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IV. NOTES ON SPECIES OF THE GENUS *HETERAGRION* SELYS
WITH DESCRIPTIONS OF NEW SPECIES (ODONATA)¹

BY E. B. WILLIAMSON

In order to identify specimens of *Heteragrion* in my collection taken by B. J. Rainey, L. A. Williamson and myself in British Guiana, and by Jesse H. Williamson and myself in Colombia, it was necessary to study carefully the species hitherto described. The results of this study are embodied in the following paper.

Heteragrions are not common in collections and the total number of specimens is not large. Yet this material has shown the existence of a relatively large number of species, twenty-two having been named. The larger number of species were described from material in the collections of de Selys and

¹I, Occ. Papers Mus. of Zool., Univ. of Mich., No. 52, April 17, 1918. II, *ibid.*, No. 59, June 24, 1918. III, *ibid.*, No. 63, January 5, 1919.

Hagen. Unfortunately specimens of species of this genus are very fragile. Apparently many specimens have been lost from Hagen's collection, and information I have received indicates that there has been considerable damage and loss in the de Selys material. This is very unfortunate as certain species are unidentifiable from existing descriptions.

ACKNOWLEDGEMENTS.—Through Dr. Ris I have obtained drawings by Mons. Menger of the material at present available in the de Selys collection. Dr. Ris has also furnished me notes on material in his collection. I am especially indebted to Dr. Calvert for the loan of specimens, for several drawings, properly credited, and for suggestions. Other material of the greatest interest was borrowed for study from the Carnegie Museum, through Mr. Kahl; from the Museum of Comparative Zoology, through Mr. Banks; from Cornell University, through Professor Needham; and from the U. S. National Museum, through Mr. Currie. Mr. Kennedy kindly prepared many of the drawings, properly credited, and the wing photographs.

The Legion Podagrion of de Selys, as defined by him (1 and 2), has been briefly summarized by Calvert (5) as follows: M_3 separating from M_{1+2} nearer to the nodus than to the arculus. Stigma normal, i.e., consisting of but a single cell. Cu_2 present. Supplementary sectors present, at least between M_{1a} and M_2 , except in Perilestes.

The genus Heteragrion (including Heteragrion and Oxystigma of this paper) of the Legion Podagrion may be briefly defined as follows: Antenodals two²; M_3 arising at or near the subnodus; R_s arising distad to the subnodus (rarely

² Herbert Campion, Proc. Acad. Nat. Sci. of Phila., May, 1913, p. 222: "A female of *Heteragrion chrysois* Hagen (*alienum*) from Vera Cruz, also in the Godman-Salvin Collection, has, in three of its wings, a supernumerary antenodal between the usual ones and limited to the costal space."

at the third postnodal, usually from the fifth to eighth); one cubito-anal cross-vein; supplementary sectors two, between M_{1a} and M_2 ; area posterior to Cu_2 one cell wide; stigma with the proximal side oblique, the proximo-posterior angle acute.

Heteragrions occur from approximately sea-level up to recorded altitudes of 3000 to 4000 feet, and they will doubtless be found at higher elevations. The genus is confined to tropical America. They are forest or shade insects, living along smaller streams from which they rarely wander for any distance, except species of group 4, *Oxystigma*, which are often found scattered through woodland. Rene Martin³ reports that in the forests of Brazil birds of the genera Trogon and Galbula eat many dragonflies, among them Heteragrion. I doubt if many Heteragrions meet this fate. Their habits and surroundings are such that they suffer little if any danger from birds. Their predominant colors are various shades of brown to black, and various shades of yellow or, less frequently, red, blue and green. Larval stages are not known.

De Selys (1) divided Heteragrion into four groups, to the fourth one of which he proposed giving the name *Oxystigma*, as a "sous-genre". In 1886 (2) he divided Heteragrion into two sections, the first section containing the first three groups of his earlier paper, and the second section containing the fourth group, without further mention of *Oxystigma*. I have been unable to devise any better grouping than that of de Selys, and it is retained in this paper with additional characters employed in defining the groups. Another species of group 4, hitherto represented by a single species, has been discovered, and I believe it is well to place these two under a separate genus, *Oxystigma*, as originally proposed by de Selys.

³ *Revue Francaise d'Ornithologie*, No. 26, June, 1911, Sur les oiseaux qui se Nourrissent de Libellules, (3e note), p 98.

a¹. Quadrangle short; usually nearly two or more postquadrangular cells; the cubito-anal cross-vein much nearer the second than the first antenodal. *Heteragrion*.

b¹. Inferior appendages of male rudimentary; teeth on genital valves of female several-rowed. Generally the hind margin of wing separating from the anal vein at a greater distance distad to the cubito-anal cross-vein than the arculus is distal to the cubito-anal cross-vein. Frons obtusely angled, similar in the sexes.

