 3.3 |
| Admiralty Is. | BM | | | | | | 1 | 74 | 74 | 3.5 | 3.5 |
| New Ireland | BM, S | 3 | 67-69 | 67.7 | 1.5 | 1.5 | 2 | 71-75 | 73.0 | 2-2.5 | 2.3 |
| Witu = French Is. | BM | 3 | 64-68 | 65.7 | 2-3 | 2.3 | 1 | 71 | 71 | 2.5 | 2.5 |

The ♂♂ are easily distinguished from those of *N. macleayi*. I saw, however, three ♂♂ with a white band in the fore wing. One of these came from Buru (BM), and is classed with *patroclus* mainly because of its ground colour. The two others, from the Vitu Is., are more puzzling and will be discussed below.

The ♀♀ of *N. patroclus* are more variable and, therefore, sometimes more difficult to identify. Although part of the ♀♀ have more or less vague bands in the fore wings, there also occur ♀♀ with clear white bands, and all possible transitions between these two types. The ♀♀ with clear white bands may be difficult to distinguish from those of *N. macleayi*. In the last mentioned species the white bands have sharper edges, and the ground colour is a darker and plainer brown.

*N. patroclus* evidently is closely related to *N. macleayi* and I am not certain at all whether these two should not be considered subspecies of one species. In that case their coexistence in Gebeh and the Kei Is. might be caused by occasional stragglers of one subspecies reaching the area of distribution of the other. Gebeh more probably belongs to the distributional area of *patroclus* than to that of *macleayi,* but since all but one of the specimens examined from the Kei Is. belong to *macleayi,* it stands to reason that here a straggling ♂ *patroclus* has reached the territory of *macleayi.* If, on the other hand, the two forms actually deserve specific rank, their coexistence in Gebeh and the Kei Is. might indicate an incipient overlapping of the areas of distribution.

The measurements of the specimens from the Admiralty Is., the Vitu Is., and New Ireland have not been considered when computing the means for this species, since there remains some doubt as to the specific identity of those from the two first mentioned archipelagos, whereas the specimens from New Ireland, though certainly belonging to *N. patroclus,* might prove to belong to another subspecies than the populations from the Moluccas.

The ♀ from the Admiralty Is. has a clear white band in the fore wing and, therefore, just is one of those border line cases that are difficult to allot either to this species or to *N. macleayi.*

Of the three ♂♂ from the Vitu Is. one is to be assigned without doubt to *N. patroclus.* A second has the light band in the fore wing whiter than typical *patroclus,* though not so much as the aberrational ♂ from Buru mentioned above. On account of its ground colour it rather matches *patroclus.* The third has the light band as white as *macleayi,* but the ground colour agrees somewhat better with *patroclus.* The ♀ has a white band which is narrower than in *macleayi,* and is matched by some ♀♀ in my series from Bachian. On the whole the series has more affinity to *N. patroclus,* but its purity is questionable. Perhaps the Vitu Is. have a hybrid population, which would be an argument in favour of the subspecific status of *N. macleayi.*

The three ♂♂ from New Ireland are matched by ♂♂ from the Moluccas; the two ♀♀ have slightly vaguer light bands in the fore wings than any vaguely banded ♀ from the Moluccas.

There can be no doubt that in New Ireland a form of *Nyctalemon* occurs that is much nearer to *N. patroclus* than to *N. macleayi.* The present series is, however, too scanty and too badly preserved for me to decide whether it belongs to the same subspecies as the populations from the Moluccas. A second subspecies of *N. patroclus* might very well be distinguished by two characters: vague bands in the fore-wings of the ♀♀, and a slight difference in colour. More and better material is, however, required to prove the existence of such differences.

Pagenstecher (1900, p. 124) already noted that *N. patroclus* occurs in

New Ireland. Although he considered all the forms of this genus to belong to one species, "*N. patroclus*", he acknowledged a "var. *goldiei* Druce = *macleayi* Montrouzier" from "New Guinea, Timor, New Britain, and New Ireland" 1), while he records the typical *patroclus* from New Ireland too. On the same page Pagenstecher records some specimens from three localities in the Gazelle Peninsula, New Britain. Of these at least one (from Lowon near Ralum) might be a *N. patroclus*, while another (from Ralum) might belong to *N. toxopeusi* nov. spec.

### 2a. **Nyctalemon macleayi macleayi** (Montrouzier, 1856)

Plate II fig. 2 (♂ underside); fig. 4 on p. 43 (distribution).

*Urania Mac-Leayi* Montrouzier, 1856, p. 410 (Woodlark Is.).
?*Nyctalemon Patroclus* Oberthür, 1878, p. 468 (Dorey); Lucas, 1880, p. LIII (Dorey, pupa); Pagenstecher, 1895, p. 209 (New Guinea).
*Nyctalemon Patroclus* Pagenstecher, 1886, p. 104 (Aru Is.).
*Chrysiridia macleayi* Westwood, 1879, p. 523.
*Lyssidia goldiei* Druce, 1882, p. 781 (Port Moresby).
?*Nyctalemon patroclus* Swinhoe, 1892, p. 149 [Dorey tantum].
?*Nyctalemon goldiei* Strand, 1912, p. 68 (Tami region, New Guinea).
*Nyctalemon* [*patroclus*] *goldiei* Seitz, [1926], pl. 69b (♂) [good].
? *Nyctalemon patroclus achillaria* Talbot, 1932, p. 254 (Biak).

Type material and synonyms

I do not know whether the types of *Urania macleayi* and *Lyssidia goldiei* still exist. The latter was not found in the collection of the British Museum (Natural History) by Mr. D. S. Fletcher, although the Druce collection entered that Museum with the Joicey collection.

The material examined agrees with the descriptions given by Montrouzier and Druce. It includes specimens from Woodlark Is., the type locality of *macleayi*, as well as from several localities in Papua, among which Aroa River is near Port Moresby, the type locality of *goldiei*.

Variation

On the whole *N. macleayi* is remarkably constant throughout its large area of distribution.

The specimens from Matthias Is. and Vulcan Is. have not been considered when the mean values of the measurements of this subspecies were computed.

The ♂ from Matthias Is. agrees fairly well with the material from New Guinea, but the occurrence of *N. macleayi* in that island is so improbable

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1) Although I saw a ♀ of *N. patroclus* labelled "Nyctalemon / menoetius / Timor / Staudinger 1888" in the Paris Museum, I am not convinced that the genus is really represented in the Lesser Sunda Is. Pagenstecher's "var. *goldiei*" from New Ireland and New Britain might be *N. toxopeusi* nov. spec.

Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gebeh | L | 1 | 62 | 62 | 2.5 | 2.5 | | | | | |
| Kei Is. | A, J, L | 6 | 64-68 | 65.3 | 2-4.5 | 2.8 | 6 | 65-76 | 71.3 | 3-4.5 | 3.8 |
| New Guinea | B, J, L | 2 | 67 | 67.0 | 2.5-3 | 2.8 | 2 | 68-72 | 70.0 | 5 | 5.0 |
| Salawati, Vogelkop, islands in Geelvink Bay | A, BM, J, L | 13 | 58-67 | 63.5 | 2-4 | 2.8 | 13 | 62-74 | 70.6 | 4-5.5 | 4.5 |
| NE. Dutch New Guinea, Ampas | B, BM, L, NY | 12 | 57-67 | 62.5 | 2-4 | 2.8 | 5 | 67-74 | 71.6 | 3.5-4.5 | 4.1 |
| Digul | B | | | | | | 1 | 68 | 68 | 5.5 | 5.5 |
| Papua | BM | 4 | 58-68 | 63.8 | 2-2.5 | 2.3 | 4 | 63-74 | 69.3 | 4-4.5 | 4.3 |
| Kar-Kar | BM | 1 | 67 | 67 | 2.5 | 2.5 | 1 | 68 | 68 | 4.5 | 4.5 |
| Ferguson-Woodlark Is. | BM | 2 | 61-67 | 64.0 | 2.5 | 2.5 | 1 | 74 | 74 | 4 | 4 |
| Woodlark Is. | BM | 1 | 65 | 65 | 3 | 3 | 1 | 72 | 72 | 4.5 | 4.5 |
| all together | A, B, BM, J, L, NY | 42 | 57-68 | 63.8 | 2-4.5 | 2.5 | 34 | 62-76 | 70.7 | 3-5.5 | 4.3 |
| Vulcan Is. | BM | 1 | 59 | 59 | 1.5 | 1.5 | 1 | 60 | 60 | 4 | 4 |
| Matthias Is | BM | 1 | 68 | 68 | 3 | 3 | | | | | |

for biogeographical reasons that more material is required to prove this occurrence.

The ♀ from Vulcan Is. is aberrant inasmuch as it has the band of the fore wing suffused. The ♀ from the same locality is exceptionally small. More material from this island is required to know if a local form has developed.

I saw another ♂ with suffused band in the fore wing in Prof. Roepke's collection at Wageningen. It comes from Julianadorp, which was a settlement in New Guinea, near Hollandia, in 1937. This specimen reminds us of *N. patroclus,* but the ground colour is plainer, and the anterior part of the light band on the underside of the hind wing is more reduced than I ever saw it in *N. patroclus.*

From the Aru Is. I could examine one specimen only, which had to be classed with the subsp. *kotzenbergi.* It seems, however, reasonable to suppose that this giant race developed in the Tenimber Is. because of the isolation of this archipelago from the Sahul shelf. Therefore it seems very improbable for biogeographical reasons that the Aru Is., which lie on the Sahul shelf, would really be inhabited by the same subspecies as the Tenimber Is. and not by the subspecies of New Guinea. Pagenstecher (1886, p. 104) does not say anything about the form from the Aru Is. being a giant variety. Hence these islands have been considered to belong to the area of distribution of the typical subspecies in fig. 4 (p. 43).

### **Nyctalemon macleayi** subsp.?

Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South East Is. | BM | 3 | 56-67 | 61.7 | 3.5-4 | 3.7 | 1 | 71 | 71 | 4.5 | 4.5 |
| Rossel Is. | BM | | | | | | 3 | 76-81 | 77.7 | 4.5-5.5 | 5.2 |

The specimens from the Louisiade Archipelago have high values for mean bw5, and the ♀♀ are exceptionally large. This suggests a remarkable convergence of the forms inhabiting the extreme West and the extreme East of the distributional area of *N. macleayi*, *N. m. kotzenbergi* and the present form respectively. The form from the Tenimber Is. is more spectacular and certainly deserves subspecific rank. More material from the Louisiade Archipelago is needed to prove that this archipelago also has its own subspecies of *N. macleayi*.

### 2b. **Nyctalemon macleayi kotzenbergi** Pfeiffer, 1925

Fig. 4 on p. 43 (distribution).

*Nyctalemon patroclus* ab. *kotzenbergi* Pfeiffer, 1925, p. 128 (Tenimber Is.).
*Nyctalemon* [*patroclus*] *kotzenbergi* Seitz [1926], pl. 69a [good]

Type material

The types, ♂ ♀, of this subspecies are in the Senckenberg Museum, Frankfurt am Main.

Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tenimber Is. | A, BM, J | 12 | 67-72 | 69.8 | 4-5 | 4.4 | 15 | 62-81 | 76.4 | 5-6.5 | 5.8 |
| Aru Is. | L | | | | | | 1 | 83 | 83 | 6.5 | 6.5 |

For the reasons pointed out above, I doubt whether the locality of a specimen in the Leiden Museum, labelled "H. J. Gilhuijs / Aroe / don. 1902", is correct.

### 3. **Nyctalemon toxopeusi** nov. spec.

Plate II figs. 1, 3, 4 (♀ upperside, ♂ under- and upperside); fig. 5 on p. 44 (distribution).

?*Nyctalemon Patroclus* Oberthür, 1878, p. 468 (Dorey); Lucas, 1880, p. LIII (Dorey, pupa); Pagenstecher, 1895, p. 209 (New Guinea).
*Nyctalemon Patroclus* Snellen, 1889, p. 397 (Roon Is.).
?*Nyctalemon patroclus* Swinhoe, 1892, p. 149 [Dorey tantum]; Pagenstecher, 1900, p. 123 [partim: New Ireland, New Britain].
?*Nyctalemon goldiei* Strand, 1912, p. 68 (Tami region, New Guinea).
? *Nyctalemon patroclus achillaria* Talbot, 1932, p. 254 (Biak).

## Type material

Holotype: ♂, Hollandia, New Guinea, 29 VI 1938, L. J. Toxopeus leg. (3rd Archbold Expedition) (L).

Allotype: ♀, Hollandia, New Guinea, 15 VII 1938, L. J. Toxopeus leg. (3rd Archbold Expedition) (L).

Paratypes: ♂, Amboina, 1912, D. den Hengst leg. (L). ♀, Bachian, Van der Weele leg. (L). ♂, Fakfak, New Guinea, Palmer van den Broek leg. (L). 2 ♂♂, Windesi, New Guinea (J). ♂, Meos Wai [recte Waar], Van den Bergh collection (A). ♀, Roon Is., Netscher leg. (L, recorded by Snellen, 1887). ♂, "Papouasie, côte entre B. Geelvinck et B. Humboldt, 4e trim. 1896", from Oberthür collection (BM). ♂, Meervlakte, New Guinea, VIII 1926, W. M. Docters van Leeuwen leg. (B). 7 ♂♂, Hollandia, New Guinea, 30 VI-15 VII 1938, L. J. Toxopeus leg. (3rd Archbold Expedition) (B, L, NY). 2 ♂♂, Hollandia, in the beginning of 1952, P. van Gurp leg. et don. (L). 2 ♂♂, Ampas, S. Bewani Hills, 20 XI 1939, W. Stüber leg., L. J. Toxopeus don. (3rd Archbold Expedition) (B, L). ♂, ? Ampas, S. Bewani Hills, 17 XI 1939, W. Stüber leg., L. J. Toxopeus don. (3rd Archbold Expedition) (B). ♂, New Britain (BM). ♂, New Britain (G). ♀, New Britain (P). ♀, New Ireland, IV 1878, Dr. Gerlach (S). ♂, New Guinea, Hann leg., 1900 (S). ♂, ?, (B).

## Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amboina | L | 1 | 66 | 66 | 3 | 3 | | | | | |
| Bachian | L | | | | | | 1 | 73 | 73 | 4 | 4 |
| NW. Dutch New Guinea | A, J, L | 4 | 67-68 | 67.8 | 3-4 | 3.8 | 1 | 74 | 74 | 4 | 4 |
| N. New Guinea | B, BM, L, NY | 13 | 61-68 | 65.4 | 3-4 | 3.5 | 1 | 70 | 70 | 5 | 5 |
| New Guinea | S | 1 | 65 | 65 | 3 | 3 | | | | | |
| New Britain | BM, G, P | 2 | 69 | 69 | 4.5-5.5 | 4.0 | 1 | 76 | 76 | 5 | 5 |
| New Ireland | S | | | | | | 1 | 73 | 73 | 5.5- | 5.5 |
| ? | B | 1 | 70 | 70 | 3.5 | 3.5 | | | | | |
| all together | A, B, BM, J, L, NY, S | 22 | 61-70 | 66.4 | 3-5.5 | 3.6 | 5 | 70-76 | 73.2 | 4-5.5 | 4.7 |

## Description

♂ upperside. Fore wings dark brown, with a slightly lighter elongated triangular area submarginally. Area between costa and radius almost black, crossed by white lines of varying width, but always narrower than the interspaces. Proximal part of the wing between the radial and anal veins with a lighter ground colour, but checkered with fine linear almost black dots. The light band is white, more or less sigmoid, originating well beyond the middle of the costa and gradually tapering before ending in the inner margin near the tornus. Hind wings of about the same colour as the primaries, lighter along the costa and submarginally, with dark markings along the outer margin and at the tornus. A yellowish brown band originates well beyond the middle of the costa, runs about parallel to the outer margin, bends inward near the tornus, and ends in the inner margin. The outer margin protrudes at the ends of veins 4, 6, 7 and 8; the tips of these protrusions (that of vein 4 is the tail) are white.

Underside. Ground colour of both wings light brown, finely dotted in the proximal part, and with coarser dots submarginally. There are some large dots and dark streaks along the outer margin and near the tornus of the hind wings. In the hind wings the proximal and marginal dotted areas are connected by series of dots along the costa and along the inner margin only, and not by a series of dots crossing the white band between veins 4 and 5. At most, some sparse dots occur in the area crossed by the white band between veins 2 and 6.

♀ somewhat larger than the ♂, the ground colour on both sides lighter, and the light bands of both wings wider.

*N. toxopeusi* is related to *N. patroclus, N. macleayi,* and *N. mutatus.* From *N. patroclus* it is distinguished by the light band in the fore wing of the ♂, by the larger and more conspicuous dotted area in the proximal part of the upperside of the fore wing, and by the pattern of the underside of the hind wing; from *N. macleayi* by the larger and more conspicuous dotted area in the proximal part of the upperside of the fore wing, and by the pattern of the underside of the hind wing; from *N. mutatus* var. *fletcheri* by the position of the light band of the hind wing, by the larger and more conspicuous dotted area in the proximal part of the upperside of the fore wing, and by the pattern of the underside of the hind wing; from *N. mutatus* by the position of the light band of the hind wing, by the finer dots in the proximal part of both wings, and by the absence of a conspicuous purple gloss.

*N. toxopeusi* agrees with *N. patroclus* as to the position of the light band in the hind wing, with *N. macleayi* in the same respect, by the dark ground colour, and by the white bands in the fore wings of both sexes, with *N. mutatus* var. *fletcheri* by the sigmoid shape of the light band in the fore wing, and with *N. mutatus* by this same feature and by the pattern of the underside of the hind wing.

The strongest affinities seem to be with *N. macleayi* and *N. mutatus.*

This new species is dedicated to the late Prof. Dr. L. J. Toxopeus of Bandung, Java.

In my preliminary paper I recognised the two ♂♂ from New Britain only as representing an undescribed form. They strike the eye at once by their extremely wide white bands in the fore wings. Later I noticed that some more specimens of the same form had been regarded as more or less aberrant specimens of *N. patroclus* and *N. macleayi,* and that a series was present among the unprepared material of the third Archbold Expedition.

## 4a. **Nyctalemon mutatus** (Butler, 1887)

Plate III figs. 1, 2, 4 (♂♂ upperside, ♂ underside); fig. 4 on p. 43 (distribution).

