

DESCRIPTION AND LIFE-HISTORY OF A NEW SPECIES OF *NANNOPHLEBIA*.

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(Plate lxxiv.)

The genus *Nannophlebia* belongs to Group i. of the *Libellulinae*, according to the new and excellent classification of Dr. Ris.* It is easily recognised by the following characters:—Small tenderly-built insects of black and yellow pattern; second cubital cross-vein falling near to, but *not right on to*, the proximal angle of the triangle in the forewing, and hence no real “subtriangle” in that wing;† proximal side of triangle in hindwing in line with arculus. Costal side of triangle of forewing broken, that of hindwing regular. Last antenodal cross-vein of forewing complete; superior sector of triangle in forewing placed far from the anal angle of the triangle.

In this genus, Dr. Ris places three distinct forms, which he considers to be all subspecies of the type, *Nannophlebia lorquini* Selys. These he distinguishes as follows:—

1. *N. lorquini lorquini* (*N. lorquini* Selys, 1869). Moluccas.
2. *N. lorquini imitans* (*N. imitans* Ris, 1900). Bismarck Archipelago.
3. *N. lorquini eludens* (*N. eludens* Tillyard, 1908). North Queensland.

The last-named is considered to be the true Australian form of the species; hence Dr. Ris associated with it two females of considerably larger size, and somewhat different markings, recorded from

* Coll. Zool. du Baron de Selys-Longchamps, Fasc. ix. Libellulinen, Part i., by Dr. F. Ris, 1909, p. 658.

† It is important to point out, however, that this cross-vein is variable in position, and sometimes (especially in the new species about to be described) falls *almost on to* the angle of the triangle. It is, therefore, doubtful whether this is a good character on which to base the genus.

Gayndah (Q.). I also noted the prevalence, at Kuranda, of this larger form of female.

In North Queensland, I found the females of *N. eludens* emerging in January, while the males were also quite fresh, but somewhat more common. I was, therefore, rather surprised at taking, early in December, 1910, a very much torn and battered female of the larger variety at Pallal, near Bingara, in the North-west of New South Wales. It seemed probable that this was a remnant of an earlier brood, or possibly even of a distinct and much earlier species. The problem was solved by me last year, when I found both sexes of the early form fully matured at the end of November, on the Bellinger River (N.S.W.). Comparing them with the types of my *N. eludens*, it was at once evident that they were a new and very distinct species, which I now propose to describe under the name of *Nannophlebia risi* n.sp., in honour of my friend, Dr. F. Ris:—

NANNOPHLEBIA RISI, n.sp. (Plate lxxiv., figs. 4, 5, 7).

♂. *Total length* 33·5, *abdomen* 24, *forewing* 24, *hindwing* 22·5 mm.

Wings (fig. 4): lightly but considerably suffused with pale yellow from base up to nodus. *Pterostigma* 1·8 mm., black, fairly thick, covering one cellule or a little over. *Nodal Indicator* $\left\{ \begin{array}{l} 6, \quad 4\text{--}5 \\ 5, \quad 5 \end{array} \right.$. *Membranule* practically nil (the very minutest trace). *Head*: *eyes* rich green in the living insect (brown when dead), meeting for quite 1·5 mm. *Vertex* tubercled, pale yellow surrounded by black, central *ocellus* large, shining orange; front high, deeply cleft, pale yellow, thickly pitted, and carrying fine black hairs; *clypeus* and *labrum* yellow, *labium* dull yellowish. *Thorax*: *prothorax* very small, black, with a dorsal and two lateral yellow spots; a conspicuous ridge of long brown hairs on collar next thorax. *Meso-* and *metathorax* velvety black marked with lemon-yellow as follows:—a conspicuous dorsal line expanding into a spot, close up to prothorax, about 0·6 mm. across, shaped like a combined “cup and ball”; a pair of wavy humeral bands narrowing and converging slightly towards wing-bases; the latter black, with three yellow spots. *Sides* of thorax yellow, with an intricate pattern of three irregular black bands joining and branch-

