

THE DRAGONFLIES (ODONATA) OF BURMA AND LOWER
SIAM—II.^a SUBFAMILIES CORDULEGASTERINÆ, CILOR-
OGOMPHINÆ, AND GOMPHINÆ.

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This paper is the second of the series, following the general plan of and based on the collections described in Part I, namely: (1) A collection made by Dr. W. L. Abbott in Lower Siam, and presented to the U. S. National Museum; (2) a collection made by Mrs. A. V. B. Crumb, presumably in the vicinity of Toungu, Burma, and owned by the Academy of Natural Sciences of Philadelphia, and (3) a collection made by Mr. R. A. Earnshaw for the present writer in the Karemi and Toungu districts, Burma. My indebtedness to Mr. R. A. Earnshaw requires a second acknowledgment. Since the publication of Part I he has sent me material containing specimens of the greatest interest and value, and necessitating at some future date additional remarks on the Calopteryginae of Burma. Through the kindness of M. Guillaume Séverin, of the Musée Royale de l'Histoire Naturelle de Belgique, I am enabled to figure in this paper the venation of twelve specimens from the De Selys collection. These photographs were made at the museum in Belgium. The photographs of other specimens were made in the laboratory of Prof. James G. Needham and under his direction. Mr. Samuel Henshaw loaned me a few very valuable specimens from the Museum of Comparative Zoology, Cambridge, Massachusetts. M. René Martin not only loaned me a number of specimens, but gave me others which have been invaluable in this study. Through the good offices of Prof. F. Foerster I purchased in Germany a collection containing many Gomphines from Tonkin. Mr. C. C. Adams has loaned me a number of specimens from India, Japan, and China. Dr. Philip P. Calvert has been freely consulted regarding many details.

In an effort to select a nomenclature for the wing veins that would meet with the approval of students in this country, at least, an exten-

^a See Part I. Subfamily Calopterygine, Proc. U. S. Nat. Mus., XXVIII, pp. 165-187, published April 22, 1905.

sive correspondence has been carried on with Doctor Calvert, Professor Needham, and Mr. Rolla P. Currie, to all of whom I am indebted for advice and suggestions. I have tried to harmonize these suggestions as much as possible, and the names used in explaining the diagram of wing-venation are the result.

In the paper on the subfamily Calopteryginae the species discussed were mostly well known and represented by large series of specimens in many collections, but in the subfamilies at present under discussion an entirely different condition exists. The reasons for this may be briefly discussed.

In the Calopteryginae there are species in which the differences in color between the sexes are probably as great as in any species of bird or butterfly, although those peculiar secondary sexual characters of the male usually shown by such birds and butterflies are wanting in the order Odonata.^a Of the oriental genera of Calopteryginae *Rhino-cypha* is the largest, and shows a maximum development in these color differences. The Calopteryginae are not specialized for protracted flight, but spend much of their lives near their birthplace; or if they wander it is by successive flights in an environment generally similar to their accustomed daily haunts. Nevertheless their flight may be swift and mobile. Like the highly colored humming-birds, some of them at least are pugnacious, though evidences of injuries to each other from this cause are wanting. Two males of *Calopteryx angustipennis* will perform such rapid evolutions about each other that the eye can scarcely follow them. Males of *Heterina* wage similar warfare. It would be strange if males of *Rhino-cypha* did not fight in the same way. In *Rhino-cypha* the hyaline spots in the wings of certain males might well serve the same function attributed to eye-spots and other striking markings on the outer portions of the wings of Lepidoptera,^b but none of the many specimens I have seen was so damaged as to indicate that they do so serve. In fact, I know of no evidence that the brightly colored and often metallic Calopteryginae are ever devoured by birds. The display of colors by the male before the female has been recorded for two species belonging to two widely different genera, though the possibility of voluntary sexual selection by these insects is, it appears to me, very remote. Those most active in their display, however, probably would be the most vigorous and highly colored of their associates and would, in competition with others of the same species, stand the best chance of reproducing. The male abdominal appendages in this subfamily are but little specialized, and throughout the group are remarkably

^a Some stigmatic differences may offer an exception to the rule.

^b These markings are supposed to produce on the insects' natural enemies the false impression that they are real vital organs, by which they may be captured with certainty.

similar in form. Calopteryginae generally do not display great sensitiveness to weather conditions. Temporary cloudiness and slight changes in wind or temperature do not result in immediate decrease of activity or in search for a new environment. There is reason to believe that as a group the species have a moderately long or protracted seasonal range.

Comparing now the subfamily Gomphinae—the largest of the subfamilies considered in this paper—with the Calopteryginae, I find in the former only slight differences, if any, between the sexes of any species, and these almost entirely confined to body-markings. Moreover, the Gomphinae are as a group obscurely or protectively colored. Metallic or other brilliant colors, so common in Calopteryginae and in certain beetles which are not eaten by birds, are unknown. The ground-color varies from pale brown through various shades of brown and yellowish or reddish brown to black. The markings are from white through pale green, green, pale yellow, and clear yellow to orange; or the ground-color may be the paler, marked with the darker colors. The wings are hyaline, or slightly fumose. In wing venation these dragonflies are highly specialized, adapting them to protracted flights. For example, some species spend much of their time in tall forest trees and during a day may make numerous trips from a stream to trees at considerable distances from the water. There is reason to believe that certain species spend much of their lives at a distance from the streams which gave them birth, being fully able, when the time arrives, to return by rapid and sustained flight. The size, structure, and consistency of these insects make them favorable food for medium-sized or larger insectivorous birds, and it may be well supposed that natural selection has tended to suppress brilliant colors and habits which would attract attention. The males do not make themselves conspicuous by pugnacious attacks on each other. Several may be on the wing in close proximity without attacking, though they frequently approach as if in search of females. In the form of the abdominal appendages of the male the Gomphinae are highly specialized. In the oriental region *Onychogomphus* is represented by the greatest number of species, and in this genus both venation and male appendages are highly specialized. This specialization and presumably more perfect adaptation of the appendages to their use would render the speedy capture of the female almost certain. Moreover, the scattering of the species through woodland and fields adjacent to streams would render the meeting of individuals to some extent accidental. In view of these facts conflicts between males are probably the exception. During the act of copulation Gomphinae generally seek more retired and elevated places than the Calopteryginae. Some Gomphinae, at least, display great sensitiveness to weather conditions, appearing about certain favorite

to forsake the water for the trees and bushes, where they rest inactive and inconspicuous till the reappearing sun brings them again to the stream. Continued cloudiness may cause them to leave the river, scattering far and wide over fields and woods. Moreover, species of this subfamily are well known to have a brief seasonal range in temperate regions, and the same thing is probably true in the tropics.

Because of the scarcity of positive records for Burma and Lower Siam of species of the subfamilies under discussion in this paper, a slightly different treatment from that employed in the paper on the Calopteryginae has seemed desirable. In this paper I have given distribution and brief notes on all the species known in the oriental fauna. From this it must not be supposed that I expect subsequent collecting to show a large percentage of these species to occur in Burma and Lower Siam. On the contrary, I believe a number of species at present undescribed will be revealed.

Throughout the paper the halftone figures of wings are of arbitrary size and give no idea of the relative size of the wings in various species. The figures representing thoracic color pattern are diagrammatic, all drawn over the same outline, and give no idea of the different forms and sizes of the insects themselves. The figure illustrating venational nomenclature is still more diagrammatic. (See figs. 1-3.) The remaining figures are drawn to scale—the same for all—and give an idea of the relative sizes in different species.

KEY TO THE ORIENTAL GENERA OF THE SUBFAMILY GOMPHINÆ (IMAGOS).

ORDER ODONATA (Neuroptera Odonata, Paraneuroptera).

- aa. Front and hind wings dissimilar in shape, the latter usually broader at base; the quadrangle of the suborder Zygoptera^a divided to form the triangle and super-triangle. Males with one inferior abdominal appendage which, however, may be deeply bifid or rudimentarySUBORDER ANISOPTERA
- b. Antenodals of first series mostly coinciding with those of the second series; triangle of front wing with its long axis at right angles to the length of the wing, and triangle of hind wing with its long axis parallel to the length of the wing.
 - FAMILY LIBELLULIDÆ
 - bb. Antenodals of first series not coinciding with those of the second series, excepting in the case of two, which are thickened.....FAMILY ÆSHNIDÆ
 - c. Radial and median supplements present; triangle of front wing at least as elongate as triangle of hind wing; M₂ paralleling M₁ at least as far as the stigma. Head globose. Lateral abdominal carinæ present.....SUBFAMILY ÆSHNINÆ
 - cc. Head transversely elongated; eyes separated or meeting at a single point only. Lateral abdominal carinæ wanting.
 - d. Radial supplement developed; triangle of front wing at least as elongate as triangle of hind wing. Median labia lobe divided...*Petalia* and allies, probably worthy of subfamily rank; (not regional.)
 - dd. Radial and median supplements not developed; M₂ paralleling R₁.

^a See Proc. U. S. National Museum, XXVIII, p. 167.

- c. Median labial lobe divided. Stigma of uniform width, the distance between C and R_1 a cell or two beyond stigma less than the distance between R_1 and M_1 at the same level; in front and hind wings at least 4 cross veins between M_{1-3} and M_4 .
- f. Subtriangles of front and hind wings similar in shape. Eyes touching dorsally or but little separated.
- g. Median space without cross veins; triangle of hind wing more elongate than triangle of front wing.....SUBFAMILY CORDULEGASTERINÆ
- gg. Median space with cross veins; triangle of front wing at least as elongate as triangle of hind wing.....SUBFAMILY CHLOROGOMPHINÆ
- h. Triangle of hind wing strongly narrowed in the direction of the long axis of the wing.....*Chlorogomphus*
- hh. Triangle of hind wing about equilateral.....*Orogomphus*
- ff. Subtriangles of front and hind wings dissimilar; triangle of front wing not as elongate as triangle of hind wing. Eyes widely separated.

SUBFAMILY PETALURINÆ (not regional)

- ec. Median labial lobe entire. Eyes widely separated. Stigma wider at middle than at either end, the distance between C and R_1 a cell or two beyond stigma about equaling the distance between R_1 and M_1 at the same level; triangle of front wing less elongate than triangle of hind wing.....SUBFAMILY GOMPHINÆ
- f. Subtriangle of front wing crossed (except in *Gomphidia javanica*); supertriangular cross veins present; distance from forking of M_{1-2} and M_3 to subnodus equal in front and hind wings, in front wing equal to one-fourth the distance from wing base to subnodus; cross veins between M_{1-3} and M_4 numerous, at least 4 in hind wing; M_3 in hind wing slightly waved; R_8 and M_4 with accessory sectors; stigma long, equaling one-third the distance from nodus to distal end of stigma.
- g. Lateral margins of abdominal segment 8 dilated. Triangle of front wing short, the inner and superior sides about equal.....*Ictinus*
- gg. Lateral margins of abdominal segment 8 not dilated. Triangle of front wing longer, the outer and superior sides about equal.
Gomphidia
- ff. Subtriangle of front wing and all supertriangles without cross veins; distance from forking of M_{1-2} and M_3 to subnodus equal to about one-third the distance from wing base to subnodus in front wing; R_8 and M_4 without distinct accessory sectors; stigma shorter, in length less than one-third the distance from nodus to distal end of stigma.
- g. Triangle of hind wing crossed; at least 3 rows of cells between M_4 and Cu_1 at level of penultimate antenodal in front wing.
- h. Triangle of front wing crossed; arculus in front and hind wings at level of second antenodal; anal area of front wing with 2 rows of cells proximal to the triangle, followed distally by more than 2 rows; M_4 and Cu_1 in front wing divergent, about 15 cells between at wing margin; in hind wing 2 cross veins between M_{1-3} and M_4 ; trigonal supplement distinctly present; distance from forking of M_{1-2} and M_3 to subnodus about equal in both wings.
- i. Cubital space with 2 or 3 cross veins in addition to the one forming the subtriangle; M_{1a} in front wing arising nearer nodus than stigma; basal antenodal of second series present in four wings; sectors strongly curved, the angle of R_8 with the hind margin obtuse.....*Sieboldius*
- ii. Cubital space with 1 cross vein in addition to the one forming the subtriangle; M_{1a} in front wing arising nearer stigma than nodus;

- basal antenodal of second series wanting; sectors less curved, R_3 meeting the hind margin of wing at an acute angle. *Hagenius a*
- hh.* Triangle of front wing free; arculus in front and hind wings near the third antenodal; anal area of front wing with 1 row of cells proximal to the triangle, followed by not more than 2 rows; M_4 and Cu_1 in front wing nearly parallel, about 9 cells between at margin; in hind wing 1 cross vein between M_{1-3} and M_4 ; trigonal supplement not distinct; distance from forking of M_{1-2} and M_3 to subnodus greater in front wing than in hind wing.....*Davidius*
- gg.* Triangles, subtriangles, and supertriangles all normally free; distance from forking of M_{1-2} and M_3 to subnodus greater in front wing than in hind wing; sectors uniformly curved; trigonal supplement not distinctly developed; stigma short, usually one-fourth or less in distance from nodus to distal end of stigma.
- h.* Normally with 3 or more cross veins between M_{1-3} and M_4 in hind wing and 4 or more in front wing; M_{1-3} and M_4 approximated at or immediately beyond their origin at the arculus; stigma without brace vein.
- i.* Basal antenodal of second series present in all wings (excepting in *Leptogomphus sp.*); anal area of front wing with 1 or 2 rows of cells before the triangle, followed by 2 or more rows.
- j.* More than 2 rows of cells between M_1 and M_{1a} at level of distal end of stigma; anal area of front wing with maximum width of 3 or more cells; proximal angle of triangle in front wing not as far distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing symmetrical.....*Macrogomphus*
- jj.* One row of cells (rarely 2) between M_{1a} and M_{1a} at level of distal end of stigma; anal area of front wing with a maximum width of 2 cells; proximal angle of triangle in front wing at least as distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing unsymmetrical.
Leptogomphus
- ii.* Basal antenodal of second series wanting; anal area of front wing with 1 row of cells throughout; 1 row of cells between M_1 and M_{1a} at level of distal end of stigma; proximal angle of triangle in front wing at least as distant from arculus as length of proximal side of subtriangle; forking of M_{1-3} and M_4 in hind wing unsymmetrical.....*Microgomphus*
- hh.* Normally with 1 cross vein (rarely 2) between M_{1-3} and M_4 in hind wing and 4 or less in front wing; M_{1-3} and M_4 distinctly separated at and beyond their origin at the arculus; forking of M_{1-3} and M_4 in hind wing symmetrical or not distinctly unsymmetrical; stigma with or without brace vein; proximal angle of triangle in front wing not as distant from arculus as length of inner side of subtriangle.^b

^a Characters based on a study of the American *H. brevistylus*, the only species of the genus known to me.

^b The following genera form a group of great venational uniformity marked by many minor diversities. At least 2 of them are of very wide distribution and others, not regional and not here considered, find their closest allies here. Genera have developed these many minor venational characters independently, at least in many

- i. Stigma long, in front wing equal to more than one-fourth the distance from nodus to distal end of stigma; triangle in hind wing greatly elongated, the upper side about twice as long as the inner side; basal antenodal of second series present in both wings; M_4 and Cu_1 in front wing divergent, 3 rows of cells between at level of the nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 rows of cells between M_1 and M_2 in front wing beginning nearer the stigma than the nodus; arculus in front wing at or proximal to second antenodal; cubital space in front wing with 1 cross vein in addition to the inner side of the subtriangle; anal area in front wing with 1 row of cells proximal to the triangle, followed by a maximum width of 3 cells or more; 3 rows of postanal cells in hind wing; distal angle of triangle in hind wing not separated from M_4 by a distinct stalk; stigma with brace vein.

Cyclogomphus

- ii. Stigma shorter, at the most equal to or less than one-fourth the distance from nodus to distal end of stigma; triangle in hind wing with upper side not twice as long as the inner side; basal antenodal of second series usually absent.
- j. Cubital space in front wing with 2 cross veins in addition to the one forming the inner side of the subtriangle; M_4 and Cu_1 in front wing with 3 rows of cells between at level of nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; arculus in front wing distal to second antenodal; anal area in front wing with 2 rows of cells proximal to the triangle, beyond the triangle but little better developed, normally only 2 cells wide at the maximum; 4 rows of postanal cells; distal angle of triangle in hind wing not distinctly separated from M_4 ; brace vein of stigma apparently variable.

Anisogomphus

- jj. Cubital space in front wing with one cross vein in addition to the one forming the inner side of the subtriangle.
- k. Triangle in hind wing not distinctly separated from M_4 by a short stalk; usually 2 (sometimes 3) cross veins between M_{1-3} and M_4 in front wing.
- l. A_2 in hind wing arising near the middle of the lower side of the subtriangle, postanal cells of about the same width throughout; arculus in front wing at or proximal to second antenodal; 1 or 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 cells between M_1 and M_2 in front wing beginning nearer stigma than nodus; stigma with brace vein.

cases, and, in the resulting confusion, relationships are almost impossible of discernment. At the same time I believe the genera may be accurately defined, though their proper grouping is impossible, by venational characters alone. Material accessible to me, as explained more fully in the following pages, has been such that I have been limited to a first-hand study of venational characters only, in the case of many genera, and in the case of all to but few specimens and species. It is to be expected, therefore, that the arrangement of genera is not entirely a natural one and that the definitions in many cases are too explicit to cover all the species. More material, both adult and nymphal, than that to be found at present in all the collections in the world and the tabulation of other as well as venational characters will be necessary for the ultimate solution of the relationships of these genera.