Groups 1 and 2.

b². Inferior appendages of male small, spine-like; teeth on genital valves of female one-rowed. Generally the hind margin of wing separating from the anal vein at a lesser distance distad to the cubito-anal cross-vein than the arculus is distal to the cubito-anal cross-vein. Frons acutely angled (males of some species) to right angled (females of some species and both sexes of some). Wings narrower (more or less) in the males than in the females.

Group 3.

a². Quadrangle long; usually one or about one postquadrangular cell; the cubito-anal cross-vein about midway between the antenodals. Inferior appendages of male small, spine-like; teeth on genital valves of female several-rowed. The hind margin of wing separating from the anal vein at a greater distance distad to the cubito-anal cross-vein than the arculus is distal to the cubito-anal cross-vein. Frons low, rounded, similar in the sexes. Group 4. *Oxystigma*.

Of de Selys' group 1 only two species have been described. Only one of these, *flavovittatum*, is well known. The group was separated from group 2 by de Selys on the following characters: Head more robust; mouth more projecting; abdomen shorter; legs longer; third joint of antenna almost three times as long as the second joint; wings broader; hind margin of wing separating from the anal vein distad to the arculus; quadrangle of medium length. I have seen only an imperfect male and female of *flavovittatum*. The species is more robust, with slightly longer legs than the species of group 2 known to me. But these characters are not very definite, and the venational and antennal characters, as well as the sexual characters, are essentially those of group 2. I have measured the second and third antennal joints of all species

known to me. In general the third joint is about twice the second, but in some females of groups 1 and 2 (*flavovittatum*, *aurantiacum*, *triangulare*) the third joint is longer, but in no case is it three times as long as the second: in group 4 (*Oxystigma*), the two joints are more nearly equal and are more robust than in the other three groups. Further evidence for the indistinctness of structural differences between groups 1 and 2 is found in the fact that the female, originally described as *ovatum*, group 1, (de Selys 1) was later (de Selys 2) referred to *ochraceum*, group 2. The species referred by de Selys to group 1 are, for convenience, discussed with the species in group 2. The type of the genus *Heteragrion* is *flavovittatum*; and of *Oxystigma*, *petiolatum*.

CHARACTERS OF GROUPS AND SPECIES.—The proportions of the second and third antennal joints have been mentioned above. *Face profiles and head coloration*: there are four fairly distinct types of face profiles (figures 63 to 66). The acute, up-turned frons is a male character confined to group 3. It is associated with a brilliant yellow or orange face, a velvety black posterior vertex (rarely the entire vertex) and a metallic yellow or orange area on either side of the median ocellus, adjoining the frons (except in those species where the black of the vertex reaches the frons). The females of these brilliant males are very different. In some of them the face may be largely black. The males of a few species of group 3 and the females of all that group have the frons about right angled. In groups 1 and 2 the frons is a little more rounded. It seems to be the same in the sexes of all the species. In coloration of head the male of *flavovittatum* approaches group 3, but the head patterns in both sexes of the species of group 2 are all very different from group 3. With few exceptions they are pale colored, variable, more or less indistinctly patterned, and

very similar in the sexes. In *Oxystigma* (group 4), the frons is low and flattened. While in *cyanofrons*, of this genus, the head pattern of the male suggests group 3, the head pattern of the female is very similar to the male, thus differing from the condition found in group 3. *The hind lobe of the prothorax* offers a character which may be valuable in certain cases in determining species, and used carefully, it may be useful in associating the sexes. In all the material studied I have seen only one malformed prothorax. *The male abdominal appendages*, especially the superiors, are specifically distinct, but are often very similar. I have detected no variation within a species. The superior appendage by pressure or other causes is often rotated on its long axis; so figures may be more or less misleading, and, in the case of species having similar appendages, such figures cannot be relied on for the proper identification of specimens without reference to other characters. The *penes* have been studied by Mr. Kennedy but his results have not been published. He writes me that he has found this organ showing no specific characters in this genus. The *genital valves* are toothed along the ventral edge in all species. In group 3 the valve is relatively thin or narrow on the ventral edge, and the teeth are one-rowed. In all the others the ventral edge is broader, the teeth are several-rowed or paved, and the teeth are more flattened and scale-like than in the single-rowed forms. In all species the style is tipped with an acute translucent point which is formed by closely appressed hairs or bristles. The toothed edge of the genital valve is obviously the instrument by which an entrance is made for the insertion of the ovipositor. Frequently the interstices of the teeth are filled with minute debris, more or less concealing the teeth. This seems especially true of those with paved teeth. Among the females of group 3, where the teeth are single-