ing in the manner shown in the plate (Fig. 7). *Notum* black, scuta and scutella yellow. *Legs* black, with yellowish lines on femora and tibiae. *Abdomen*: 1-2 moderate, 3-6 very pinched, 7-10 much clubbed. *Colour* black marked with yellow as follows:—1, brown, very narrow; 2, a pair of large lateral spots running downwards to genitalia; auricles very small; 3, a pair of large dorsal marks, just touching; 4, a pair of dorsal spots one-third from base, a narrow transverse band two-fifths from apex; 5, dorsal spots one-fifth from base, transverse band about central; 6, dorsal spots close up to base, a pair of elongate central spots touching dorsally; 7, two very small basal spots, a pair of large oval central spots; 8, two round central spots quite separated, with two smaller indistinct spots nearer to base; 9-10, black without spots, yellow lines in sutures (Fig. 5). *Appendages*: *Superior* 1.5 mm., yellow with black bases and tips; seen from above, straight and pointed; in profile, first three-fifths curving slightly downwards, remainder curving strongly upwards to a very sharp tip; underside with a conspicuous angle carrying minute serrations. *Inferior* 1 mm., yellow, hollowed out above, tip reaching well beyond the angle of the superior (Plate lxxiv., figs. 9, 10)

♀. *Total length* 33, *abdomen* 23.5, *forewing* 26, *hindwing* 24.5 mm. Differs from the male as follows:—*wings* slightly touched with brown all over, and *saffroned at bases in subcostal and submedian spaces only*. (See Ris' "Libellulinen," *loc. cit.*, p. 58, fig. 23, Gayndah, which belongs to this species and not to *N. eludens*). *Pterostigma* 2 mm., *nodal indicator* ||6-7, 5-6|. *Colours* duller; *abdomen*, 1-2 thicker, with lateral ||5-6, 5-6| spots large and lunulate; 3-6 not so pinched as in male, 7-10 not so swollen; central spots of 7 large; no spots on 8. *Appendages* dull greyish-black tipped with orange-brown, subcylindrical, the somewhat blunt tips carrying a short black spine (Fig. 13).

Hab.—Northern New South Wales up to North Queensland. Bellinger River, 7♂, 1♀, November-December, 1911. Pallal, 1♀, very old, December, 1910. Gayndah, 2♀ (Coll. Ris and Martin). Mount Tambourine (several specimens in Brisbane Museum). Kuranda, 1♀, January, 1905.

Types: ♂♀. in Coll. Tillyard (Bellinger River, N.S.W.).

The following are the chief differences between the new species and *N. eludens* Tillyard:—*N. risi* is considerably larger (hindwing of ♂ 22·5 as against 18·5 mm. in *N. eludens*); the pterostigma is considerably larger (1·8 against 1·4 mm.); the vertex is pale yellow (brown in *N. eludens*). The thoracic pattern is much bolder and more intricate in *N. risi*, the bands being black, while those of *N. eludens* are brown, and the second and third bands of the sides practically joining in two places so as to isolate a large yellow oval spot, whereas in *N. eludens* these bands are short and separated (Figs. 7-8). The number of yellow spots, and bands on the abdomen is much greater in *N. risi* than in *N. eludens*, there being two yellow areas on each of segments 4-8 in *N. risi* ♂, while *N. eludens* ♂ has one only on 4-6 and none on 7-8 (Figs. 5-6). The anal appendages of the males of the two species are very different; those of *N. risi* being long, straight, and parallel when seen from above, while those of *N. eludens* appear short and incurved, almost forcipate; seen in profile, the differences are quite as striking (Plate lxxiv., figs. 9-12). The genitalia of segment 2 of the male are not quite similar, the hamule being more prominent in *N. eludens* (Plate lxxiv., Figs. 14-15).

