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Memoirs of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE.

VOL. VIII. No. 1.

THE

IMMATURE STATE OF THE ODONATA.

PART II.—SUBFAMILY ÆSCHNINA.

BY LOUIS CABOT.

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WITH FIVE PLATES.

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P R E F A C E.



UP to this time seven species only have been described by H. Hagen. One from Brazil, *Gynacantha spec.*; the others from Europe, *Anax formosus*; *Æschna rufescens*, *grandis*, *cyanea*, *affinis*; *Brachytron pratense*.

There have been figured before, —

Anax formosus; Muralto; Drury? Evans; Dufour.

Æschna cyanea; Swamerd? Frisch? Reaumur; Donovan; Dufour.

Æschna mixta; Reaum?

Æschna grandis; Roesel; De Geer; M. Harris.

Æschna rufescens; Dufour?

Æschna constricta; Sanborn.

In all six species, three only, however, are recognizable, and none of the figures are accurate enough for specific determination. Of the twenty-four species now described and figured, containing the types of the seven species described by H. Hagen and others, there are of

Europe, nine.

America, nine; seven from U. S. A.

Asia, four.

Africa, one.

Half of the species described were raised, viz., the nine European species and three United States species. The actual number of described species of *Æschnidae* has not been exactly ascertained, but the twenty-four immature states given are about one tenth. In the United States there are twenty-one species known; of these, seven in the immature state are given. In Europe, thirteen are known; of these, nine in immature states are given. To make any general remarks on the classification of *Gomphina* and *Æschmina* has been found impossible, until the *Libellulina* and *Cordulina* have been described.

The following grouping is the best that can be made at present :—

Mask flat (agreeing with Agrionina), — all *Æschmina* and *Gomphina* (except *Cordulegaster*).

Mask, spoon-shaped (agreeing with *Libellulina*), — *Cordulegaster*.

Antennæ, four-jointed and flattened, — *Gomphus* and Allies.

Antennæ filiform and seven-jointed, — *Cordulegaster* and *Æschmina*, excepting two aberrant genera having six and five joints.

All legs with tarsus three-jointed, — *Æschmina* and *Cordulegaster*.

All legs with tarsus two-jointed, — *Ictinus*.

The two anterior pairs of legs with tarsus two-jointed, — *Gomphina*.

These general characters are sufficient to determine the place of any nymph.

AUGUST, 1881.

BIBLIOGRAPHY.

1634. Th. Moufet, *Insectorum Theatrum*, p. 321 and p. 322, figured a nympha without agreeing description, as *Scolopendra marina*. The figure is recognizable only for the genus.
1684. F. Muralto, *Ephem. Naturæ Curios.* Dec. II. Ann. II. p. 194. Figured and described as *Phryganeon Perlac*, the nympha of *Anax formosus*.
1706. Anonym. (probably W. Homberg). *Observations sur l'insecte poisson, qui se transforme en demoiselle.*
Histoire Acad. des Sc. Paris, p. 9, described shortly the nympha of an *Æschna* and the transformation.
1730. G. L. Frisch, *Beschreibung von allerlei Insecten in Teutschland*, T. VIII. pl. x. p. 20, figured the full-grown nympha of a female (perhaps *Æ. grandis* or *Æ. cyanea*), with a good description.
1732. L. Roberg, *De Libella lacustri*, Upsaliae 4^{to}, p. 9, copies the figure given by Frisch without description.
1737. J. Swammerdam, *Biblia naturæ*, pl. xii, f. 4, figured the nympha of probably *Æ. cyanea*.
1742. De Reaumur, *Mém.* Vol. VI. pl. 36, f. 3, 4, figured the nympha of *Æ. mixta* or *Æ. affinis*; and pl. 39, f. 1-4, the nympha of *Æ. cyanea* in the act of transformation. The general description and the observations are excellent, but not sufficient for specific characters.
1743. E. Hebenstreit, *de insectorum natalibus*, f. cc, figured the nympha of an *Æschna*. Species not determinable.
1749. J. Roesel, *Insectenbelustigung*, Vol. II. p. ii. pl. 3, f. 1-9, figured very well the nympha of *Æ. grandis* in all stages; and pl. 4, f. 10-12, in the act of transformation. The prolix description is not sufficient for specific characters.
1752. J. Bartram, *Observations on the Dragonfly, or Libellula, from Pennsylvania*, *Philos. Transact. London*, Vol. XLVI. pp. 323 and 400, described shortly the nympha of an *Æschna* and the transformation.
1770. D. Drury, *Illustr. of Nat. Hist.*, Vol. I. pl. 47, f. 3, figured the nympha of perhaps *Anax formosus*. The description, p. 115, is not sufficient.
1771. Ch. De Geer, *Mémoires*, Vol. II. pl. 19, f. 12-19, figured the nympha of *Æ. grandis*, with a good description.

1772. M. Harris, Exposition of Engl. Insects, pl. xii., f. 3, figured the nymphæ of *Æ. grandis*.
1793. E. Donovan, the Natural History of British Insects, Vol. II. pl. 44, figured as *Libellula depressa*, the nymphæ of *Æschna* (perhaps *cyanea* or *grandis*). The figure is good, except some minor errors.
1826. Kirby and Spence, Introduction, etc., Vol. III. pl. 16, f. 5, figured as *Libellula*, the nymphæ of an *Æschna*. Described in letter xxx.
1830. (Rennie), Insect Transformations, p. 137, has a copy of Roesel's transformation of *Æ. grandis*.
1845. W. F. Evans, British Libellulina, pl. 1, f. 20, figured the nymphæ of *Anax formosus* as *Æschna*.
1852. Leon Dufour, Etudes anatom. and physiolog. sur les larves des Libellules. Ann. sc. natur. ser. 3. Vol. XVII, pp. 65-110, pl. 3. He is the first to attempt a systematical arrangement of the nymphæ. He described and figured *Æ. grandis* (= *A. formosus*), *Æ. De Geerii* (*Æ. rufescens*), *Æ. inominata* (*Æ. cyanea*).
1853. H. A. Hagen, Stettin. Entom. Zeit. Vol. XIV., has given a review of the literature, and described seven species,—*A. formosus*; *Æ. cyanea*, *affinis*, *rufescens*, *grandis*; *B. pratense*; *Gynacantha spec.*
1857. F. Brauer, Neuroptera Austr. pp. xiv.-xvi., gives an excellent review of the nymphæ. He had raised himself a large number of species, and to him is due most of our knowledge about the species. The nymphæ described by Hagen were mostly communicated to him by F. Brauer.
1862. Fr. Sanborn, Tenth Ann. Rep. Mass. Board of Agric., p. 149, figured the nymphæ of *Æ. clepsydra* (= *Æ. constricta*). The figure is reproduced in A. S. Packard's Guide, p. 602.
1879. Miss Olga Poljetajewa, Mémoires Russian Entom. Soc., Vol. XI. (in Russian language) described the Odonata from St. Petersburg and the nymphæ of *Æ. juncea*, *viridis*, both shortly, and of *Æ. grandis* very detailed and complete.

General descriptions and figures are to be found in the works of Vander Linden, Charpentier, Burmeister, Latreille, Westwood, Lacordaire, Rambur, Stephens, Newport, Newman, and in a large number of popular works; but they are not detailed enough for species or genera. Fossil nymphæ are figured and described. The literature is given by Heer and Hagen.

THE
IMMATURE STATE OF THE ODONATA.

PART II. — SUBFAMILY ÆSCHNINA.

ÆSCHNINA.

BODY elongated. Length from three to six times the breadth. Gills in the end of abdomen. Head large, breadth greater than length, except in *Gynacantha*, in which the length is the greatest. The form of head, mostly square, depends upon situation and form of eyes. Eyes always large and produced at inner hind angles in triangular lobe, separated from each other by advanced portion of occiput, which is generally raised and cut square at front border. The eyes vary in prominence, being least prominent in *Gynacantha*, more so in *Anax*, and most prominent in *Æschna*; — the line behind the eyes is sometimes straight, sometimes oblique, and sometimes curved. Vertex divided into two parts more or less well defined; the posterior portion is generally more nearly square than the anterior, and has generally indications of ocelli. The anterior portion is cut straight in front, and is generally somewhat semicircular; both portions are about on the level of the eyes. On each side of the vertex is an elongated polished spot, in front of which are inserted the antennæ. Antennæ short, slender, and with two exceptions seven-jointed. The two basal joints are globular, stouter than the others; the third, the longest, generally longer than the two basals taken together; fourth usually shortest; following joints longer. In *Gynacantha* the sixth joint is the longest. *E. Heros* has only six-jointed antennæ; the last joint the longest. In the *La Guayra* specimen the antennæ are abnormal, being only five-jointed. Occiput rather flat, shorter in *Brachytron* than in the other described species; sides more or less oblique, sometimes nearly straight; hind angles more or less rounded; in *Gynacantha* forming a sharp angle; hind border more or less notched, approaching in some species a straight line. That part of the head which lies before the eyes forms a

somewhat semicircular space, and consists of the following parts: a transverse short part, representing the front of the imago, separated by a well-marked border from a similar space, representing the epistoma and rhinarium joined in front to the large transverse upper lip, the front part of which is larger than the base and has oblique sides. On each side next to the upper lip, the base of the mandibles is visible. The mandibles, maxillæ, and tongue offer as far as observed no special characters. Mask flat, long, covering the mouth parts beneath, as far as upper lip; extending to between middle legs, except in *Gynacantha*, in which it extends to hind legs. The fore border is always broader than base, never more than twice as large, and the whole mask is more or less gradually enlarged forward. Side bent up and narrowly margined. The middle third of fore border is produced and more or less rounded, sometimes forms an obtuse angle, and is always cleft, generally not deeply, — in *Gynacantha* more deeply, surmounted by a comb of small hairs; on each side the cleft there is sometimes a small tooth, which in *Gynacantha* is strongly developed. Palpus consists of a narrow, nearly straight lobe, either straight at tip or slightly rounded, produced at inferior angle in more or less developed tooth, and more closely meeting the opposite one. The inner edge is either smooth or finely denticulated; movable hook, strong, rounded, very sharp, somewhat bent towards the tip and generally reaching the base of opposite one, and exceptionally it either extends beyond the base of opposite or does not quite reach it. Prothorax small, rather convex, rounded behind, more or less produced at the sides; the stigmata are large, open, and transverse, placed behind the prothorax and not covered by it; except in the *La Guayra* specimen, in which they are completely covered. The sides of the prothorax are produced above the fore legs in two processes, more or less divided and of varying proportion to each other. The form and size of these processes, being mostly rather distinct in form and size in the different species, seem to afford good specific characters. Analogous but less developed processes are found above the middle legs, and indications of them above the hind legs. Legs equally distant at base, or so nearly as not to give any character of importance, except in the *La Guayra* species, in which the hind legs are markedly more distant at base. Legs slender, not reaching tip of abdomen; femora and tibiæ of nearly equal length; tarsi half length of tibiæ, three-jointed; — basal joint very short; claws strong, bent, sharp. Thorax comparatively small. Wing cases large, reaching fourth segment or beyond.