rowed, the apical tooth is more or less distinctly larger, and there is a pretty uniform decrease in size basally. The number and spacing of the teeth vary in the different species of this group but are variable and of little use apparently in recognizing species. The single-rowed or paved condition is however recognizable at a glance. It is a most useful character, permitting for the first time the certain determination of the group relationships of any female specimen. The *ovipositor* consists of four parts, two anterior and two posterior, each anterior closely appressed to its corresponding posterior process. Each anterior process has its distal outer edge beaded or convoluted in a manner apparently characteristic of each species. The posterior process has along its distal outer border a series of oblique grooves or teeth, which extend basally farther than the beading or convolutions of the anterior process. When viewed from the ventral surface only the two anterior processes are seen, except that in certain cases the edge or apex of the posterior processes may be in view. This latter condition is especially true in the case of those species with narrow anterior processes. In those species with wide, flattened anterior processes, the apical portions of the posterior processes, bearing the grooves or teeth, lie well within the outer edges of the anterior processes and are not visible in a ventral view. The ovipositor is narrow in group 3, and widest in *Oxystigma*. I have studied it in only a limited number of species as it is usually concealed by the valves, and I did not wish to relax older and typical material loaned me for study. A thorough study of this organ must await the accumulation of more material. The apical beading of the anterior process I think has little or no function in the insertion of the ovipositor. In fact, it seems these irregularities would render the insertion more

difficult. But in plant tissues, if it is in such situations that the eggs are placed, such a structure would serve to steady or maintain the ovipositor after it had been inserted. Likewise the grooves of the posterior processes cannot, I think, aid much in the insertion of the ovipositor. They lie generally within the lateral edges of the anterior processes and between these processes and the abdomen. Their function is probably concerned with the extrusion of the egg. *Venation*: several characters have been employed in describing groups or species. The distance between the arculus and the cubito-anal cross-vein, for example, can be measured with accuracy, for these parts lie at approximately right angles to the longitudinal veins bounding them. But the distance between the cubito-anal cross-vein and the point of departure of the anal vein from the posterior wing margin is an entirely different matter, as the anal vein and the posterior wing margin meet in a very acute angle. If the parts are viewed at such an angle as to superimpose the anal vein on the wing margin near their juncture point, the point of separation appears much more distal than is really the case. In studying this character I have held the plane of the wings at right angles to the line of vision, and with the long axis of the wings at right angles to the observer, studying them under a binocular microscope. With these simple precautions one can detect the real point of separation with a fair degree of accuracy. There is a great difference in the width of the wings between species and, in some cases, between the sexes of the same species. Wing narrowness in this genus is brought about solely by the narrowing of cells and no other change in the position of the larger veins takes place. Hence the character can only be used with difficulty, especially since all gradations between the extremes exist. The only way of expressing the character seems to be

in some terms of measurement or in the proportion of width to length. Associated with wing narrowing is a reduction in the size of the stigma (compare figures 3 and 4). But this character, like narrowing, is difficult to express. The number of postquadrangular cells is an indefinite character, dependent as it is on the variable position of the origin of M_3 and an undifferentiated cross-vein. M_3 arises at or near the subnodus, but varies in the same species. The proximal cross-vein between M_3 and M_4 is the cross-vein which marks the distal extension of the postquadrangular cells. But this cross-vein has no specialized relation to the cross-veins posterior to it, which form the ends of the postquadrangular cells, and it may coincide with one of these or occupy any position between two of them. *Thoracic and abdominal color patterns* are varied and usually of specific value. The common ground color is some shade of orange-yellow; flesh, red, blue or bluish and green or greenish are rarer. With the exception of shining or metallic areas on the heads of some species, there are no brilliant or metallic colors. With but rare exceptions they are rather dull colored insects, and the females are practically all dull brown, obscurely patterned and inconspicuous. Generally in group 2 the dorsum of the thorax is pale with a middorsal black carina, which is universal in the genus, though rarely reduced to a mere thread. The mesepimeron is often largely dark, forming a conspicuous posthumeral dark stripe. But in group 3, males of many species, which as teneral have a similar pale thoracic pattern, have the dorsum darken with age till it may become entirely black. The color of the abdomen also undergoes some change with age, but it is slight and does not result in a virtual loss of color pattern, as is the case on the thorax. In males the third to fifth segments are usually the most definitely and intricately patterned. This pattern is of

several distinct types. Each segment may be of a single color, without pattern, as in *erythrogastrum*; the segment may be apically dark or black as is *albifrons* or *chrysops*; the segment may be black at both apex and base with a pale mid-area, making a three-banded segment, as in *calendulum*; or the base may be pale, followed by a more or less distinct dark area, followed by the pale ground color, which is in turn followed by a distinct dark apex, thus making a four-banded segment. This last pattern is the most common. In this pattern the subbasal dark area varies in intensity with age. It is superimposed on the pale basal color and shades out apically. To a certain extent its development, by contrast, determines the presence or absence of a pale basal ring. The apical black is deeper and appears at an early age. The distinction between the two black areas is possible even in *majus*, where the excessive development of the subbasal dark area has resulted in segments 3-6 becoming chiefly black with pale basal rings.