There is, besides, a well-marked difference in flight and habits. *N. risi* flies very swiftly in and out along the edges of the creeks and rivers, while *N. eludens* indulges in fantastic gyrations and evolutions, often rising in a complicated spiral to settle high up on a near-by tree. I did not notice this habit in *N. risi*, though I watched carefully for it. In resting also, *N. eludens* depresses its wings much more than *N. risi* does.

In my opinion, it is impossible to consider these two species as parts of one geographical whole, because *their areas of distribution* overlap, both being found in North Queensland in the same localities. *N. eludens* is on the wing from January to May, while *N. risi* is only represented in December and January by a few old and battered females. I have no doubt that males of *N. risi* could be taken in North Queensland by collecting in September or October, the latter of which is the month during which it appears further south. The supposition that they might be two broods

(spring and summer) of a single species also cannot be entertained, even if *N. eludens* were to be found further southwards, because of the very distinct differences already enumerated.

The discovery of this species makes it appear to me more than ever probable that the three forms, now classed as subspecies by Dr. Ris, must be regarded as distinct species. But to settle this point satisfactorily, we require much more material from many localities.

Life-History.—Along the beautiful Bellinger River, the females fly very rapidly, and oviposit by dashing in close to the edge, washing the ova out by brushing the abdomen rapidly on the surface of the water. This action is somewhat similar to that of *Cordulephya* ♀, but is not carried out so furtively. They are very difficult to catch while ovipositing. I knocked one into the water, but it rose quickly and flew away; while the only one I actually caught, had not been ovipositing, and had no eggs inside her.

Although most of the specimens seen were evidently quite mature, I secured two larval skins on the reeds and grass bordering the river. The first was taken about 6 a.m. on October 30th. The temperature was then about 95° Fahr., and dragonflies began to fly actively soon after sunrise; though by 10 a.m., (the temperature then reaching 104°) all signs of *Odonate* life had vanished. A newly-emerged *Nannophlebia* flew up into the trees from a point about a yard in front of me, and although I could not secure the imago, I soon found the larval skin quite close by. A second skin was found on a grass-stem only a few feet away.

These exuviae are of great interest, as they throw some light on the phylogenetic relationship of the *Libellulinae* with the *Cordulinae*. Exactly how far this bears out existing theories, it is difficult to say, because it is not easy to decide what larval characters ought properly to be regarded as *Libelluline*, and what as *Corduline*. I propose now to give a careful description of the exuviae, and then to consider how far it combines the characters of the two sub-families:—Nymph ♀. (Plate lxxiv., figs. 1-2): *Total length* 13 mm. Colour almost uniform dull brownish all over, except legs, which are spotted with darker brown. Head small, 1.5 × 3.7 mm.,

eyes fairly prominent, postocular lobes rounded; antennæ 1.5 mm., seven-jointed. *Labium* (Fig. 3): *mentum* short and broad, (2.5×3.7 mm., when flattened out), median lobe forming a prominent obtuse angle, with a few isolated hairs; *lateral lobes* subtriangular, inner margin and angle slightly rounded, carrying seven very distinct rounded crenations, each separated from the next by an incision *about as deep as the width of the crenation*; each crenation carries two sharp spines, of which the upper is shorter than the lower; these crenations are themselves *very slightly* crenulate, mostly on their upper margins. After the seventh (lowest) crenation, the margin curves round in a single broad curve carrying, firstly, a set of two spines, then a set of five spines close together, of which the first is very small, and, finally, three single spines on the part opposite the median lobe. *End-hook* rather weak, very sharp and narrow, 0.8 mm. *Setæ*: mental 5, lateral 5, all rather weak. Surface of lateral lobes considerably marked with small black spots. *Thorax*: *prothorax* short and wide, 0.8×2.5 mm., with distinct, but not very sharp, antero-lateral prominences. *Meso-* and *metathorax* fairly short and smooth, *wing-cases* about 4 mm. long, lying parallel along the back, and reaching about up to end of segment 5 of abdomen. *Legs* of medium length, slender; measurements of femur, tibia and tarsus: fore, 3, 3.4, 1.5; middle, 3.6, 3.8, 1.5; hind, 4.8, 4.5, 1.8 mm. *Abdomen*: oval, 8×4 mm., moderately convex beneath, very rounded above, and rising to the dorsal ridge, so that the cross-section appears broadly triquetral. *Lateral spines* only on 8-9, very small; *dorsal spines* on 5-10, nodding; those on 5-6 large, that of 7 flatter and smaller, that of 8 still smaller, while those of 9-10 are close together, very small and depressed. Segment 10 not enfolded by 9, except in so far as the dorsal and lateral spines of 9 project beyond its level (Fig. 2). *Appendages* 0.5 mm., broadly triquetral, with slightly concave sides, tips bluntly pointed; *involucres* of ♀ imaginal appendages very short, lying close in between the larval appendages, the whole forming a truncated triangular pyramid.