*Lyssidia mutata* Butler, 1887, p. 241 (Alu) [♂ tantum].

*Nyctalemon ulysses* Pfeiffer, 1925, p. 130 ("Gross-Key"); Seitz, [1926], pl. 71a (♂) [good, but purple gloss missing].

*Lyssidia achillaria* Carpenter, 1937, p. 234 (Tulagi, attacked by *Leucocirca leucophrys melaleuca* (Q. & G.), a flycatcher); Lever, 1943, p. 40.

*Nyctalemon ? patroclus mutata* Carpenter, 1937, p. 235 (Tulagi, probably attacked by *Halcyon* spec., a kingfisher).

### Type material and synonyms

The type of *mutatus,* a ♂, is in the British Museum (Natural History), London. Mr. D. S. Fletcher was so kind as to confirm my supposition that the purple form with coarse dots and generally a concave band in the hind wing is the typical one.

The type of *ulysses,* a ♂ too, is in the Senckenberg Museum, Frankfurt am Main. In the description no mention is made of the characteristic purple gloss, which is lacking also in Seitz' figure. In all other respects, however, the ♂♂ examined match Pfeiffer's description and the figure by Seitz. Since all the specimens of *Nyctalemon* from the Kei Is. which I could examine are very different from *ulysses,* the type locality given by Pfeiffer is most probably erroneous.

Prof. G. C. Varley, Oxford, was so kind as to send me for examination the specimens collected by Lever and commented upon by Hale Carpenter. Though they are mentioned under two names, they all doubtlessly belong to the typical form of this species.

### Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Choiseul | BM | 1 | 69 | 69 | 1.5 | 1.5 | | | | | |
| Gizo Is. | BM | 2 | 65-67 | 66.0 | 1.5-2 | 1.8 | | | | | |
| Florida Is. | BM | 3 | 66-68 | 67.0 | 2-3 | 2.3 | | | | | |
| Solomon Is. | BM | 1 | 65 | 65 | 1.5 | 1.5 | 1 | 69 | 69 | 2.5 | 2.5 |
| all together | BM | 7 | 65-69 | 66.7 | 1.5-3 | 1.9 | 1 | 69 | 60 | 2.5 | 2.5 |

In the ♂♂ the light band of the fore wing is white, or more or less suffused, in the latter case it shows a tendency to be divided into spots by the nervures. In the only ♀ examined this band is white with vague edges.

## 4b. **Nyctalemon mutatus** (Butler, 1887) var. **fletcheri** nov. var.

Plate III figs. 3, 5, 6 (♂ under- and upperside, ♀ upperside); fig. 4 on p. 43 (distribution).

*Lyssidia mutata* Butler, 1887, p. 241 (Alu) [♀ tantum].

*Nyctalemon [patroclus] mutata* Seitz [1926], pl. 71a (♂) [good].

### Type material

Holotype, ♂, and allotype ♀: Bougainville, from A. J. Buis collection (A).

Paratypes: ♀, Harawa, N. Bougainville, 1907—1908, from Oberthür collection. ♀, Alu. ♂, Florida Is., 1901, Meek ex Janson, from Oberthür collection. ♂, Gizo Is., 1903, from Oberthür collection. ♂, Solomon Is., Crowley bequest (all BM).

### Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bougainville | A, BM | 1 | 66 | 66 | 2 | 2 | 2 | 70-76 | 73.0 | 3-4 | 3.5 |
| Alu | BM | | | | | | 1 | 69 | 69 | 3.5 | 3.5 |
| Gizo Is. | BM | 1 | 72 | 72 | 1.5 | 1.5 | | | | | |
| Florida Is. | BM | 1 | 70 | 70 | 2.5 | 2.5 | | | | | |
| all together | A, BM | 3 | 66-72 | 69.3 | 1.5-2.5 | 2.0 | 3 | 69-76 | 71.7 | 3.5-4 | 3.7 |

### Description

This new variety is distinguished from the typical *N. mutatus* by the light band of the hind wing being always straight or practically straight, by the dark dots in the proximal area of the upperside of the fore wing and in the proximal areas of the underside of both wings being smaller and more numerous, by the absence of an obvious purple gloss in the ♂, and by the pattern of the underside of the hind wing being of the type found in *N. patroclus*, while in the typical form it is rather of the type found in *N. toxopeusi*.

The light band of the fore wing is white or suffused in the ♂♂, in the two ♀♀ examined it is white.

The true taxonomic status of this form is uncertain; it has provisionally been described as a variety. Future investigations might prove it to be a second species from the Solomon Is.

| locality | typical form | variety |
|---|---|---|
| Bougainville | — | + |
| Alu | + | + |
| Choiseul | + | — |
| Ranonga | — | + |
| Gizo Is. | + | + |
| Tulagi | + | — |
| Florida Is. | + | + |
| Guadalcanar | — | + |
| Bugotu 1) | — | + |

The two forms probably occur throughout the archipelago. Mr. D. S. Fletcher kindly checked the remaining specimens in the collection of the

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1) This locality was not indicated on the maps at my disposal. The others are arranged from W. to E.

British Museum. With these additional data the preceding table of the known distribution of the two forms could be drawn up.

I take great pleasure in dedicating this new form to Mr. D. S. Fletcher, who provided me with a great number of data, mainly of specimens in the British Museum (Natural History), without which it would have been impossible for me to discuss in detail the systematics of the genus *Nyctalemon.*

## 5. **Nyctalemon curvatus** Skinner, 1903

*Nyctalemon curvata* Skinner, 1903, p. 298, pl. 13 (♂, New Hebrides, Tonga off Santo) [good]; Seitz, [1926], pl. 71a (♂) [good].

### Type material

Two syntypes, ♂♂, of this species are stated to be in the Academy of Natural Sciences at Philadelphia.

### Measurements

| locality | collection | ♂♂ | wl | mean | bw5 | mean | ♀♀ | wl | mean | bw5 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| New Hebrides | BM | 2 | 62 | 62.0 | 3 | 3.0 | 2 | 66-67 | 66.5 | 3.5-5 | 4.3 |

The ♀ differs in the following points from the ♂. The colour of the upperside is lighter, and the light bands on the fore wings are a little wider. The underside is also lighter, with brighter white bands, and a larger white patch at the apex of the fore wings.

The specimens of the British Museum collection which I examined came from Efate Is. and Mallicoba.

## 6a. **Nyctalemon menoetius celebensis** subsp. nov.

Plate I fig. 2 (♂ genitalia); Plate IV figs. 1, 2 (♂ ♀ upperside); fig. 6 on p. 44 (distribution).

?*Nyctalemon Menoetius* Hopffer, 1874, p. 47 (♂, N. Celebes).
*Nyctalemon patroclus* Nieuwenhuis, 1946, p. 60 (Sambiut, Banggaai Is.) [♀ tantum].

### Type material

Holotype, ♂, and allotype, ♀ : N. Celebes, 1912, P. J. van den Bergh Lzn. coll. (A). Paratypes: ♂ ♀, N. Celebes, 1912, P. J. van den Bergh Lzn. coll. (L.). ♀, Tondano; 2 ♀ ♀, Minahassa; 2 ♀ ♀, Minahassa, 1920, all P. J. van den Bergh Lzn. coll. (A). ♂, C. Celebes, Luwu, Masamba, N. Tomoni, Kalaena, 4 III 1941, L. L. A. Maurenbrecher leg. (B). ♀, Sambiut, Banggaai Is., 10 VI 1933, J. D. van den Bergh leg., E. J. Nieuwenhuis don. (L).

### Measurements

| locality | collection | number | sex | wl | mean | bw3/4 | mean | 100a/b | mean |
|---|---|---|---|---|---|---|---|---|---|
| N. and C. Celebes | A, B, L | 3 | ♂ | 60-61 | 60.7 | 6-7 | 6.3 | 69-72 | 71.0 |
| | | 8 | ♀ | 59-64 | 61.4 | 13-18 | 15.3 | 73-76 | 74.5 |

This new subspecies is distinguished from those occurring in the Philippine Is. and Borneo by its smaller size, and by the light band of the fore wing ending relatively nearer the tornus. Both characters appear from a comparison of the tables of measurements given for the three subspecies. The colour is about the same as that of the typical subspecies, but the ♂♂ of *celebensis* are slightly darker brown than those of *menoetius*.

In N. Celebes and the Banggaai Is. this form was captured in the same localities as *N. zampa dilutus*.

### 6b. **Nyctalemon menoetius menoetius** Hopffer, 1856

Fig. 6 on p. 44 (distribution).

*Nyctalemon Menoetius* Hopffer, 1856, p. 2 [references excluded], pl. 3 fig. 1 (Manilla) [♂, good]; Boisduval, 1874, p. 45; Pagenstecher, 1890, p. 24 (Palawan) [part of the references excluded].

*Nyctalemon hector* Walker, 1856, p. 1771 (Borneo).

*Nyctalemon longicaudus* Schaufuss, 1870, p. 13 (Manila).

*Lyssidia hector* Westwood, 1879, p. 526.

*Lyssa Menoetius* Aurivillius, 1882, p. 26 [partim].

*Nyctalemon menoetius* Semper, 1896-1902, p. 598 (1901), pl. 63 fig. 2 (♀, Mindanao) [excellent]; Seitz, [1926], pl. 70a ♂ [♀, good].

*Nyctalemon* [*menoetius*] *zampa* Seitz [1926], pl. 70a ♂ [tantum, good].

*Nyctalemon menoetius* ab. *albiapicalis* Pfeiffer, 1925, p. 130 (Manila).

#### Type material and synonyms

The ♂ figured by Hopffer, which I consider the type of this species, presumably still is in the Zoological Museum of the University of Berlin.

The type of *hector,* also a ♂, is in the British Museum (Natural History), London. Mr. Fletcher informs me that it is labelled simply "Borneo" and comes from a collection sent from Sarawak to England in 1855-1856 by a Captain Brooke. It is matched by ♂♂ from British N. Borneo but differs from those of E. Borneo.

I do not know whether the type of *N. longicauda* still exists.

The type of of the ab. *albiapicalis* is in the Senckenberg Museum, Frankfurt am Main.

Both *menoetius* and *hector* were described in 1856. The introduction to Walker's publication is dated May 1st 1856, but my search for additional information as to the exact date of publication of the two descriptions was in vain. The name *menoetius* has been chosen here, because those authors who synonymised *hector* with *menoetius* used the latter name.

#### Variation

The series from N. Borneo is of a somewhat darker, more greyish brown colour than the specimens examined from the Philippine Is. My material is, however, quite insufficient to prove a subspecific difference between the form flying in N. Borneo and that from the Philippine Is.

### Measurements

| locality | collection | number | sex | wl | mean | bw3/4 | mean | 100a/b | mean |
|---|---|---|---|---|---|---|---|---|---|
| Philippine Is., | A, BM, S, P | 3 | ♂ | 67-69 | 68.0 | 8-9 | 8.7 | 62-67 | 64.0 |
| Sangir | | 4 | ♀ | 61-72 | 68.0 | 12-19 | 15.5 | 60-66 | 63.8 |
| N. Borneo | BM, S | 4 | ♂ | 65-67 | 65.8 | 6-11 | 8.5 | 62-64 | 62.5 |
| | | 3 | ♀ | 69 | 69.0 | 12 | 12.0 | 63 | 63.0 |
| all together | A, BM, S | 7 | ♂ | 65-69 | 66.7 | 6-11 | 8.6 | 62-67 | 63.1 |
| | | 7 | ♀ | 61-72 | 68.4 | 12-19 | 14.0 | 60-66 | 63.4 |

Two ♀♀, from Luzon (S), and from Sangir (A), agree with Pfeiffer's ab. *albiapicalis*.

## 6c. **Nyctalemon menoetius adspersus** nov. subsp.

Plate IV fig. 3 (♂ upperside); fig. 6 on p. 44 (distribution).

*Urania Patroclus* VerHuell, 1858, p. 132 (off Borneo, in Strait of Macassar).

### Type material

Holotype: ♂, Kariorang (near Sangkulirang), E. Borneo, 24 I 1937, Quarles de Quarles leg. (W).

Allotype: ♀, Kariorang, E. Borneo, 2 I 1937, Quarles de Quarles leg. (W).

Paratypes: 3 ♂♂, 5 ♀♀, Kariorang, 12-24 I 1937; 2 ♀♀, Sangkulirang, 17 IX, 9 XI 1936; ♂, Samarinda; ♀, Samarinda, 24 X 1935; ♂, ?; ♀, 1 I 1937; all E. Borneo, Quarles de Quarles leg. (W). ♀, Kariorang (near Sangkulirang), 15 I 1937; ♂, Samarinda, 16 XI 1935; both E. Borneo, Quarles de Quarles leg., W. Roepke don.; ♀, Mahakkam, 1894, Dr. Nieuwenhuis leg.; ♂, Central E. Borneo, 1925, H. C. Siebers leg.; ♂, E. Borneo; ♀, Batang Alar Kendengan, SE. Borneo, Van Weert leg.; ♂, Borneo, Stdl. leg. (L). ♂ ♀, Longhut, Central E. Borneo, 21 VIII 1925, H. C. Siebers leg. (B). ♂, Balik Papan, E. Borneo, 1914; ♂, Strait of Makassar, 1927, Mörzer Bruyns leg. (A). ♂ ♀, Balik Papan, E. Borneo, in collection Ir. M. Hardonk, The Hague. ♀, S. Borneo (P). ♂, Borneo, ex coll. De Joannis (P). ♂, Borneo (S).

### Measurements

| locality | collection | number | sex | wl | mean | bw3/4 | mean | 100a/b | mean |
|---|---|---|---|---|---|---|---|---|---|
| E. and S. Borneo, Str. of Macassar | A, B, L, W | 13 | ♂ | 60-68 | 64.8 | 5-7 | 5.7 | 62-68 | 64.2 |
| | | 15 | ♀ | 60-73 | 67.6 | 10-14 | 12.5 | 63-68 | 65.2 |

This new subspecies is distinguished from the typical *N. m. menoetius* by the ♂♂ having narrower and suffused light bands in the fore wings. The series of ♂♂ examined is a little darker than the ♂♂ from N. Borneo. Their colour hardly differs from that of fresh *N. zampa docilis*, but they seem to be less susceptible to discoloration.

I cannot distinguish the ♀♀ from those of *N. m. menoetius*, especially from the ♀♀ from N. Borneo.

### 7a. **Nyctalemon zampa docilis** Godman, Salvin & Druce, 1878

Plate 1 fig. 4 (♀ genitalia); fig. 7 on p. 45 (distribution).

*Nyctalemon docile* Butler, 1877, p. 197 (Malacca) [nomen nudum]; Godman, Salvin & Druce, 1878, p. 642 (Billiton); Butler, 1879a, p. 562; Swinhoe, 1892, p. 150 (Sumatra, Penang, Singapore).

*Lyssidia docilis* Westwood, 1879, p. 527.

*Nyctalemon Patroclus* Weymer, 1885, p. 279 (Nias); Snellen, 1890, p. 309 (Billiton); 1895, p. 146 (Deli).

*Nyctalemon Menoetius* Pagenstecher, 1885, p. 44 (Nias) [part of synonymy excluded].

*Nyctalemon patroclus* v. *crameri* Jurriaanse & Lindemans, 1919, p. 38 (Tukang Besi Archipelago ?).

*Nyctalemon patroclus* Corbett & Dover, 1927, p. 409 (Malaya, damage to the "Malay Apple", *Eugenia malaccensis*); Hagen, 1890, p. 225 (Deli).

*Lyssidia achillaria* Corbett & Dover, 1927, p. 409 (Malaya, damage to the "Malay Apple", *Eugenia malaccensis*).

*Nyctalemon menoetius* Gaede, 1932, p. 60 (Sumatra); 1933, p. 1 (Kuala Lumpur).

*Nyctalemon menoetius deliensis* Van der Meer Mohr, 1933, p. 60, figs. 1, 2 (Medan, on light) [♂, good].

*Nyctalemon patroclus deliensis* Roepke, 1935b, p. 8 (Medan, on light).

*Nyctalemon* Van der Meer Mohr, 1940, p. 150 (Sibolangit and other localities, on light).

#### Type material and synonyms

In his Butterflies of Malacca of 1877 Butler only says about this species: "*Nyctalemon docile,* male and female, a local representative of *N. hector.*" The last sentence seems too vague to be an indication in the sense of art. 25 of the International Rules of Zoological Nomenclature. Therefore the first valid description of "*Nyctalemon docile*" is that given by Godman, Salvin & Druce, although the name is generally attributed to Butler.

In this description *docilis* is said to differ from *N. hector* Walker in three characters: by larger size, broader white bands, and longer tails. The first and last characters were also mentioned by Butler in his detailed description of 1879, which leaves no doubt that the present form is referred to. Concerning the white bands Butler says just the opposite of Godman, Salvin & Druce. The only form of *Nyctalemon* flying in Billiton agrees with that from Malaya in having the white bands narrower than *hector* Walker. The two other characters given by Godman, Salvin & Druce may appear right when comparing certain specimens from Billiton with certain specimens of *hector,* but they are by no means characteristic of the present form. Therefore, the first valid description of this subspecies is quite unsatisfactory. As, on the other hand, the reference to Butler's unpublished description makes it practically certain that the Billiton material was named after comparison with the specimens later described by Butler, and no second form of *Nyctalemon* occurs in Billiton, there can be no doubt that the present form was described by Godman, Salvin and Druce.

Unfortunately, Mr. Fletcher looked in vain for the type of this subspecies in the British Museum, though it must have entered this institution with the Joicey collection, of which the Druce collection formed part.

I examined the specimen that Jurriaanse & Lindemans record with some doubt from the Tukang Besi Archipelago as *Nyctalemon patroclus* v. *crameri*. It certainly is a ♀ of the present subspecies and consequently the locality must be wrong.

Corbett & Dover recorded insects injurious to the "Malay apple" in Malaya under the names *Nyctalemon patroclus* L. and *Lyssidia achillaria* Hub. Mr. H. T. Pagden, Senior Entomologist of the Department of Agriculture at Kuala Lumpur, kindly informed me that he was convinced that the specimens labelled with these names in the collection of his institution belonged to the same species. When I sent him sketches showing the main characters of: (1) a *Nyctalemon* of the *patroclus*-group (2) *N. menoetius*, and (3) *N. zampa*, he readily identified his species with *N. zampa*.