GEOGRAPHICAL DISTRIBUTION OF GROUPS.—The two species of group 1 are recorded from Southern Brazil or Brazil. Of group 2, *macilentum* has been recorded from Venezuela, and *ictericum* and *melanurum* are now known from British Guiana; all the others are known between parallels 10° and 35° S., from southern and eastern Brazil, Paraguay, and Argentina. Of group 3, *icterops* has been recorded from Brazil (Santarem), Venezuela, Ecuador and Peru. It seems possible there have been some misidentifications. Four species have been recorded south of the equator in western South America, from Ecuador, Peru, and Bolivia. One species besides *icterops* is known from Brazil and one species occurs in British Guiana. The others occur to the west and north. Four species are known from the Magdalena River in Colombia; and one of these and the remaining species of the group occur in Central

America as far north as about 20° N. All the species known for Central America and for the Magdalena River (Colombia) belong in this group. Of group 4, the two species occur in British Guiana, and one of these has been recorded from as far south as Santarem, Brazil.

Key to Males of Groups 1 and 2⁴

- a.¹ Dorsum of head, prothorax, thorax and first seven abdominal segments largely black, apical half of 8 and 9 and 10 entirely or largely yellow.
 - b.¹. A wide yellow humeral stripe; a dorsal black spot on abdominal segment 10 *flavovittatum*.
 - b.². Dorsum of thorax on each side with a yellow oval spot; abdominal segment 10 without a black spot *ovatum*.
- a.². Not as above.
 - b.¹. Segments 9 and 10 black above; head largely pale, markings obscure.
 - c.¹. Segment 8 largely yellow or yellowish above..... *ictericum*.
 - c.². Segment 8 black above *melanurum*.
 - b.². Segments 9 and 10 pale above (reddish or yellowish), similar to 8 or distal part of 8.
 - c.¹. A broad black posthumeral stripe; head above broadly and definitely patterned with black.
 - d.¹. Dorsum of thorax largely black; area below between the fork of the mid-dorsal carina black; mid-area of hind lobe of prothorax a definite round black spot. *triangulare*.
 - d.². Dorsum of thorax, except area of the middorsal carina, pale, the area below between the fork pale; prothorax pale, the hind lobe without definite markings..... *beschkeii*.
 - c.². No definite posthumeral stripe; head above largely pale, markings generally obscure and indefinite.
 - d.¹. Superior appendages in profile not swollen ventrally at base; apex of 7 and all of 8 pale..... *aurantiacum*.
 - d.². Superior appendages in profile swollen ventrally at base; apex of 7 and basal part of 8 black..... *consors*.

Key to Females of Groups 1 and 2⁵

- a.¹. Prothorax and thorax dark above; a wide yellow antehumeral stripe, occupying about two-fifths the width of the mesepisternum and ex-

⁴ For a discussion of *cinnamomeum*, *dorsale*, *macilentum*, *obsoletum* and *ochraceum*, known to me only from descriptions and not included in the key, see text.

⁵ For a discussion of *macilentum*, *beschkeii* and *amazonicum*, the females of which have been described but which are otherwise not known to me and are not included in the key, see text.

- tending from the wings to the anterior edge of the prothorax. Antenna long, the second joint about .3 mm., the third joint nearly three times as long, the ratio about 1.5:4. *flavovittatum*.
- a². Thorax not sharply patterned as above; humeral or antehumeral stripe if present narrower and obscure, not definitely a part of the prothoracic pattern. Antenna shorter, the second joint about .2 mm., the third joint from two to nearly three times as long as the second.
- b¹. Cubito-anal cross-vein proximal to the arculus a distance equal to or less than the length of the latter. A distinct dark posthumeral stripe.
- c¹. Basal dark area on dorsum of segment 9 divided in the median line by pale nearly or quite to the base of the segment.
 *triangulare*.
- c². Basal dark area on dorsum of segment 9 not divided by pale in the median line *ictericum*.
- b². Cubito-anal cross-vein proximal to the arculus a distance greater than the length of the latter. Dark color on dorsum of segment 9 not divided by pale in the median line.
- c¹. No dark posthumeral stripe. *aurantiacum*.
- c². A distinct dark posthumeral stripe.
- d¹. Posthumeral stripe brown, the same color as the dorsal thoracic brown stripes. Hind lobe of prothorax narrow, rounded and high—a female in Hagen's collection labelled *aurantiacum*.⁶
- d². Posthumeral stripe black, darker than the thoracic dorsum. Hind lobe of prothorax similar to *aurantiacum*, broad, winged and with a median dark area. *ochraceum*.