Abdomen large, long, more or less tapering, more than half length of body, rounded above, flat beneath. Segments of equal length, tenth always, and occasionally the ninth shorter, no dorsal spines except in the La Guayra species. Lateral spines always on segments seven to nine, generally on six to nine, and exceptionally on five to nine and four to nine. Appendages as long or longer than the two last segments; inferiors long, sharp, triangular; middle appendage generally a little shorter, notched at tip, — sometimes of equal length, with undivided or split tip. Lateral superiors cylindrical, generally shorter, exceptionally as long and sharp as inferiors. Male has on the basal portion of middle appendage a triangular projection; short, sometimes cut at tip. Genitals not very distinctly marked; on ventral segments two, three, and nine. Female valve is visible on segment nine, sometimes reaching end of segment.

The whole body is either smooth, or has a granulated appearance, which is due to microscopical spines and small holes, sometimes with flattened yellow or pale colored hairs of differing size, never however such as to give a hairy look. The La Guayra species is distinguished by its strongly sculptured appearance. Generally, the occiput has on each side the median line a polished depression, and on the hind angles a series of parallel polished bands, separated by narrow rough lines. The abdomen has on each segment, less distinct on the first and apical segments, eight polished impressions; two near the median line and two on the edge of abdomen on each side. Color pale gray, sometimes darker or brownish black.

There are frequently black spots on occiput, and the sides near the eyes are sometimes bordered with black. Legs have frequently darker rings on femora and tibiae, sometimes on tarsi. Abdomen has sometimes a broad dorsal band, pale in color, divided in centre by a band which is darker, except along the median line, which is again pale. Appendages have the tip sometimes darker than the basal part.

GYNACANTHA.

Rambur, *Hist. des Neuroptères*, p. 209.

Body elongated, very slender, flattened. Length of head greater than breadth. Occiput deeply notched at base; sides straight, forming right angle with base. Eyes narrow in proportion, two thirds length of head, not prominent, broadest in middle, not much produced at inner angles. Antennae seven-jointed; sixth joint longest. Mask extending between hind legs, very

long, narrow, middle third of front border somewhat produced in two triangular lobes, rather deeply cleft; on each side of cleft highly developed spinous processes. Legs very slender. Processes enclosing right angle; posterior longer, anterior thicker. Abdomen long; lateral spines on segments six to nine. Appendages sharp, middle one as long as the inferiors, not deeply notched; laterals somewhat shorter, male projection conical.

1. GYNACANTHA? SPECIES.

PLATE III. FIG. 2.

Hagen, Stettin Zeit. XIV. p. 268.

Locality unknown, probably Brazil. Nymphæ two, male and female not fully grown, types described by Hagen. Length, 42 mm.; breadth, 7 mm. A smaller nympha from Charleston, S. C., and one from Florida, and some 25 mm. length from Rio San Francisco, Brazil, Thayer Exp., are identical.

Body exceptionally slender and elongated, flat. Head very flat, and longer than broad. Eyes elongated, two thirds the length of head, narrow, moderately prominent, at the hind inner angles somewhat produced; separated from occiput by straight line. Ocelli hardly discernible, space between the eyes in general shape almost square. The two parts of the vertex are not very distinctly marked. The lobe at the sides large and polished; part behind the eyes one third the length of head; sides straight; occiput long and deeply notched; hind angles acute, and with polished bands separated by roughened lines on upper side. Antennæ very slender, little longer than head, exceptional in having the sixth joint longest. Mask extending to between hind legs, very long and narrow, enlarged abruptly at apical third to twice the width of basal portion; middle third of front border deeply cleft, into two very prominent teeth, placed one on each side on the inner slope of the cleft. Palpus finely denticulated, cut nearly straight at tip; hooks of palpus prolonged so as to more than meet; movable hooks extending beyond the base of each other, cylindrical. Prothorax nearly as broad as back part of head, rounded behind. Processes enclosing right angle, posterior one longer, anterior thicker. Legs slender, hind legs reaching middle of seventh segment. Thorax small; wing cases in the largest specimen, extending only a little beyond first segment. Abdomen long, slender, small at base and enlarged as far as seventh segment; thence tapering, smooth; the eight impressions not very distinct. The four middle ones, transverse; dorsal band

darker on posterior segments, not well marked on the anterior ones. Side border somewhat projecting. Segments six to nine have lateral spines. Appendages nearly equal in length to segments nine and ten, sharp of nearly equal length, lateral superiors a little shorter; lateral inferiors longest; middle appendage very slightly notched. Male projection triangular, one third of length of middle appendage. Female valve distinguishable in young specimen. The determination is by supposition; no species living both in South Carolina and Brazil being known; indeed no species of *Gynacantha* is known in the United States. This is, however, not of so much importance, as Baron de Selys has described a species from Mexico. The nympha plainly belongs to *Æschnina*, and its abnormal shape strongly points to *Gynacantha*; at least no other genus so abnormal is known. The different species of *Gynacantha* are very similar and are widely spread; and as a species is described from Mexico and three from Cuba, one may also be found in South Carolina; this is even more probable by one full-grown female nympha, 40 mm. length, received from Haskinsville, St. John's River, Florida.

ANAX.

Leach, Edinboro' Encyclopædia, 1817. XI. p. 1, 137.

The largest of the *Æschnina*. Head large, flat, breadth greater than length. Eyes large, forming two thirds of head, prominent, broadest at posterior portion, much produced at inner angle. Antennæ have third joint longest. Occiput rounded at hind angles. Mask extending to middle legs, produced at middle third of front border in short, rounded, cleft lobe. Legs very slender. Abdomen large, lateral spines on segments seven to nine. Appendages long, sharp; middle one notched at tip. Male projection short, cut straight at tip.

2. ANAX FORMOSUS.

PLATE I. FIG. 1.

Selys, Revue des Odonates, p. 110.

Nympha, male and female, in alcohol and dry; one male just half transformed. Length, 52 mm.; breadth, 10 mm. Locality, Vienna, Austria, raised by Dr. F. Brauer; Silesia, Schneider. Coll. Mus. Comp. Zoöl.

Head very flat, rather broader than long. Eyes large, more prominent

than in *A. Junius*, separated from occiput by nearly straight line. Posterior part of vertex has indication of ocelli. Elongated elevations outside of vertex, large and marked. Antennæ small, similar to *Æschna*. Occiput short, hind angle rounded with indistinct bands on upper side, notch of hind border rather shallow. Mask long, extending to between middle legs, narrow, gradually enlarged forward. Middle third produced in rounded lobe, cleft, with comb of hairs. Palpus meeting opposite one; narrow, cut straight at end, with lower angle produced in short tooth, finely denticulated; movable hook, sharp bent, reaching base of opposite one. Prothorax as broad as occiput, rather short. Stigmata behind the prothorax uncovered. Processes nearly equal in length, short, blunt, enclosing right angle, posteriors largest. Legs long, slender, nearly cylindrical, hind legs longest, reaching end of segment eight. Femora longer than tibiæ; tarsi about one half length of tibiæ; apical joint making one half of tarsus; claws strong, sharp, bent; thorax comparatively small. Wing cases reaching nearly to segment five. Abdomen rather small at base, gradually enlarged to segment seven; thence tapering, rounded above, each segment with eight impressions. Dorsal band dark, interrupted throughout its length by paler line; lateral paler bands on each side; margin of abdomen darker, indistinctly marked with paler linear spots. Strong lateral spines on segments seven to nine; that on ninth as long as segment ten. Segments of equal length, tenth shorter. Inferior appendages long, sharp, as long as two last segments; middle one shorter than inferiors, notched; lateral superiors cylindrical, sharply pointed, half as long as middle one; male projection very small, cut square at tip, less than one half the length of laterals: female valve two thirds of segment nine, small. Nymphæ described are types of *H. Hagen*, *Stett. Zeit.* XIV. p. 268, and *F. Brauer*, *Neur. Austr.* p. xvi. Dr. Hagen considers this species to be the "*Æschna grandis*" described by *L. Dufour*, *An. Nat. Ser. 3, XVII.* p. 69, pl. 3, f. 1. The younger nymphæ from Vienna, mentioned by *H. Hagen*, *Stett. Zeit.* XIV. p. 267, as belonging perhaps to *Anax Parthenope*, prove to be young specimens of *Anax formosus*.

3. ANAX MAURICIANUS.

Rambur, *Neuroptères*, p. 184.

Nympha, male and female, dry, full-grown, and young. Length, 46 mm.; breadth, 10 mm.: the smallest young, length, 26 mm. Locality, Mauritius

Island, Mr. Pike, one full-grown male and two younger ones in alcohol, together with some imagos. Zanzibar, Mr. C. Cooke, ten specimens, male and female, in alcohol; length, 23 to 26 mm.

Very similar to *A. formosus*; differing by the two processes above the first legs, more blunt, enclosing an obtuse angle; mask narrower, the apical third more suddenly enlarged; middle appendage longer, nearly as long as the inferiors.

I had at first the specimens from Zanzibar, considered to belong to *A. formosus*, and the young ones are indeed similar to this species. One male, 34 mm. long, does not show the male projection; the smallest, 26 mm. long, has the wing cases just covering the first segment. Apparently, the characters are not so well expressed in the young ones; and I consider them probably belonging to *A. Mauricianus*, though this species is not yet received from Zanzibar.

4. ANAX JUNIUS.

PLATE I. FIG. 2.

Drury; Hagen, Synops. N. Amer. Neur. p. 118.

Nympha, male and female, dry and in alcohol. Length, 40 to 52 mm.; breadth, 10 mm. Locality, Springfield, Mass.; Boston and Cambridge, Mass.; Amherst, N. H.; Caledonia Creek and Crown Point, N. Y., Mr. J. A. Lintner; New Jersey; Detroit, Mich., Mr. H. J. Hubbard, a large number, young and full-grown; Charleston, S. C.; Pilichody, Mobile, Ala.; St. Louis, Mo., Mr. Ch. V. Riley, Kentucky; N. Mexico; Port de France, Martinique. Coll. Mus. Comp. Zoöl.

Very similar to *Anax formosus*. Differs in having the palpus not so straight at tip, with stronger end hooks; processes more obtuse, and enclosing an obtuse angle, of same size and shape; lateral appendages having the lower end more abruptly pointed than *A. formosus*, in which it is tapering. Male projection notched at tip. Very young specimens, 16 mm. long, from Springfield and from Detroit, have the palpus cut straight at tip; wing cases covering first segment. Besides the numerous specimens in alcohol, there are three raised by Mr. Ch. V. Riley and Mr. S. Henshaw.

Several specimens from San Diego, Cal., differ in having two black teeth in the middle of the comb of the front border of the mask, and the abdomen more bulky and broader. From the same locality and from the same collection *A. validus* was received. Nevertheless, it seems very doubtful

that nymphæ very similar to those of *A. Junius* should belong to the gigantic and very different *A. validus*.

A specimen in alcohol from New Mexico, Dr. Yarrow, differs by a shorter and broader mask. Perhaps it belongs to a new, still unknown species.