Hab.—Bellinger River, at Never-Never (N.S.W.). Emerged October 30th, 1911.

Type: Coll. Tillyard.

A second larval skin, also ♀, is slightly larger than the one described. From the fact that both these larvæ were females, and that battered female imagines have been taken as late as January, it is evident that the males of this species emerge first. It would seem that, at Kuranda, the males of *N. eludens* begin to emerge at a time (January), when only a few battered females of *N. risi* are left, and these few have completed oviposition. The females of *N. eludens* begin to come out a week or two later, and keep on the wing until May. Intercrossing between the two species would, therefore, appear to be quite impossible, apart from structural differences.

Those who are interested in the phylogeny of the *Libellulidæ*, will regard the discovery of the larva as of the utmost importance, since it is the first larva of Group i. of the *Libellulinae* to be recorded. It is generally admitted that the *Libellulinae* are, on the whole, cænogenetic from a more ancient *Corduline* stock. In so far, then, as Group i. is claimed to be an assemblage of the most archaic remnants of the early *Libellulinae*, we must look for *Corduline* characters in our newly-found larva. But also, in so far as Group i. may be regarded as *asthenogenetically modified* from the original *Libelluline* stock, we may expect to find very distinct *non-Corduline* characters, which may be similar to those of most *Libelluline* nymphs now existing, or might possibly be peculiar to the genus.

A satisfactory solution of this difficult problem requires a very clear and definite knowledge of what are the truly *Corduline*, and what the truly *Libelluline* characters of present-day nymphs. The two groups are closely allied, and it is difficult to fix upon many distinguishing characteristics. I regard the following as being the most definite *Corduline* (*i.e.*, archaic) characters of the nymphal forms.

(1) By far the most important, because it is found almost without exception throughout the *Cordulinae sens. lato*, is the greater

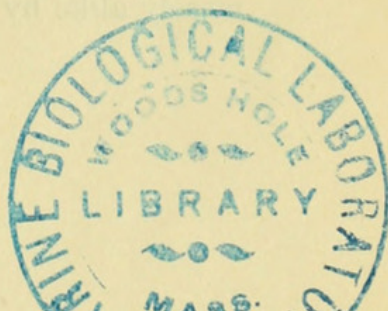
comparative depth of the crenations of the inner margin of the lateral lobes in the nymphal labium. Ranging from a deeply dentate margin in some forms, to the more prevalent crenate form of the *Corduliinæ s. str.*, (in which the depth of the crenate lobe is roughly equal to the width of the depression between them), we find this as the distinguishing mark of the larvæ of this subfamily. The only exceptions are the most cænogenetic forms, such as *Hemicordulia*, *Tetragoneuria*, etc., which show the more shallow *Libelluline* crenations; while, in the *Libellulinæ*, the only nymph having moderately deep crenations, is that of *Pantala flavescens*. This latter being one of the most recent and highly developed *Libellulinæ*, we must suppose this Corduline character of the labium to be secondarily developed.

