

## REVISIONAL NOTES ON SOME SPECIES OF *COPERA* KIRBY,

With notes on habits and larvae (Odon., Platycneminidae).

By

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### Introduction and Acknowledgements.

The present short paper is the outcome of an effort to identify a rich material of *Copera* collected for me in Borneo by Mr. L. COOMANS DE RUITER and Mrs. M. E. WALSH, in the island of Billiton by Mr. F. J. KUIPER, and in Sumatra and Java by L. COOMANS DE RUITER, Dr. M. BARTELS, Dr. L. J. TOXOPEUS and myself.

DE SELYS, who founded the genus *Psilocnemis* (recte *Copera* KIRBY) in 1863, had but 2 specimens of only 1 species of the group discussed in this paper; 2 other species which he had not seen himself were described as new after descriptions he got from H. A. HAGEN; when he revised the genus in 1886, SELYS had about 5 specimens of supposedly 2 species, the others he had not seen; KRÜGER had not examined the earlier described species and therefore described 2 new species of which he possessed 24 specimens (from N.E. Sumatra only). RIS (1915 and 1926) had 13 specimens of the two species described by KRÜGER.

For the present study 235 (181 males, 54 females) have been available from the Buitenzorg Museum's collections and those lent by various other Museums. Very important assistance has been afforded by M. ANTOINE BALL (Brussels Museum) in giving opportunity to study the type of *Psilocnemis vittata* SELYS, by Lt.-Col. F. C. FRASER for giving me specimens of *C. vittata deccanensis* LAIDLAW, by Mrs. HOWARD K. GLOYD (Michigan Museum, Ann Arbor) for the loan of FÖRSTER's specimens of *C. vittata acutimargo*, by Dr. W. LUDWIG (Zool. Institut, Halle a.S.) for the loan of the type of *Psilocnemis imbricata* SELYS, and by Mr. KAI HENRIKSEN (Zool. Museum, Copenhagen) for the loan of the type of *Psilocnemis serapica* SELYS.

Mr. KENZO KUWASIMA (Maloong, P.I.), Messrs. P. BUWALDA (Buitenzorg) and J. C. VAN DER MEER MOHR (Medan), and Fr. Dr. ELLI FRANZ (Naturmuseum Senckenberg, Frankfurt a.M.) have supplied valuable material with their usual generosity. To all these friends I would extend my hearty thanks for their kind help.

### Historical summary.

In 1863, in his "Synopsis des Agrionines", DE SELYS established the genus *Psilocnemis* for two groups of species, viz. *marginipes* RAMB. and *ciliata* SELYS. The type-species of the first group was *marginipes* RAMB., the first described



species of the second group being *annulata* SELYS. In group I 5 species were placed that were described successively as *marginipes* (RAMB.) from Java and Malaya, *striatipes* SELYS from Java, *vittata* SELYS from Malaya, *serapica* SELYS from the Nicobars, and *imbricata* SELYS from Padang, W. Sumatra; the latter two were described after notes furnished by HAGEN. Group II, "2me groupe (*Ps. ciliata*)" contained 2 species, the first of these being *annulata* SELYS, from Shanghai, the second *ciliata* SELYS, from Malaya. Group I was separated from group II on the character of the armature of the posterior lobe of the ♀ prothorax.

In 1886, in his "Revision du Synopsis des Agrionines", DE SELYS placed *striatipes* correctly as a synonym of *marginipes*. Unfortunately enough, great confusion was caused by the removal from group I to group II of *serapica*, which he knew only from HAGEN's description. At the same time he added one species, *atomaria* from N.W. Borneo, to the first group as a race of *imbricata*.

The type of the two species, *vittata* and *atomaria*, were in two European Museums, and there is nothing to indicate that direct comparison of the two was ever made. At the present time there is no reason for thinking the two species are not conspecific.

At the end of his description of *Ps. atomaria* DE SELYS remarks: "L'*atomaria*, la *serapica* (si elle en est distincte), la *vittata* et la *marginipes* ont entre elles la plus grande analogie, et pourraient bien n'être au fond que les races locales d'une seule espèce primordiale si l'on admet que la dilatation des tibias et la longueur des appendices anals supérieurs des mâles peuvent varier du plus au moins dans une certaine limite". (p. 123).

The confusion which has arisen in the synonymy of this cluster of species and races is entirely due to the fact that the various 'species' were founded only on males from various localities scattered all over the archipelago. By the absence of females of *vittata*, *imbricata* and *serapica*, DE SELYS could do hardly more than pointing out the relationships. On the other hand, everything points to the fact that he did not compare the ♀ prothorax of the common *marginipes* with that of *atomaria*, which was the only species of which he had seen the female.

Group I thus included 4 species: *marginipes* (RAMB.), *vittata* SELYS, *imbricata* SELYS, and *atomaria* SELYS. As we have seen already, one species, viz. *serapica* from the Nicobars, for some inexplicable reason was placed in group II as a race of *annulata*, while *subannulata* SELYS from Tenasserim and Calcutta, and *ciliata* SELYS from Malaya also stood as races of *annulata*.

Of group I, *Copera marginipes* (RAMB.) is well known and will not concern us here. Of group II, LAIDLAW (1917) suggested that the large and well known species *annulata* is one of which long series are necessary for determining the value of the differences which exist between individuals. It is generally accepted by present writers, including I think LAIDLAW himself, that the 'races' *ciliata* and *subannulata* are merely colour-varieties of *annulata*, as is the case with *stevensi* LAIDLAW (1914) from Assam. *C. annulata* is easily distinguished from *marginipes* and the *vittata* group so that it is left out of consideration here.



KIRBY (1890) first designated a genotype (*marginipes* RAMBUR) for *Copera*, the substitute created by him to replace the preoccupied generic name *Psilocnemis* SELYS. KIRBY also catalogued the above-mentioned species.

Owing to the small amount of material which was accessible to previous writers and the consequent uncertainty as to the validity of supposedly specific or subspecific characters, the exact identification of the species of the *vittata* cluster of *Copera* has been a matter of much difficulty. Because of the inadequacy of the earlier descriptions nobody has been able to certainly identify HAGEN's species *serapica*, and it was no easy matter either to decide just what SELYS's *vittata* really was.

In 1898, KRÜGER, while engaged with a study of two closely allied Sumatran species of the *vittata* group, cut the Gordian knot and created two new names for the reception of these species. His introductory remarks are very instructive:

"SELYS unterscheidet bei *Psilocnemis* in seiner Revision fünf Arten mit noch vier Rassen, von denen *alatypes* MAC LACHLAN von Madagascar hier nicht in Betracht kommt. Die Art *annulata* SELYS mit ihren Rassen *subannulata* SELYS, *serapica* HAGEN, *ciliata* HAGEN ist durch Größe (bis 37 mm Abdomen) und ihr Aussehen augenfällig unterschieden von den bleibenden *vittata* SELYS, *imbricata* HAGEN mit Rasse *atomaria* SELYS, *marginipes* RAMBUR; nur *serapica* HAGEN soll ♂ 32, ♀ 29 mm Abdomenlänge haben, somit den kleineren Arten sich nähern. Es sollen die grösseren Arten sich von den kleineren besonders dadurch unterscheiden, dass bei ihren ♀ der Hinterrand des Prothorax nicht nach vorn umgebogen ist. In die Gruppe *annulata* hat SELYS in der Revision *serapica* aufgenommen, obwohl er in der Synopsis das Gegentheil in Betreff des Prothorax beschreibt; anderseits spricht er in der Revision die Vermuthung aus, dass *serapica* von der kleinen *atomaria* nicht verschieden ist. Die kleinen Arten sollen sich im ♀ durch den Prothorax von den grossen unterscheiden, und dabei kennt SELYS weder von *vittata* noch von *imbricata* das ♀, sondern nur von *atomaria* (hier auch nur junge, weisse Thiere) und *marginipes*. SELYS befindet sich somit, wie er auch selber andeutet, in grosser Verlegenheit über diese Arten, dies besonders auch deshalb, weil die ♂ derselben fast gar keine deutlichen Unterscheidungsmerkmale haben, und weil die früher als *striatipes* SELYS beschriebenen ♀ als Art aufgehoben und theils *atomaria*, theils *marginipes* zugetheilt werden mussten. Dazu kommt noch, dass die jungen Thiere dieser Arten sämmtlich von weisser Farbe sind und früher als *Platycnemis lacteola* SELYS, *Psilocnemis serapica* var. *pallida* von ihm beschrieben wurden. Es ist daher ohne Vergleichung mit den Typen einfach unmöglich, nach SELYS diese Arten zu bestimmen." (KRÜGER, *l.c.* p. 103 - 104). KRÜGER was therefore fully justified to say that: "Bis ihre eventuelle Identität mit *vittata*, *imbricata*, *atomaria*, *serapica* nachgewiesen wird, [sind] als neue Art[en] zu betrachten: *Psilocnemis acutimargo* n. sp. und *Ps. lobimargo* n. sp." (*l.c.* p. 106).

As these names imply, the characters employed by KRÜGER are mainly based on the structure of the posterior lobe of the ♀ prothorax, and with the



help of his descriptions the discrimination of two closely allied but yet quite distinct species was no longer a matter of much difficulty.

FÖRSTER (*l.c. postea*, 1907, p. 7) followed SELYS and at the same time mistook KRÜGER's *lobimargo* for *marginipes*. But he goes further than SELYS when he says: ..... "This type, *Psilocnemis vittata vittata* DE SELYS, includes three well-marked races, namely, *Psilocnemis vittata imbricata* HAGEN (found in Padang in Sumatra, synonymous with *Ps. acutimargo* KRÜGER), also *Ps. vittata serapica* HAGEN, found in the Nicobars, and *Ps. vittata atomaria* DE SELYS, from Borneo." (Translated by F. F. LAIDLAW).

*C. atomaria* is synonymous with *vittata vittata* and *C. imbricata* is considered a good species, although even now there remains some slight doubt as to the correct determination of *imbricata*, of which I have not seen topotypical females. Further notes on this species are given *postea*.

In 1915, RIS described additional material from the island of Simaloer under the specific name of *acutimargo* employed by KRÜGER, and figured, for the first time, the prothorax of the female. The same writer, in his "Odonaten von Sumatra" (1936) gave a comparison of KRÜGER's two species with the widely spread and common *C. marginipes*, and in a first key to the species, introduced some characters not employed by his predecessors, besides giving excellent figures of the prothorax of the female of *marginipes* and *lobimargo*. We will soon see that some of these characters are ontogenetic and variable, and therefore not necessarily specific characters, as assumed by RIS. Immediately following the tentative key to the species, RIS attempted to homologize the earlier described species of HAGEN-SELYS with KRÜGER's insects but because of the inadequacy of the earlier descriptions his treatise on the synonyms was wrong.

No efforts have since been made to examine the types of *vittata*, *serapica* and *imbricata*, and although SCHMIDT (1934) discussed 6 males and 5 females from Central South Sumatra, giving useful sketches of the ♂ thorax, this species was wrongly identified as *acutimargo*. Through the kind help of Mr. COOMANS DE RUITER I have been able to examine quite similar specimens from the same region, and these are discussed below under the name *vittata*.

#### Synonymy of Species and Subspecies.

A careful examination of the various forms and a comparison of the material studied with the existing types has resulted in the following arrangement and synonymy: <sup>1)</sup>.

*Copera vittata vittata* (SELYS), 1863. — Terra typica: Malay Peninsula.

Syn.: *Psilocnemis atomaria* SELYS, 1886.

*Copera vittata deccanensis* (LAIDLAW), 1923. — Terra typica: Cochin State, S.W. India.

*Copera vittata serapica* (SELYS), 1863. — Terra typica: Nicobar Is.

*Copera vittata acutimargo* (KRÜGER), 1898. — Terra typica: N.E. Sumatra.

<sup>1)</sup> *Copera assamensis* LAIDLAW, which is possibly also a subspecies of *vittata*, has been left out of consideration here.



*Copera vittata javana*, subsp. n. — Terra typica: S.W. Java.

*Copera vittata palawana*, subsp. n. — Terra typica: Palawan.

*Copera imbricata* (SELYS), 1863. — Terra typica: W. Sumatra.

Syn.: *Psilocnemis lobimargo* KRÜGER, 1898.

In connection with the preceding list of species and subspecies, it may be pointed out that the arrangement adopted is largely that suggested by DE SELYS as early as 1886, at least so far as the subspecies *atomaria* and *serapica* are concerned. Further, the chief result of my studies has been that most of the species described by early writers may be retained as subspecies of *vittata* SELYS.