A very young specimen in alcohol from Key West Island, Florida, Mr. Garman, differs by a large head and very long legs. Perhaps it belongs to *A. longipes*.

5. *ANAX JULIUS*.

Brauer, Voyage of the "Novara," p. 63.

Seven nymphæ, male and female, in alcohol and dry. Length, from 28 to 50 mm; breadth, from 6 to 10 mm. Coll. Mus. Comp. Zoöl. Locality, Kanagava, Japan.

Very similar to the other forms of *Anax*. Processes as in *A. Junius*. Lateral appendages as in *A. formosus*. Male projection short, blunt; indication of notch at tip. In full-grown female, wing cases reaching segment five; palpus somewhat larger at tip, straighter, superior angle very little rounded; female valve, two thirds of ninth segment.

The nymphæ were received, together with the imago. No other species is known from Japan.

6. *ANAX GUTTATUS*.

Burm. Hdb. T. II. p. 340.

Twelve nymphæ, male and female, nearly full-grown, and young, in alcohol. Length, 60 to 40 mm.; breadth, 6 to 10 mm. Coll. Mus. Comp. Zoöl. Locality, Ebon, Marshall Island, Pacific Ocean, Rev. B. G. Snow.

Longer and less broad than the other species. Mask reaching the base of hind legs, narrow, more than four times longer than the breadth of base, gradually enlarged forward; front margin rounded, cleft; palpus narrowed to tip, superior angle obtuse, rounded; lower angle forming a very strong tooth; processes unequal, upper part blunt, lower part smaller, angular behind; enclosing a very obtuse angle, with a smaller median notch. Legs slender, long. Inferior appendages longer than the two last segments; lateral appendages sharply pointed; male projection narrow at tip, cut square; female valve small, half as long as the segment.

The nymphæ were received, together with the imago. The supposed identity is probable.

7. ANAX AMAZILI.

Burm. Hdb. II. p. 841.

Nympha, full-grown, male and female, dry; one in alcohol. Length, 53 to 58 mm.; breadth, 10 mm. Locality, Jamaica, Mr. H. J. Hubbard; Central America.

Similar to *A. Junius*, but considerably longer, though not broader; the mask four times longer than broad at the base (little more than three times longer in *A. Junius*); palpus cut straight at tip, with strong hook; processes above the first legs of equal size and length, enclosing a very obtuse angle; lateral appendages sharply pointed (in *A. Junius* dilated internally to the abruptly pointed tip); basal projection of the middle appendage of the male narrowed on tip and notched, about one third as long as the lateral appendages (broad on tip and emarginated, half as long as the lateral appendages in *A. Junius*).

A. Amazili is known from Cuba and Barbados, not yet from Jamaica; but there is no other species of *Anax* known from the Antilles.

8. ANAX SPECIES.

Nymphæ, full-grown and young, male and female in alcohol. Length, 20 to 42 mm.; breadth, 9 mm. Locality, Holy tank at Ibanca, East India, Rev. M. Carleton.

Similar to *A. Junius*. Processes more blunt; posterior smaller, enclosing an obtuse angle. Mask longer, the front margin less prominent, more rounded. Palpus narrowed at tip, upper angle rounded, lower one produced in a strong oblique end hook, below finely denticulated. Appendages, as in *A. Junius*, abruptly pointed, more so at the male; projection of male slightly notched at tip.

The determination of the species is not possible. One, *A. immaculifrons*, was received by Rev. M. Carleton, though not from the same locality. *A. Bacchus*, perhaps identical with *A. Parthenope*, lives in the sub-Himalaya; and *A. perplexus* Hagen, from Kooloo Valley, Himalaya, was received by Rev. M. Carleton; both sexes. Perhaps the nymphæ belong to the latter undescribed species.

ÆSCHNA.

Fabricius, Syst. Entom.

Body stout in proportion. Head, breadth twice the length, flat. Eyes large, very prominent, rounded forward, prolonged at inner angles in enlarged lobe. Antennæ have third joint longest. Mask extends to middle legs, large, broad; front border produced in short rounded lobe, cleft at middle. Legs longer and stouter than *Anax*. Abdomen broader; lateral spines on segment five or six to nine. Appendages long, sharp; middle one notched at tip; laterals shorter than middle one. Male projection conical; female valve reaching tip of segment.

9. ÆSCHNA RUFESCENS.

PLATE V. FIG. 4.

Vander Linden; Selys, Revue des Odonates, p. 129.

Nympha skins, male and female. Length, 40 to 44 mm.; breadth, 9 mm. Locality, Vienna, Austria. Raised by Dr. Brauer; Lueneburg, Mr. Heyer; Koenigsberg, H. Hagen.

Stout. Head large, flat, broader than long. Eyes large, very prominent, separated from occiput by nearly straight line. Occiput short, hind angles rounded and with polished bands on upper side; a polished spot on each side of the median line; hind border notched. Ocelli indicated. Anterior portion of vertex semicircular. Antennæ short, not extending beyond the eyes; seven-jointed, third joint longest. Mask extending between middle legs, stout; length greater than breadth; enlarged gradually forward; middle third somewhat produced; cleft in middle, with comb of hairs. Palpi broad, straight, cut square at end and produced only slightly in end hooks, finely denticulated. Movable hooks sharp and bent, thin, just reaching the base of their opposite. Prothorax not as broad as occiput, hind border rounded. Processes enclosing an acute angle, anterior one half length of posterior, both sharp. Legs rather slender, hind legs longest, extending to eighth segment; femora somewhat arcuated; two faintly-marked pale rings on lower portion of femora. Wing cases extending to fourth segment. Abdomen stout, very convex above, tapering from the middle to the tip, smooth; two parallel dark dorsal bands best defined at beginning of segments. Lateral spines on segments six to nine, strong, last shorter than segment ten. Appendages sharp, long as the last two segments; lateral

inferiors longest, lateral superiors two thirds the length of middle, middle nearly or quite straight at tip. Male projection stout, blunt, triangular, angular, half length of lateral superior appendages. Female ventral valve reaches end of segment. The described nymphæ are the types of Hagen Stettin Zeit. XIV. p. 267. Brauer, Neuropt. Austr. p. xvi.

Æ. De Geerii Dufour, Ann. se. nat. ser. 3, XVII. p. 69, pl. 3. fig. 3, is apparently this species. L. Dufour has overlooked the small lateral spine on segment 6.

10. *ÆSCHNA GRANDIS*.

PLATE II. FIG. 1.

Linnaeus. Selys, Revue des Odonates, p. 131.

Nympha skins. Length, 44 mm; breadth, 9 mm. Locality, Lueneburg. Mr. Heyer; Königsberg, Hagen.

Dr. Hagen observed the transformation of this species more than thirty years ago. The specimens are, however, no longer in his collection. A large number of nympha skins sent him by M. Heyer, unassorted, as *Æ. grandis* and *Æ. viridis*, were easily distinguishable as two species, but it could not be determined which were *Æ. grandis* and which *Æ. viridis*. Two specimens, both labelled *Æ. viridis*, pinned during transformation, were sent by M. Heyer; but of these one has only the head developed, and the other the parts only as far as the metathorax; and, as the color and shape are not fully shown, they can neither of them be considered as fully determined. These latter specimens, seeming probably *Æ. viridis*, Dr. Hagen refers the other nympha skins, which were sent before and were similar, to *Æ. viridis*; those dissimilar to *Æ. grandis*.

Very similar to *Æ. rufescens*; hind angles of occiput more sloping, line back of eyes more curved, palpus more convex and narrower. Processes different, of equal length, more widely separated, anterior thinner, somewhat bent outward at tip. Appendages different; middle shorter in proportion to inferiors than in *Æ. rufescens*. Lateral superiors about one half length of middle. Male projection shorter, tip sharper. This species is more brightly colored than *Æ. rufescens*. Abdomen brownish, dorsal band broad and dark, divided by a light median line. The nymphæ described are the types of Hagen, Stettin Zeit. XIV. p. 268, and F. Brauer, Neur. Austr. p. xvi.

Miss Olga Poljetajewa has raised this species, and fully described the nympha in Horæ Ross, St. Petersburg. 1879, 5, p. 15. The description confirms the identity with the above-described nymphæ.

11. *ÆSCHNA CYANEA*.

PLATE IV. FIG. 3.

Mueller. Selys, *Revue des Odonates*, p. 115.

Nymphæ, in alcohol and skins, male and female. Length, 48 mm.; breadth, 9 mm. Locality, Vienna. Raised by F. Brauer; Lueneburg, raised by M. Heyer; raised by Prof. Rosenhauer, Erlangen, Bavaria.

Body elongated and slender. Head large, flat, narrow behind. Eyes large, prominent, globular, occupying half the head; inner hind angles much produced. Line between occiput and eyes curved. Sides of head oblique, hind angles rounded. Occiput notched; on each side of median line a polished spot, on upper side of hind angles polished bands separated by roughened lines. Vertex, antennæ, and mouth parts as in *Æ. rufescens*. Head grayish, with paler band at sides; a pale spot on each side the median line of occiput. Mask extending between the middle legs; narrow at base, one half width of front border. Middle third of front border somewhat produced, at very obtuse angle, cleft with a comb of hairs. Palpi meeting broad, cut straight at ends, and produced very slightly into end hooks. Movable hooks sharp and thin, reaching base of the opposite one. Prothorax small, as broad as back part of occiput, ash gray at each side, pale at border. Processes short, scabrous, enclosing a little more than a right angle; anterior shortest; legs slender, hind legs reaching eighth segment. Femora and tibiæ ringed with two darker bands. Thorax not very large; wing cases reaching fourth segment. Abdomen long, slender, enlarged gradually to beyond the middle, thence tapering, grayish; dorsal band dark, divided by paler band; a pale band on each side of dorsal band. Segments of about equal length, except tenth, which is shorter. Lateral spines on segment six to nine. Inferior appendages as long as two last segments, triangular, sharp; lateral superiors one half length of inferiors. Middle appendage notched; male projection conical, rather enlarged at base, shorter than lateral appendages. The whole body finely granulated with what appears, when highly magnified, to be spines pointing backward, and with short yellow hairs inserted behind them. Genital parts of the male indicated, those of the female extending somewhat beyond the ninth segment.

The nymphæ described are types of Hagen, *Stettin Zeit.* XIV. p. 266; and F. Brauer, *Neur. Austr.* p. xvi. *Æschna innominata*, Dufour, *Ann. se. nat. ser. 3*, XVII. p. 69, pl. 3, f. 5, is apparently *Æ. cyanea*.

12. ÆSCHNA JUNCEA.

PLATE IV. FIG. 1.

Linnæus; Selys, *Revue des Odonates*, p. 116.

Three nymphæ, male and female, skins, by M. Heyer; five from J. Boll. Length, 44 m.; breadth, 8 mm. Locality, Lueneburg, Zurich. Five nymphæ raised by Mr. J. Boll, Switzerland.