It will be seen, at once, that the larva of *Nannophlebia* possesses this *Corduline* character. This is clear evidence of the proximity of Group i. to the *Corduline* stem, and, therefore, of their being archaic, as compared with the general body of the *Libellulinæ*.

(2) Coupled with the above character, but not so distinctive, is the smooth unspotted surface of the lateral lobes, and their fuller and more rounded outline in the *Corduliinæ*, together with a smaller development of spines on the crenations. The tendency of the *Libelluline* labium seems to me to be the development of a broad subtriangular mentum, the compression basally of the lateral lobes to subtriangular form, and a general decrease of the broad curvature of the inner margin. With this comes the increase in the *number* (as distinct from the size) of the crenulations, an often corresponding increase in lateral setæ, and a strong tendency to the production of black spots and warts on the surface of the lobe.

The larger number of setæ is not usually, however, found in any small nymphs, and need not therefore be looked for in *Nannophlebia*. Judged, however, by the general form of the lateral lobe, and by the appearance of black warty spots on it, we must regard the labium as showing distinct *Libelluline* characters.

On the whole, then, the evidence of the labium is that *Nannophlebia* is an archaic *Libelluline* which branched off long ago from the old *Corduline* stock.



(3) The average length of the legs in *Corduline* nymphs (and imagines also) is considerable greater than in the *Libellulinae*. *Nannophlebia* may be said to have rather long legs for a *Libelluline*, but distinctly shorter than we might expect for a *Corduline* (compare *Cordulephya*). This character may, therefore, be held to agree with the conclusion stated just above.

(4) In *Corduline* nymphs there appears to be a much greater tendency to the retraction of segment 10 of the abdomen, and the enveloping of it by segment 9, (or sometimes even 9 and 10 may be retracted into 8). There are, however, many exceptions to this. Also, the appendages in *Corduline* nymphs are usually somewhat longer than in the *Libellulinae*, though the difference in some particular cases is not very great. In so far as these characters may be judged to have any value, *Nannophlebia* must be held to be distinctly *Libelluline*.

(5) The general outline of the nymphs of the two groups is somewhat variable, but there is a type that is common to both, viz., the smooth oval body, triangular front, and rounded post-ocular lobes of the head (compare *Diplacodes*, *Hemicordulia*, *Cordulephya*); and to this general type, *Nannophlebia* belongs.

Reviewing the above evidence, I am inclined to conclude as follows:—

Group i. of the *Libellulinae*, as proposed by Dr. Ris, is justified as an archaic group, probably heterogeneous, but containing all those asthenogenetic remnants that still exist, of the earliest offshoots in a *Libelluline* direction from the parent (*Corduline*) stem.

We have now to face a further and most interesting problem, which may be stated as follows. Both the *Libellulinae* and the *Cordulinae* possess archaic forms which appear to be fairly closely allied; e.g., Group i. of the *Libellulinae*, *Cordulephya* in the *Cordulinae*. How far is this resemblance due to real affinity; how far is it due to asthenogenetic convergence? The answer to this contains within it the solution of the vexed problem of the genesis of the *Libelluline* anal loop. If we can prove that *Nannophlebia* and *Cordulephya*, for instance, are really close allies, and not merely alike by convergence, we have a strong ground from which

to argue that the present-day broad hindwing and specialised anal loop of the *Libellulinae* was developed secondarily from a wing in which the original broad *Anisopterous* hindwing had been reduced to approximately equal width with the forewing. If not, we should rather accept a theory of the development of all the present-day loops from a broad-winged but very generalised archaic type, to which *Chlorogomphus* may hold the clue, and regard all the narrow-winged forms, even if proved archaic, to be the result of asthenogenetic convergence. The former theory is strongly held by Dr. Ris, whose opinion, as without doubt that of the most accomplished Odonatologist of the present day, cannot be lightly put aside. To me, however, the latter seems to be by far the more probable.