He was also so kind as to examine paintings of the larvae described by Corbett & Dover, and, although unfortunately the so-called *patroclus* is a dorsal, and the so-called *achillaria* a lateral view, in his opinion they are the same species of different ages. Formally "*Nyctalemon patroclus*" and "*Lyssidia achillaria*" are synonyms for a species occurring in the Moluccas and the Bismarck Archipelago. There can be no doubt, however, that these

Measurements

| locality | collection | ♂♂ | wl | mean | bw3/4 | mean | ♀♀ | wl | mean | bw3/4 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Simalur | A, J, L | 4 | 61-64 | 63.0 | 6-9 | 7.5 | 7 | 58-73 | 65.7 | 5-7 | 6.0 |
| Nias | L, S | | | | | | 2 | 73-76 | 74.5 | 4-6 | 5.0 |
| Engano | A, J, L | 8 | 53-63 | 58.1 | 6-10 | 7.5 | 3 | 64-65 | 64.7 | 6-8 | 7.3 |
| Pulu Weh, N. Sumatra | B, L | 3 | 65-67 | 66.0 | 6-8 | 7.0 | 1 | 71 | 71 | 5 | 5 |
| E. coast Sumatra (S.O.K.) | A, L | 8 | 57-67 | 62.1 | 5-11 | 7.4 | 5 | 70-78 | 73.2 | 5-6 | 5.4 |
| W. & C. Sumatra | A, L | 7 | 61-67 | 64.4 | 5-7 | 6.3 | 2 | 69-73 | 71.0 | 7 | 7.0 |
| Singapore, Rhio arch., etc. | A, B, L | 6 | 55-66 | 62.7 | 6-8 | 7.0 | 4 | 61-73 | 67.5 | 6-8 | 7.3 |
| S. Sumatra | A, B, J, L | 5 | 60-65 | 62.8 | 6-8 | 6.6 | 6 | 57-75 | 67.7 | 4-8 | 6.3 |
| Billiton | L | 4 | 55-68 | 61.5 | 7-8 | 7.3 | 7 | 56-77 | 66.1 | 7-9 | 7.6 |
| W. Java | B, L | 10 | 59-68 | 64.3 | 5-7 | 6.3 | 3 | 67-77 | 71.3 | 4-7 | 6.0 |
| Karimon Djawa Is. | L | | | | | | 1 | 73 | 73 | 6 | 6 |
| W. Borneo | A | 2 | 63-67 | 65.0 | 6 | 6.0 | | | | | |
| all together | A, B, J, L, S | 57 | 53-68 | 62.7 | 5-11 | 6.9 | 41 | 56-78 | 68.5 | 4-9 | 6.4 |

names were wrongly attributed to their specimens by Corbett & Dover, and that they actually reared *Nyctalemon zampa docilis*.

Mr. J. C. van der Meer Mohr kindly informed me that the type material of his *N. menoetius deliensis* was lost during the Japanese occupation of Sumatra.

Variation

This subspecies is distinguished from the typical *zampa* Butl. by its wider bands in the fore wings. These bands are composed of white and yellowish or light brown scales. In most specimens of *docilis* the white scales dominate. I examined only three specimens, 1 ♂ and 1 ♀ from Java, and 1 ♂ from Sumatra (bw3/4: 5, 4, and 5 respectively) in which the opposite was the case, which gives these bands a suffused appearance. Fresh specimens of *docilis* are coloured dark grey, museum specimens brown, and somewhat lighter.

This is the only subspecies of which I could examine a large number of specimens. Nevertheless I could find no indication of clinal variation within the subspecies of those characters of which the variation was studied.

The series from Engano is distinguished by the low figure for mean wl in both sexes. When this series is left out of consideration, the mean wl for *N. zampa docilis* ♂ is 63.4 (from 49 ♂♂) and for *N. zampa docilis* ♀ 68.8 (from 38 ♀♀), which probably are more representative figures of this subspecies.

### 7b. **Nyctalemon zampa zampa** Butler, 1869

Plate 1 fig. 3 (♂ genitalia); fig. 7 on p. 45 (distribution).

...... Seba, 1765, pl. 47 figs. 13, 14 ("America") [♀]; [Bonnaterre], 1797 [?], pl. 8 fig. 1 [copy of Cramer's fig.].

"La chauve-souris de la Chine" D'Aubenton, 1765, pl. 17 (China) [non vidi].

*Patroclus* Drury, 1770, pp. 14, 16, index p. 1, pl. 7 fig. 1, pl. 8 fig. 1 (China) [♀]; Cramer, 1779, p. 19 [part of references excluded], pl. 109 figs. A, B (China) [♂, poor figure: light bands on fore wings too wide for *zampa*, on the other hand not white as in *docilis*].

*Papilio Patroclus* Herbst, 1790, pp. III, 14 [partim], pl. 54 figs. 2, 3 (China) [♂, evidently a copy of Cramer's fig.]; [Guérin], 1818, p. 2.

*Lyssa Patroclaria* Hübner, 1816[-1826], p. 289 [1823, partim].

*Nyctalemon patroclus* Westwood, 1837, p. 13 [partim], pl. 7 fig. 1, pl. 8 fig. 1 [♀, same fig. as Drury's]; Horsfield & Moore, 1857, p. 256 (Sylhet) [part of synonymy excluded]; Hampson, 1895, p. 111 [partim], fig. 57 [good].

*Nyctalemon Patroclus* Walker, 1854, p. 8 (Sylhet) [part of synonymy excluded]; Guenée, 1857, p. 15 [partim].

*Ph. patroclus* B[lyth], 1854, p. 217 (China, Assam, Sylhet, Arakan, Burma).

*Nyctalemon Zampa* Butler, 1869, p. 273 (♂, Sylhet; ♀, ?); Preiss, 1888, p. 6, pl. 8 fig. 1 (♀, "E. Indies") [good].

*Nyctalemon Crameri* Boisduval, 1874, p. 44 (la Chine, la Cochin Chine et quelques autres parties du continent indien).

*Lyssidia menoetius* Westwood, 1879, p. 526 [part of synonymy excluded].
*Lyssa Menoetius* Aurivillius, 1882, p. 26 [partim].
*Nyctalemon zampa* Moore, 1884, p. 234 (Cachar); Cotes & Swinhoe, 1888, p. 463 (Sylhet, Assam); Swinhoe, 1892, p. 149 (India).
*Nyctalaemon patroclus* Imms, 1925, fig. 438 (♂, after Hampson); 1951, fig. 452 (id.).
*Nyctalemon* (*menoetius*) *zampa* Seitz, [1926], pl. 70a ♀ U [tantum].
?*Lyssidia zampa* Nicholson, 1932, p. 187 (specimen hatched from cocoon found near Mt. Edgcumbe, Cornwall, England).

### Type material and synonyms

The name *patroclaria* is not available for the present species, because it was not proposed as a new name by Hübner, but is an emendation of *patroclus*, as explained on p. 4.

The type of *Nyctalemon zampa* Moore, a ♂, is in the British Museum (Natural History), London.

This Museum also possesses a ♂ bearing a label: "N. Crameri / Bdv. / Monog. Agaristidées / Cramer 109 Ab. / Patroclus Gn." in Boisduval's handwriting, and a second: "Ex musaeo Dris. Boisduval". The fore wing length of that specimen is 65, and bw3/4: 6. The latter figure is higher than I ever found it in continental specimens of *zampa*, and Mr. D. S. Fletcher informs me that this specimen agrees with the Philippine series of *zampa* in the British Museum rather than with continental specimens. Since there is no proof that this insect was among the specimens on which Boisduval founded *crameri*, and no specimens matching it are known from the type locality, this specimen cannot be designated as the lectotype of *crameri*.

### Measurements

| collection | locality | ♂♂ | wl | mean | bw3/4 | mean | ♀♀ | wl | mean | bw3/4 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Assam | J, S | 3 | 63-66 | 64.3 | 4-5 | 4.3 | 3 | 73-74 | 73.3 | 3-5 | 4.3 |
| Tonkin | P | | | | | | 2 | 70-75 | 72.5 | 3 | 3 |
| Cochin-China | BM | 3 | 67-70 | 69.0 | 4 | 4.0 | 1 | 74- | 74 | 3 | 3 |
| Hongkong | BM | | | | | | 1 | 70 | 70 | 4 | 4 |
| Hainan | BM | 4 | 63-68 | 66.5 | 4-5 | 4.5 | 2 | 73-74 | 73.5 | 4-5 | 4.5 |
| all together | BM, J, P, S | 10 | 63-70 | 66.6 | 4-5 | 4.3 | 9 | 70-75 | 72.9 | 3-5 | 3.9 |

In the typical continental specimens of this subspecies the bands in the fore wings are distinctly narrower than in *N. z. docilis*, and have a suffused appearance. I examined only one continental specimen in which the white scales dominate in these bands: a ♀ from Khasia Hills, Assam, bw3/4: 5. In two of the four specimens from Hainan, however, white scales dominate in the light bands of the fore wings.

The Indian specimens examined are greyish brown, and so are those from Cochin China. The others have a colour pattern of various shades of brown.

## 7c. **Nyctalemon zampa najabula** Moore, 1877

Fig. 7 on p. 45 (distribution).

*Nyctalemon najabula* Moore, 1877, p. 620 (S. Andamans, Port Blair); Cotes & Swinhoe, 1888, p. 463.

*Lyssidia najabula* Westwood, 1879, p. 526.

*Nyctalemon* [*menoetius*] *najabula* Seitz, [1926], pl. 69b (♀) [good].

### Type material

The type of this subspecies, a ♂, is in the British Museum (Natural History), London.

### Measurements

| locality | collection | ♂♂ | wl | mean | bw3/4 | mean | ♀♀ | wl | mean | bw3/4 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Andaman Is. | J, L | 2 | 56-63 | 59.5 | 3 | 3.0 | 1 | 69 | 69 | 4 | 4 |

As pointed out above (p. 8) Moore's statement that this form is of "a much darker fuliginous brown colour" than typical *zampa* and *docilis* does not hold true. Hence the subspecies is characterised by its small size and narrow light bands in the primaries only. My few measurements are insufficient to prove this difference, but, as I saw three more ♀♀ in the Copenhagen Museum showing the same characters, and the ♀ figured by Seitz also agrees with the ♀♀ examined, I believe that *najabula* is a distinct subspecies.

## 7d. **Nyctalemon zampa** subsp. ?

Fig. 7 on p. 45 (distribution).

*Nyctalemon zampa* Semper, 1896-1902, p. 597 (1901) [partim], pl. 63 fig. 1 (♀, Mindanao) [excellent].

### Measurements

| locality | collection | ♂♂ | wl | mean | bw3/4 | mean | ♀♀ | wl | mean | bw3/4 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Philippine Is. | BM, L, S, P | 8 | 49-70 | 64.1 | 4-7 | 4.9 | 5 | 68-71 | 69.6 | 4-9 | 5.8 |

This is probably a good subspecies, but my material is insufficient to characterize it. As to the light band in the fore wing it seems nearer to *zampa* than to *docilis*. The colour, and the sharply delimited bands on the underside of the wings of the ♀♀ point to a close affinity to *dilutus*.

## 7e. **Nyctalemon zampa dilutus** Röber, 1927

Plate 4 figs. 4, 5 (♀ ♂ upperside); fig. 7 on p. 45 (distribution).

?*Nyctalemon Patroclus* Kühn, 1887, p. 183, pl. 6 fig. 9a-c (larva et pupa, Tombugu, E. Celebes).

*Nyctalemon patroclus* Hampson, 1895, fig. 56 on p. 110 (larva, copy of Kühn's figure); Nieuwenhuis, 1946, p. 60, (Sambiut, Banggaai Is.) [♂ tantum].

*Nyctalemon patroclus dilutus* Röber, 1927, p. 429 (♀, Tombugu, E. Celebes).

### Type specimens

Kühn (1884, p. 183) reared *"Nyctalemon Patroclus* L." from Tombugu, E. Celebes. As this is the type locality of *N. zampa dilutus*, it seems possible that the latter was based on a ♀ reared by Kühn which found its way to some German collection. I could, however, not confirm this supposition, and, because *N. menoetius celebensis* may very well occur in Tombugu too, it remains doubtful which species Kühn reared.

Dr. Elli Franz kindly informs me that the type of this subspecies, a ♀, may be in the Dresden Museum.

### Measurements

| locality | collection | ♂♂ | wl | mean | bw3/4 | mean | ♀♀ | wl | mean | bw3/4 | mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Celebes | A, L | 2 | 57-58 | 57.5 | ? | ? | 9 | 62-67 | 64.1 | ? | ? |

The ♂ is somewhat smaller and has the upperside of the wings of a darker, plainer brown colour than the ♀. The underside is also slightly darker and the narrower light bands have sharp outer edges, just as in the ♂♂ of the other subspecies of this species.

In most specimens of this subspecies I failed to measure bw3/4, because the light band is not well defined.

## f. Disregarded Specimens

Everyone acquainted with large museum collections of insects knows that, in spite of all efforts of the staff of these institutions to avoid mistakes in the labels, errors in labelling are made now and then. In older collections, dating from a time when the great importance of exact locality labels was not so clear to entomologists as it is nowadays, such errors are more frequent. Therefore, every revisor of a group has to disregard a number of specimens of which the localities on the labels do not fit into the picture which the examination of his material has led him to believe to be right. As a subjective element is always involved when discarding such specimens, I have listed them below.

*Nyctalemon patroclus:* ♂, Java (S); ♀, Java?, Blume (L); ♀, Makassar, Bernelot Moens (A); ♀, Timor (P, cf. p. 15); ♀, Australia (G).

*Nyctalemon macleayi macleayi*: ♀, Sumatra, Insula Pulu Bras (L).

*Nyctalemon menoetius* subsp. (non *celebensis*): ♀, New Guinea (G).

*Nyctalemon menoetius menoetius*: ♂, Kendasi, SE. Celebes, III 1939, Bekking (B); ♂, S. Am[erica] (S).

*Nyctalemon menoetius adspersus*: ♂, Java (G).

*Nyctalemon zampa docilis*: ♀, Tukan Besi Archipelago, L. E. C. Krauss, don v. Bemmelen (J, cf. p. 26).

### g. WILCOXON TESTS FOR THE DIFFERENCE BETWEEN CERTAIN MEASUREMENTS IN ALLIED SUBSPECIES

The distinction of some subspecies of *Nyctalemon* is wholly or partly based on the differences found in certain measurements of the series of the specimens examined. In order to find out whether the conclusions drawn on the basis of these measurements hold good, they were checked by means of Wilcoxon's method (Wilcoxon, 1945). The procedure has been described by H. R. van der Vaart (1950). His report served me as a guide when I prepared the present section of this paper, but I should not have been able to carry out this part of my investigation without the personal help of Dr. van der Vaart, teacher of biological mathematics at the Leiden University. Therefore I wish to thank Dr. van der Vaart in this place for his kind cooperation.

The measurements which were tested by Wilcoxon's method are those of the length of the fore wing and of the width of the light band in that wing. They are compiled in the table on pp. 32 and 33. Those populations of which the subspecific status is doubtful, like *N. patroclus* from the Bismarck Archipelago, *N. macleayi* from the Louisiade Archipelago, and *N. zampa* from the Philippine Is., have been kept apart. Since the length of the fore wing, especially of the ♂♂, of the population of *N. zampa docilis* from Engano appears to be noticeably smaller than in other populations of the same subspecies, this population has also been dealt with separately.

Wilcoxon's test is a simple computation of the probability that two samples (= sets of measurements) belonging to one and the same collection show a difference as great as or greater than the difference found. As the measurements of the first set may be larger as well as smaller than those of the second, this probability will be called 2P, i. e., 1P for the first measurements being larger, 1P for the first measurements being smaller. Whenever 2P is small, say 0.05 or less, I will consider the difference between the two samples significant.

The measurements of the ♂♂ and the ♀♀ must be considered separately, since both the wing length and the band width appear to be sex-linked characters. When applying Wilcoxon's test to the measurements of the wing length in ♂♂ and ♀♀ of the same subspecies or monotypic species, we find a value for 2P showing a significant difference in the cases compiled in the table on p. 34.