Very similar to *Æ. cyanea*, a little shorter. Processes strikingly different. Anterior only half as large as posterior and much smaller. Granulation, color of legs, body, and appendages as in *Æ. cyanea*. The lateral appendages are more slender and more pointed, and the hind angles of occiput more rounded than in *Æ. grandis*.

The imago has been raised, and the nymphæ shortly described, by Miss Olga Poljetajewa, l. c. p. 15.

13. ÆSCHNA VIRIDIS.

PLATE V. FIG. 5.

Eversmann. Selys, *Revue des Odonates*, p. 127.

Nymphæ skins, male and female; and full-grown nymphæ, dry. Locality, Lueneburg, M. Heyer; Kœingsberg, H. Hagen. Length, 42 mm.; breadth, 9 mm.

Similar to *Æ. rufescens*, more slender. Head narrower behind; hind angles of occiput more rounded. Sides of head not so straight. Mask somewhat shorter and broader. Palpus narrower, more convex. Processes nearly equal length, enclosing nearly a right angle; tips bent outward. Abdomen more slender, uncolored; lateral spines on segments six to nine. Middle appendage shorter and more notched than in *Æ. rufescens*; lateral superiors short, one half length of middle one; male projection nearly as long as the lateral superiors, conical, tip rather sharp.

The species was raised by Miss Olga Poljetajewa, l. c. p. 15. She says the nymphæ is very similar to *Æ. juncea*, except that the lateral spines of abdomen are developed as well as in *Æ. grandis*.

14. ÆSCHNA MIXTA.

PLATE V. FIG. 2.

Latreille; Selys, *Revue des Odonates*, p. 122.

Nymphæ skins, male and female, raised by M. Heyer. Length, 33 mm.; breadth, 7 mm. Locality, Lueneburg.

Similar to *Æ. cyanea*. Body shorter, and stouter in proportion. Head flatter. Eyes larger and more prominent, separated from occiput by nearly straight line. Vertex more in the same plane with the eyes. Occiput shorter and straighter behind. Bands on hind angles less marked; color grayish; a pale elongated spot on each side of median line, and a narrow pale band on hind angle, often scarcely discernible. Mask long, extending through middle legs, gradually enlarged; front border a little more than twice width of base; middle third of front border somewhat produced and rather widely cleft, with comb of hairs. Palpus broad, rounded at upper angle, and produced in very short black teeth at lower angles; denticulation beneath discernible; movable hook, reaching the base of opposite one. Prothorax as broad as back part of occiput, rounded behind. Processes stout and blunt, not much separated, anterior more contracted. Legs very slender; hind legs extending to ninth segment, ash-gray; femora with two pale rings. Wing cases extending to middle of fifth segment. Abdomen short, stout, tapering from seventh segment; dorsum very convex; finely granulated as in *Æ. cyanea*, but with whitish hairs; color grayish; each segment with eight darker impressed spots, four on middle and two on each side near margin. Segments of nearly equal length, except tenth, which is half as long; lateral spines on segments six to nine; that of ninth nearly as long as tenth segment. Inferior appendages as long as two last segments, triangular, sharp; middle appendage notched, not so long as inferiors; lateral superiors rather more than half length of middle one, cylindrical, slender, and sharp. Male projection conical, rather sharp, nearly as long as lateral superiors. Male genital parts slightly marked; female valve extending somewhat beyond ninth segment.

15. *ÆSCHNA AFFINIS*.

PLATE V. FIG. 3.

Vander Linden; Selys, *Revue des Odonates*, p. 124.

Nympha, male, raised by F. Brauer. Length, 33 mm.; breadth, 7 mm. Locality, Vienna.

Similar to *Æ. mixta*. More slender in proportion. Eyes not so large or prominent. Occiput more rounded. Mask shorter and broader in proportion, extending through middle legs, enlarged gradually forward, so that front border is twice as broad as base; middle third not so produced as in *Æ. mixta*, and finely cleft, with a comb of hairs. Palpus broad and straight

at ends, and more nearly meeting than in *Æ. mixta*. Movable hooks as in *Æ. mixta*. Prothorax similar to *Æ. mixta*. Processes blunt, depression between them very shallow, of nearly equal size. Abdomen more slender, iron gray; the whole insect of this color; dorsal band darker, interrupted by lighter spots. Lateral spines on segments five to nine, that on fifth very small. Spine of ninth shorter than tenth segment. Finely granulated; hairs pale, and when present finer and shorter than in *mixta*. Appendages similar, except lateral superiors, only half as long as middle one, somewhat longer than male projection. The nympha described is the type of Hagen, *Stettin Zeit.* XIV. p. 267; and F. Brauer, *Neur. Austr.* p. xvi.

16. *ÆSCHNA EREMITICA.*

PLATE II. FIG. 2.

Scudder, *Proc. Boston N. H. Soc.* XI. p. 213.

Nymphæ, male and female, skins, and some not full-grown, in alcohol. Length, 39 to 47 mm.; breadth, 10 mm. Locality, mouth of Red River of the North; Hermite Lake, White Mountains, New Hampshire, Mr. Sanborn; Minnesota. *Coll. Mus. Comp. Zoöl.*

Similar in general shape to *Æ. rufescens*. Head much larger, remarkably large in proportion. Eyes large and prominent. Occiput not very deeply notched behind; sides oblique, and rounded at hind angles; three polished spots on middle; polished bands on hind angles. Antennæ, third joint nearly as long as first and second; fourth, about one half third; other, somewhat longer. Mask broad, passing through middle legs, gradually enlarged forward; base more than half width of front border; middle third produced in small rounded lobe, cleft and with comb of hairs. Palpus cut straight at end; rather flat, nearly or quite smooth. End hooks short; movable hook bent, sharp, reaching base of opposite one. Prothorax as broad as hind part of occiput. Legs slender, hind legs reaching ninth segment. Femora with dark ring on lower part. Processes long, of equal length, sharp, enclosing somewhat less than right angle, a little bent outward. Wing cases reaching segment five. Abdomen rather broad; enlarged gradually to seventh segment, thence tapering rather abruptly. Segments with four dorsal and four lateral darker spots, and two polished impressions on each side; tenth segment shortest. Lateral spines on segments five to nine, that on ninth nearly as long as tenth segment. All segments finely

granulated. Appendages longer than two last segments; sharp, middle one a little shorter than inferiors, deeply notched; lateral superiors cylindrical, sharp, nearly two thirds as long as middle one. Female valve not quite reaching end of segment nine. Male projection conical, rather sharp, a little shorter than lateral superiors. The two male specimens are not fully developed in these parts, being only 30 and 33 mm. long. A full-grown female specimen from Minnesota, 47 mm. long, belongs apparently to this species. The determination seems to be justified, as Mr. Sanborn found nymphæ and imago at the same place, Hermit Lake, in middle of July.

17. *ÆSCHNA CONSTRICTA*.

PLATE III. FIG. 1.

Say. Hagen, Synopsis N. American Neur, p. 123.

Nymphæ, two full-grown, in alcohol. Length, 41 mm.; breadth, 7 mm. Locality, Shooley's Mountain, Pa.; Boston, Mass., raised by Mr. S. Henshaw. Coll. Mus. Comp. Zool.

Similar to *Æ. eremita*. Longer and more slender in proportion. Head very similar. Mask narrower at base, more abruptly enlarged at apical third. Palpus finely denticulated, tip cut straight. Processes similar to *Æ. eremita*, not so long nor so sharp, the anterior less bent, the posterior a little larger. Legs similar in shape, shorter in proportion; hind legs not reaching segment eight. Granulation on abdomen very fine. Lateral spines on segments six to nine, an indication on fifth. Ninth segment half length of tenth. Inferior appendages as long as two last segments, very sharp; middle one not so long as inferiors; deeply notched; lateral superiors more than half length of middle one, cylindrical and abruptly sharpened. Male projection conical, somewhat shorter than lateral superiors, sharp. Hairs among granulation, small, yellowish.

Two full-grown female nymphæ, one from Maryland, the other without locality, and a small male seem to belong to this species. Male, in alcohol, from Lake Champlain, is sufficiently like to be placed in this species. Somewhat less slender, darker in color; two black rings on femora and tibiæ and on end of tarsal joints.

A very small nympha from Bethel, Me., and some younger ones from Cambridge, Mass., are colored in the same manner. Abdomen in many specimens dark, varied with short linear spaces of paler color and with large

black rings on femora and tibiæ. This nympha is figured by Mr. F. Sanborn, Report Mass. Board of Agricult., 1862, p. 149, and copied in A. S. Packard's Guide, p. 602. Mr. Sanborn stated it to be the nympha of one of the most common species, and Mr. Packard considered that it belonged to *Æ. constricta* or *Æ. clepsydra*. The type of Mr. F. Sanborn's figure is in his collection of nymphæ.

A full-grown nympha from Sitka, Northwest America, belongs perhaps to *Æ. Sitkensis*. It is in bad condition, and is not figured, but is very similar to the above described species.

Three nymphæ, supposed to belong to *Æ. clepsydra*, multicolor, and verticalis were not described. None of them is full-grown.

18. *ÆSCHNA* SPECIES.

PLATE IV. FIG. 2.

Nymphæ, male and female, very young to full-grown. Length, 20 to 57 mm.; breadth, 9 mm. Locality, Himalaya, Kooloo, and Sutledge River. Rev. M. Carleton.

Similar to *Anax*; very long, but narrow; third joint of antennæ about as long as the following together. Processes blunt; posterior more prominent, enclosing an obtuse angle. Mask cleft wider, with a small black tooth on each side. Palpus cut straight at tip, upper angle sharp and lower one produced in a strong end hook; below finely denticulated. Lateral appendages half length of middle one, abruptly pointed. Male projection shorter, conical. Femora with dark rings before the lower end. Abdomen not very thickly covered with spinous tubercles.

No imago arrived with the nymphæ. Perhaps they belong to *Æ. ampla*.

19. *ÆSCHNA* SPECIES.

PLATE I. FIG. 4.

Nine nymphæ, male and female, full-grown and young, in alcohol. Length, 45 mm.; breadth, 9 mm. Locality, Rio San Francisco and Carundahi, Rio do Macacos; one male nympha from Reajinha River, near Corpo de Pompo, from Barbacena, Brazil. Thayer Expedition. Coll. Mus. Comp. Zoöl.

Full-grown and very young nymphæ, 24 mm. long, wing cases not reaching first segment, from Rio do Macacos have appendices similar.

Similar to *Æschna grandis*, stout. Eyes rather large and more prominent. Ocelli indicated. Antennæ very small; third joint length of first and second and twice as long as fourth. Occiput more deeply notched than in *Æschna grandis*, sides oblique and rounded; a number of polished bands on upper side. Mask extending to between middle legs, broad, enlarged gradually forward, middle third produced in short rounded lobe, cleft, sides of cleft rounded and on each side a small black tooth. Palpus denticulated, cut straight at tip, movable hook extending somewhat beyond base of opposite one. Prothorax rounded behind; processes sharp, enclosing rather less than right angle; posterior nearly twice as long as anterior, and bent backward. Legs rather slender; femora arcuated; hind legs reaching middle of seventh segment. Abdomen broad and stout, rather densely covered with short yellow hairs; dorsal band dark; lateral spines on segments six to nine, spine on ninth shorter than tenth segment. Appendages rather longer than two last segments, very sharp; lateral superiors nearly as long as inferiors, very sharp; middle appendage somewhat shorter and deeply notched. Male projection conical, rather sharp, one half length of middle appendage. Female valve reaching somewhat beyond ninth segment. This species cannot be determined. It may perhaps belong to a peculiar group named *Ura-cantha* by De Selys. To this group belong *Æschna Januaria*, Hagen's Synopsis, *Æschna castor*, Brauer, Voyage of Novara, and two or three species not yet described.

