

No. 4 — *Observations on Chinese Gomphine Dragonflies*

BY JAMES G. NEEDHAM

Chinese dragonflies first caught my attention in 1927, when I received an unanticipated invitation to spend a year in China visiting and conferring with departments of Biology in the Universities of that country under the auspices of the China Foundation for the Promotion of Education and Culture. I looked about for aids to the study of the local dragonflies and found there were none. There were only bare descriptions of the adults of many species, printed in half a dozen languages, and well scattered through the zoological literature of the world. Nothing was known of the immature stages.

Since I was invited to lend what aid I might to the study of biology in China, I conceived the idea that by supplying a manual for the study of the one group of insects with which I already had some practical acquaintance at home, I might help Chinese students in the study of their local fauna. Indeed, I was quite sure that such aid might be more real and the results more lasting, than any that might come from merely lecturing to them. So I began at once gathering together the materials for a manual, going in the field to collect dragonflies as I had opportunity, and enlisting the aid of local collectors wherever possible.

I started with no collection at all, and with almost no personal acquaintance with the Oriental Odonate fauna. The literature of the group was largely lacking in that country. Wherefore, such time as could be taken from teaching and conferences, I devoted to collecting and studying dragonflies.

After my arrival in September I did a little collecting of autumnal species in and about Peiping, with the invaluable aid of Dr. Chen-fu Wu of Yen Ching University, and Dr. Chung-lo Liu of Tsing Hua University, and their advanced students. They guided me to the best collecting places in some of the most beautiful aquatic situations in North China. During the winter I was able to work on my collections in the private laboratory of my good friend, Dr. N. Gist Gee, who was himself a lifelong student of the Chinese fauna, and a distinguished specialist in fresh-water sponges. In the spring he went with me to the Yang-tze valley; to Soochow and to Hang Chow Universities where other generous collaborators were found. I spent the month of April in Nanking; that was my real harvest season. In Nanking I had the generous assistance of Dr. C. Ping and a number of his research students. There I had considerable time for collecting adult dragonflies, and for working out partial life histories. In May I returned to Peip-

ing, and thereafter war conditions prevented further field work. It was with profound regret that I had to leave China at the very opening of the best collecting season. Then I returned home to America, bringing all the collections, made and borrowed. Acknowledgment is made in the *Manual* of the many sources of the borrowed material.

The *Manual* was written at my home in Ithaca, in such intervals of time as I could take from teaching and departmental administration. I wrote it for the use of Chinese students in the study of their homeland fauna. I sought merely to provide them with concise descriptions, keys and tables for families, genera and species; and in all the larger genera, where species are difficult of identification, to provide figures of the genital characters that are the ultimate criteria for species.

In matters of classification I considered it in the interest of students that I should keep to the older and simpler family groupings, rather than use the many recently introduced and still untested subdivisions of the families, concerning the validity of which the specialists are not as yet in entire agreement. I wanted to provide something that the college students could use; and I have had the satisfaction of knowing that they have used the *Manual* successfully.

In only one group, the *Gomphinae*, did I add any considerable number of new species. Seventeen of these were in the large and heterogeneous genus *Gomphus* of the older authors. Among them were new heterogeneities that I could not fit to some of the subdivisions of that genus that had been recently proposed. I contemplated further work upon them when more adequate collections and more time should make that possible; but little new material has come to hand. On completion of the *Manual* borrowed specimens were returned to their owners; but I kept duplicates of the few species that were represented by more than one specimen; and I took occasion, while the others were in my hands, to make photographs of the wing venation of most of them. And now that, in retirement, I have time for more adequate study, I have only this scanty material available. A careful restudy of the wing venation of the Chinese Gomphines is hereinafter attempted.

The venation of the basal half of the hind wing appears not to have been thoroughly explored; for in it there are structural characters whose taxonomic value has been quite overlooked. The late lamented E. B. Williamson discovered some new characters in these parts, and used them to good purpose in his well known Burmese paper of 1907. There are yet other unused characters to which I want to direct at-

tention here. To them I will apply convenient terms for use in the descriptions that are to follow. The new terminology will be merely supplemental to that used in my *Manual* and fully illustrated in Plate I of that volume.

In the accompanying figure is shown a diagram based on a careful drawing of the base of the hind wing of *Gomphus campestris* Ndm., labelled to supply names for the parts hereinafter used. The principal longitudinal veins, Costa, Subcosta, and Radius, Media, Cubitus and