Let us first of all, therefore, compare both larval and imaginal forms of *Nannophlebia* and *Cordulephya**:—

A. Larvæ:—

(1) *The labia*.—These are very distinct, *Cordulephya* showing high specialisation in several points. Compare *a*, the long narrow gulf-like incisions of the upper part of the inner margin of the lateral lobe in *Cordulephya*, with the normal crenations of *Nannophlebia*; *b*, the much longer end-hook in *Cordulephya*; *c*, the more numerous and more strongly developed setæ, both lateral and mental, in *Cordulephya*; *d*, the larger number of spines (3-4), on the lower (normal) crenations of *Cordulephya*; *e*, the finely speckled or spotted surface of the lateral lobes in *Cordulephya*, with the few but larger and more conspicuous black spots on *Nannophlebia*. One cannot but conclude that *Nannophlebia* is really more closely allied, in its labium, to the main *Eucordulian* stock, than it is to the distinctly aberrant *Cordulephya*.

(2) *The antennæ*.—Though both are seven-jointed, those of *Nannophlebia* are very much shorter than those of *Cordulephya*.

(3) *The legs*.—Those of *Cordulephya* are very much the longer.

(4) *The abdomen*.—In *Cordulephya*, segment 10 is fully recessed into 9; while in *Nannophlebia*, it is normal in position. [The ar-

* For characters of *Cordulephya*, see Plates xi. and xii., pp.421-2, These Proceedings, Vol. xxxvi., Part 2, 1911.

rangements of dorsal and lateral spines show nothing in common; but I do not regard these as beyond specific value.]

B. Imagines:—

(1) *Colour-scheme*.—Somewhat similar in broad outline; very distinct in detail.

(2) *General build and habits*.—These show considerable similarity, but cannot be held to indicate affinity, as the results of asthenogenetic convergence must necessarily tend to a general resemblance in form and habits.

(3) *Wing-venation*.—Beyond the fact that both are of the narrow-winged type, there is very little similarity in detail. Contrast *a*, the *Corduline* angulated hind-wing of *Cordulephya* ♂ with the rounded *Libelluline* hind-wing of *Nannophlebia* ♂; *b*, the difference in position of second antenodal compared with arculus; *c*, the number of antenodals; *d*, the points of origin and amounts of fusion of the sectors of the arculus; *e*, the positions of the cubital cross-veins; *f*, the points of origin of the superior sector of the triangle; *g*, the position of the hind-wing triangle (compare also *Cordulephya* with *Tetrathemis* or *Hypothemis*, which are closer to it in this character); *h*, the anal loops (*Cordulephya* reduced to two strongly marked large cells in *C. pygmaea*)

If these two wing-forms were really close approximations to an archaic wing-type, I do not think we could expect so much diversity of detail. Assuming, however, that the narrowing of the wing is due to asthenogenesis, the marvel would be, not that they are so close as they are, but that elimination and reduction should fail to produce something even closer (consider, for example, the long but excessively similar set of reduction-forms in the *Agrio-nidae*).

(4) *Tibial keel*.—A recognised *Corduline* character. Present in *Cordulephya*; no sign of it in *Nannophlebia*.

The main weight of the above evidence seems to me, however much one may regret the fact, to be strongly against the assumption of a close relationship between *Nannophlebia* and *Cordulephya*. It points rather to the fact that the ancestral *Libellulinae*

branched off from the *Corduliinæ* much further back than we are inclined to suspect, and that, in the resemblance between Group i. of the *Libellulinæ* and such forms as *Cordulephya*, we have only a *partial* solution of the problem. These two are *nearer by asthenogenetic convergence* at the present day *than their ancestors probably were before asthenogenesis began to act upon them*. Nevertheless, those ancestors did possess archaic characters common to the original stock, and it was their failure to improve on the weak points of their venational structure, that caused them to drop behind in the race of progress. The main body of these ancestral forms has long ago perished, but there remain to-day those few "end-twigs" of the old stem, which have survived by adopting asthenogenesis. This line of development must, of necessity, produce forms that are true convergences, in the sense that they now appear more closely related than they would, if we knew their past history in full.

