

# A REVISION OF THE NEW WORLD GENUS *NEURAESCHNA* HAGEN, 1867 (ODONATA: AESHNIDAE)

by

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## ABSTRACT

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A synopsis is given of the twelve representatives of the genus *Neuraeschna* Hagen. The species are classified into groups. Separate keys to the males and females are constructed. *N. inarmata* is synonymized with *N. dentigera* Martin, and *N. rostrifera* Martin is considered to be a synonym of *Heliaeschna simplicia* (Karsch), a species confined to SE Asia. Five new taxa are described and illustrated, viz. *N. cornuta* (male holotype: Suriname, Distr. Nickerie, Sipaliwini), *N. maya* (male holotype: Costa Rica, Prov. Limón, Barra de Tortuguero), *N. mayoruna* (female holotype: Peru, Dept. Loreto, Iquitos), *N. maxima* (male holotype: Brazil, State of Pará, Belem), and *N. titania* (male holotype: Ecuador, Prov. of Pichincha, Jaruqui). Lectotypes are designated for three species described by Martin, viz. *N. claviforcipata*, *N. dentigera* and *N. harpya*. The larva type of *Neuraeschna* is determined by a reared individual of *N. harpya*.

Key words. – South and Central America; *Neuraeschna*; new species.

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## INTRODUCTION

The New World genus *Neuraeschna* Hagen, 1867 includes at least twelve species of small to very large Aeshnidae which are instantly recognizable in the venation of the wing by the presence of cross-veins in the midbasal space and in having the subcosta prolonged through and beyond the nodus.

The species of *Neuraeschna* are mainly Neotropical in distribution but one specimen is here recorded from the subtropical region of Brazil. They haunt in woodlands. Their breeding places seem mainly to be swampy areas but the only larva of *Neuraeschna* was taken in a bush creek. At sunset the adults suddenly appear, sometimes in troupes, to hunt in the dusk along the edges of the woods and along the river banks near over bush and water plants. Due to this crepuscular habit and the fact that their flight is very erratic and rather swift, these dragonflies are rarely collected. As soon as the darkness falls more intensively, they disappear again.

Davies and Tobin (1985) listed nine species of *Neuraeschna* but two species should be discarded since *Neuraeschna rostrifera* Martin proves to fall beyond the limits of the genus while *Neuraeschna*

*inarmata* Kimmins is found to be a junior synonym of *Neuraeschna dentigera* Martin. Here five more taxa of *Neuraeschna* are introduced under the names *N. cornuta*, *N. maya*, *N. mayoruna*, *N. maxima* and *N. titania* bringing the total number of *Neuraeschna* species to twelve.

Lectotypes are designated for the three Martin species *Neuraeschna claviforcipata*, *N. dentigera* and *N. harpya*. These three species are redescribed in common with the type-species *N. costalis* (Burmeister). The hitherto unknown larva-type of *Neuraeschna* could be determined by a reared individual of *N. harpya*.

An attempt is undertaken to divide the genus *Neuraeschna* into species-groups. Separate keys for the males and females have been prepared. Unless otherwise indicated, the illustrations are camera lucida drawings made by me (details completed by free-hand). The photographs have been made by the museum photographers of the Rijksmuseum van Natuurlijke Historie, Leiden, and the British Museum (Natural History), London. The reproductions of these photographs are at three-quarters of the full size of the dragonflies. The Comstock-Needham terminology of the wing-veins is used.

#### DISPOSITION OF MATERIAL STUDIED AND ACKNOWLEDGEMENTS

The material on which the present review is based, belongs to the institutions and personal collections listed below; the names are preceded by the acronyms used throughout the text of this paper; they are followed by the names of the persons who made this material accessible for this study. These persons are most gratefully acknowledged here.

- ANSP - Academy of Natural Sciences, Philadelphia; Mr. Donald Azuma.  
 BMNH - British Museum (Natural History), London; Mr. D. E. Kimmins (†) and Mr. Stephen J. Brooks.  
 CG - Collection Garrison, Azusa; Dr. Rosser W. Garrison.  
 CH - Collection Hellebuyck, Sherbrooke; Mr. Victor Hellebuyck.  
 CM - Collection Machado, Belo Horizonte; Prof. Dr. Angelo B. M. Machado.  
 FSCA - Florida State Collection of Arthropods, Gainesville; Prof. Dr. Minter J. Westfall, Jr.  
 IRSN - Institut Royal des Sciences Naturelles, Brussels; Dr. Georges Demoulin and Dr. P. Grootaert.  
 MNHP - Muséum National d'Histoire Naturelle, Paris; Dr. Jean Legrand.  
 NHMV - Naturhistorisches Museum, Vienna; Dr. A. Kaltenbach.

- RNHL - Rijksmuseum van Natuurlijke Historie, Leiden; Mr. J. van Tol.  
 UCV - Instituto de Zoología Agrícola, Universidad Central de Venezuela, Maracay; Mr. Jorge de Marmels.  
 UMAA - University of Michigan, Ann Arbor; Mrs. L. K. Gloyd.  
 USNM - National Museum of Natural History, Smithsonian Institution, Washington, D. C.; Dr. Oliver S. Flint, Jr.  
 ZMHB - Zoologisches Museum, Humboldt Universität, East Berlin; Dr. Kurt K. Günther.

#### SYSTEMATIC SECTION

The name *Neuraeschna* was proposed by Selys but the genus was firstly characterized by Hagen (1867: 54) and therefore it must be credited to Hagen. Hagen compared *Neuraeschna* with its closest relative *Staurophebia* Brauer which has also the subcosta prolonged through and beyond the nodus but the midbasal space of *Staurophebia* is free from cross-veins.

In addition to the characteristics given *antea* in the introduction, the species of *Neuraeschna* are characterized by the following features:

Head. Superior surface of frons generally dark brown in anterior part and pale brown in basal part but one species has a well-marked brown T-spot. Rear of head light brown with a narrow black stripe bordering posterior margin of eyes from occipital triangle to lateral emargination in eye border.

Pterothorax. Predominantly brown with pale markings as follows: On each lateral side of dorsum a pale antehumeral marking representing a more or less ovoid spot prolonged below in a narrow point at lateral end of transverse mesepisternal ridge or representing a more or less stripe-shaped marking which tapers below and which generally abruptly widens at upper edge. Lateral sides of pterothorax with two complete pale stripes parallel to the sutures and more or less of even breadth throughout, one pale stripe on the mesepimeron and the other on the metepimeron. Posterior to these pale stripes the two sclerites are often blackish brown to black. Metepisternum with a more or less subtriangular pale dorsal spot, and there is a small pale spot close above the spiracle.

Wings. Contrary to *Staurophebia* the costal and subcostal interspaces possess accessory cross-veins proximal to the first primary antenodal. Some species, however, lack the basal costal cross-veins and have only basal subcostal cross-veins. A marked brown costal stripe is often present, especially in the larger species. Membranule well-developed and pale dirty white. Male anal triangle in hind

wing three-celled but there is sometimes an interpolated cell.

Abdomen of male. Swollen at base and constricted on segment 3, then, in dorsal view, gradually widening to rear of segment 8, 9 or 10. Dorsum of segment 9 raised convex and generally denticulated in basal half, depressed concave and not denticulated on apical half. Accessory genitalia of similar type to those of *Staurophlebia*. Base of inferior anal appendage with a dorsal prolongation that is notably bulbous in the larger species (fig. 34).

Abdomen of female. Also swollen at base but in general moderately constricted on segment 3, then, in dorsal view, almost parallel-sided or gradually narrowing to segment seven. Ventral process on tenth segment two-pronged and usually with subsidiary teeth at anterior side of base of fork, the subsidiary teeth often discernible in a caudal view of the fork.

The larva of *Neuraeschna* is easily distinguished from that of *Staurophlebia* by the marked protruding eyes, by the lack of knobs on head and thorax, and by the lack of a comb-like external prominence on either mandible.

**Treatment of the species**

There are excellent characters available in the structure of the male anal appendages for separating species of *Neuraeschna*. The accessory genitalia are conversely of little importance since they show no or hardly differences in closely allied species. The tenth sternite of the female abdomen exhibits characters which can be used sometimes for the determination of species. The features of the thoracic colour pattern are kept off in the keys because this pattern often disappear completely or almost

completely through post mortem discoloration and this applies especially to the females. Table 1 is an alphabetic list of all valid taxa. The genus *Neuraeschna* is provisionally divided into six species groups which show some overlapping.

Within each group the species are treated chronologically. For each species is given a list of the main references, the new material and a description or descriptive notes.

**KEY TO THE MALES OF NEURAESCHNA**

(The male of *N. mayoruna* is unknown)

1. Superior surface of frons with a well-marked brown T-spot (fig. 14) (*N. harpya* group) . . . . . *N. harpya*
  - Superior surface of frons without well-marked brown T-spot but largely or anteriorly dark brown shading to pale light brown at base . . . . . 2
2. Small species. Hind wing < 54 mm . . . . . 3
  - Large species. Hind wing > 54 mm . . . . . 6
3. Superior appendages with a stout, submedian, dentiform dorsal process. Inferior appendage about three-fourths the length of superiors (*N. dentigera* group) . . . . . 4
  - Superior appendages without such a dorsal process. Inferior appendage half as long as superiors (*N. claviforcipata* group) . . . . . *N. claviforcipata*
4. Dentiform process of superior appendage very large, its base about one-third the length of appendage. Inferior appendage in profile view nearly straight for its proximal two-thirds, than curved slightly dorsad and again straight in its distal third (fig. 53, 54) . . . . . *N. mina*
  - Dentiform process much smaller. Inferior appendage in profile view bent throughout its whole length . . . . . 5

Table 1. - Alphabetic list of names of the species of *Neuraeschna*, with type locality, type status and type location.

Species	Type locality	Type			
		holo	lecto	sex	location
1. <i>calverti</i> Kimmins, 1951	Peru (eastern)	X		♂	BMNH
2. <i>claviforcipata</i> Martin, 1909	"Amazon region"		X	♂	IRSN
3. <i>cornuta</i> spec. nov.	Sipaliwini, Surinam	X		♂	RNHL
4. <i>costalis</i> (Burmeister, 1839)	Bahia, Brazil	X		♀	NHNV
5. <i>dentigera</i> Martin, 1909	Turuty, Brazil		X	♂	IRSN
6. <i>harpya</i> Martin, 1909	"Amazon region"		X	♂	IRSN
7. <i>maya</i> spec. nov.	Barra de Tortuguero, Costa Rica	X		♂	FSCA
8. <i>mayoruna</i> spec. nov.	Iquitos, Peru	X		♀	UMAA
9. <i>maxima</i> spec. nov.	Belem, Brazil	X		♂	RNHL
10. <i>mina</i> Williamson & Williamson, 1930	Porto Velho, Brazil	X		♂	UMAA
11. <i>producta</i> Kimmins, 1933	Iquitos, Peru	X		♂	BMNH
12. <i>titania</i> spec. nov.	Jaruqui, Ecuador	X		♂	BMNH

5. Superior appendages with a truncated apex. Dorsum of base of inferior appendage inflated and discernible in dorsal view of abdomen (fig. 41) ..... *N. dentigera*
  - Apex of superior appendages tapering off to a point. Dorsum of base of inferior appendage not inflated (fig. 55) ..... *N. cornuta*
6. Superior appendages more or less flattened and widened; in dorsal view the outer margin of each appendage almost straight (*N. costalis* group) ..... 7
  - Superior appendages long, slender and forcipate; in dorsal view the outer margin of each appendage strongly convex from base to apex (fig. 57) (*N. maxima* group) .... *N. maxima*
7. Superior appendage in profile view with the upper edge of the raised apical portion produced in a long robust point (figs. 36, 43) ...
  - ..... *N. costalis*
  - Superior appendage in profile view with the raised apical portion appearing more or less as a rhomboidal projection with round angles ..... 8
8. First angulation of inner margin of superior appendage with a peg-like or spine-like projection (figs. 45-47) ..... *N. calverti*
  - First angulation of inner margin of superior appendage rounded and smooth ..... 9
9. Dorsal prolongation of base of inferior appendage in profile view not projecting above superior appendage. Superior appendage with outer apical margin angled and sometimes bearing a distinct point ..... 10
  - Dorsal prolongation of base of inferior appendage in profile view projecting above superior appendage. Superior appendage with outer apical margin broadly rounded (figs. 48, 49) ...
    - ..... *N. producta*
10. Outer apical angle of superior appendage bearing a small but distinct laterally directed sharp point (fig. 51). Wings with well-developed brown costal stripes, the brown colour of the stripes extending over interspace behind R1, between arculus and subnodus. Costal edge of pterostigma in fore wing 5.5-5.8 mm, in hind wing 4.1-4.5 mm ..... *N. titania*
  - Outer apical angle of superior appendage without sharp point, at the most with a small tubercle at inferior margin. Wings without or with rather weakly developed brown costal stripes, the brown colour of the stripes not extending over interspace behind R1, between arculus and subnodus. Costal edge of pterostigma in fore wing 4.2-5.0 mm, in hind wing 3.2-4.0 mm ..... *N. maya*

## KEY TO THE FEMALES OF NEURAESCHNA

(The females of *N. cornuta* and *N. mina* are unknown)