Key to Males of Group 3

- a¹. Abdomen above predominantly pale, no segment as much as one-fourth definitely black; segments 1 and 2 without any definite black areas; 8-10 largely or entirely pale or obscure.
- b¹. Abdomen brilliant red, black inconspicuous or wanting.
- c¹. Face black; abdomen without black. *erythrogastrum*.
- c². Face bright light yellow; abdomen with some segments narrowly apically black *albifrons*.
- b². Abdomen reddish yellow or flesh to almost red, segments 3-6 with distinct apical black areas; face yellow.
- c¹. Abdomen 47-51.5 mm. long; usually three postquadrangular cells *tricellulare*.

⁶ By the form of the hind lobe of the prothorax certain known species are excluded, and the species may be *dorsale* (of which the female has not been described), *cinnamomeum* (unless this is a synonym of *aurantiacum*, as de Selys has stated; the female of *cinnamomeum* is not described), or *macilentum* (of which only the teneral female is described). See under *aurantiacum* in the text.

- c². Smaller; usually two postquadrangular cells.
 d¹. Segment 7 colored like 8.....*chrysopt.*
 d². Segment 7 darker than 8.....*alienum.*
- a². Abdominal patterns various but segments 1 and 2 with definite dark areas or at least some segments definitely largely or entirely black above.
- b¹. Nasus and frons above black, face not bright yellow; the brightest and most conspicuously colored area is the middle lobe of the prothorax which is bright yellow.....*peregrinum.*
- b². Face bright yellow or orange, frons above the same, and, with rare exceptions, on either side of and in front of the median ocellus, an area of the same color with metallic reflections.
- c¹. Thoracic pale colors bluish or greenish: dorsum abdominal segments 8-10 black, on 8 the black narrowed from the base to a middorsal line at the apex; 3-7 narrowly but distinctly pale ringed at base.
- d¹. Black on dorsum of head extended forward only to about the level of the front of the median ocellus; abdomen 37 mm. long*inca.*
- d². Black on dorsum of head extended forward to between the antennae; abdomen 32 mm. long.....*icterops*⁷.
- c². Thoracic pale colors yellow or yellowish; dorsum of abdominal segments 8-10 various, but dorsum of 8 not continuously dark in midline from base to apex.
- d¹. Dorsum of abdominal segments 3-5 for two-thirds or more the length of each segment with a wide median longitudinal yellow stripe, bounded laterally by a dark line which thus separates the dorsal and ventral yellow; 8 with the dark area above confined to the basal half; 9 and 10 dark above; pale basal rings on 3-7 obscure or wanting...*flavidorsum*.⁸
- d². Dorsum of 3-5 without a broad yellow stripe as above.
- e¹. Size large, abdomen over 40 mm. in length.
- f¹. Segments 3-6 dorsally and laterally largely black; 8-10 and the appendages to near the apex bright yellow*majus.*
- f². Segments 3-6 dorsally and laterally narrowly pale at base and black at apex, the intermediate area yellowish or reddish, more or less obscured and dark on the basal half of each segment; 8 largely or entirely yellow or yellowish; 9 and 10 black above.
- g¹. Legs blackish*aquatoriale.*
 g². Legs largely yellowish.....*angustipenne*.⁹

⁷ Known to me only from descriptions; see text.

⁸ Known to me only from description; see text.

⁹ Known to me only from description; see text.

- e². Size smaller, abdomen not exceeding 40 mm. in length.
- f¹. Abdominal segments 4 and 5 without pale basal rings, the apical black on each segment anterior to them continuous with the basal black of 4 and 5, the intermediate color dull or yellowish red; segments 6 and 7 with this median pale area darkened so these segments are nearly or quite entirely black, unmarked; 8 reddish, indefinitely marked black, especially basally; 9 and 10 black above.....*calendulum*.
- f². Pale basal rings on segments 3 to 6 or 7, thus each segment four-banded (narrow pale basal ring followed by an extensive dark area, shading out into an extensive pale area, followed by an apical black ring) instead of three-banded (as segments 4 and 5 in *calendulum*).
- g¹. Thorax dark above, in mature specimens entirely black; broad definite dark stripes on the mesepimeron and metepisternum; abdominal segments 3-6 with the large subapical pale area equal to or more extensive than the subbasal dark area which shades into it*mitratum*.
- g². Thorax yellow above with a dark middorsal stripe and one on either side of the dorsum; mesepimeron with an extensive obscure area, and metepisternum with a very narrow obscure line; segments 3-6 with the dark subbasal area more extensive than the pale subapical area which follows it*simulatum*.