Two nymphæ from Rio Janeiro, Brazil, are similar, but belong probably to a related but different species.

BRACHYTRON.

Evans, British Libellulina, p. 22.

Body elongated, lateral spines on segments six to nine, slender. Head rather small and convex; base of occiput narrow. Eyes small in proportion. Front border of mask produced in oblique angle, cleft; no teeth. Legs rather short. Appendages short; middle one somewhat shorter than inferiors, cut at tip; laterals short. Male projection conical; female valve not reaching tip of segment.

20. BRACHYTRON PRATENSE.

PLATE V. FIG. 1.

Mueller. Selys, Revue Odonates, p. 115.

Nympha skins, male and female. Length, 39 to 42 mm.; breadth, 7 mm. Locality. Vienna, raised by F. Brauer; raised by Mr. Heyer, Lucneburg; Danzig, by Mr. Brischke; Silesia from Charpentier.

Long and slender. Head smaller in proportion than in the other European species, narrower behind, more convex on top. Eyes rather small, placed at forward angles of head, prominent, and separated from occiput by very curved line. The inner hind angles much produced and rounded, with no appearance of facets, which occur in other species, with exception of *Æ.* affinis, which wants facets in inner part of produced angle. Occiput longer, hind angle sharper and notched behind at almost a right angle; a spot on each side of median line, which forms a ridge; polished bands on hind angles. Antennæ differ in having third joint only half length of fourth. Mask reaching middle legs, less gradually enlarged, enlargement being chiefly of apical third; more produced at middle third of front border, cleft narrower, and comb of hairs longer. Palpus shorter, more denticulated; movable hook not meeting the base of opposite one, nearly as thick at base as palpus. Prothorax small, a little wider than hind border of occiput, more rounded behind. Stigmata uncovered. Processes not much separated; anterior nearly twice as long as posterior. Legs shorter and stronger; hind legs reaching middle seventh segment; femora somewhat areuated. Wing cases reaching fourth segment. Abdomen long, slender, broadest at middle, tapering gradually, smooth; four dark spots in middle of each segment, two on each side, and near margin two polished impressions. Segments nearly equal in length, except tenth, which is somewhat shorter. Lateral spines small on segments six to nine; only indicated on sixth sometimes; that on ninth only one third length of tenth segment. Appendages short and blunt, a little longer than segment ten. Inferiors cut obliquely, middle one nearly as long, cut straight at tip, not notched. Lateral superiors nearly as long as middle one, bluntly pointed. Male projection large, conical, rounded, more than half length of lateral superiors. Male genitals slightly marked; female valve not reaching end of ninth segment.

The nymphæ described are the types of Hagen, Stett. Zeit. XIV. p. 268, and Brauer, Neur. Austr. p. xvi.

GOMPHÆSCHNA.

Body long, slender. Eyes rather small. Abdomen with lateral spines on segments five to nine. Appendages as long as segments nine and ten. Inferiors sharp, bent inward at tip; middle one a little shorter, sharp, bifid at tip; laterals very short.

21. GOMPHÆSCHNA FURCILLATA.

PLATE II. FIG. 4.

Say. Hagen, Synopsis N. Amer. Neur. p. 131.

Two nymphæ, in alcohol, young. Length, 26 mm.; breadth, 7 mm. (figured). Locality, Berkshire, Tioga County, N. Y. Three male and female, length, 32 mm., Brookline, Mass. Two young, Cambridge, Mass.

Head large, very broad; length less than half the breadth, much narrower behind. Eyes very prominent, placed at forward angles, separated from occiput by very curved line; space between the eyes wide, convex. Posterior portion formed of three orbicular elevations, showing the indications of ocelli more distinctly than in the other species. Antennæ small, third joint somewhat longer than fourth. Occiput short, rough, with yellowish scales, sides oblique: hind angles somewhat more than a right angle, with parallel polished bands; elliptical polished spot on each side of median line; hind border not very deeply notched. Mask extending to between middle legs gradually enlarged forward. Middle third of front border rather strongly produced; cleft and with a well defined tooth on each side of cleft. Palpus meeting the opposite one, straight on tip, somewhat arcuated; inner border rounded and finely denticulated; end hook small; movable hook bent, reaching base of opposite one. Prothorax narrow, as broad as occiput, somewhat bent up at sides. Processes conical, sharp, enclosing rather less than right angle; posterior somewhat shortest and not so sharp. Legs rather strong, arcuated; hind legs reaching segment eight. Femora and tibiæ ringed twice with darker color. Wing cases reaching somewhat beyond second segment. Abdomen stout in proportion; lateral spines on segments five to nine, strong; that on ninth nearly as long as tenth segment; tenth segment as long as ninth. Appendages stout, sharp, hairy, as long as two last segments. Inferiors pyramidal, sharp, and somewhat curved inward; middle one nearly as long as inferiors, and split at tip; lateral superiors only one fourth as long as middle one, conical. Male projection conical, as long as

the lateral superiors. Male genitals indicated; female valve, in young specimen, — only 19 mm. long, — only half length of segment, hairy. There is a smaller specimen in the coll., Lee Co., Virginia, length, 12 mm., similar; differs only in having the middle appendix more widely split and the inferiors more curved.

This determination is only conjectural, as *G. furcillata* has in imago the inferior appendage of the male bilid. Perhaps the young nympha from Virginia may belong to *G. antilope*.

NEURÆSCHNA.

Similar to *Gomphæschna*; movable hook, extending somewhat beyond the base of opposite one. Lateral spines on segments four to nine. Appendages long, middle one as long as inferiors, pointed; laterals very short.

22. NEURÆSCHNA VINOSA (QUADRIGUTTATA).

PLATE II. FIG. 3.

Say. Hagen, Synopsis N. Amer. Neur. p. 130.

Nine nymphæ, male and female, full-grown and young, in alcohol. Length, 35 mm.; breadth, 7 mm. Coll. Mus. Comp. Zool. Locality, Berkshire, Tioga County, N. Y., from M. A. Mayer; Kentucky; Vermont; Lake Superior.

Long, rather stout. Head as in *G. furcillata*. Eyes broader at inner hind angles. Vertex shorter. Ocelli hardly indicated; antennæ, third joint, as long as first and second; fourth more than half length of third; following as long as fourth. Occiput notched behind. Sides oblique; parallel bands on hind angles less defined. Mask extending to between middle legs, rather narrow in proportion; middle third of front border produced in obtuse lobe, cleft, and with a black tooth on each side of cleft. Palpus similar to *G. furcillata*. Movable hook reaching somewhat beyond base of opposite one. Prothorax similar. Processes more prominent, sharp, of nearly equal length, and enclosing rather less than right angle. Anterior more compressed. Legs rather stouter in proportion, short; hind legs reaching seventh segment. Femora and tibiæ with two paler rings. Tarsal joint darker at end. Wing cases reaching somewhat beyond middle of fourth segment. Abdomen straighter at side than *Gomphæschna*: rough, marked with eight polished impressions. Lateral spines on segments four to nine, those on ninth nearly

as long as tenth segment. Appendages a little shorter than segments nine and ten, stout, sharp, hairy. Inferiors triangular, sharp; middle appendage as long as inferiors, sharp-pointed at tip; lateral superiors short, less than one fourth length of middle one, blunt. Male projection as long as laterals, triangular, rounded at tip; female valve half length of ninth segment, hairy at edges. There is a young specimen in the collection, 17 mm., similar.

The above determination is conjectural. There is no other described species to which this nympha seems so likely to belong.

EPIÆSCHNA.

Hagen Ms's.

Body stout; antennæ six-jointed, sixth longest, pointed. Prothorax bluntly pointed at outside angles. Legs short in proportion. Abdomen large and broad. Segments four to nine have lateral spines; inferior and middle appendages of equal length.

23. EPIÆSCHNA HEROS.

PLATE I. FIG. 3.

Æschna Heros. Fab. Ent. Pyst. Suppl. p. 285.

Hagen. Synopsis, N. Amer. Neur. p. 128.

Nymph, female, full-grown, alcoholic. Length, 50 mm.; breadth, 12 mm. Locality unknown; Portland, Me., raised by Mr. Jones. Coll. Comp. Zool.

Stout, head large, rather convex, slopes rather abruptly at sides. Eyes rather small in proportion, prominent, egg-shaped, prolonged obliquely at inner angles in a lobe which is divided by a linear impression, in front of which the lobe has indications of facets, behind rough and like occiput, except just along border of occiput, where it is obscurely faceted. Vertex rather above the level of the eyes; indications of ocelli on posterior portion; anterior semicircular, small. Antennæ six-jointed, small; third longer than fourth, somewhat shorter than the two basals; sixth longer than fourth and fifth together, pointed. Occiput longer than fore part of head, roughened by small black tubercles; sides oblique, rounded at hind angles; rather deeply notched behind; polished bands on hind angles. Mask extending to middle legs, enlarged at apical half rather abruptly, and rounded at sides; middle third of foreborder not much produced, cleft rather shallow, on each side of cleft a small tooth. Palpus meeting opposite one, cut straight at end,

lower angle produced in tooth, inner edge sharply denticulated. Movable hook, sharp, bent, not reaching base of opposite one. Prothorax small, nearly as broad as occiput, notched in front; median line impressed; front angles produced and sharp. Processes long, not very sharp, not much separated; posterior half as long as anterior. Legs short, of nearly equal length, middle legs reaching seventh segment; femora somewhat bent. Wing cases nearly reaching segment five. Abdomen broad, rounded above, rounded off rather abruptly beyond seventh segment. Segments of nearly equal length, tenth shortest, almost smooth; eight dark points on each segment, as in *B. pratense*. Stout lateral spines on segments four to nine, smaller on four and five. Lateral spines on segment nine only one third length of tenth segment. Appendages stout, blunt, one half longer than segment ten. Lateral inferiors cut obliquely at tip; middle a little notched on tip, as long as inferiors. Lateral superiors cylindrical, strong, pointed, somewhat more than half the length of middle one. Female valve reaching end of segment nine. There are in the collection two very young male nymphæ, 20 and 22 mm. long; one from Medford, Mass., very similar to the above. Antennæ six-jointed, male projection just indicated, conical, flat, shorter than the lateral superiors.

The peculiar features, unusual number of joints of antennæ, etc., were strong reasons for referring it, even before it was raised, to *Epiaschna Heros*, which is the largest species living in this country, and differs so considerably from other species as to form a new genus.

