# THE TRUE POSITION OF THE GENERA *OROGOMPHUS* AND *CHLOROGOMPHUS* AS DEMONSTRATED BY A STUDY OF THE LARVAE OF *O.ATKINSONI* AND *O.CAMPIONI* AND BY A COMPARISON OF THE LATTER WITH THE LARVA OF *ANOTOGASTER NIPALENSIS* (ODONATA).

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(Plates IX, X.)

In the Memoirs of Pusa, Vol. VIII, No. 3, Feb. 1923, I described the exuvia of *Orogomphus atkinsoni* Selys. A large number of these exuviae were found clinging to rocks in the bed of a stream at Kurseong, Sikhim, 5,000 ft., by Mr. T. Bainbrigge Fletcher. Mr. Fletcher was very emphatic that no other large dragonflies were about at the time except *O. atkinsoni*, so that there was every reason to surmise that the exuviae belonged to that species.

On first examination I reported all the exuviae sent to be males, this owing to the ovipositor scale being so minute that I entirely overlooked it. The result of this error was to cast considerable doubt on the exuvia being that of an *Orogomphus* at all, thus Dr. Ris, having read the description quoted above, wrote to me as follows :—

" Let me tell you that this discovery, if it holds good, is a disappointment. The sub-family loses its ambiguous position and becomes a group of Cordulegasterinae. With your description and figures of the nymph in hand, I have very carefully confronted again the venation of *Orogomphus-Chlorogomphus* and. *Cordulegaster*; really there is nothing so radically different that the two might not be united.
I should have expected from this larva something between a *Gomphine* and a *Macromia* larva but not simply a *Cordulegaster* type. What you have figured is clearly like *Cordulegaster*. It is very unfortunate that you have no female nymph cases. They would decide the case at once. For *Oro-Chloro-gomphus* something like the structure of *Gomphus* is to be expected (two minute tubercles, or better, a minute, deeply cleft scale, so as to form two tubercles at the terminal border of the 8th sternite), whereas the *Cordulegaster* female larva bears a large sheath for the future ovipositor. I must say that so far as I am concerned, the question remains open, so long as no nymph has been observed in actual transformation, or so long as no female nymph of *Oro-Chloro-gomphus* has come to hand."

Dr. Ris of course had every right to express such doubts, as there was only circumstantial evidence to support the claim of the exuvia to be that of *Orogomphus atkinsoni.*

In March 1924, Dr. Chopra of the Zoological Survey of India, secured a single larva in the Balasan River, below Kurseong, 1,500 ft., which unfortunately also turned out to be a male. I made a careful examination of the venation depicted in the wings of this specimen but here again failed to get any conclusive evidence. Parts of the venation

were heavily pigmented and thus easily discernible, but the essential parts, the triangles, etc., were far too obscure to be made out with any degree of certainty. So far as I could interpret the venation, the wing was that of a Cordulegasterine type. As a control, I made an examination of the gizzard folds, with the result that I found them to be typically Cordulegasterine, differing only in minor details.

The accumulated evidence was all in favour of Dr. Ris' view, and it only needed the discovery of a female exuvia or larva to make this conclusive.

In May 1924, Mr. Bainbrigge Fletcher, collecting at Shillong, 5,000 ft., Khasia Hills, Assam, secured several more exuviae which he forwarded to me for examination. Some of these were similar in size and morphology to those from Kurseong and undoubtedly belonged to the same species. An important fact was that Mr. Fletcher again took several specimens of teneral *Orogomphus atkinsoni* clinging to bushes alongside the stream where the exuviae were found, thus coinciding with his experience at Kurseong.

In addition to these exuviae, and on the same stream, he found three much larger exuviae, very similar however in appearance and with a Cordulegasterine mask. He forwarded these as females of the former, but on making a close examination, I found two only to be females, both of these possessing a very large projecting ovipositor scale. A comparison of these with the smaller species quickly revealed differences in detail, clearly proving their specific distinctness.