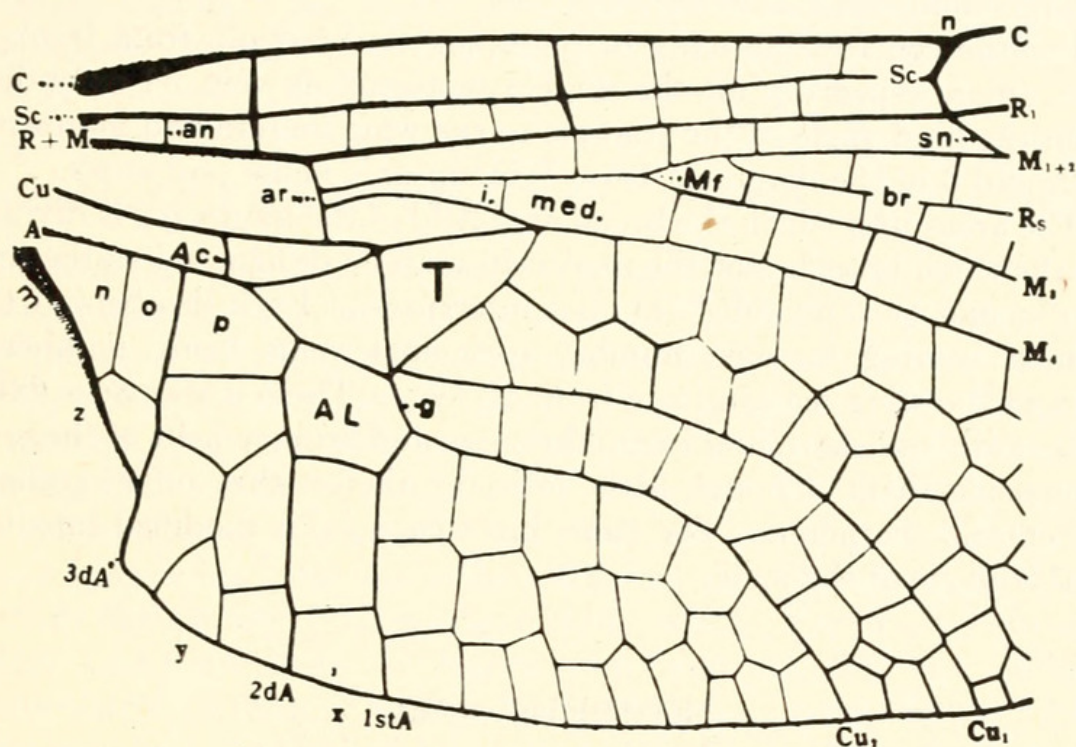


Fig. 1. Base of the hind wing of *Gomphus* (? *Burmagomphus*) *campestris* Ndm.

Anal, are labelled in the figure at both ends of each vein, with appended numerals designating the branches of some of them; four important cross braces, nodus (*n*), subnodus (*sn*), arculus (*ar*), and anal crossing (*Ac*) and three other parts, middle fork (*Mf*), anal loop (*AL*), and membranule (*m*), illustrated in Plate I of the *Manual*, are repeated in this diagram.

New designations here introduced are as follows: *intermedian cross-veins* (*i. med.*: in this wing there is but one) lie in the space between veins *M3* and *M4* and beyond the arculus to the middle fork (*Mf*).

In the anal area of both wings the cells that lie in line alongside the anal vein from base to gaff (*g*)¹ are called paranals. In the fore wing there is oftenest but a single row of them: there is always more than

¹ The gaff is the fused portion of veins *Cu2* and *A1*.

one row in the hind wing and the cells of the first row are highly differentiated and are of great systematic importance. In our diagram they are labelled *n*, *o*, *p*, and *AL*. Cells *n* and *o* are constantly present as large single cells in all Gomphinae known to me, with the single exception of *Anormogomphus*; cells *p* and *AL* may be divided by cross-veins. An anal loop (*AL*) is said to be present only when this area is definitely bounded by a strong vein in the rear (with that boundary generally much stronger than shown in this figure); this loop is often enlarged and divided into several cells.

For the cell rows running in the opposite direction, from front to rear, (more especially for the single row alongside vein *A1* extending from the hind angle of the triangle to the wing margin and numbered 1, 2, and 3 in the diagram) I use Williamson's name *post anals*.

The areas into which the broad anal field of the hind wing is divided by the three branches of the anal vein may be designated as the first (*x*), second (*y*) and third (*z*) anal interspaces. Each lies behind the branch bearing its own number (principal veins being numbered around the wing margin from front to rear). These interspaces differ in breadth and slant, and in number, size and arrangement of the cells composing them. Though little noticed hitherto, they offer excellent systematic characters. The third interspace (*z*) is modified into the anal triangle of the male.

GOMPHUS s.lat.

I wish now to make a further analysis of the species that I lumped together in the great genus *Gomphus* in the *Manual*. As evidenced by wing venation, these species fall into natural groups as follows:

Group 1. G. ABDOMINALIS only

For it I propose the generic name *GASTROGOMPHUS*. Its characters are: a very long, thick abdomen, about a third longer than the hind wing; anal vein 3 arises generally after, and sometimes opposite the anal crossing; no basal subcostal cross vein, and no cross veins in any of the triangles; first and fifth antenodals thickened; a single row of large paranal cells in the fore wing; anal triangle of the male three celled, and four postanals cells in the hind wing (see *Manual*. Pl. I, fig. 4); appendages of the male of about equal length and divergence (*Manual*. Pl. VI, fig. 2).

It should be noted also that in the one known species there is a very wide differentiation in size among the cells of three wing areas; very large before the level of the arculus, a little smaller outward to a line drawn from the stigma to the hind angle of the wing, and much smaller thence outward to the margin.

The nymph (*Manual*. Pl. VII, figs. 1 and 1a) differs from all known related forms in having neither dorsal hooks nor lateral spines; in having the front border of the median labial lobe doubly produced (bilobed) and fringed at the sides of a bare median notch; and in having the strongly incurving terminal third of the lateral lobe very feebly denticulate on its concave inner margin.

Group 2. XENOGOMPHUS, gen. nov. Type G. AGRICOLA Selys.

Characters: middle fork (*Mf*) unsymmetrical, askew forward; gaff as long as or usually longer than the inner side of the triangle; intermediate crossveins 3/1 in fore and hind wing respectively; anal triangle of the male hind wing usually of five cells; no basal subcostal antenodal crossvein; first and fifth antenodals thickened; no anal loop, but usually two complete rows of cells in the first anal interspace; male caudal appendages of equal length but the branches of the inferior much more widely outspread (see *Manual*. Pl. VI, figs. 6 and 6a).