- m. Three rows of postanal cells in hind wing.
- n. Anal area in front wing with maximum width of 2 cells, distal to the level of the triangle scarcely 2 cells wide, and that only for a short distance; M_1 and Cu_1 in front wing parallel to beyond the nodus, 2 cells between at level of nodus.
- o. One row of cells between M_1 and M_{1a} in front wing to the wing margin; anal area in front wing with 1 row of cells proximal to the triangle; Cu_2 in front wing ending under the nodus. . . . *Anormogomphus*
- oo. Two rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; anal area in front wing proximal to the triangle, 2 cells wide for a distance of 1 cell only, or only 1 cell wide; Cu_2 in front wing ending before the nodus.
- Burmagomphus*
- nn. Anal area in front wing with a maximum width of 3 cells, proximal to level of triangle 1 cell wide; M_1 and Cu_1 in front wing divergent, at least 3 rows of cells between at level of nodus; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma. *Platygomphus*
- mm. Four or more rows of postanal cells in hind wing; 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; anal area in front wing proximal to triangle, 2 (or in some American species 1) cells wide, distally reaching a maximum of at least 3 cells (2, fully developed, in some American species); M_1 and Cu_1 in front wing divergent, at least 3 cells between them at level of nodus. *Gomphus*^a
- ll. A_2 in hind wing arising near or proximal to the inner angle of the subtriangle, A_1 or A_2 or both usually decidedly angled, at least 4 rows of postanal cells; anal area in front wing proximal to the triangle, 2 cells wide for at least the length of 1 cell, followed distally by a maximum width of not less than 3 cells.
- m. M_1 and Cu_1 in front wing parallel to beyond the nodus, 2 cells between at level of nodus; arculus in front wing at or proximal to second antenodal; 1 or 2 rows of cells between M_1 and M_{1a} in front wing at level of distal end of stigma; 2 cells between M_1 and M_2 appearing first nearer the stigma than the nodus in front wing; first postanal cell in hind wing divided, not twice as wide as the second; stigma with brace vein. . . . *Onychogomphus*
- mm. M_1 and Cu_1 in front wings divergent, 4 rows of cells between at level of nodus; arculus in front wing distal to second antenodal; 3 rows of cells between M_1 and M_{1a} at level of distal end of stigma in front wing; 2 cells between M_1 and M_2 appearing first nearer the nodus than the stigma in front wing; first postanal cell in hind wing divided, twice as wide as the sec-

^a As shown by Needham's studies of some of the North American species, subgroups are definable, but more material is needed for a final disposition of the subject.

ond; stigma without brace vein (in *cochinchinensis*, the only species of the genus I have studied).

Heterogomphus

kk. Triangle in hind wing distinctly separated from M_4 by a short stalk (the extreme development from the condition found in *Agriogomphus* and *Neogomphus*, for examples); M_4 and Cu_1 in front wing divergent, 4 cells between at level of nodus; 3 rows of cells between M_1 and M_{1a} at level of distal end of stigma in front wing; 2 rows of cells between M_1 and M_2 in front wing appearing first nearer stigma than nodus; arculus in front wing distal to second antenodal; anal area in front wing with 2 rows of cells proximal to the level of the triangle, followed distally by a maximum width of 4 or 5 cells; A_2 in hind wing arising near the inner angle of the subtriangle; 5 rows of postanal cells; 3 or 4 cross veins between M_{1-3} and M_4 in front wing; stigma with brace vein.

Merogomphus

Subfamily CORDULEGASTERINÆ.

Genera ALLOGASTER De Selys, ANOTOGASTER De Selys and THECAGASTER De Selys.

No species of the subfamily Cordulegasterinæ have been reported for Burma or Siam and none is represented in the collections accessible to me, though representatives of three genera are known from India.

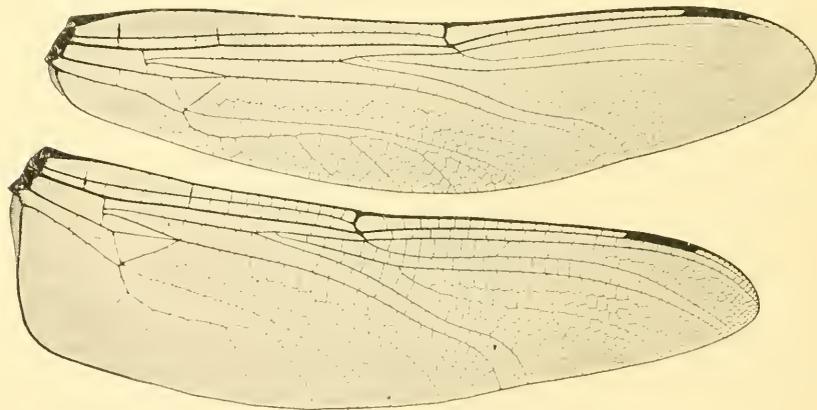


FIG. 4.—WINGS OF MALE ANOTOGASTER SIEBOLDII FROM JAPAN.

These genera are separated by De Selys as follows: *Allogaster* is distinguished by the greatly developed frons, almost as wide as the eyes, with the crest as elevated as the base of the occiput. Only one species, *latifrons* De Selys, from Bengal, is known. In *Anotogaster* the stigma is long, the head globose; and in *Thecagaster* the stigma is short, the head transverse. Four species of *Anotogaster* are known, occurring in Nepal and North India, through Tibet and China to Japan. *A. basalis* De Selys, occurring in North India,

is distinguished by De Selys from *nipalensis* De Selys, occurring in Nepal, as follows: By yellow venation instead of black; by a large yellow ring on abdominal segment 10, wanting in *nipalensis*, and by other characters. *Thecagaster* is represented by two species from North India (North India and Himalaya). These species, originally placed in this genus by De Selys, were later definitely referred by him to *Cordulegaster* (Causeries Od. No. 7). The two species, *brevistigma* De Selys and *parvistigma* De Selys, have the abdomen black with dorsal spots in a half ring. *T. brevistigma* has 14 or 15 antenodals in front wing, while *parvistigma* has 21. Some other differences mentioned by De Selys are: *T. brevistigma* has the upper lip bordered with black, and abdominal segment 10 black with a lateral longitudinal yellow spot; *parvistigma* has the upper lip not bordered with black, and 10 without yellow markings. Representatives of the subfamily Cordulegasterinae will certainly eventually be found in Burma and probably also in Siam. (See fig. 4.)

Subfamily CHLOROGOMPHINÆ.

Genus CHLOROGOMPHUS De Selys.

This genus is represented by two species confined to Sumatra and Java.

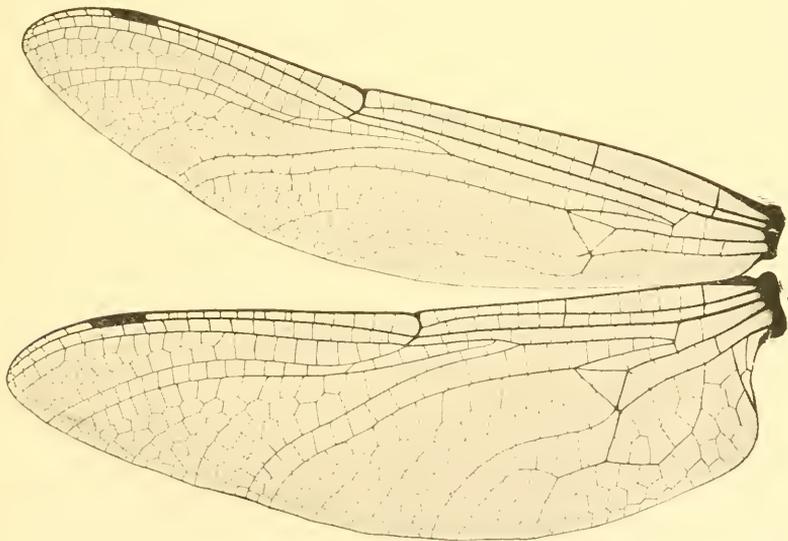


FIG. 5.—WINGS OF MALE OROGOMPHUS ATKINSONI. DE SELYS' COLLECTION.

Genus OROGOMPHUS De Selys.

Three species are known, found in Luzon, Bengal, Tonkin, and Burma. The three species are distinguished by De Selys as follows: *O. splendidus* De Selys, Luzon and Tonkin, and *speciosus* De Selys,

Burma, are distinguished from *atkinsoni* De Selys, from Bengal, by having the frons less elevated, entirely black in front; 3 yellow lateral thoracic stripes, the middle the widest, instead of 2; and the end of the abdomen a little dilated. (See fig. 5-6.)

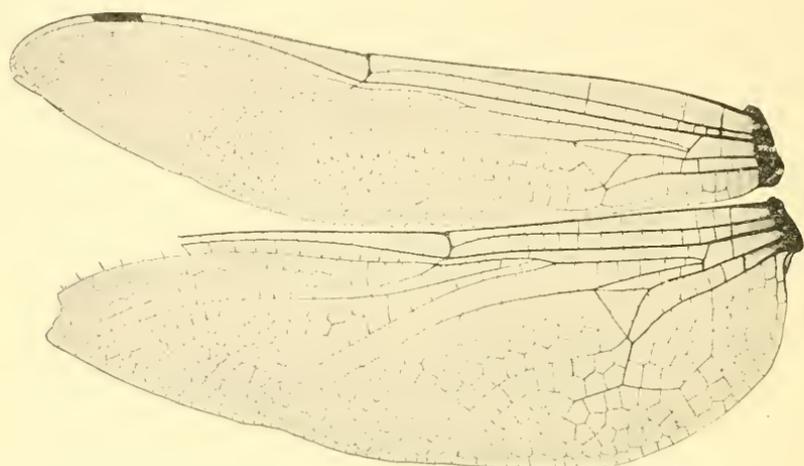


FIG. 6.—WINGS OF FEMALE *OROGOMPHUS ATKINSONI*. DE SELYS' COLLECTION.

O. splendidus has the wings marked with brownish yellow, the apices reddish brown, and abdominal segments 3-7 black. In *speciosus* the wings are hyaline, and segments 3-7 are black, with an apical yellow spot on each.

1. *OROGOMPHUS SPECIOSUS* De Selys.

"Tahò en Mars (Fea)." Known only from the female. I have not seen specimens. Abdomen 57 mm., hind wing 46 mm.

Subfamily GOMPHINÆ.

Genus *ICTINUS* Rambur.

Fifteen species and one variety of the genus *Ictinus* are at present recognized, or twelve species and four varieties, if De Selys's views are followed. Twelve of these sixteen occur in the oriental region. These have been divided into two groups by De Selys, defined most readily by the color pattern of the head, thorax, and legs, as follows:

First group.—Face largely black; posterior edge of side of thorax black; femora largely black or brown. *I. tenax* Hagen occurs in the Philippines. It has been described from a single male and an incomplete female. According to De Selys it is distinct by having the femora with an external double yellow stripe, obliterated on the second femora of the female; the nasus banded, not spotted, with yellow; abdominal segment 7 spotted, not ringed, with yellow; and the inferior abdominal appendage of the male not more divaricate

than the superior appendages. *I. decoratus* De Selys occurs in Java, Sumatra, Borneo, and Tonkin. It may be recognized by the association of the following characters: Antehumeral yellow stripe slightly or not interrupted; frons black, with a narrow yellow line; a yellow stripe between the two lateral thoracic sutures; posterior edge of side of thorax broadly black; and femora largely brown. *I. melænops* De Selys occurs in Indo-China, Sumatra, and Borneo. It is distinct from all by having the antehumeral stripe reduced to a superior spot and the area between the lateral thoracic sutures uniformly black, or with 1 or 2 small superior spots. Of the remaining four oriental species (or two species and two varieties) of this group, *pertinax* Hagen, occurring in China and Tonkin, is separated by having the nasus without a median yellow spot, abdominal segment 8 laterally spotted, without a yellow ring, and 10 all black. *I. rapax* Rambur, known from India and Indo-China, is very closely related to *præcox* Hagen, from India, and *mordax* De Selys, from India, the latter two being regarded by De Selys as varieties of *rapax*. *I. mordax* may be recognized from the fact that it has the black stripes on the lateral sutures joined at the middle, reducing the yellow stripe between them to a superior and an inferior spot; as in *pertinax*, abdominal segment 10 is black. In *rapax* the abdomen is 47–52 mm., hind wing 40–44 mm.; in *præcox* the abdomen is 50–53 mm., hind wing 39–40 mm.; in *præcox* the basal black of the frons connects at the middle with the black of the frons in front; in *rapax* yellow occupies the basal half of abdominal segment 3 and basal two-fifths of 4–6; in *præcox* the yellow is reduced. Closely related as these species are, Hagen's figures in *Monographie des Gomphines* indicate differences which should permit of more decisive definitions if material were at hand.

Second group.—Face largely yellow; posterior edge of side of thorax without black; femora largely yellow. In *angulosus* De Selys, from India, and *atrox* De Selys, from India, the leaf-like expansions of segment 8 are of medium size, largely or entirely black; in *clavatus* Fabricius, from Japan, China, and Tonkin, and *phaleratus* De Selys, from China and Tonkin, the expansion is larger, yellow, broadly bordered with black. In *atrox* the upper lip is not bordered with black, the rear of the head is black, the expansion of abdominal segment 8 is yellow at the base, and there are 5–6 enlarged spines on the posterior femora; in *angulosus* the upper lip is bordered with black, the rear of the head is black and yellow, the expansion of 8 is entirely black, and there are 7–8 enlarged spines on the posterior femora. *I. phaleratus* was regarded as a variety of *clavatus* by De Selys, distinguished by a smaller expansion of segment 8, by having segment 10 without a dorsal yellow spot, as in *clavatus*, and by having the triangle of the front wing followed by 3 cells instead of 4 as in *clavatus*. Three

males from Tonkin in my collection have segment 10 and appendages as described for *phaleratus*, but are otherwise like *clavatus* excepting that the venational character mentioned is intermediate; in one specimen the triangle in both front wings is followed by 3 rows of cells, in another specimen by 4 rows, and in the third specimen one wing has 3, the other 4 rows. Either such a species as *phaleratus* does not exist or it has been imperfectly described.

2. *ICTINUS MELÆNOPS* De Selys.

Trong, W. L. Abbott, collection U.S.N.M., 4 males, 12 females.

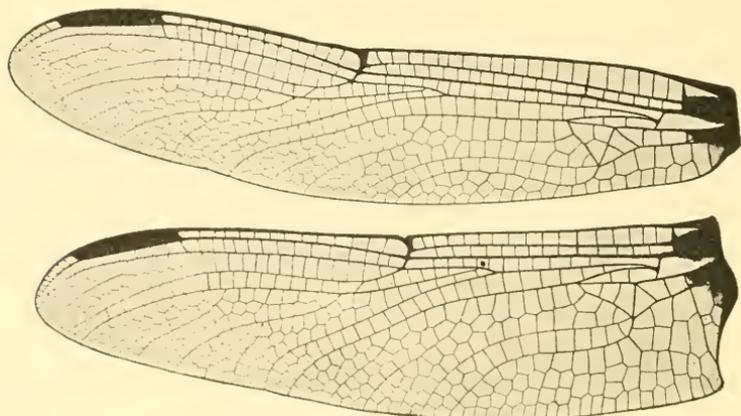


FIG. 7.—WINGS OF MALE *ICTINUS MELÆNOPS* FROM SIAM.

Wings more or less fumose in one male and nine females. Subtriangle in front wing 2-celled in all but the right wing of one

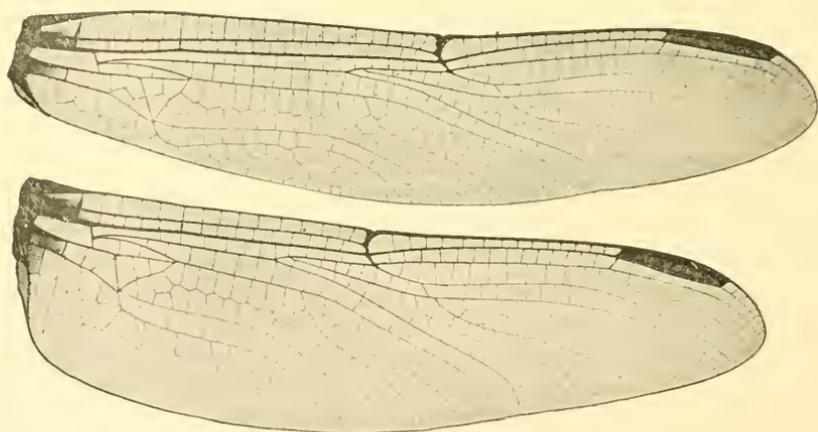


FIG. 8.—WINGS OF FEMALE *ICTINUS MELÆNOPS* FROM SIAM.

male, where it is open, and one wing of a female where it is 3-celled; subtriangle in hind wing open in all. Triangle in front wing 2 cells long, the first cell divided, making the triangle 3-celled—in

4 male wings and 10 female wings (in three cases slightly abnormal, the divisions obscured or disguised); triangle in front wing 3 cells long, the first cell divided, making the triangle 4-celled—in 3 male wings and 15 female wings (disguised in one case): triangle in hind wing 2 cells long and 2-celled—in one male wing; triangle in hind wing 3 cells long and 3-celled—in 5 male wings and 19 female wings: triangle in hind wing 3 cells long, the first cell divided, making the triangle 4-celled—in 2 male wings and 5 female wings. Upper lip entirely black in one male and one female; upper lip with 2 basal yellow spots, more or less distinct, in all the others. Nasus with a more or less distinct yellow spot at either end in all. Pale area of frons above of about uniform width in three males and five females; narrowed or divided in the middle in one male and seven females. *Ictinus melanops*, race *sumatranus* Krüger from Sumatra does not seem sufficiently different. (See figs. 7 and 8.)