For the subspecies and monotypic species not mentioned in this table the Wilcoxon test fails in showing a significant difference in the length of the

Measurements

*patroclus*

♂ n=57

| wl | bw5 |
|---|---|
| 70 | 2.5 |
| 69 | 2.5 |
| 69 | 2 |
| 69 | 1.5 |
| 68 | 3 |
| 68 | 2.5 |
| 68 | 2.5 |
| 68 | 2.5 |
| 68 | 2 |
| 67 | 2 |
| 67 | 1.5 |
| 67 | 1.5 |
| 66 | 2 |
| 66 | 2 |
| 66 | 2 |
| 66 | 2 |
| 66 | 2 |
| 66 | 2 |
| 65 | 3 |
| 65 | 2 |
| 65 | 2 |
| 65 | 2 |
| 65 | 2 |
| 65 | 1.5 |
| 65 | 1.5 |
| 65 | 1.5 |
| 65 | 1.5 |
| 65 | 1.5 |
| 65 | 1.5 |
| 64 | 2.5 |
| 64 | 2 |
| 64 | 2 |
| 64 | 2 |
| 64 | 2 |
| 64 | 2 |
| 64 | 2 |
| 64 | 1.5 |
| 64 | 1.5 |
| 64 | 1.5 |
| 63 | 2.5 |
| 63 | 2 |
| 63 | 2 |
| 63 | 2 |

♂ cntd.

| wl | bw5 |
|---|---|
| 63 | 2 |
| 63 | 1.5 |
| 63 | 1.5 |
| 62 | 1.5 |
| 62 | 1.5 |
| 61 | 2.5 |
| 61 | 2 |
| 60 | 2 |
| 59 | 2 |
| 59 | 1.5 |
| 59 | 1.5 |
| 57 | 2 |
| 57 | 1.5 |
| 57 | 1.5 |

♀ n=27

| wl | bw5 |
|---|---|
| 77 | 5.5 |
| 76 | 3.5 |
| 75 | 4 |
| 74 | 4 |
| 74 | 3 |
| 73 | 2.5 |
| 71 | 3.5 |
| 71 | 3 |
| 71 | 3 |
| 71 | 2.5 |
| 70 | 4 |
| 70 | 4 |
| 70 | 3.5 |
| 70 | 3 |
| 70 | 3 |
| 70 | 2.5 |
| 69 | 4.5 |
| 69 | 4 |
| 69 | 3 |
| 69 | 3 |
| 69 | 2.5 |
| 69 | 2.5 |
| 68 | 3.5 |
| 68 | 3 |
| 68 | 3 |
| 68 | 2 |
| 67 | 1.5 |

*macleayi*

♂ n=42

| wl | bw5 |
|---|---|
| 68 | 4.5 |
| 68 | 2.5 |
| 67 | 4 |
| 67 | 3 |
| 67 | 3 |
| 67 | 3 |
| 67 | 2.5 |
| 67 | 2.5 |
| 67 | 2.5 |
| 66 | 4 |
| 66 | 3 |
| 66 | 2.5 |
| 66 | 2.5 |
| 66 | 2.5 |
| 65 | 3.5 |
| 65 | 3 |
| 65 | 3 |
| 65 | 2.5 |
| 65 | 2.5 |
| 65 | 2.5 |
| 65 | 2 |
| 64 | 2.5 |
| 64 | 2.5 |
| 64 | 2.5 |
| 64 | 2 |
| 63 | 3 |
| 63 | 3 |
| 63 | 2 |
| 62 | 3 |
| 62 | 2.5 |
| 62 | 2.5 |
| 62 | 2.5 |
| 62 | 2.5 |
| 61 | 2.5 |
| 61 | 2.5 |
| 61 | 2 |
| 60 | 3 |
| 60 | 3 |
| 58 | 3 |
| 58 | 2.5 |
| 58 | 2 |
| 57 | 3 |

♀ n=34

| wl | bw5 |
|---|---|
| 76 | 4 |
| 74 | 4.5 |
| 74 | 4.5 |
| 74 | 4.5 |
| 74 | 4.5 |
| 74 | 4.5 |
| 74 | 4 |
| 74 | 4 |
| 73 | 5 |
| 73 | 4.5 |
| 72 | 5.5 |
| 72 | 5 |
| 72 | 4.5 |
| 72 | 4.5 |
| 72 | 4.5 |
| 72 | 4.5 |
| 72 | 4 |
| 71 | 5 |
| 71 | 4 |
| 70 | 5 |
| 70 | 4.5 |
| 70 | 3.5 |
| 70 | 3 |
| 68 | 5.5 |
| 68 | 5 |
| 68 | 4.5 |
| 68 | 4 |
| 68 | 4 |
| 67 | 4 |
| 67 | 3.5 |
| 65 | 3 |
| 63 | 4 |
| 62 | 4 |

*kotzenbergi*

♂ n=12

| wl | bw5 |
|---|---|
| 72 | 4.5 |
| 71 | 4.5 |
| 71 | 4.5 |
| 71 | 4 |
| 71 | 4 |
| 70 | 5 |
| 70 | 4.5 |
| 70 | 4.5 |
| 69 | 4.5 |
| 68 | 4.5 |
| 68 | 4 |
| 67 | 4.5 |

♀ n=16

| wl | bw5 |
|---|---|
| 83 | 6.5 |
| 81 | 6 |
| 80 | 5.5 |
| 79 | 6 |
| 79 | 6 |
| 78 | 6.5 |
| 78 | 6 |
| 78 | 5.5 |
| 77 | 6 |
| 77 | 6 |
| 77 | 6 |
| 77 | 5.5 |
| 75 | 6 |
| 75 | 6 |
| 73 | 5.5 |
| 62 | 5 |

*toxopeusi*

♂ n=22

| wl | bw5 |
|---|---|
| 70 | 3.5 |
| 69 | 5.5 |
| 69 | 4.5 |
| 68 | 4 |
| 68 | 4 |
| 68 | 3 |
| 68 | 3 |
| 67 | 4 |
| 67 | 4 |
| 67 | 3.5 |
| 67 | 3.5 |
| 67 | 3 |
| 66 | 4 |
| 66 | 3 |
| 66 | 3 |
| 65 | 4 |
| 65 | 3.5 |
| 65 | 3 |
| 64 | 4 |
| 64 | 3.5 |
| 63 | 3 |
| 61 | 3.5 |

♀ n=5

| wl | bw5 |
|---|---|
| 76 | 5 |
| 74 | 4 |
| 73 | 5.5 |
| 73 | 4 |
| 70 | 5 |

*patroclus* ssp.? 1)

♂ n=6

| wl | bw5 |
|---|---|
| 69 | 1.5 |
| 68 | 3 |
| 67 | 1.5 |
| 67 | 1.5 |
| 65 | 2 |
| 64 | 2 |

♀ n=4

| wl | bw5 |
|---|---|
| 75 | 2.5 |
| 74 | 3.5 |
| 71 | 2.5 |
| 71 | 2 |

*macleayi* ssp.? 2)

♂ n=3

| wl | bw5 |
|---|---|
| 56 | 4 |
| 62 | 3.5 |
| 67 | 3.5 |

♀ n=4

| wl | bw5 |
|---|---|
| 71 | 4.5 |
| 76 | 5.5 |
| 76 | 4.5 |
| 81 | 5.5 |

*mutatus*

♂ n=7

| wl | bw5 |
|---|---|
| 69 | 1.5 |
| 68 | 2 |
| 67 | 2 |
| 67 | 1.5 |
| 66 | 3 |
| 65 | 2 |
| 65 | 1.5 |

♀ n=1

| wl | bw5 |
|---|---|
| 71 | 2.5 |

---

1) From the Bismarck Archipelago.

2) From the Louisiade Archipelago.

*fletcheri*

| ♂ n=3 | | ♀ n=3 | |
|---|---|---|---|
| wl | bw5 | wl | bw5 |
| 72 | 1.5 | 76 | 4 |
| 70 | 2.5 | 70 | 3 |
| 66 | 2 | 69 | 3.5 |

*curvatus*

| ♂ n=2 | | ♀ n=2 | |
|---|---|---|---|
| wl | bw5 | wl | bw5 |
| 62 | 3 | 67 | 3.5 |
| 62 | 3 | 66 | 5 |

*celebensis*

| ♂ n=3 | | ♀ n=8 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 61 | 7 | 64 | 14 |
| 61 | 6 | 63 | 16 |
| 60 | 6 | 63 | 14 |
| | | 61 | 14 |
| | | 61 | 13 |
| | | 60 | 18 |
| | | 60 | 16 |
| | | 59 | 17 |

*menoetius*

| ♂ n=7 | | ♀ n=7 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 69 | 9 | 72 | 12 |
| 68 | 8 | 70 | 18 |
| 67 | 9 | 69 | 19 |
| 67 | 7 | 69 | 12 |
| 66 | 6 | 69 | 12 |
| 65 | 11 | 69 | 12 |
| 65 | 10 | 61 | 13 |

*adspersus*

| ♂ n=13 | | ♀ n=15 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 68 | 6 | 73 | 12 |
| 68 | 6 | 71 | 11 |
| 67 | 5 | 70 | 14 |
| 66 | 6 | 70 | 12 |
| 66 | 5 | 69 | 10 |
| 65 | 7 | 68 | 13 |
| 65 | 6 | 68 | 13 |
| 64 | 5 | 68 | 11 |
| 64 | 5 | 67 | 13 |
| 63 | 6 | 67 | 11 |
| 63 | 6 | 66 | 14 |
| 63 | 6 | 66 | 14 |
| 60 | 5 | 66 | 12 |
| | | 65 | 14 |
| | | 60 | 13 |

*docilis*

| ♂ n=49 | | ♀ cntd. | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 68 | 7 | 57 | 6 |
| 68 | 7 | 55 | 8 |
| 68 | 5 | 55 | 6 |
| 67 | 8 | | |
| 67 | 8 | ♀ n=38 | |
| 67 | 6 | wl | bw3/4 |
| 67 | 6 | 78 | 6 |
| 67 | 5 | 77 | 7 |
| 66 | 8 | 77 | 4 |
| 66 | 7 | 76 | 4 |
| 66 | 6 | 75 | 7 |
| 65 | 7 | 75 | 7 |
| 65 | 7 | 74 | 6 |
| 65 | 7 | 73 | 8 |
| 65 | 7 | 73 | 7 |
| 65 | 7 | 73 | 6 |
| 65 | 6 | 73 | 6 |
| 65 | 6 | 73 | 6 |
| 65 | 6 | 72 | 6 |
| 65 | 6 | 72 | 5 |
| 65 | 5 | 72 | 5 |
| 64 | 9 | 71 | 6 |
| 64 | 9 | 71 | 5 |
| 64 | 8 | 70 | 7 |
| 64 | 8 | 70 | 6 |
| 64 | 6 | 70 | 5 |
| 64 | 6 | 69 | 7 |
| 64 | 5 | 69 | 7 |
| 63 | 8 | 69 | 4 |
| 63 | 8 | 68 | 7 |
| 63 | 7 | 68 | 7 |
| 63 | 7 | 68 | 5 |
| 63 | 6 | 67 | 7 |
| 63 | 6 | 66 | 8 |
| 62 | 11 | 64 | 8 |
| 62 | 7 | 64 | 7 |
| 62 | 7 | 64 | 5 |
| 62 | 6 | 62 | 6 |
| 61 | 7 | 61 | 9 |
| 61 | 7 | 61 | 7 |
| 61 | 6 | 58 | 7 |
| 60 | 6 | 58 | 6 |
| 60 | 6 | 57 | 8 |
| 59 | 7 | 56 | 8 |
| 59 | 6 | | |
| 58 | 7 | | |

*docilis* var.? [3]

| ♂ n=8 | | ♀ n=3 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 63 | 8 | 65 | 8 |
| 60 | 10 | 65 | 6 |
| 60 | 7 | 64 | 8 |
| 58 | 9 | | |
| 58 | 7 | | |
| 58 | 6 | | |
| 55 | 6 | | |
| 53 | 7 | | |

*zampa*

| ♂ n=10 | | ♀ n=9 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 70 | 4 | 75 | 3 |
| 70 | 4 | 74 | 5 |
| 68 | 5 | 74 | 5 |
| 68 | 4 | 74 | 3 |
| 67 | 4 | 73 | 5 |
| 67 | 4 | 73 | 4 |
| 66 | 5 | 73 | 3 |
| 64 | 4 | 70 | 4 |
| 63 | 5 | 70 | 3 |
| 63 | 4 | | |

*najabula*

| ♂ n=2 | | ♀ n=1 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 63 | 3 | 69 | 4 |
| 56 | 3 | | |

*zampa* ssp.? [4]

| ♂ n=8 | | ♀ n=6 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 70 | 4 | 71 | 5 |
| 68 | 7 | 70 | 9 |
| 67 | 4 | 70 | 4 |
| 66 | 5 | 69 | 5 |
| 65 | 5 | 69 | ? |
| 65 | 4 | 68 | 6 |
| 63 | 5 | | |
| 49 | 9 | | |

*dilutus*

| ♂ n=2 | | ♀ n=9 | |
|---|---|---|---|
| wl | bw3/4 | wl | bw3/4 |
| 58 | — | 67 | — |
| 57 | — | 66 | — |
| | | 66 | — |
| | | 65 | — |
| | | 63 | — |
| | | 63 | — |
| | | 63 | — |
| | | 62 | — |

---

3) From Engano.

4) From the Philippine Is.

| species or subspecies | n ♂ 1) | n ♀ 2) | s 3) | | 2P |
|---|---|---|---|---|---|
| *N. p. patroclus* | 57 | 27 | 78-31 | ≪ 4) | 0.0026 5) |
| *N. patroclus* ssp. ? 6) | 6 | 4 | 0 | | 0.0095 |
| *N. m. macleayi* | 42 | 34 | 110-71 | ≪ | 0.0026 |
| *N. m. kotzenbergi* | 12 | 16 | 12 | ≪ | 0.0026 |
| *N. toxopeusi* | 22 | 5 | 1-0 | | 0.000049-0.000025 7) |
| *N. m. adspersus* | 13 | 15 | 47-30 | | 0.021-0.007 |
| *N. z. docilis* | 49 | 38 | 402-351 | ≪ | 0.0026 |
| *N. z. docilis* var. ? 8) | 8 | 3 | 0 | | 0.012 |
| *N. z. zampa* | 10 | 9 | 4-0 | < 9) | 0.0026 |
| *N. zampa* ssp. ? 10) | 8 | 6 | 6-3 | | 0.02-0.0046 |
| *N. z. dilutus* | 2 | 9 | 0 | | 0.036 |

1) n ♂ : number of ♂♂ examined; 2) n ♀ : number of ♀♀ examined; 3) s: number of possible combinations of a ♂ and a ♀ among the examined specimens in which the wing length of the ♂ is larger than that of the ♀ ; 4) ≪ : much less than; 5) the figure 0.0026 so often appears in this and the following tables, because in the Report which served me as a guide the value for P when n1 and n2 are larger than 10 is not calculated farther down than 0.0013; 6) from the Bismarck Archipelago; 7) these figures were computed by Dr. van der Vaart by the method described by Kemperman (1950); 8) from Engano; 9) < : less than; 10) from the Philippine Is.

fore wing in the two sexes. As the number of measured specimens in most of these forms is small, and as in the cases listed above 2P is generally smallest in those systematic units of which the largest number of specimens were measured, I venture the supposition that this failure is due to the insufficient number of specimens measured, and that throughout the genus the ♂♂ are smaller than the ♀♀. I got, however, the impression that this difference in size is less pronounced in *N. menoetius* than in most other species of *Nyctalemon*.

In a similar way it appears that the light band of the fore wing is narrower in the ♂♂ than in the ♀♀ in the species of the *patroclus*-group and *N. menoetius*.

| species or subspecies | n ♂ | n ♀ | s 1) | | 2P |
|---|---|---|---|---|---|
| *N. p. patroclus* | 57 | 27 | 148-51 | ≪ | 0.0026 |
| *N. m. macleayi* | 42 | 34 | 87-25 | ≪ | 0,0026 |
| *N. m. kotzenbergi* | 12 | 16 | 1-0 | ≪ | 0,0026 |
| *N. toxopeusi* | 22 | 5 | 21-6 | | 0.0333-0.0007 2) |
| *N. m. celebensis* | 3 | 8 | 0 | | 0.012 |
| *N. m. menoetius* | 7 | 7 | 0 | | 0.0006 |
| *N. m. adspersus* | 13 | 15 | 0 | ≪ | 0.0026 |

1) s: the number of possible combinations of a ♂ and a ♀ among the examined specimens in which bw5, respectively bw3/4, is larger in the ♂ than in the ♀ ;
2) these figures were computed by Dr. van der Vaart by the method described by Kemperman (1950). For explanation of the other symbols see the notes following the first table of this section.

No such difference could, however, be found between the ♂♂ and ♀♀ of *N. zampa.* although the number of specimens measured, especially of *N. z. docilis,* would be sufficient to show such a difference, if any, and if of the same order of magnitude as in the other species.

The following Wilcoxon tests of differences in measurements which are important for the distinction of subspecies gave significant results:

| subspecies compared | measurement | sex | n1 1) | n2 2) | s 3) | | 2P |
|---|---|---|---|---|---|---|---|
| *kotzenbergi* & *macleayi* | wl | ♂ | 12 | 42 | 13-2 | ≪ | 0.0026 |
| *kotzenbergi* & *macleayi* | wl | ♀ | 16 | 34 | 47-43 | ≪ | 0.0026 |
| *kotzenbergi* & *macleayi* | bw5 | ♂ | 12 | 42 | 17-3 | ≪ | 0.0026 |
| *kotzenbergi* & *macleayi* | bw5 | ♀ | 16 | 34 | 15-2 | ≪ | 0.0026 |
| *menoetius* & *celebensis* | wl | ♂ | 7 | 3 | 0 | | 0.017 |
| *menoetius* & *celebensis* | wl | ♀ | 7 | 8 | 5-3 | | 0.006-0.002 |
| *adspersus* & *celebensis* | wl | ♂ | 13 | 3 | 3-2 | | 0.025-0.014 4) |
| *adspersus* & *celebensis* | wl | ♀ | 15 | 8 | 7-5 | < | 0.0026 |
| *docilis* & *zampa* | bw3/4 | ♂ | 49 | 10 | 12-0 | ≪ | 0.0026 |
| *docilis* & *zampa* | bw3/4 | ♀ | 38 | 9 | 33-9 | ≪ | 0.0026 |
| *docilis* var.? 5) & *zampa* | bw3/4 | ♂ | 8 | 10 | 0 | | 0.000045 |
| *docilis* var.? 5) & *zampa* | bw3/4 | ♀ | 3 | 9 | 0 | | 0.0090 |
| *docilis* & *dilutus* | wl | ♂ | 49 | 2 | 3-1 | | 0.0031-0.0094 4) |
| *docilis* & *dilutus* | wl | ♀ | 38 | 9 | 79-74 | | 0.012-0.0094 |
| *zampa* ssp.? 6) & *dilutus* | wl | ♀ | 6 | 9 | 0 | | 0.0004 |
| *zampa* & *dilutus* | wl | ♂ | 10 | 2 | 0 | | 0.030 |
| *zampa* & *dilutus* | wl | ♀ | 9 | 9 | 0 | | 0.00004 |

1) n1: number of measured specimens of the first subspecies; 2) n2: number of measured specimens of the second subspecies; 3) s: number of possible combinations of a specimen of the first and one of the second subspecies in which the measurement was larger in the second than in the first; 4) these figures were computed by Dr. van der Vaart by the method described by Kemperman (1950); 5) from Engano; 6) from the Philippine Is. For explanation of the other symbols see the notes following the first table in this section.

The band width of the three subspecies of *N. menoetius* had to be compared two by two, as no analogous poly-sample test has yet been devised.