Here belong also *G. succumbens* Ndm. (Peking Soc. N. H. Bull. 5, 3, 1930), *G. citimus* Ndm., *G. lautus* Ndm., and probably also (judging by similarity in form of male appendages) *G. sven-hedini* Sjöstedt from Szechuan and *G. chichibui* Fraser and *G. melampus* Selys from Japan. This is the only group of species in the *Gomphus* series of Williamson that has the middle fork (*Mf*) unsymmetrical.

The nymph (see *Manual* Pl. VII, figs. 2 and 2a) is depressed with strictly lanceolate abdomen bearing short triangular lateral spines on segments 7 to 9, and low dorsal hooks on segments 3 to 9, the latter very small at the front and regularly increasing in size to rearward to the 8th segment. The middle lobe of the labium is prominent, triangularly produced with a pair of little teeth at its slightly truncate tip, and fringes of marginal hairs at either side. The terminal fourth of the lateral lobe beyond the base of the strong movable hook is roundly incurved to meet the denticulate inner border, without forming a distinct terminal hook.

The type species of the two preceding genera are both pond species, common in central China, where I made rearings of both of them repeatedly.

Group 3. *EOGOMPHUS*, gen. nov. Type *GOMPHUS NEGLECTUS* Ndm.

Characters: Triangles of both fore and hind wings long in the axis of the wing, and generally four-sided by failure of the long sides to meet at the outermost angle; both usually traversed by a single cross vein; bridge vein shortened distally, the distance from subnodus to oblique vein being about a third of the distance of subnodus from the middle fork; gaff nearly as long as the inner side of the hind wing triangle; basal subcostal crossvein present in fore wing, absent in the hind; vein A2 weak and angulated so as to be almost unrecognizable;

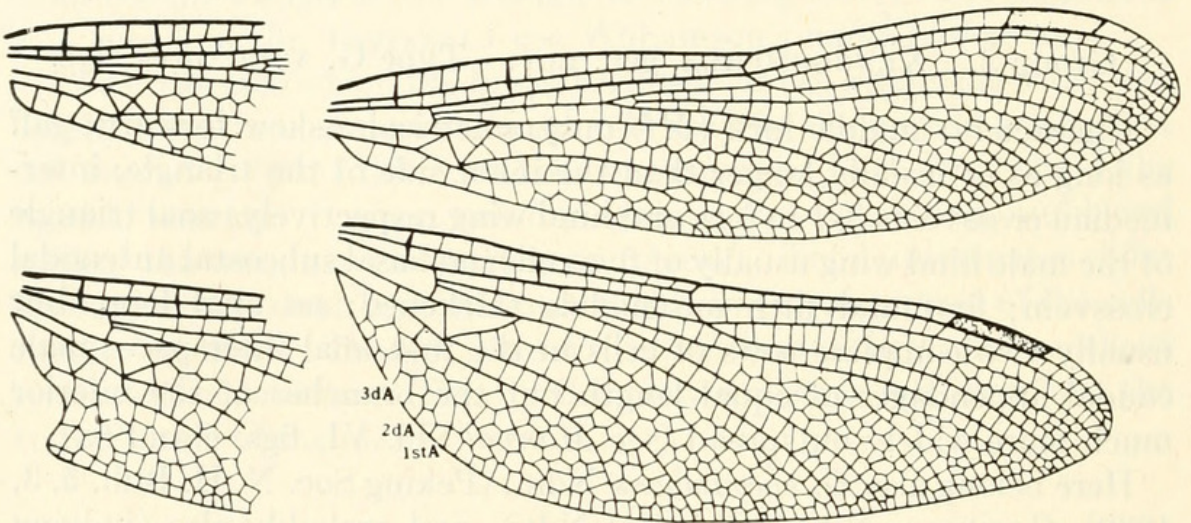


Fig. 2. The wings of male (basal part) and female *Eogomphus neglectus* Ndm.

for a considerable distance from the wing margin the paired long veins inclose more than one cell row, the greatest doubling between M3 and M4, less between Cu1 and Cu2, least between Rs and M2; behind Cu2 in the fore wing are two or three cell rows traversed by ill developed accessory branch-like sectors; and middle fork (*Mf*) symmetrical.

This genus is perhaps nearest to *Davidius* of the *Gomphus* series, but it differs in having the fore wing triangle longer and not angulated on the outer side; the intermedian crossveins are little reduced, being 5/2 in fore and hind wings respectively. This character transgresses the lines heretofore drawn between the Gomphine and Epigomphine series, as does also the general aspect of the rather elongate wings.

The nymph is unknown. The nymph figured in the *Manual* on Plate VII, figures 3 and 3a, referred to on page 67 as possibly belonging to this species, is the nymph of *Merogomphus*.

The three teneral specimens representing this most unusual Gomphine came to me just before the manuscript of the *Manual* left my hands. One male was retained for the Cornell University Collection.

After a reexamination of it, I may here add another note of description.

The face and top of the head and dorsum of the first abdominal segment are densely hairy. The dorsum of the bilobed occiput is thinly clad with short hair that is parted in the middle and outspread flat both ways therefrom. The spines on femora and tibiae are very numerous; short and in uneven alignment in the outer row on the hind femur, with the last one in the row but little longer than the others; those of the middle femur are more than twice as long, equally numerous and they form an even regular row.