The comparatively enormous size of the ovipositor scale in these specimens, coupled with the remarks of Dr. Ris, led me at this time to make a re-examination of the Kurseong exuviae in the hope that I might find some evidence of an ovipositor scale, in at least some of them, especially as in the imago of *O. atkinsoni* the ovipositor is nearly obsolete. The examination was made under a quarter inch objective and to my surprise I was able to make out a very minute ovipositor in nearly half of the specimens. Possibly my failure to notice this organ at my primary examination was due to the fact that most of the exuviae were coated with clinging detritus and diatomaceous material. Thus Dr. Ris' argument against the exuviae belonging to an *Orogomphus* was met, but it still needed a larva in which the venation could be read clearly to render the proof conclusive. With this object in view, I determined to make a great effort to find the adult larva of *Orogomphus campioni*, a species which occurs in Coorg and South Kanara, from April to the early part of June. In the former locality, its particular haunt is in the jungles at the source of the Sampaji river. Rising here as a small brook with sandy bottom, the river winds steeply down amidst dark gloomy primeval jungle, forming occasional pools with muddy or rocky bottoms, and later, after receiving several tributaries, expands into a mountain river of great magnitude.

During the month of May I had often seen as many as fifteen specimens of *O. campioni* soaring above the jungle at the source of this river (Plate IX, fig. 2). I had also seen considerable numbers at Khatlkad, near Mercara, but as the approach to the stream feeding this area had to be negotiated through dense thorny lantana, and involved the des-

cent of about 1,000 ft. of precipitous hill-side, I determined to first explore the Sampaji river, which was of easy approach from the Mangalore ghat road. As it was essential that an adult larva should be secured, I had to postpone my search till as late a date as possible before the emergence of the insects in April, but as I was due to leave Coorg in February, I had to carry out my explorations at a date earlier than I could have wished.

On the 13th January I carried out extensive dredging in the upper part of the stream where it flows through very dense dark jungles, but after some hours was compelled to cease, partly from fatigue and partly from the approach of nightfall. I had secured a number of larvae which appeared to be Gomphine in nature, but amongst which, when examined at leisure in my laboratory, I found a single Cordulegasterine larva. Now the subfamily Cordulegasterinae has no known representative in India south of the northern montane tracts, nor is it at all likely that any occur. (In this particular district of Coorg I had collected continuously for two years, motoring to various collecting grounds a total distance of 17,000 miles during that period, so that it was improbable that so large an insect as a *Cordulegaster* could have escaped my notice.)

Apart from its juvenile condition, my new find was exactly similar to the larva taken by Dr. Chopra at Kurseong. The remaining larvae collected on this date proved to be all Gomphines belonging to two species :—*Gomphus nilgiricus* Laid. and *Acrogomphus fraseri* Laid.

On the 15th January I again dredged this stream, but at a point lower down where it emerges from the jungle and flows through a narrow valley under paddy cultivation (Plate IX, fig. 1). Here the stream is bordered by cane brakes and is favoured by such dragoflies as *Megalogomphus*, *Gomphus*, *Heliogomphus*, *Gomphidia*, *Neurobasis*, *Pseudophaea* and *Rhinocypha*. A prolonged search in many likely pools and rivulets resulted in dredging up more larvae of *Acrogomphus* and a few of *Orthetrum* and *Neurobasis*. Many pools were cleaned entirely of stones and accumulated sand until the bare bed-rock was exposed, so that after the great toil involved, the result was most disappointing.

A third attempt to find the larva was made two days later, 17th January, this time the river being worked higher up from a point a little below where it rises in a cardamom swamp. After dredging for nearly two hours I turned up from clean sand, at the bottom of a pool about one foot deep, two adult Cordulegasterine larvae in two successive dips. Both were females and exactly similar otherwise to the Kurseong larva.

A third larva was secured after much toil, on the 5th February, also feminine in sex.