No significant difference in fore wing length was found between *N. z. docilis* var. ? from Engano and the comformable sex of *N. z. dilutus.*

No significant difference is found between the wing length of the ♂♂ of *N. zampa* ssp. ? from the Philippine Is. and *N. z. dilutus.* This is mainly due to the fact that among the small number (8) of *zampa* ssp. ? ♂♂ there is one aberrant specimen, the smallest measured of any subspecies of *N. zampa.* It has a length of fore wing of 49 mm only, while this length varies from 63 to 70 mm in the other 7 ♂♂. If this specimen is left out of consideration, 2P appears to be nearly significant:

| subspecies compared | measurement | sex | n1 | n2 | s | 2P |
|---|---|---|---|---|---|---|
| *zampa* ssp.? & *dilutus* | wl | ♂ | 7 | 2 | 0 | 0.055 |

It seems highly probable, therefore, that both sexes of *N. z. dilutus* are smaller than the comformable sexes of the population of *N. zampa* occurring in the Philippine Is.

No difference can be shown by the Wilcoxon test between the population of *N. macleayi* from the Louisiade Archipelago and *N. m. macleayi*. The small number (2 ♂♂, 1 ♀) of specimens of *N. z. najabula* available for examination precludes a statistical treatment of the measurements taken from these specimens.

Eventually it appeared impossible to show that the population of *N. zampa* inhabiting the Philippine Is. is intermediate between *N. z. docilis* and *N. z. zampa* as to the width of the light band in the fore wing:

| subspecies compared | measurement | sex | n1 | n2 | s | 2P |
|---|---|---|---|---|---|---|
| *docilis* & *zampa* ssp.? | bw3/4 | ♂ | 49 | 8 | 196-70 | 0.021-0.0038 |
| *docilis* & *zampa* ssp.? | bw3/4 | ♀ | 38 | 6 | 81-52 | not significant |
| *zampa* ssp.? & *zampa* | bw3/4 | ♂ | 8 | 10 | 39-9 | not significant |
| *zampa* ssp.? & *zampa* | bw3/4 | ♀ | 6 | 9 | 16-6 | not significant |

## h. Early stages

In the previous sections the early stages have not been considered, because our knowledge of the larvae and pupae of *Nyctalemon* is still very fragmentary. This section is merely a short survey of the scarce data in literature.

Boisduval (1874, p. 45) gave a short description of the larva and pupa of *Nyctalemon menoetius,* which was reared by Lorquin.

Kühn (1887, p. 183) reared "*Nyctalemon Patroclus* L." from Tombugu, E. Celebes. It has been pointed out on p. 30 that Kühn's notes refer to either *N. zampa dilutus* or *N. menoetius celebensis.*

Corbett & Dover (1927, p. 407) described the larvae of "*Nyctalemon patroclus* L." and "*Lyssidia achillaria* Hub.", which names have been shown (cf. p. 26) to refer to different stages of *N. zampa docilis.*

Lucas (1880, p. LIII) described at some length the pupa and cocoon of "*Nyctalemon Patroclus*" from Dorey, New Guinea. Since two species occur in this region, his description either refers to *N. macleayi macleayi* or to *N. toxopeusi,* both belonging to the *patroclus*-group.

Nicholson (1932, p. 187) cited a short description of a cocoon found in Cornwall near Tamar estuary from which a specimen of *N. zampa* was reared.

The few indications about the larva of *N. menoetius* given by Boisduval do not contradict the more elaborate description by Kühn of a larva of doubtful identity, but certainly belonging to the *menoetius*-group. The larva described as "*Nyctalemon patroclus* L." by Corbett & Dover is quite different, but the larva recorded as "*Lyssidia achillaria* Hub." by the same authors seems to be more like that described by Kühn, although Corbett & Dover do not mention the hairy tubercles. As long as the identity of the larva described by Kühn is still questionable, it is premature to discuss the differences between the descriptions.

All authors agree in that the pupa is about 35 mm long, dark brown, and lies in a cocoon spun between leaves. These characters may be common to all medium-sized species of the genus.

## i. The Species Concept in Nyctalemon

Since our knowledge of the early stages and biology is very incomplete, the division of the genus into species and subspecies had to be based wholly on the morphological differentiation and the distribution of the imagines.

Both in the western and eastern parts of the East Indian Archipelago there are regions where two sympatric forms of *Nyctalemon* occur. As the differences between these sympatric forms inter se is much smaller than the difference between the forms occurring in Celebes and Westward and those occurring in the Moluccas and more to the East, it seems reasonable to assume the existence of at least four species.

When writing my preliminary paper, I was convinced that all the forms occurring in the eastern territory replaced each other, the marginal overlapping of *patroclus* and *macleayi* being left out of consideration. Therefore, all the forms of the eastern group were classed as subspecies of one species.

It appeared, however, that *toxopeusi* has a much larger distributional area than I had realised. It overlaps both *patroclus* and *macleayi*, and is consequently specifically distinct from these two. Further, I found that *mutatus* from the Solomon Is. consisted of two forms which might prove to be specifically distinct. These two forms have several characters in common, and the same holds true for the certainly specifically distinct *macleayi* and *toxopeusi*. It follows that species of the *patroclus*-group can be morphologically very near to each other. Therefore, the group has now been tentatively divided into five species, of which at least one is polytypic. This classification, however, needs to be checked by further investigations; in my opinion the most doubtful points are the specific distinctness of *N. macleayi* from *N. patroclus*, and the status of *N. mutatus* var. *fletcheri*.

In the *menoetius*-group it does not seem reasonable to assume the existence of more than two species. Of the geographical races of *N. menoetius* that from Celebes is the most differentiated. Nevertheless, its affinities to the typical subspecies, as well as the apparent mutual replacing of these two forms, seem to be sufficient grounds for giving it subspecific status.

In *N. zampa* the subspecies are not sharply delimited. When comparing a series of *N. z. zampa* with a series of *N. z. docilis* the difference is clear enough, but there are specimens of both these geographical races which cannot be classed with certainty without statement of locality. My material was not large enough to judge about the status of all the regional representatives of this species. The examination of a large material of *N. zampa* from the Phillippine Is. might clear up the relationship between the subspecies, *zampa, docilis* and *dilutus.*

## 3. BIOLOGY

Very little is known about the biology of the larvae and their food plants.

Lorquin found the larvae of *N. menoetius* on some species of palm (Boisduval, 1874, p. 46).

Kühn (1887, p. 183) reared larvae collected on a shrub that is common at Tombugu in mangrove woods and of which he gives a short description. Prof. Dr. C. G. G. J. van Steenis kindly informs me that no plant answering this description occurs in true mangrove woods, but that Kühn may have meant tidal forests, which have a much richer flora. He was unable to identify this shrub though he was certain that it could not belong to the Myrtaceae.

The larvae described by Corbett & Dover (1927, p. 407) were a pest to the "Malay Apple" (*Eugenia malaccensis*), which belongs to the Myrtaceae.

We can consequently state that the larvae of the *menoetius*-group feed on widely different plants.

In the specimens from Celebes reared by Kühn (l. c.) the pupal period was about a fortnight and the same holds true for *N. zampa docilis* according to Corbett & Dover (l. c.).

The imagines of *Nyctalemon* are generally said to have nocturnal habits; during daytime they will only fly some 8-10 m distance when startled (Seitz [1930], p. 96). Some representatives of the *patroclus*-group, however, are on the wing in daytime, even when not disturbed. This is the case with *N. patroclus* in Bachian according to Roepke (1935a, p. 81) whose observation is corroborated by some participants of an expedition to Halmahera in the autumn of 1951. Mr. A. M. R. Wegner of the Museum Zoologicum of Bogor, Java, was so kind as to inform me that some of his people who joined that expedition saw *N. patroclus* flying in daytime in somewhat dark places in the wood, at a height of several metres. The same species was. however, also captured at night on light.

According to observations made by R. A. Lever published by Carpenter (1937, p. 235), *N. mutatus* (cf. p. 20) of the Solomon Is. has diurnal habits. Mr. Lever saw specimens flying at noon in a cutting, and attacked by *Rhipidura leucophrys melanoleuca,* a flycatcher.

*N. macleayi,* on the contrary, is said to be a nocturnal species (Montrouzier, 1856, p. 411).

The species of the *menoetius*-group seem to be strictly nocturnal. Semper (1896-1902, p. 598) states that *N. menoetius menoetius* flies in the evening on the blossoms of trees, and then occasionally enters houses [presumably attracted by light]. The moths reared by Kühn (1887, p. 183) always emerged in the night between 11 and 1 o'clock.

During his stay in Balik Papan, E. Borneo, in 1921 and 1922 Ir. M. Hardonk often saw *N. menoetius adspersus* attracted by light. His two paratypes of this new subspecies were collected in this way.

*Nyctalemon zampa docilis* was often captured on light. Van der Meer Mohr (1933) described how on December 22, 1932, at least 20 specimens were attracted by the lights on a terrace at Medan, Sumatra. He had earlier collected specimens on light in Medan as well as in Brastagi. In a subsequent short note he described how in the first half of December 1939 specimens attracted by light appeared at Sibolangit, Brastagi (some 30 specimens at the power plant), and Bandar Baru, all in E. Sumatra (Van der Meer Mohr, 1940, p. 150). In the last mentioned locality they reappeared on January 6 or 7, and some worn specimens were eventually seen on January 28.

In a letter dated November 1, 1951, Mr. H. T. Pagden wrote to me that some days before he saw several of these large moths which had been attracted to the lights of a hotel at Kuala Lumpur.

The specimens collected on board ships in the Strait of Malacca and the Strait of Macassar, which are dealt with below, probably were attracted by the lights of the ships when crossing the sea.

Ribbe, on the contrary, never collected any *Nyctalemon* spec. on light, nor on the bait used for moths, but sometimes found them on putrifying bananas used as a bait for butterflies (Pfeiffer, 1925, p. 127).

For the two species belonging to the *menoetius*-group there are some records of specimens captured on board ships, which shows their tendency to vagrancy, or perhaps even migration.

VerHuell (1858, p. 132) published an observation which translated into

English runs as follows: "Another important observation was made by me during my trip on board the ship of the line "Admiraal Evertsen" standing under my command when sailing in the year 1817 from the Island of Ternate through the Strait of Macassar to Java. While the nearest coast was that of Borneo, the sailors brought me some specimens of *Urania Patroclus* (Cramer, Uitl. Kapellen, Pl. 109. fig. A, B) which had been caught with the hand when the portholes of the lower battery were opened at dawn. .... The moths consequently must have crossed the distance of some nautical miles in the short time between first day-break and sunrise, or while it was dark." Since the only form of *Nyctalemon* occurring in SE. Borneo is *N. menoetius adspersus*, VerHuell's observation must refer to that subspecies. There is a ♂ of this subspecies in the Amsterdam Museum from the Strait of Macassar, 1927, Mörzer Bruyns leg.

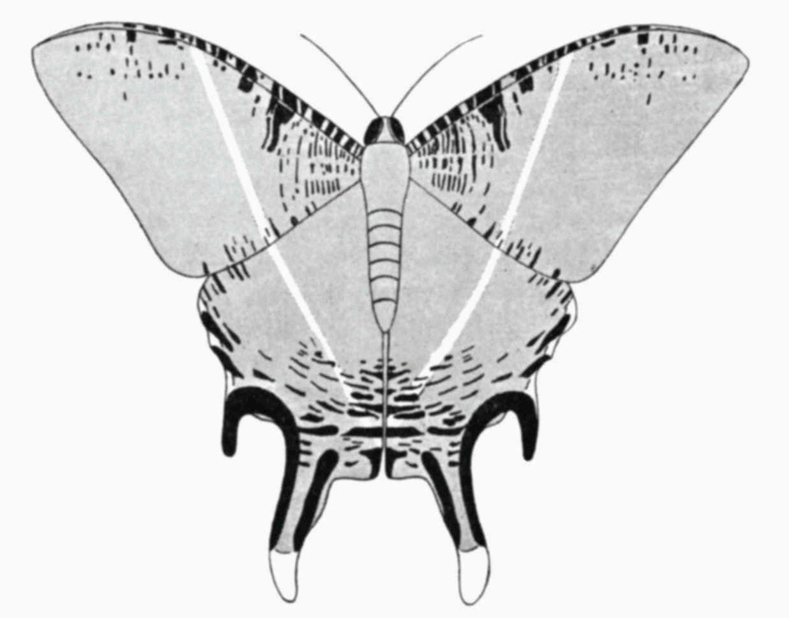

Fig. 2. Diagram of *Nyctalemon zampa docilis* ♂ in supposed resting position.

Similar records exist of *N. zampa docilis* in the Strait of Malacca. A ♂ in the Leiden Museum was taken off the N. coast of the Island of Bengkalis on April 20, 1893. There is a note on the label stating that the wind was SE. A ♀ in the Amsterdam collection is labelled: "Strait of Malacca, XI 1896, Capt. Faringa". And, finally, the late Prof. Toxopeus sent me a ♂, captured May 22, 1950, upon which he thus commented in a letter dated June 4, 1950: [Prof. N. A. van den Heuvel] was on his way back from Bagan Si-Api-Api at the coast of Sumatra to Batavia and saw, at night, when they had sailed one day and were about 25 km off the coast of Malaya, how several moths came on board flying thwartships from the Malayan coast. There was a slight wind from that side; the sea was calm. It began at twilight with a single sphingid, later several noctuids joined in. It was only a small ship... with few lights; the coast, of course, could not be seen. Next morning he found this specimen of *N. docile* dead on deck, still soft and practically undamaged. ...... At the departure from B. Si-Api-Api there was not one moth on the lamp."

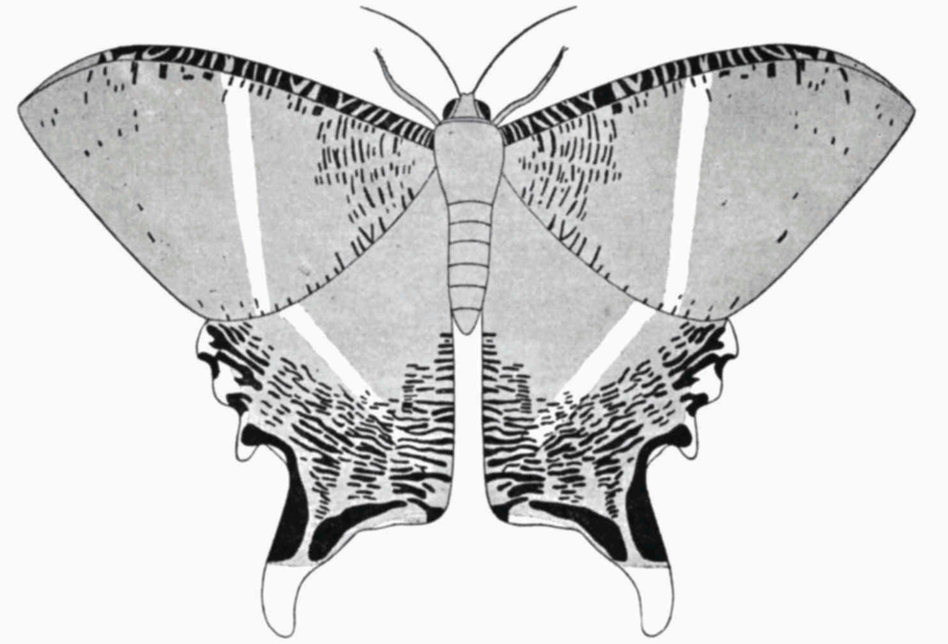

Fig. 3. Diagram of *Nyctalemon patroclus* ♀ in resting position.

Specimens of *Nyctalemon* hide in dark places, e. g., under the roofs of huts and houses (Seitz [1930], p. 96), at the foot of large trees (Pfeiffer, 1925, p. 127), or at the underside of leaves (*N. patroclus* in Halmahera, Wegner in lit.). They then sit down with spread wings and the head downward. It seems likely, therefore, that the upperside of the wings have a protective colour pattern, and that the light bands that cross the wings in all the species of this genus have a disruptive function.

In the *menoetius*-group the light bands of the fore and hind wings are likely to correspond exactly when the insect assumes its resting position (fig. 2). This would, therefore, be a case of coincident disruptive coloration

(Cott, 1940, p. 68). In *N. patroclus,* however, and most probably in the whole *patroclus*-group, these bands do not coincide in the resting position. On my request Mr. A. M. R. Wegner of the Museum Zoologicum at Bogor, Java, was so kind as to ask the members of the expedition of this Museum to Halmahera in the autumn of 1951 to watch the habits of *N. patroclus.* Fortunately, they could observe the species both in the field and in rearing cages, and it appeared that in the resting position the light bands of the wings are 2.5—3 mm apart at the inner margin of the fore wings (fig. 3). The fore wings have to shift some 16—17 mm downward to get coincidence of the bands. When such is forced in living specimens by a slight pressure of the fingers, the insect will assume its former position again as soon as this pressure ceases. As there is reason to suppose that the *menoetius*-like pattern evolved from a *patroclus*-like one (cf. p. 47) coincident coloration

| spec. or subsp. | region | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N. patroclus* | N. Moluccas | | | | | | | (7— | 8) | 9 | | | |
| | S. Moluccas | | | (3— | 4) | | | | 8 | | | | |
| | Bismarck Arch. | | 2 | | | | (6 | — | 8) | | | | |
| *N. m. macleayi* | W. New Guinea | | 2 | | | | | | | | | 11 | |
| | NE. Dutch New Guinea (coast) | (1 | — | 3) | | | 6 | 7 | | | 10 | | |
| | Id. (mountains) | 1 | | 3 | | | | | 8 | | | 11 | |
| | Papua | 1 | | (3— | 4) | (5 | | — | | 9) | | | |
| | | (1 | | — | | 5) | | | | | | | |
| | Biak | | | | | | | | | | (10 | — | 12) |
| *N. macleayi* ssp. | Louisiade Arch. | (1— | 2) | | | | | | | | | | 12 |
| *N. toxopeusi* | NE. Dutch New | 1? | | | | | 6 | 7 | 8 | | | 11 | |
| | Guinea | | | | | | | | | | (10 | — | 12) |
| | New Ireland | | | | 4 | | | | | | | | |
| *N. mutatus* (typical) | Solomon Is. | | | 3 | 4 | | 0 | 7 | | | | | |
| *N. curvatus* | New Hebrides | | | | | | | 7 | | | | | |
| *N. m. celebensis* | Celebes | | | 3 | | | 6 | | | | | | |
| *N. m. menoetius* | N. Borneo | | | | | | | 7 | | | | | |
| *N. m. adspersus* | E. Borneo | 1 | | | | | | | 8 | 9 | 10 | 11 | 12 |
| *N. z. docilis* | Simalur | | | | | 5 | | 7 | | | | | |
| | N. Sumatra | 1 | | | 4 | | | | | | | | |
| | Padang Highl. | | | 3 | | | | | | | | | |
| | E. Sumatra, Malaya, Rhio | 1 | 2 | | 4 | 5 | 6 | 7 | | 9 | 10 | 11 | 12 |
| | S. Sumatra | | | 3 | | | 6 | 7 | | | | | |
| | Billiton | | | | | | 6 | | | | | | |
| | W. Java, Karimon Djawa | | 2 | | 4 | 5 | | 7 | | | 10 | | 12 |
| *N. z. zampa* | Tonkin | | 2 | | | 5 | | | | | | | |
| | Cochin China | | | | | | | 7 | 8 | | | | |
| | Hainan | | | | | | | 7 | | | | | |
| *N. zampa* ssp. | Philippine Is. | | | | | 5 | | | | | 10 | | |
| *N. z. dilutus* | Celebes | | 2 | | | | | | | | | | |

would be a character acquired by the more progressive forms of *Nyctalemon*.