ÆSCHNA??

Body stout, short, broad in proportion. Head, length half breadth. Eyes in anterior half of head, orbicular, rather small comparatively, prolonged at inner hind angles in narrow and extended lobe. Antennæ five (?), jointed, third joint longest. Mask extending to middle legs, small comparatively; middle third of foreborder produced in cleft lobe, having a small tooth on each side of cleft. Legs strong, long, and with femora notched at upper edge; hind legs more separated at base than fore and middle legs. Abdomen rather rounded behind than tapering; tenth segment enclosed in ninth. Dorsal spines on all segments; lateral spines on all segments. Appendages short, stout, sharp on tip; middle one blunt. Male projection conical.

This curious nymphæ was referred to *Gomphina* at first, with which it

agrees more in general appearance than with *Æschmina*. The three-jointed tarsi and slender antennæ are like *Cordulegaster*, from which, however, it is excluded by the different shape of mask, which again refers it to *Æschmina*.

A nearer determination is now not possible.

24. *ÆSCHINA* (?) SPECIES.

PLATE III. FIG. 3.

Male nymphæ, dried. Length, 37 mm.; breadth, 13 mm. Locality, La Guayra, Venezuela.

Stout, short, broad, somewhat depressed, in general looking like some forms of *Gomphus*. Head, body, and legs covered with cylindrical or pyramidal spines, dark at the base and light-yellow at upper portion, which has a slight depression, in which there may be an orifice. The spines point backward, and vary in size. Head large; breadth, twice length. Eyes prominent, prolonged at the inner angle into a triangular lobe, which in the specimen is wrinkled so as to have appearance of vanes of a feather. Situated in front of this is a polished ridge lighter in color. Upper lip very large. Vertex rather wide and slightly convex; posterior portion showing indications of ocelli. Antennæ rather short, five-jointed; two basal joints globular; third as long as both basals, cylindrical; fourth shorter than fifth, which is also shorter than third and pointed. It is possible there may be two more rudimentary joints; but from the single specimen, which has only one of the antennæ, it is impossible to decide. Occiput rather deeply notched, sides oblique, hind angles rounded. Just back of eyes is a small conical projection near each side. Mask small in proportion, extending between middle legs, narrow and gradually enlarged; middle third of foreborder somewhat produced, and cleft surmounted by comb of light hairs, and with a small tooth on each side of cleft. Palpus nearly if not quite smooth. Movable hooks, slender, and bent near tip. Prothorax as broad as occiput; cut rather square at sides, and projected in rather sharp angle at forward part. Stigmata entirely covered. Thorax rather long in proportion. Legs strong, formed for running; fore and middle legs of nearly equal length; hind legs longer, reaching ninth segment. The femora of all the legs are stouter and shorter than the tibiæ, and have a notched hook on the upper edge; tarsi three-jointed. Processes above fore legs of equal length; posterior one triangular, sharp; anterior large, square, notched at tip. Abdomen stout,

broader than the thorax, and rather rounded behind than tapering. The segments are produced at the sides in modified spines, giving the general appearance of the abdomen's being notched and slightly turned up at the edges. The segments have dorsal spines more developed on the third and fourth segments than on the following. Segments of nearly equal length; ninth longest at sides, and enclosing the tenth, which is much shorter. Appendages short. Middle appendage pyramidal, two thirds as long as inferiors, blunt. Male projection one half length of middle appendage. Inferiors three-cornered, length somewhat greater than breadth. Lateral superiors less than half as long as middle one, very small, blunt, pyramidal. Genital parts are visible on second and third ventral segments and valves on ninth.

It is very difficult to place this nympha. The mask is like *Æschna* in the produced and cleft middle third of foreborder. The antennæ have two joints less than *Æschna* (?) as far as can be seen. The legs have three-jointed tarsi, as in *Æschna*, but are not equally distant at base, as is the case in all known forms of *Æschna*, while the notched appearance of upper edge of femora is wholly peculiar. The processes above front legs are *Æschna*-like, there being no such formation in *Gomphina*. The form of abdomen is more like *Gomphus* than *Æschna*, as are the dorsal hooks; the sides of abdomen are more like *Gomphus* and *Hagenius*, as is also the enclosed tenth segment. The appendages are peculiar, but more like *Gomphus* than *Æschna*. The entirely closed stigmata are again unlike *Æschnina*. The imago is perhaps still unknown. It may belong to *Staurophlebia*, but is certainly not *Æschna* or *Anax*. The large size of upper lip would suggest *Zonophora* among *Gomphina*, but *Cordulegaster* is the only known genus of *Gomphina* having three-jointed tarsi, and the form of the mask is quite unlike that of *Cordulegaster*. The marked and peculiar sculpture is unlike *Æschnina* and *Gomphina*, unless in some species of North American *Æschnina*, which show a somewhat similar sculpture. Altogether, the nympha is the most peculiar observed.

A second specimen of this nympha, in the collection of Professor Rosenhauer, in Erlangen, Bavaria, is stated to be received from Chili. Perhaps the aberrant nympha may belong to a species of the aberrant genus *Petalia*.

SYNOPSIS OF SPECIES DESCRIBED.

SUBFAMILY ÆSCHNINA.

DIVISION I. — ANTENNÆ SEVEN-JOINTED.

A. *Head longer than broad; mask extending through hind legs; front border of mask in the middle with two sharp triangular lobes.*

Gynacantha Ramb. (Supposition.)

Body very slender, flattened; head long; eyes small, not very prominent, slightly produced at inner hind angles; occiput sharply prolonged behind on each side; mask long, narrow; lateral spines on segments six to nine.

1. G. spec.

Nympha, full-grown. Brazil, South Carolina, and Florida.

Characters of the genus: appendages sharp; the middle one as long as the inferiors, cut at tip, slightly notched; laterals a little shorter; male projection conical.

B. *Head broader than long.*

Anax Leach.

The giants of the family. Body long, stout; eyes large, more prominent in the middle of the flat head; mask extending beyond middle legs; front border produced in a short rounded lobe, cleft in middle; legs slender; abdomen large; lateral spines on segments seven to nine; appendages strong, sharp, the middle one shorter, notched; laterals half as long; male projection short, cut at tip; female valves shorter than the segment.

2. A. Formosus Vander Linden. (Raised.)

Europe; full-grown nymphæ.

The two processes above first legs short, broad at tip; in right angle, the posterior larger; both enclosing a right angle; lateral appendages sharply pointed; male projection cut straight.

3. A. Mauricianus Rambur. (Supposition.)

Nympha, full-grown, male and female, Mauritius Isl.; Zanzibar.

Similar to *A. formosus*; processes blunt, enclosing an obtuse angle; mask more suddenly enlarged; middle appendage nearly as long as inferiors.

4. A. Junius Drury. (Raised.)

Nymphæ, full-grown and young, male and female. United States.

Processes similar to *A. formosus*, more obtuse at tip, equal in size; lateral appendages cylindrical, pointed suddenly at tip; male projection notched at tip.

5. A. Julius Brauer. (Supposition.)

Nymphæ, male and female. Japan.

Processes and lateral appendages similar to *A. formosus*; male projection as in *A. Junius*.

6. A. Guttatus Burm. (Supposition.)

Nymphæ, full-grown, male and female. Marshall Isl., Pacific Ocean.

Body more elongated; processes unequal, anterior blunt, posterior smaller, angular behind; enclosing a very obtuse angle, with small median notch; male projection narrow at tip, cut square.

7. A. Amazili Burm. (Supposition.)

Nymphæ, full-grown, male and female. Jamaica; Central America.

Similar to *A. Junius*, but more elongated; processes of equal length and size, enclosing a very obtuse angle; lateral appendages sharply pointed; male projection shorter; notched at tip.

8. A. spec.

Nymphæ, male and female. East India.

Similar to *A. Junius*; processes more blunt, posterior smaller, enclosing an obtuse angle; lateral appendages abruptly pointed; male projection notched at tip.

Æschna Fabr.

Body, long, stout; head large; eyes very prominent at the forecorner; mask extending to middle legs, broad, front border slightly produced in round or oblique lobe, cleft; legs longer, stouter; abdomen broader; lateral spines on segments six to nine, or five to nine, or four to nine; appendages long, sharp; male projection conical; female valves reaching tip of segment.

A. Lateral spines on sixth to ninth segments; no teeth on front border of mask; lateral appendages shorter than the inferiors; middle one notched at tip.

9. Æ. Rufescens Vander Lind. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Hind angles of head rounded; mask large, gradually enlarged; processes enclosing an

acute angle, triangular, sharp, the anterior half length of the posterior; lateral appendages only one fourth shorter than middle one.

10. *Æ. Grandis* Linn. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Hind angles of head more oblique; mask similar to *Æ. rufescens*; processes longer, more separated, of equal length, sharp, bent a little outwards, the anterior rather slender; lateral appendages about half the length of the middle one.

11. *Æ. Cyanea* Muell. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Hind angles of head oblique; basal half of mask, narrower; processes short, about of equal length, enclosing a right angle; posterior larger, rounded in sides; lateral appendages half length of middle one.

12. *Æ. Juncea* Linn. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Similar to *Æ. cyanea*; anterior process half length of posterior, much smaller.

13. *Æ. Viridis* Eversm. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Similar to *Æ. rufescens*; hind angles of head more oblique; processes of equal length, sharp tips a little bent outwards, enclosing right angle; lateral appendages half length of middle one.

14. *Æ. Mixta* Latr. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Similar to *Æ. cyanea*; hind angles of head rounded; mask gradually enlarged at apical third; processes blunt, stout, equal in length, anterior narrower; not much separated; lateral appendages about half length of middle one.

15. *Æ. Affinis* Vander Lind. (Raised.)

Nympha, full-grown, male. Europe.

Similar to *Æ. mixta*, more slender; processes blunt, very slightly separated, of equal length and size; lateral appendages shorter.

B. *Lateral spines on fifth to ninth segments; no teeth on front border of mask; lateral appendages shorter than the inferiors; middle one notched at tip.*

16. *Æ. Eremitica* Scudder. (Supposition.)

Nymphæ, full-grown, male and female. Arctic America and New Hampshire.

Similar to *Æ. rufescens*; hind angles of head oblique; processes long, equal, sharp, tips bent a little outwards, enclosing less than right angle; lateral appendages two thirds length of middle one; female valves not quite reaching tip of segment.

17. *Æ. Constricta* Say. (Raised.)

Nymphæ, full-grown, male and female. United States.

Similar to *Æ. eremitica*, more slender; apical half of mask less enlarged; processes similar, less sharp, the anterior less bent outwards, the posterior a little larger; lateral spine of segment fifth generally only indicated; lateral appendages longer than half the middle one.

C. Lateral spines on sixth to ninth segments; front border of mask with two small teeth; tip of middle appendage notched.

18. *Æschna spec.*

Nymphæ full-grown, male and female. Himalaya.

Similar to *Anax*, very long; processes blunt, posterior more prominent, enclosing obtuse angle; lateral appendages half length of middle one, abruptly pointed.