An examination of the wings of these proved them to be indisputable specimens of *Orogomphus campioni*. In the first female examined, the venation is so clearly depicted, that the most minute details are easily readable. Thus one notes the characteristic *Orogomphine* triangles, the incomplete basal antenodals and the nervures traversing the median space. Specific differences are present, proving it to be *campoini*,—thus the nodal indices agree, the number of cells in the loop,

the number under the pterostigma, the number of cells in the triangles and the arrangement of cells at the proximal end of the discoidal field. The dental folds of the gizzard are typically Cordulegasterine but show marked differences, of a specific value, from those of *O. atkinsoni.* (These are given in detail below.)

The larva taken on the 5th February was kept alive for a few days to observe its habits. It was placed in a bowl with a few inches of sand at the bottom, obtained from the Sampaji river. (This sand is of a rusty tint and the larva corresponds in colour, especially its head and dorsum of thorax). Placed on the surface of the sand, it remained quiescent for some time and then began burrowing vigourosly with its *hind legs.* (Quite contrary to the habits of Gomphines which use their especially adapted forelegs.) The end of the abdomen was curled up evenly and used as a plough as the insect burrowed down and backwards. Thus the middorsum was the first part of its anatomy to be lost to sight. As soon as the head had descended to a level with the plane of the sand, it was brought into use as a spade, and the use of the spade-like frons, common to all the Cordulegasterinae, was thus explained. This curious instrument is used in precisely the same way as is the similar structure found in scavenger beetles.

At times the insect only sank into the sand until all but its head and fore part of thorax was visible, and in such a posture, owing to its cryptic colouring, it was quite invisible except to the trained eye.

All the larvae were found at the foot of minature waterfalls in moderately deep pools containing about a foot of clean sand at the bottom.

The Kurseong and Shillong exuvia and larva resemble that of *O. campioni* so closely that there can be no doubt that they belong to the same genus, and the fact that *atkinsoni* was taken in the same neighbourhood is sufficient proof that they belong to the latter species.

The late Mr. Herbert Campion pointed out that the two sexes of *O. campioni* combined the characters of *Orogomphus* and *Chlorogomphus*, the male being a typical *Orogomphus*, whilst the female was equally typical of the second genus. It is clear from this that *Chlorogomphus* can no longer stand as a distinct genus. As regards the sub-family Chlorcgomphinae, in the light we now possess of two species of larvae, it is clear that the two known genera belong to the family Cordulegasteridae, or at the most cannot be considered of greater value than a group within the family.

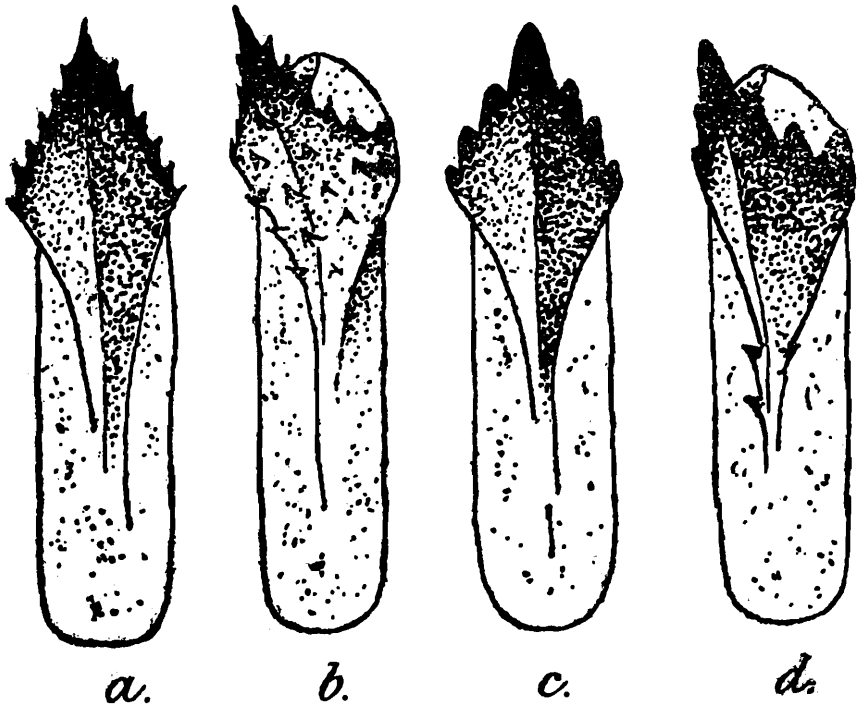
The description of the exuvia of *O. atkinsoni* has already been published (*Mem. Pusa, l. c.*), and it only remains to add a note on its larva.