The superior caudal appendages are widely divergent from the base, tapering and convergent only toward their tips. Each ends in a small black tooth. Below the base is a large inferior branch that ends in a blunt black tooth. The inferior appendage is little more than half as long as the superiors and its tips have less than half their spread. It is quadrangular, with a straight hind margin from the angles of which arise two stout branches that project straight to rearward. Each ends in a blunt black upturned tooth. The genitalia of the second segment are rather prominent. The anterior hamule somewhat resembles the cheliped of a craw-fish with both tips bluntly rounded, the anterior tip slightly longer and inflexed around the other. The posterior hamule is perhaps twice as long as the anterior. There is a bulbous enlargement of its upper third, bearing on its inner side a cluster of about a dozen small black denticles; then suddenly tapering to a claw-like incurved tip. The peduncle ("vesicle") of the penis slopes down to rearward, and is deeply cleft on the anterior side for the reception of the greatly expanded penis tip. It is nearly bare except for the edges of this cleft and the hood-like inner side of it. The second joint is clavate toward its tip, and lacks an apical spine. The reflexed third joint bears a remarkable enlargement at its tip; a deeply cupped expansion that carries a suggestion of likeness to an irregular flower. Above, the rim of the cup is deeply emarginate, and within it arise two petal-like lobes. Far out from its center projects a bifid stigma-like process ending in a pair of blunt, recurved, flabellate tips, below which projects a spine of half their length.

The apical carina of the tenth abdominal segment is produced to rearward in a low bare triangular prominence, on either side of which is the usual line of black denticles.

Group 4. MEROGOMPHUS Martin. Type M. PAVIEI Martin

A more careful examination of the single known female specimen of *Gomphus torpens* Ndm. of the *Manual* leads me to conclude that it should have been placed in this genus and associated with *Merogomphus vandykei* Ndm., for it has the following characters: vein A3 arises opposite the anal crossing (*Ac*), and not beyond it; basal subcostal cross vein (*an*) present in the fore wing; intermedian crossveins 3/1 in fore and hind wing respectively, middle fork (*Mf*) symmetrical; gaff more than half as long as the inner side of the triangle; two rows of paranal cells in the fore wing; first anal interspace (*x*) wider than the second (*y*), and no anal loop. It also has a half a dozen very large spines in the outer row on the hind femur.

A nymph of this genus was figured in the *Manual* without name (Plate VII, figs. 3 and 3a) and described on pages 66 and 67. It is probably the nymph of *M. vandykei*, as determined by a recent study of the venation of its crumpled wings.¹

Group 5. MESOGOMPHUS Foerster. Type GOMPHUS COGNATUS Rambur

The *Gomphus brevipennis* Ndm. of the *Manual* belongs here, as evidenced by the following characters: vein A3 arises just before or opposite the anal crossing (*Ac*); two rows of paranal cells in the fore wing; intermedian crossveins 2/1 in fore and hind wing respectively; first and fifth antenodals thickened; middle fork (*Mf*) symmetrical; arculus unusually close to the triangle of both fore and hind wings and the front side of the subtriangle much shorter than the inner side of the triangle; four postanal cells in the hind wing; four or five cells in the male anal triangle; no anal loop, and the first anal interspace wider than the second.

The nymph has been described and figured for one species of this genus, *M. balneorum* by Needham and Gyger (*Philippine Jour. Sci.* 63, 33, Pl. X, figs. 125 and 126) and for two others, *M. lineatus* and *M. reinwardti* by Lieftinck (*Tijd.v.Entomol.* 77, 21, 1934).

Group 6. BURMAGOMPHUS Williamson. Type B. WILLIAMSONI Fraser

The *Gomphus dolus* Ndm. of the *Manual* belongs here. In venation it is very close indeed to the type species as figured by Williamson

¹ The method used was that described by Dr. May K. Gyger in *Entomological News*, 50, p. 21, 1939.

(*Proc. U. S. Nat. Mus.* **33**, 298, fig. 27, 1907). The combination of venational characters by which this genus has been set apart is as follows: In the fore wing, a single row of paranal cells; a small triangle slightly angulated near the middle of its outer side; a long close parallel of veins M4 and Cu1 beyond it with but two intervening rows of cells out to the level of the oblique vein, with a rather sudden widening thereafter; and in the hind wing but three postanal cells.

The nymph of this genus has been mentioned, and given an unintelligible two-line description by Fraser in *Fauna of British India: Odonata* **2**, 212, 1934.

Another small species that would appear to belong near to *Burmagomphus* is the one a portion of whose hind wing is shown in the accompanying figure of *Gomphus campestris* Ndm. of the *Manual*. (See figure 1.) It is of small size (hind wing 25 mm), with slightly angulated outer side to the hind wing triangle, and only three postanal cells. The single-celled anal loop is quite like that of *B. williamsoni*. There are these discordant characteristics: there is a basal subcostal crossvein in both fore and hind wings; one or two cells of the paranal row in the fore wing are divided, and the double row of cells beyond the triangle does not extend outward beyond the level of the nodus.¹ The venation as a whole is more sparse, there being but 11:7/8:7 nodal crossveins in fore and hind wing respectively and only three crossveins under the bridge.

My material is inadequate for determining whether these differences are constant enough to justify generic separation. Since this species has been taken on the campus of Yen Ching University, it should be possible for some one there to obtain additional specimens including also its immature stages.

Group 7. GOMPHUS s. str. Type LIBELLULA VULGATISSIMA Linn

The remaining species appearing under this generic name in the *Manual* may be allowed to remain so for the present. They show a general conformity to the type, but with numerous small divergencies which I shall now try to indicate in so far as they appear in the venation of the wings. They all seem to have the following characters in common: middle fork (*Mf*) symmetrical; vein A3 arises beyond the anal crossing (*Ac*); intermedian crossveins generally 2/1; paranal cells in the fore wing more than a single row, some cells at least being

¹ This disagreement applies also to Fraser's figure of *Burmagomphus pyramidalis*, Faun. British India Odonata: **2**, 212, fig. 66, 1934.

divided; postanal cells four to seven; anal triangle of the male generally three celled; and no basal subcostal cross veins.