3. ICTINUS PERTINAX Hagen.

One male from Burma collected by Earnshaw.

This has the upper lip black, with two small squarish basal spots, separated by black, about equal to their width; the antehumeral stripe widely divided. I have two adult males and a teneral male from Tonkin. This teneral specimen, which I refer to *perlinax*, has the spots on the upper lip larger and connected; and the antehumeral stripes are narrowed but not divided above.

Genus GOMPHIDIA De Selys.

The seven described species all occur in the Oriental region. *G. krugeri* Martin is rivalled in size only by *perakensis* Laidlaw. It is known from Tonkin; abdomen 63 mm., hind wing 50 mm.; front wing, antenodals 24, postnodals 13–14; distinct from all the others by having the dorsal thoracic stripes on either side of the middorsal carina joined at their upper end with a spot which represents the upper end of the antehumeral stripe. *G. confluens* De Selys occurs in Central China, Tonkin, and Anam; abdomen 53 mm., hind wing 48 mm.; front wing, antenodals 19–20, postnodals 11; distinguished from all others by having the dorsal thoracic stripes joined below with the mesothoracic half collar. *G. javanica* Foerster, from Java, has the abdomen about 53 mm., hind wing 40–43 mm.; front wing, antenodals 16–18, postnodals 12; it is peculiar in having the subtriangle of the front wing free, not divided (the subtriangle of the front wing is sometimes free in *maclachlani*, but in *javanica* the rhinarium is yellow, while it is black in *maclachlani*). *G. kirschii* De Selys and *perakensis* Laidlaw are peculiar in having a relatively large number of postnodals. *G. kirschii* occurs in the Philippines, Borneo, and Tonkin; abdomen 45–48 mm., hind wing 38–42 mm.; front

wing, antenodals 18-19, postnodals 15-17; on the sides of the thorax in the black area between the two lateral sutures is a row of yellow spots. *G. perakensis* Laidlaw was described from the Malay Peninsula; abdomen 59 mm., hind wing 54 mm.; front wing, antenodals 22-23, postnodals 17-18; the abdomen is largely black, with the dorsal basal one-third of 7 yellow; Doctor Laidlaw compared his specimen in coloration with a *Macrogomphus* in the British Museum erroneously determined as *quadratus*; there is no similarity between *perakensis* and *quadratus*. The two remaining species of *Gomphidia* are separated at once by the color of the head. *G. maclachlani* De Selys occurs in Borneo, Sumatra, Tonkin, and Anam; abdomen, male 51-55 mm., female 52 mm.; hind wing, male 38-43 mm., female 46 mm.; front wing, antenodals 19-21, postnodals 10-14; face entirely black excepting part of the frons. *G. t-nigrum* De Selys is known only from North India; abdomen 52 mm., hind wing 39.5 mm.; front wing, antenodals 15-16, postnodals 9-10; face, vertex, and occiput largely yellow. An eighth species is described below as new, from a specimen from Siam.

4. GOMPHIDIA ABBOTTI, new species.

Abdomen, male without appendages 50 mm., superior appendages 3.5 mm.; hind wing, male 41 mm.

Wings hyaline, without trace of basal spot; membranule white; stigma very dark brown, covering 4 or 5 cells, brace vein present;

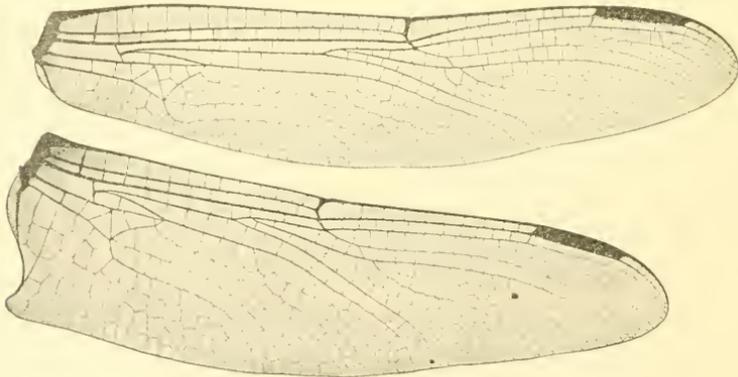


FIG. 9.—WINGS OF MALE GOMPHIDIA ABBOTTI FROM SIAM.

antenodals, front wing 18-19, hind wing 12-13; postnodals, front wing 11, hind wing 10-11; triangle in front wing 3 cells long, the first cell divided, making 4 cells in the triangle, followed by 3 cells, then 2; triangle in hind wing 2 or 3 cells long, followed by 3 or 4 cells, then 2; subtriangle in front wing once divided, in hind wing free; cubital

space in front wing with 3, in hind wing with 2 additional cross veins; 1 or 2 supertriangular cross veins in front wing, 1 in hind wing; 6-8 cross veins between M_{1-3} and M_4 in front wing, 4-5 in hind wing; anal triangle 5-celled. (See fig. 9.)

Lower lip dull brownish, the adjacent portion of the rear of the eyes dull yellow; remainder of the head black, marked with yellow as follows: Upper lip with a superior spot on either side, separated by more than their own length; base of mandibles, margined with black; rhinarium; a very small inferior lateral spot on nasus; a narrow superior line on the frons in front; the anterior half of the frons above, this pale area nearly or quite divided by a broad low triangle of black continuous with the basal black of the frons. Occiput high, rounded, with short cilia.

Prothorax rich dark brown. Thorax of the same color, paler below, marked with light yellow as follows: A wide mesothoracic half collar, divided at the median line; short, widely divaricate, cuneiform stripes on either side above, beginning just in front of the antealar sinus and reaching about half way to the mesothoracic half collar; antehumeral stripe entirely wanting, not represented by a spot or line; mesepimeron with a stripe a little more than 1 mm. wide, of nearly uniform width for its entire length; just behind the extreme upper end of this stripe a minute inconspicuous spot (probably this is variable and specimens with a row of spots in the black area would not be surprising); metepimeron with a stripe not quite 2 mm. wide at its widest part; a spot between the front wings, and a transverse row of 3 spots in juxtaposition between the bases of the front and hind wings. Legs dark brown, apices of femora and the tibiae black.

Abdomen brown anteriorly, black posteriorly, marked with yellow as follows: 1 and 2 obscurely marked, 1 with a dorsal basal spot, 2 with a dorsal median spot, the auricles dull yellowish tipped with black; basal dorsal rings on 3-7, occupying two-fifths of 3, one-third of 4-6, and nearly one-half of 7; these yellow areas minutely punctate with black and on 3-6 divided posteriorly in the median line by the encroaching black; on 7 the yellow is produced slightly posteriorly in the median line; 8 with a small obscure basal lateral spot, a hint of which is found on 9; 10 with an obscure dorsal median greenish spot, the spot itself with a median black spot; appendages black; abdomen beneath dark, base of 3, vesicle, and portion of apices of genital hamules pale. (See fig. 10.)

Genital lobe represented on the margin of the segment by a low ridge with 4-6 short black teeth; anterior lamina prominent, the median third produced posteriorly as a smoothly rounded tubercle; hamules thin, plate-like, extending well beyond the vesicle of the

penis, the anterior not reaching the apex of the posterior, its apical third a long slender hook; posterior hamule elongated triangular in general shape, the sides somewhat rounded.

Described from a single male, collection U.S.N.M., collected at Trong, Lower Siam, Jan.-Feb., 1899, by Dr. W. L. Abbott, for whom this fine species is named.

Type.—Cat. No. 10449, U.S.N.M.

Contrasted with other species of the genus certain differences may be noted. From *t-nigrum* it differs in having the triangle of the front wing followed by 3, not 4, cells; the face largely black; anterior femora without pale stripe; abdominal segment 8 black, with a lateral basal pale spot, not yellow with apical one-third black; 7 with scarcely basal half yellow, not basal three-fourths; 9 almost entirely black, and

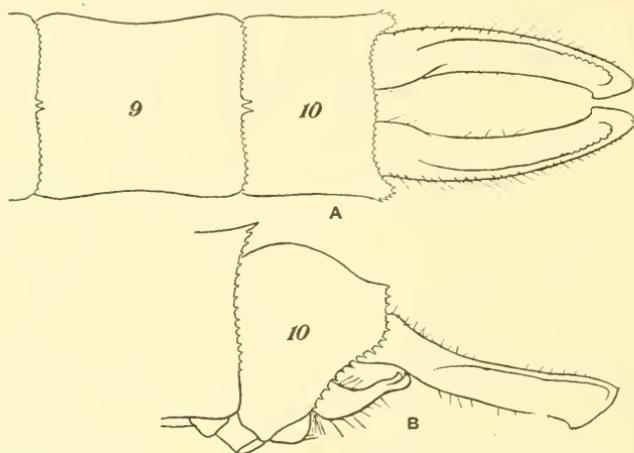


FIG. 10.—GOMPHIDIA ABBOTTI FROM SIAM. A, DORSAL, AND B, LATERAL VIEWS OF MALE ABDOMINAL APPENDAGES. 9 AND 10, ABDOMINAL SEGMENTS.

appendages differently shaped. From *maclachlani* it differs by having the upper lip spotted with yellow and the rhinarium yellow; the abdomen with less black, and the appendages differently shaped. From *kirschii* it differs in having a darker nasus; the antehumeral spots or stripes absent; abdominal spots not lateral but dorsal, reduced on 8 instead of more prolonged; appendages differently shaped, and a smaller number of postnodals. From *perakensis* it differs by the more extensive yellow on abdominal segments 3-6 and the smaller number of postnodals. From *confluens* it differs by having the subtriangle of front wing 2-celled, not 3-celled; by the differently colored face; by the isolated dorsal thoracic stripes; by the black legs, and by the much darker abdominal segments 7-10. From *krugeri* it differs by the 2-celled, not 3-celled, subtriangle of the front wing, by the dorsal

thoracic pattern, by the more extensive yellow on abdominal segments 3-6, and by the very different appendages. From *javanica* by having the subtriangle of front wing divided, not free; by the more extensive yellow on abdominal segments 3-6, and by the form of the appendages.

Genus **SIEBOLDIUS** De Selys.

Three species have been described in this genus. All are large insects, abdomen 55-61 mm., hind wing 47-55 mm. *S. albardæ* De Selys occurs at Pekin; *japponicus* De Selys is known from Borneo and the Malay Peninsula; and *grandis* Krüger has been described from two females from Sumatra. *S. grandis* is based largely on characters of the occiput and it remains to be seen if the species is separable from *japponicus*. Laidlaw's record of *grandis* from the Malay Peninsula should really be *japponicus*, I believe.

5. **SIEBOLDIUS JAPPONICUS** De Selys.

Four males. Khow Sai Dow Mountain, 1,000 feet, Trong, Lower Siam, Jan.-Feb., 1899, Dr. W. L. Abbott, collector. collection U.S.N.M. One of these is teneral. All agree with De Selys's descrip-

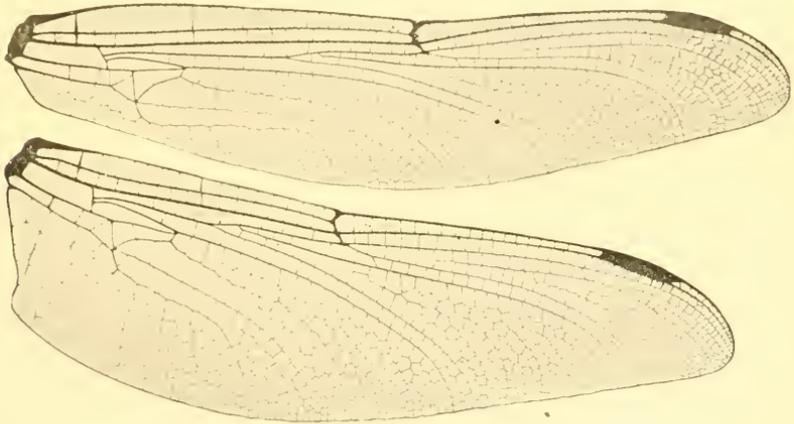


FIG. 11.—WINGS OF MALE *SIEBOLDIUS JAPPONICUS* FROM SIAM.

tion in Odonates du Japon and with Laidlaw's description of a male "caught at the foot of Gumong Inas (about 1,000 feet above sea level) near a small jungle pool, in January, 1900." (See fig. 11.)

Genus HAGENIUS De Selys.

In addition to the American *brevistylus* De Selys, Martin has described a second species, *gigas*, from Tonkin. Martin's species is much the larger of the two, having the abdomen 71 mm. and the

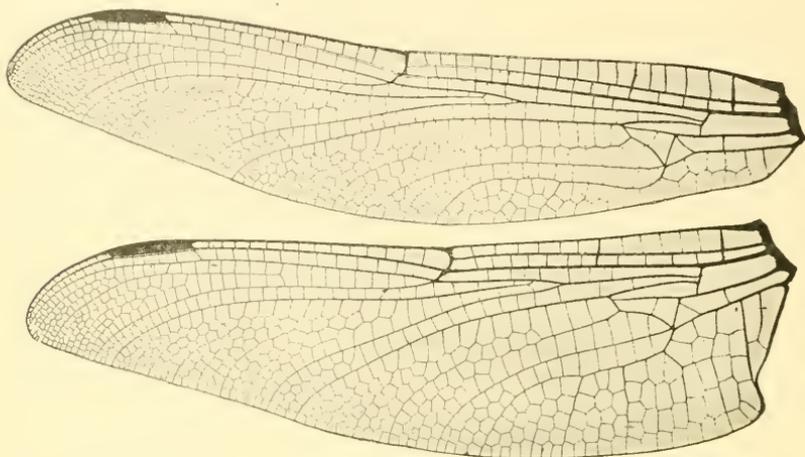


FIG. 12.—WINGS OF MALE HAGENIUS BREVISTYLUS FROM NORTH AMERICA.

hind wing 54 mm., and the dorsal thoracic stripes are joined with the mesothoracic half collar and not isolated as in *brevistylus*. (See fig. 12.)

Genus DAVIDIUS De Selys.

The species of this genus are all small or of moderate size, ranging from abdomen 29 mm. and hind wing 27 mm. to abdomen 44 mm. and hind wing 40 mm. There is great indefiniteness throughout the genus in the development of cross veins in the triangles. In *nanus* De Selys, from Japan, the triangles of all 4 wings were crossed in the first female studied by De Selys; later material had the triangle of front wing free and triangle of hind wing crossed and the supertriangle, normally free, accidentally crossed. Of *bicornutus* De Selys, from Japan, only one female has been described, and this has the triangle of front wing free and triangle of hind wing crossed. *D. davidii* De Selys, known from two females from Thibet, has the triangle of front wing free, of hind wing crossed. *D. ater* Hagen, from Japan, has the triangle free in all 4 wings, excepting that it is crossed in one hind wing of a female. *D. fruhstorferi* Martin, from Tonkin, in 6 specimens has the triangle of front wing free, of hind wing crossed; in a seventh specimen, female, all the triangles are crossed. *D. aberrans* De Selys, known from a single female from the north of India, has the triangle of one front wing free, the other triangles crossed. *D. zallorensis* Hagen, Himalaya, known from a single male, has the tri-

angle of front wing free, of hind wing crossed. None of the species has been taken in Burma or Siam. The two Indian species are very similar and were regarded by De Selys as probably the sexes of a single species. They are separated from *fruhstorferi* by having two pale areas on either side of the thorax above, instead of one; by the presence of a black stripe on second lateral suture, wanting in *fruhstorferi*: in *aberrans* and *zallorensis* there are 10–12 antenodals in the front wing (7 or 8 in hind wing of *aberrans*), and 7–10 post-

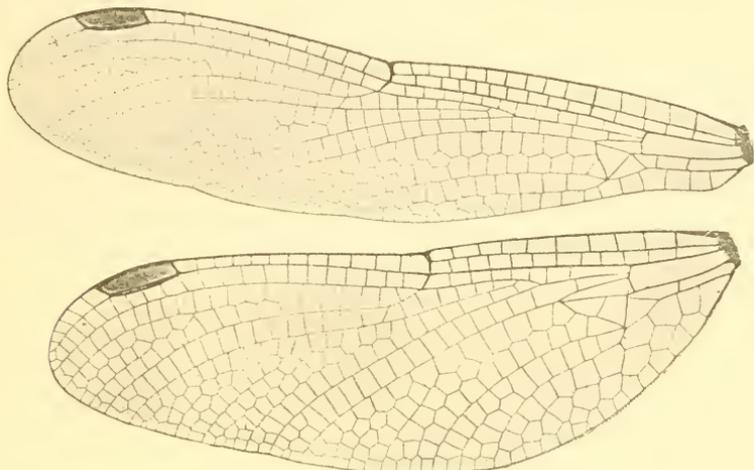


FIG. 13. WINGS OF FEMALE DAVIDIUS FRUHSTORFERI FROM TONKIN.

nodals; in *fruhstorferi* there are 14–16 antenodals in front wing, 10 in hind wing, and 11 or 12 postnodals in front wing and 10 in hind wing. Characters for separating the two Indian species are not evident in the descriptions. In both the abdomen is largely black, 1 and 2 largely yellow, and the following segments to 8 each with a lateral basal and apical spot. The type of *aberrans* has the last 6 segments wanting. (See fig. 13.)