1. Superior surface of frons with a well-marked brown T-spot (fig. 14). Hind wing 55-60 mm (*N. harpya* group) ..... *N. harpya*
  - Superior surface of frons without well-marked brown T-spot but anteriorly pale or brown shading to light brown at base ..... 2
2. Small species. Hind wing < 54 mm ..... 3
  - Larger species. Hind wing > 54 mm ..... 4
3. Wings with diffuse brown basal patches which in antenodal interspaces are sometimes extended nearly to second primary antenodal. Hind wing 50-51 mm; width of hind wing at nodus 14 mm. Costal edge of pterostigma in fore wing 4.0-4.5 mm (*N. claviforcipata* group) ..... *N. claviforcipata*
  - Wings without basal spots. Hind wing 46-48 mm; width of hind wing at nodus 13 mm. Costal edge of pterostigma in fore wing 3.5-4.0 mm (*N. dentigera* group) ..... *N. dentigera*
4. No basal costal cross-vein, only basal subcostal cross-veins present. Fork of tenth sternite in profile view distinctly rising before the line of posterior margin of sternite (fig. 22). Hind wing 61 mm; width of hind wing at nodus 17.5 mm. Costal edge of pterostigma in fore wing 4.5 mm (*N. mayoruna* group) .....
  - ..... *N. mayoruna*
  - Basal costal and subcostal cross-veins present. Fork of tenth sternite in profile view not or not notably rising before the line of posterior margin of sternite ..... 5
5. Abdomen swollen on segments 1 and 2, then strongly constricted on segment 3; in dorsal (or ventral) view the abdomen is three times as wide at segment 2 as it is in the middle of segment 3 (fig. 59). Hind wing 70 mm; width of hind wing at nodus 19 mm. Costal edge of pterostigma in fore wing 6 mm (*N. maxima* group) ..... *N. maxima*
  - Abdomen also swollen on segments 1 and 2 but moderately or slightly constricted on segment 3 (*N. costalis* group) ..... 6
6. Superior surface of frons largely pale and with a weakly developed brown central spot (fig. 15). Hind wing 66 mm; width of hind wing at nodus 18.5 mm. Costal edge of pterostigma in fore wing 6.3 mm. Specimen from subtropical region of southern Brazil .... *N. spec. indet.*
  - Superior surface of frons with a brown anterior marking extending over the whole breadth of the frons ..... 7

- 7. Vertex brown. Hind wing 59 mm; width of hind wing at nodus 16.5 mm. Costal edge of pterostigma in fore wing 5 mm. Wings without or with weakly developed brown costal stripes ..... *N. calverti*  
 - Vertex black. Hind wing larger and broader 8
- 8. Fork of tenth sternite in profile view strongly angled caudad, the prongs notably slender and long, and curved at two-thirds length (figs. 18, 26). Hind wing 65 mm; width of hind wing at nodus 17-18.5 mm. Costal edge of pterostigma in fore wing 5.5-6 mm .....  
 ..... *N. producta*  
 - Fork of tenth sternite not or not so strongly curved caudad, the prongs not as in the preceding species ..... 9
- 9. Large species with relative short pterostigma. Hind wing 66-68 mm; width of hind wing at nodus 18-19.5 mm. Costal edge of pterostigma in fore wing 4.9-5.4 mm (= 7.7%-8.1% of fore wing length). Central American species ..... *N. maya*  
 - Pterostigma relatively longer, that of fore wing 9%-10% of fore wing length ..... 10
- 10. Large species with well-developed brown costal stripes, the brown colour of the costal stripe extending over adjoining interspace behind R1, between arculus and subnodus (figs. 72, 73). Tenth sternite robust, the fork in profile view generally continuing the line of posterior margin of sternite (figs. 20, 28). Hind wing 63-68 mm; width of hind wing at nodus 18-19.5 mm. Costal edge of pterostigma in fore wing 5.5-6 mm ..... *N. titania*  
 - Somewhat smaller species. The brown costal stripes generally not so well-developed as in the preceding species. Tenth sternite less robust, the fork in profile view generally angled caudad (figs. 17, 24). Hind wing 59-64 mm; width of hind wing at nodus 17-18 mm. Costal edge of pterostigma in fore wing 5-6.3 mm ..... *N. costalis*

THE *N. DENTIGERA* GROUP

In this group I place *N. dentigera*, *N. mina* and *N. cornuta* which are bound together by the following characters: (1) small species (hind wing < 54 mm); (2) no basal costal cross-veins but at least one basal subcostal cross-vein present; (3) Superior surface of frons without well-marked brown T-spot; (4) pale antehumeral marking stripe-shaped with pointed lower end and generally widened upper end; (5) male superior appendage blade-shaped and provided with a stout dentiform process at or slightly before mid-length.

Species of the *N. dentigera* group: *N. dentigera* Martin, *N. mina* Williamson & Williamson and *N. cornuta* spec. nov.

**Neuraeschna dentigera** Martin, 1909  
 (figs. 1, 41, 42, 64)

*Neuraeschna dentigera* Martin, 1909: 207, 208, fig. 213 (♂ app.) - ♂♀ Surinam; Williamson & Williamson 1930: 15 (♂, ♀ Guyana); Kimmins 1951: 48.  
*Neuraeschna inarmata* Kimmins, 1951: 46-48, figs. 8, 9 (♂ app.) - ♂ New River, Guyana. **Syn. nov.**

Material. - Brazil: state of Para; Rio Xingu Camp, ca. 60 km S. of Altamira (52° 22' W., 3° 39' S.), 8 October 1986, 1 ♀ (Igarape, mist nets at dusk); 9 October 1986, 1 ♀ (1st jungle stream, trail 1); 9 October 1986, 1 ♀ (mist net at dusk), all P. Spangler & O. Flint, USNM. - Guyana: Essequibo River, Rockstone, 1 February 1912, 1 ♂, 1 ♀, L. A. & E. B. Williamson & B. J. Rainey, UMAA. - Peru: Dept. Loreto, Prov. Maynas, Iquitos, 8 July 1931, 1 ♂ (teneral), from Paul Nagel, FSCA.

Lectotype designation of *Neuraeschna dentigera* Martin, 1909. - According to Martin (1909) the original series of *Neuraeschna dentigera* is in the Selysian collection and consists of two males and two females from "Surinam". However, I found three males and one female while, from the pin labels, these specimens appeared to be secured in Turuty at the Amazon River by Bates. The chosen lectotype is the male which has served for fig. 213 in Martin's monograph of 1909. This male is distinguished from the other two of the original series by the somewhat more strongly curved inferior appendage. The pin labels are "31", "Turuty", "*Neuraeschna dentigera* Bates ♂ Turuty" (in Selys' hand; the words "modesta Selys" deleted and changed into "dentigera Bates"), "Collection Selys Type *Neuraeschna dentigera* Bates Revision Martin 190 *Neuraeschna dentigera* Martin" (text partly printed) and "Type *Neuraeschna dentigera* Martin" (the word "Type" printed in red). I have added the yellow pin label "LECTOTYPE Rev. J. Belle, 1988".

The lectotype is in fairly good condition but the tips of the right pair of wings are broken off distal to the pterostigmata.

At the end of the description of *Neuraeschna inarmata*, Kimmins (1951) stated that his species is closely related to *Neuraeschna dentigera* Martin but readily separable from it by the form of the male superior anal appendage "unless his (= Martin's) figure is very inaccurate". Because fig. 213 in Martin's monograph shows the superior anal appendage with a second tooth-like projection on the

inner margin of each appendage in contrast to Kimmin's male which has not such an extra (second) tooth.

On 19 April 1961 I visited the Brussels Museum in order to check fig. 213 in Martin's monograph. The depiction proved to be very inaccurate, indeed. In stead of a second tooth-like projection there was a broad rounded lobe. Also the inferior appendage appeared not so strongly curved as depicted. At my visit of the British Museum (Natural History) on 20 June 1961 I was able to compare the males of *Neuraeschna dentigera* from the Selysian collection with the holotype male of *Neuraeschna inarmata*. No character was found that would justify a specific distinctness of the two species. Thus we consider *Neuraeschna inarmata* Kimmins a junior synonym of *Neuraeschna dentigera* Martin.

Male. - Total length 64-69 mm; abdomen 49-53 mm (incl. app. 5.0-5.2 mm); hind wing 43-46 mm; costal edge of pterostigma in fore wing 3.9-4.0 mm, in hind wing 2.9-3.0 mm.

Head. Face orange-brown, the anteclypeus with greyish tinge. Superior surface of frons dark brown anteriorly, fading to pale light brown basally. Vertex dark brown. Antennae light brown. Occipital triangle brown. Upper part of rear of head black.

Pterothorax: Dark brown with pale (= green) stripes. Pale antehumeral markings stripe-shaped, the upper part widened mesad, the lower third tapering to lateral end of transverse mesepisternal ridge (fig. 1). Pale mesepimeral and metepimeral stripes about equal in width. A small pale dorsal spot on metepisternum. Wing articulations with pale spots.

Legs. Reddish brown but dark brown at knees.

Wings. Clear, in old specimens faintly brown tinged. Pterostigma light brown. Membranule dirty white, that of hind wing extending along posterior wing margin to a point about two-fifths the way along first paranal cell. Antenodals in fore wing 23-28, in hind wing 19-21.

Abdomen. Dark brown but segment 2 with green middorsal stripe. In dorsal view constricted on segment 3, then gradually wider on segments 4 to 9 with the segments 6 to 9 becoming more depressed successively. Upper surface of segment 10 flat and elevated at apex. Appendages dark brown and shaped as shown in figs. 41 and 42.

Female. - Total length 65-67 mm (excl. app.); abdomen 50-54 mm (excl. app.); hind wing 46-48 mm; width of hind wing at nodus 12.5-13.5 mm; costal edge of pterostigma in fore wing 4.0-5.0 mm, in hind wing 2.7-3.0 mm.

Similar to male regarding stature and general

coloration but dark brown colour of pterostigma less dark and abdominal segment 2 not constricted. Antenodals in fore wing 23-30, in hind wing 19-22. Fork of tenth sternite in profile view continuing the line of posterior margin of sternite. Anterior surface of sternite at base of fork with two or three small subsidiary teeth on either side.

Save the deviations in the curving of the inferior appendage the males also differ in the development of the tooth-like projection and the conformation of the apical portions of the superior appendages. These have or have not a small acute tooth on the outer apical end.

*Neuraeschna mina* Williamson & Williamson,  
1930  
(fig. 53, 54)

*Neuraeschna mina* Williamson & Williamson, 1930:  
9-15, figs. 1, 2 (♂ app.) - ♂, Brazil (Território de Rondônia).

*Neuraeschna cornuta* spec. nov.  
(figs. 2, 55, 56)

Material. - Holotype: Suriname: Distr. Nickerie, Sipaliwini (at a small creek along a patch to the airstrip), 14 February 1961, 1 ♂, D. C. Geijskes, RNHL.

Male (holotype; a pinned specimen in perfect condition). - Total length 67 mm; abdomen 51.5 mm (incl. app. 4.9 mm); hind wing 44 mm; costal edge of pterostigma in fore wing 3.3 mm, in hind wing 2.5 mm.

Head. Face light brown but upper half of vertical part of frons dark brown. Superior surface of frons dark brown on anterior half with convex posterior margin (no T-spot), the basal half pale light brown. Antennae light brown. Vertex black. Occipital triangle dark brown.

Pterothorax. Dark brown with pale (= green) markings. Antehumeral markings stripe-shaped, the lower end tapering and directed to lateral edge of anterior mesepisternal ridge, the upper end slightly widened mesad but much widened laterad (fig. 2). Pale mesepimeral stripe rather narrow. Pale metepimeral stripe as wide as pale mesepimeral stripe at its upper end, becoming gradually narrower toward below.

Wings. With a faint brown tinge, the costal margins slightly darker. Pterostigma brown-yellow. Membranule reaching to a point about one-third the way along first paranal cell. Antenodals in fore wings 28-30, in hind wings 22-23.

Abdomen. Dark brown with pale (= yellow to

yellow-green) markings on segments 2 and 3. Segment 2 with a broad pale streak along ventral tergal margins and behind auricles; middorsum of segment with a pale stripe over whole length of segment, not connected with the pair of two short, transverse pale stripes at posterior border of segment. Segment 3 with large pale basal side spots extending along ventral tergal margin to halfway the segment, and with a pair of small, transversely elongated, dorsal posterior pale spots. Segment 3 constricted. Apical segments depressed. Anal appendages shaped as shown in figs. 55 and 56, the superiors being a trifle longer than segments 9 and 10 together.

#### THE *N. CLAVIFORCIPATA* GROUP

*N. claviforcipata* shows the features listed for the *N. dentigera* group except for point (6). In *N. claviforcipata* the dorsal dentiform process is replaced by a mere raised outer edge of the superior appendage on the basal half.

Species of the *N. claviforcipata* group: *N. claviforcipata* Martin.

#### *Neuraeschna claviforcipata* Martin, 1909 (figs. 3, 4, 16, 33, 39, 40, 65)

*Neuraeschna claviforcipata* Martin, 1909: 206, 207, fig. 212 (♂ app.) – ♂ ♀ Amazon region; Williamson & Williamson 1930: 15 (♂ Brazil, State of Pará); Racenis 1970: 29 (♂ Venezuela); Geijskes 1971: 664 (♂ French Guiana).

Material. – Brazil: State of Amazonas, Rio Negro (at Manaus), 2 ♂, ex coll. Lacroix, MNHP; State of Pará, 1 ♂; State of Pará, June 1935, 1 ♂, G. V. Vredenburg, BMNH; State of Pará, Belem, 5 August 1922, 1 ♂ (teneral), J. H. Williamson, UMAA. – Ecuador: Prov. Napo, Río Napo, Limoncocha (300 m), 5 November 1980, 1 ♀ (teneral), M. J. Westfall, Jr. & David Robinson, FSCA. – Suriname: Distr. Marowijne, Tapanahoni River, Drietabette (in forest), 8 October 1952, 1 ♀, D. C. Geijskes, RNHL. – Venezuela: Est. Bolívar, Guayaraca-Auyantequi, 16 April 1956, 1 ♂, J. Racenis, UCV.

Lectotype designation of *Neuraeschna claviforcipata* Martin, 1909. – For this purpose the best preserved male of the original series of this species in the Selysian collection (IRSN) has been taken. The pin labels are "109", "Bates", "Neuraeschna claviforceps Bates ♂ Amazone" (in Selys' hand), "Collection Selys Type Neuraeschna claviforcipata Bates Revision Martin 190 Neuraeschna claviforcipata Martin" (text partly printed) and "Type Neuraeschna claviforcipata Martin" (the word "Type" printed in red). I have added the yellow pin label "LECTOTYPE Rev. J. Belle, 1988".

The wings of the lectotype are not perfect. The tip of the right fore wing is broken off proximal to the pterostigma while the hind border of the hind wings displays some damages.