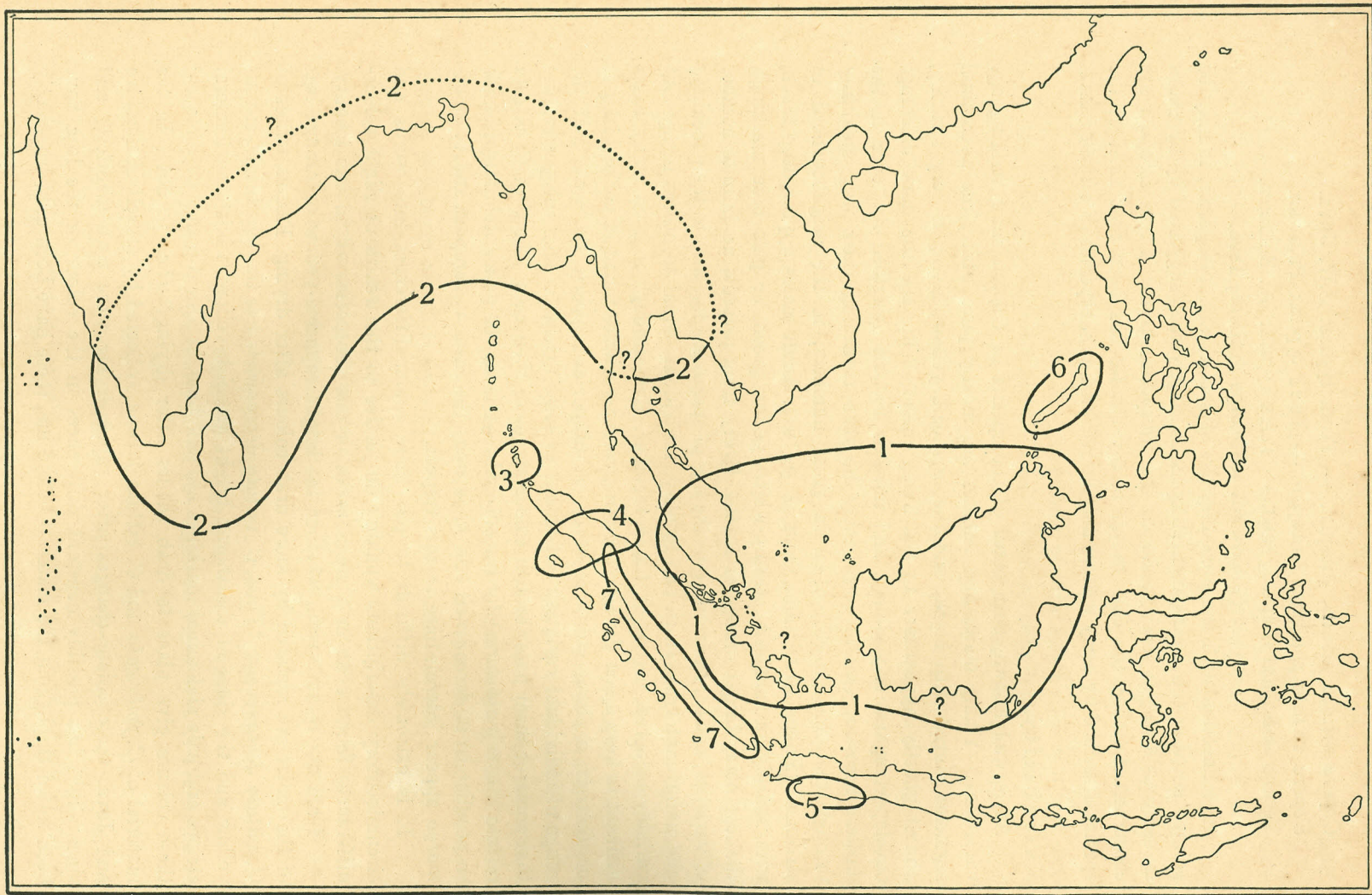
#### Variability.

As is well known, both sexes of the species of *Copera* show striking age variations. Young males and females are mostly pure white, the abdominal segments ringed with black, and the legs pale yellow, giving a very striking, almost ghostly appearance to the living insect. With age the dark markings develop comparatively slowly, and thus, as FRASER described it, "even in the darkest recesses, teneral forms may be seen threading their way stealthily through the undergrowth, often in great numbers, in the neighbourhood of streams." (Fauna Brit. India, Odon. I, p. 191). Adult males appear deep black, with sharply pronounced, creamy-white, yellow green, or pale blue markings, the legs being bright orange or rufous. Every form presents an infinite number of varieties, not only according to the age of specimens but also to their locality; and unfortunately, even in one locality, individuals equal to others in age but variably coloured, are to be found together. But although it is in many cases difficult to keep apart the corresponding colour-varieties found in various islands or districts, a closer study of races or subspecies supports the view that the range of individual variation is peculiar to some extent to each subspecies, and that some of them pass through colour-stages of their own. The ♂ of *C. vittata vittata* (SELYS's *atomaria*) for instance, always lacks the pale antehumeral bands so peculiar to *v. deccanensis* and *v. javana*; the races *v. serapica* and *v. acuti-margo* appear intermediate in this respect.

It is extremely difficult to put these colour-differences into words and circumlocutory descriptions wouldn't do justice to the wealth of slight colour-differences found even in a small series of one subspecies all in one locality.

I am not quite certain whether the bright capucine-yellow or orange legs of the males are replaced by more drab colours after drying. FRASER writes of *C. vittata deccanensis*: "Thus, *C. vittata deccanensis* has the legs bright citron-yellow and the sides of the thorax bright greenish-yellow, whilst the humeral stripes and pale abdominal markings are pale blue, as also the anal appendages; these colours give place to drab shades after drying." (*l.c.*; p. 201). In the material of *C. imbricata* and *C. vittata javana*, collected by myself in Sumatra and Java, these colour-changes after rapid drying were not manifest; and since slight but possibly constant differences in the colour of the legs have been found throughout the material before me, these have been used transiently





Map showing distribution of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS).  
 1. *C. vittata vittata* (SELYS). — 2. *C. vittata deccanensis* (LAIDLAW). — 3. *C. vittata serapica* (SELYS). — 4. *C. vittata acutimargo* (KRÜGER).  
 — 5. *C. vittata javana*, subsp. nov. — 6. *C. vittata palawana*, subsp. nov. — 7. *C. imbricata* (SELYS).



in the key to the subspecies of *vittata*. However, in view of the great ontogenetic variation in colours, these differences should be relied upon with caution.

#### Structural Characters.

The males of *Copera* present marked individual variation. It has been found that the extent of the pale colour of the last segments of the abdomen, a character employed by KRÜGER and RIS, is of no value in discriminating species or subspecies. It has further been ascertained that the ratios between the length of hinder wing and abdomen, in individuals of one species or subspecies from one locality, vary considerably and hence cannot be used as a means of distinction.

The most valuable specific and subspecific characters are found in the degree of dilatation of the hind tibiae, and in the anal appendages of the male. These differences are enumerated in the key and figured on the accompanying plates.

A character which is constant for *C. imbricata* and all the races of *C. vittata* but one which I have not seen noted, is that the superior anal appendage carries on its ventral surface a very distinct tooth- or rather more hook-like projection. This hook originates from the middle of the appendage, at its extreme base, and is best visible when looked at from behind. Sometimes the spur is well visible in side-view but ordinarily it is concealed and not visible without a partial removal of the inferior appendage. In *C. imbricata* this inconspicuous projection is narrow basally and very slenderly hooked, whereas in all the races of *vittata* it is broadly triangular at base, much more flattened dorso-ventrally, with the apex narrow and curved downwards or upwards, according to its position. This slight but noteworthy difference in the shape of the basal spur in the males of *C. vittata* and *C. imbricata*, may indicate some interesting sexual co-adaptation. As the prothorax and anterior border of the mesonotum are armed quite differently in the females of these two species, it would be interesting to correlate definitely the structures of the two sexes of each species when in the copulatory position.

The males, although better known, are much less easily characterized than the females, which have as very useful distinguishing characters the remarkable structure of the posterior margin of the prothorax and the shape and extent of the median process of the anterior border of the mesonotum. By the employment of these characters it is possible to subdivide the species *vittata* into a number of clearly defined subspecies. In the latter case it must be noticed that in those races in which lateral developments of the hind margin of the prothorax occur, these developments are relatively weakly chitinized and some variation or post-mortem distortion must be looked for.

#### Geographical Distribution.

According to present information the genus *Copera* extends from India through Indo-China and China to Japan and Formosa, and south-eastwards through the Malay Peninsula as far as the Lesser Soenda Islands, Flores and Soemba. Two species are found in the Ethiopian Region.



The distribution of the two Asiatic species discussed in this paper is still very incompletely known and much, still, remains to be learned concerning the limits and areas of distribution of *C. imbricata*, and perhaps even more of the races *deccanensis* and *acutimargo* of *C. vittata*.

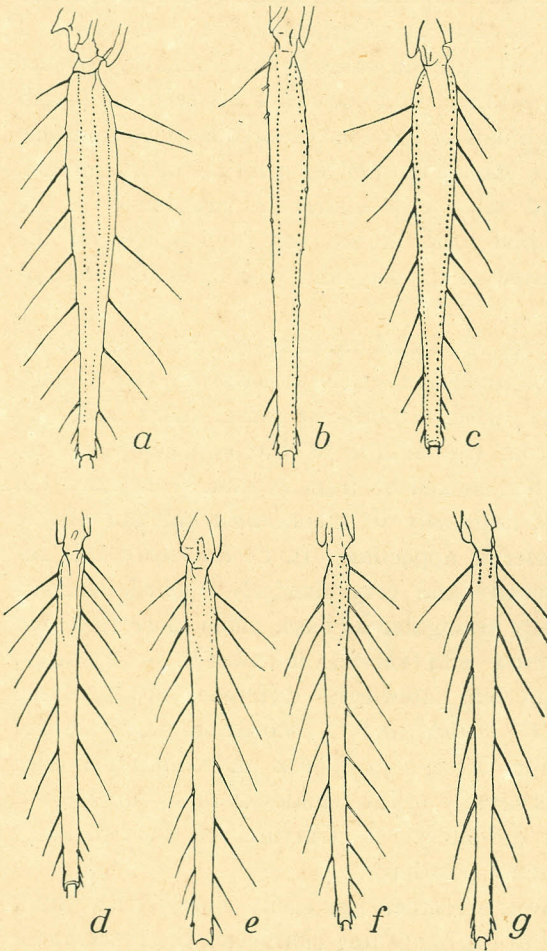


Fig. 1. — Posterior tibia of male *Copera vittata serapica* (a); *C. v. deccanensis* (b); *C. v. javana* (c); *C. v. vittata* (Billiton, d); *C. v. palawana* (e); *C. imbricata* (lectoholotype, W. Sumatra, f); *C. imbricata* (S. Sumatra, g).

*nensis* the exact limits of variation and of its distribution are unknown. It is most nearly related to *acutimargo*, from N.E. Sumatra and Simaloer, and these races possibly intergrade in Burma and Lower Siam, from where I have not seen specimens <sup>1</sup>). This race is also reported from the Mergui Archipelago but the record needs confirmation.

The restricted distribution of *imbricata* and each subspecies of *C. vittata* is the more remarkable when contrasted with that of the allied species *C. marginipes*, with which they are nearly always associated in India, the Malay Peninsula, Sumatra and Java. This common species is distributed all over the continent of southeast Asia; but although it ranges to the islands of Flores and Soemba in south-easterly direction, it has not, so far as I am aware, been reported from Borneo, the Philippines or Celebes.

As far as our present knowledge goes, *C. imbricata* is confined to the islands of Sumatra, from 'Soekaranda' on the northern slope of the van Heutsz Mts. (Wampoe River plain) southwards to the Ophir district, and thence west of the Barisan Range to Padang, Benkoelen and the southern Lampoeng districts, where it is very common. A northern and a southern subspecies of *imbricata* may ultimately prove definable.

The races of *C. vittata* are best defined. Of the Indian *decca-*

<sup>1</sup>) *Copera vittata assamensis* LAIDLAW, which I have not examined, is considered a distinct species by FRASER (cf. LAIDLAW, *loc. cit. postea*, 1914, and FRASER, *l.c.* p. 201-203). According to FRASER, it ranges from Assam to Indo-China and fills up the gap on our map showing the distribution of subspecies.



*C. vittata serapica* is a well-marked race, probably confined to the Nicobar Islands. The typical subspecies *vittata* inhabits the southern Malay States (northern limits unknown), and the whole of the great plains of S.E. Sumatra; it is common all over the island of Billiton and apparently universally distributed in the lowlands of Borneo. *C. vittata vittata* varies considerably in colour throughout its range, but the structural characters are remarkably constant. I have neither seen examples from the islands of Banka, nor yet from the lowlands of South Borneo, but it will doubtless turn up there sooner or later.

A very distinct subspecies occurs in the wooded districts of South Java; this race, *javana* subsp. n., appears to be closely related to the Indian *decanensis*.

Lastly, the most eastern subspecies, *palawana* subsp. n., is found in the island of Palawan. It shows remote affinities with typical *vittata* and structurally comes very near to it, but its colours are very different, and it is remarkable on account of its extreme melanism.