Genus MACROGOMPHUS De Selys.

The nine species belonging to this genus are confined to the Orient. In addition to the two distinct patterns of thoracic colors, separating these species into two groups, venational differences exist, but whether these venational differences are constant for the two groups I do not know. I have seen only one species of each of the two groups. In the case of the species of the *quadratus* group, in addition to several minor differences, the greater complexity and remarkable curving of the sectors, as compared with the species belonging to the *parallelogramma* group, may be noticed.

Quadratus group.—Dorsum of thorax black, with a large squarish yellow spot on either side below. In *quadratus* De Selys, from

Borneo, and possibly Sumatra, the yellow dorsal thoracic spots do not extend laterally beyond the humeral suture, and the auricles of the male are entirely black. In *thoracicus* McLachlan, from the Malay Peninsula and Sumatra, the thoracic spots extend laterally

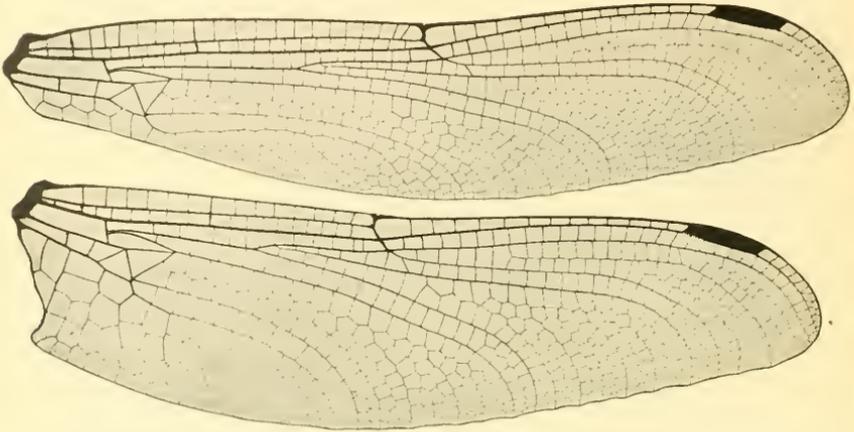


FIG. 14.—WINGS OF MALE *MACROGOMPHUS QUADRATUS* FROM BIG TAMBELAN ISLAND, CHINA SEA.

onto the mesepimeron, and the auricles are largely yellowish. In *abnormis* De Selys, probably from Borneo, the thoracic spots extend entirely across the sides of the thorax.

Parallelogramma group.—Dorsum of thorax black, with yellow dorsal stripes. The following notes are from De Selys' synopsis of the species in Quatrième Addition au Synopsis des Gomphines. In

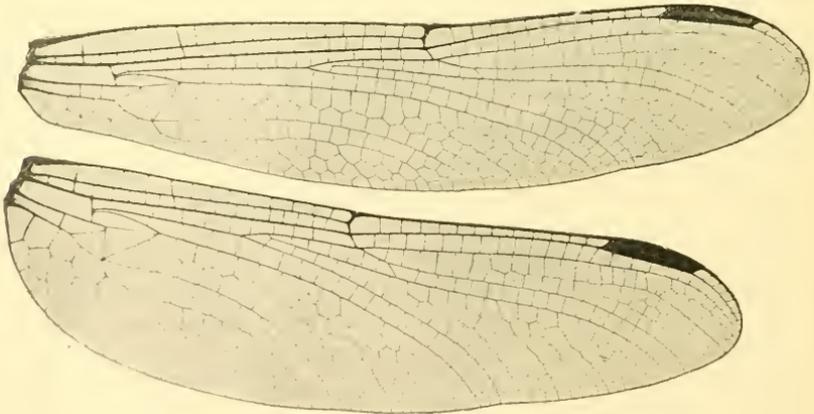


FIG. 15.—WINGS OF FEMALE SPECIES OF *MACROGOMPHUS* FROM SIAM.

annulatus De Selys, from India, Tonkin, and Anam, the outer and inner branches of the superior appendage of male are about equal in length, with a short inferior tooth; inferior appendage seen in profile with a double curve; rear of occiput of female with a median

bifid tubercle. In *robustus* De Selys, from Thibet, the male had the appendages destroyed, while the female is not known. In *albardæ* De Selys, from Sumatra, the outer branch of the superior appendage of the male is slightly shorter than the inner; branches of inferior appendage straight; a small tubercle at either end of the occiput in the female. In *parallelogramma* Burmeister, from Java and Sumatra, the outer branch of the superior appendage of the male is slightly shorter than the inner; branches of inferior appendage straight; rear of occiput of female slightly elevated. In *montanus* De Selys, from Assam, the outer branch of the superior appendage of the male is much shorter than inner branch; branches of inferior appendage straight; rear of occiput of female elevated and conical. In *deccmlincatus* De Selys, from Sumatra and Borneo, the outer branch of

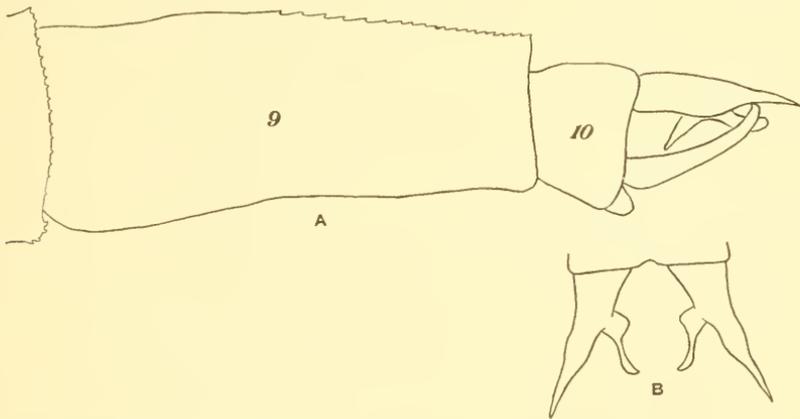


FIG. 16.—MACROGOMPHUS QUADRATUS FROM BIG TAMBELAN ISLAND, CHINA SEA. A, LATERAL, AND B, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES. 9 AND 10, ABDOMINAL SEGMENTS 9 AND 10. THE SHORT HAIRS PRESENT ON THE APPENDAGES ARE NOT SHOWN IN THE FIGURES.

the superior appendage of the male is much shorter than the inner; branches of inferior appendage straight; female not known.

The color differences may be tabulated as follows:

1. Lips and face black *robustus*
 Lips and face black, varied with yellow.....*annulatus, parallelogramma, deccmlincatus*
 Upper lip and face brown, varied with yellowish.....*albardæ*
 Lips and face yellow, varied with black *montanus*
2. Sides of thorax black, with 2 isolated oval yellow bands.
robustus, annulatus, albardæ
 Sides of thorax black, with 3 equal isolated yellow stripes..... *deccmlincatus*
 Sides of thorax yellow, with approximated stripes on the lateral sutures and a third stripe at the posterior edge.....*parallelogramma*
 Sides of thorax yellow, with black stripes on the lateral sutures..... *montanus*
3. Legs black *robustus*
 Legs black, first femora pale spotted beneath.....*annulatus, montanus, deccmlincatus*
 Legs black, femora shading into reddish *albardæ*
 Legs black, femora yellow *parallelogramma*

I have seen only three specimens of *Macrogomphus*. One of these is a male of *quadratus* collected by Doctor Abbott on Big Tambelan Island, China Sea, August, 1899. The other two are females of a form which I am unfortunately unable to refer to any described species and which I hesitate to name from the single sex, though the specimens show many characters which might justify this. (See figs. 14, 15, 16.)

6. MACROGOMPHUS SPECIES (parallelogramma group).

Abdomen without appendages 45 mm.; hind wing 37-38 mm. Antenodals, front wing 17-18; hind wing 12-14; postnodals, front wing 12; hind wing 10-12. Cubital space in front wing with 2 additional cross veins. Five cross veins between M_{1-3} and M_4 in front wing and 3 in hind wing; basal antenodal second series present. Abdominal segments 7-10 measuring: 7, 5 mm.; 8, 3.5 mm.; 9, 6 to 6.5 mm.; 10, 1 mm.

Rear of head and lower lip pale dull yellow, darker above behind the eyes; face in front obscure brown without markings, shading continuously from the frons into paler below, so that the upper lip at its lower edge passes into the color of the lower lip; frons above entirely greenish yellow; vertex black, dull yellow at the base of the occipital plate; occipital plate dark brown, produced in the middle in a two-pointed tubercle.

Thorax black, the yellow dorsal stripes almost parallel, beginning just before the antealar sinus and widened below to form a mesothoracic half collar, interrupted at the middle. A long yellow stripe, gradually widening below, on the mesepimeron; a similar but wider stripe on the metepimeron; the black area between the stripes with a superior yellow spot, which may be greatly reduced or may extend downward half the length of the spot on the metepimeron. Legs brown, without distinct markings; tibiae and apices of femora black.

First 3 abdominal segments obscurely colored, dorsum of 2 and 3 with a median dorsal stripe, wide on the basal half of 3, reduced to a line on the apical half; 4-7 basally annulate with yellow, scarcely one-third of each segment on 4-6, fully one-half on 7; 8 black; 9 with a small obscure basal lateral spot; 10 pale obscure yellow.

Described from two females, Trong, Lower Siam, Dr. W. L. Abbott, collection U. S. National Museum. The head of one specimen is lost.

This species is separated at once from *robustus* by the color of the head. From *annulatus* it is separated by several characters: Color of head, legs, and abdomen. From *albardæ* by color of head and abdomen, and form of occiput. From *parallelogramma* by color of head and abdomen and form of occiput. From *montanus* by color

of head, thorax, and legs, and form of occiput. From *decemlincatus* by color of head, thorax, legs, and abdomen.

Genus LEPTOGOMPHUS De Selys.

The ten species referred to this genus, some with considerable question, are all members of the oriental fauna; four have been recorded for Burma. The following notes gathered from the literature of the subject may be of value in separating the species:

L. assimilis Krüger. Tentatively proposed by Krüger for Sumatran specimens very close to *lansbergei*. The size is somewhat smaller, the stigma somewhat shorter than the figures given by De Selys for *lansbergei*; there are 2 additional postoccipital spines; the upper lip has 2 large instead of 2 small yellow spots; the prothorax is more yellow, and the anterior femora are yellow beneath.

L. gestroi De Selys. Burma and Tonkin. Abdomen, male 40–42 mm., female 39 mm. hind wing, male 34–35 mm., female 35 mm.; antenodals, front wing 15–16; postnodals, front wing 11; basal antenodal of second series present in 4 wings.

L. gracilis Krüger. Sumatra. Abdomen without appendages, male 27–28 mm., female 30 mm.; hind wing, male 23–25 mm., female 25 mm.; antenodals 12–13; postnodals 10–12; basal antenodal of second series not present; between M_{1-3} and M_4 4 or 5 cross veins in front wing, 3 or 4 in hind wing. Krüger regards *nietneri* and *gracilis* as not congeneric with *semperi*.

L. inclitus De Selys. Burma and Moolai. Abdomen, female 36 mm.; hind wing, female 32–33 mm.; antenodals, front wing 14–19; postnodals, front wing 9–11.

L. kilantanensis Laidlaw. Malay Peninsula. Abdomen, 31 mm.; hind wing 26 mm.; antenodals, front wing 11, hind wing 10; postnodals, front wing 10, hind wing 10; basal antenodal of second series wanting. Laidlaw's description and figure of venation and his description of male appendages clearly indicate the genus *Leptogomphus* rather than *Gomphus*, to which he assigned the species. His figure represents 3 cross veins between M_{1-3} and M_4 in front wing and 3 or 4 in hind wing.

L. lansbergei De Selys. Java and Sumatra (see *L. assimilis* above) Abdomen, female 39 mm.; hind wing 35 mm.; antenodals, front wing 17–18; postnodals, front wing 13 (De Selys). Abdomen without appendages, male 36–37 mm., female 36 mm.; hind wing, male 29 mm., female 33 mm.; antenodals, front wing 14–16; postnodals, front wing 11–12; basal antenodal of second series present; between M_{1-3} and M_4 4 or 5 cross veins in front wing, 2 or 3 in hind wing (Krüger).

4. Abdominal segments 8-10 black.

gestroi, gracilis, inclitus, kelantanensis, lansbergei, maculivertex

Some yellow on at least one of segments 8-10.....*nictneri, parvus, semperi*

5. Legs largely black or dark; yellow, if any, confined to first femora.

gestroi, gracilis, lansbergei, nictneri, parvus

Legs with much yellow.....*inclitus, maculivertex, semperi*

Uncertain.....*kelantanensis*

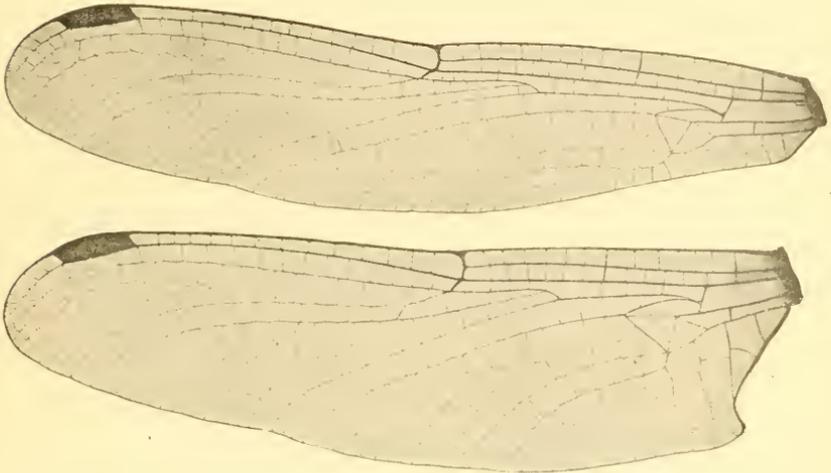


FIG. 18.—WINGS OF MALE SPECIES OF LEPTOGOMPHUS FROM TONKIN. MARTIN'S COLLECTION.

7. LEPTOGOMPHUS INCLITUS De Selys.

Described from two females from the east of Burma and a single female from Moolai, but not mentioned in Odonates de Birmanie.

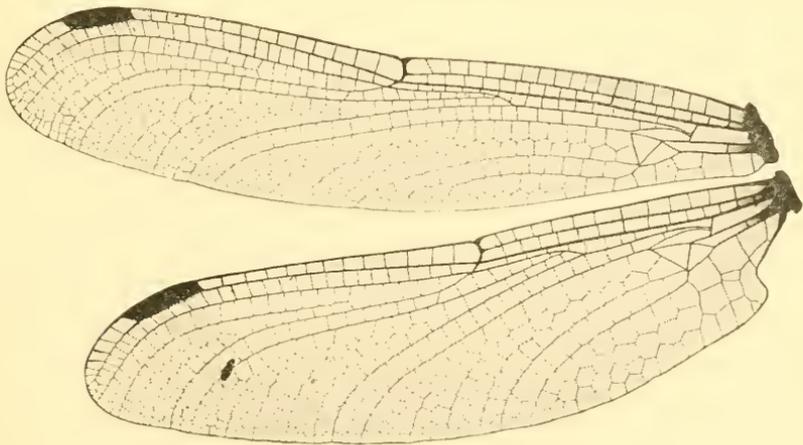


FIG. 19.—WINGS OF MALE LEPTOGOMPHUS INCLITUS. DE SELYS' COLLECTION.

I have not seen specimens. The following brief description is condensed from De Selys: Lips yellowish, the upper bordered with black

in front: rhinarium, nasus, and frons blackish, center of nasus yellowish, and frons above with yellow anteriorly. Thorax black; a dorsal stripe, confluent below with the mesothoracic half collar to form a 7,^a and an antehumeral of the same width, yellow; sides and below pale yellow, with a blackish stripe on the second suture, confluent above with a black area which occupies the upper ends of the 2 sutures and extends to the posterior edge of the thorax. Legs dusky blackish, the lower surface of the first 4 femora and a larger part of the last femora yellowish. Abdomen with 1-7 each with a dorsal yellow longitudinal stripe; 1 and 2 with lateral yellow band; 3-7 each with a similar but reduced and interrupted basal yellow band. (See figs. 19 and 20.)