Male. – Total length 70–75 mm; abdomen 56–58 mm (incl. app. 4.5–5.0 mm); hind wing 49–51 mm; costal edge of pterostigma in fore wing 3.2–4.0 mm, in hind wing 2.5–3.0 mm.

Head. Face light brown. Superior surface of frons dark brown anteriorly, fading to pale light brown basally. Antennae brown, the first antennal segment darker. Vertex black. Occipital triangle black.

Pterothorax. Dark brown with pale stripes. Antehumeral markings green to bluish-green, stripe-shaped, the upper part widened mesad, the lower third tapering to lateral end of transverse episternal ridge (figs. 3, 4). A moderately wide green stripe on mesepimeron and an equal one on metepimeron. A small green dorsal spot on metepisternum. Wing articulations green.

Legs. Red-brown, darker at knees and on tarsi and claws.

Wings. Clear, in aged individuals slightly brown tinged with faintly discernible brown costal stripes. Pterostigma light brown. Membranule of hind wing extending along posterior margin of wing to a point nearly halfway along first paranal cell. Antenodals in fore wing 27–36, in hind wing 19–25.

Abdomen. Long and slender. Segment 3 constricted. Segments 7 to 10 distinctly depressed. Dark brown with pale (= yellow to yellow-green) markings on segments 1 to 4. Segment 1 with two connected pale dorsolateral spots. Segment 2 pale behind auricles and along ventral tergal margins, with a fine pale middorsal stripe from base to a point three-fourths the way along segment, and with a submedian dorsal pair and a more posterior dorsal pair of transversely elongated pale spots. Dorsum of segment 3 with two small pale spots at transverse carinae and another pair of small pale spots at posterior margin. Dorsum of segment 4 with two small pale spots near posterior margin. Appendages dark brown, about as long as segments 9 and 10 together, shaped as shown in figs. 39 and 40.

Female. – Total length 67–69 mm (excl. app.); abdomen 51–54 mm (excl. app.); hind wing 50–51 mm; width of hind wing at nodus 14 mm; costal edge of pterostigma in fore wing 3.8–4.5 mm, in hind wing 2.8–3.1 mm.

Similar to male but abdominal segment 3 not constricted and end segments of abdomen not depressed. Wings clear with diffuse brown basal

patches which in antenodal interspaces are sometimes extended to second primary antenodal (fig. 65). Antenodals in fore wing 29–32, in hind wing 21–23. Fork of sternite of abdominal segment 10 shaped as shown in fig. 16.

The measurements here mentioned are those of fully mature specimens. They are smaller in the teneral specimens. The teneral male from Belem has the dimensions: total length 64 mm, abdomen 50 mm (incl. app. 4.5 mm) and hind wing 46 mm; those of the teneral female from Limoncocha are: total length 64 mm (excl. app.), abdomen 50 mm (excl. app. 5.5 mm) and hind wing 47 mm.

The teneral female from Limoncocha is the only female with intact anal appendages. Each appendage is slender and narrow on the basal third; the apical two-thirds portion is blade-shaped and has a rounded median keel on the upper surface (fig. 33). The fork of the tenth sternite has on its anterior surface a relatively large central supplementary tooth which is discernible in caudal view. There is not such a supplementary tooth in the other females.

The prongs of the fork of the tenth sternite are more divergent in the complete syntype female than in the other females. The fork of the other syntype female is broken away.

#### THE *N. COSTALIS* GROUP

The characters of this groupe are: (1) large species (hind wing > 54 mm); (2) basal costal and subcostal cross-veins present; (3) superior surface of frons without well-marked brown T-spot; (4) pale antehumeral marking more or less ovoid, the lower end pointed, the upper end sometimes slightly constricted; (5) male superior appendages blade-shaped without any kind of a dorsal process on basal half.

The members composing the *N. costalis* group: *N. costalis* (Burmeister), *N. producta* Kimmins, *N. calverti* Kimmins, *N. titania* spec. nov. and *N. maya* spec. nov.

#### *Neuraeschna costalis* (Burmeister, 1839) (figs. 5, 17, 24, 31, 34, 35, 36, 43, 66–68)

*Aeschna costalis* Burmeister, 1839: 837 – ♀ Brazil, State of Bahia.

*Gynacantha ferox* Erichson, 1848: 585 (♂ Guiana, holotype in ZMHB); Hagen 1867: 54.

*Neuraeschna costalis*; Hagen 1867: 55, 56; Selys 1883: 748 (40 sep.); Kirby 1890: 95; Martin 1909: 205, fig. 210 (♂ app.); Kimmins 1933: 226; Rácenis 1970: 29, 30 (♂ Venezuela); Geijskes 1971: 663 (♀ French Guiana); Davies & Tobin 1985: 15.

Material. – Brazil: State of Pará, Óbidos, 1 ♂, ANSP (ex coll. Calvert); Óbidos, March 1971, 1 ♂, B. Ferreira; Distrito Federal, Brasilia, May 1970, 1 ♀, Frits, CM. State of São Paulo, Rio Guaratuba (Varjão), 7 March 1969, 3 ♂, 1 ♀; 29–30 April 1969, 9 ♂, 5 ♀; 21 April, 2 ♂, 1 ♀; 23 April 1970 (at 6 p.m.), 1 ♀; 15 April 1971 (at 5.30 p.m.; riverbank), 1 ♂; 19 April 1971 (at 5.30 p.m.; riverbank), 2 ♂; 19 March 1972, 2 ♀, all E. Dente, CM but 2 ♂, 1 ♀ in RNHL. – Ecuador, Prov. Pastaza, Río Napo, Puyo-Oriente (elev. 1000 m), 29 November 1936 (at 5.30 p.m.), 1 ♂, W. Clark-Macintyre, UMAA. – Guyana: Mazaruni-Potario Dist.; Kartabo Point; Earthwatch Research Exped. 21 December 1983, 1 ♀, W. E. Steiner, USNM. – Suriname: Distr. Suriname, Paramaribo (Cultuurtuin), 9 November 1938, 1 ♀; Distr. Saramaca, Coesewijne River (at light), 25 October 1945, 1 ♀; Distr. Marowijne, between Moengotapoe and Wia Wia (trail 19, at swamp), October 1948, 2 ♂; Marowijne River (first island), 23 October 1948, 1 ♂, all D. C. Geijskes; Distr. Saramacca, Garnizoenspad (km 20, at 6.30 p.m.), 7 September 1955, 2 ♂; Distr. Suriname, Fernandesweg naar Zee, 9 September 1955, 1 ♂, 1 ♀; Para River (along road to Domburg, at 6.15 p.m.), 21 September 1955, 1 ♂, Rijsdijkweg, 4 March 1957, 1 ♂, Paramaribo (Zorg en Hoop), 19 August 1958, 1 ♀; 17 August 1959, 1 ♀, all J. Belle; Distr. Marowijne, Albina, August 1973, 1 ♂ (teneral); 28 September 1973, 1 ♀; Distr. Suriname, Zanderij, 13 September 1973, 1 ♀, all J. J. Belle, RNHL. Distr. Suriname, Paramaribo (Zorg en Hoop), 22 August 1958, 1 ♀; Zanderij (Weg naar Matta), 28 July 1963, 1 ♂; both J. Belle, ZMHB. – Venezuela: 1899, 1 ♂, F. Gray, MHN. Est. Amazonas, Simarawochi, 30 March 1973, 1 ♂, W. Perez (No. 13892). Est. Bolívar, Uruyen, 11 April 1956, 1 ♂, Foldat (No. JR-06637); El Bochinche, 5–8 December 1985, 1 ♀, L. D. Otero & A. Chacón, UCV.

Male. – Total length 82–91 mm; abdomen 62–71 mm (incl. app. 5.9–6.5 mm); hind wing 56–62 mm; costal edge of pterostigma in fore wing 5.0–5.8 mm, in hind wing 3.6–4.6 mm.

Head. Face yellow-brown to brown but anteclypeus with a tinge of green. Frons granulous. Superior surface of frons dark brown anteriorly, fading to pale light brown basally; the posterior margin of the dark brown marking straight or convex. Vertex dark brown to black. Antennae light brown. Occipital triangle dark brown and tufted with brown hairs. Eyes in freshly killed specimens dark green on upper half and yellow-green on lower half.

Pterothorax. Dark brown with pale markings. Antehumeral pale markings blue-green, ovoid, its antero-lateral corner prolonged in a narrowed point reaching to lateral end of transverse mesepisternal ridge (fig. 5). The two pale lateral stripes rather narrow and green, followed by a dark brown to black stripe. Wing articulations dark blue.

Legs. Red-brown, darker at knees.

Wings. Clear, the brown costal band variable, in some specimens developed only at base of wings,

in other specimens well-developed and extending over adjoining interspaces behind R1. In aged individuals the wings becoming dark brown tinged, often firstly in the middle from discoidal triangle to pterostigma. Venation dark brown. Pterostigma brownish yellow. Membranule dirty white, that of hind wing extending to a point halfway along first paranal cell. Antenodals in fore wing 31–36, in hind 23–26.

Abdomen: Dark brown. Constricted on segment 3, becoming gradually wider and more depressed on segments 4 to 10. Anal appendages shaped as shown in figs. 35 and 36.

Female. – Total length 81–85 mm (excl. app.); abdomen 61–64 mm (excl. app. 3.5–4.0 mm); hind wing 59–64 mm; width of hind wing at nodus 17–18 mm; costal edge of pterostigma in fore wing 5.0–6.2 mm, in hind wing 4.0–5.3 mm.

Coloration similar to male. Abdomen slightly constricted on segment 3, then in dorsal view almost parallel-sided on segments 4 to 7, slightly wider on segments 8 and 9. Fork of tenth sternite in profile view generally distinctly angled caudad (fig. 17) and with one to four subsidiary teeth on anterior basal side of fork. Anal appendages antenna-shaped and short, about as long as abdominal segment 9 (fig. 31). Antenodals in fore wing 30–37, in hind wing 23–27.

Intraspecific variation. – The specimens from Suriname are the smallest of the series, those from southern Brazil the largest.

The male anal appendages show some interesting morphological variations. In some males the raised apical portion of the superior appendage in profile view appears as a rhomboidal projection with an upper apical point but in other males more or less as a triangular projection (fig. 43). The male from Óbidos in the Machado collection has the upper apical points of the superiors notably converging; they are generally parallel or diverging. The inferior appendage shows variation in its curvature and in the degree of swollenness of its basal dorsal prolongation. The tip of the interior appendage reaches to a point between two-thirds and four-fifths of the way along the superiors as the base of the inferior may be more or less hidden between the superiors and the anal tubercles.

The thoracic colour pattern is variable and especially the pale antehumeral markings can considerably vary in size. The males from Venezuela have a relatively small pale antehumeral spot in the centre of each lateral side of the thoracic dorsum. In other specimens the pale antehumeral marking

occupies almost the whole lateral side of the thoracic dorsum.

The specimens of *Neuraeschna* exhibit also a typical colour-heteromorphism with regard to the brown costal stripes. I distinguish:

Type. This is of course the form in the holotype (fig. 66). The brown colour of the stripe is not extended over the adjoining interspace behind R1, between arculus and subnodus.

Var. *hyalinata* nov. Here the brown costal stripe is absent or reduced to a mere diffuse brown basal patch. Specimens pertaining to var. *hyalinata* seem only to occur in the Guianas and Venezuela (fig. 67, 68).

Var. *marginata* nov. Specimens of this variation have definite brown costal stripes with the brown colour of the stripes extended over the adjoining interspace behind R1, between arculus and subnodus. In the material before me the two males from Bolívar, Venezuela and the female from Brasília, Brazil belong to var. *marginata*. The brown costal stripes of these examples approach in development those of *N. titania* spec. nov. (figs. 72, 73).

#### *Neuraeschna producta* Kimmins, 1933 (figs. 6, 18, 26, 48, 49)

*Neuraeschna producta* Kimmins, 1933: 226–228, figs. 1, 2 (♂ app.) – ♂ ♀ Peru; 1951: 45, 46, figs. 5–7 (♂ hw-base & tip of app., fork of ♀ 10th sternite).

Material. – Brazil: State of Pará. Tapajós River (Barreira), 1 ♂, IRSN.

One of the male paratypes (dated 25 September 1930) ex coll. Hincks in the Manchester Museum has been carried over to the Rijksmuseum van Natuurlijke Historie at Leiden. This male has weakly developed brown costal stripes with the brown colour of the stripe not extended over the interspace behind R1, between arculus and subnodus. The present male from Barreira, however, has hyaline wings with well-developed brown costal stripes, the brown of the stripe being extended over the interspace behind R1, between arculus and subnodus.

The female allotype is notably larger than the males, has relatively broader wings and well-developed brown costal stripes with the brown colour of the stripe extended over the interspace behind R1, between arculus and subnodus. The colour pattern of the pterothorax is lost through post mortem discoloration. The hind margin of the brown anterior marking on the superior surface of the frons is strongly convex in the female allotype; it is straight in the males. In the Selysian collection

there is an Amazonian female collected by Bates which possibly belongs to *N. producta*. This female, with relatively narrower wings (hind wing 65 mm; width of hind wing at nodus 17.5 mm), has the posterior margin of the brown anterior marking of the frons straight. Unfortunately the fork of the tenth sternite is broken away and due to this damage the specimen cannot well be compared with the female allotype.

***Neuraeschna calverti* Kimmins, 1951**  
(figs. 7, 8, 19, 27, 45–47, 70, 71)

*Neuraeschna calverti* Kimmins, 1951: 43–46, figs. 1–4 (♂ app. & hw base, fork of ♀ 10th sternite) – ♂ ♀ Peru.

Material. – Brazil: State of Amazonas, Manaus, no date, 1 ♂, Vieira leg., CM. – Suriname: Distr. Suriname, Zanderij, 18 December 1973, 1 ♂, J. J. Belle, RNHL.

Two illustrations in the original description of *N. calverti* are inaccurate. In the figure of the male appendages in dorsal view (Kimmins' fig. 1) the dorsal prolongation of the lamina supra-analis is not depicted while in the figure of the fork of the tenth sternite of the female (Kimmins' fig. 4) the subsidiary teeth are missing. The present figures 47 and 19 are improved versions of these figures.