19. *Æschna spec.*

Nymphæ, full-grown, male and female. Brazil.

Stout, shape of *Æ. grandis*; processes prominent, sharp, the posterior longer, bent outwards; enclosing right angle; lateral appendages very sharp, length of the inferiors.

***Brachytron* Evans.**

Body long, slender; head smaller, rather convex above, much narrower behind; front border of mask produced in oblique angle, cleft; legs shorter; abdomen long, narrow; appendages short, middle one a little shorter than inferiors, cut at tip; laterals shorter; male projection conical; female valves not reaching tip of segment.

20. *B. Pratense* Mueller. (Raised.)

Nymphæ, full-grown, male and female. Europe.

Processes slightly separated, sharp, the posterior half length of the anterior; lateral spines on sixth to ninth segments.

***Gomphæschna* Selys.**

Body long, slender; eyes small; lateral spines on segments five to nine; middle appendage a little shorter than the inferiors, bifid at tip.

21. *G. Furcillata* Say. (Supposition.)

Nymphæ, male and female, nearly full-grown. United States.

Characters of genus; processes conical, sharp, posterior shorter, enclosing less than right angle.

***Neuræschna* Selys.**

Similar to *Gomphæschna*; lateral spines on segments four to nine; appendages long, the middle one as long as the inferiors; all sharply pointed.

22. N. Vinosa Say. (Supposition.)

Nymphæ, full-grown, male and female. United States.

Similar to *G. furcillata*. Characters of genus: processes prominent, sharp, of equal length, enclosing less than right angle; body rough.

DIVISION II. — ANTENNÆ SIX-JOINTED.

Epiæschna Selys.

Similar to *Æschna*; antennæ six-jointed; lateral spines on segments four to nine; inferior and middle appendages of equal length.

23. E. Heros Fabr. (Raised.)

Nymphæ, full-grown, male and female. United States.

Characters of genus: processes long, the posterior half as long as anterior, not much separated; middle appendage a little notched at tip.

DIVISION III. — ANTENNÆ FIVE-JOINTED.

Æschna??**24. Species Nova.**

Nympha, male. La Guayra, Venezuela, and Chili.

Genus and species very abnormal. Cf. the description. Perhaps belonging to *Gomphina* and to genus *Petalia*.

EXPLANATION OF THE PLATES.



[*a*, sideview ; *b*, labium ; *c*, appendages ; *d*, processes above the base of first pair of legs ;
e, front view of the head.]

PLATE I.

- FIG. 1. *Anax formosus*.
" 2. *Anax Junius*.
" 3. *Epiæschna heros*.
" 4. *Æschna* species. No. 19.

PLATE II.

- FIG. 1. *Æschna grandis*.
" 2. *Æschna cremitica*.
" 3. *Neuræschna vinosa*.
" 4. *Gomphæschna furcillata*.

PLATE III.

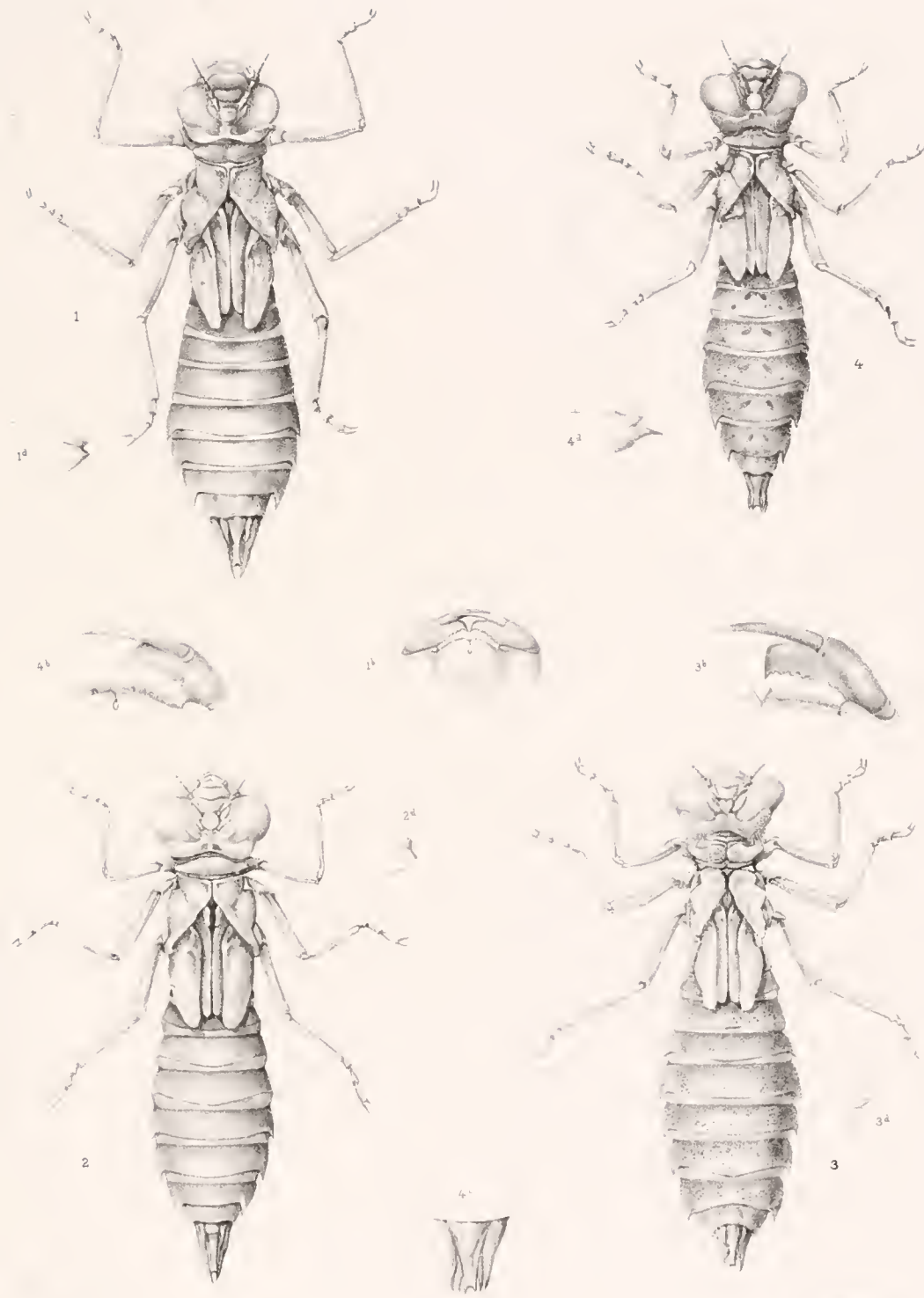
- FIG. 1. *Æschna constricta*.
" 2. *Gynacantha* species. No. 1.
" 3. Species. No. 24.

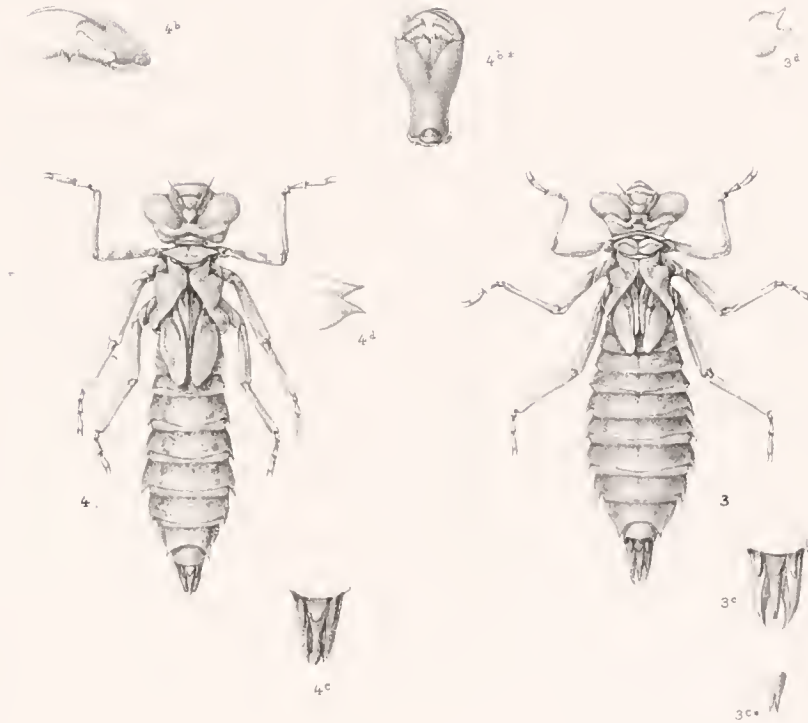
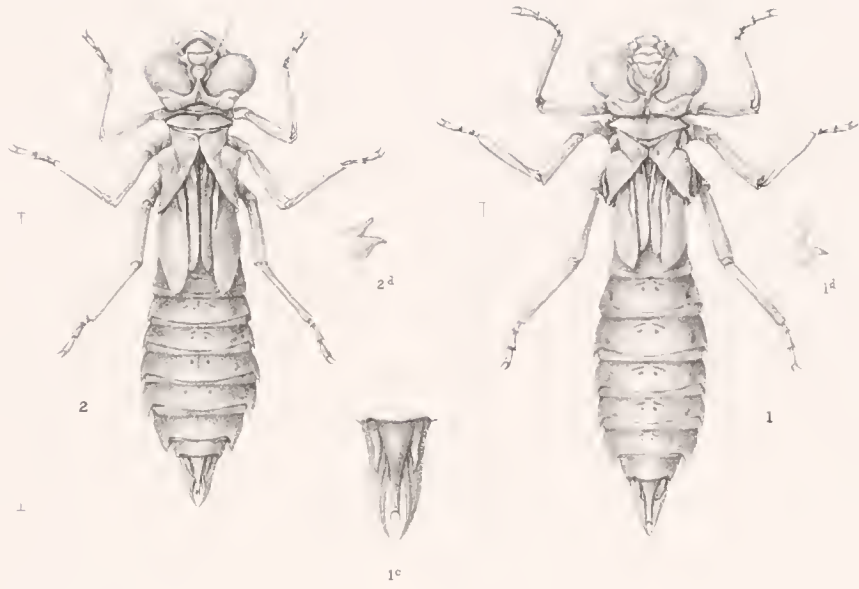
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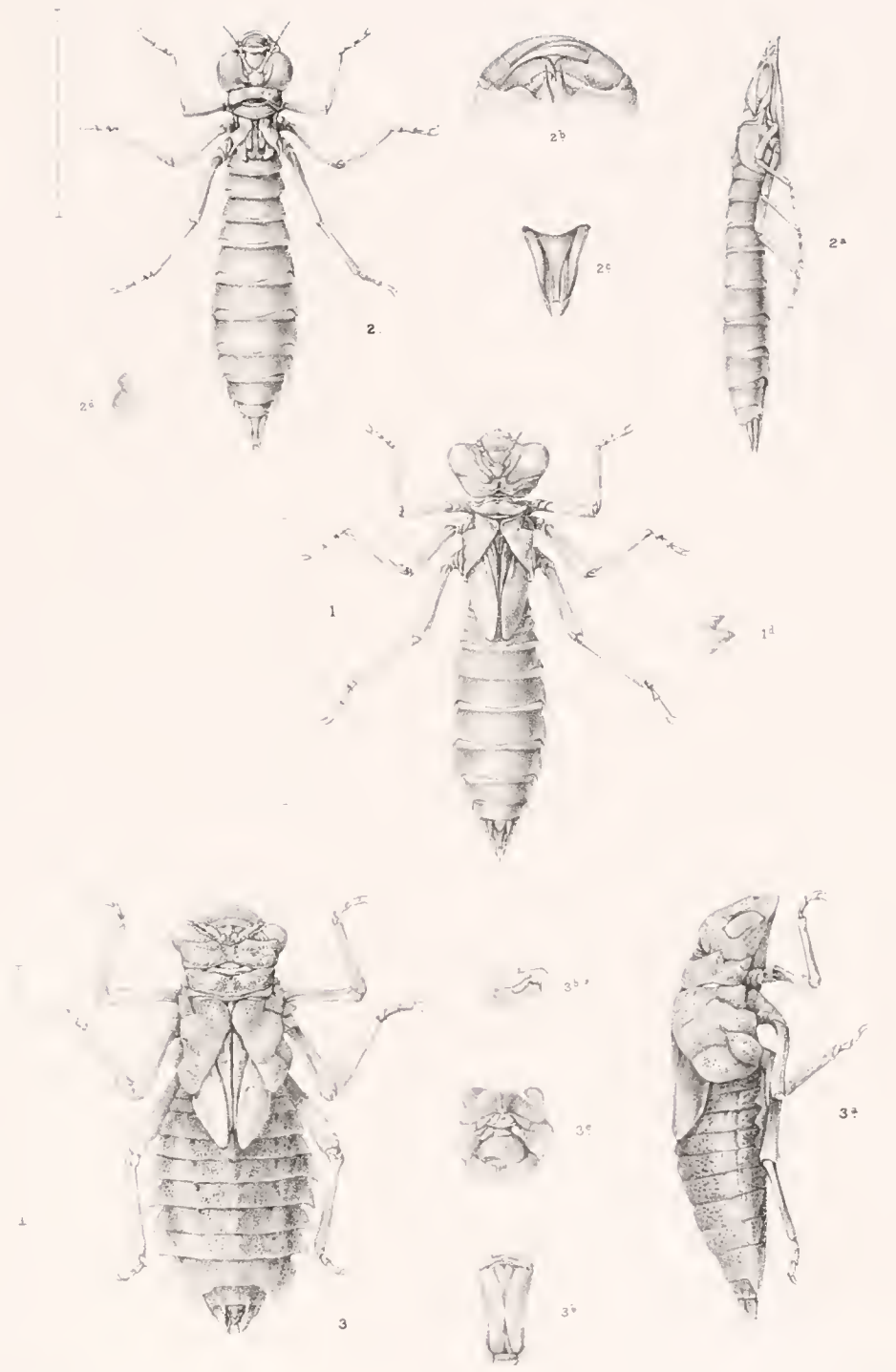
- FIG. 1. *Æschna juncea*.
" 2. *Æschna* species. No. 18.
" 3. *Æschna cyanea*.