According to Seitz [1930], p. 96 the species of *Nyctalemon* fly throughout the year, although they are decidedly rarer in the dry season. The available data are insufficient to check this statement, as in a great part of the examined specimens no date is noted on the label. The occurrence of those subspecies, however, of which I could examine a number of dated specimens of some importance, never appeared to be restricted to a certain season.

In the preceding table all dated records known to me are compiled. Two figures between brackets and connected by a hyphen mean that one or more specimens captured in that period, but not dated more precisely, were examined.

One should, however, be careful when drawing conclusions from this table. The monsoon-climate, which prevails in the distributional area of *Nyctalemon*, presents many vicissitudes and hence it is not certain at all that a certain form will occur every year during the same months. The phenology of *Nyctalemon* should, therefore, be studied by correlating observations carried on during several years in one or more places with the local meteorological data.

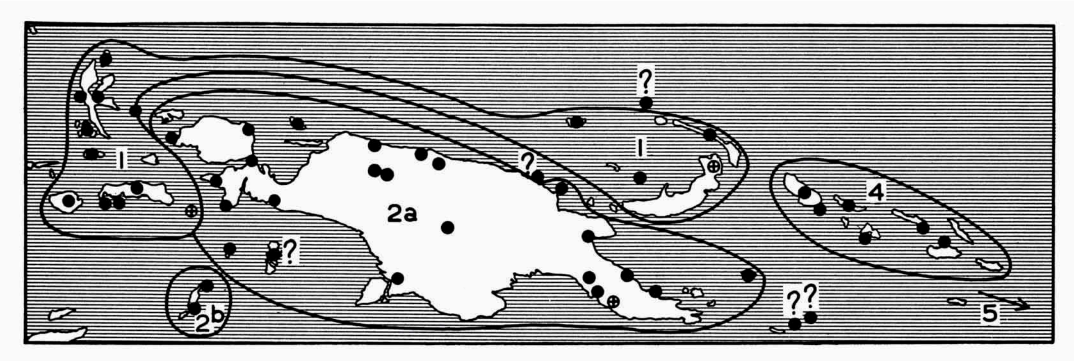

Fig. 4. Distribution of: 1, *Nyctalemon patroclus*; 2a, *N. m. macleayi*; 2b, *N. m. kotzenbergi;* 4, *N. mutatus* with var. *fletcheri*. No. 5, *N. curvatus,* inhabits the New Hebrides.

The observations published by Van der Meer Mohr (1933, 1940), and already referred to above, tend to show that *N. zampa docilis* is most common in Deli (Sumatra) about November to January, that is normally towards the end of the wet and the beginning of the dry season.

## 4. DISTRIBUTION

Figures 4—7 show the distribution of the species and subspecies of *Nyctalemon*. The black dots indicate the localities from which I examined

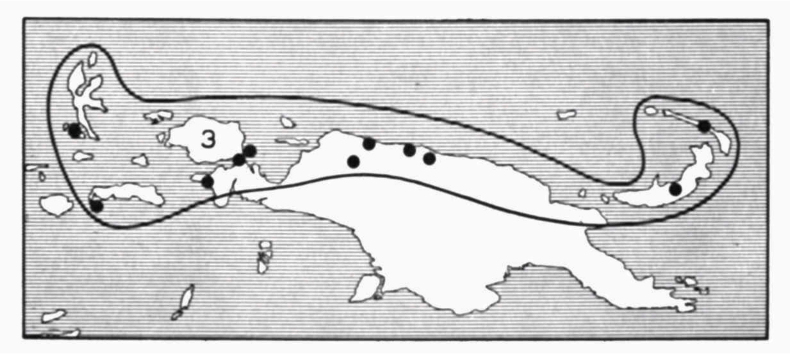

Fig. 5. Distribution of *Nyctalemon toxopeusi.*

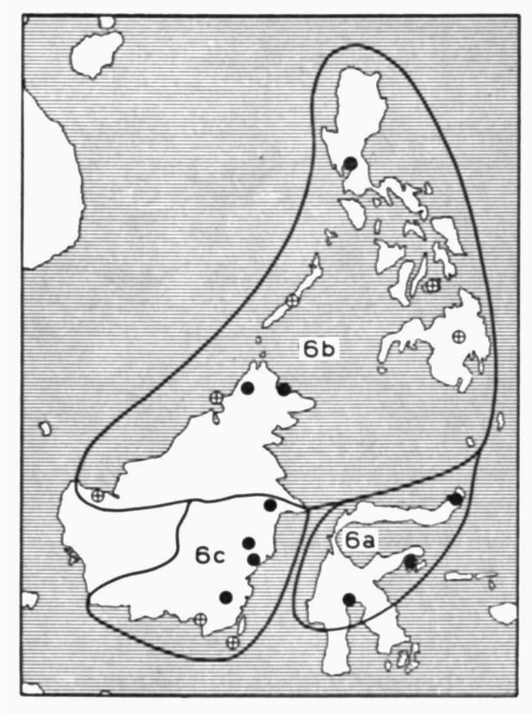

Fig. 6. Distribution of: 6a, *Nyctalemon menoetius celebensis*; 6b, *N. m. menoetius*[1]; 6c, *N. m. adspersus.*

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[1] The Sangir Is., from which I examined a specimen of *N. m. menoetius*, have erroneously not been marked by a black dot.

specimens, the open circles localities taken from the literature or checked in the British Museum collection by Mr. D. S. Fletcher. Owing to the small scale of the maps several localities had often to be indicated by one joint mark. The recorded localities of every subspecies or monotypic species have been surrounded by a line delimiting the probable range of the systematic unit.

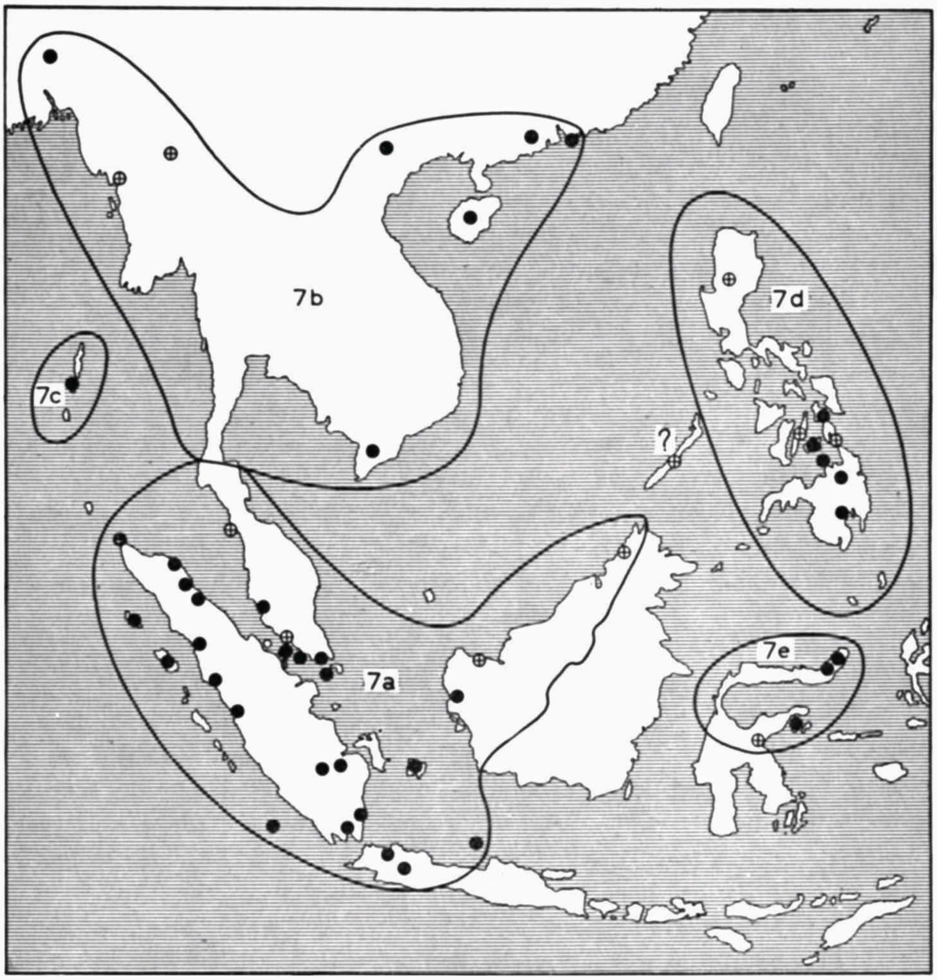

Fig. 7. Distribution of: 7a, *Nyctalemon zampa docilis*; 7b, *N. z. zampa*; 7c, *N. z. najabula*; 7d, *N. z.* subsp.?; 7e, *N. z. dilutus.*

The species of *Nyctalemon* are inhabitants of the plain from sea-level onward; they ascend in the mountains to a maximum height of about 1800 m.

The following captures from above 1000 m can be put on record:

*N. patroclus,* Gamos Mrapat, Central W. Buru, 1650 m (BM).

*N. macleayi macleayi,* Mist camp (3rd Archbold Expedition), E. Dutch New Guinea, 1800 m (B).

*N. zampa docilis,* Tjibodas, W. Java, 1400 m (B); Tjiniruan, Mount Malabar, W. Java, 1700 m (L); Wanasari, Pengalengan, W. Java, 1400 m (L).

According to some sources of information the species of *Nyctalemon* are inhabitants of forests (Montrouzier, 1856, p. 411: *N. macleayi macleayi* in Woodlark Is.; Wegner in lit.: *N. patroclus* in Halmahera). This may apply to all the species of the genus, and it would explain why *N. zampa docilis* is chiefly confined to the mountain districts of Java, though Piepers took it twice in Batavia (Parapattan, 1882, and Petamburan, 1883).

The distributional areas of most subspecies and monotypic species of *Nyctalemon* comprise several islands, as was to be expected of insects known to have a tendency to vagrancy (cf. p. 39). Nevertheless, most border lines appear to be formed by the sea, and even the isthmus of Kra apparently keeps down the gene exchange between the population of *N. zampa zampa* inhabiting Burma and Siam on one hand, and the population of *N. zampa docilis* living in the Malayan Peninsula on the other. The high mountain chains of Borneo most likely are the barriers limiting the range of *N. menoetius menoetius, N. menoetius adspersus,* and *N. zampa docilis* in Borneo. The northern limit of the distribution of *N. zampa zampa* in continental Asia seems to be climatic and, therefore, has been assumed to lie more to the N. in plain country than in the mountains.

It is difficult to explain why the genus is apparently lacking in E. Java, the Lesser Sunda Is., N. Australia, and S. Celebes. E. Java and the Lesser Sunda Is. have a drier climate than most of the area occupied by the genus, which might be the reason why *Nyctalemon* is absent here. If *N. macleayi macleayi* reached the S. coast of New Guinea only after the Torres Strait had been submerged again at the end of the Pleistocene, this can be the reason why *Nyctalemon* has not been found in Australia. There seems to be no obvious reason why the genus was never recorded from S. Celebes.

## 5. EVOLUTION

In this section only the evolution of species groups, species and subspecies in the genus will be considered, while the origin of the genus and its relation to other genera will not be discussed.

It seems hazardous to try and trace the evolution of a group on the mere ground of the close study of some hundreds of mostly discoloured exoskeletons. Nevertheless in so many cases the morphological differentiation and geographical distribution of certain systematic units point in the same direction, that it seems worth while to see if the results obtained on this basis can be correlated with what is known about the geological history of the region inhabited by the genus. In this way it is at least possible to advance some hypotheses which can be checked by future investigators. In a preliminary paper read before the seventh section of the Ninth International Congress of Entomology in Amsterdam in August 1951 (v. R. Altena, 1953) I could not go into details, and my views especially as to the *patroclus*-group, underwent considerable changes since then. Therefore, it seems justified to discuss this subject once more.

The genus studied appears adequate for an examination of its possible evolution, as it comprises large moths which have attracted the attention of naturalists wherever they occur. Therefore, it seems improbable that there are still large gaps in our knowledge of the morphological differentiation and geographical distribution of the species, although as to the details many complementary data are still to be expected.

As the two species groups distinguished on morphological grounds occupy totally separated areas of distribution, I suppose that they developed quite independently. Of these two groups I consider the *patroclus*-group to be the more primitive, mainly because it has differentiated into morphologically far more different species than the *menoetius* group. There is some reason to consider *N. menoetius celebensis* a link between the two groups, because it has a mean value for the index 100a/b which is intermediate between the mean values found in the *patroclus*-group and those of the other subspecies of *N. menoetius* and of *N. zampa*. If this view is accepted, the genus would seem to have spread Westward from the Moluccas via Celebes. It would be interesting to know if *Nyctalemon* occurs in the Sula Is., and if so, by which species it is represented here.

The *patroclus*-group has been divided into five species of which at least one is polytypic, but this classification is to some extent tentative, as explained on p. 37.

As to the distribution of the species of the *patroclus*-group it is striking that, except *N. macleayi*, they all occur in Melanesia 1), though they are not restricted to that region. These four species together occupy a long area of

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1) Melanesia taken in its zoogeographical sense: Northern Melanesia including the Admiralty Is., the Bismarck Archipelago, and the Solomon Is., belonging to the Papuan Subregion, plus Southern Melanesia including the Santa Cruz Is., the New Hebrides, and some other groups of no importance in this context, belonging to the Polynesian Subregion (cf. Mayr, 1939, p. 193).

distribution comprising the Moluccas, the North coast of New Guinea, the Bismarck Archipelago, the Solomon Is., and the New Hebrides. As this is the region in which the group has developed such highly different species, it is most likely to represent, or at least to contain, the oldest part of its distributional area. The occupation of New Guinea (except the most northern and western parts, see fig. 5, *N. toxopeusi*) and some groups of small islands to the East of New Guinea may therefore have been of comparatively recent date. The following facts are in agreement with this hypothesis: (1) The fifth species, *N. macleayi,* is the least differentiated and might even be a subspecies of *N. patroclus.* (2) Though the Torres Strait was temporarily dry during the Pleistocene, probably more than once and certainly still in the younger part of that period, the genus *Nyctalemon* is lacking in Australia. This would not be surprising if *N. macleayi* had only recently spread over New Guinea. (3) Although the genus is represented in the Tenimber Is. by the endemic *N. macleayi kotzenbergi* it has not spread farther West to the Lesser Sunda Is.

It is not surprising that endemic species have developed in such isolated archipelagos as the Solomon Is. and the New Hebrides. The strongest affinities of these forms are with *N. patroclus,* with which *N. mutatus* var. *fletcheri* and *N. curvatus* have several characters in common. The typical form of *N. mutatus* stands farther apart, its extreme differentiation qualifies it as one of the oldest forms of the group. The true status of the var. *fletcheri* must be a matter of future research, it may appear to be specifically distinct from *N. mutatus.* The genus has not yet been reported from the Santa Cruz Is., situated between the Solomon Is. and the New Hebrides.

The situation is much more intricate in the western part of the distributional area of the *patroclus*-group, viz., in the Bismarck Archipelago, western New Guinea, and the Moluccas. Two important facts need an explanation: (1) the discontinuous distribution of *N. patroclus,* and (2) the coexistence of *N. toxopeusi* with *N. patroclus* and *N. macleayi.*

The most simple explanation of the discontinuous occurrence of *N. patroclus* would be to assume a former land connection between the northern Moluccas and the Bismarck Archipelago, North of and separated from New Guinea. This case would not be the only one easily explained by such a connection.

In his discussion of the composition and origins of the Australian fauna Harrison (1928, p. 392) cites the amblycephalid snakes and the ranid genus *Cornufer* as instances of groups occurring on both sides of New Guinea, but not in that island. The distribution of *Merula* (Harrison, 1928, p. 368, fig. 9) is a similar case, though one species inhabits eastern New Guinea.

According to Hoffmann (1932, p. 114) the subgenus *Atopos* of the mollusc genus *Atopus* Simroth occurs in New Britain, the Moluccas and westward, while the genus is represented by the subgenus *Prisma* Simroth in New Guinea.

In his fascinating study of the papilionid genus *Troides* and its near allies Zeuner (1944, p. 150) draws attention to the *victoriae* group of *Ornithoptera,* which is restricted to the Solomon Is., except one species that inhabits northeastern New Guinea, while its nearest relatives are found in the Moluccas. The intermediate area, New Guinea, is inhabited by several forms of the related genus *Schoenbergia,* which is lacking in the Solomon Is., and has only one representative in the Moluccas, on the island of Ceram.

Voous & Van Marle (1949, p. 513 seq., fig. 5) found a similar type of distribution in the *novaehollandiae* group of the avian genus *Coracina.*

Lieftinck (1949, p. 326) drew attention to the dragonfly *Rhinocypha liberata* Lieft., which is endemic in the Solomon Is. whilst its nearest relatives are a few species inhabiting some islands of the southern Moluccas.

Though some of the instances recorded above may eventually appear not to be to the point, since in future links may be discovered in New Guinea, especially those dealt with by Zeuner, Voous & Van Marle, and the present one seem well established, because the group that is common to northern Melanesia and the Moluccas is replaced by a closely related group in New Guinea. There is no doubt that the strongest affinities of the fauna of northern Melanesia are with New Guinea, but because of what has been said above it seems possible that a biogeographic analysis of its whole fauna would show that a certain part of this fauna is related rather to the fauna of the Moluccas than to that of any other region.