Only three males of *N. calverti* are known. The differences noticed between them and listed below seem to me not of specific value.

(1) Peg-like projection on inner margin of superior anal appendage small and very acutely pointed in the male from Suriname (fig. 45).

(2) Inner apical projection of superior appendage longer in the male from Manaus (fig. 46).

(3) Pterostigma different in size; costal edge of pterostigma of fore wing 4.5 mm in the male holotype, 5.0 mm in the male from Manaus, and 5.5 mm in the male from Suriname.

(4) Pale antehumeral marking smallest and very similar to that of the males of *N. costalis* from Venezuela in the male from Suriname (fig. 7); the pale antehumeral marking is largest and almost completely occupying the lateral half of the thoracic dorsum in the male from Manaus (fig. 8).

(5) Anterior lamina of accessory genitalia stouter in the male from Manaus.

***Neuraeschna titania* spec. nov.**  
(figs. 9, 20, 28, 50–52, 72, 73)

Material. – Holotype: Ecuador, Prov. Pichincha, Jaruqui, 1 ♂ (from Staudinger) in BMNH. Paratypes: Ecuador: Prov. Napo, Archidona (675 m), May 1977 (at light), 1 ♀, Herman G. Real, CG; Prov. Pastaza, Puyo (watershed Río Pastaza-Río Napo, 1000 m), 21 November

1936 (at twilight), 1 ♀ (teneral); 28 November 1936, 1 ♀ (allotype); watershed Río Arajuno-Río Napo (headwaters, 1000 m), 29 April 1941, 1 ♀, all W. Clark-Macintyre; Prov. Zamora-Chinchipec, Amora (700 m), 3 December 1941, 1 ♂ David B. Laddey, UMAA; Prov. Pinchincha, Jaruqui, 1 ♀, from Staudinger, BMNH – Peru: Prov. Lima, vicinity of San Pedro (900 m), 26 May 1935, 1 ♂ (flying at dusk), Felix Woytkowski, UMAA.

Male (holotype; an aged individual; tip of right fore wing broken away; fig. 72). – Total length 90 mm; abdomen 70 mm (incl. app. 5.5 mm); hind wing 64 mm; costal edge of pterostigma in fore wing 5.5 mm, in hind wing 4.5 mm.

Head. Face largely pale brownish yellow shading to pale brown above. Superior surface of frons anteriorly dark brown shading to pale light brown basally, the posterior margin of the dark brown margin strongly convex and reaching nearly to base. Vertex black. Antennae brown. Occipital triangle brown, provided with brown hairs.

Pterothorax. Dark chocolate brown, the brown colour darkest immediately posterior to the two greenish yellow lateral stripes. On each lateral side of the thoracic dorsum a large, bluish green ovoid spot prolonged below in a narrowed point at lateral end of transverse mesepisternal ridge (fig. 9). The two pale lateral stripes slender and about equal in width.

Legs. Third femur brown, second femur darker brown, first femur blackish brown with brown-yellow inner side. Tibiae reddish brown. Knees and tarsi darker brown.

Wings. Brown tinged with a marked brown costal stripe, the brown colour of the costal stripe extending over adjoining interspace behind R1, between arculus and subnodus. Venation dark brown but costa pale brown anteriorly. Pterostigma brown-yellow. Membranule extending along hind wing margin to a point half way the first paranal cell. Antenodals in fore wings 36–37, in hind wings 25–30.

Abdomen. Dark brown with some indefinite pale areas on lower part of sides of segments 1 and 2 and basal three-fourths of segment 3. Broad at base. Segment 3 moderately constricted. Segments 4 to 9 gradually widening. Segments 7 to 9 gradually more depressed. Dorsum of segment 9 strongly convex and densely denticulated in basal half, depressed concave and not denticulated on apical half. Anal appendages shaped as shown in figs. 51 and 52, the superiors a little shorter than segments 9 and 10 together.

Female (allotype; an aged individual; anal appendages broken away; tip of fore wings broken off but not lost). – Total length 90 mm (excl. app.);

abdomen 67 mm (excl. app.); hind wing 68 mm; greatest width of hind wing 19.5 mm; costal edge of pterostigma in fore wing 6.4 mm, in hind wing 5.9 mm.

Similar to male holotype but abdomen slightly constricted on segment 3, then gradually narrowing to apex of segment 7. Fork of tenth sternite continuing the line of the hind margin of the sternite. Base of fork with a relatively large supplementary tooth each side and well-developed minor teeth on anterior surface (fig. 20, 28). Antenodals in fore wings 38–39, in hind wings 27.

The male from Peru and the female from Archidona (Ecuador) are younger than the type specimen. Their wings are hyaline and have definite brown costal stripes. The male from Peru is also the smallest male of the series (abdomen 67 mm; hind wing 60 mm) and has a paler thoracic colour pattern. Especially the anterior streaks of the two pale lateral stripes are notably lighter. Like in the males of the other species of the *N. costalis* group the raised apical portion (comb) of the superior appendages varies in height and length.

The apices of the anal appendages of the female allotype are, like in the other females, broken away; the remaining pieces are parallel-sided, 2 mm long and 0.6 mm wide. The anal appendages are highly probable antenna-shaped, like in *N. costalis* and *N. harpya*. The fork of the tenth sternite of the female paratype in the British Museum (Natural History) is damaged, the right prong being broken away.

### *Neuraeschna maya* spec. nov.

(figs. 10, 21, 25, 44, 74)

Material. — Holotype: Costa Rica: Prov. Limón, Barra de Tortuguero, 17 July 1985, 1 ♂ (Victor Hellebuyck) in FSCA. Paratypes: Costa Rica: Prov. Limón, Tortuguero, 17 July 1985, 1 ♂; Barra de Tortuguero, 17 July 1985, 2 ♂, 1 ♀ (allotype); 18 July 1985, 6 ♂; 19 July 1985, 2 ♂, all Victor Hellebuyck, CH, but 1 ♂ in RNHL. — Honduras: 1 ♀, IRSN; Puerto Cortez, 30 May 1917, 1 ♀, F. J. Dyer, USNM.

Male (holotype; an aged individual; head broken off but not lost; distalia of antennae lost). — Total length 88 mm; abdomen 67 mm (incl. app. 5.8 mm); hind wing 59 mm; costal edge of pterostigma in fore wing 4.5 mm, in hind wing 3.5 mm.

Head. Face dull olive green. Dark anterior marking of superior surface of frons developed, its posterior margin convex in middle. Base of superior surface of frons pale light brown. Vertex black. Scape of antenna black, pedicel yellowish brown. Occipital triangle yellowish brown anteriorly, dark brown posteriorly.

Pterothorax. Blackish brown white pale markings. On each lateral side of thoracic dorsum a bluish-green ovoid spot which is not distinctly prolonged below on lateral side (fig. 10). Meso-para-pectera (antealar sinus) largely yellow-green. Mes- and metepimeral pale stripes rather narrow and yellow-green.

Legs. Third femur brown, black at knees. Second and first femora very dark brown. Tibiae brown, tarsi and claws darker brown.

Wings. Brown tinged with faint brown costal stripe. Venation dark brown but costae light brown anteriorly. Pterostigma light brown. Membranule rather broad and along posterior wing margin reaching to a point nearly halfway the first paranal cell. Antenodals in fore wings 32–33, in hind wings 23.

Abdomen. Dark brown with some indefinite paler areas on lower part of sides of segments 1 and 2 and base of segment 3. Broad on basal segments 1 and 2, constricted on segment 3, almost parallel from apex of segment 3 to base of segment 7, then gradually widening to apex of segment 8 and more depressed to segment 9. Segments 9 and 10 equal in width. Dorsum of segment 9 strongly convex and denticulated on basal half, depressed concave and not denticulated on apical half. Anal appendages very resembling those of *N. titania* but outer apical angle of each superior appendage without a sharp point. Instead there is a small tubercle on inferior margin at the outer apical angle of the superior appendages (fig. 44).

Female (allotype; a very aged individual; apices of anal appendages broken away). — Total length 87 mm (excl. app.); abdomen 68 mm (excl. app.); hind wing 65 mm; width of hind wing at nodus 18 mm; costal edge of pterostigma in fore wing 4.9 mm, in hind wing 3.8 mm.

Similar to male but abdomen not constricted on segment 3 and then gradually narrowing to apex of segment 7. Fork of sternite of tenth abdominal segment angled caudad; anterior surface of base of fork with two small subsidiary teeth on left side only (fig. 21). Wings very dark brown tinged with weakly discernible brown costal stripes. Antenodals in fore wing 36, in hind wing 26.

All Costa Rican specimens are aged to very aged individuals and due to their brown tinged wings the brown costal stripes are not well discernible. The two females from Honduras, however, are young specimens (one teneral). The wings of these females are hyaline and the brown costal stripes can well be studied (fig. 74). The brown colour of the costal stripe is not extended over the interspace behind R1, between arculus and subnodus.

THE *N. HARPYA* GROUP

Although evidently related to the members of the *N. costalis* group, *N. harpya* is aberrant from its members and from all other species of the genus by the presence of a well-marked brown T-spot on the top of the frons. With a hind wing length of 52–60 mm, *N. harpya* belongs to the moderately large species of the genus.

It is classified here as a separate group: *N. harpya* Martin.

***Neuraeschna harpya* Martin, 1909**

(figs. 11, 14, 32, 37, 38, 60–63, 69)

*Neuraeschna harpya* Martin, 1909: 206, fig. 211 (♂ app.)  
– ♂ ♀ Amazon region, Suriname; Williamson & Williamson 1930: 15 (♀ Guiana); Kimmins 1933: 226, 227; 1951: 48; Geijskes 1971: (♂ ♀ French Guiana).

Material. – Brazil: State of Pará, Tapajós (53° 27'), 1 ♂, BMNH; State of Pará, Rio Xingu Camp (52° 22' W 3° 39' S, ca. 60 km S. of Altamira, 1 October 1986 (at dusk), 1 ♀; same camp, Igarape (N. of camp, trail 4), 9 October 1986, 1 ♂, P. Spangler & O. Flint, USNM; same camp and collectors, 3 October 1986, 1 ♂, CG. Rio Negro, 20 August 1951, 1 ♀, Pe. J. Falco; Rio Uaupés (Taracua), 14 August 1964, 1 ♀, CM. – French Guiana: Camopi (on light), 19 November 1969, 1 ♂, Balachowski & Grüner, CM. – Guiana: Essequibo River, Rockstone, 1 February 1912, 1 ♀, L.A. & E.B. Williamson & B. J. Rainey, UMAA. – Peru: Dept. Loreto, Río Ampí Yaco, Estiron, 29 March–9 April 1970, 1 ♀ (teneral), B. Malkin, RNHL. – Surinam: 1 ♂, H. Fruhstorfer (99–103); Distr. Marowijne, Litani River (Feti Creek), 17 August 1939, 1 ♀, D. C. Geijskes, BMNH. Distr. Marowijne, Litani River (Feti Creek), 16–22 July 1939, 2 ♂ 5 ♀. Distr. Suriname: Coropina Creek, Republic, 27 May 1951, 2 ♂ (teneral), all D. C. Geijskes. Distr. Nickerie, Corantijn River, Wonotobo Falls, 1 February 1956, 1 ♂ 1 ♀; Kabalebo River, 26 August 1963, 1 ♀; Distr. Suriname, Zanderij, Troelinde Creek (Bos Beheer), 20 July 1958, 1 ♀; Zanderij, Pontji Creek, Dauwdröpkamp, 2 September 1958, 1 ♂; Zanderij, Pontjibrug, 19 November 1958, 1 ♀, all J. Belle; Distr. Nickerie, Wilhelmina Mountain Range, camp at Lucie River, 21 August 1963 (6.30 p.m.), 1 ♂, S. Ligorie; Corantijn River, Wonotobo Falls, 23 July 1959, 1 ♀ (reared), D. C. Geijskes, RNHL.

Lectotype designation of *Neuraeschna harpya* Martin, 1909. – In the Selysian collection there are three syntypes of *Neuraeschna harpya*, two males and one female. The male, which bears the pin labels "Santarem", "149 *Æ. harpya* B." and "Collection Selys *Neuraeschna harpya* Bates ♂ Revision Martin 190 *Neuraeschna harpya* Bates" (partly printed), is here designated as the lectotype of *Neuraeschna harpya* Martin, 1909. To the pin of this specimen I have added the yellow label "LECTOTYPE Rev. J. Belle, 1988".

The lectotype is in fairly good condition. The costae of the fore wings are broken just proximal to the pterostigma but restored. The pterothorax is broken between the second and third pair of legs but otherwise all critical details are intact and can well be studied.

Male. – Total length 73–74 mm; abdomen 57–58 mm (incl. app. 5 mm); hind wing 52–54 mm; costal edge of pterostigma in fore wing 3.9–4.3 mm, in hind wing 2.8–3.0 mm.

Head. Face yellow-brown. Superior surface of frons with dark brown to black T-spot, the area next to the stem of the T-spot raised convex and pale light brown. Vertex black. Antennae brown. Occipital triangle black. Eyes in freshly killed specimens green above, becoming yellowish below and bluish along black hind border.

Pterothorax. Brown with broad pale (= light green) stripes. Pale antehumeral markings stripe-shaped, the upper end widened on both sides, the lower part becoming narrower and reaching lateral end of transverse mesepimeral ridge (fig. 11). Pale mes- and metepimeral stripes very broad and equal in width, each pale lateral stripe posteriorly bordered by a very dark brown stripe. A small green dorsal spot on metepisternum. Wing articulations with green to bluish green spots.

Legs. Dark brown, the inner side of first femur green for the basal three-fourths portion.

Wings. Clear, sometimes with a faintly developed brown costal band. Venation dark brown but frontal margin of costa lighter. Pterostigma light brown. Antenodals in fore wing 28–36, in hind wing 21–25. Membranule of hind wing extending to a point one-third the way along first paranal cell.