#### Key to the Species and Subspecies <sup>1)</sup>.

The following table shows the grouping of *imbricata* and the subspecies of *vittata*, which I suggest, and indicates the characters, chiefly structural it is true, on which I rely to establish them. Except where some specific condition demands mention of them, the details of the coloration of the body are given under each subspecies or are expressed in the colour-pattern diagrams on pls. 10 - 12, and are not repeated in the key.

1. ♂. Sup. anal apps. divergent, usually less than half as long as the inferior pair, their inner margin at first parallel in dorsal view, thence distinctly and rather abruptly divaricate with slightly outbent tips; in side-view rather swollen before the middle, with the apices slender and depressed. Inferior ventro-basal tooth very slender and hook-like from base to apex, the tips finely curled (pl. 13 fig. 8a). Inf. apps. in dorsal view broad at base, basal third at most with a blunt, obtuse-angulate or slightly irregular projection along inner margin, thence tapering very gradually towards the apex which is broadly rounded; in side-view broad at base and almost straight, thence slightly and evenly downbent, tapering very gradually to a rounded, obtuse apex (pl. 13 fig. 3 and 8). Humeral pale lines complete though narrow. Thoracic sides variably mottled with brown; upper half of mesepimera for the greater part pale-coloured (pl. 10, fig. 6 - 8). Legs orange-buff to capucine-orange. Apices of all femora finely bordered with black. Posterior two pairs of tibiae not noticeably dilated (fig. 1 f-g). —

<sup>1)</sup> *Copera vittata assamensis* is omitted from this key.




- ♀. Posterior lobe of prothorax short and broad, depressed and of simple structure, its hind border with a shallow median concavity lacking any protuberances; the lobe in side-view is directed straight backwards and appears roughly triangular in outline. Antero-median mesonotal projection extremely short, its anterior border almost in a straight line with the laminae mesostigmales (pl. 14 fig. 8). Length: ♂ abd. + app. 28 - 33.2, hw. 16 - 18.5; ♀ 27 - 30, 17.8 - 20 mm. Hab.: Sumatra. .... *imbricata*.
- 1'. ♂. Sup. anal apps. directed almost straight backwards, at least half as long as the inferior pair; in side-view slightly swollen and noded before the apex. Inferior ventro-basal tooth broadly triangular, tapering gradually toward apex, which is acutely pointed (pl. 13 fig. 2a and 5a). Inf. apps. in dorsal view of slenderer build, more abruptly narrowed about their middle and provided along inner margin with obtuse or rectangulate protuberances; apices more or less pointed. Body-colouring and structure of legs variable. — ♀. Posterior lobe of prothorax of complex structure: usually deeply notched and with the angles of the lobe prolonged upwards and strongly forwards so as to form two divergent lobes of variable length and shape. Antero-median mesonotal projections sub-quadrangular, projecting anterad and beyond the anterior margin of the laminae mesostigmales (pl. 14 fig. 1 - 7). Size variable. Hab.: India to Borneo and Palawan.  
(*vittata*) 2
2. ♂. Legs black; posterior two pairs of tibiae not noticeably dilated (fig. 1e). Head above and thorax coloured blue and black (pl. 10 fig. 20 - 21). — ♀. Head and thorax deep black marked with palest bluish-white (pl. 10 fig. 22). Posterior lobe of prothorax shaped much as in *vittata vittata* (pl. 14 fig. 7). Length: ♂ abd. + app. 29.5 - 29.8, hw. 16.5 - 17; ♀ 28.5, 18 mm. Hab.: Palawan. .... *vittata palawana*.
- 2'. ♂. Legs pale-coloured. ♂♀. Head and thorax with no definite blue colouring. 3
3. ♂. Posterior two pairs of tibiae not noticeably dilated. — ♀. Lateral prolongations of posterior lobe of prothorax either rather short and horn-like, or very long, narrowly triangular and rather pointed apically. .... 4
- 3'. ♂. Posterior two pairs of tibiae distinctly dilated. — ♀. Lateral prolongations of posterior lobe of prothorax more or less rounded apically and usually in the form of broad lamellae. .... 5
4. ♂. Dorsum of synthorax with pale humeral stripes complete and sharply defined, a little narrower than in *deccanensis* (pl. 10 fig. 1 - 2); side predominantly pale-coloured, variably and similarly mottled with brown to *deccanensis* but dark markings on metapleurae ill-defined and paler. Legs carnelian-red. Anal apps. intermediate between *deccanensis* and *vittata*: superiors distinctly longer than half the inferior pair, slender and evenly narrowed posteriorly, without mesial sub-basal angular projection in dorsal view; inferiors similar in principle to *deccanensis* though still slenderer, the inner shelf-like projection less broad and the protuberances more obtuse;



apices rounded as in *deccanensis*. — ♀. Posterior lobe of prothorax very deeply notched and with the angles prolonged and strongly recurved so as to form two long, divaricate, narrowly triangular, pointed lobes that ly on the back of the prothorax. Antero-median mesonotal projection saddle-shaped, much swollen basally (pl. 14 fig. 3). Length: ♂ abd. + app. 31 - 32.2, hw. 16 - 17.5; ♀ 28.5 - 29.5, 18 - 19 mm. Hab.: N. Sumatra.

*vittata acutimargo.*

4. ♂. Dorsum of synthorax with pale humeral stripes incomplete or absent altogether, usually consisting of a row of separate spots or points; sides predominantly brown or blackish-brown, especially on mesepimera; metapleurae variably mottled with yellow. Legs capucine- to mikado-orange. Anal apps. shorter and less slenderly built, superiors about half as long as inferior pair, with a distinct mesial, sub-basal, angular projection in dorsal view; inferiors with two low mesial protuberances along margin of basal third; apices bluntly pointed (pl. 13 fig. 5 - 6). — ♀. Posterior lobe of prothorax short and broad, recurved; median incision very broad and -shaped, with the angles produced into short and small, divaricate, flattened hooks, which project upwards and a little forwards or sideways (pl. 14 fig. 5 - 6). Subspecies usually of small size: ♂ abd. + app. 26 - 32, hw. 14 - 17.5; ♀ 24 - 28.5, 15.5 - 17.5 mm. Hab.: Malaya, Sumatra, Billiton, Borneo. .... *vittata vittata.*

5. ♂. Humeral pale stripes incomplete. Posterior two pairs of tibiae strongly dilated (fig. 1a). Legs long, rufous, femora not obscured apically. Metapleurae of thorax apparently unmarked (pl. 10 fig. 4). Inner margin of inf. anal apps. with the ante-median protuberances obtuse, only little projecting in dorsal view (pl. 13 fig. 2). — ♀. Posterior lobe of prothorax with the median division narrow in dorsal view, the angles prolonged upwards as rather narrow lobes (pl. 14 fig. 2). Length: ♂ abd. + app. 32.3, hw. 18; ♀ 29.2, 19.5 mm. Hab.: Nicobar Is. .... *vittata serapica.*

5'. ♂. Humeral pale stripes complete and rather broad (pl. 10 fig. 1, 2, 23). Posterior two pairs of tibiae less strongly dilated (fig. 1b, c). Legs shorter, differently coloured. Metapleurae striped with brown or blackish. Inner margin of inf. anal. apps. with the antemedian protuberances sharply pronounced, obtuse- or almost rectangulate in dorsal view. — ♀. Posterior lobe of prothorax with the median division broader in dorsal view, the angles broadly lamellar and only slightly upcurved. .... 6

6. ♂. Posterior two pairs of tibiae only slightly dilated (fig. 1b). Legs carnelian red. Sup. anal. apps. in side-view rather inflated on middle, apices twisted and broadly rounded (pl. 13 fig. 1). — ♀. Posterior lobe of prothorax very broad, shallowly notched, angles widely divaricate, projecting forwards and slightly upwards as broad, ear-like lobes (pl. 14 fig. 1). Hab.: India.

*vittata deccanensis.*

6'. ♂. Posterior two pairs of tibiae markedly dilated (fig. 1c). Legs mikado-



orange. Sup. anal apps. in side-view thumb-shaped, apices not twisted (pl. 13 fig. 4). — ♀. Posterior lobe of prothorax narrower, deeply notched, angles slightly divaricate, projecting almost straight forwards as oval blades (pl. 14 fig. 4). Hab.: Java. .... *vittata javana*.

**Copera vittata deccanensis** LAIDLAW.

1923. LAIDLAW, Rec. Ind. Mus. 13, p. 337-339. — ♂♀ Cochin State, S. W. India.  
 1923. FRASER, J. Bomb. Nat. Hist. Soc. 29, p. 744.  
 1924. FRASER, Rec. Ind. Mus. 26, p. 428, 498 (distrib., biol. notes). — S.W. India.  
 1931. FRASER, Ibid. 33, p. 448 (distrib.). — India.  
 1933. FRASER, F. B. I. Odon. I, p. 192 (key), 198-201, fig. 88a-b (heads ♂ Bengal-Burma & S. India), 89 (apps. ♂ S. India). — ♂♀ "India, Bengal, Assam, Burma, Siam" (*vittata*).  
 1933. FRASER, J. Bomb. Nat. Hist. Soc. 36, p. 608 (key), 612-614, fig. 2c (head ♂). — "India, Assam, Burma, Siam" (*vittata*).

Material studied: — 9 ♂, 2 ♀ (juv.-ad.), from S. Peninsular India. — 4 ♂, 1 ♀, Nilgiris, 3000 - 3500', Wynaad, 19.XI.1922, Nadgani, 24.VIII.1922, Deva-lashok, 16.X.1921; 1 ♂, Gudalur, 4000'; 2 ♂, 1 ♀, Coorg, Makut, 29.XI.1923, and Srimangala, 20.I.1924; all Lt.-Col. F. C. FRASER leg.; 2 ♂, Palni Hills, 3500 - 4000', 28.VIII.1923, Major FRERE leg. All in the author's collection.

Resembling pale specimens of *C. vittata javana* but legs differently coloured, tibiae of posterior two pairs less markedly dilated, and apical segments of abdomen more extensively pale-coloured.

Male (ad.). — Head, prothorax and thorax rather similar to *javana* (pl. 10 fig. 1-2). Humeral pale bands complete and very wide, especially ventrally, where they are only little narrower than the episterna. A yellow line bordering the median carina. Thoracic sides variably marked with brown; metepisternal and metepimeral stripes confluent, as is the dark stripe covering the second lateral suture. Venter pale-coloured.

Legs unicolorous carnelian-red, femora not obscured apically. Posterior two pairs of tibiae only slightly dilated (much less so than in *v. javana* and *v. serapica*).

Abdomen comparatively very long, coloured similarly to the other sub-species. The pale basal rings of the segments 3 - 7 whether or not interrupted mid-dorsally, greenish- or bluish-white in well-preserved examples. Segm. 9 bears a large cream-coloured spot covering most of the dorsum. In 3 males (adults from Makut, Coorg, and the Palni Hills), this spot extends from end to end, occupying the entire dorsum; on the apical half it covers also part of the sides, while it is slightly narrowed and restricted to the dorsum on the basal half of the segment. In the remaining specimens only the apical half to two-thirds of the segment are marked with white, the pale spot being three-pronged or three-lobed anteriorly. Segm. 10 entirely cream-coloured.



Anal appendages shaped as on pl. 13 fig. 1; yellowish-white, inferior pair with some basal, interior, dark streaks, a stripe on their ventral surfaces, and with the apices blackish.

Female (ad.). — The two specimens in our collection agree in most respects with FRASER's descriptions of this sex. This author's notes on the shape of the posterior lobe of the prothorax, however, are incorrect ("posterior lobe deeply notched, with a small median lobe lying within it, angles of lobe prolonged as fine spines, strongly divergent forwards", *loc. cit.* 1933, p. 200). In the two females examined by me, the lobe is neither deeply notched, nor are the angles of the lobe prolonged as fine spines; in fact, the posterior lobe is only shallowly notched, while the angles are prolonged as very broad ear-like lobes, which are directed forwards and a little sideways (pl. 14 fig. 1, Nadgani, Nilgiris).

The ventral surface of the thorax is either entirely unspotted, or bears three blackish streaks, two elongate lateral ones, and one, rather more roundish, spot on the middle of the poststernum (intersternum of GARMAN, 1917). Lastly, it may be well noted that the blackish marks on the terminal abdominal segments vary a great deal in size and shape.

Length: ♂ abd. + app. 32.5 - 35.2, hw. 17.8 - 19.2; ♀ 29.5 - 32, 19 - 20 mm. (FRASER, *loc. cit.*: ♂ 28 - 34, 16 - 18; ♀ 28 - 30, 18 mm, Indian specimens only?).

#### ***Copera vittata assamensis* LAIDLAW.**

1914. LAIDLAW, Rec. Ind. Mus. 8, p. 342 - 343. — ♂ (♀?) Upper Assam.

1917. LAIDLAW, Rec. Ind. Mus. 13, p. 338 (diagnosis).

1933. FRASER, F. B. I. Odon. I, p. 608 (key), 614 - 615. — ♂ Assam; "Assam to Indo-China" (*C. assamensis*).

I have not seen this species, nor have I had opportunity to satisfy myself as to the correctness of the specific determination by FRASER, but, as Dr. LAIDLAW informs me, it appears distinct from *C. vittata deccanensis* LAIDLAW, and *vittata vittata* SELYS. According to LAIDLAW and FRASER, the position of the ♀ of *assamensis* is uncertain.