### Larva of *Orogomphus atkinsoni* Selys.

Bright yellow ochre in colour, the face and fore part of head clouded with blackish brown. Structure similar to that already described for the exuvia. Wing cases rather widely divaricate.

Dental folds of gizzard typically Cordulegasterine in shape. Four folds, of which two are anterior and two posterior. Each fold ending

in a very robust dark brown tooth sharply pointed at its apex and presenting six acutely pointed teeth along each foreborder. In




Text-fig. 1.

*a* and *b*. Posterior and anterior gizzard folds of *Orogomphus atkinsoni* Selys. The posterior tooth is naked, the anterior beset with scattered spines.

*c* and *d*. The same of *Orogomphus campioni* Fras. The anterior tooth bears three basal spines.

addition, the two anterior teeth have the hinder surface coated with twelve to thirteen spines of various sizes (text-figure 1, *a* and *b*).

## Larva of *Orogomphus campioni* Fras.

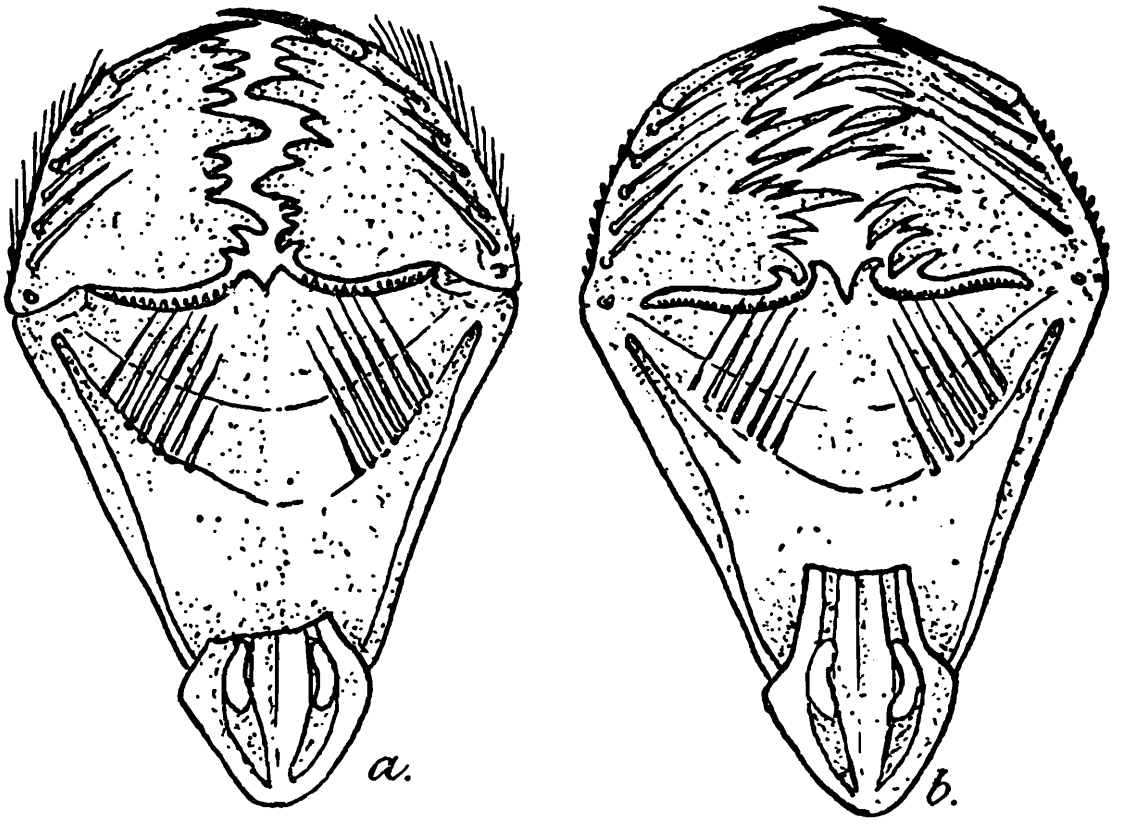
(Plate X, figs. 2, 2*a* and 3).