Key to Females of Group 3

- a¹. Usually three postquadrangular cells in the front wing and sometimes (25%) in the hind wing; area enclosed by the fork below of the thoracic middorsal carina black; abdomen 40 mm. or more in length*tricellulare*.³⁰
- a². Two postquadrangular cells in front and hind wings.
- b¹. A dark longitudinal dorsal stripe on either side of abdominal segment 2 dull and interrupted or wanting, not black and continuous and wider apically; sides above of 3 little if any darkened subbasally, hence a narrow middorsal pale line continuous with a pale basal ring wanting or obscure.

³⁰I have before me a single female lacking the entire abdomen, so I do not try to place this species in the key more satisfactorily. It will be immediately recognized by the characters given. Some other species are nearly as large.

- c¹. Area enclosed by the fork below of the thoracic middorsal carina entirely or partly pale.....*albifrons*.
- c². Area enclosed by the fork below of the thoracic middorsal carina entirely black.
 - d¹. No trace of a longitudinal median dorsal pale stripe on the abdomen*erythrogastrum*.
 - d². A very narrow thread-like longitudinal median dorsal pale stripe on abdominal segments 3 to 5 or 6.....*alienum*.
- b². A black longitudinal dorsal stripe on either side of abdominal segment 2, enclosing a median pale stripe which does not reach the apex; 3 with a distinct pale basal ring joining a pale longitudinal median stripe.
 - c¹. Abdominal segment 9 with a black basal spot on either side, enclosing a distinct pale median bar which extends from the base to more than half the length of the segment; appendages black*mitratum*.
 - c². Abdominal segment 9 pale or obscured but without definite pattern; appendages more or less pale, especially at the base.
 - d¹. Size large, abdomen over 35 mm. in length; anal vein separating from the posterior border near or at the cubito-anal cross-vein*majus*.
 - d². Size small, abdomen less than 35 mm. in length; anal vein separating from the posterior border at the level of or distad to the arculus.....*peregrinum*.

Key to Species of Group 4, Oxystigma

- a¹. Male.—Thorax black or dull above, lateral pale markings obscure; face largely blue. Male and female.—Quadrangle short, not reaching the level of the nodus; R_s and M₃ widely separated at their termination, R_s turned toward M₂.....*cyanofrons*.
- a². Male.—Thorax with dorsal and humeral pale stripes or lines, dorsum and sides bright, not obscure, and color pattern definite; face black. Male and female.—Quadrangle long, reaching the level of the nodus; R_s normal at its termination.....*petiolatum*.

DISCUSSION OF SPECIES

I. *Heteragrion flavovittatum* Selys

Figures 12, 13, 119, 120, 133

This species has been recorded from Minas Geraes, Brazil. There are a male and a teneral female in the Hagen collection, both imperfect. Each has a small label "Hagen", a small blue

locality label, "MG" (Minas Geraes), and a large green species label; in addition the male has a black-bordered species label, and a label by Kennedy "penis drawn." The male in the de Selys collection, figured by Menger (figures 119 and 120), bears identical blue and green labels. There is also in the Hagen collection a female with a small printed label "Hagen", a large white label on which is written "Lagoa Santa Lund", and another similar but larger label on which is written "*Argya signata* nob." The specimen is teneral and in poor condition, but I believe it is certainly *flavovittatum*.

The hind lobe of the prothorax of the male specimen is not fit to figure, but it is apparently similar to that of the female, with the black more extensive.

A wing of this species has been figured by Needham (A Geneologic Study of Dragon-fly Wing Venation, Proc. U. S. Nat. Mus., Vol. XXVI, Plate LIII, figure 6), in which Rs arises at the third postnodal, at about one-fifth the distance from nodus to stigma, instead of at about one-third the distance as stated by de Selys in his definition of Heteragrion.

The arculus is distal to the cubito-anal cross-vein .7 to .8 mm.; and the anal vein separates from the posterior border .7 to 1.0 or 1.1 mm. distad to the cubito-anal cross-vein. The face profiles in both sexes are about as in figure 65.

2. *Heteragrion ovatum* Selys

A much larger species than *flavovittatum* (abdomen male 44, hind wing 31, as compared with abdomen 32 to 35, hind wing 27 to 28 in the male of *flavovittatum*), and with a relatively longer abdomen. Only the male is known, the teneral female provisionally referred to this species by de Selys in 1862, being referred to *ochraceum* in 1886. The male is known only from a single male from Brazil in the Museum of St.

Petersburg. It was seen and described (in manuscript) by de Selys about fifteen years before the Synopsis of 1862 was published. Apparently it was never seen again by de Selys. Evidently its resemblance to *flavovittatum*, as shown by de Selys' notes on the St. Petersburg specimen, was his reason for referring it to his group 1. In the note following his description (de Selys 1), where he compares it with *dorsale*, *flavovittatum* is certainly meant.

From the above notes, it is evident that the species is poorly known, its relationships uncertain, and its indicated habitat indefinite.