The following (incomplete) notes are taken from the original description:

♂. Legs rich russet-brown with black spines, the posterior pair of tibiae show a trace of dilatation.

Anal appendages dull brown, upper pair one half the length of lower pair. Both pairs straight, tapering, cylindrical.

♀. The prothorax has a pair of short forwardly directed spurs projecting from the middle of its dorsal posterior margin.

Length of abdomen ♂ 32, hind wing 17; ♀ 30, 17 mm. — 1 ♂, 1 ♀ N. Lakhimpur, base of hills, Upper Assam (H. STEVENS). The type is in the Indian Museum, Calcutta.



**Copera vittata serapica** SELYS.

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 171. — ♂♀ Nicobars (*Psilocnemis serapica*).  
 1886. SELYS, Mém. cour. Acad. Belg. 38 (4), p. 121 (key), 125. — ♂♀ Nicobars (*Psilocnemis annulata* race *serapica*).  
 1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (note) (*serapica*).

Material studied: — 1 ♂ (ad.), 1 ♀ (nearly ad.), labelled: "Nikobar maj(or)", "*Psil(ocnemis) serapica* Hagen ♂, ♀" (in HAGEN's hand), ♂ with additional label: "Hagen det.", in the Copenhagen Museum. These examples are selected here as lectoholotype ♂ and allotype ♀. (In the Copenhagen Museum are five more male paratypes of *serapica*, all topotypical and identified by HAGEN; these I have not examined).

The two specimens, male and female, now before me, need no full description. SELYS's notes on the colours of the male, copied from HAGEN's, apply perfectly to the one examined by me and are sufficiently detailed to justify its separation from *vittata* as a subspecies. ("Se distingue bien de la *vittata* par sa taille plus forte et les pieds du mâle dilatés", *l.c.* p. 171). Unlike *vittata deccanensis* the humeral pale thoracic band tends to become obliterated, as in typical *vittata*, but the sides of the thorax lack the dark stripes and spots so characteristic for that race, approaching typical *imbricata* from W. Sumatra very closely.

Thorax unicolorous ventrally, without black streaks.

The legs are rather long, uniformly rufous, without any indication of an apical obscuration of the femora. The femora, when adpressed to the body, reach the base of the second abdominal segment. Posterior two pairs of tibiae strongly dilated (fig. 1a).

Abdomen (pl. 11 fig. 1) with the posterior membrane of segm. 9 and most of segm. 10 maize-yellow, 10 with a black ring occupying about the basal one-sixth of the segment.

Superior anal appendages maize-yellow, ventro-basal tooth black. Inferior pair lemon-yellow, basal half of mesial tubercle black (pl. 13 fig. 2).

The female, although apparently quite matured, has the ground-colour of the body cartridge-buff. The dark marks on the anterior portion of the head are not sharply defined, brownish-black in colour, with a rusty tinge in front of frons. Prothorax entirely yellow, shaped as on pl. 14 fig. 2.

Dorsum of synthorax bronzed black on each side of the median carina, mesepimera marked with brown as shown on pl. 10 fig. 5. Venter pale.

Legs cream-buff to pale orange-yellow; apical margin of all femora and tibiae very narrowly and but slightly obscured.

Wings long, pterostigma pale brown surrounded by a whitish margin.

Abdomen cream-buff, segments diffusely ringed with brown apically, as shown on pl. 12 fig. 1; apical segments buff-yellow.

Length: ♂ abd. + app. 32.3, hw. 18; ♀ 29.2, 19.5 mm.



**Copera vittata vittata** SELYS.

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 170. — ♂ Malacca (*Psilocnemis vittata*).  
 1886. SELYS, Mém. cour. Acad. Belg. 38 (4), p. 121-122. — ♂ Malacca (*Psilocnemis vittata*).  
 1886. SELYS, *Ibid.*, p. 121 (key), 122-123. — ♂♀ Labuan, Borneo (*Psilocnemis atomaria*).  
 1902. LAIDLAW, P. Z. S. London, p. 386. — ♂♀ Kwala Aring, notes (*atomaria*).  
 1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (remarks on synonymy) (*vittata* with 'races' *imbricata*, *serapica* and *atomaria*).  
 ? 1914. LAIDLAW, Rec. Ind. Mus. 8, p. 342-343. — ♂♀ Upper Assam (*vittata assamensis*).  
 1917. LAIDLAW, Rec. Ind. Mus. 13, p. 338 (descr. ♂ Borneo) (*vittata atomaria*).  
 1920. LAIDLAW, P. Z. S. London, p. 334, fig. 3 (proth. ♀). — ♂♀ Sarawak (*atomaria*).  
 1931. LAIDLAW, J. Fed. Mal. States Mus. 16, p. 247. — Borneo, cat. (*atomaria*).  
 1934. SCHMIDT, Arch. Hydrob. Suppl. 13, p. 336, fig. 30b-c (thor. ♂). — ♂♀ Centr. S. Sumatra (*acutimargo*).  
 1935. LIEFTINCK, Misc. Zool. Sum. 92-93, p. 8 (pars!). — Sumatra (*acutimargo*).  
 1936. KIMMINS, J. Fed. Mal. States Mus. 18, p. 88. — ♂♀ Sarawak (*atomaria*).

Material studied: — 82 ♂, 33 ♀ from Malaya, S.E. Sumatra, Billiton, and Borneo (various districts). — 1 ♂ (ad.), labelled: "MAL/CA" (round), "Mal. W(allace)" (square, yellow, SELYS' hand), "*Psilocnemis vittata* D.S. ♂ Malacca" (brown, SELYS' hand), "*Ps. vittata* ♂" (yellow, SELYS' hand), holotype in the Brussels Museum. 2 ♂, 1 ♀ def. (juv.), Perak, Prof. RUD. MARTIN (RIS' hand), in the Senckenberg Museum (unnamed). Billiton I., 23 ♂, 11 ♀ (juv.-ad.): Tandjong Pandan, Ajer Nangka & Tjeroetjoek, 2.VIII, 5.IX, 12.X, 3.XI, 24.XII. 1935 & 21.I, 16.II, 31.III - 10.IV, VI & IX. 1936, all F. J. KUIPER leg. S.E. Sumatra: 3 ♂, 3 ♀ (juv.-ad.), Palembang Res., Palembang & Soengei Doea Rd., sea-level, 25.IX, 16-25.XI & 21.XII. 1937, L. COOMANS DE RUITER leg. 1 ♂, 1 ♀ (ad.), Riouw Res., Rengat-Inderagiri, Pangkalankasai, 2.IV. 1939, P. BUWALDA leg. Borneo: 7 ♂, 4 ♀ (juv.-ad.), W. Borneo, Singkawang distr., Tjapkala, Bakoean, Patengahan etc., 7-9.XII. 1931, 18.II & 4.IV. 1932, L. COOMANS DE RUITER leg. 42 ♂, 12 ♀ (juv.-ad.), E. Borneo, Koetai, Sangkoelirang, Pelawan Besar, Kariorang etc., III, V-VI. 1937, M. E. WALSH & J. W. QUARLES DE QUARLES leg. 1 ♀ (juv.), Centr. E. Borneo Expedition 1925, H. C. SIEBERS leg. 1 ♂ (juv.), Sarawak, Kuching, ROLLE vdt., 9.I. 1896, ex coll. F. RIS, in the Senckenberg Museum. 2 ♂ (ad.), Banguay (off N. Borneo), W. KEDENBURG, ded. 20.VII. 1894, in the Hamburg Museum.

Of the typical *Copera vittata*, I have been able to examine, and to study carefully, the type from "Malacca" (Singapore?) in the Brussels Museum collection, and a very large series of both sexes chiefly from various districts of Borneo, the island of Billiton, and from the lowlands of E. and S.E. Sumatra. These individuals tally very well with the type so that I have no doubt but that all these specimens are correctly referred to the present subspecies.

Apart from structural details, *C. vittata vittata* is chiefly characterized by its small size and dark body-colouring. The pale humeral stripes on the



dorsum of the synthorax are never complete, either indicated by irregular yellow lines and spots, or wanting altogether. The sides of the thorax are preponderantly blackish or brown, variegated with yellow.

The colour of the legs varies from capucine-orange to mikado-orange in all specimens from the Malay Peninsula, Billiton, Sumatra, and West Borneo; all of them agree in that the apices of the femora are finely bordered with black. In our series of males from East Borneo, however, the legs appear rufous, and there is no fine black line bordering the apical margin of the femora. Posterior two pairs of tibiae not noticeably dilated (fig. 1d).

**Male** (including type).—Head, thorax and abdomen, see pl. 10 fig. 13, and pl. 11 fig. 4 (holotype!). Posterior leg fig. 1d. Anal appendages pl. 13 fig. 5-6 (fig. 5 and 5a holotype!).

Apart from the type, there is a second male in the collection of the Brussels Museum, also collected by WALLACE in the Peninsula, which does not differ from the type.

In our material of the Malaysian islands two slightly different forms can be recognized, which do not differ structurally from one another.

a). Our examples from Billiton and western Borneo are among the smallest which I have examined:

Length: ♂ abd. + app. 26-29, hw. 13.5-15.5 mm. Proportionate measurements of abdomen and hind wing: 26:14, 26.5:13.5, 28:15, 29:15, 29:15.5.

Legs capucine- to mikado-orange.

b). Slightly larger: abd. + app. 28-32, hw. 15.5-17.5 mm. Proportionate measurements: 28:15.5, 30:16, 31:17.5, 32:16, 32:17.5.

Legs rufous.

**Female**.—The colour-variability of the ♀ of typical *vittata* is best understood from the drawings on pls. 10 and 12. Chiefly characterized by its small size, the short processes to the posterior lobe of the prothorax, and the dull colours. The great reduction of the dark transverse band crossing the posterior ocelli, on the vertex, is noteworthy, and I have not yet seen females presenting the more contrasting colour-pattern of blackish-brown and yellow as seen in *v. acutimargo* and *v. javana*.

Thorax pale greyish- or greenish-yellow. Median thoracic band dull bronze-brown, ill-defined on both sides and at all times with a fine sprinkle of pallid spots (whence SELYS's name *atomaria*!). Sides of the thorax also mottled and sprinkled brown and yellow. Venter usually unspotted: in adult specimens from E. Borneo the ventral surface of the metepimeron presents a dark longitudinal streak on either side, parallel to the lateral border.

Legs capucine- to orange-buff. A row of squarish black dots along dorsal surface of posterior pair (or two pairs) of femora. Apices of all femora finely bordered with brown or black.

Examples of this sex from East Borneo differ from those of other localities in our collection by the body-markings being darker and better pronounced, except for the colour of the head, which is identical. The posterior prothoracic



projections are small and triangular, and their upward or forward direction is subject to individual variation. The figures 5 and 6 on plate 14 represent two examples, picked out without purpose, from the west- and east-coasts of Borneo.

Measurements. — Abd. 25 - 27, hw. < 16 - 16.5 (Sumatra); 24 - 26, 15.5 - 16 (Billiton); 25.2 - 27, 15.5 - 16.2 (W. Borneo); 25 - 28.5, 16 - 17.5 mm (E. Borneo). Proportionate measurements variable, e.g.: 24:16, 25:15.5, 26:16 (Billiton).

### ***Copera vittata acutimargo* (KRÜGER).**

1898. KRÜGER, Stett. Ent. Zeitg. 59, p. 105 - 106. — ♂♀ N. E. Sumatra (*Psilocnemis acutimargo*).
1915. RIS, Tijdschr. Ent. 58, p. 7 fig. 1 - 2 (proth. ♀). — ♂ P. Babi; ♂♀ Simaloer I. (*acutimargo*).
1927. RIS, Zoöl. Meded. Leiden, 10, p. 18 (key ♂♀ Simaloer, synonymic notes) (*acutimargo*).
1935. LIEFTINCK, Misc. Zool. Sum. 92-93, p. 8 no. 35 (pars!). — lit. quoted (*acutimargo*).

Material studied: — 7 ♂, 1 ♀ from N.E. and W. Sumatra, 1 ♀ from Simaloer I. — N.E. Sumatra: 1 ♂ (ad., pinned), Eastcoast Gvt., [Serdang] labelled: "Tebbing Tinggi, [Soengei] Padang, Sumatra" (FÖRSTER's hand), "Schlüter vdt., Dr. Mauer lgt. 1895" (id.), "*Psilocnemis vittata* Selys Rasse *imbricata* Hagen" (id.), ex coll. F. FÖRSTER in the Ann Arbor Museum. 2 ♂ (ad., def.), Eastcoast Gvt. [Deli], Medan, Kp. Dadap, 14.II.1929, J. C. VAN DER MEER MOHR leg. 3 ♂, 1 ♀ (ad.), id., Deli, Medan, Saëntis Estate, 10.X.1936, L. J. TOXOPEUS leg., in the Buitenzorg Museum. Simaloer Island: 1 ♀ (semiad.), "Urwald", VII.1913, EDW. JACOBSON leg., "*C. acutimargo* Krüg.", det. F. RIS, in the Leiden Museum.