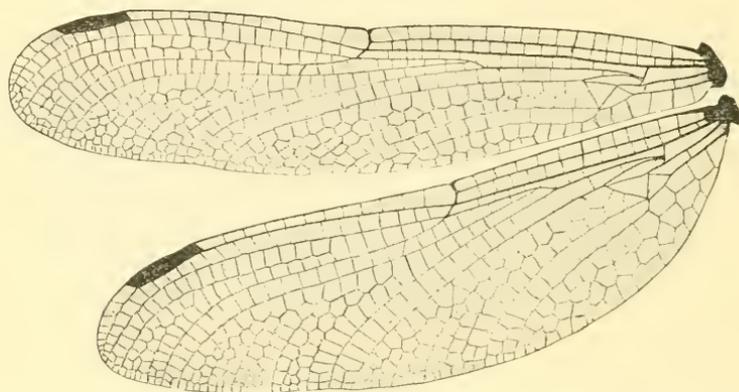


FIG. 20. WINGS OF FEMALE *LEPTOGOMPHUS INCLITUS*. DE SELYS' COLLECTION.

8. *LEPTOGOMPHUS GESTROI* De Selys.

"Leitò, à la fin de mai (Fea)." Not represented in the collections before me. The following brief description is condensed from De Selys: Head pale yellow, black as follows: Occipital plate, vertex on either side, sutures of the face, rhinarium, and anterior border of upper lip which is obscurely and incompletely traversed. Thorax black above; a short mesothoracic half collar, isolated dorsal stripe, and an antehumeral stripe, yellow; sides and pectus yellow, first lateral suture with a black stripe, second with an irregular spot. Feet black, three-fourths of all femora and inner side of first femora livid. Abdomen black, yellow as follows: A basal spot and sides of 1, a trilobed dorsal spot and auricles of 2, a dorsal stripe, not reaching base or apex of each segment, on 3-7.

^a Not confluent in female from Moolai.

9. LEPTOGOMPHUS? MACULIVERTEX De Selys.

“Metelèd, un exemplaire unique (female), le 10 septembre, 1888 (Fea).” Not seen by me. The following brief description is condensed from De Selys: Head black, yellow as follows: A transverse band above on frons, a rounded spot on each side of nasus, a band on upper lip, cheeks, a round point at center of vesicle, and the occipital plate. Thorax black, yellow as follows: A mesothoracic half collar, narrowly interrupted in the median line, joined at either side with the dorsal stripes to form a 7; a narrow antehumeral stripe terminating above in a rounded isolated spot; a trace of pale on the mid-dorsal carina; sides and below clear yellow, a black line on the upper half of the first suture and a complete line on the second suture. Legs black, femora yellow, with an external black stripe. Abdomen black, marked with yellow; 3-7 with dorsal yellow spots not reaching the extremities of the segments, on 7 occupying only the basal two-thirds of the segment; 8-10 black.

10. LEPTOGOMPHUS? NIETNERI Hagen.

“Leitèd, un male, unique pris le 27 octobre (Fea).” Not seen by me. The following brief description is condensed from Hagen and De Selys: Lower lip pale yellowish, middle lobe apically brownish; upper lip black, with 2 large yellow basal spots; rhinarium and nasus black; frons black, with a transverse yellow band in front above. Thorax black above, yellow as follows: An interrupted mesothoracic half collar, isolated oblique dorsal stripes, and a superior antehumeral spot; sides yellow, with a black stripe on each lateral suture. Legs black, femora with brown markings. Abdomen black marked with yellow; 1-7 (1-6 De Selys) with a dorsal stripe, narrowed on 3-7; on 6 and 7 a larger dorsal basal spot (not mentioned by De Selys); yellow markings on the sides of 1-3; 4-8 each with a short linear lateral basal spot (not mentioned by De Selys); a lateral apical yellow spot on 8 and 9 (not mentioned by De Selys). A comparison of Hagen's description based on a male from Ceylon with De Selys's description based on a male from Burma creates some doubt as to whether the 2 specimens really represent the same species.

Genus MICROGOMPHUS De Selys.

Only one species of this genus is known. It has been taken in the Malay Peninsula and Sumatra. *M. chelifera* De Selys is a small species, abdomen 25 mm., hind wing 18.5-22 mm. The face is black, marked with yellow. Thorax above black, with a pale dorsal stripe on either side joined with the interrupted mesothoracic half collar;

sides yellow, with a single black stripe. Abdomen black, with narrow indistinct basal rings and narrow mid-dorsal stripes as far as 7. (See figs. 21 and 22.)

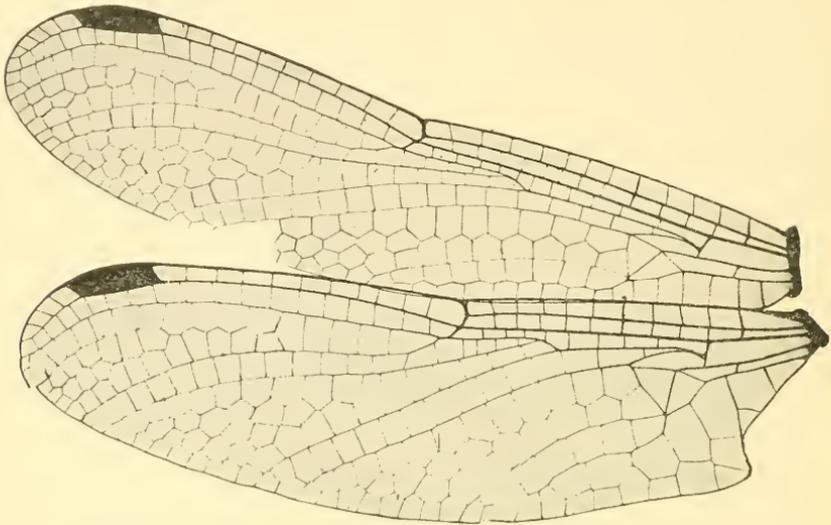


FIG. 21.—WINGS OF MALE *MICROGOMPHUS CHELIFER*. DE SELYS' COLLECTION.

Genus *CYCLOGOMPHUS* De Selys.

Six species, all described by De Selys, are known from India. *C. minusculus*, the smallest species, may be known at once by its size, abdomen 22 mm., hind wing 21 mm.; only the female is known. *C.*

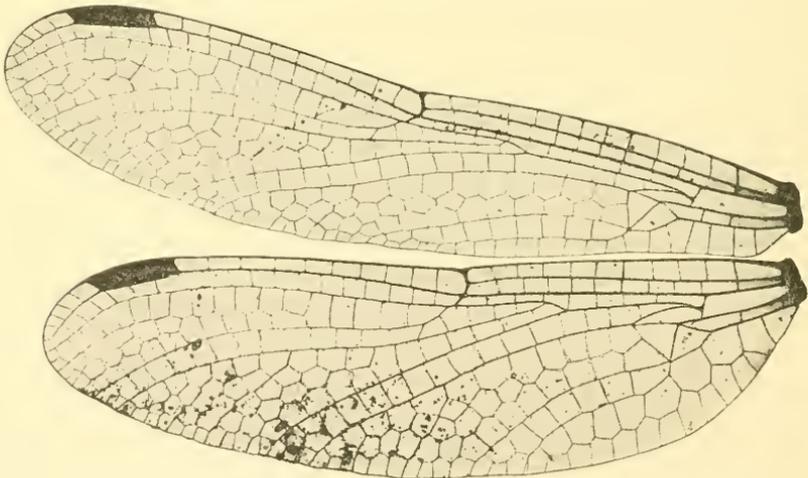


FIG. 22.—WINGS OF FEMALE *MICROGOMPHUS CHELIFER*. DE SELYS' COLLECTION.

verticalis, of which only the female is known, has the abdomen 27 mm., hind wing 25 mm.; it is separated from all the other species by

having a yellow spot on the vertex between the eyes. In *torquatus* and *heterostylus* the black on the sides of the thorax forms a distinct Y. *C. heterostylus*, of which the male has been described, has the stigma yellow, with a central brown spot; *torquatus* is known only from the female.

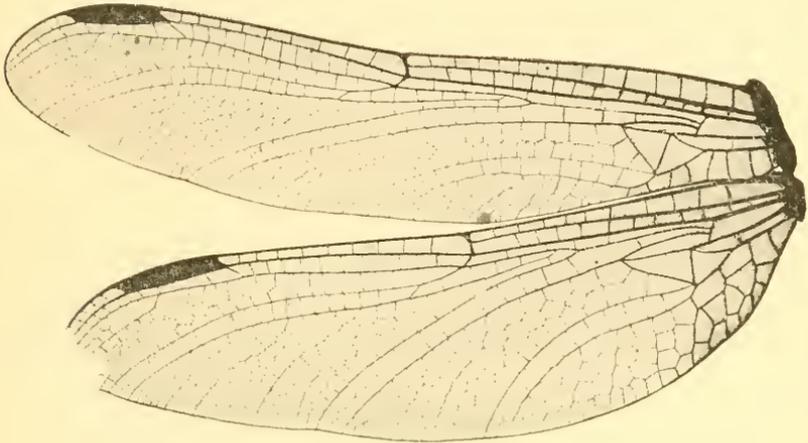


FIG. 23.—WINGS OF FEMALE *CYCLOGOMPHUS HETEROSTYLUS*. DE SELYS' COLLECTION.

In *vesiculosus* and *ypsilon* the black on the sides of the thorax does not form a distinct Y. *C. vesiculosus* has the abdomen 25 mm., hind wing 23 mm., the female is not known; *ypsilon* has the abdomen 32 mm., hind wing 29 mm. Only in the case of *ypsilon* are both sexes

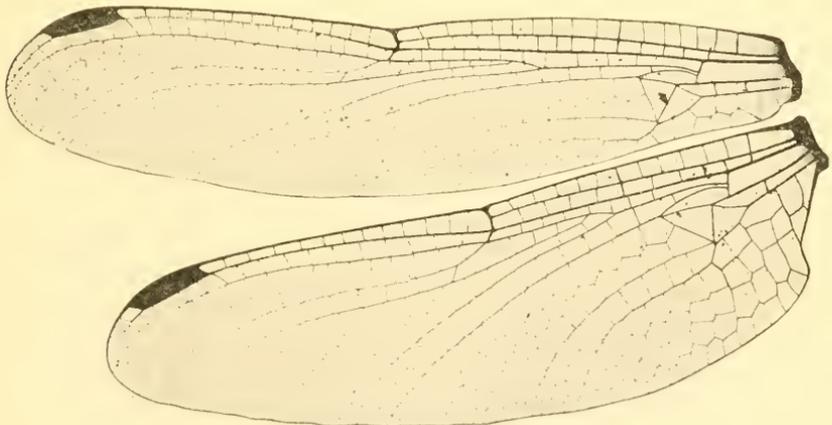


FIG. 24. WINGS OF *ANISOGOMPHUS OCCIPITALIS*. DE SELYS' COLLECTION.

known; *heterostylus* and *vesiculosus* are known only from males, and the single male of *vesiculosus* has the last 5 abdominal segments wanting; *minusculus*, *verticalis*, and *torquatus* are known from females only. The abdominal appendages of the males in the two

species known are remarkable by the small size of the superiors and the large widely divaricate inferior, which is one and one-half to twice as long as the superiors. (See fig. 23.)

Genus ANISOGOMPHUS De Selys.

Five or six species have been referred at different times to this genus. The type of the genus and another species are oriental, the two occurring in India. *A. occipitalis* De Selys and *bivittatus* De Selys are about of the same size; *occipitalis* has the abdomen, male

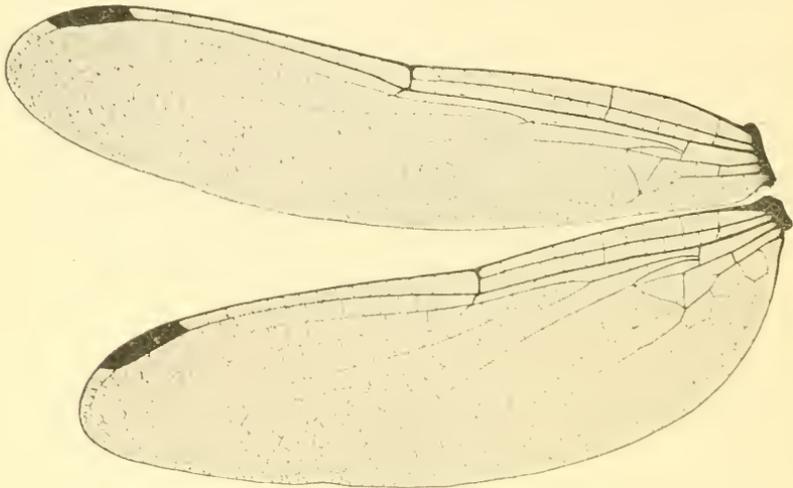


FIG. 25. WINGS OF FEMALE ANISOGOMPHUS OCCIPITALIS. DE SELYS' COLLECTION.

33–35 mm., female 35–37 mm.; hind wing, male 29–31 mm., female 32–35 mm.; *bivittatus* has the abdomen, female 38 mm.; hind wing, male 29 mm., female 36 mm. (De Selys was not certain that the male on which the description of that sex of *bivittatus* was based, really was *bivittatus*, and he tentatively proposed the name *bifrenatus* for this specimen. Syn. Gomph. and Mon. Gomph.). In *occipitalis* the nasus is black, with median and lateral yellow spots; in *bivittatus* it is largely yellow. (See figs. 24 and 25.)

Genus ANORMOGOMPHUS De Selys.

The single species referred to this genus is known only from India. *A. heteropterus* De Selys is a small species, abdomen 25 mm., hind wing 22 mm., with largely yellow coloration. (See fig. 26.)

Genus BURMAGOMPHUS, new genus.

Type of the genus.—*Gomphus vermiculatus* Martin.^a

For details of venation see key to genera on pages 272–275. In the front wing 2 cross veins between M_{1-3} and M_4 and in the hind wing 1,

^aI have studied specimens from Burma only. These have been identified as *Gomphus vermiculatus* and from them the characters of the genus have been drawn.

the position of these cross veins definite and subject to but slight variation, the first near the distal end of the supertriangle; 3 rows

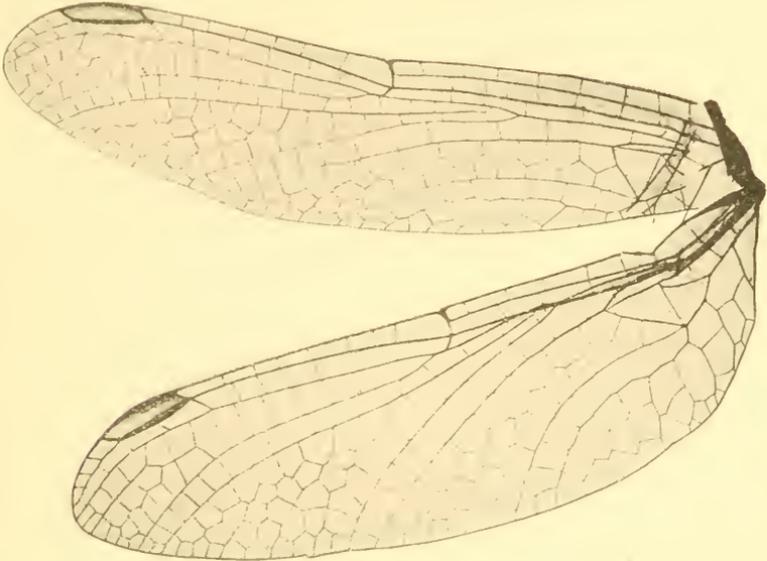


FIG. 26. WINGS OF MALE ANORMOGOMPHUS HETEROPTERUS. DE SELYS' COLLECTION.

of postanal cells, the first 2 undivided, similar in size and shape, the third wider and once divided; A_2 in hind wing arising near the middle of the lower side of the triangle; area included between Cu_2 and A_1

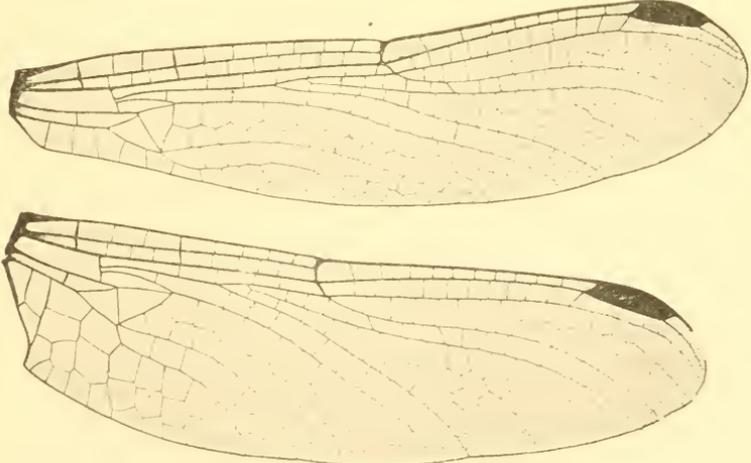


FIG. 27.—WINGS OF MALE BURMAGOMPHUS VERMICULATUS FROM BURMA.

in hind wing of moderate length, at the margin not twice as long as wide. At first glance the venation of the hind wing suggests *Gomphus* with the anal area reduced. In *Lanthus*, an American genus very

closely related to *Gomphus*, we have 2 small species about equal in size to *Burmagomphus vermiculatus*, described below, but in *Lanthus* no such reduction of the anal area takes place. In Gomphiinae generally, however, small size is associated with reduced anal area (there are notable exceptions), so the value of this character for generic distinctions is open to question. In the minute *Microgomphus* reduction of anal area reaches its maximum in the subfamily and there are only 2 rows of postanal cells. In the venation of the front wing *Burmagomphus* is at once separated from *Gomphus* by the parallelism of M_1 and Cu_1 , a character it shares in common with several

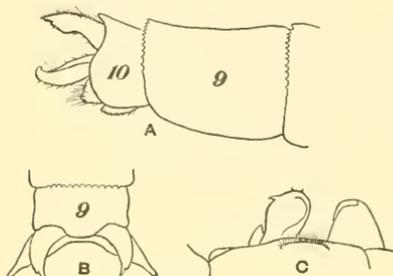


FIG. 28.—BURMAGOMPHUS VERMICULATUS FROM BURMA. A, LATERAL, AND B, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES. C, PROFILE OF ACCESSORY GENITALIA OF ABDOMINAL SEGMENT 2. 9 AND 10, ABDOMINAL SEGMENTS.

other genera, notably *Onychogomphus*. By its well-braced stigma, strongly and symmetrically forked M_{1-2} and M_3 , reduced and definitely placed cross veins between M_{1-3} and M_4 , distinctly and strongly shaped postanal cells in the hind wing, paralleling of M_4 and Cu , in front wing, undivided triangles, supertriangles and subtriangles, and absence of basal ante nodals of the second series, *Burmagomphus* allies itself with the venationally highly specialized genera of Gomphiinae. (See fig. 27.)