Harrison (1928), and later Zeuner (1944, p. 173) showed how well these cases could be explained by the theory of continental drift. Indeed, a glance at Wegener's figure 24 (Wegener, 1929, p. 91) suffices to show this.

As to *Nyctalemon* it might be assumed that *N. patroclus* has originated in the northern chain of islands, *N. toxopeusi* in the southern chain. When the chains were disrupted by the northward drift of New Guinea the ends were displaced, but both the western and the eastern extremities of the chains got nearer to each other, which enabled the species evolved to invade each others' areas in the West as well as in the East.

Subsequently *N. toxopeusi* may have immigrated into New Guinea, where it occupies a rather narrow area along the North coast. The absence of *N. patroclus* in New Guinea might be caused by the presence of the related *N. macleayi,* which possibly occupies the same ecological niche.

According to Van Bemmelen (1949, p. 721), however, serious objections to the theory of continental drift as a base for explaining the present structure of the East Indian Archipelago have arisen in the course of the study of the geology of this region. It seems wiser, therefore, to try to correlate the evolution of *Nyctalemon* with the results of the geological exploration of New Guinea and the neighbouring islands. Van Bemmelen recently gave a compilation of the geology of the East Indian Archipelago, from which the data presented in the next paragraphs were borrowed (cf. Van Bemmelen, 1949, pp. 710 sqq.).

The present island of New Guinea is the result of orogenesis after a long period of geosynclinal subsidence in the early Palaeogene. In the middle part of New Guinea Van Bemmelen (p. 719, tab. 124) distinguishes the following structural belts:

| Structural belts | Geotectonic relations | |
|---|---|---|
| Northern coastal ranges<br>(Cyclops Mts., Bougainville Mts.) | Relics of the inner arc | Melanesian orogenic system |
| Mamberano-Bewani depression | Interdeep | |
| Northern Divide Range | Non-volcanic outer arc | |
| Rouffaer-Idenburg depression | Foredeep<br>Sidedeep | Median orogenic system of New Guinea |
| Central Ranges | Extinct volcanic median geanticline | |
| Digul-Fly depression | Sidedeep | |
| Merauke Ridge | Margin of the Australian Continent | |

The "northern coastal ranges" and the "central ranges" emerged in the Oligo-Miocene (op. cit., fig. 377 II), the "northern divide range" only in the Mio-Pliocene (op. cit., fig. 377 III), while the depressions were still partly submerged in the Pleistocene. The "northern coastal ranges" and the "northern divide range" belong to the "Melanesian orogenic system", which extends from the Halmahera group in the West to New Britain in the Bismarck Archipelago in the East. The central part of the inner arc of this system has been engulfed for the greater part during the Quaternary.

It seems to me that this inner arc of the Melanesian orogenic system may have been of considerable biogeographic importance. About the Miocene it may have provided a communication — by which term I do not mean to indicate a continuous land bridge, but rather a migration route consisting of a chain of islands which need not have been continuous at any time — between the Moluccas and the Solomon Is. before New Guinea existed in its actual form. During the Quaternary the central part has for a great deal been submerged, but some parts are at present included in the northern coastal regions of New Guinea and in some of the satellite islands like Biak. It seems possible that those forms which occur in the Moluccas on one side and in the Bismarck Archipelago and/or the Solomon Is. on the other without being found in New Guinea, died out in northern New Guinea due to competition with younger related forms that had originated in other ancient regions of the island while these were still isolated. These forms were enabled to spread over the whole island when the intermediate depressions emerged at the end of the Tertiaries and during the Quaternary. In the case of *Nyctalemon* this would mean that *N. patroclus* was replaced by *N. macleayi* in North New Guinea and some satellite islands.

A more detailed knowledge of the history of the local geography would be required for explaining the coexistence of *N. patroclus* and *N. toxopeusi* in the Moluccas and the Bismarck Archipelago.

It will be clear from the above that in my opinion *N. macleayi* originated in one of the anticlines of the "median orogenic system" of New Guinea, probably in the "central ranges", where it could spread to the S.E. and W. during the late Tertiary. When the intermediate depressions had emerged, the species also spread to the N. and the S., but it probably reached the Torres Strait only after its last emersion in the last glacial period. Probably from the Kei Is. the species reached the Tenimber group, where the subspecies *kotzenbergi* developed.

The changes in sea level during the Pleistocene, which are generally accepted to have had a great influence on the biogeography of the western part of the East Indian Archipelago, probably also controlled the evolution of the *menoetius*-group to a great extent. I refer to Zeuner's (1941, figs. 1, 2) suggestive maps of the maximal submergence and emergence of land in this area during the Pleistocene.

It seems reasonable to assume that well developed light bands existed in the fore wings of the primitive forms of *Nyctalemon*. Therefore, *N. menoetius* has to be considered a more primitive species than *N. zampa*. This supposition is corroborated by the shape of the wings of *N. menoetius* agreeing better with the general type of the *patroclus*-group, and by the distributional area of *N. zampa* reaching farther from the centre of distribution of the genus. As *N. zampa docilis* is the race that shows the best developed light bands in the fore wings, I consider it to be the most primitive subspecies of *N. zampa*.

The differentiation of the group into two species most likely occurred in an early phase of the Pleistocene with high water level. The forerunners of *N. menoetius* probably spread from Celebes via the Philippine Is. to North Borneo, while those of *N. zampa* may have lived somewhere in the area now occupied by Sumatra and Malaya. From there *N. zampa* must have spread into India and China and back into Borneo, the Philippine Is., and Celebes. Judging from the morphological relationships of the here distinguished subspecies there are some possibilities, the uncertain point being the status of the Philippine Is. population of *N. zampa*. This population in some respects seems to be intermediate between *N. zampa zampa* and *N. zampa docilis*, and can be regarded as (1) a transitional link between *docilis* and *zampa*, (2) a hybrid population, and (3) a convergent offshoot of the primitive *docilis*-like ancestor of the recent subspecies of *N. zampa*. The following diagrams show the three possible ways of subspeciation in *N. zampa* in accordance with the three possible status of the Philippine Is. population:

(1)

$$\begin{tikzcd}
& \textit{zampa} \arrow[dl] & & \text{subsp. ? (Philippine Is.)} \arrow[ll] \arrow[dr] & \\
\textit{najabula} & & \textit{docilis} \arrow[ur] & & \textit{dilutus}
\end{tikzcd}$$

(2)

$$\begin{tikzcd}
& \textit{zampa} \arrow[dl] \arrow[rr] & & \text{subsp. ? (Philippine Is.)} \arrow[dr] & \\
\textit{najabula} & & \textit{docilis} \arrow[ul] \arrow[ur] & & \textit{dilutus}
\end{tikzcd}$$

(3)

$$\begin{tikzcd}
& \textit{zampa} \arrow[dl] & & \text{subsp. ? (Philippine Is.)} \arrow[dr] & \\
\textit{najabula} & & \textit{docilis} \arrow[ul] \arrow[ur] & & \textit{dilutus}
\end{tikzcd}$$

Of these three I consider the second to be the most probable, because in that case *docilis* might be assumed to have reached Borneo and Java at a recent date, which might explain why it has not yet spread farther to the East in these islands.

## BIBLIOGRAPHY

AGASSIZ, L., 1846. Nomina sytematica generum lepidopterorum, etc., in: Nomenclator Zoologicus, Soloduri.

ALTENA, C. O. VAN REGTEREN, 1953. Biogéographie du genre Nyctalemon Dalman (Lepidoptera, Uraniidae). Trans. Ninth Int. Congr. Entom. Amsterdam, vol. 1, pp. 564-567, 1 fig.

AURIVILLIUS, P. O. CHR., 1882. Recensio critica Lepidopterorum Musei Ludovicae Ulricae quae descripsit Carolus a Linné. K. Svenska Vet.-Ak. Handl., Stockholm, vol. 19 no. 5.

BEMMELEN, R. W. VAN, 1949. The Geology of Indonesia. The Hague, vol. 1.

B[LYTH], E., 1854. "Our accessions to the Museum for the last three months are as follows:" Journ. As. Soc. Bengal, Calcutta, vol. 23, pp. 212-219.

BOISDUVAL, 1874. Monographie des Agaristidées (Lépidoptères). Rev. Mag. Zool., Paris, (3) vol. 2, pp. 26-110.

[BONNATERRE], 1797 [?] [1]. Planches 1-268, in: Tableau encyclopédique et méthodique des trois règnes de la nature. Paris, vol. 18, Insectes.

BUTLER, A. G., 1869. Descriptions of species of Lepidoptera, confounded with others described by Linnaeus and Fabricius. Ent. Monthly Mag., London, vol. 5, pp. 270-273.

——, 1877. The Butterflies of Malacca. Journ. Linn. Soc., London, vol. 13, pp. 196-197.

——, 1879a. The Butterflies of Malacca. Trans Linn. Soc., London, (2) vol. 1 (Zool.), pp. 533-568, pls. 68, 69.

——, 1879b. On the Heterocera in the Collection of Lepidoptera from New Ireland obtained by the Rev. G. Brown. Proc. Zool. Soc., London, vol. for 1879, pp. 160-166.

——, 1887. Descriptions of new Species of Lepidoptera from the Solomon Islands, collected by C. M. Woodford, Esq. Ann. Mag. Nat. Hist., London, (5) vol. 20, pp. 240-247.

CARPENTER, G. D. H., 1937. Further Evidence that Birds do attack and eat Butterflies. Proc. Zool. Soc., London, (A) vol. 107, pp. 223-247, pls. 1, 2.

CLERCK, C., 1764. Icones Insectorum Rariorum. Holmiae, vol. 2.

CORBETT, G. H., & C. DOVER, 1927. Notes on Miscellaneous Insects of 1926. Malayan Agric. Journ., Kuala Lumpur, vol. 15, pp. 408-419, 2 figs.

COTES, E. C., & C. SWINHOE, 1888. A catalogue of the moths of India. Calcutta, vol. 4, Geometrides.

COTT, HUGH B. 1940. Adaptive coloration in animals. London.

CRAMER, P., 1779, 1782. De uitlandsche kapellen voorkomende in de drie waereld-deelen Asia, Africa en America [= Papillons exotiques, etc.]. Amsteldam, vol. 2, 3.

DALLA TORRE, K. W. VON, 1924. Epiplemidae, Uraniidae. Lepid. Cat., Berlin, part 30.

DALMAN, J, W., 1825. Försök at närmare bestämma slägtet Castnia Fabr., samt detsamma tillhöranda Arter. K. Svenska Vet.-Ak. Handl., Stockholm, vol. 1824, pp. 392-407.

D'AUBENTON, L. J. M., 1765. Planches Enluminées. [non vidi].

DIAKONOFF, A., 1939. The genera of Indomalayan and Papuan Tortricidae. Zool. Meded., Leiden, vol. 21, pp. 111-240, 19 figs.

DRUCE, H., 1882. Descriptions of a new Genus and some new Species of Heterocera. Proc. Zool. Soc., London, vol. for 1882, pp. 777-782, pl. 40, 41.

DRURY, D., 1770. Illustrations of Natural History. London.

FABRICIUS, J. C., 1794. Entomologia Systematica emendata et aucta. Hafniae, vol. 3 part 2.

GAEDE, M., 1932. Uraniidae, Drepanidae, Notodontidae, in: Rés. Scientif. Voy. Indes Néerl. Pr. Léopold Belgique. Mém. Mus. R. Hist. Nat. Belg., Bruxelles, (hors série) vol. 4 part 6, pp. 57-61.

——, 1933. Ergebnisse der Forschungsreise S. Kgl. H. Prinz Leopold von Belgien (Lepidopteren). Bull. Mus. R. Hist. Nat. Belgique, Bruxelles, vol. 9 no. 43.

GODMAN, F. D., O. SALVIN & H. DRUCE, 1878. Catalogue of the Lepidoptera collected by Mr. S. N. Walter in the island of Billiton. Proc. Zool. Soc., London, vol. for 1878, pp. 637-643, pl. 40.

GUENÉE, A., 1857. Uranides et Phalénites. Paris, vol. 1 [= Boisduval & Guenée, Histoire naturelle des insectes. Species général des Lépidoptères, vol. 9].

[GUÉRIN, 1818] [1]. Explanation, pp. 1-142, in: Tableau encyclopédique et méthodique des trois règnes de la nature. Paris, vol. 18, Insectes.

HAGEN, B., 1890. Die Pflanzen- und Tierwelt von Deli auf der Ostküste Sumatra's. Tijdschr. Ned. Aardr. Gen., Leiden, (2) vol. 7, pp. 1-240, 1 pl.

---

1) Cf. Sherborn, C. D., & B. B. Woodward, 1893, Proc. Zool. Soc., p. 584.

HAMPSON, G. F., 1895. Moths (in: Fauna Br. India, London, Calcutta, Bombay, and Berlin), vol. 3.

HARRISON, L., 1928. The composition and origins of the Australian fauna, with special reference to the Wegener hypothesis. Rep. 18th Meeting Austral. Ass. Adv. Sci., W. Austral. Meeting Perth Aug. 1926, vol. 18, pp. 332-396, figs. 6-20.

HERBST, J. F. W., 1790. Natursystem aller bekannten in- und ausländischen Insekten, als eine Fortsetzung der von Büffonschen Naturgeschichte. Berlin, Schmetterlinge, vol. 4.

HOFFMANN, H., 1932. Nacktschnecken aus dem Bismarck-Archipel. Zool. Anz., Leipzig, vol. 100, pp. 133-149, 11 figs.

HOPFFER, C. H., 1856. Neue oder wenig bekannte Schmetterlinge der Insecten-Sammlung des Königl. Zoologischen Musei der Universität Berlin. Berlin, part 2.

——, 1874. Beitrag zur Lepidopteren-Fauna von Celebes. Stett. Ent. Zeit., Stettin, vol. 35, pp. 17-47.

HORSFIELD, TH., & F. MOORE, 1857. A catalogue of the lepidopterous insects in the museum of the Hon. East-India Company. London, vol. 1.

HÜBNER, J., 1816 [-1826] 1). Verzeichnis bekannter Schmettlinge [sic]. Augsburg.

ILLIGER, K., 1807. Die neueste Gattungs-Eintheilung der Schmetterlinge aus den Linneischen Gattungen Papilio und Sphinx. Mag. Insektenk., Braunschweig, vol. 6, pp. 277-295.

IMMS, A. D., 1925. A general Textbook of Entomology. London.

——, 1951. Idem, 8th ed., London.

JURRIAANSE, J. H., & J. LINDEMANS, 1919. Bijdrage tot de kennis der Lepidoptera van Z. O.-Celebes en omliggende eilanden. Tijdschr. Entom., 's-Gravenhage, vol. 62 suppl., pp. 1-39, pl. 1-5.

KEMPERMAN, J. H., 1950. De verdelingsfunctie van het aantal inversies in de test van Mann en Whitney. Rapp. T. W. 7 Mathem. Centr., Amsterdam.

KIRBY, W. F., 1892. A synonymic catalogue of Lepidoptera Heterocera (moths). London.

KÜHN, H., 1887. Zur Kenntnis indischer Lepidopterenlarven. Corresp.-Blatt Iris, Dresden, vol. 1, pp. 179—183, pl. 6.

LEVER, R. J. A. W., 1943. Further notes on the fauna of the British Solomon Islands. Trop. Agric., Port-of-Spain, Trinidad, vol. 20, pp. 40-42.

LIEFTINCK, M. A., 1949. Synopsis of the Odonate Fauna of the Bismarck Archipelago and the Solomon Islands. Treubia, Buitenzorg, vol. 20, pp. 319-374, 12 figs.

LINNAEUS, C., 1758. Systema Naturae. Holmiae, ed. 10, vol. 1.

——, 1764. Museum ...... Ludovicae Ulricae Reginae. Holmiae.

LUCAS, H., 1880. (Communication dans la séance du 14 avril 1880). Bull. Soc. Ent. France, Paris, vol. for 1880, pp. LIII-LIV.

MAYR, E., 1940. Borders and subdivisions of the Polynesian region as based on our knowledge of the distribution of birds. Proc. VIth Pac. Sci. Congr., Berkeley and Los Angeles, vol. 4, pp. 191-195.

MEHTA, D. R., 1933. Comparative Morphology of the Male Genitalia in Lepidoptera. Rec. Indian Mus., Calcutta, vol. 35, pp. 197-266, 114 figs.

MOHR, J. C. VAN DER MEER, 1933. Een mooie vangst. Tropische Natuur, Weltevreden, vol. 22, pp. 60-61, 2 figs.

——, 1940. Korte zoölogische aanteekeningen (V). Op. cit., vol. 29, pp. 145-150, 5 figs.

MONTROUZIER, 1856. Suite de la faune de l'Ile de Woodlark ou Moiou. Ann. Sciences Phys. Nat. Agric. Ind., Lyon, (2) vol. 8, pp. 393-416.

MOORE, F., 1877. The Lepidopterous Fauna of the Andaman and Nicobar Islands. Proc. Zool. Soc., London, vol. for 1877, p. 580-632, pl. 59, 60.

---

1) cf. Opinion 150 of the Int. Comm. on Zool. Nomencl.

——, 1884. List of the Lepidopterous Insects collected in Cachar, by J. Wood-Mason, Part 1, Heterocera. Journ. As. Soc. Bengal, Calcutta, vol. 53 (2, Nat. Sci.), pp. 234-237.

NICHOLSON, E., 1932. A peculiar moth. Entomologist, London, vol. 65, pp. 187-188.

NIEUWENHUIS, E. J., 1946. Lepidoptera van den Banggaai-archipel. Tijdschr. Entom., [Amsterdam], vol. 87, pp. 37-61, pl. 2.

OBERTHÜR, CH., 1878. Etude sur les Lépidoptères recueillis en 1875 à Doreï (Nouvelle-Guinée) par Mr. le Prof. O. Beccari. Ann. Mus. Civ. Storia Nat., Genova, vol. 12, pp. 451-470.

PAGENSTECHER, A., 1884. Beiträge zur Lepidopteren-Fauna von Amboina. Jahrb. Nass. Ver. Naturk., Wiesbaden, vol. 37, pp. 150-326, pls. 6, 7.