Very similar in outward appearance to *C. imbricata* though immediately distinguished from this species by the shape of the male appendages and the female prothorax.

Male (ad.). — Head, prothorax and thorax coloured much as in *imbricata*; humeral pale bands complete, always much wider than in that species, only little narrower than in *vittata deccanensis*, and thoracic sides marked with brown almost exactly as in the Indian race. Thorax pale-coloured ventrally, epimera occasionally with a diffuse brownish, longitudinal streak on each side of the latero-ventral carina.

Legs unicolorous carnelian-red, femora not obscured apically. Posterior two pairs of tibiae not dilated.

Abdomen coloured similarly to the other subspecies of the 'formenkreis', e.g. not differing from *vittata javana* (pl. 11 fig. 3), but with the basal rings narrower and interrupted on mid-dorsum (not so in semiadult examples). Segm. 9 apparently very variably coloured, either entirely black, or marked with an oval, bluish-white apical spot, which in our series of specimens may occupy the distal third at most of the dorsum. Segm. 10 and superior appendages entirely yellowish- or bluish-white; inferior pair also pale-coloured but for



the intero-basal protuberances and the outer sides on distal half of each, which are striped with black.

Anal appendages very similar to those of typical *vittata*; superiors comparatively longer and more evenly rounded interiorly (see the description in the key; the apps. of neither of our present specimens are fit for making adequate sketches).

**Female** (semiad., Deli and Simaloer I.). — The two examples in our collection match each other closely; both are somewhat intermediate between the pure white and the androchromatic (darkly coloured) colour-phase.

Head, thorax and abdomen coloured as on pl. 10 fig. 10 and pl. 12 fig. 2.

Posterior lobe of prothorax of very characteristic shape, quite identical in our two specimens examined (pl. 14 fig. 3).

Coxae and femora light buff, each of the latter with a row of partly confluent, sub-quadrangular black spots; tibiae and tarsi light ochraceous buff, apical tarsal joint tipped with black. Apical border of all femora black.

The basal rings and the terminal segments of the abdomen are of a delicate creamy-white tint. In the ♀ from Saëntis Estate, the 8th segment is entirely brown and the sides of 9 are almost black save for two whitish spots along the lower margin, one basal and one terminal; in the ♀ from Simaloer I., the pale colours are more extensive and better pronounced.

Length: ♂ abd. + app. 31 - 32.2, hw. 16 - 17.5; ♀ 29.5, 18 (Saëntis Est.), 28.5, 19 mm (Simaloer I.) Proportionate lengths of ♂ abdomen and hind wing, 31:16, 31.2:17, 32:16.4, 32:17.5.

This subspecies is an average larger than *vittata vittata*, from the Malay Peninsula, Billiton, Borneo and S.E. Sumatra. The ♀ is characterized by the strongly forwardly bent, triangular horns on the posterior lobe of the prothorax, whilst the ♂ is easily separated from typical *vittata* by the complete pale humeral stripes and by the thoracic colour-pattern.

#### **Copera vittata javana**, subsp. n.

Material studied: — 38 ♂, 7 ♀, from South Java. — 10 ♂ (semiad.-ad.), Mid Java, southcoast, Banjoemas Res., Kalipoetjang & Tjimerak (Dirk de Vries Bay), 200 - 400 m alt., 18-22.VII.1936, AUTHOR leg. 7 ♂, 1 ♀ (ad.), West Java, southcoast, Priangan Res., Tjitoë & Tjiastana (Tjipandak distr.), 100 - 200 m alt., 6-13.VIII & 13.IX.1935, M. BARTELS leg. 2 ♂, 6 ♀ (juv.-ad.), West Java, southcoast, Buitenzorg Res., Oedjoeng Genteng, sea-level, 26-29.III.1937 & 30.VI.1939, AUTHOR leg. — Holotype ♂ and allotype ♀: Oedjoeng Genteng, 26-29.III.1937, in the Buitenzorg Museum.

**Male** (ad.) — Head, thorax and abdomen coloured as on pl. 10 fig. 23 and pl. 11 fig. 3. Transverse pale stripe on top of head complete, pale green in fully coloured specimens. Black head-marks posterior to the ocelli variable,



usually continuous from eye to eye but very often surrounded by a pale line bordering the inner margin of the eyes. Transverse pale occipital lines invariably present.

Dorsum of pro- and synthorax deep bronzed black. Humeral stripes of variable width but never broader than on pl. 10 fig. 23. Mesepimera usually wholly black; occasionally there is a narrow yellow line joining the upper part of the humeral suture, and in some examples the mesepimerites, in addition to the shoulder-stripe, are irregularly mottled with a few pale points. Sides with blackish or pale brown, partly confluent stripes on either side of the second suture. Venter of thorax pale-coloured, unmarked.

Legs unicolorous mikado-orange. Apical border of all femora extremely narrowly obscured. Intermediate and posterior tibiae distinctly widened, posterior tibiae shaped as in fig. 1c. Posterior femur reaching apex of abdominal segment 1.

Abdomen coloured as on pl. 11 fig. 3. Dorsum of segm. 10 invariably pale green or yellow. Segm. 9 either entirely black (in the great majority of specimens), or with a small yellow spot, variable in outline, on dorsum occupying the apical  $\frac{1}{3}$  to  $\frac{1}{4}$  of the segment.

Anal appendages, superior pair yellow, inferiors yellow or ochreous, striped variably with black laterally (pl. 13 fig. 4).

Male (juv.) — Differs from the adult male chiefly in that the juxta-humeral mesepimeral stripe is more extensive and usually somewhat broader; the mesepimerites are more conspicuously mottled with yellow. Segm. 9 of abdomen at a maximum with the apical half of the dorsum bearing a roundish yellow spot. Anal appendages entirely yellow.

Female (ad.). — Head and thorax coloured as shown on pl. 10 fig. 24-25 (extremes). Dorsum of thorax and lower  $\frac{3}{4}$  of mesepimerites pitchy-black. Humeral stripes complete and sharply defined. Venter of thorax with a longitudinal, crescent-shaped, black spot on either side near the margin.

Prothorax pl. 14 fig. 4.

Legs capucine-buff to orange-buff. All femora marked exteriorly with a row of closely approximated, elongate or roundish black points, and with the apical border very narrowly obscured.

Abdomen in very old females almost black (pl. 12 fig. 3); more frequently segm. 1-7 are dark brown, 8-10 only being deep black aside; 9 with a posteriorly widened, pale bluish dorsal mark; 10 and appendages wholly pale-coloured.

Female (juv.). — Thorax deep black dorsally and laterally, with sharply delimited yellowish-white markings. Legs paler. Abdomen, segm. 1-7 pure white with narrow black apical rings and indistinct, sub-apical greyish spots. Terminal segments as in the adult insect (pl. 12 fig. 4).

Length: ♂ abd. + apps. 28 - 32.5, hw. 15 - 17.5 (e.g. 31.5, 16.5; 31.5, 17.5; 32.5, 17.5); ♀ 27 - 29.5, 18 - 18.5 mm.



Description of the full-grown larva (fig. 2).

Total length of body without caudal gills 9.4; median gill 4.7, lateral gill 5.5; length of head 1.47, width of same across the eyes 2.96, width between occipital lobes 1.49; length of antenna 1.75 (circa). Length of hind wing rudiment 3.4; of posterior femur (excl. troch.) 2.8 mm.

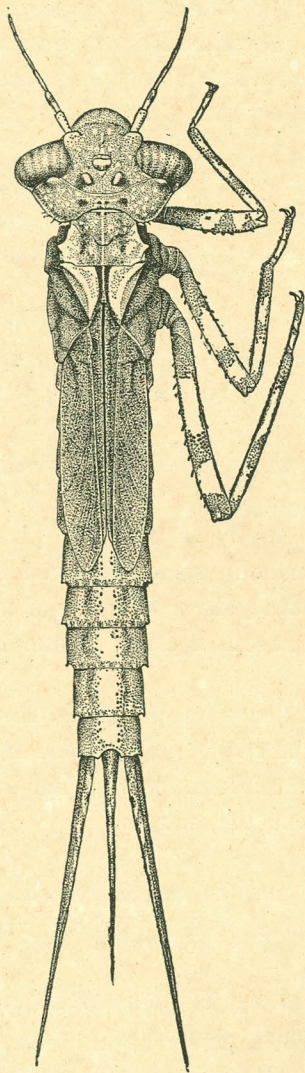


Fig. 2. — Full-grown larva of *Copera vittata javana*, subsp. n., Oedjoeng Genteng, Southwest Java.

Body Agrionine in shape, though more compactly built and abdomen shorter. Head large, wider than thorax, its length about equal to the width between occipital lobes. Eyes large, very prominent laterally and narrowly rounded. Occipital lobes very prominent posteriorly and covered with a number of short, spike-like setae. Antennae moderately long, length of separate joints 0.34, 0.33, 0.34, 0.31, 0.20, 0.15, 0.09 mm. Slightly lateral to the middle of the posterior border, at the highest point of the eyes, there rises a low pyramidal tubercle. This post-ocular prominence is sub-angular above and in side-view projects well beyond the highest level of the eyes.

Labium rather long and slender, adpressed to the body, hinge reaching as far back as half-way between coxae of first and second pair of legs. Mentum narrow basally, strongly and evenly widened apically. Median lobe with 6-7 short spinulose setae along each lateral margin; anterior part of the lobe prominent, obtuse-angulate and rounded, with a row of microscopical, squarish, marginal setae. Mental setae 2 each side, placed in a single transverse straight row. Lateral lobe with about 7 short marginal setae, apical portion divided into two unequal portions; the upper division is wedge-shaped, truncated apically and ends in four rounded prominencies, the first one being a little longer than the others; lower division with the inner margin microscopically serrulate and ending in a strong, incurvate end-hook. Lateral setae 4 each side. Movable hook long and strong, arcuate.

Prothorax flat above, with a lateral acute-angular prominence directed obliquely anterad from its postero-lateral angle; posterior border slightly keeled, rounded.

Wing-cases parallel, reaching back almost to the end of segm. 6.

Legs strong; all femora beset with a row of 5-7 very short, spinulose dark setae along their posterior edges.



Abdomen short; lateral spines on 6-10, increasing in length and prominence posteriorly and with a cluster of spinules on 10 externally at the base of the lateral gill.

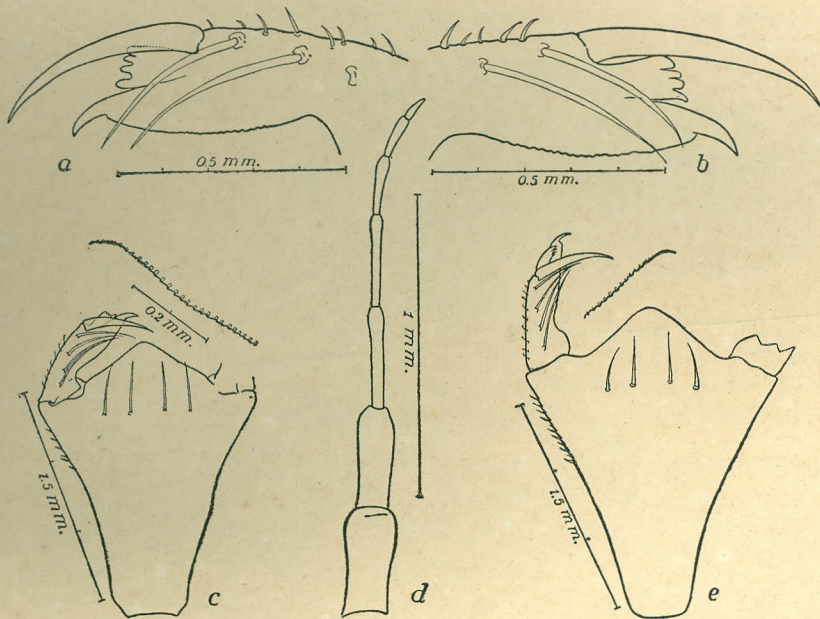


Fig. 3. — Larval structures of *Copera vittata javana*, subsp. n. (a, c and d), and of *C. marginipes* (RAMB.) (b and e). — Inner view of lateral lobe of labium (a - b), of labium (c and e), and left antenna (d).

Caudal gills shorter than abdomen, lamellar, of the denodate vertical type <sup>1)</sup>, oblanceolate. Median gill much shorter than the two lateral ones, slightly bent, basal portion only little narrowed, widest at mid-way its length and from there strongly fimbriate, pointed. Lateral gills elongate, straight; lateral carina obtuse, outer surfaces with 5-6 irregularly distributed, very short, tooth-like setae. All gills heavily pigmented, semi-opaque, crossed by three very irregular and partly confluent, oblique, transverse bands of a chocolate-, purplish- or seal-brown tint. Main tracheae of gills indistinct, tracheal system only visible in places, secondary tracheae irregularly branched.