Recalling *Burmagomphus* are the two small shortwinged species *G. arvalis* Ndm. and *G. sowerbyi* Ndm. These have a well defined one celled anal loop with the base of vein A1 kinked around its outer corner. The outer side of the nearly equilateral fore wing triangle is slightly angulated in the middle. The arculus is between the first and second antenodal cross veins. The gaff is about half as long as the inner side of the hind wing triangle. Vein M4 is slightly undulate, and there are four post anal cells. This latter character prevents placing them in *Platygomphus*, as does also the well developed 3-celled anal triangle in the male. De Selys placed a question mark before his *Platygomphus occultus* when he placed it in that genus. It belongs rather with the above named pair. The three might possibly be made the basis of a new genus; but until *Burmagomphus* and *Platygomphus* are better defined, and until *Gomphus campestris* has found its place, and until the nymphs of all of them are made known, another name would only add to the confusion.

Two somewhat larger species of the *Manual*, *G. intinctus* and *G. collaris*, are like the three preceding in most characters, but the arculus is nearer the second antenodal crossvein, and *intinctus* has five postanal cells. In all five the gaff is about half as long as the inner side of the triangle.

A peculiar species that is known unfortunately from only a single female specimen is *G. edax* Ndm. The triangles are both elongated in axis of the wings, the outer end of the hind wing triangle being turned up at the end like a sled runner (see the next figure); there are seven postanal cells; the branches of the anal vein are aslant outward.

Another peculiar species, described later by me (*Lingnan Sci. Jour.* 10, 227, 1931) from a single female specimen taken in Hainan is *G. hoffmani*. It has the first and sixth antenodals thickened, the arculus at or beyond the second; no basal subcostal antenodal crossvein, the fore wing with two rows of paranal cells, no large cells in the anal area behind the first paranal row, and the first anal interspace much wider than the second. Added to this array of differences there is a peculiarly elongated three-celled anal loop, around the outer end of which vein A1 makes a short sharp bend. Also the hind wing is widest at the nodus. The gaff is as long as the inner side of the triangle, which latter in the fore wing is a little longer than the front side. Whether this wing is quite normal I cannot say.

There remain six large species (hind wing 37-40 mm.) that conform

more closely (still none too well) to the type of the genus. One, *G. cuneatus* Ndm. of the *Manual* appears to be distinguished by having the veins M3 and M4 not at all undulate, strictly parallel and regularly curved and inclosing somewhat larger cells than in the other five species. In general it has a more open venation. It also has a longer gaff, almost as long as the inner side of the triangle, and a shorter kink in the base of the anal vein at the outer angle of the one celled anal loop. There is in the type specimen but one extra cell in the otherwise single paranal row of the fore wings.

Of the five remaining species, *G. endicotti* appears to be separable by reason of the shortness of the front side of the fore wing triangle—not longer than the inner side of the same; and *G. flavicornis* (*Peking Soc. Nat. Hist. Bull.* 1, 2, 1930) by having its anal crossing close to the inner end of the subtriangle in the hind wing—less than half its own length therefrom.

Finally *G. amicus* is separable from the remaining two by the shortness of its gaff—less than half the length of the inner side of the front wing triangle; and these last two may be separated by the position of the arculus in relation to antenodal crossveins: it is midway between the first and second in *G. clathratus*, and at or very close to the second in *G. septimus*.

THE FRAMEWORK OF THE WING ABOUT THE TRIANGLES

In the preceding pages I have been pointing out the best single venational characters that I have been able to find for distinguishing each of the species listed in my *Manual* under *GOMPHUS* (all of them except *G. somnolens*, of which I now have neither wings nor photographs of venation available). I now wish to present in the form of a table some correlations of characters especially to show the relations of the parts of the strong framework of the wing that are in or around the triangles.

As a standard of comparison I take the part marked *a*, which forms the one common side of triangle and subtriangle, and which is formed in development about the posteriorly deflected portion of the main Cubital trachea. Two additional reasons for its selection are (1) its central location, its ends being in contact with all the other parts compared; and (2) its relative constancy in length. A little comparison

showed all the other parts to be more variable. Next in constancy was the part marked *e*, which is formed about the main Anal trachea.

The part *a* was given an assigned value of 10, and the length of all the other parts were estimated in tenths of it. That is the meaning of the numerals in the central columns of the table. These values are

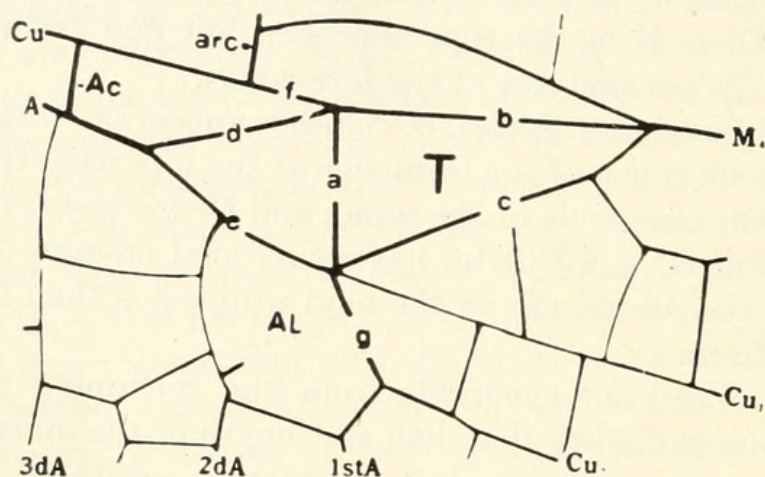


Fig. 3. The parts about the triangle (T) in the wing hind of *Gomphus edax* Ndm. to illustrate the terms used in the following table.

merely estimates made under inspection with a lens, without careful measurements: wherefore allowance (possibly up to 10%) may have to be made for errors of judgment, and additional allowance for variation in individual specimens.