Abdomen. Brown, the posterior margin of each segment almost black. Segments 1 and 2 with light green side spots. Segment 3 to 7 with a yellowish green lateral spot at transverse carina, the one of segment 3 extending on basal half of segment along ventral tergal margin. Segment 3 somewhat constricted, slightly wider on segments 4 to 9, successively. Segment 10 narrower, its upper surface flat and elevated at apex. Segments 6 to 9 becoming more depressed, successively. Anal appendages dark brown, shaped as shown in figs. 37 and 38.

Female. – Total length 73–78 mm (excl. app.); abdomen 57–61 mm (excl. app. 3.5 mm), hind wing 55–60 mm; costal edge of pterostigma in fore wing 4.6–5.0 mm, in hind wing 3.0–3.5 mm.

Coloration similar to male. Abdomen very slightly constricted on segment 3, in dorsal view almost parallel-sided on segment 4 to 9, narrower on segment 10. Anal appendage antenna-like, as

long as segment 9, in dorsal view almost parallel-sided, slightly tapering at apex, the apical two-fifths portion superiorly keeled (fig. 32). Fork of tenth sternite in profile view almost continuing the line of posterior margin of sternite, but sometimes slightly curved caudad. There are often no subsidiary teeth on the anterior surface of the base of the fork. Antenodals in fore wing 30–36, in hind wing 21–25.

Larva (described from a larval cast-off skin of a reared female). – Total length 38.5 mm; abdomen 26.5 mm (incl. app. 3.7 mm); greatest width of abdomen 8 mm; width of head over the eyes 9 mm; third femur 7.5 mm.

Larval skin clean and practically hairless. It is light brown, almost without colour pattern but there are conspicuous dark markings on the femora.

Head. Flat above. Eyes very prominent. Posterior portion of occiput produced laterally with tapering sides. Antennae 7-jointed, the first two basal segments short and rounded, the third segment longest and the fourth segment shortest (fig. 62). Labium brown, its basal hinge reaching to third coxae. Front margin of mentum with a pair of rather long spines, each spine slightly curved outward and located in the middle of the part between the small median cleft and the base of the lateral lobe. End hook of lateral lobe terminating in a strong acute spine, its inner border nearly semicircular. Movable hook strong, two and a half times as long as outer border of lateral lobe (fig. 61).

Prothorax. Flat above. Dorsal disc with prominent rounded lateral margins. Supracoxal armature with the first process conical and twice as small as the second one.

Synthorax. Without knobs. Tips of wing-cases reaching to well upon segment 4.

Legs. Femora flattened, distal third black, proximal two-thirds of inner and outer surface with a row of small black roundish spots. Claws simple.

Abdomen. Base of segment 7 with a middorsal pair of black dashes. Widest on segments 6 and 7. No dorsal hooks. Lateral spines on segments 5 to 10, the ones on segment 5 minute but distinct, the ones on segments 8 and 9 largest, the ones on segment 10 small. Inferior anal appendages slightly shorter than segments 9 and 10 together, the superiors about two-thirds as long as inferiors, the middorsal appendage a trifle shorter than inferiors (fig. 63). Gonapophyses reaching backward to well beyond segment 9.

The larva of *Neuraeschna harpya* was found in

a small bush creek near the Wonotobo Falls by Dr. D. C. Geijskes. It was in the transformation period climbing up a grass stem at 9 a.m. After it was taken to the camp at the Wonotobo Falls, the imago appeared in the following night (Dr. Geijskes 1959, personal communication).

#### THE *N. MAXIMA* GROUP

*N. maxima* is characterized in both sexes by the strongly constricted abdomen on the third segment, and in the male sex by the very long, slender and forcipate superior anal appendages. Otherwise the species agrees with the characters of the *N. costalis* group.

Species of the *N. maxima* group: *N. maxima* spec. nov.

#### *Neuraeschna maxima* spec. nov.

(figs. 12, 57–59, 75)

Material. – Holotype: Brazil; State of Pará, Belem, Val-de-Can airport (5.30 a.m.), 11 September 1963, 1 ♂ (B. Malkin) in RNHL. Paratypes: Brazil: State of Pará, Belem (Utinga Forest), 10 October 1954, 1 ♂ 1 ♀ (allotype), both Inacio, CM; Belem, December 1954, 1 ♂, ex coll. Agriculture Station (D. C. Geijskes).

Male (holotype) – Total length 100 mm; abdomen 78 mm (incl. app. 9 mm); hind wing 67 mm; costal edge of pterostigma in fore wing 6 mm, in hind wing 4.5 mm.

Head. Face brown but anteclypeus darker and vertical part of frons blackish brown. Superior surface of frons blackish brown on anterior half, pale brown on basal half. Vertex black-brown. Scape of antenna black, the pedicel and distalia brown. Occipital triangle brown-yellow.

Pterothorax. Dark colour brown. On each lateral side of dorsum a large ovoid bluish green spot prolonged below in a narrow point at lateral end of transverse mesepisternal ridge (fig. 12). Mes- and metepimeral pale stripes greenish yellow, the area anterior to each pale lateral stripe lighter brown and the area posterior to each pale lateral stripe very dark brown.

Legs. Femora dark brown. Second and third tibiae red-brown, first tibia dark red-brown. Tarsi and claws blackish brown.

Wings. Hyaline with a distinct brown costal stripe extending from base to pterostigma, the brown colour of the costal stripe extending over adjoining interspace behind R1, between arculus and subnodus. Pterostigma, light yellow. Antenodals in fore wings 39, in hind wings 28–30.

Abdomen. Swollen on segments 1 and 2,

strongly constricted on segment 3, then gradually widening to apex of segment 10. Convex basal half of segment 9 nearly devoid of denticles. Anal appendages shaped as shown in figs. 57 and 58. Dorsal prolongation of base of inferior appendage moderately developed, not rising above superior appendages and not discernible in dorsal view of abdomen.

Female (allotype; much broken but details well-preserved; apices of anal appendages broken away). – Total length 97 mm (excl. app.); abdomen 75 mm (excl. app.); hind wing 70 mm; width of hind wing at nodus 18 mm; costal edge of pterostigma in fore wing 6.0 mm, in hind wing 4.8 mm.

Very similar to male regarding stature and coloration. Wings also very similar to those of holotype. Antenodals in fore wings 33–44, in hind wings 30–31. Fork of sternite of abdominal segment 10 shaped as in *N. costalis*. Anterior surface of base of fork with three (left side) and four (right side) small subsidiary teeth.

#### THE *N. MAYORUNA* GROUP

The unique specimen of *N. mayoruna* is a female which agrees with the characters of the *N. costalis* group except for point (2). *N. mayoruna* has no basal costal cross-veins, only basal subcostal cross-veins. In this respect it agrees with the members of the *N. dentigera* group and *N. claviforcipata* group. Further the female is distinguished from all other species of the genus in having the fork of the sternite of the tenth abdominal segment distinctly rising before the posterior side of the sternite (fig. 22).

Species of the *N. mayoruna* group: *N. mayoruna* spec. nov.

#### *Neuraeschna mayoruna* spec. nov. (figs. 13, 22, 29)

Material. – Holotype: Peru: Dept. Loreto, Mishquiyacu (15 km from Iquitos), 29 July 1931, 1 ♀ (from Paul Nagel) in UMAA.

Female (holotype; apices of anal appendages broken away; wings slightly damaged). – Total length 85 mm (excl. app.); abdomen 65 mm (excl. app.); hind wing 61 mm; width of hind wing at nodus 17.5 mm; costal edge of pterostigma in fore wing 4.7 mm, in hind wing 3.5 mm.

Head. Face reddish brown-yellow. Superior surface of frons dark brown on anterior half, pale brown on basal half (fig. 13). Vertex black. Antennae with black scapes, the pedicels and distalia brown. Occipital triangle black.

Pterothorax. Obscured through post mortem discolouration but there is something like a pale stripe discernible on mes- and metepimeron.

Legs. Femora reddish brown. Dark brown at knees, on tibiae, tarsi and claws.

Wings. Brown tinged with a distinct brown costal stripe extending from base to pterostigma; the brown colour of the stripe faintly developed in adjoining interspace behind R1, between arculus and subnodus. Pterostigma yellow. Antenodals in fore wing 41–45, in hind wing 32–33. Wings with only a single basal subcostal cross-vein. Area between Cu1 and Cu2 with two rows of cells for its proximal one-fourth portion (in left hind wing with an extra third cell) followed by one row of cells; Cu2 sagged out on this proximal one-fourth portion.

Abdomen. Very dark brown, moderately swollen on segments 1 and 2, not constricted on segment 3, then gradually narrowing to apex of segment 7. Fork of sternite of tenth segment shaped as shown in figs. 22 and 29; anterior surface of base of fork with a subsidiary tooth on each side.

#### *Neuraeschna* spec. indet. (figs. 15, 23, 30)

Material. – Brazil: State of Santa Catarina, Joinville, 1 ♀, Staudinger & Bang-Haas vend., BMNH (ex coll. Cowley, No. 9994).

Female (frons above transversely crushed; apices of anal appendages broken away; wings slightly damaged). – Total length 86.5 mm (excl. app.); abdomen 66.5 mm (excl. app.); hind wing 66 mm; width of hind wing at nodus 18.5 mm; costal edge of pterostigma in fore wing 6.3 mm; in hind wing 5.0 mm.

Head. Face brown-yellow. Superior surface of frons predominantly pale brown, the central portion becoming darker brown, the anterior border broadly brown-yellow (fig. 15). Vertex laterally brown-yellow, in middle darker brown. Scape of antenna dark brown, pedicel brown-yellow, distalia brown.

Pterothorax. Due to post mortem discoloration there are no pale markings discernible on the dorsum. Posterior half of mes- and metepimeron blackish brown; each of these dark streaks preceded by brown areas (the usual pale lateral stripes being apparently discoloured).

Legs. Femora brown, dark brown at knees. Second and third tibiae red-brown. Tarsi, claws and first tibia dark to very dark red-brown.

Wings. Hyaline proximal to nodus, brown

tinged distal to nodus. There are distinct brown costal stripes extending from base to pterostigma, the brown colour of the stripe not extending over adjoining interspace behind R1, between arculus and subnodus. Pterostigma yellow. Antenodals in fore wings 36–37, in hindwings 24–26.

Abdomen: Dark brown. Moderately swollen on segments 1 and 2, then gradually narrowing to apex of segment 7. Fork of tenth sternite shaped as shown in figs. 23 and 30; anterior surface of base of fork with six small subsidiary teeth.

This female is the only specimen of *Neuraeschna* reported from the subtropical region. It highly probable belongs to a member of the *N. costalis* group. Though very closely allied with *N. costalis* it seems to be inconspicuous with it unless the subtropical representatives of this species have a paler frons and larger proportions. By the absence of sufficient clear distinguishing characters I have refrained from giving it a name.

#### THE STATUS OF *NEURAESCHNA* *ROSTRIFERA* MARTIN

In his monograph of 1909 (pag. 208, 209; fig. 214), Martin described *Neuraeschna rostrifera* on the basis of a unique male from Suriname. The late lamented Dr. D. C. Geijskes, who was most interested in the odonate fauna of Suriname, located and studied (June 1966) the male holotype of *Neuraeschna rostrifera* in René Martin's collection. On his return from Paris he communicated me that the type fell beyond the limits of the genus *Neuraeschna* simply because the subcosta was not prolonged through and after the nodus.

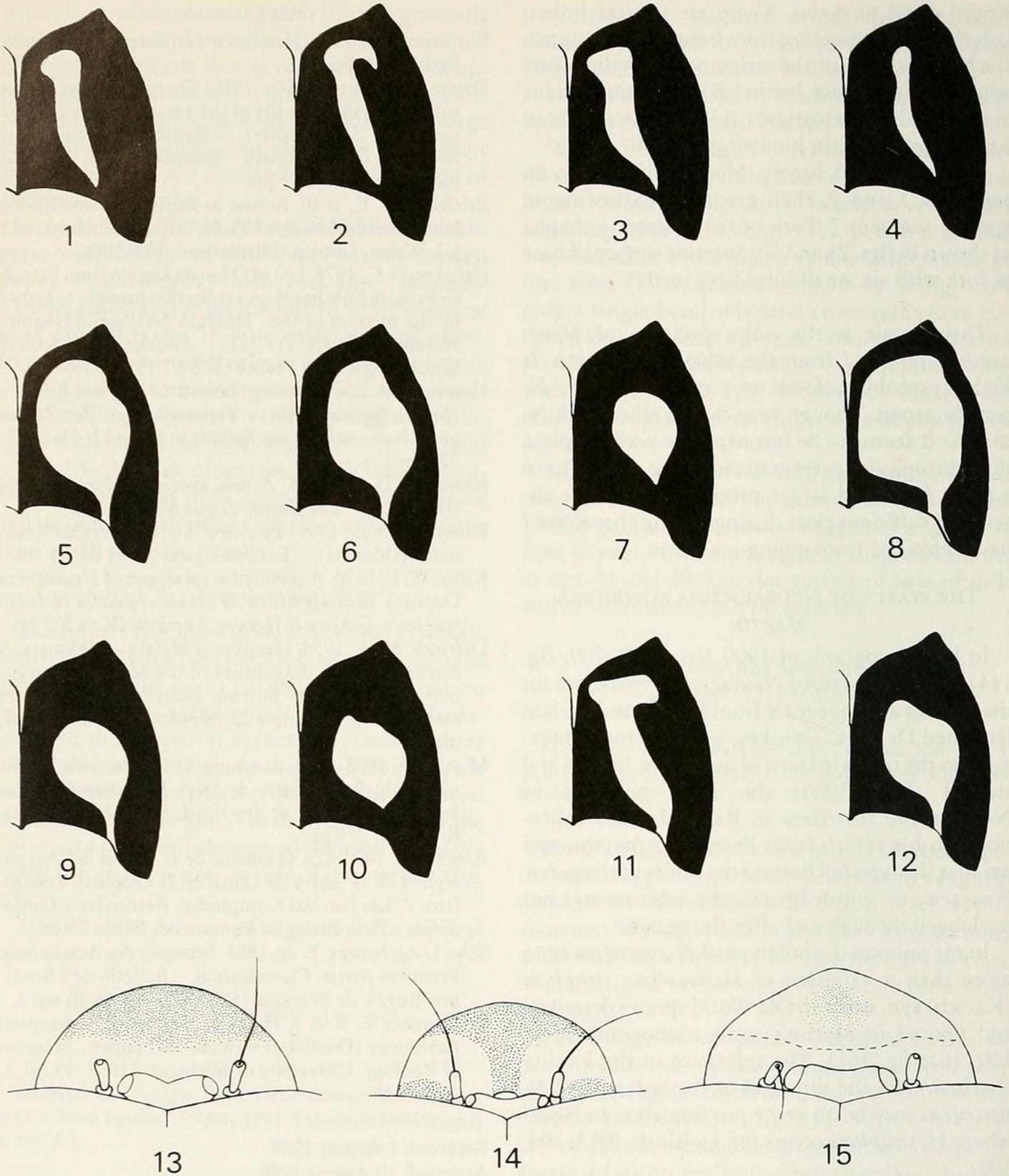
In my opinion the holotype of *N. rostrifera* is no more than a variation of *Heliaeschna simplicia* (Karsch) *syn. nov.*, an Old World species described and figured in Martin's same monograph (pag. 160, 161; fig. 161). The reference to the locality "Surinam" on the pin label of the holotype of *N. rostrifera* may be an *error pro* Sumatra, an island where *H. simplicia* occurs (cf. Lieftinck, 1954: 104, 105).