**Coloration.** — Dark blackish-brown variegated with pale yellow-brown on the pro- and mesonotum. Head pale brown, mottled with darker brown. Antennae pale-coloured; second joint indistinctly ringed with brown. Thoracic sides and wing-cases brownish-black.

Legs pale reddish-ochreous; basal third of anterior femora sharply defined dark brown or blackish.

Abdomen light brown, indefinitely and longitudinally striped with dark brown.

<sup>1)</sup> R. J. TILLYARD, Proc. Linn. Soc. N. S. Wales, 42, 1917, p. 98.



The above description of the larva of *C. vittata javana* may serve to the easy recognition of not only this species but also of *C. marginipes* (RAMB.); and, quite probably, of *C. imbricata* (SELYS) as well.

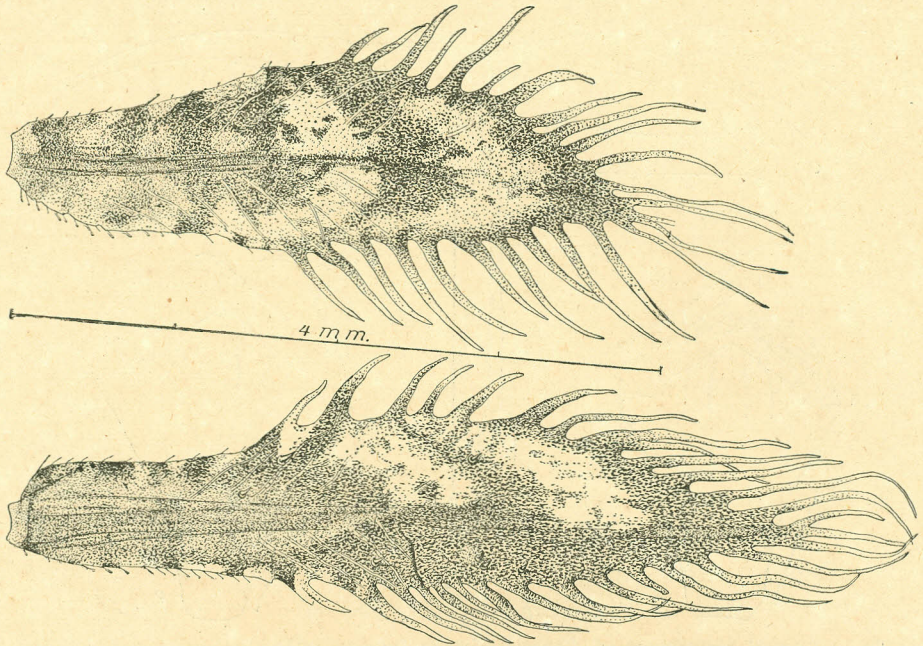


Fig. 4. — *Copera vittata javana*, subsp. n. Median and left lateral caudal gill of full-grown larva from Oedjoeng Genteng, Southwest Java.

Some brief notes on the larva of *C. marginipes* have been published by FRASER <sup>1)</sup>, who also gave outline-figures of the insect and its labium. The description and sketches as offered by NEEDHAM <sup>2)</sup> are more accurate and correspond well with the above description of *vittata*.

The larva of *C. marginipes* is found almost everywhere in slowly running waters such as brooks flowing through bamboo-groves and *Metroxylon* bushes. This species is also quite common in cultivated areas, breeding in jungly wells, tanks or small streams in native gardens, rubber plantations, &c. The larvae are found among rotten leaves, débris and roots.

*C. vittata*, however, breeds exclusively in small streams in dense jungle, or in trickles flowing through forest-marshes <sup>3)</sup>.

The larvae of *marginipes* and *vittata* are very similar in appearance. They are easily recognised from other zygopterous larvae by the curiously fringed gills; and, as FRASER <sup>4)</sup> justly remarks, "The larva makes a fuller use of its caudal gills than most species and is to be seen clinging to roots in rapid flowing

<sup>1)</sup> F. C. FRASER, Rec. Ind. Mus. 16, 1919, p. 464-465, pl. 35, fig. 3, pl. 37 fig. 6.

<sup>2)</sup> J. G. NEEDHAM, Zool. Sinica (Peiping), 11, 1930, p. 250-251, pl. 18, fig. 2, 2a.

<sup>3)</sup> Some notes on the breeding-place of *C. vittata javana* at Oedjoeng Genteng, on the south-coast of Java, are contained in the writer's previous paper (Treubia, 17, 1939, p. 50-51).

<sup>4)</sup> F. C. FRASER, Rec. Ind. Mus. 26, 1924, p. 498.



streams, its gills erect over its back and swayed constantly from side to side in the current. At the approach of danger it lowers the gills and lies flush on its resting place or manoeuvres this between itself and the point of danger".

Larvae of *marginipes* kept alive in the aquarium for a long time did not abandon this peculiar habit.

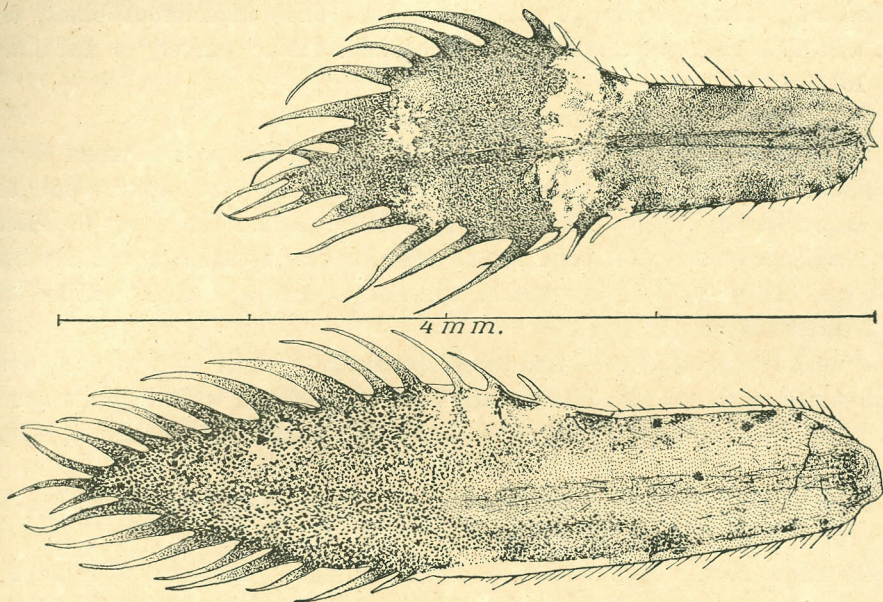


Fig. 5. — *Copera marginipes* (RAMB.). Median and right lateral caudal gill of full-grown larva from Buitenzorg, West Java.

There are only few points of distinction between the larvae of these two species. As is shown on fig. 3, the armature of the mask is almost identical and the difference found in the proportions of the head are so slight as to be almost negligible:

Greatest width over the eyes	2.96 ( <i>marginipes</i> ),	2.83 ( <i>vittata javana</i> ).
Length of head (median line)	1.56	1.47
Width between occipital lobes	1.49	1.42

The slight differences in the shape of the caudal gills are elucidated by the accompanying sketches (fig. 4 and 5).

#### ***Copera vittata palawana*, subsp. n.**

Material studied: — 2 ♂, 1 ♀ (ad.), Palawan I., Alfonso XIII, 6.V.1935, K. KUWASIMA leg. Holotype ♂ and allotype ♀ in the Leiden Museum.

Male. — Labium pale yellow. Mandible-bases, labrum and genae yellow. Anteclypeus yellow-brown. Head black, marked with pale blue as shown on pl. 10 fig. 20-21; rear black with a yellow spot close to the eye-margin. Antennae blackish-brown.

Prothorax black with some confluent pale blue spots on each side of the middle, placed in line with the humeral stripe.



Synthorax dark bronzed black, marked with blue as shown on pl 10 fig. 20 (paratype). In the holotype (pl. 10 fig. 21) the blue marks are somewhat more extensive and partly confluent. Venter of thorax yellow with a sharply delimited, elongate, deep black spot on each side near the margin of the metasternum.

Coxae pale bluish, somewhat obscured laterally; trochanters yellowish, spotted with black exteriorly. All femora and tibiae unicolorous black, tarsi with a reddish tinge, especially the apical joints. Tibiae scarcely or not dilated (fig. 1e).

Wings hyaline. Pterostigma dark brown.

Abdomen almost entirely black. Basal rings obliterated; segment 9 with the distal one-third bright bluish-white, the remainder black (paratype), or 9 with an additional yellow spot on each side of the median line about the middle of the segment (holotype). Segm. 10 and superior anal appendages entirely blue-white (pl. 11 fig. 8). Inferior pair of appendages yellow, broadly striped with black exteriorly (pl. 13 fig. 7).

Female (allotype). — Head and thorax deep black marked with palest bluish-white as shown on pl. 10 fig. 22. Rear of the head whitish, cross-banded with black behind occiput. Venter of thorax as in the male. Prothorax shaped as on pl. 14 fig. 7.

Legs pale yellow (cream-buff); exterior surfaces of all femora with a row of more or less confluent black spots.

Abdomen black, coloured much as in the male. Dorsum of segm. 8-9 partly, of 10 entirely yellowish-white. Appendages whitish (pl. 12 fig. 9).

Length: ♂ abd. + app. 29.5 (type), 29.8 (paratype), hw. 17 (type), 16.5 (paratype); ♀ 28.5, 18 mm.

### **Copera imbricata** (SELYS).

1863. SELYS, Bull. Acad. Belg. (2) 16, p. 171-172. — ♂ Padang, W. Sumatra (*Psilocnemis*).
1898. KRÜGER, Stett. Ent. Zeitg. 59, p. 106-107. — ♂♀ N. E. Sumatra (*Psilocnemis lobimargo*).
1907. FÖRSTER in LAIDLAW, Fasc. Malay. Zool. 4, p. 7 (note) (*Psilocnemis lobimargo*).
1927. RIS, Zoöl. Meded. Leiden, 10, p. 17-19 (key ♂♀, remarks on synonymy), fig. 9 (proth. ♀). — ♂♀ Centr. W. Sumatra, Ophir distr., Padangsche Bovenlanden (*lobimargo*).
1935. LIEFTINCK, Misc. Zool. Sum. 92-93, p. 8 no. 35 (pars !), no. 37. — S. Sumatra (Lampoeng Res.) (*acutimargo*), lit. quoted (*lobimargo*).

Material studied: — 42 ♂, 8 ♀ from W. and S. Sumatra. — 1 ♂ (semiad., in good condition, legs mostly missing), indicated as type on a triangular pin-label by a black cross-mark, under the (erroneous!) yellow drawer-label: "serapion Hag., *Platycnemis*, Java, Jngh." (JUNGHUHN?) (unknown hand), type of *Psilocnemis imbricata* HAGEN-SELYS, in the Halle Museum. 2 ♂ (ad.), West-coast Res., Ophir distr., Moeara Kiawai, VI.1915, E. JACOBSON leg., in the Leiden Museum. 2 ♂, Benkoelen Res., Tandjong Sakti, 600 m alt., I.VI-19.VII.1935,



M. E. WALSH leg. 4 ♂, 2 ♀, Lampoeng Res., Mt. Tanggamoës, Giesting, 600 m alt., 17.VI - 10.VII.1934, L. J. TOXOPEUS leg. 33 ♂, 6 ♀, same locality, Wailalaän & Waiteboe, 24.XII.1934 - 3.I.1935, AUTHOR leg.

Male (semiad., holotype). — Head, thorax and abdomen coloured as shown on pl. 10 fig. 6, and pl. 11 fig. 2. Rear of the head pale-coloured, with a continuous black transverse band to the rear of the pale postoccipital fascia. Humeral stripe complete, though narrow. Venter of thorax pale-coloured, unmarked.

Legs unicolorous carnelian-red (semiadult!), femora not obscured apically. Posterior two pairs of tibiae not noticeably dilated (fig. 1f).

Segm. 9 of abdomen with three diffuse pale spots: one ante-apical, mid-dorsal spot, and two slightly larger ones, placed on either side of it. Segm. 10 entirely yellowish.

Anal appendages also yellowish, distal two-thirds of the exterior surfaces and apices of inferior pair blackish (pl. 13 fig. 3). Intero-apical tooth of superior appendage similar to the one figured (pl. 13 fig. 8a).

Male (ad., Lampoeng). — A uniform series of comparatively large specimens, differing from the type only in details of coloration and in the slightly shorter inferior appendages.

Humeral stripes slightly variable in width, always complete but usually very narrow (pl. 10 figs. 7-8). Metapleurae variably and irregularly banded with dark brown as shown in the figures; venter always unmarked.

Legs orange-buff to capucine-orange in matured examples. Apices of all femora invariably, though narrowly, bordered with black; tarsal joints slightly obscured apically. Hind tibia (fig. 1g).