The accompanying enlarged diagram, based on a drawing of the wing of *Gomphus edax* Ndm. will be useful for comparison.

In general it may be said concerning venational characters that the conjunctions and proportions and directions of the component parts of the strong framework of the wing, and the layout of the spaces between principal veins and their branches offer far more dependable taxonomic characters than are to be found in the number of intervening crossveins.

Venational Characters in 20 SPECIES OF GOMPHUS

| Species | Hind wing | Inter-med. cvs. f/h w. | Length of parts about hind w. triangle | | | | | | | Cells extra post | | A3 ⁸ Ac | A. loop present |
|-------------|-----------|---------------------------|--|----|----|----|----|---|----|------------------|-------|--------------------|-----------------|
| | | | a | b | c | d | e | f | g | paran. | anals | | |
| abdominalis | 35 | 2/1 | 10 | 17 | 18 | 9 | 11 | 5 | 5 | 0 | 4 | opp | yes |
| agricola | 25 | 3/1 | 10 | 16 | 18 | 10 | 11 | 6 | 12 | 0 | 4 | out | no |
| amicus | 40 | 2/1 | 10 | 16 | 18 | 11 | 12 | 8 | 4 | 3 | 4 | in | yes |
| arvalis | 29 | 2/1 | 10 | 18 | 20 | 12 | 12 | 7 | 4 | 2 | 4 | in | yes |
| campestris | 26 | 2/1 | 10 | 12 | 13 | 11 | 12 | 5 | 5 | 1 | 3 | in | yes |
| clathratus | 38 | 3/1 | 10 | 17 | 19 | 10 | 11 | 7 | 5 | 2 | 4 | in | yes |
| collaris | 31 | 2/1 | 10 | 15 | 16 | 10 | 11 | 7 | 4 | 2 | 4 | in | yes |
| cuneatus | 38 | 2/1 | 10 | 15 | 16 | 10 | 11 | 7 | 7 | 1 | 5 | in | yes |
| dolus | 23 | 2/1 | 10 | 9 | 11 | 9 | 11 | 4 | 6 | 0 | 3 | in | no |
| edax | 35 | 3/1 | 10 | 18 | 20 | 11 | 12 | 6 | 8 | 2 | 5 | in | yes |
| endicotti | 34 | 2/1 | 10 | 17 | 19 | 10 | 11 | 7 | 9 | 3 | 5 | in | yes |
| flavicornis | 37 | 2/1 | 10 | 17 | 19 | 10 | 11 | 5 | 4 | 2 | 5 | in | yes |
| gideon | 36 | 4/2 | 10 | 16 | 17 | 10 | 11 | 6 | 5 | 3 | 4 | in | yes |
| hoffmanni | 34 | 2/1 | 10 | 15 | 16 | 10 | 11 | 7 | 9 | 4 | 5 | in | no |
| intinctus | 31 | 2/1 | 10 | 14 | 15 | 10 | 11 | 7 | 4 | 4 | 5 | in | yes |
| neglectus | 36 | 5/2 | 10 | 19 | 20 | 10 | 11 | 5 | 7 | 0 | 5 | out | no |
| occultus | 30 | 2/1 | 10 | 14 | 15 | 9 | 10 | 5 | 7 | 1 | 4 | in | yes |
| septimus | 40 | 2/1 | 10 | 13 | 15 | 9 | 11 | 6 | 7 | 3 | 5 | in | yes |
| sowerbyi | 29 | 2/1 | 10 | 14 | 15 | 9 | 11 | 6 | 4 | 2 | 4 | in | yes |
| torpens | 30 | 3/1 | 10 | 15 | 16 | 9 | 11 | 4 | 10 | 2 | 4 | in | no |

Column 1. Length of hind wing in millimeters.

Column 2. Number of crossveins joining the sectors of the arculus between the arculus and the middle fork in fore and hind wing.

Column 3. Relative lengths of the parts about the triangle of the hind wing in terms of tenths of the length of the inner side of the triangle.

Column 4. Number of extra paranal cells in the front wing (more than the single row always present).

Column 5. Number of cells in the postanal row on the proximal side of vein 1st A between the triangle and the hind margin of the wing.

Column 6. Position of origin of vein 3d A: *in*, proximal to it; *opp*, opposite it; *out*, distal to it.

Column 7. Anal loop of hind wing.

LEPTOGOMPHUS UNICORNIS Ndm.

A study of the wings of the single known specimen of this species shows it to have been misplaced in the *Manual* in the genus *Davidius*. It has more in common with *Leptogomphus*, including (1) the form of the wings; (2) the lack of brace vein to the stigma; (3) the trigonal interspace regularly widening outward to the wing margin; (4) the small triangles; (5) the narrow fore wing subtriangle; (6) the little expanded anal area of the wing; and (7) the 3rd anal interspace (z) longer in the axis of the wing than wide. All these I regard as primitive characters, of relative fixity.