The relatively greatly developed and widely divaricate inferior abdominal appendage of the male suggests to a certain extent some species of *Gomphus* and the following genera: *Notogomphus*, *Anisogomphus*, *Neogomphus*, and *Cyclogomphus*. Of these genera I know the venation of all but *Notogomphus*, in which there is not the great difference in the length of abdominal segments 9 and 10, as in *Burmagomphus*, and the superior appendages are about twice as long as the inferior, and not about equal as in *Burmagomphus*. Moreover, the color patterns of both thorax and abdomen are very different in the two genera. In the thoracic pattern *Burmagomphus* is unique among Gomphiinae, so far as known to me, in having the dorsal stripes united below on either side with the antehumeral stripes, the upper end of the reduced antehumerals represented by a rounded spot.

Abdominal segments 8 and 9 about equal, about two and two-thirds times as long as 10.

Legs short, hind femora slender, 5 mm., reaching to base of second abdominal segment, armed with short spines.

A male from Burma was sent to M. Martin, who writes as follows: "It is a species very near to *vermiculatus* but slenderer, the stripes of the thorax different, the inferior appendage slenderer and more divaricate." Specimens from Anam and Tonkin are slightly larger, abdomen 30-32 mm., and the antenodals and postnodals are more numerous; as described the nasus is not spotted and the pale dorsal stripe on the frons is divided; the black stripe on the first lateral suture is forked above, not reduced as in the specimens from Burma; and the color pattern of the abdomen is slightly different, with 9 bearing a small posterior spine, which is not represented in my material.

11. BURMAGOMPHUS VERMICULATUS Martin.

Abdomen, male 28 mm.; hind wing, male 23 mm. Antenodals, front wing 10, hind wing 8; postnodals, front wing 8-9, hind wing 8-10. Second thickened antenodal normally the fourth; oblique vein the second or third beyond the subnodus; stigma covering 3-4 cells, followed in the front wing by about the same number; triangle in front wing followed by 2 rows of cells, in hind wing by 3 rows, then 2 increasing; anal triangle 3-celled.

Head 6 mm. wide, distance between eyes above at closest point 1 mm.; black throughout except as follows: Lower lip white or pale plumbeous, paler at the margins: a large transverse rectangular green spot on either side of the upper lip at its base; the base of the mandibles green; a short, narrow, transverse, median, inferior streak, and a large rounded spot on either side of the nasus: frons low, yellowish green above in front, black at the base, the black extending anteriorly at the middle in a broad low triangle, but not dividing the pale area, and widening on either side, giving the pale area a rounded posterior border on either side of the median line; eyes in dried specimens chestnut brown, probably in life blue, shading below into pale.

Prothorax black, the dorsal anterior border narrowly yellow; a greenish-yellow triangular spot on either side of the posterior border, and a smaller spot below this on the inferior margin; these spots represented below by a short pale streak at the bases of the first legs. Thorax black, marked with greenish yellow as follows: A mesothoracic half collar, interrupted by the merest line, wide on either side of the median line and tapering to an acute apex at either extremity; widely divergent dorsal stripes, the lower portion of which really consists of a portion of the antehumeral stripes (see diagram of thoracic pattern, fig. 29), continued below as a pale stripe extending on to the bases of the middle legs; a dorsal antehumeral spot; a wide stripe on the mesepimeron, joined above for about one-third its length with a wider stripe on the metepisternum, the later stripe extending below on to the metinfrapisternum and with its upper posterior corner more or less isolated by a narrow black

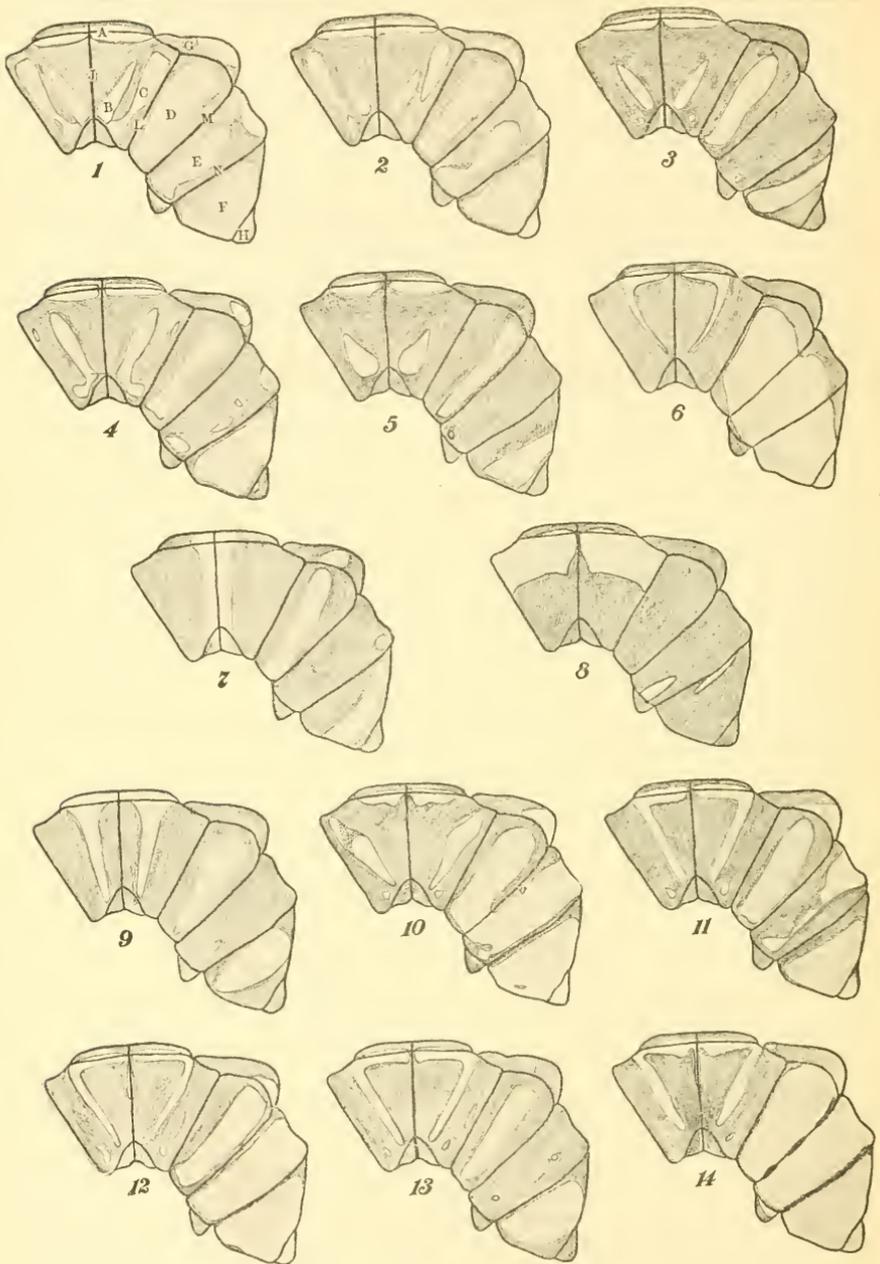


FIG. 29. DIAGRAMS REPRESENTING THE THORACIC COLOR PATTERN OF SOME ORIENTAL GOMPHINÆ.

1. *ICTINUS CLAVATUS*, TONKIN. 2. *ICTINUS PERTINAX*, TONKIN. 3. *ICTINUS MELENOPS*, SIAM. 4. *GOMPHIDIA KRUGEL*, TONKIN. 5. *GOMPHIDIA ABBOTTI*, SIAM. 6. *DAVIDIUS ERCHSTORFERI*, TONKIN. 7. *SIEBOLDIUS JAPONICUS*, SIAM. 8. *MACROGOMPHUS QUADRATUS*, BIG TAMBELAN ISLAND, CHINA SEA. 9. *MACROGOMPHUS SPECIES*, SIAM. 10. *BURMAGOMPHUS VERMICULATUS*, BURMA. 11. *GOMPHUS XANTHENATUS*, BURMA. 12. *ONYCHOGOMPHUS ANSULARIS*, BURMA. 13. *ONYCHOGOMPHUS SAUNDERSII*, BURMA. 14. *ONYCHOGOMPHUS SPECIES*, BURMA.
- A. MESOTHORACIC HALF COLLAR. B. DORSAL THORACIC STRIPE. C. ANTEHUMERAL STRIPE (IN LITERATURE SOMETIMES HUMERAL STRIPE OR JUXTAHUMERAL STRIPE). BAND C ON THE MESEPIMERON. D. PALE STRIPE ON THE MESEPIMERON. E. PALE STRIPE ON THE METEPIMERON. F. PALE AREA OR STRIPE ON THE METEPIMERON. G. MESEPIMERON. H. METASTERNUM. J. MIDDORSAL CARINA. L. HUMERAL SUTURE. M. FIRST LATERAL SUTURE. N. SECOND LATERAL SUTURE. DOTTED PORTION OF NO. 10 REPRESENTS THE PALE AREA CONNECTING THE DORSAL AND ANTEHUMERAL STRIPES.

stripe; metepimeron largely pale, narrowly edged in front with black, and a small black spot on its posterior border; pectus shaded with brown and black. Legs slender, black, the first femora and coxæ with an inner gray stripe; wings hyaline; stigma brown.

Abdomen slender, largest basally, slightly dilated apically; segments measuring in length about as follows: 1, 1 mm.; 2, 2 mm.; 3, 4 + mm.; 4, 4 + mm.; 5, 4.5 mm.; 6, 4 mm.; 7, 3 + mm.; 8, 2 + mm.; 9, 2 + mm.; 10, 0.75 mm.; appendages, 0.75 mm. Color black, marked with greenish yellow as follows: A dorsal spot and a large inferior lateral spot, not reaching the anterior border, on 1; a narrow dorsal longitudinal trilobed spot, a lateral spot covering the auricles, and a large subapical lateral spot, the 2 lateral spots joined along the inferior border, on 2; a narrow longitudinal dorsal stripe on 3, widening basally and not reaching the apex; a similar stripe on 4 and 5, the dorsal stripe shortened apically and widened basally into an almost complete ring; on 6 the basal ring is practically complete, about one-eighth the length of the segment, and with the dorsal stripe reduced to a small acute triangle; on 7 the basal ring is complete (that is, extending to the inferior margins of the segment), covering about one-sixth of the segment, and without a trace of the dorsal stripe; 8 with the merest trace of a basal ring; 9 with a little less than the apical dorsal half or third clear yellow, the pale area a low, rounded triangle in shape, with its apex dorsal and anterior, its base formed by the posterior edge of the segment and not reaching the inferior margin; this spot is the striking feature in the coloration of the abdomen, suggesting *Gomphus melanops* and its allies, all larger species. Appendages black. Considerable variation in the development of the longitudinal middorsal abdominal stripe must be expected. (See fig. 28.)

Described from three males collected by Mr. R. A. Earnshaw.^a

Genus PLATYGOMPHUS De Selys.

Three species, one of them questionably, have been placed in this genus by De Selys. *P. dolabratus* De Selys occurs in India; *P. feæ* De Selys in Burma; and *P. ? occultus* in China. In *dolabratus* the basal yellow rings on segments 3-7 are confluent with the dorsal lanceolate spot on each segment; in *occultus* the dorsal spots are narrower and are isolated; and in *feæ* the dorsal spots on 5-7 are wanting. (See figs. 30 and 31.)

12. PLATYGOMPHUS FEÆ De Selys.

“Bhamò en juillet et août (Fea).” Not seen by me. Only the male is known. The following brief description is condensed from

^aThese specimens were originally described in this paper as representing a new species. In the opinion of Prof. F. Foerster, with whom I have corresponded on the matter, and to whom I have sent a specimen from Burma, the species from Burma and Tonkin are identical. Moreover, M. René Martin seemed undecided as to the distinctness of the two, so my specimens are here referred to *vermiculatus*.

De Selys: Abdomen 35–37 mm.; hind wing 30–31 mm.; antenodals, front wing 12–13 mm.; hind wing 9–10 mm.; postnodals, front and hind wings 6–10 mm. Sutures of the face without black, vertex without a central yellow spot. Thorax above black, with small oval or triangular isolated dorsal stripes and an antehumeral stripe yellow;

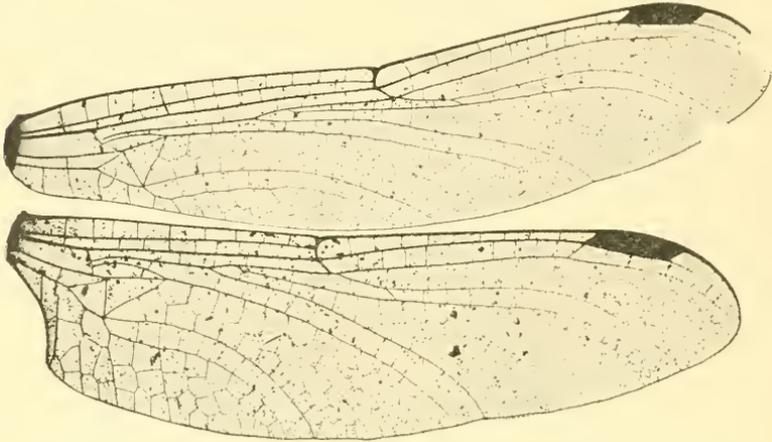


FIG. 30.—WINGS OF MALE *PLATYGOMPHUS DOLABRATUS*. DE SELYS' COLLECTION.

sides yellow, with a stripe on the second suture, this stripe forked above a branch going to the base of each wing. Abdominal segments 3–6 with a basal yellow ring, prolonged on the sides; a small dorsal median spot on 3 and 4; basal half of 7 yellow; 8 and 9 dilated, the sides largely yellow; 10 light brown.

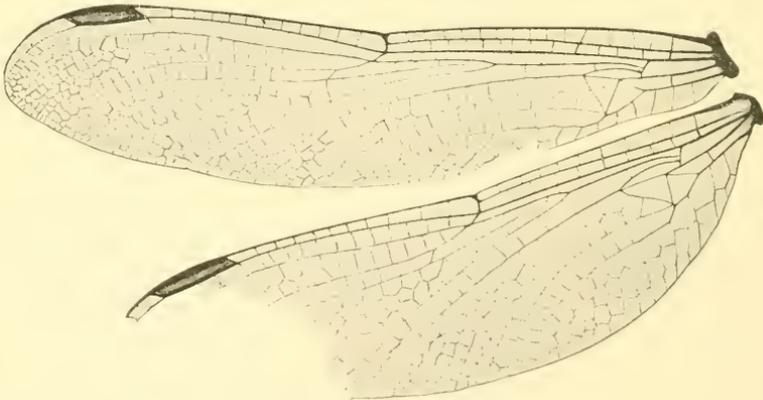


FIG. 31.—WINGS OF FEMALE *PLATYGOMPHUS DOLABRATUS*. DE SELYS' COLLECTION.

Genus *GOMPHUS* Leach.