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Figs. 1-12. Diagram of colour pattern of left lateral side of thoracic dorsum of males in *Neuraeschna*: 1, *dentigera* (lectotype); 2, *cornuta* (holotype); 3, *claviforcipata* (lectotype); 4, *claviforcipata* (Venezuela); 5, *costalis* (Surinam); 6, *producta* (paratype); 7, *calverti* (Surinam); 8, *calverti* (Brazil); 9, *titania* (paratype, Peru); 10 *maya* (holotype); 11, *harpya* (lectotype); 12, *maxima* (holotype).

Figs. 13-15. Colour pattern of superior surface of frons in *Neuraeschna*: 13, *mayoruna* (holotype); 14 *harpya* (♂ Suriname); 15 spec. indet.

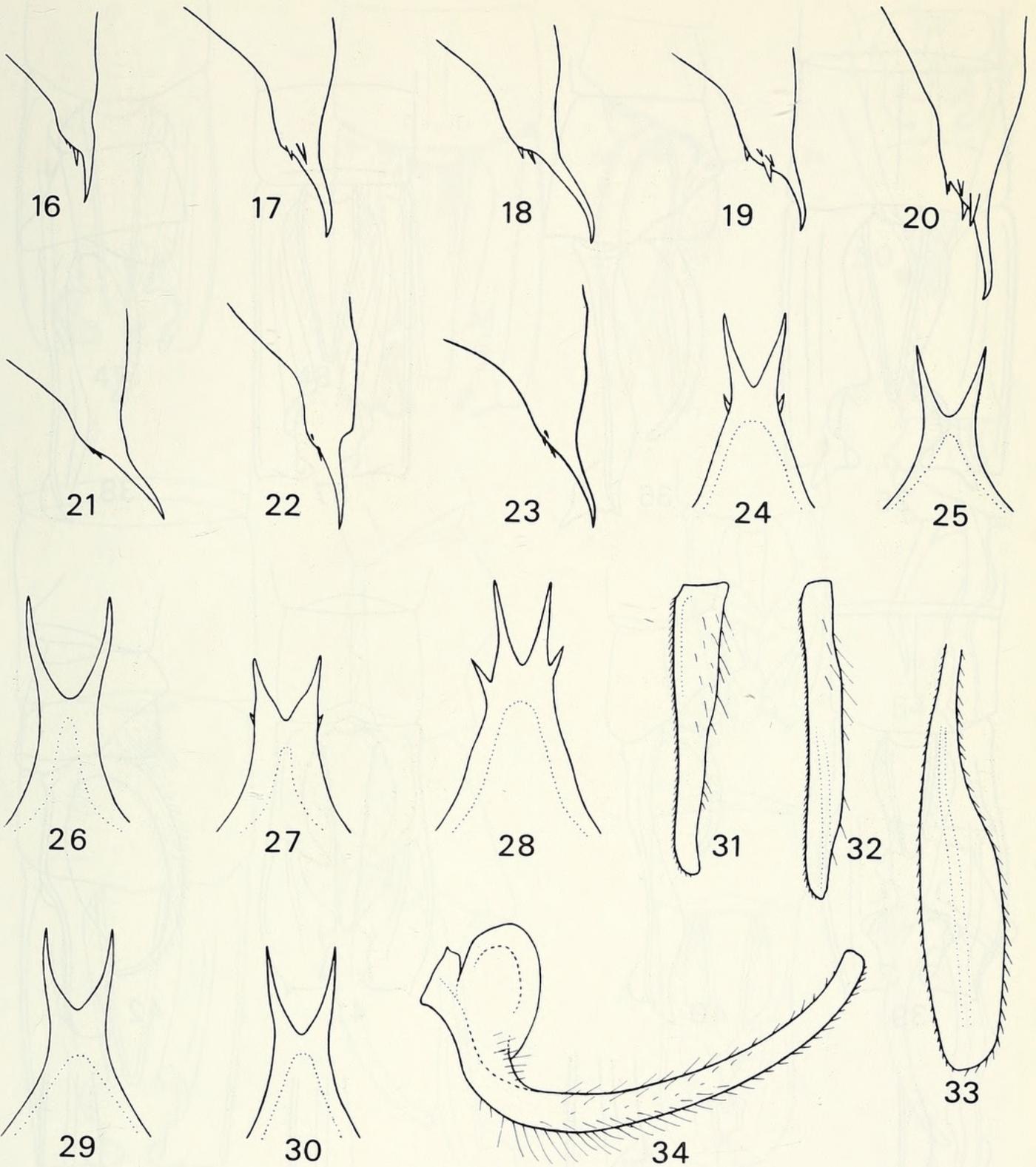
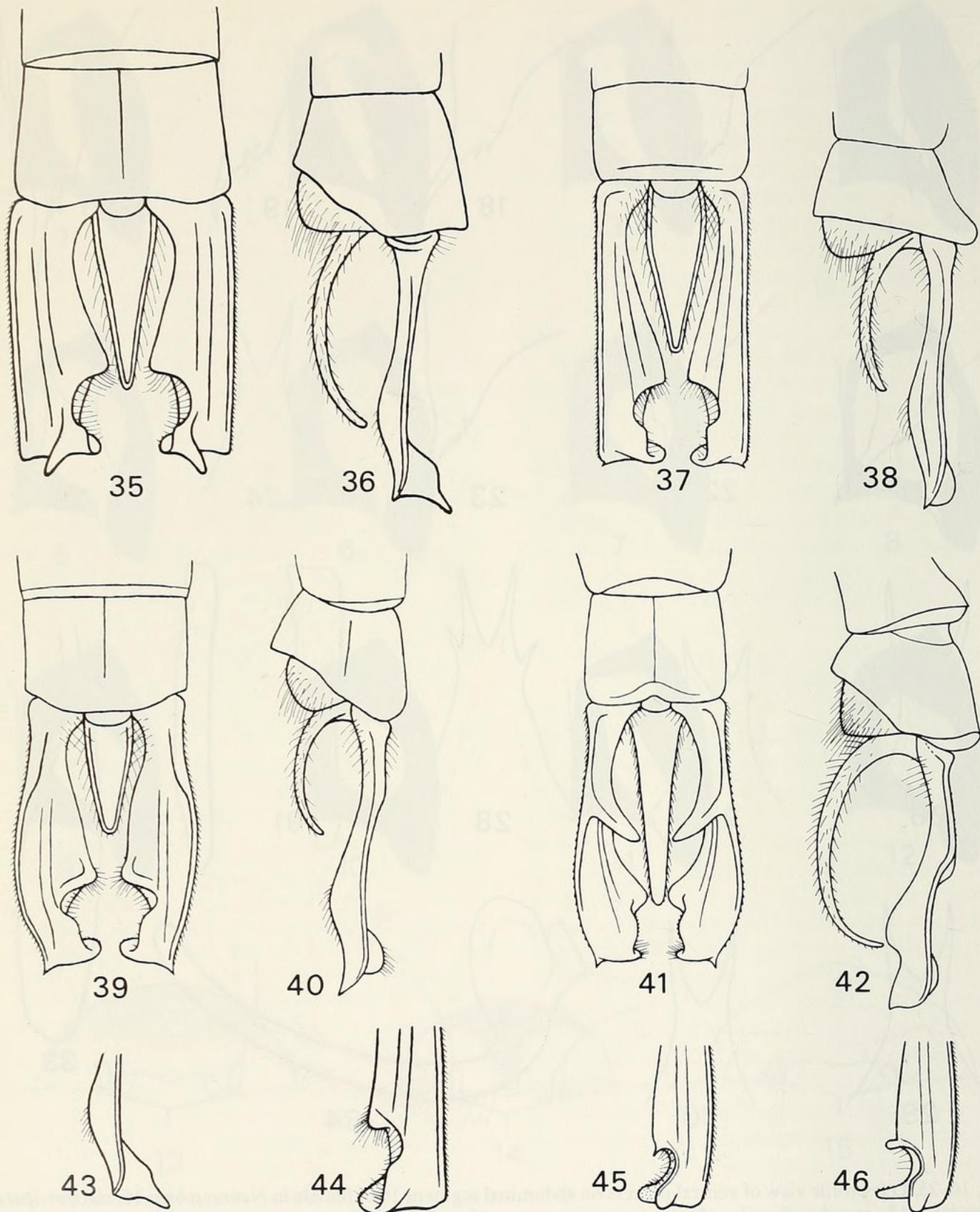


Fig. 16-23. Left profile view of ventral process on abdominal segment 10 of female in *Neuraeschna*: 16, *claviforcipata* (Ecuador); 17, *costalis* (Brazil); 18, *producta* (paratype); 19, *calverti* (allotype); 20, *titania* (allotype); 21, *maya* (allotype); 22, *mayoruna* (holotype); 23, spec. indet.

Figs. 24-30. view of ventral process on abdominal segment 10 of female in *Neuraeschna*: 24, *costalis* (Brazil); 25, *maya* (allotype); 26, *producta* (paratype); 27, *calverti* (allotype); 28, *titania* (allotype); 29, *mayoruna* (holotype); 30, spec. indet.

Figs. 31-33. Dorsal view of left anal appendage of female in *Neuraeschna*: 31, *costalis* (Suriname); 32, *harpya* (Surinam); 33, *claviforcipata* (Ecuador. Basal one-tenth portion of distorted appendage not depicted).

Fig. 34. Left profile view of lamina supra-analis (inferior appendages) of male in *Neuraeschna costalis* (Brazil).



Figs. 35-42. Improved versions of figs. 210-213 in Martin, 1909. *Neuraeschna costalis*, ♂: 35, tenth abdominal segment and anal appendages, dorsal; 36, the same, left profile. *Neuraeschna harpya*, ♂: 37, tenth abdominal segment and anal appendages, dorsal; 38, the same, left profile. *Neuraeschna claviforcipata*, ♂: 39, tenth abdominal segment and anal appendages, dorsal; 40, the same, left profile. *Neuraeschna dentigera*, ♂: 41, tenth abdominal segment and anal appendages, dorsal; 42, the same, left profile.

Fig. 43. *Neuraeschna costalis*, ♂. Apex of left superior appendage, left profile (BMNH).

Figs. 44-46. Dorsal view of apex of left superior appendage of male in *Neuraeschna*: 44, *maya* (holotype); 45, *calverti* (Suriname); 46, *calverti* (Brazil).