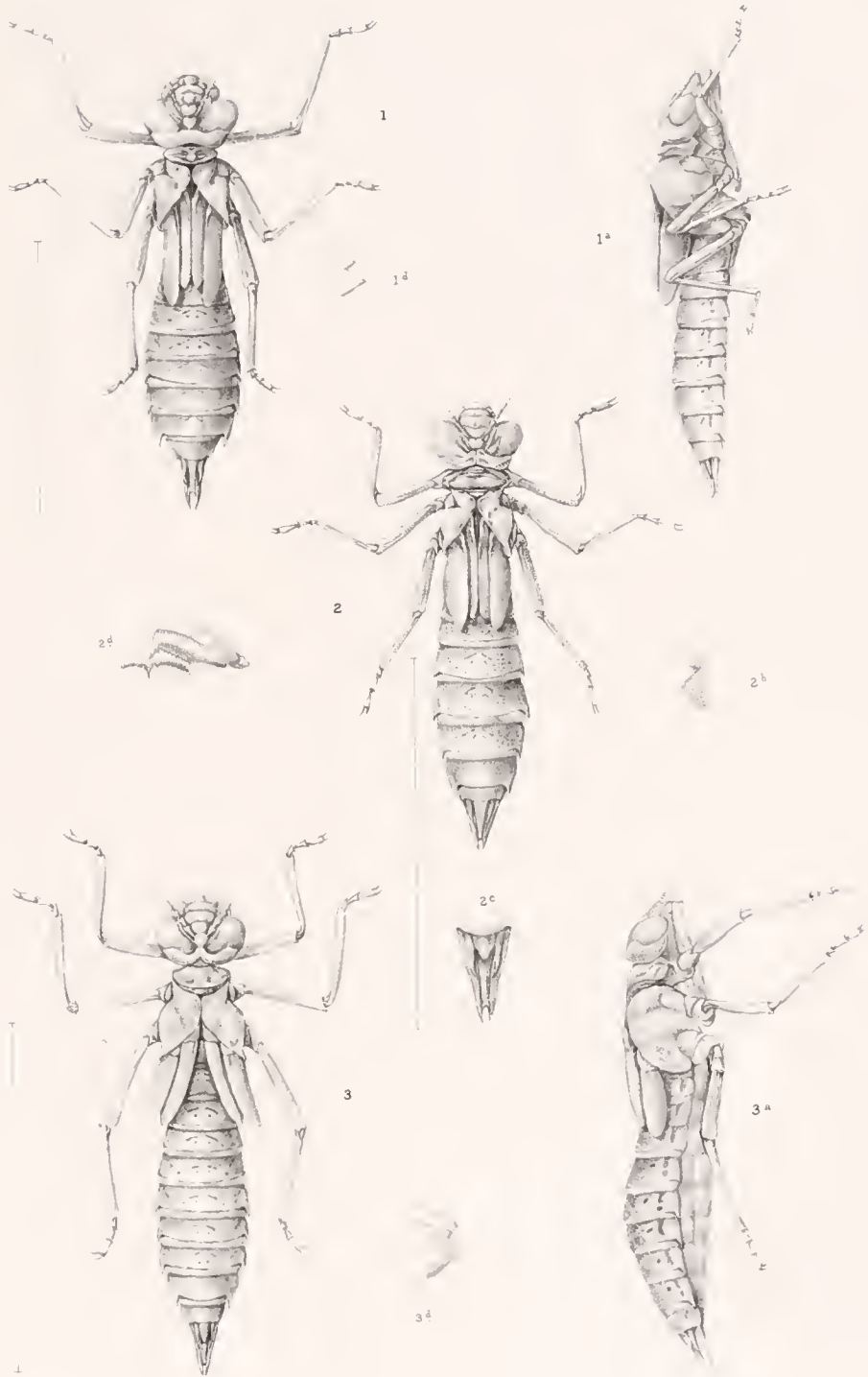
PLATE V.

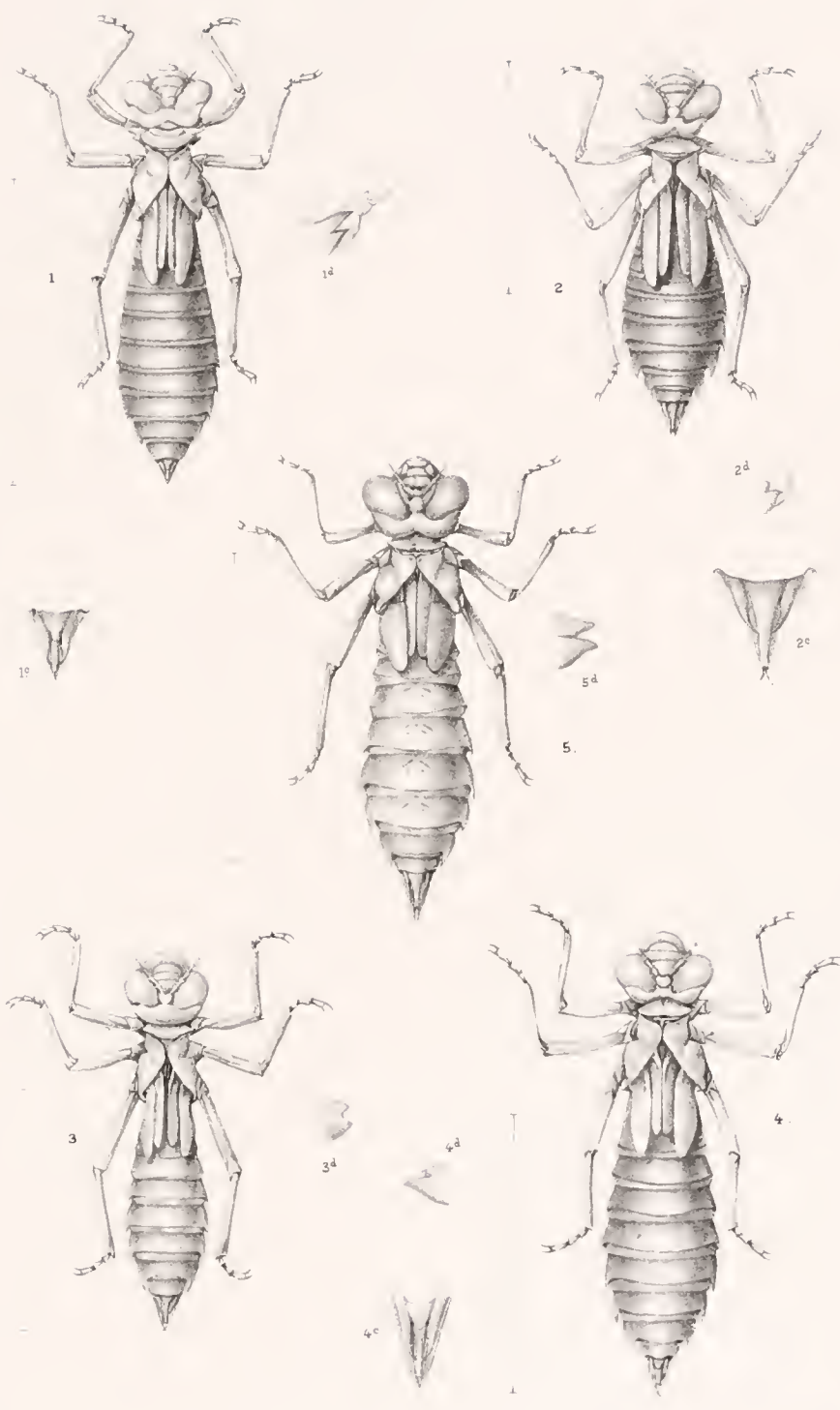
- FIG. 1. *Brachytron pratense*.
" 2. *Æschna mixta*.
" 3. *Æschna affinis*.
" 4. *Æschna rufescens*.
" 5. *Æschna viridis*.











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