Abdomen mostly black; basal rings of segm. 3-6 sharply pronounced, interrupted mid-dorsally, creamy-white. Segment 9 entirely black in full-coloured specimens, the membrane between 8 and 9 brownish. Segm. 10 bluish-white to bright green in living specimens, occasionally with a narrow, black, dorsal basal line.

Anal appendages, superior pair at first greenish-white, growing darker with age until they become entirely brownish-black in adult individuals, only the extreme apices being yellowish. Inferior pair black, distal half of inner surfaces brownish. Intero-basal tooth of superior appendages black, shaped as on pl. 13 fig. 8, 8a.

N.B.—The two specimens from Moeara Kiawai (Ophir distr.), and the males from Benkoelen as well, do not differ from the above described series from South Sumatra, except that the inferior appendages of the Ophir specimens are relatively a little shorter than in the others. The ratios are: 1:2.1 (type *imbricata*), 1:2.3 (Ophir distr.), 1:2.4 - 1:2.5 (Lampoeng distr.). The Ophir males are not fully adult and match the type of *imbricata* very closely. Although I have not seen KRÜGER's type of *lobimargo* from N.E. Sumatra, it is evident



from his description of the colour of the 9th abdominal segment, that most of his specimens were immature ("1 reifes ♂, 5 junge von Soekaranda"; "das 9. und 10. Segment des Abdomen weisslich").

**F e m a l e** (ad., Lampoeng). — Colour-pattern of head and thorax generally as on pl. 10 fig. 9. Ground-colour of the thorax cinnamon-buff dorsally, fading to pinkish-buff laterally. Labrum, base of mandibles, and genae partly, light green to light orange-yellow.

Prothorax dull yellowish above, variably mottled with brown, sides deep black. Posterior lobe mainly yellowish (pl. 14 fig. 8).

The bronzed green median band on the dorsum of the thorax varies in width; usually it is shaped as on pl. 10 fig. 9, but occasionally it is much narrower, tapering considerably ventrally, after the slight constriction below its middle. The outer border of this band is rather irregular, caused by the intrusion of the pale ground-colour. Upper half of the mesepimera always unmarked. Sides variably mottled with brown; metepimeral dark spots comparatively small and linear, or spot-like, whether or not confluent. Venter pale.

Legs, including the coxae, light ochraceous-buff; femora and tibiae rarely more vividly coloured, at most light orange-yellow; femora with a small apical spot of black along margin, and with the exterior surfaces striped in such a way as to show a complete row of narrowly interrupted, squarish black spots, which are at times coalescent, or nearly so.

Abdomen lighter to darker brown, segments progressively darker from before backwards. Pale basal rings on segm. 3-6 (pl. 12 fig. 10) very narrow though sharply defined, whitish or light green, interrupted mid-dorsally, obscured or barely traceable on 4-6 in very matured individuals. Terminal segments black. Segm. 9 usually with a roundish dorsal sub-apical bluish-white spot; 10 and anal apps. entirely blue-white. Valves brown to almost black.

Size as well as proportions very variable. Length: ♂ abd. + app. 29, hw. 16.3 (type Padang); 28-33.2, 16-18.5 (Lampoeng); 29, 16.2 (Benkoelen); ♀ 27-30, 17.8-20 mm (Lampoeng). Proportionate lengths of abdomen and hind wing, e.g.: 28:16, 29:16.2, 30:17.4, 31:17, 31.5:18.3, 32.2:18, 32.5:8, 33.2:18.5 (♂ Lampoeng); 27: 18, 27.3: 18, 28.2: 17.8, 30: 20 mm (♀ Lampoeng).

A stream-dwelling species. Very common in the southern districts of Sumatra, and although chiefly restricted to jungly areas, found also in cultivated tracts, often in company with *marginipes*.

Unlike *C. vittata*, which is generally found in the deltaic regions of the large rivers of Malaysia, the known distribution of *C. imbricata* seems to indicate rather a sub-montane habitat (see map).

The interest of the South Sumatran collection lies in the fact that it has added materially to our knowledge of the geographical distribution of many of the common species of the island.



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Pl. 10. — Colour-pattern diagrams of head and synthorax of *Corymbus*

1  
S. India  
deccanensis

2  
S. India  
deccanensis

3  
S. India  
deccanensis

4  
Nicobars  
serapica

5  
Nicobars  
serapica

6  
W. Sumatra  
imbricata

7  
S. Sumatra  
imbricata

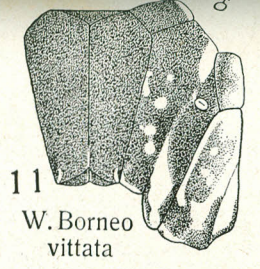
8  
S. Sumatra  
imbricata

9  
S. Sumatra  
imbricata

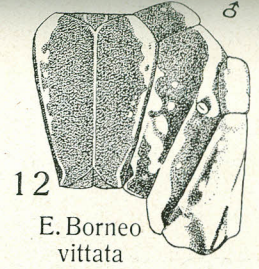
10  
Simaloer  
acutimargo



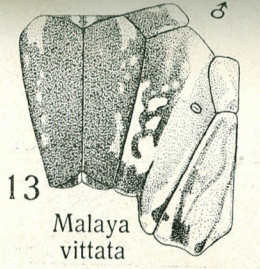
*vittata* (Selys) and its subspecies, and of *C. imbricata* (Selys).



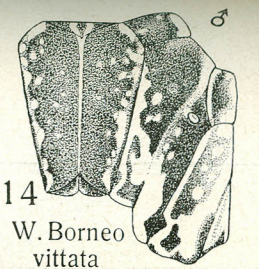
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W. Borneo  
*vittata*



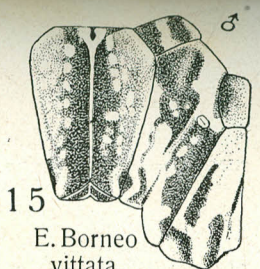
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E. Borneo  
*vittata*



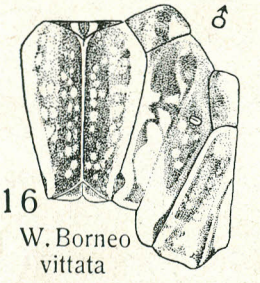
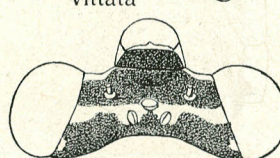
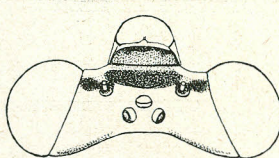
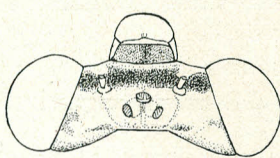
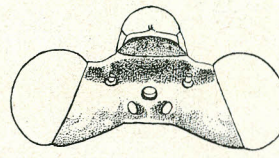
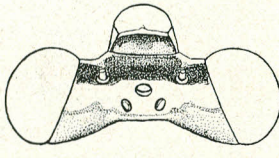
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Malaya  
*vittata*



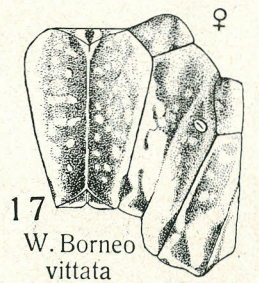
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*vittata*



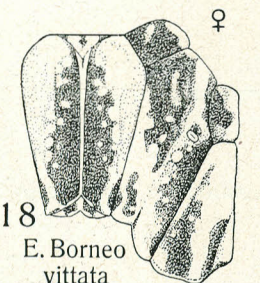
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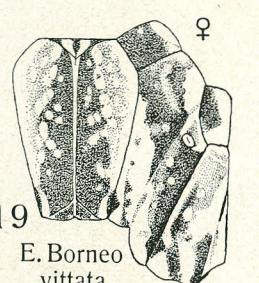
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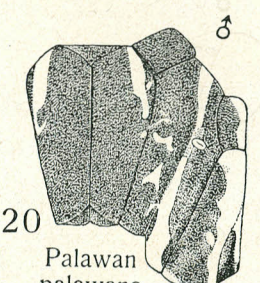
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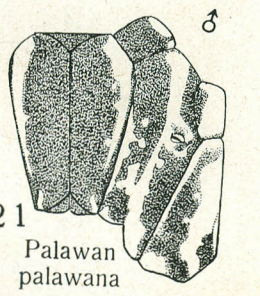
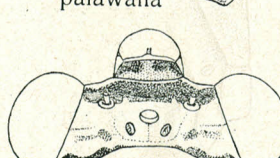
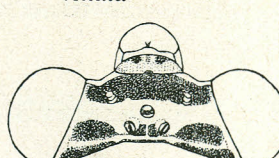
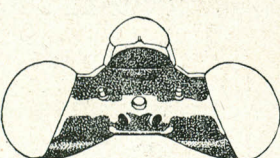
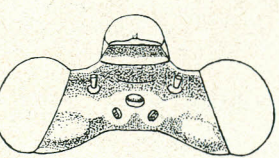
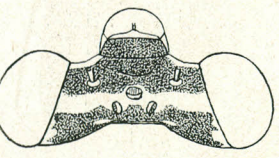
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E. Borneo  
*vittata*



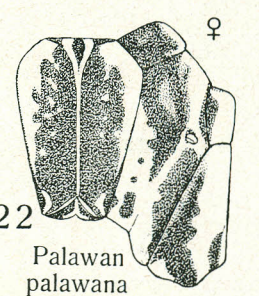
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*vittata*



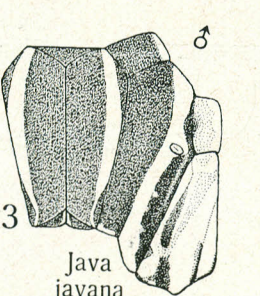
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Palawan  
*palawana*



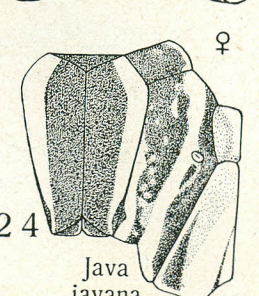
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*palawana*