3. *Heteragrion ictericum*, new species

Figures 8, 14, 15, 54, 65, 74, 75, 134, 135

Abdomen, male 31 to 36 mm., average 34; female 28.5 to 30: hind wing, male 22 to 23; female 24.

Male.—Rear of head, genae, face and vertex, yellow, lighter in front, passing gradually into darker posteriorly to become orange on the vertex; labrum more or less obscured, angle of rhinarium and nasus usually darker, sometimes black; ocelli with their opposed sides narrowly bordered with black; on each side, between the lateral ocellus and the eye is a more or less defined black bar, widened at either end and not reaching the ocellus; occipital crest black with more or less obscure shadings at the ends; all markings on vertex ill defined and variable. Antenna brown, the first two segments paler to yellow. Profile as figured, figure 65.

Front lobe of prothorax black in front, a median yellow area; middle lobe yellow, a dusky area on either side; hind lobe yellow, a dusky median area and a black spot on the extreme lateral margin. Propleuron yellow.

Thorax with a narrow middorsal black stripe, continuous above with the antealar sinus and covering the area included

in the fork of the carina below; on either side of this median black stripe a more or less distinct yellow stripe of about equal width; a wider and clearer antehumeral stripe; between these two pale stripes the mesepisternum is yellow, darkened with brown shading to a very variable degree, so the dorsum may appear largely yellow, or, at the other extreme, almost black; in every case the dark area is most developed above and along its outer border; the antehumeral yellow stripe runs straight across the mesinfraepisternum; above it becomes posthumeral and occupies the upper end of the mesepimeron, which otherwise is largely black; the dark area is carried across the mesinfraepisternum which latter below, and the lower and posterior portion of the mesepimeron are yellow; metepisternum yellow with a black or brown stripe, starting near the upper end and passing through the stigma to the coxa; metepimeron paler yellow than the two anterior sclerites, sometimes with a small dusky area above. Beneath and coxae yellow.

Abdomen above largely dark, 4-7 and 9-10 the darkest; 1 pale dull yellow, darker in the median line and apically; 2 brown, a long rounded median basal yellow spot, darker basally on either side of this spot; 3 brown, a yellow basal ring and a black apical one of about the same width, a very narrow pale middorsal line continuous with the basal ring, varying from about one-third the length of the segment to, but not dividing, the apical black ring; an obscure but evident subapical pale area; 4-7 similar, black replacing the brown and the middorsal longitudinal pale line absent; 8 dull orange yellow, obscure at the base and narrowly black ringed apically; 9 and 10 black. Seen from the side 1 is largely dull yellow, an inferior posterior marginal black spot; lower half of 2 yellow, the inferior border black edged; 3-8 with the dorsal colors and pattern carried onto the sides; 9 dark obscure orange at base be-

low; 10 with sides largely dark obscure orange. Superior appendages black; rudimentary inferiors dull yellow.

Legs light brown, femora each with two more or less distinct darker areas.

Wings clear or with a very faint tinge of brownish; stigma black or very dark brown, oblique, covering two to two and one-half cells; of 30 front wings, 20 have two postquadrangular cells, 2 have two plus, 4 have three minus and 4 have three; of 30 hind wings, 18 have two minus and 12 have two; postnodals of front wing are 16 to 20, of hind wing 15 or 16; in the front wing the arculus is distal to the cubito-anal cross-vein about .4 mm., in the hind wing about .3 mm.; in both front and hind wings the anal vein separates from the posterior border about .4 to .5 mm. distad to the cubito-anal cross-vein.

Female.—Head similar to that of male, but much duller, rhinarium and nasus more extensively dark. Profile as in the male.

Prothorax light brown, front lobe black along the front border, wider on either side; middle and posterior lobes patterned as in the male, largely dusky. Propleuron light, or light yellowish, brown.

Thoracic pattern as in the male, but the pale colors are light brown, the two pale stripes on the mesepisternum only more or less yellow tinged; between these two stripes the mesepisternum is always brown, black below at the outer border, thus darker than the darkest males in the present material.

Abdominal segments 1-7 similar to the male, slightly duller, brown rather than black except at each apex; 8-10 brown, 10 lighter, 9 with a broad dull yellow oblique ring which is subapical in the middorsal line and runs downward and forward ending on the extreme antero-ventral border; sides of 8 and

10 dull yellowish below. Appendages dull yellow at base, brown at apex.

Legs similar to those of male.

Wings clear to tinged yellowish brown; stigma light brown, oblique, covering two to nearly three cells; 6 front wings all have two postquadrangular cells; of 6 hind wings, 4 have two postquadrangular cells, and 2 have two minus; postnodals of front wing 17 or 18, of hind wing 13 to 15; the relations of the cubito-anal cross-vein to the arculus and to the separation of the anal vein from the posterior border are as in the male.