To deal, finally, with the problem of the *Libelluline* anal-loop, we have to state one very strong objection to the theory of its re-development from a narrowed-down type of hind-wing. It is this: those who support this theory will scarcely admit the possibility of the re-formation of the unstressed four-sided "triangle" from a more highly-developed three-sided structure. They say, that, when once so useful a form as the latter had become developed, no species could possibly have gone back to the ancestral form, or it must have perished. But they ask us to believe a far harder thing; *viz.*, that a race with a broad hind-wing, whose anal area was built up roughly on lines similar to *Petalura*, could not only lose this structure (whose *uselessness* they surely would not attempt to prove, in the face of the survival of the *Aeschnine* and *Macromian* loops), but also that, having lost it, they redeveloped a new type of loop afresh. Surely this theory is only supported because of the apparent necessity of insisting on the archaic value of the narrow-winged types. This *Libelluline* loop (like all other loops, but not necessarily on the same plan) developed from the original fairly broad hindwing of the *Anisopterid* stock, which contained *all the material* (in the form of numerous small cells) for the for-

mation of *any* suitable bracing or strengthening of the wing-area, either on *Aeschnine* or *Libelluline* lines.

I do not contend that it is necessary to assume even that the present-day "quadrilaterals" in the *Libellulidæ*, ever possessed ancestors with a *fully-formed* three-sided triangle. I think, rather, that their ancestors were the laggards in this race for the perfect triangle, and that they attained only a certain measure of success in that direction, without gaining a position of equilibrium. Needham has shown (without emphasising the point) by his excellent diagrams of the gradual formation of the triangle, what an enormous stress must be thrown on to those originally weak cross-veins, which are finally called upon to play the part of strong sides to the triangle. Anything less than complete success, in this difficult piece of evolution, must surely have stood self-condemned, and either exists still as an unstable form (e.g., *Synthemis*) or embarked on the backward path of asthenogenesis, in which, since the aim is no longer to produce the ideal flying wing, the reduction back to the weaker form would rapidly proceed.

The argument for the Single-Development Theory of the Anal Loops may be briefly put as follows:—All present-day hind-wings of the *Anisoptera* were developed from an original *anisopterous* type, which had a hind-wing broad enough to contain all the cell-material necessary for present-day developments. By various arrangements of the basal cells and the anal and cubital branch-veins traversing them, *all* the present-day loops (and probably other kinds now lost) were developed. Thus arose, with varying degrees of final success, the *Gomphine*, *Petalurine*, *Chlorogomphine*, *Aeschnine*, *Macromian*, and *Libelluline* loops, in all their forms and variations. Of these, the most recent and most successful is the *Libelluline* loop, whose origin may probably be sought near to the point from which *Chlorogomphus* sprang, and from which that genus appears to have diverged but little.

Besides these *menogenetic* types, at various points along the evolutionary route, unsuccessful competitors gave up the race, and adopted, as a means for their preservation, the process of *asthenogenesis*, so successfully carried out long before by the main

army of *Zygoptera*. The effect of reduction of the wing-venation has been to produce a *superficial* convergence in all these forms, mainly by the return of the triangle to quadrilateral form (though not necessarily from an actual three-sided triangle, which was probably never formed with stability), and by the reduction of the anal area of the hind-wing to a comparatively few cells, *whose arrangement is then bound to show some similarity in all these forms*. But *they all retain clear indications of the stock from which they branched, e.g., Hypothemis, Tetrathemis, and Nannophlebia* are essentially *Libellulinae*, *Cordulephya* essentially *Corduline*, *Agriogomphus* essentially *Gomphine*. These forms, while based upon ancestral characters that are truly archaic compared with those of the more successful menogenetic forms *most closely allied to them, but not necessarily archaic in comparison with other menogenetic forms not closely allied (e.g., Chlorogomphus)*, are usually quite highly specialised in some other directions, *e.g., in flight, larval development, tibial armature, etc.*