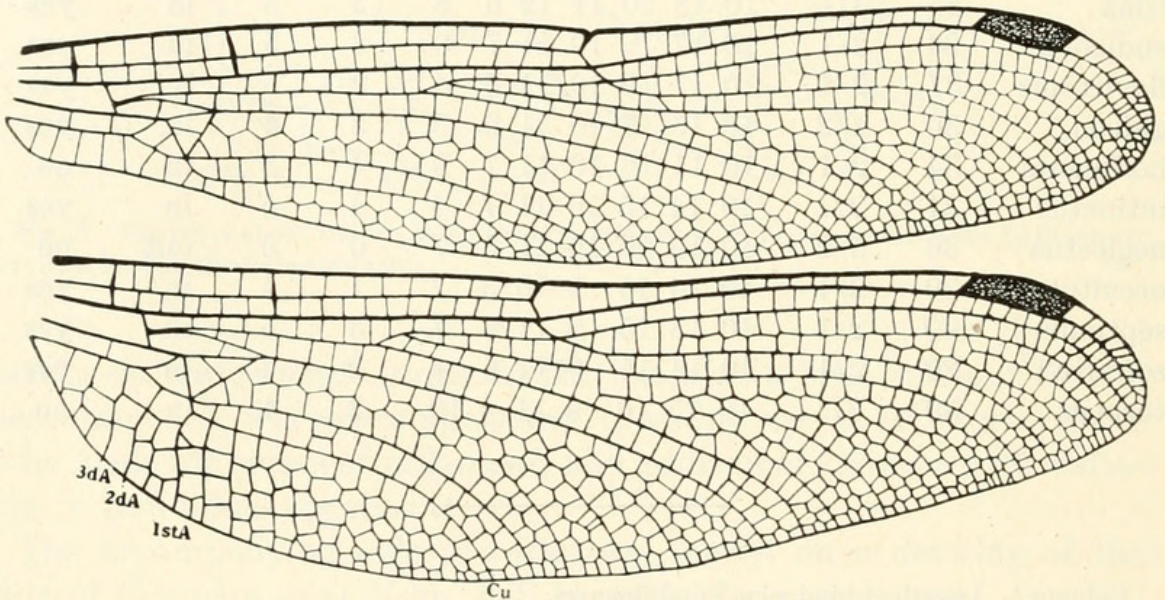


Fig. 4. Wings of ?*Leptogomphus unicornis* Ndm.

It seems to differ from *Leptogomphus* as represented by its type species, *L. sauteri* Selys, in having but a single row of very large paranal cells in the fore wing, in having no basal subcostal antenodal crossvein, and in having crossveins in all the triangles and in the supratrangular space of both the wings. I present a figure of the venation to call attention to these discrepancies. At first glance they seemed to me to be so great as to call for generic separation; but on further experience with the *Epigomphus* alliance, I think they are very unreliable variants, having only specific value.

TWO NEW SPECIES AND SOME NEW RECORDS

Since the publication of the *Manual* and of the Additions and Corrections (in the *Peking Soc. of Nat. Hist.* 5, 1-10, 1930) only one small collection of dragonflies has come to me from China. It was from Dr. Ting-wei Lew. It contained two new species of Gomphines and established a few new records.

GOMPHURUS GIDEON spec. nov.

Length 63 mm.; abdomen 45; hind wing 38.

This is a blackish species with spatulately dilated abdomen; face black with an oblong stripe of yellow covering about half of the labrum. A similar somewhat larger isolated stripe covers the top of the frons. The remainder of the top and rear of the head is black.

The synthorax is black in front with a pair of isolated dorsal stripes that are divergent downward, not reaching the divided cross stripe on the collar. An antehumeral stripe of yellow is represented by a very small spot high up near the crest, and a thin faint streak low down on the side, its lower end. Behind the broad black humeral band the sides are yellow with a black line on the third lateral suture, that connects with the back subalar carina above, and below runs down behind the coxa of the middle legs. A vestige of a middle stripe is present in front of the spiracle. Legs black beyond the short bicolored basal segments. Wings hyaline, with a faint tinge of yellow in the membrane. Ante- and postnodal crossveins are 16:12 and 10/12 in fore and hind wing respectively.

The abdomen is very moderately enlarged on the two basal segments narrowly cylindric on segments 3 to 7, and spatulate on 7 to 10, with widely flaring lateral expansion of the margins of 7, 8 and 9. The dorsum of 1 is mainly yellow and a narrow lanceolate spot appears on the base of 2. The sides of 1 and 2 are mainly yellow, and also the base of 3. Basal yellowish rings on 3 to 7 become narrower to rearward, with only fine yellow intersegmental lines across the apices of 7, 8, and 9; segment 10 and appendages wholly black. The relative length of the last four segments middorsally is about as 11; 9: 10:5; and appendages, on the same scale as 7. Diffuse large yellow spots cover about half of the sides of segments 8 and 9. Caudal appendages are as

shown in figure. The posterior hamules of the male, completely hiding the anterior ones, project strongly downward even beyond the level of the "vesicle", and taper to claw-like sharp tips that are directed forward.



Fig. 5. The abdomen of *Gomphurus gideon* sp.n., dorsal view.

The female is very similar in coloration, with the yellow areas a little more extended, especially on the abdomen. The subgenital plate is divided deeply into two blunt equilateral triangles that extend to rearward across about a fifth of the 9th sternite. The supraanal plate is shining black above, yellow beneath.

A single pair, type and paratype, collected in Chengtu, Szechuan on June 29th, 1929, and sent me by Dr. Lew. They are now in the Cornell University Collection.

Because of the striking dilatation of the 7th and 8th segments of the abdomen, shown in the figure herewith, and general accord in caudal appendages and in venation, I have placed this species in *Gomphurus*; a genus hitherto known only from North America. Another Chinese species, *Gomphus kryenbergi* Ris, compared by its describer with the American *Gomphus scudderi*, doubtless belongs beside it. *G. gideon* has however a somewhat more copious venation than the American species, with four cells in the anal triangle in both right and left hind wings of the male: intermedian crossveins $4/2$ in both male and female, and six postanal cells.