Total length ♂ 33 mm., ♀ 35 mm., abdomen 24-26 mm., hind femur 7 mm. General colouring ochreous, dorsum of head and thorax rust red, face and mask blackish brown.

Form of head, thorax and abdomen exactly similar to those of *atkinsoni*. The mask with two or three more teeth than in the latter species and with seven setae on the body of mask instead of five (text-figure 2, *b*).

Dental folds of gizzard typically Cordulegasterine, four in number and differing from those of *atkinsoni* in the following particulars ; the teeth are smaller, the apices are bluntly pointed, the secondary teeth along the free borders very robust, bluntly pointed and only three in number. Each of the two anterior teeth presents three robust spines at its base in place of the more numerous, smaller scattered spines seen in *atkinsoni* (text-figure 1, *c* and *d*).

The hindlegs are more robust than is suggested in the figure illustrating the exuvia in the Memoirs quoted. Vulvar scale in both species cleft into two minute triangular tubercles (plate X, 2*a*).




TEXT-FIG. 2.

*a*. Mask of *Anotogaster nipalensis* Selys, inner aspect.
*b*. The same of *Orogomphus campioni* Fras.

## Exuvia of *Anotogaster nipalensis* Selys.

(Plate X, figs. 1 and 1*a*.)

Dimensions of male slightly smaller than the female, of the latter :— Total length 52 mm., abdomen 32 mm., width of head 10 mm., width of abdomen at segment 5, 8·5 mm. ; hind femur 5·5 mm. in length. (Total length of male 45 mm.)

Body very elongate and cylindrical, abdomen tapering gradually to a point. Head flattened above, wide and markedly squared laterally where the eyes form prominent antero-lateral corners. Frons produced into a squarish flattened plaque similar to that found in *C. annulatus* and *Orogomphus*, this plaque furnished anteriorly with a fringe of coarse thick vibrissae. Antennae 9-jointed. Wing-cases widely divaricate, overlapping the 4th abdominal segment. Legs comparatively stout and short, probably formed for burrowing as in *Orogomphus*, the hind femora the most robust.

Mask very similar to that of *Cordulegaster annulatus* or *Orogomphus*, but the teeth of lateral lobes fewer, shorter and decidedly more obtuse than in the latter. Five setae on the lateral lobes, six to seven on body of mask, these latter unequal in length (text-figure 2, *a*).

The ovipositor sheath highly developed and projecting, extending from the base of the 8th sternite for the whole length of the 9th, triangular, with a median suture (plate X, fig. 1*a*).

Two females and one male exuvia found clinging to trees alongside a stream at Shillong, Assam, 12. V. 24. A large number of exuvia of *Orogomphus atkinsoni* were found clinging to rocks in this same stream on the same date.

The projecting frons of the imago, common to all species belonging to the family Cordulegasteridae, and which has been regarded as an archaic structure, appears to be merely an expression of the same organ found in the larva and, as has been shown above, is used by the larva for purposes of ploughing its way through sand and mud in search of food.