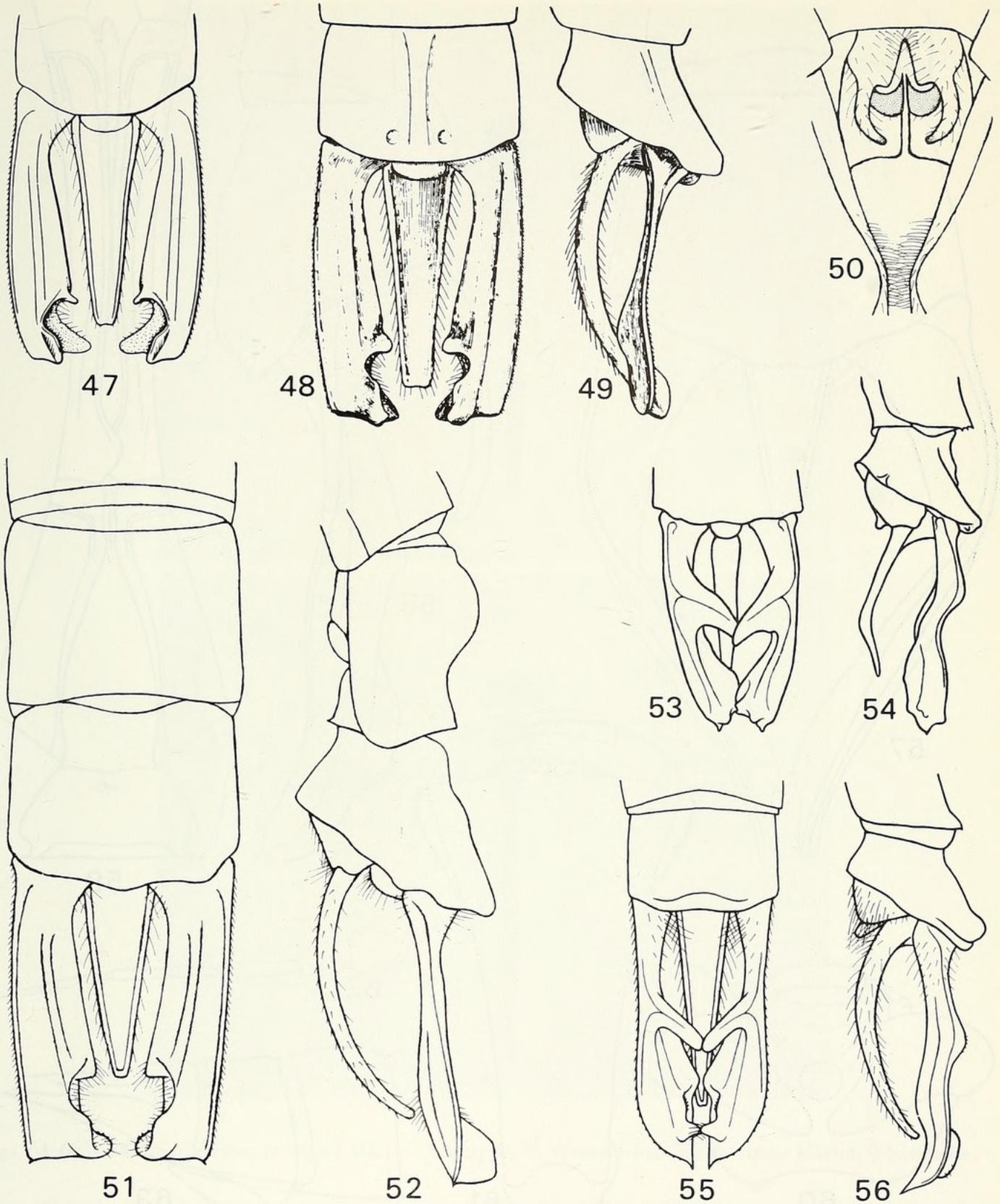
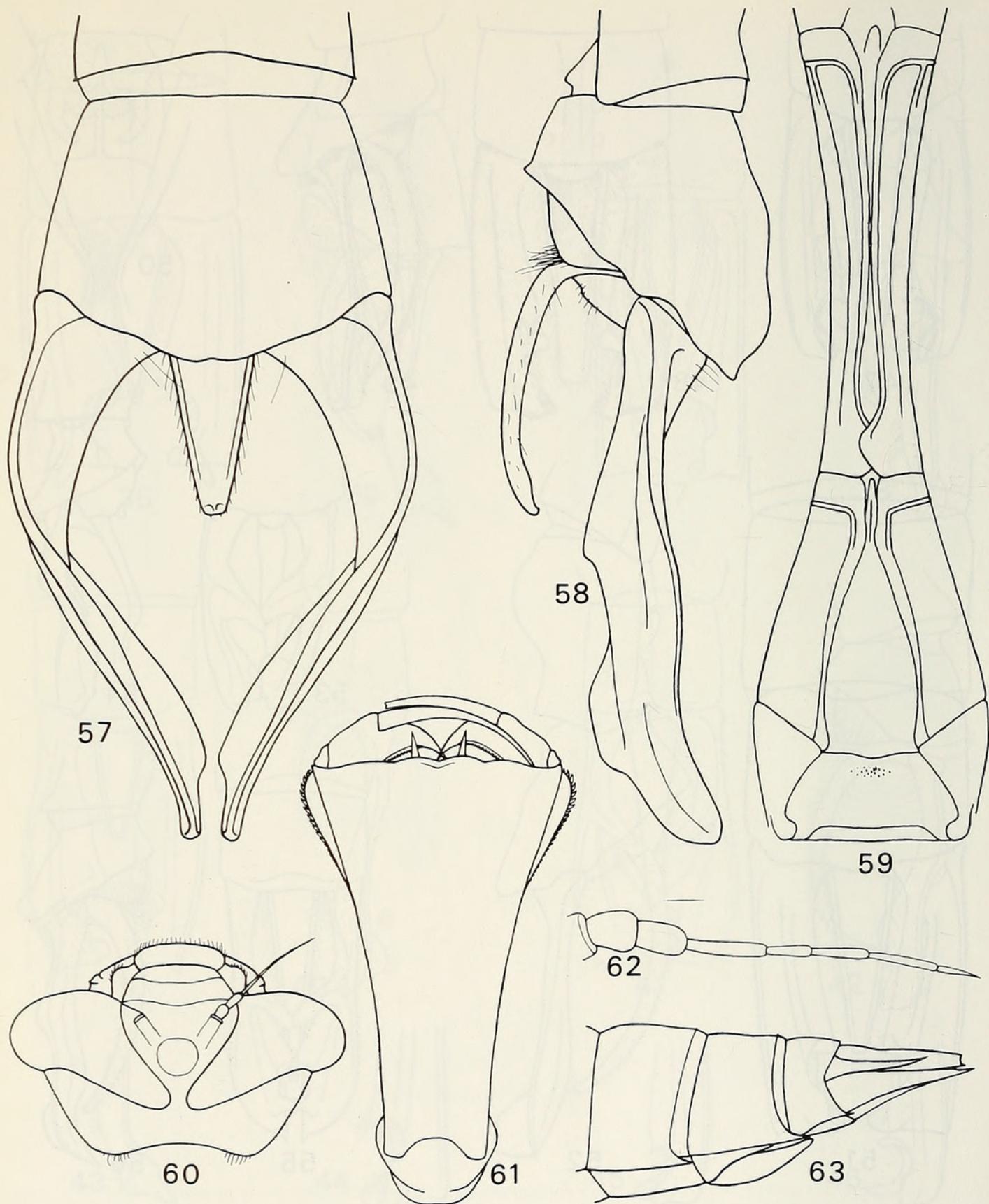


Fig. 47. *Neuraeschna calverti*, ♂. Anal appendages, dorsal (improved version of fig. 1 in Kimmins, 1951). Figs. 48, 49. *Neuraeschna producta*, ♂ (after Kimmins, 1933): 48, tenth abdominal segment and anal appendages, dorsal; 49, the same, left profile.

Figs. 50-52. *Neuraeschna titania*, ♂ holotype: 50, accessory genitalia, ventral; 51, apical segments of abdomen with anal appendages, dorsal; 52, the same, left profile. Figs. 53, 54. *Neuraeschna mina*, ♂ holotype (after Williamson & Williamson, 1930): 53, anal appendages, dorsal; 54, tenth abdominal segment and anal appendages in left profile. Figs. 55, 56. *Neuraeschna cornuta*, ♂ holotype: 55, tenth abdominal segment and anal appendages, dorsal; 56, the same, left profile.

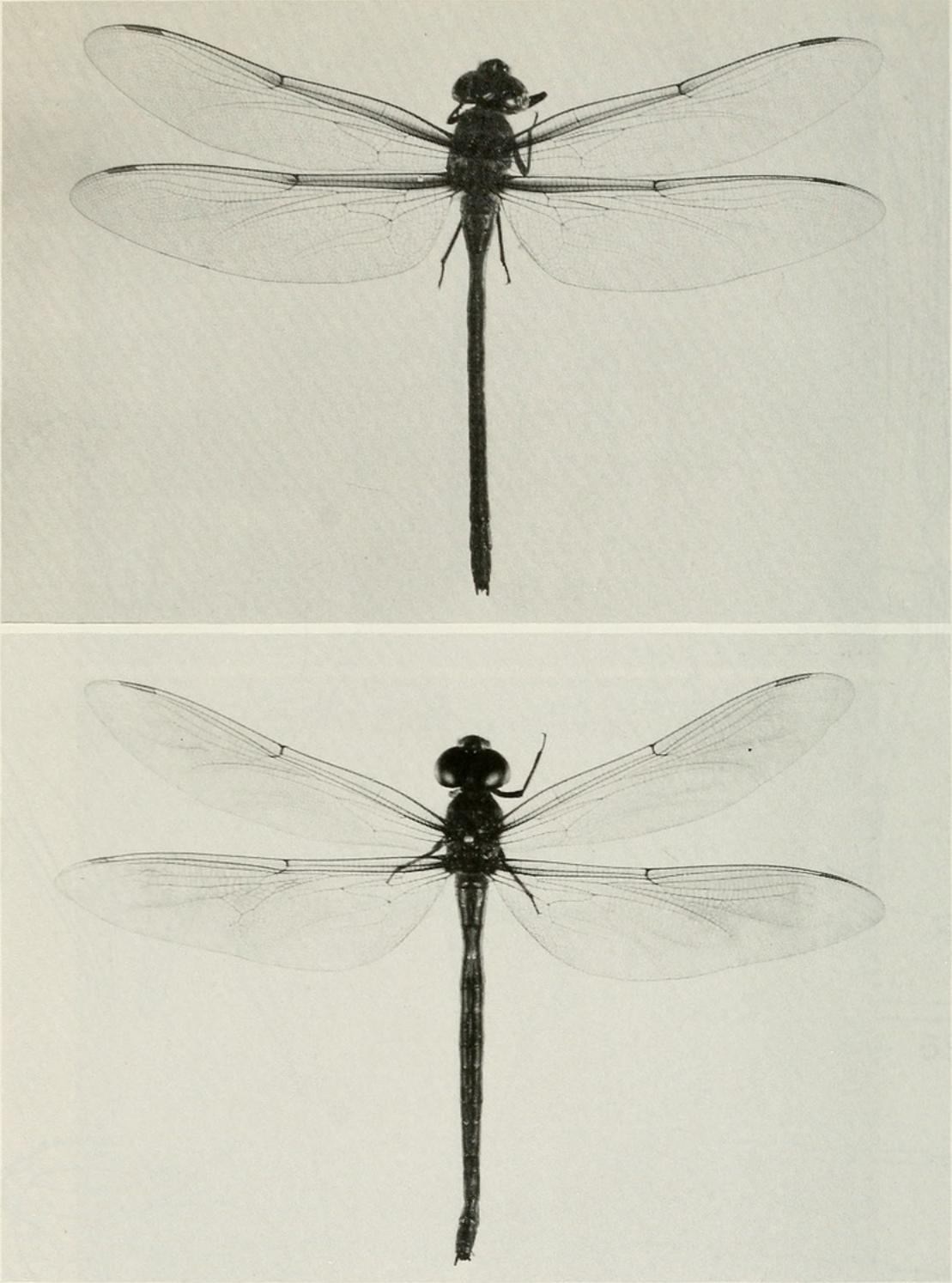


Figs. 57-59. *Neuraeschna maxima*: 57, tenth abdominal segment and anal appendages of ♂ paratype, dorsal; 58, the same, left profile; 59, basal segments of abdomen of ♀ allotype, ventral.

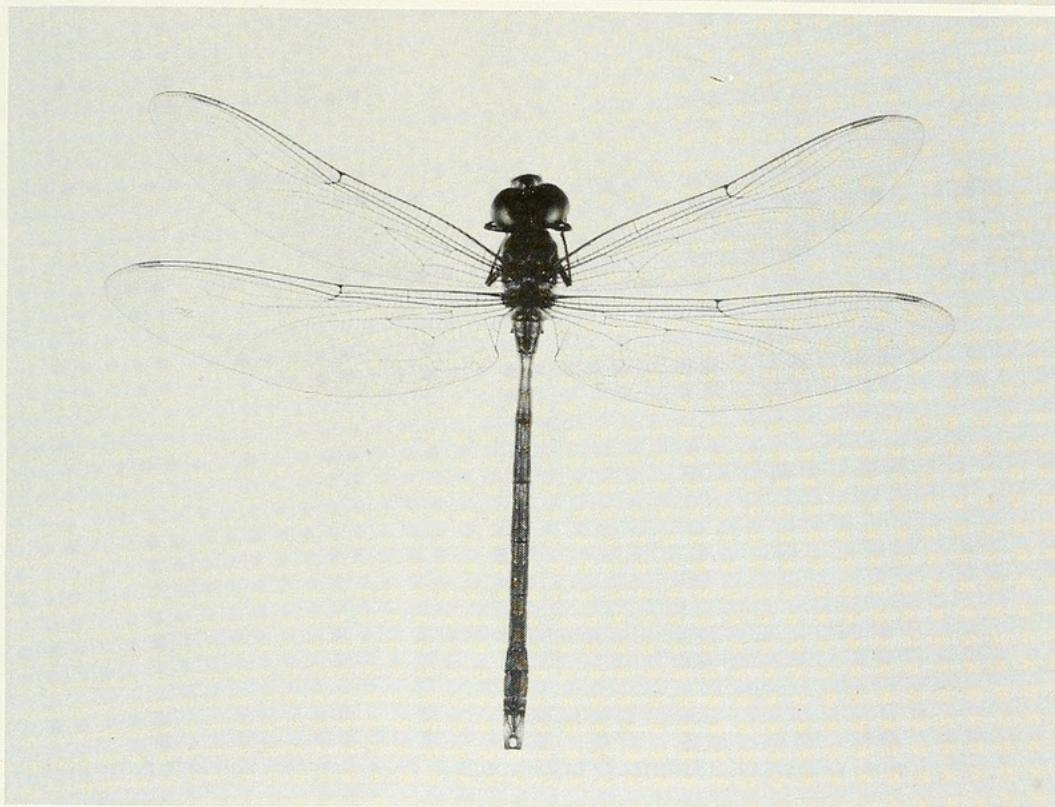
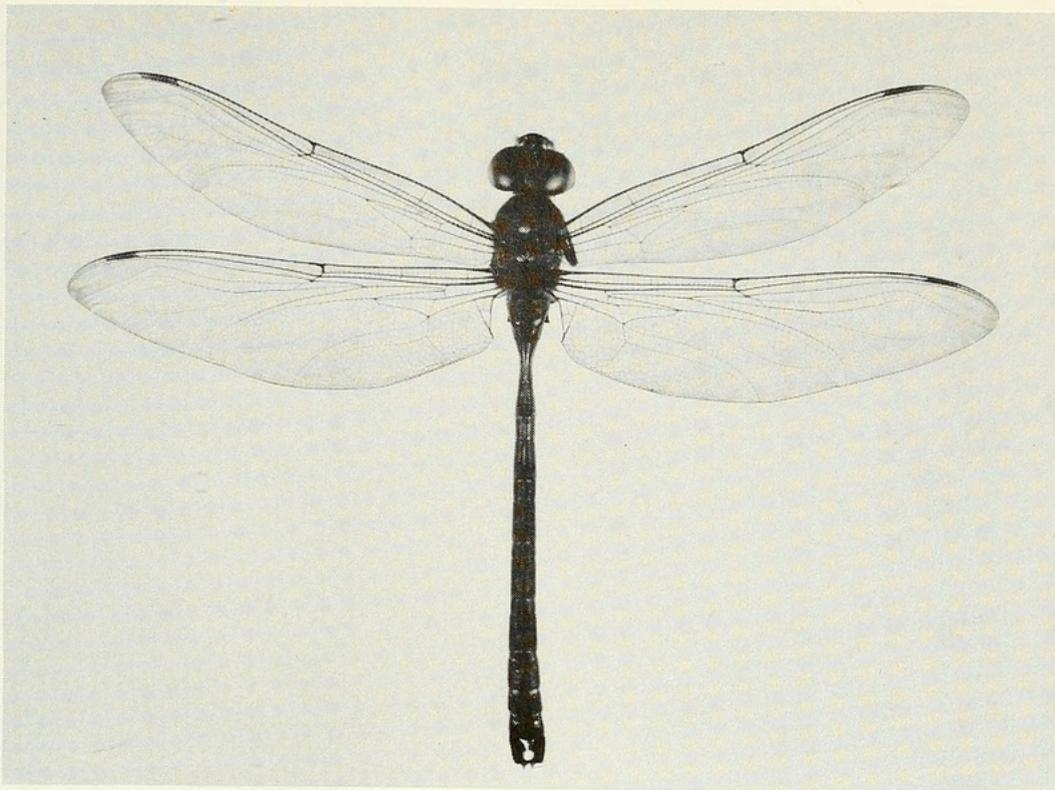
Figs. 60-63. *Neuraeschna harpya*, ♀ exuviae: 60, head, dorsal; 61, mentum, ventral; 62, right antenna, dorsal; 63, apical segments of abdomen with anal appendages, left profile.