If this theory be correct, we are still a long way off from discovering the point of origin of the *Libelluline* from the *Corduline* stock. We must, perhaps, confess that this is lost in antiquity. Nevertheless, we may still hope for light on this problem from the discovery of the larva of *Chlorogomphus*, which may very possibly show characters common to both of the groups in question.

One other point is worthy of mention. In the development of his theory of the classification of the *Libellulinae*, Dr. Ris places together in Group ii. the narrow-winged forms, *Agrionoptera* and *Lathrecista*, with the normal-winged *Orthetrum*. We want, therefore, the larva of one of these narrow-winged genera. If it turns out to be similar to *Orthetrum* (a very distinct type), it will vindicate his classification. If, however, it does not, it will be a serious blow to the evolutionary view expressed for Group ii., and will, I take it, require a reconsideration of the Double-Origin Theory of the *Anisopterid* anal loops. In my view, forms like *Agrionoptera* are not, in any sense, ancestral to *Orthetrum*, but are an asthenogenetic development on a line of their own, converging towards *Orthetrum* (if one may say so, though the convergence has not

gone far) by elimination or alteration of characters originally essentially different.

In conclusion, then, the discovery of the nymph of *Nannophlebia* leaves these problems in a most interesting state; for while the new light thrown by it is not to be despised, yet it is not sufficient to solve the problem satisfactorily.

EXPLANATION OF PLATE LXXIV.

- Fig.1.—Exuviae of *Nannophlebia risi*, n.sp., ♀ ($\times 4.5$).
Fig.2.—Exuviae of *Nannophlebia risi*, side view of abdomen ($\times 4.5$).
Fig.3.—Exuviae of *Nannophlebia risi*, labium, left side ($\times 30$).
Fig.4.—*Nannophlebia risi*, n.sp., imago, basal half of wings of male (yellow shading omitted) ($\times 4.5$); *m*, obsolescent membranule.
Fig.5.—*Nannophlebia risi*, n.sp., imago, ♂, colour-pattern of abdomen ($\times 4.5$).
Fig.6.—*Nannophlebia eludens* Tillyard, ♂, colour-pattern of abdomen ($\times 4.5$).
Fig.7.—*Nannophlebia risi*, n.sp., ♂, colour-pattern of side of meso- and metathorax ($\times 4.5$).
Fig.8.—*Nannophlebia eludens* Tillyard, ♂, colour-pattern of side of meso- and metathorax ($\times 4.5$).
Fig.9.—*Nannophlebia risi*, n.sp., ♂, appendages, lateral view.
Fig.10.—*Nannophlebia risi*, n.sp., ♂, appendages, dorsal view.
Fig.11.—*Nannophlebia eludens* Tillyard, ♂, appendages, lateral view.
Fig.12.—*Nannophlebia eludens* Tillyard, ♂, appendages, dorsal view.
Fig.13.—*Nannophlebia risi*, n.sp., ♀, appendages, right side, dorsal view.
Fig.14.—*Nannophlebia eludens* Tillyard, ♂, genitalia of segment 2, lateral view, ventral side uppermost.
Fig.15.—*Nannophlebia risi*, n.sp., ♂, genitalia of segment 2, lateral view, ventral side uppermost.



Tillyard, R. J. 1913. "Description and life-history of a new species of *Nannophlebia*." *Proceedings of the Linnean Society of New South Wales* 37, 712–726. <https://doi.org/10.5962/bhl.part.22371>.

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