As at present understood but two oriental species are certainly referable to this genus. For a discussion of *G. vermiculatus* Martin see *Burmagomphus*; for *G. kelantanensis* Laidlaw see *Leptogom-*

phus; and for *G. (Aeshna) thomassoni* Kirby see *Onychogomphus*. *Gomphus* ? *promelas* De Selys, from India, and *Gomphus* ? *ceylonicus* Hagen, from Ceylon, are known each from a single female, in the case of *promelas* the type lacking the last 7 abdominal segments. In the case of each the stigma is *without* brace vein; the yellow dorsal thoracic stripes are isolated, not joined below with the mesothoracic half collar. Each has the abdomen about 41 mm., hind wing 38–39 mm. The stigma is blackish in *promelas*, yellow in *ceylonicus*; the mesothoracic half collar is scarcely interrupted in *promelas*, widely interrupted in *ceylonicus*; and the dorsal stripes are more widely separated from the half collar in *ceylonicus* than in *promelas*. The two species above referred to which certainly belong in the genus *Gomphus* are *personatus* De Selys, known from Assam, Bengal, and Tonkin, and a new species described below from Burma.

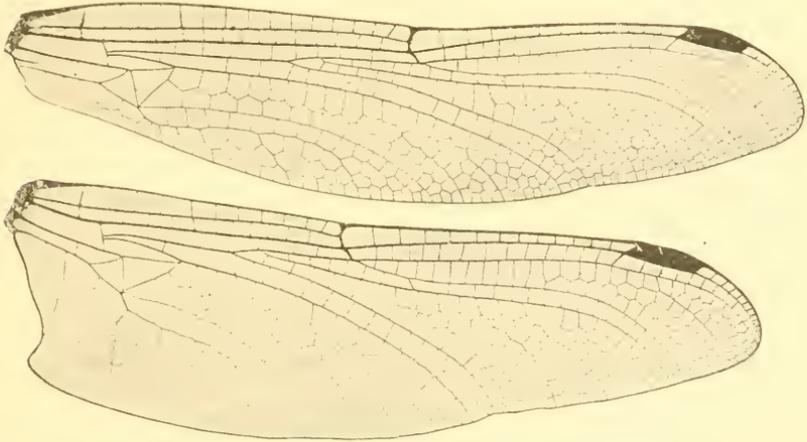


FIG. 32.—WINGS OF MALE *GOMPHUS XANTHENATUS* FROM BURMA.

13. *GOMPHUS XANTHENATUS*,^a new species.

Abdomen, male 45 mm.; hind wing, male 39 mm. Antenodals, front wing 16, hind wing 10–12; postnodals, front and hind wings 11–12. Basal antenodal of second series present in the 4 wings of two specimens, present in front wings and wanting in hind wings of one specimen, and wanting in 4 wings of one specimen. (In a male of *melanops* it is present in the front wings, wanting in the hind wings; in a female of the same species it is present in one front wing, wanting in the other 3 wings.) (See fig. 32.)

^a The specific name refers to the conspicuous yellow on the ninth abdominal segment.

Head black, yellow as follows: Lateral lobes of the lower lip; base of mandibles; a basal spot on either side of the upper lip; a spot at either end of the nasus; sometimes a trace at middle of rhinarium and middle of lower edge of nasus; the upper half of the frons in front and all the frons above, excepting the extreme base; the occipital plate at the middle, or entirely black.

Prothorax black, yellow as follows: The anterior border, a geminate median spot on the middle lobe, a small spot just behind it, and a large spot on either side. Thorax above black, largely yellow between the wings; middorsal carina with its extreme edge yellow for a short distance; straight, slightly divergent, yellow dorsal stripes of nearly uniform width throughout, almost reaching the antealar sinus above and connected below with the slightly narrower, broadly interrupted, mesothoracic half collar; just behind the upper end of the dorsal stripe is a round spot representing the antehumeral stripe; in one specimen this spot is prolonged downward about two-thirds the length of the mesepisternum by the faintest, frequently interrupted line; in another case the spot is reduced to the merest pin point; mesepimeron with a broad yellow stripe, represented on the mesinfraepisternum by an isolated spot; metepisternum with a narrow irregular yellow stripe which is infringed on by the black stripes on the 2 lateral sutures and which may be thereby completely obliterated excepting for a large inferior spot; metepimeron largely yellow, with the black of the second lateral suture on its upper edge, and a slight trace of black on its lower edge. Pectus dark, almost or quite black.

Legs black, venation black, or dark brown; stigma reddish brown, surrounded by black veins; membranule almost wanting; anal triangle in male 3-celled.

Abdomen slender, 7-9 moderately dilated for the genus; black, yellow as follows: A dorsal longitudinal stripe on 1 and 2, trilobed on 2, in one specimen continued as the merest line to the apex of 3; sides of 1 and 2 below largely yellow, auricles yellow, genitalia black; 3-7 each with a basal yellow ring, not quite reaching the lower edge of each segment, narrowly interrupted in the middorsal line on 7, widest on 3, where it occupies about one-fourth of the segment, on 4-6 occupying scarcely one-fifth, and on 7 about one-fifth of each segment; 8 has a transverse basal linear spot on either side (wanting in one specimen), representing the basal ring of the preceding segments, and a small lateral apical spot, variable in size; in one specimen 8 has an inferior subbasal lateral spot equal in size to the more superior lateral apical spot; 9 above with the apical half or three-fourths yellow, the yellow area widening rapidly posteriorly, but not quite reaching the extreme lower edge of the segment; in shape this yellow area is that of a truncated triangle; 10 and appendages black; in one specimen 10 has a small round apical spot on either side of the dorsum

at the base of the superior appendages. Abdomen black beneath. (See fig. 33.)

Described from four males from Burma sent me by Mr. R. A. Earnshaw. One of these was sent to M. René Martin and Professor Foerster, who regard it as an undescribed species.

Paratype.—Cat. No. 10451, U.S.N.M. One specimen. The type is in the author's collection.

The small series shows an extent of variation in color remarkable in a species of *Gomphus*. This is most evident on the sides of the

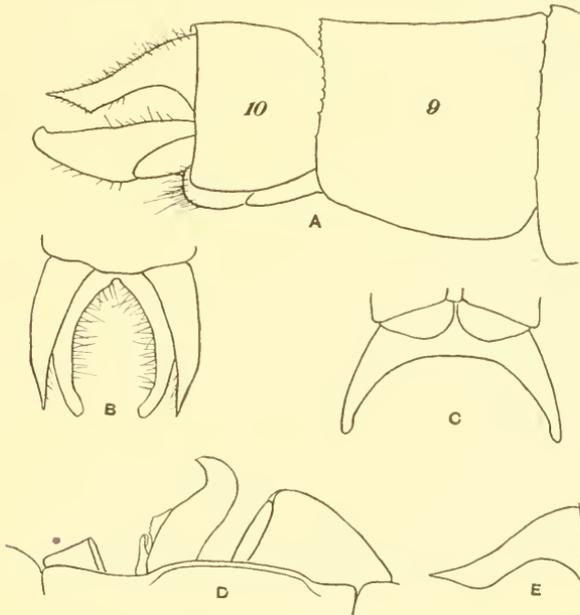


FIG. 33.—*GOMPHUS XANTHENATUS* FROM BURMA. *A*, LATERAL, AND *B*, DORSAL VIEWS OF MALE ABDOMINAL APPENDAGES, IN THIS SPECIMEN UNNATURALLY COMPRESSED BY THE ENVELOPE IN WHICH SPECIMEN WAS PRESERVED; IN *C*, VENTRAL VIEW OF INFERIOR APPENDAGE, ANOTHER SPECIMEN IS FIGURED, AND THE INFERIOR APPENDAGE IS NOT DISTORTED; IN THIS SPECIMEN THE APICES OF THE SUPERIOR APPENDAGES ARE SEPARATED BY $1\frac{1}{2}$ THE DISTANCE REPRESENTED IN *B*. AND THE INFERIOR APPENDAGE IS EQUALLY DIVARICATE; *D*, PROFILE OF ACCESSORY GENITALIA OF ABDOMINAL SEGMENT 2. *E*, LATERAL VIEW OF SUPERIOR ABDOMINAL APPENDAGE OF A SPECIMEN DIFFERING FROM *A* IN HAVING THE LOWER SUBAPICAL EDGE ROUNDED, NOT ANGULATE, AND MINUTELY TOOTHED. 9 AND 10, ABDOMINAL SEGMENTS.

thorax and on abdominal segments 8–10. Throughout the description the pale markings have been described as yellow. It is probable that in life these are not of the same color throughout, tending to greenish on the thorax and to orange on the abdomen, excepting that the pale area of 9 is probably clear yellow, paler than the markings of the segments anterior to it. Venationally, if the frequent presence of the basal antenodal of the second series is disregarded, this species and the Japanese *melanops* De Selys are similar to North American

species of Needham's subgenus *Stylurus* and to related species of which *fraternus* and *vastus* may serve as examples. *G. xanthenatus* is separated at once from *melænopis* by the spotted upper lip, by the narrower dorsal thoracic stripes, not widening below, by the absence of a distinct pale antehumeral stripe, by the wider black stripes on the lateral thoracic sutures, by the annulation of segments 3-7, and the greater extent of yellow on 9. *G. personatus* De Selys is known to me only from the description. It is separated from *xanthenatus* by the presence of a pale antehumeral stripe, sometimes interrupted, by having the stripes on the lateral thoracic sutures very narrow, the first interrupted, by the pectus largely yellow, and by the abdomen with a longitudinal middorsal stripe and not annulated. *Gomphus pryori* De Selys, from Japan, and *Gomphus scissus* McLachlan, from western China, are two related species known only from female specimens. Both are distinct from *xanthenatus* by a number of characters.

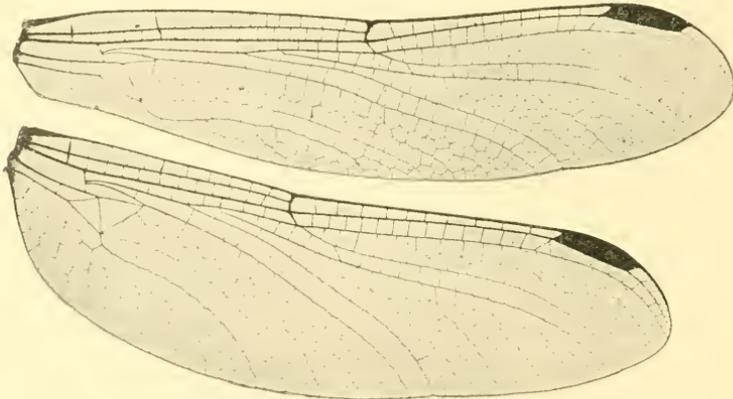


FIG. 34. WINGS OF FEMALE ONYCHOGOMPHUS ANNULARIS FROM BURMA.

Genus ONYCHOGOMPHUS De Selys.

Of the about forty described species in this genus, seventeen are oriental. These arranged alphabetically are:

O. annularis De Selys. Known from two incomplete males from North Burma. Abdomen 34-37 mm.; hind wing 29-32 mm.; abdominal appendages not known. (See fig. 34.)

O. biforceps De Selys. Described from a single male from India; recorded from Tonkin by Martin. Abdomen 41 mm.; hind wing 32 mm. (if measurements are correct the abdomen is relatively long); male superior abdominal appendages longer than 9+10, turned abruptly downward near apex; inferior appendage equally long, near apex curved abruptly upward, the two branches separated for a distance near the base to inclose an oval space.

O. bistrigatus Hagen. Described from India. (The male described by De Selys in his Second Addition to the Synopsis des Gomphines is not certainly *bistrigatus*, and the second female described in the Mon. des Gomphines as *bistrigatus* is *m-flavum*.^a) Recorded from Anam by Martin. Abdomen 39 mm.; hind wing 33–34 mm.; male superior abdominal appendages twice as long as 10, turned downward at apex; inferior appendage slightly shorter, in profile with 2 teeth, one at the first third, the other at the second third; female vulvar lamina half as long as 9, divided at apex into two points.

O. camelus Martin. Tonkin and Anam. Abdomen 50 mm.; male abdominal appendages similar to *biforceps*, but larger, the branches of the inferior not separated at base; female described as similar to *biforceps*, but vulvar lamina and occipital plate not mentioned.

O. cerastis De Selys. India and Nepal. Abdomen 40–43 mm.; hind wing 34–37 mm.; male appendages not known; female vulvar lamina small, short, one-fourth the length of 9, notched for one-half its length; female occipital plate with two median spines.

O. circularis De Selys. North Burma. Abdomen 41 mm.; hind wing, male 32 mm.; female 38 mm.; male superior abdominal appendages equal in length to 9 + 10, curved toward each other and slightly downward, the apex beneath emarginate; inferior appendage destroyed; female vulvar lamina divided into two conical contiguous tubercles.

O. frontalis De Selys. Described from a teneral female from India. Abdomen 29 mm.; hind wing 25 mm.; vulvar lamina half as long as 9, lanceolate, the apex divided.

O. geometricus De Haan. Java. Abdomen 36–37 mm.; hind wing 29–31 mm.; male superior abdominal appendages twice as long as 10, curved toward each other and apically downward; inferior appendage little shorter, curved strongly upward, and bearing a tooth near the base; female vulvar lamina very short, its apex broadly emarginate.

O. grammicus Rambur. India. Abdomen 37–39 mm.; hind wing 30 mm.; male superior appendages as long as 9 + 10, in profile strongly curved, the apex flattened into a horizontal, almost bifid plate; inferior appendage a little shorter, enlarged and flattened basally, then curving abruptly upward in 2 slender contiguous branches.

O. inscriptus Hagen. Known only from the female from Java. Abdomen 36 mm.; hind wing 32 mm.; vulvar lamina short and wide, the apex truncated and emarginate.

O. lineatus De Selys. India and Nepal. Abdomen 33–35 mm.; hind wing 27 mm.; male superior appendages almost as long as 9 + 10,

almost parallel, apically turned rather abruptly downward; inferior appendage not quite half as long, the branches inclosing an oval space, in profile forming a semicircle; female vulvar lamina short and rounded, divided to its middle by a narrow incision; occipital plate in both sexes bearing a number of small spines.

O. maclachlani De Selys. Described from a single female from North Burma. Abdomen 43 mm.; hind wing 38 mm.; vulvar lamina destroyed.

O. m-flavum De Selys. India. Abdomen 38-39 mm.; hind wing 33-36 mm.; male superior appendages longer than 10, curved toward each other and downward; inferior appendage of equal length, almost entirely divided into 2 contiguous branches, seen in profile curved upward, bearing near the middle on the upper surface a lateral tooth; female vulvar lamina very long, broad at the base, divided into 2 con-

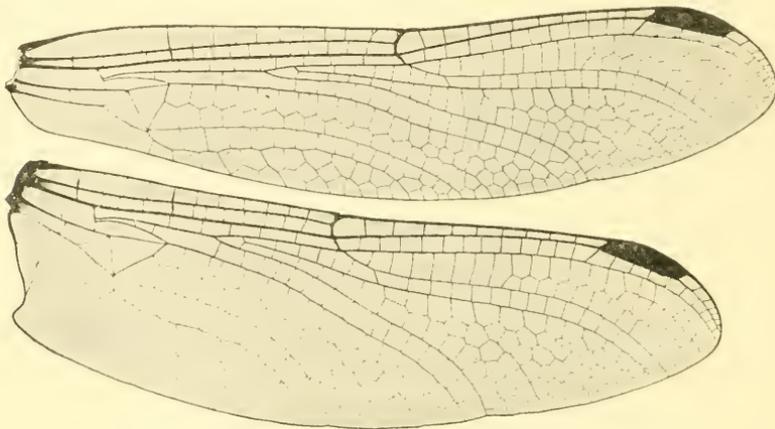


FIG. 35.—WINGS OF MALE *ONYCHOGOMPHUS SAUNDERSII* FROM BURMA.

tiguous lanceolate branches of which the acute apices reach the tenth segment.

O. modestus De Selys. India. Abdomen 27-28 mm.; hind wing 23-29 mm.; male superior appendages as long as 9+10, slightly curved toward each other and downward; inferior appendages as long, deeply divided into 2 contiguous branches.

O. nigrescens Laidlaw. Described as a variety of *geometricus*, from a single female from the Malay Peninsula. Doctor Laidlaw agrees with my suggestion to him that this is really *saundersii*. The venational character pointed out by Doctor Laidlaw is not peculiar to the species, but is common to a large group of genera.

O. reinwardtii De Selys. Java. Abdomen 33 mm.; hind wing 26-29 mm.; male appendages not known; female vulvar lamina one-third as long as 9, triangular, the apex bifid; occipital plate in both sexes with 10-12 small black spines.

O. saundersii De Selys. India and Indo-China. Abdomen 37-39 mm.; hind wing 31-32 mm.; male superior appendages almost as long as 9+10, curved toward each other and downward; inferior appendage about as long, in profile the basal two-thirds nearly straight, the apical third turned upward, the branches slender and contiguous; female vulvar lamina short, apex deeply emarginate. (See figs. 35 and 36.)