Figs. 64-65.—64, *Neuraeschna dentigera* Martin, ♂ syntype; 65, *Neuraeschna claviforcipata* Martin, ♀ Suriname.



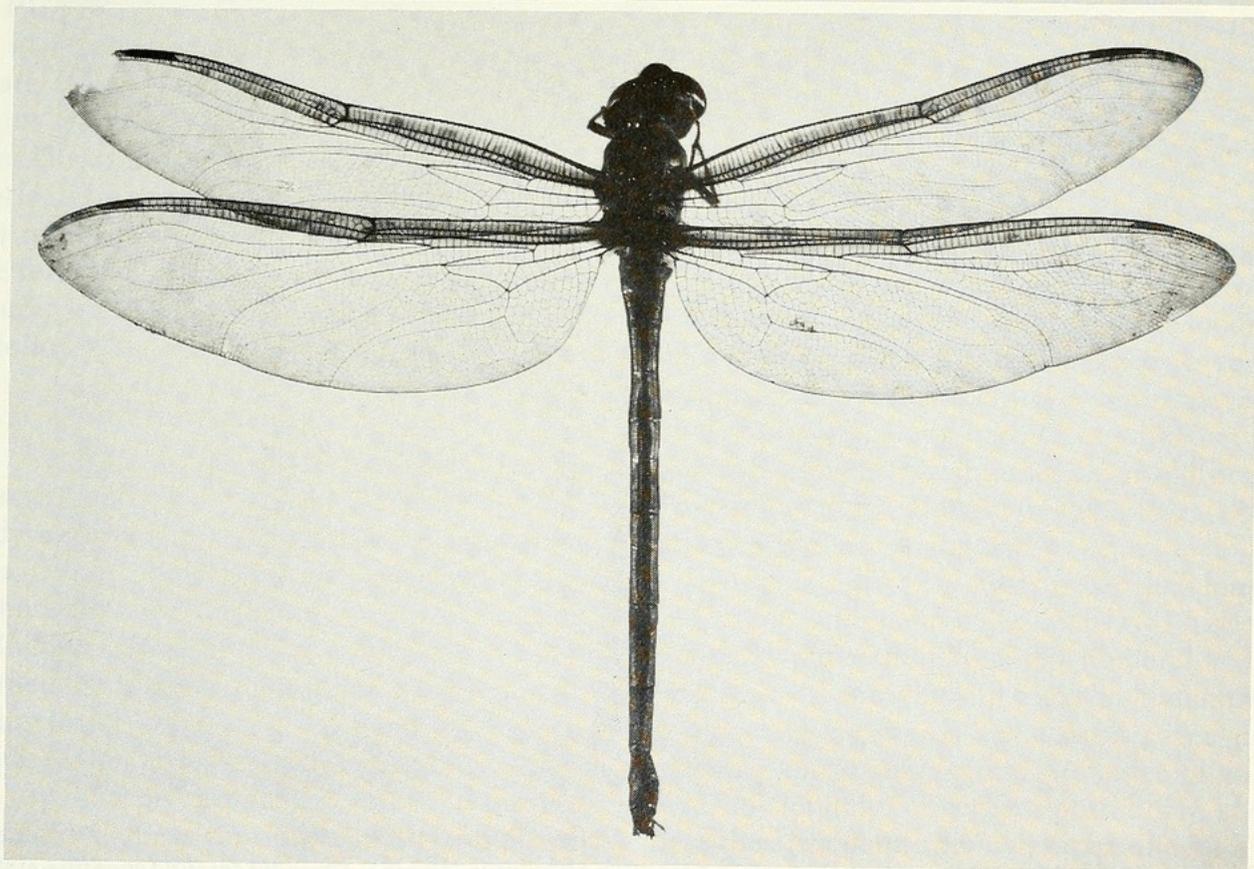
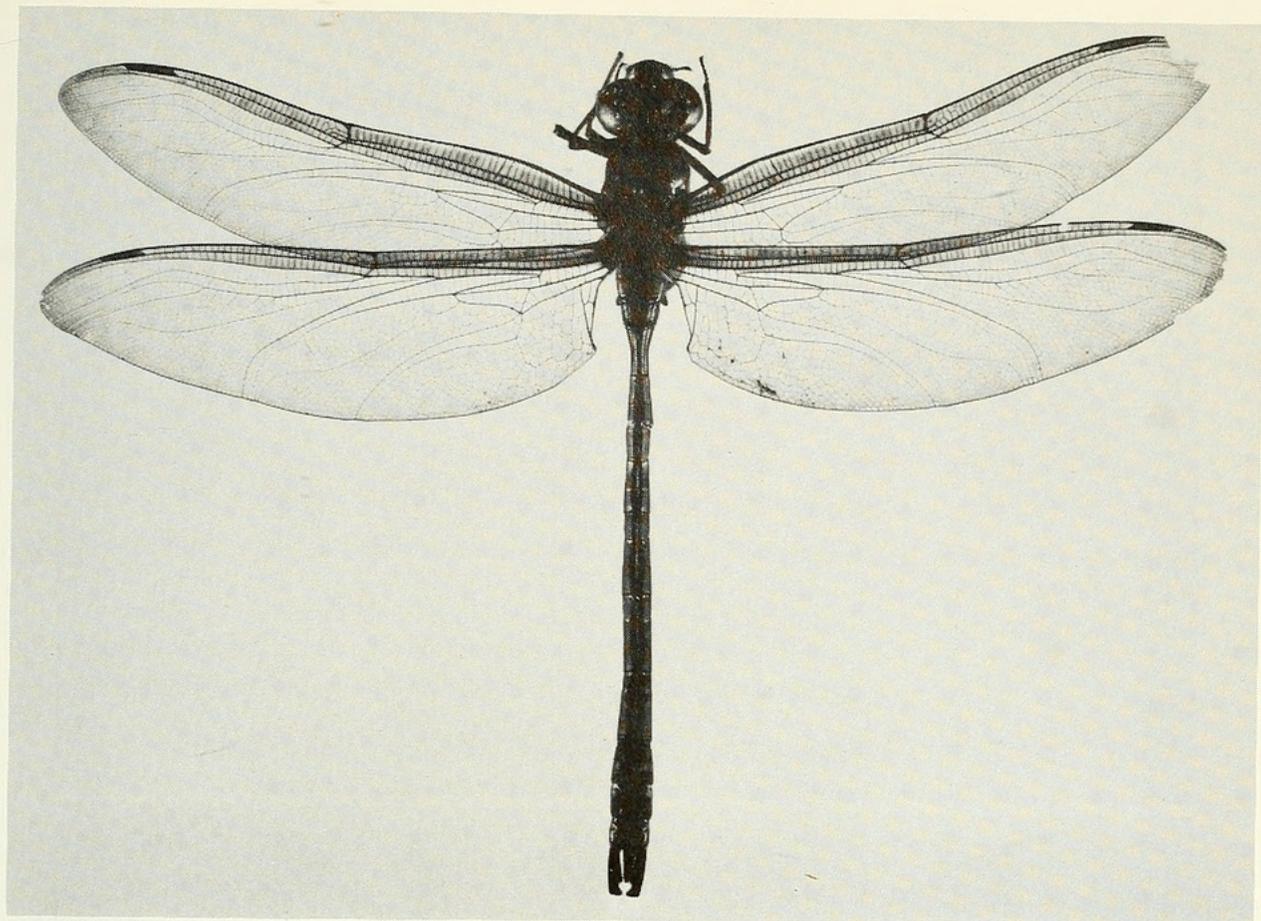
Figs. 66-67.—66, *Neuraeschna costalis* (Burmeister), ♀ holotype; 67, *Neuraeschna costalis* (Burmeister), var. *hyalinata* nov., ♀ Suriname.



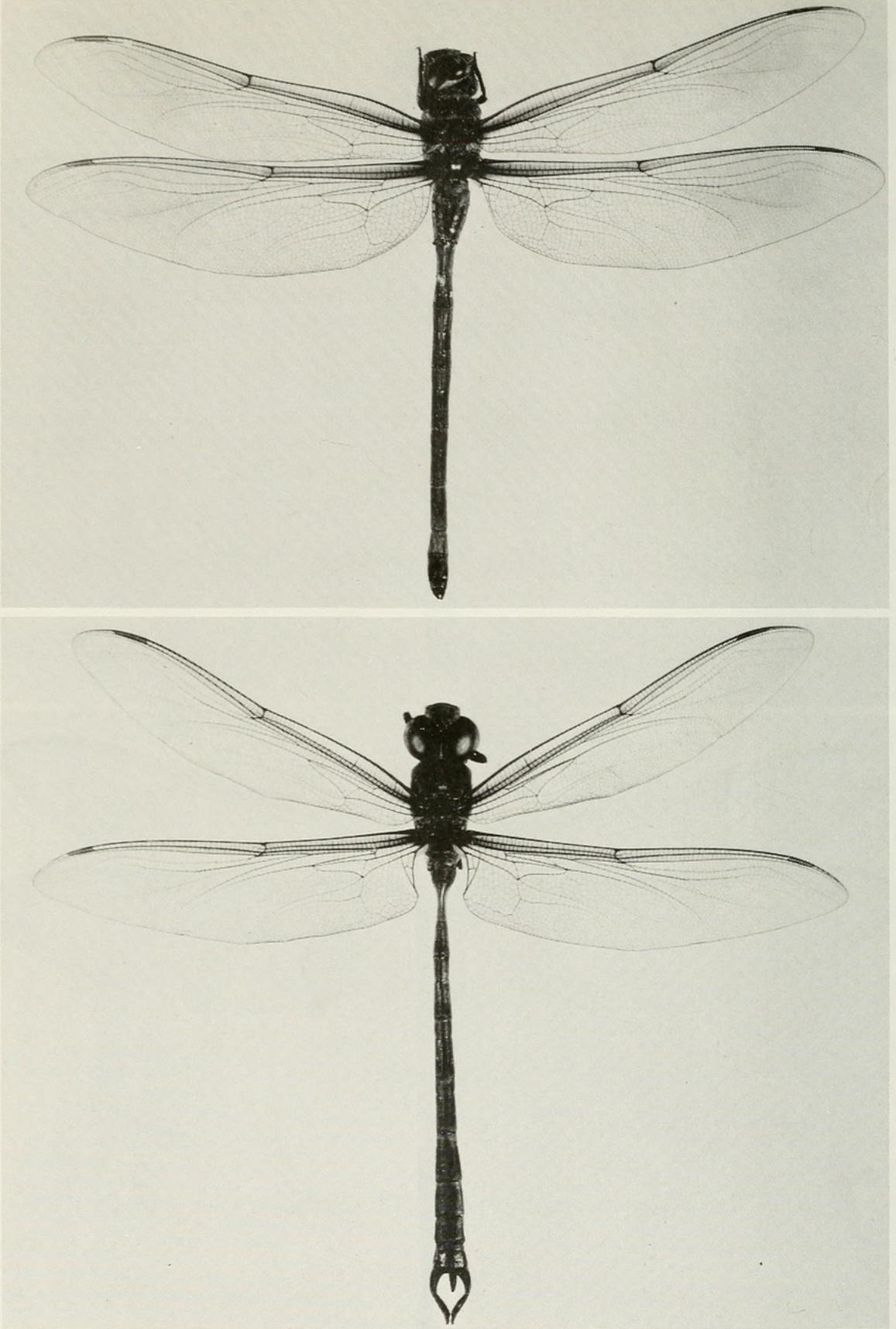
Figs. 68-69.—68, *Neuraeschna costalis* (Burmeister), var. *hyalinata* nov., ♂ Suriname; 69, *Neuraeschna harpya* Martin, ♂ Suriname.



Figs. 70-71.—70, *Neuraeschna calverti* Kimmins, ♂ holotype; 71, *Neuraeschna calverti* Kimmins, ♀ allotype.



Figs. 72-73.—72, *Neuraeschna titania* spec. nov., ♂ holotype; 73, *Neuraeschna titania* spec. nov., ♀ paratype from same locality as holotype.



Figs. 74-75.—74, *Neuraeschna maya* spec. nov., ♀ paratype, Honduras (IRSN); 75, *Neuraeschna maxima* spec. nov., ♂ paratype (RNHL).



Belle, Jean. 1989. "A revision of the New World genus *Neuraeschna* Hagen, 1867 (Odonata: Aeshnidae)." *Tijdschrift voor entomologie* 132, 259–284.

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