——, 1885. Heterocera der Insel Nias (bei Sumatra). Op. cit., vol. 38, pp. 1-71, pls. 1, 2.

——, 1886. Heteroceren der Aru-Inseln, Kei-Inseln und von Südwest-Neu-Guinea. Op. cit., vol. 39, pp. 104-195, pl. 10.

——, 1890. Heteroceren der Insel Palawan. Iris, Dresden, vol. 3, pp. 1-33.

——, 1895. Lepidoptera Heterocera, in: Zool. Forschungsreisen Austral. Malay. Arch. R. Semon, vol. 5. Denkschr. Medic.-naturw. Ges., Jena, vol. 8, pp. 205-222, pl. 13.

——, 1900. Die Lepidopterenfauna des Bismarck-Archipels. Teil II. Die Nachtfalter. Zoologica, Stuttgart, vol. 12, part 29.

PFEIFFER, L., 1925. Einiges über die Uraniiden und Sematuriden (Lep.) der alten und neuen Welt (Fortsetzung). Ent. Zeitschr., Frankfurt a. M., vol. 39, pp. 127-128, 131-132.

PIERCE, F. N., 1914. The genitalia of the group Geometridae of the Lepidoptera of the British Islands. Liverpool.

PREISS, P., 1888. Abbildungen hervorragender Nachtschmetterlinge aus dem indo-australischen und südamerikanischen Faunengebiet mit erläuterndem Text. Coblenz.

RÖBER, J., 1927. Neue exotische Falter. Int. Ent. Zeitschr., Guben, vol. 20, pp. 428-430, 1 pl.

ROEPKE, W., 1935a. Herinneringen van een entomoloog aan het eiland Batjan. Tropische Natuur, Weltevreden, vol. 24, pp. 73-83, 9 figs.

——, 1935b. Über eine kleine Sammlung Lepidoptera Heterocera aus Ost-Sumatra. Misc. Zool. Sumatr., Medan, no. 99.

SALVIN, O., & F. DUCANE GODMAN, 1877. On a Collection of Lepidoptera made by the Rev. G. Brown on Duke-of-York Island and its Neighbourhood. Proc. Zool. Soc., vol. for 1877, pp. 139-151.

SCHAUFUSS, L. W., 1870. Die exotischen Lepidoptera heterocera der früher Kaden-schen Sammlung. Nunquam otiosus, Dresden, vol. 1, pp. 7-23.

SEBA, A., 1765. Locupletissimi Rerum Naturalium Thesauri accurata descriptio. Amstelaedami, vol. 4.

SEITZ, A., [1926] 1). Nyctalemon-Alcidis. Die Grossschmetterlinge der Erde, Stuttgart, vol. 10, pls. 69-71.

——, [1930] 1). Uraniinae. Op. cit., pp. 94-97.

SEMPER, G., 1896-1902. Die Schmetterlinge der Philippinischen Inseln, vol. 2, Die Nachtfalter, Heterocera. Reisen Arch. Philipp. Dr. C. Semper, Wiesbaden, vol. 6.

SKINNER, H., 1903. A new species of Nyctalemon. Proc. Ac. Nat. Sci., Philadelphia, vol. 55, p. 298, pl. 13.

SNELLEN, P. C. T., 1889. Aanteekeningen over Lepidoptera van Nieuw-Guinea. Tijdschr. Entom., 's-Gravenhage, vol. 32, pp. 377-400, pls. 8-10.

——, 1890. Aanteekeningen over de Lepidoptera van het eiland Belitoeng. Op. cit., vol. 33, pp. 279-310, pl. 12.

---

1) cf. Griffin, 1936. Trans. Ent. Soc., London, vol. 85, pp. 256, 258.

——, 1895. Verzeichnis der Lepidoptera Heterocera von Dr. B. Hagen gesammelt in Deli (Ost-Sumatra). Iris, Dresden, vol. 8, pp. 121-151.

Strand, E., 1912. Zweites Verzeichnis von Herrn Prof. Dr. L. Schultze in Neu Guinea gesammelter Lepidoptera. Arch. Naturgesch., Berlin, vol. 28A, part 11, pp. 64-69.

Swinhoe, C., 1892. Catalogue of Eastern and Australian Lepidoptera Heterocera in the collection of the Oxford University Museum. Oxford, part 1, Sphinges et Bombyces.

Talbot, G., 1932. The Lepidoptera of Schouten Islands. Bull. Hill Mus., Tring, vol. 4, pp. 206-256.

Vaart, H. R. van der, 1950. Gebruiksaanwijzing voor de toets van Wilcoxon. Rapp. S. 32 (M4) Mathem. Centr., Amsterdam.

VerHuell, 1858. Eigenschappen van twee exotische Lepidoptera. Tijdschr. Entom., 's-Gravenhage, vol. 1, pp. 131-132.

Voous, K. H., & J. G. van Marle, 1949. The distributional history of Coracina in the Indo-Australian Archipelago. Bijdr. Dierk., Leiden, vol. 28, pp. 513-529, 7 figs.

Walker, F., 1854. List of the specimens of lepidopterous insects in the collection of the British Museum. London, part 1.

——, 1856. Idem, part 7.

Wegener, A., 1929. Die Entstehung der Kontinente und Ozeane. Braunschweig, 4th ed.

Westwood, J. O. 1837. Illustrations of Exotic Entomology, etc. by Dru Drury. London, new ed.

——, 1879. Observations on the Uraniidae, a Family of Lepidopterous Insects, with a Synopsis of the Family and a Monograph of Coronidia, one of the Genera of which it is composed. Trans. Zool. Soc., London, vol. 10, pp. 507-542, pls. 85-88.

Weymer, G., 1885. Exotische Lepidopteren. III. Beitrag zur Lepidopteren-Fauna von Nias, Stett. Ent. Zeit., Stettin, vol. 46, p, 257-285, pls. 1, 2.

Wilcoxon, F. 1945. Individual comparisons by ranking methods. Biometrics, vol. 1, pp. 80—83.

Zeuner, F. E., 1941. Geology, climate and faunal distribution in the Malay Archipelago. Proc. R. Ent. Soc. London, (A) vol. 16, pp. 117-123, 3 figs.

——, 1943. Studies in the Systematics of Troides Hübner (Lepidoptera Papilionidae) and its Allies; Distribution and Phylogeny in Relation to the Geological History of the Australasian Archipelago. Trans. Zool. Soc., London, vol. 25, pp. 107-184, 115 figs.

## EXPLANATION OF THE PLATES

### Plate I

Fig. 1. *Nyctalemon patroclus* (L.) ♂, Bachian (L), genitalia, slide 117.

Fig. 2. *Nyctalemon menoetius celebensis* subsp. nov. ♂, N. Celebes, ex coll. P. J. van den Bergh Lzn. (L), genitalia, slide 116.

Fig. 3. *Nyctalemon zampa zampa* Butl. ♂, Assam (J), genitalia, slide 119.

Fig. 4. *Nyctalemon zampa docilis* G., S. & Dr. ♀, Billiton (L), genitalia, slide 126.

All figures 5 × natural size.

### Plate II

Fig. 1. *Nyctalemon toxopeusi* spec. nov. ♀, allotype, Hollandia, 15 VII 1938, L. J. Toxopeus leg. (L).

Fig. 2. *Nyctalemon macleayi macleayi* (Montr.) ♂, Fakfak, 13 II 1907, Palmer van den Broek leg. (L), underside.

Figs. 3, 4. *Nyctalemon toxopeusi* spec. nov. ♂, type, Hollandia, 29 VII 1938, L. J. Toxopeus leg. (L), fig. 3 the underside.

All figures ¾ natural size.

### Plate III

Figs. 1, 4. *Nyctalemon mutatus* (Butl.) ♂, Gizo Is., 1903, Meek leg. (BM), fig. 4 the underside.

Fig. 2. *Nyctalemon mutatus* (Butl.) ♂, Florida Is., Meek ex Janson (BM).

Figs. 3, 5. *Nyctalemon mutatus* (Butl.) var. *fletcheri* var. nov. ♂, type, Bougainville, ex coll. A. J. Buis (A), fig. 3 the underside.

Fig. 6. *Nyctalemon mutatus* (Butl.) var. *fletcheri* var. nov. ♀, allotype, Bougainville, ex coll. A. J. Buis (A).

All figures ¾ natural size.

### Plate IV

Fig. 1. *Nyctalemon menoetius celebensis* subsp. nov. ♂, type, N. Celebes, 1912, ex coll. P. J. van den Bergh Lzn. (A).

Fig. 2. *Nyctalemon menoetius celebensis* subsp. nov. ♀, allotype, N. Celebes, 1912, ex coll. P. J. van den Bergh Lzn. (A).

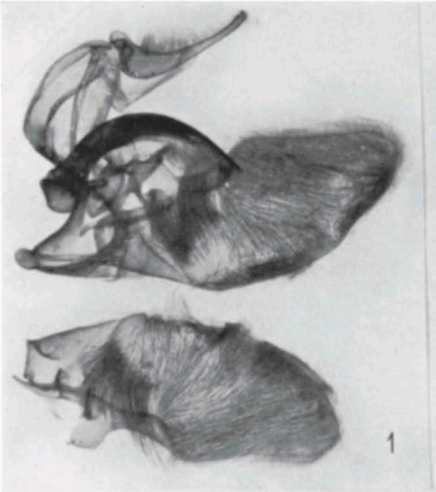
Fig. 3. *Nyctalemon menoetius adspersus* subsp. nov. ♂, type, E. Borneo, Kariorang, 14 I 1937, Quarles de Quarles leg. (W).

Fig. 4. *Nyctalemon zampa dilutus* Röber ♀, Minahassa, 1920, ex coll. P. J. van den Bergh Lzn. (A).

Fig. 5. *Nyctalemon zampa dilutus* Röber ♂, Minahassa, ex coll. P. J. van den Bergh Lzn. (A).

All figures ¾ natural size.

N.B. In all the figures of plates II-IV the light bands of the fore wings show somewhat wider and brighter than they really are.



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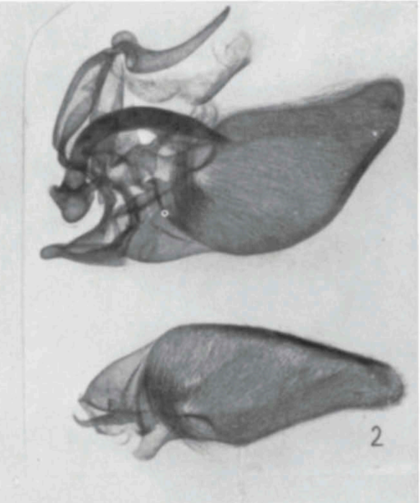

2

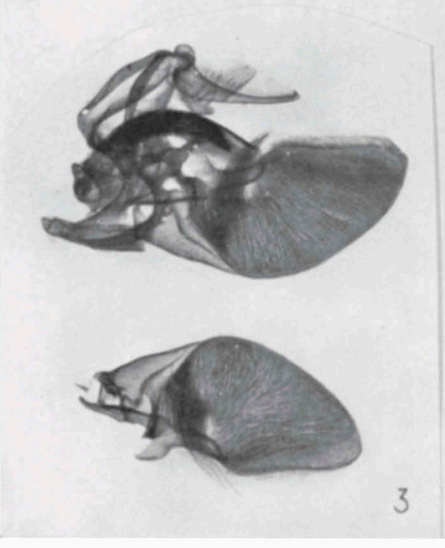

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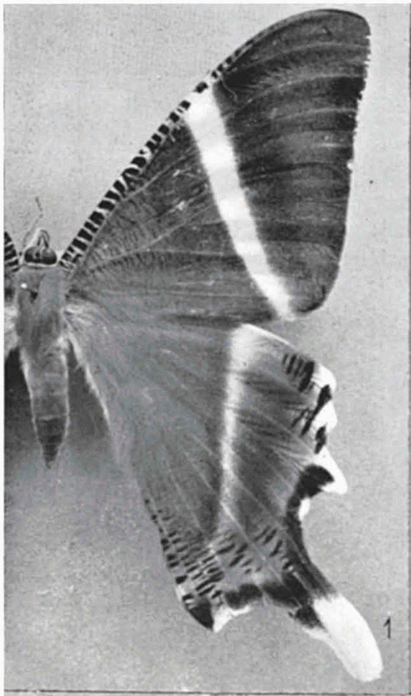
PLATE II



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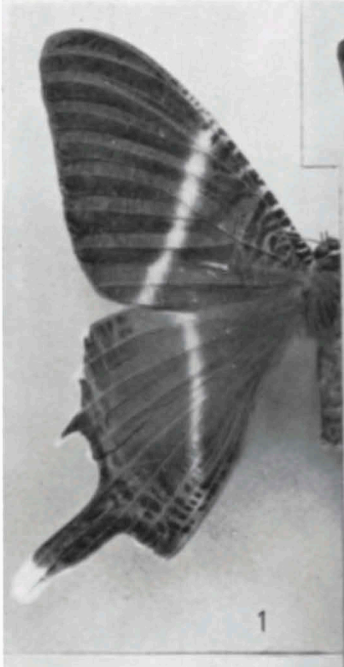
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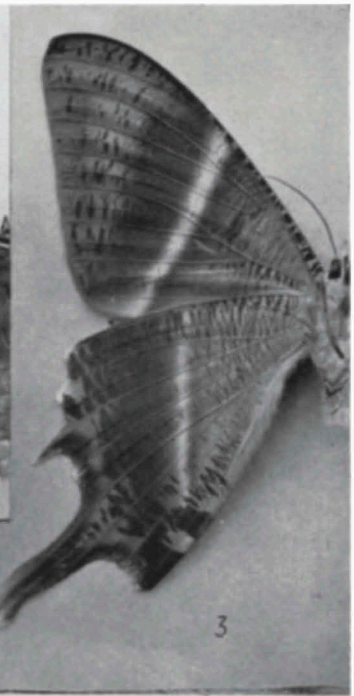
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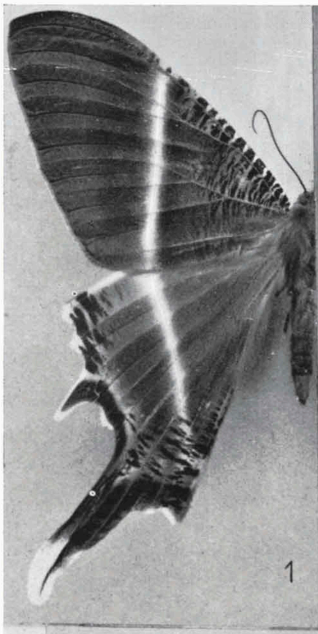
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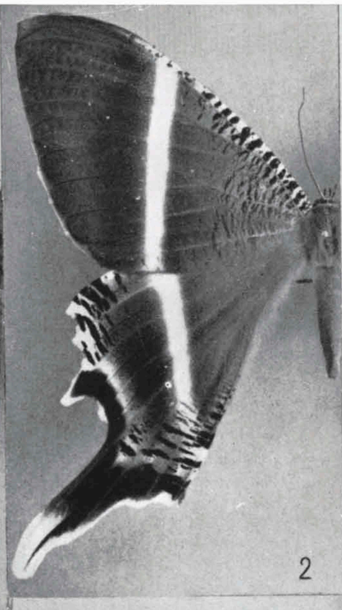
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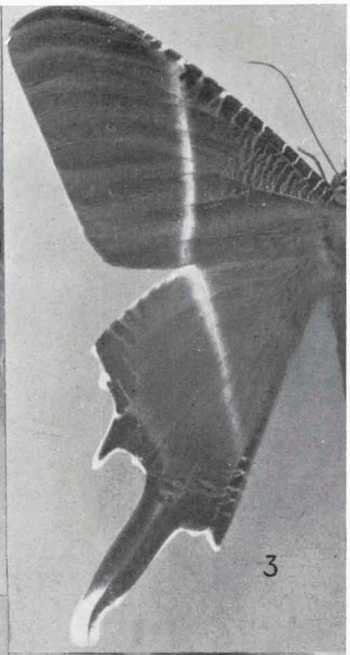
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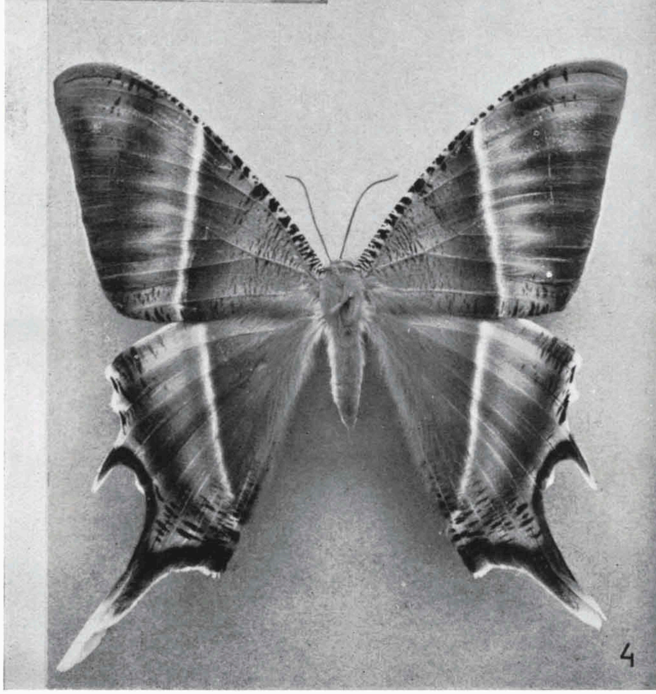
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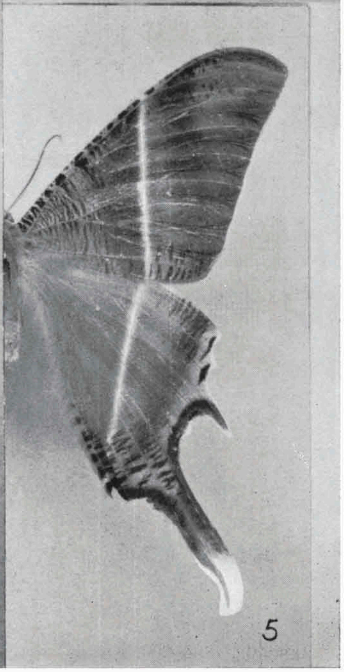
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