O. thomassoni Kirby. Hainan and Tonkin. Alar expanse 74 mm. (hind wing 35 mm.); male superior appendages longer than 10, strongly curved toward each other; inferior appendage less than half as long as the superiors, the branches divaricate and recurved at the end. On the basis of specimens of both sexes Martin takes this species from *Gomphus* and places it in *Onychogomphus*; his description of the inferior appendage does not suggest *Onychogomphus*, however, and Kirby's figure, in the pattern of the thorax, strongly suggests *Gomphus prycei*. The details of venation in Kirby's figure are probably not accurate, but the anal triangle suggests *Onychogomphus*.

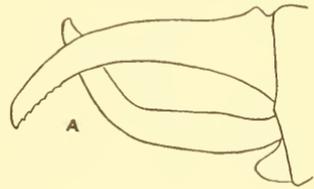


FIG. 36.—*ONYCHOGOMPHUS SAUNDERSII* FROM BURMA. A, LATERAL VIEW OF MALE ABDOMINAL APPENDAGES. THE SHORT HAIRS ON THE APPENDAGES ARE NOT SHOWN.

The above notes have been compiled from the literature relating to these species. On the same basis the following provisional key has been prepared:

- a. Dorsal thoracic stripes on either side of the middorsal carina isolated, not joined below with the mesothoracic half collar.
 - b. Above described stripes short, oval.
 - c. Abdominal segment 9 black; abdomen about 29 mm *frontalis*
 - cc. Segment 9 with some yellow; size larger *lineatus* (India and Nepal) and *reinwardtii* (Java).
 - bb. Stripes longer, not oval.
 - c. Abdominal segments 3-6 black, with a short basal dorsal half ring of yellow; abdomen and hind wing less than 30 mm *modestus*
 - cc.* Segments 3-6 with more yellow; size larger.
 - d. Segments 3-6 basally about one-third yellow.
 - e. Face without black markings; sides of thorax dark, with 2 oblique yellow bands. *inscriptus*
 - cc. Face with black markings; sides of thorax yellow, sutures with black stripes *cerastis*
 - dd. Segments 3-6 largely yellowish *grammicus*
- aa. Dorsal thoracic stripes joined below with the mesothoracic half collar.
 - b. Abdominal segment 6 one-half or more yellow.
 - c. Segments 8-10 yellow, dorsally black; femora largely yellow *bistrigatus*
 - cc. Segments 8-10 black; femora largely black *geometricus*

- bb. Segment 6 more than one-half black.
- c. Black stripes on the 2 lateral thoracic sutures confluent.
- d. Size very large, abdomen about 50 mm.....*cauculus*
- dd. Size smaller.
- e. Abdominal segments 8 and 9 black; dorsal thoracic stripes very wide.
thomassoni
- cc. Segments 8 or 9 or both with lateral basal yellow spots.
- f. Segments 3-7 with basal one-fifth yellow.....*maclachlani*
- ff. Segments 3-6 with basal one-fourth, 7 with basal one-half yellow.
saundersii
- cc. Black stripes on the 2 lateral thoracic sutures not confluent for their entire lengths.
- d. Face largely yellow, nasus yellow marked with black.....*circularis*
- dd. Face largely black, nasus black or black marked with yellow.
- e. Abdominal segments 8-10 all black.....*annularis*
- cc. Segments 8-10 black, 8 with lateral basal yellow spots.....*biforceps*
- ccc. Segments 8-10 with yellow laterally.....*m-flavum*

Four species of the genus are certainly known to occur in Burma; a fifth species probably is an *Onychogomphus*.

14. *ONYCHOGOMPHUS SAUNDERSII* De Selys.

"Bhamò. Un couple en juillet et août (Fea)." I have a single male from Earnshaw. This is the only *Onychogomphus* known from Sumatra.

Head largely black; upper lip with a basal spot on each side, almost all rhinarium, a lateral spot on the nasus, and a band above on the frons anteriorly yellow; female with black more restricted, the yellow on the frons descending a little in front and upper lip yellow with a black border. Pale antehumeral stripe reduced to a line below and a spot above. Sides of thorax largely black, a yellow stripe on the mesepimeron and a wider one on the metepimeron. Legs black, first femora with inner surface pale.

15. *ONYCHOGOMPHUS CIRCULARIS* De Selys.

"*Patrie*: Nord de la Birmanie. Un couple unique. (Coll. McLachlan)." Recorded from Tonkin by Martin.

Face yellow, black as follows: Upper lip bordered and traversed, rhinarium margined, nasus at the center, and the suture between nasus and frons. Antehumeral stripe reduced to a trace. Sides of thorax yellow, with black stripes on the two lateral sutures. Femora yellow, with brown and black markings. Abdomen black, varied with yellow; 3-7 with yellow basal rings, larger on 3 and 7; 3-5 with dorsal lanceolate spots; 8 with dorsal and lateral spots; 9 and 10 black.

16. *ONYCHOGOMPHUS ANNULARIS* De Selys.

"*Patrie*: Le Nord de la Birmanie. Deux mâles (à abdomen incomplet). Communiqué par M. McLachlan." A female in my collection from Earnshaw.

Antenodals, front wing 14-16; hind wing 9-11; postnodals, front wing 9-10; hind wing 10. Head black, yellow as follows: Two spots on upper lip, rhinarium, a small spot at the upper end of nasus, frons above with a spot on each side; lower lip pale. A narrow pale antehumeral stripe, widened into a spot above. Sides of thorax yellow, the two lateral sutures with black stripes, wider on the first. Legs black. Abdomen with basal rings on 3-7 narrowly interrupted above, about one-third to one-fourth the length of each segment, largest on 7; median dorsal spot on 3 and 4 and a trace on 5; 8-10 black. Female vulvar lamina one-fourth length of 9, rounded triangular, apex notched; female occipital plate with hind margin almost straight, slightly lower at the middle; female abdominal appendages a little longer than 10, yellow, a short black tubercle between them. The venation of the female figured in this paper is peculiar for the genus, so far as known to me, by the position of the arculus in the front wing, slightly beyond the second antenodal, and by having the second postanal cell in the hind wing divided.

17. *ONYCHOGOMPHUS MACLACHLANI* De Selys.

"*Patrie*: Le Nord de la Birmanie. Une femelle unique (collect. McLachlan)."

Head black, frons above with an anterior yellow stripe narrowed at the middle. Sides of thorax black, with a yellow stripe on the mesepimeron and metepimeron. Legs brownish black. Abdominal segments 3-7 with basal yellow rings occupying about one-fifth of each segment; 8 with a small basal spot on each side replacing the ring.

18. *ONYCHOGOMPHUS?* SPECIES.

A single male in fragments from Earnshaw in my collection.

Hind wing 33 mm. Antenodals, front wing 13, hind wing 10; postnodals, front wing 10, hind wing 9.

Lower lip pale yellow; upper lip yellow, bordered basally and anteriorly and traversed medianly with black; rhinarium yellow, below on either side black; nasus black, a narrow margin below at the middle and a large spot at either end yellow; frons yellow, in front the lower half and above a median basal triangular spot, not dividing the yellow, black; occiput nearly straight, yellow, black against the eyes; rear of head black.

Prothorax black, margined with yellow. Thorax above black, middorsal carina below narrowly yellow; yellow stripes joined below with the uninterrupted mesothoracic half collar to form a 7 on each side of the carina; the antehumeral yellow stripes represented by a spot above and a smaller one below; first lateral thoracic suture with a black stripe interrupted to form 3 short stripes; second lateral suture

with a continuous but little wider black stripe; no trace of black posteriorly. Costa yellow, stigma black. Femora largely yellow, apically and externally with some brown; tibiae black.

Abdominal segment 1 with a dorsal interrupted crescent of brown, the ends of the crescent reaching backward and downward; 2 yellow, with a superior lateral brown stripe which at the apex of the segment meets its fellow dorsally; 3 yellow, black as follows: A very narrow basal ring, an interrupted median ring and a lateral apical triangular spot which meets its fellow dorsally; 4 similar to 3; 5-7 similar, the apical black spots confluent dorsally to form apical rings covering about one-half the segment; 7 with the median transverse black line reduced to a trace; 8-10 black; 8 with a large lateral basal yellow spot, the merest trace of which exists on 9; the suggestion of a dorsal basal spot on 8.

Superior appendages twice as long as 10, simple, slender, tapering, curved toward each other and downward, the extreme apex with a shining black tooth, the lower external edge on the curve before the apex minutely denticulate; brown at base, shading at once into light yellow. Inferior appendage a little more than one-half as long, broadly bifid for more than one-half its length, the branches simple, rounded, tapering, widely and continuously divaricate, but little recurved dorsally, terminating apically in a minute tooth; color similar to the superiors.

While the single male has served for a fairly complete description, its condition is such as to make figures of the appendages of questionable accuracy, and future study by others of this specimen will be difficult. For this reason it is unnamed, though M. Martin, who has seen it, pronounces it as certainly new.

As to its generic position some discussion is necessary. I should refer it to *Onychogomphus* without question were it not that Foerster has described as *Heterogomphus naninus* a male from Tonkin which is a darker colored but, I believe, closely allied species to the one described above. In actual usage describers of new species have defined *Onychogomphus* solely by one character, the form of the inferior appendage of the male; and De Selys in naming species based on female specimens alone has followed the generic name *Onychogomphus* with a question mark. In this Burman specimen the superior appendages are similar to the form found in a number of species of *Onychogomphus*, and had the inferior been lost, few would hesitate to refer the specimen to *Onychogomphus*. Moreover, the form of the inferior appendage throughout the genus, as heretofore understood, can hardly be defined as of one type, if we may use Hagen's figures in Monographie des Gomphines for comparison. The figure of *O. flexuosus* certainly shows a decided step away from *O. saundersii*, for

example, toward the condition found in the species described above. Opposed to this weak negative evidence of the form of the inferior appendage against referring this specimen to *Onychogomphus*, is the very positive evidence for such a relationship shown by the venation which is figured in this paper. Compared with *saundersii*, which is also figured, there are some very slight, and, I believe, unimportant differences. In *Onychogomphus? species* in front wing the first cells included between Cu_1 and Cu_2 are relatively short in the antero-posterior direction, and the number of cells between these 2 veins at the wing margin is larger in both front and hind wings. In the hind wing of *Onychogomphus? species* there is a single row of cells between M_1 and M_{1a} , excepting that the marginal cell is divided. There are also slight differences in the shape of the triangles and subtriangles, and other equally slight differences might be pointed out. (See fig. 37.)

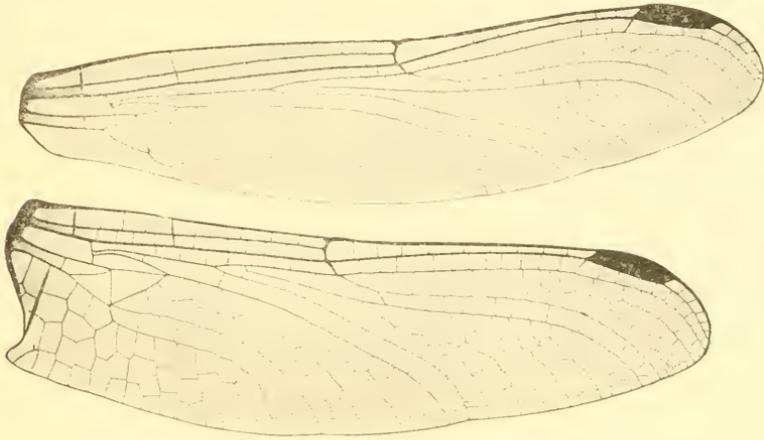


FIG. 37.—WINGS OF MALE SPECIES OF ONYCHOGOMPHUS FROM BURMA

Genus HETEROGOMPHUS De Selys.

Seven species have been named in this genus. Foerster regards *cochinchinensis* De Selys from French Indo-China, and also probably *sommeri* De Selys from China, as probably races of *smithii* De Selys from Silhet. These three are large species, with the abdomen about 55 mm. or more in length and the hind wing 47 to 55 mm. In *smithii* abdominal segments 3-7 have the orange more extensive than the black; in *cochinchinensis* and *sommeri* black predominates on 3-6 and 7 has about the basal half yellow. The character mentioned by De Selys for separating *sommeri* and *cochinchinensis* is the coloration of the frons above; in *cochinchinensis* the yellow area on the frons above is not divided medianly by black as in *sommeri*. Foerster has described a male specimen from Tonkin as *Hetero-*

gomphus nanivus, which is unique in the genus by its small size (abdomen 43 mm., hind wing 32 mm.) and by the simple structure of the inferior appendage, the apices of which are not bifid or toothed, as is the case in all the other known males. (See discussion under *Onychogomphus? species*, p. 313.) The remaining three species are intermediate in size. All are distinguished by pale indefinite coloration, and all may be in reality the same species. (See fig. 38.)

H. icterops Martin, from Java, is briefly described in "Mission Pavie" from a specimen in De Selys's collection. Abdominal segment 7 is largely yellow, and this character may separate it from the other two. The first described species of this group of three is *sumatranus* Krüger from Sumatra. The remaining species is *unicolor* Martin, described from Siam.

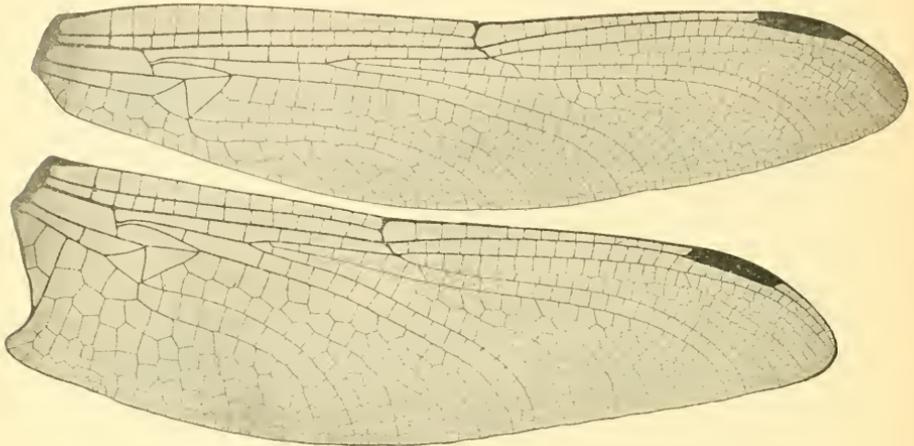


FIG. 38.—WINGS OF MALE HETEROGOMPHUS COCHINCHINENSIS FROM TONKIN.

19. HETEROGOMPHUS UNICOLOR Martin.

"Un male unique de Siam, Museum de Paris." Abdomen 52 mm., hind wing 48 mm. Face and frons entirely yellow. Thorax brown, with a poorly defined darker brown humeral stripe. Abdomen brown, tinged above, especially toward the end, with blackish; 7 tinged with yellowish.

H. sumatranus is somewhat smaller; abdomen about 50 mm., hind wing 42 mm. From the descriptions no definite distinguishing characters are recognizable, and it is probable that *unicolor* is a synonym of *sumatranus*.

Genus MEROGOMPHUS Martin.

The single species, *paviei* Martin, is known only from Tonkin (presumably, since in the description of both genus and species no locality is given). This is a large, handsome species; abdomen 48

mm., hind wing 40 mm. I am indebted to Monsieur Martin for a beautiful male specimen in my collection. (See fig. 39.)

SUMMARY.

Eleven genera and 19 species of the subfamilies discussed in this paper are known from Burma and Lower Siam. In the preparation of this paper 34 specimens from these localities have been studied.

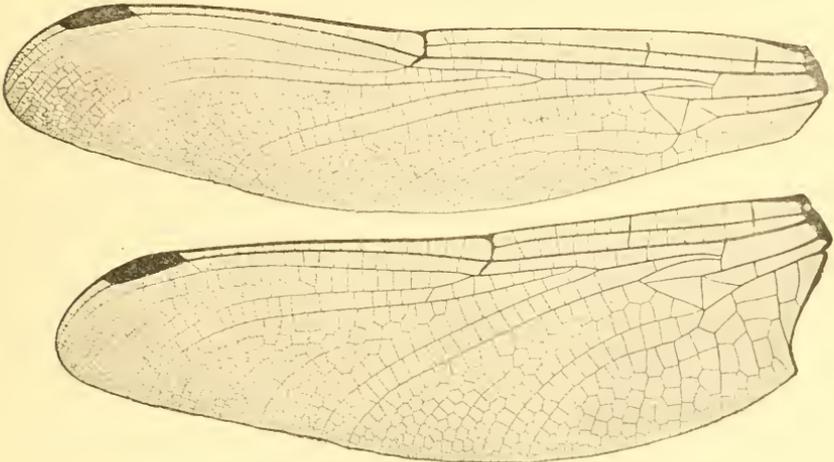


FIG. 39.—WINGS OF MALE *MEROGOMPHUS PAVIEI* FROM TONKIN.

Of the 19 species I have seen specimens of only 10. Of the 21 species of Calopteryginae known from Burma and Lower Siam I had seen 17 and studied 233 specimens. Many more specimens of Calopteryginae have been received from Mr. Earnshaw during the preparation of this paper. Further comment on the relative numbers of specimens in the different subfamilies and on the unavoidable incompleteness of this paper is unnecessary.