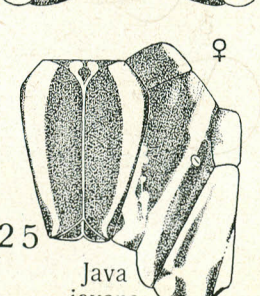
22  
Palawan  
*palawana*



23  
Java  
*javana*

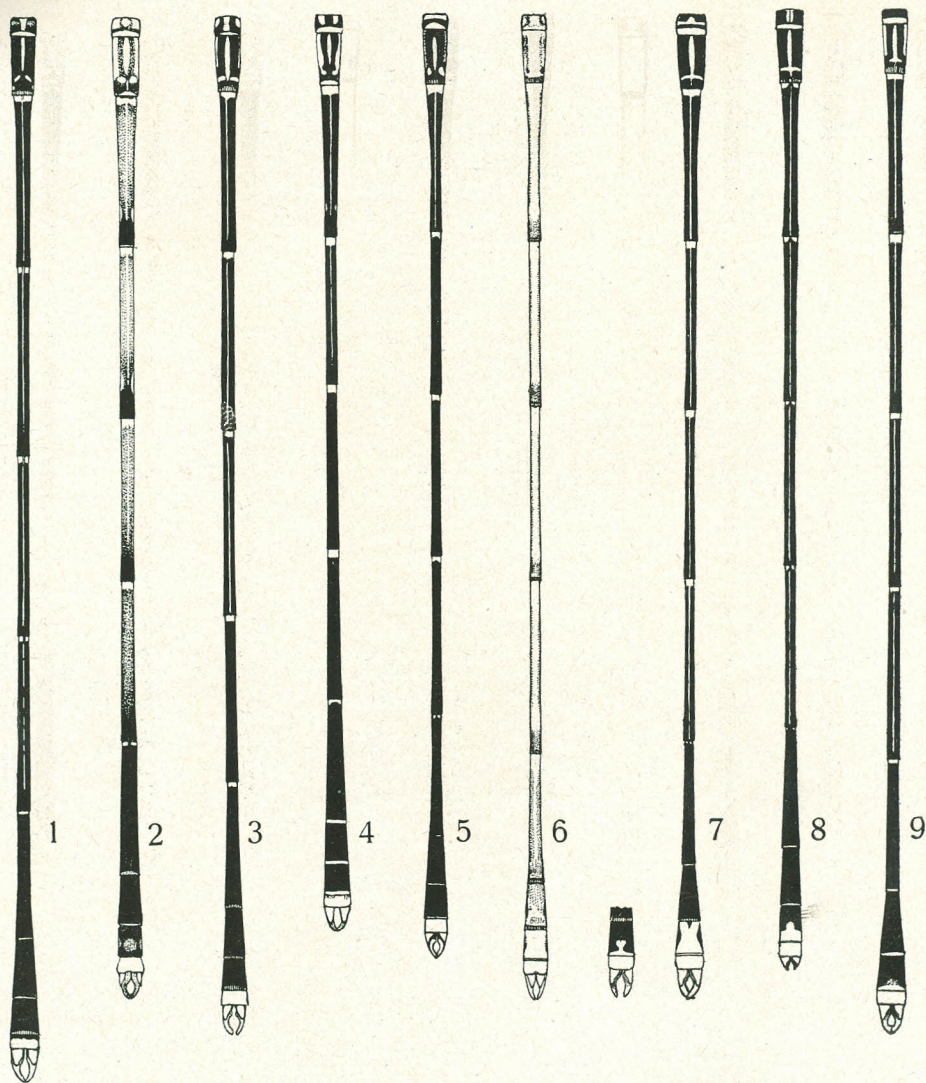


24  
Java  
*javana*



25  
Java  
*javana*

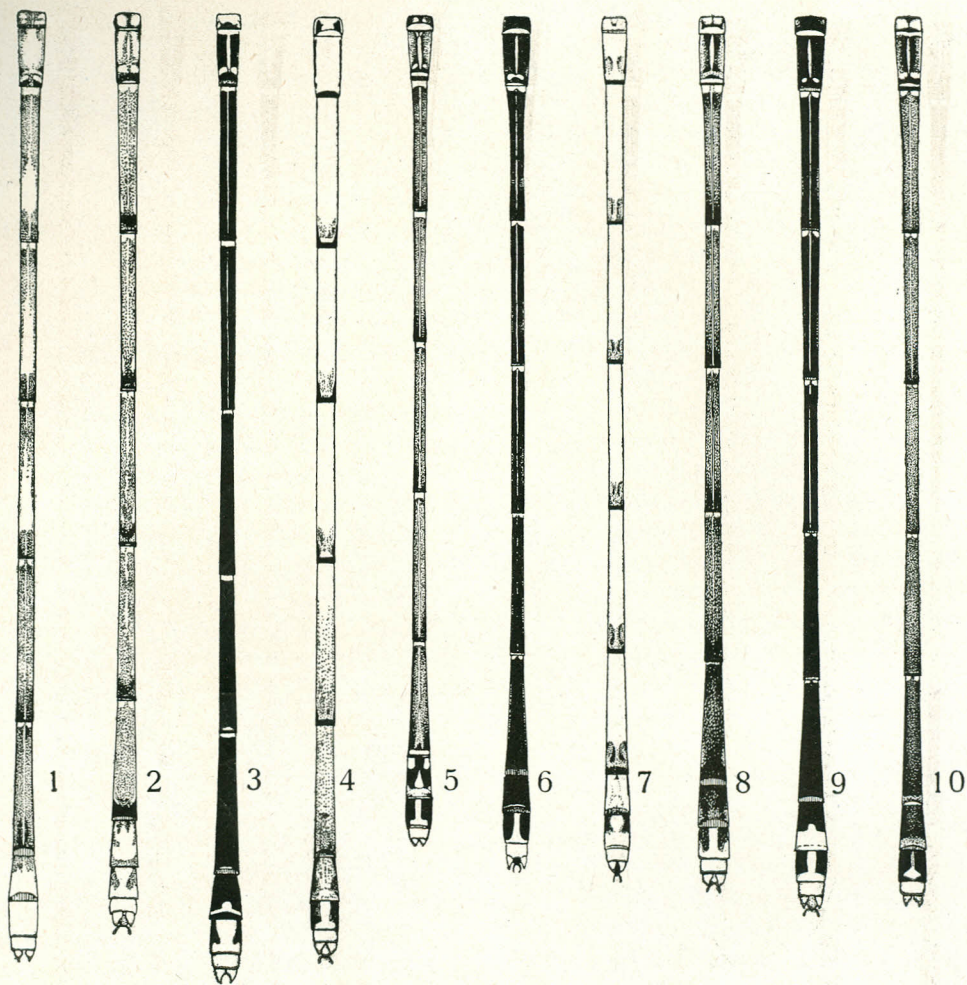




Pl. 11. — Colour-pattern of abdomen of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Males.

1. *C. v. serapica* (SELYS), lectoholotype, Nicobar I.
2. *C. imbricata* (SELYS), holotype, Padang, W. Sumatra.
3. *C. v. javana*, subsp. n., holotype, S. W. Java.
4. *C. v. vittata* (SELYS), holotype, Malaya.
5. *C. v. vittata* (SELYS), adult, W. Borneo.
6. *C. v. vittata* (SELYS), teneral, W. Borneo.
7. *C. v. vittata* (SELYS), adult, E. Borneo.
8. *C. v. palawana*, subsp. n., paratype, Palawan I.
9. *C. imbricata* (SELYS), adult, S. Sumatra.

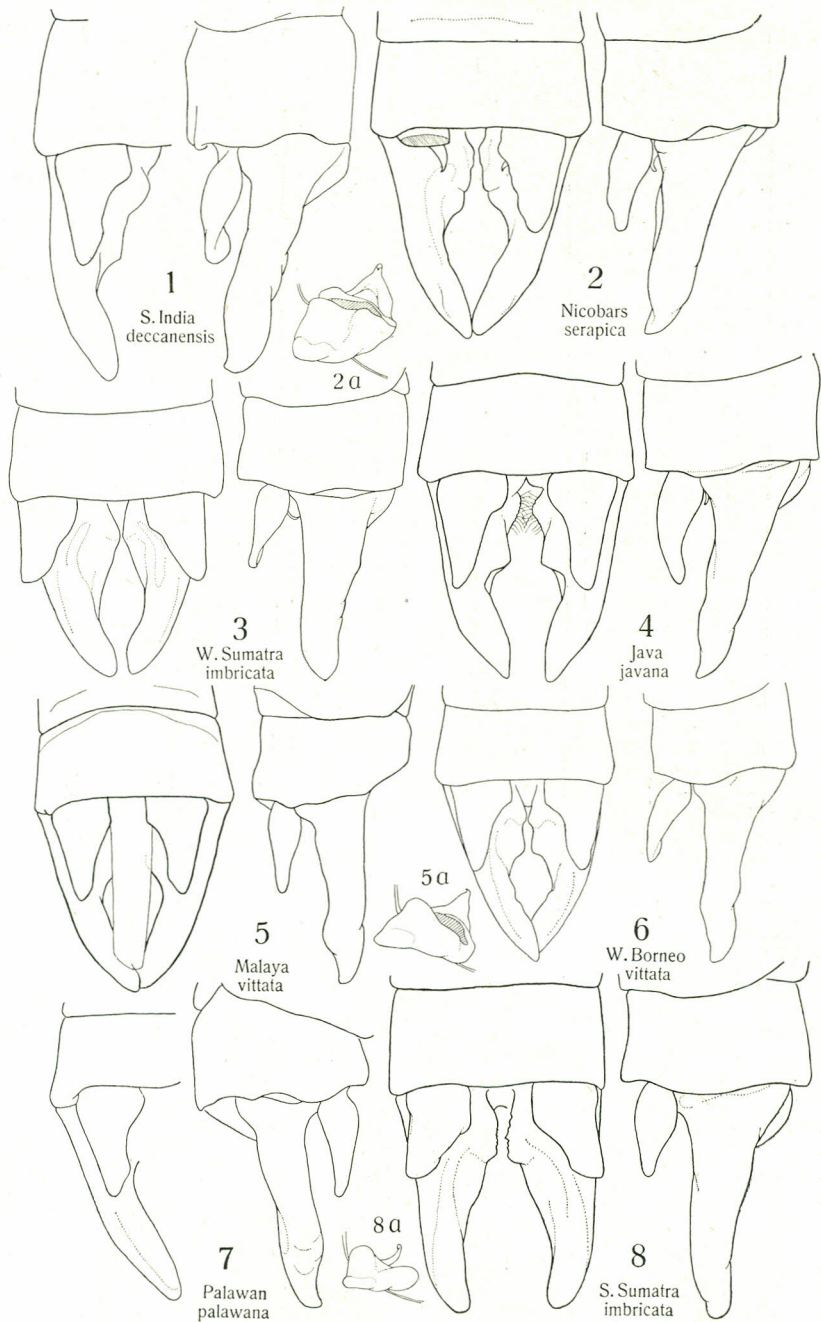




PL. 12. — Colour-pattern of abdomen of *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Females.

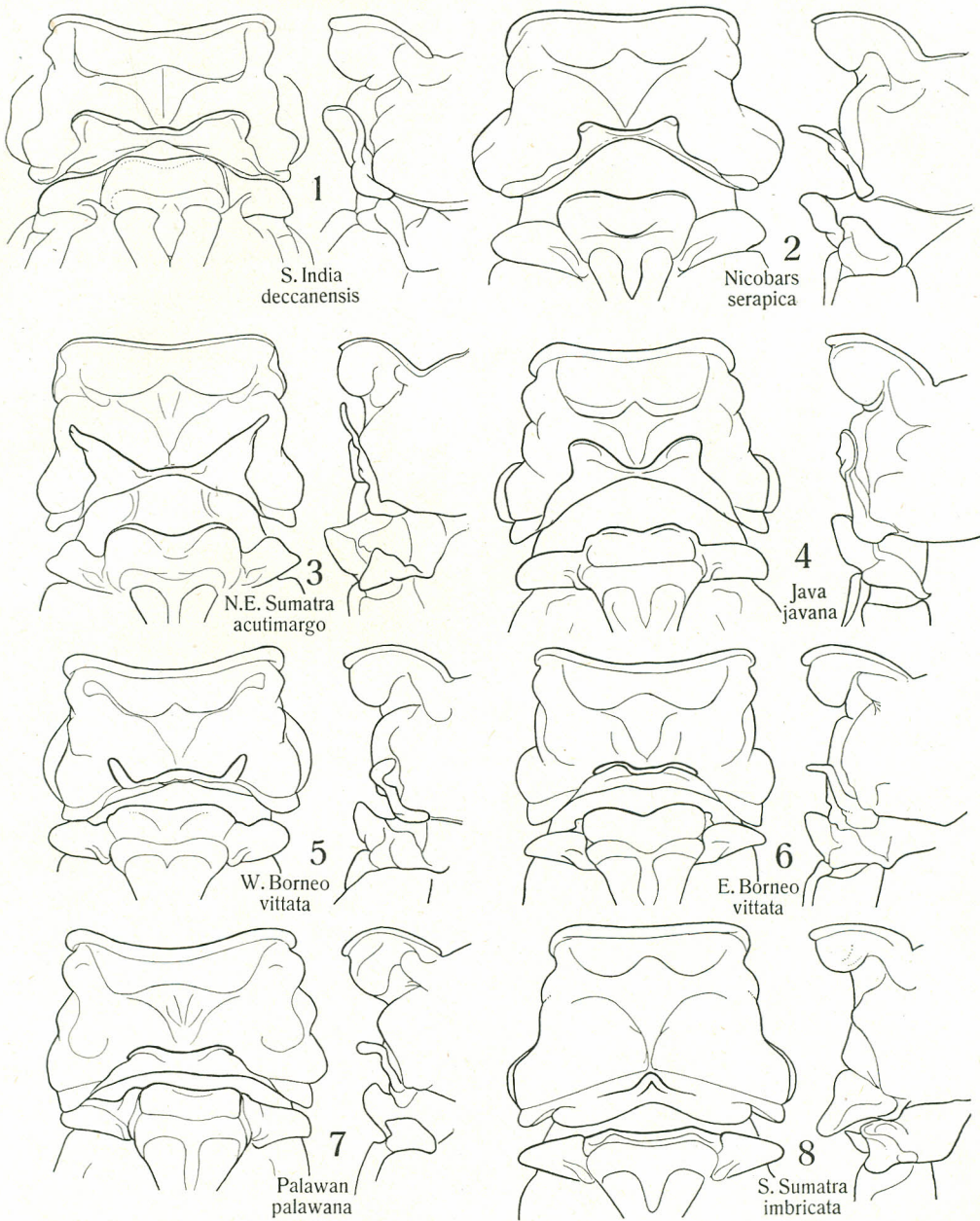
1. *C. v. serapica* (SELYS), allotype, Nicobar I.
2. *C. v. acutimargo* KRÜGER, semi-adult, Simaloer I.
3. *C. v. javana*, subsp. n., adult, S. W. Java.
4. *C. v. javana*, subsp. n., teneral, S. W. Java.
5. *C. v. vittata* (SELYS), adult, W. Borneo.
6. *C. v. vittata* (SELYS), adult, W. Borneo.
7. *C. v. vittata* (SELYS), teneral, E. Borneo.
8. *C. v. vittata* (SELYS), adult, E. Borneo.
9. *C. v. palawana*, subsp. n., allotype, Palawan I.
10. *C. v. imbricata* (SELYS), adult, S. Sumatra.





Pl. 13. — Anal appendages of male *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Dorsal and lateral view. Figs. 2a, 5a and 8a, right superior appendage, seen from behind, showing inferior basal projection.





Pl. 14. — Prothorax and anterior portion of mesothorax of female *Copera vittata* (SELYS) and its subspecies, and of *C. imbricata* (SELYS). Dorsal and right lateral view.