DAVIDIUS SERENUS spec. nov.

Female; length 41 mm.; abdomen 31; hind wing 27.

This is a small blackish species with yellow sides. The head is all black except the outer sides of the mandibles and a broad transverse stripe across the very low prominence of the frons, which are yellow. The thorax is black in front except for a pair of opposed 7-marks that just meet at the middle of the collar. The stalks of the 7s are slightly tapered upward and blunt at their isolated upper ends. There is no antehumeral yellow stripe at all. Behind the very broad black humeral band the sides are mainly yellow with a narrow black stripe on the third lateral suture that is connected forward with the humeral above and below. The black of the ventral side extends upward at the middle suture to cover the spiracle. The legs are black. The long slender hind femora are sagged downward in the middle and beset underneath with more than a score of slender black short subequal spines.

Wings hyaline. Ante- and postnodals 13:12/9:11 in fore and hind wing respectively. There is an extra cubito-anal crossvein in the fore wing, and there is a single row of cells behind the anal vein.

Abdomen mostly black with a diminishing amount of yellow on the sides of segments 1 to 7; segment 1 mostly yellow dorsally and 2 with a lanceolate streak of the same color. On the sides of segments 3 to 5 the yellow is broken into a row of three spots; reduced to two spots on 6, and to a single spot on 7: 8 to 10 black. Appendages yellow.

The subgenital plate of the female is oblong flat, slightly tapering to rearward, with a deep notch at the tip, and about four fifths as long as the venter of the 9th segment.

This species is nearly allied to *D. trox* Ndm., but differs in being smaller in size, in having the labium all black, in lacking the pale spot that is a vestige of the antehumeral stripe, in lacking the J-spot at the rear of the side of the thorax, and in having the abdominal segments wholly black and the appendages yellow.

There is a single specimen collected at Kuling, China in July 1933 by Dr. Ting-wei Lew, and now in the Cornell University collection.

Among the specimens sent me by Dr. Lew were five females of *Gomphus septimus* Ndm. The male was described in the *Manual*, p. 61. The female, heretofore unknown, is like the male in coloration, with a basal yellow halfring on abdominal segment 7 more conspicuous than in the male. The relative length of the last four abdominal segments is as 15:12:10:7, with the appendages 8, on the same scale. The prominent subgenital plate is scoop-shaped or shaped like the spout on a

pitcher, triangular, black, more than half as long as the venter of the 9th segment, and directed conspicuously downward. Among the rather stout spines on the hind femur are four to six stronger than the others, but intermixed with the others, and none of them is as long as the femur is thick.

Two of the specimens came from Foochow in May; one from Mt. Poliang ding, near Ho-kiang and Ming-kiant Fukein; and two from Tu-ching, Min-giang in Fukien.

Dr. Lew sent also a fine pair of *Megalogomphus sommeri* Selys from Kuling; a species that has hitherto been without definite locality assignment in China.

TWO CORRECTIONS FOR THE *MANUAL* AND A CONFIRMATION

(1) *Agricnemis amelia* Ndm. (*Manual*, p. 256) is a synonym of *Ischnura delicata* Hagen, which is in turn considered by some authorities to be a synonym of *Ischnura aurora* Burmeister.

(2) *Taolestes nectans* Ndm. (*Manual*, p. 256) is correctly described and illustrated, but the nymph associated with it belongs elsewhere. The female type specimen was presented to me along with a cast nymphal skin, supposedly reared, and with several nymphs that had been collected at the same spot. I uncritically accepted them as belonging together. The nymphs were not well preserved; but in a recent examination of one of the best of them I find enough venation still remaining in its wing pads to show that the antenodal crossveins are numerous. That is sufficient to show that they are not *Taolestes*.

The nymph is structurally very similar to those now known belonging to the genus *Euphaea*. Judging by its size, it should be *Euphaea opaca*.

A word about the placement of *Taolestes*. As explained at the beginning of this article, I followed the older and easier system that segregated the Lestinae from the others on one principal character: middle fork (*Mf*) nearer the arculus than the nodus. But in doing so I pointed out (p. 226) the nonconformity of *Taolestes* with the true Lestinae.

Two additional species have since been described from China by Erich Schmidt (*Konowia* 10, 178-183, 1931) as species of *Rhipidolestes*: *R. bidens* and *R. truncatidens*; they conform much more closely to *Taolestes*, not only in having the middle fork nearer the arculus than

to the nodus, but also in many other points of venation, and in the male genitalia. The species *T. nectans* differs from both in having unmarked hyaline wings, much more open venation, and a shorter and thicker stigma.

Concerning the nymph of *Megalestes*, I noted on page 229 of the *Manual* that Laidlaw had described a nymph that he referred by supposition to *M. major* (*Ind. Mus. Record*, **19**, 185-187, 1920). I said I was not convinced that Laidlaw's nymph belonged to *Megalestes*. My remark was more than justified: this, notwithstanding Leiftinck's oracular pronouncement (*Treubia* **17**, 58-61, 1939) in support of Laidlaw's supposition. I obtained an almost identical, certainly congeneric nymph of *Rhinagrion philippinum* from Luzon, well preserved, and showing so complete venation in its wing pads as to leave no doubt as to its identity. It is described and figured in the *Philippine Journal of Science*, **70**, 266, Plate 15, figs. 206-213 and 215-216, 1939. Laidlaw's nymph is *Rhinagrion*.



Needham, James G. 1944. "Observations on chinese gomphine dragonflies." *Bulletin of the Museum of Comparative Zoology at Harvard College* 94, 145–163.

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