Material Studied: Wismar, Tumatumari and Potaro Landing, all in British Guiana, January 31 to February 10, 1912, a total of fifteen males and three females, collection E. B. W.: Tamanoir, Mana River, French Guiana, May and June, 1917, S. M. Klages collector, collection Carnegie Museum, a total of twenty-four males and thirteen females, both tenerals and adults in each month. Type male, Wismar, January 31, 1912; allotype female, Tumatumari, February 9, 1912.

In the Proceedings of the National Museum, Vol. 48, pp. 626 and 627, I have described a small stream between Wismar and Christianburg where we collected. *Heteragrion ictericum* was taken along this stream associated with *Epipleoneura lamina* and *fuscaenea*.

4. *Heteragrion melanurum*, new species

Figures 9, 16, 76, 77, 136

Abdomen, male 32 to 34 mm.: hind wing, male 21 to 22.

Male.—Rear of head and genae yellow; labrum yellow to dark brown, yellow along the anterior border, rhinarium and nasus yellow, the latter sometimes darker to deep orange, darker medianly and in front; frons orange or reddish brown;

vertex orange brown or dull red, obscurely marked with black to a varying degree; ocelli with their opposed sides very narrowly black; a short transverse line through the median ocellus, with a more or less anterior fork on each side or with a transverse line near the frons; on either side a black bar between the antenna and eye; a thread of black, not always discernible, from behind each lateral ocellus to the eye; occipital crest black. Antenna obscure yellow, first joint brown or black, second joint darker at apex, third joint with basal half pale, and the apical half darker, with a submedian black or brown ring. Profile similar to figure 65.

Prothorax dull yellow, front lobe bordered with black in front; middle lobe brown in the middle and with an indefinite brown area on either side; hind lobe black, posterior margin on either side, but not reaching the extreme lateral margin, yellow. Propleuron bright yellow.

Thorax very similar to that of *ictericum*; the large dark area on the mesepisternum, between the pale line adjoining the middorsal carina and the pale antehumeral line, is better developed than in *ictericum*, covering the entire area between the two pale stripes, reddish brown along its inner border, but developing into very dark brown or black along the entire outer border; on the other hand, the dark on the mesepimeron, as compared with *ictericum*, is slightly shortened above and is interrupted below a short distance above the mesinfraepisternum; the brown on the metepisternum is variable, sometimes interrupted; the small superior spot on the metepimeron is always present.

The description of abdominal segments 1-7 and 9 and 10 of *ictericum* will apply equally well to *melanurum*, except that possibly in the latter the pale colors are lighter and brighter yellow, and 2 lacks the median basal pale spot; but 8, which is

largely dull orange yellow in *ictericum*, is black or dark brown above, paler below in *melanurum*, with a narrow obscure pale basal ring which widens at the lower lateral margin. Superior appendages brown, paler basally; rudimentary inferiors yellow.

Legs yellow, femora each with two large brown or black areas, dividing the femur into five subequal areas; a trace of darker at base and apex.

Wings clear or with a very slight brownish tinge; stigma brown or black, covering from scarcely two to two and one-half cells; two postquadrangular cells in all wings but one hind wing where there are two minus; postnodals of front wing are 15 to 19, of hind wing 14 to 16; the arculus is distal to the cubito-anal cross-vein about .3 mm. or slightly less in both front and hind wings; the anal vein separates from the posterior border from less than .4 to .5 mm. distad to the cubito-anal cross-vein.

Female.—Not known.

Material Studied: Wismar and Rockstone, British Guiana, January 30 to February 1, 1912, four males, collection E. B. W. Type male, Rockstone, February 1, 1912.

The darker abdomen and the slenderer appendages will separate this species from its close ally, *ictericum*.

5. *Heteragrion triangulare* Selys

Figures 17, 18, 112, 137, 138

The type is a female from southern Brazil in the Museum of Vienna (1). In 1886 de Selys described an incomplete male and female from Rio Janeiro in McLachlan's collection and referred them to *triangulare*, with the remark that it was uncertain that the specimens were the same as the unique

female at Vienna. Calvert (4), in identifying specimens in the Carnegie Museum from Chapada, Brazil, as *triangulare*, clearly implied that he did not regard this material as conspecific with the McLachlan specimens. I have studied the specimens from Chapada, and I agree with Calvert. I have no idea what the McLachlan specimens are, but they are certainly nearer *aurantiacum* than the species determined by Calvert as *triangulare*. The species was credited to Hagen by de Selys (1) but later (2) was credited to de Selys. The same shift occurs in the case of *macilentum*.

The profile of the head in both cases is similar to figure 65. The arculus is distal to the cubito-anal cross-vein .3 to .4 mm., and the anal vein separates from the posterior border .2 to .3 mm. distad to the cubito-anal cross-vein in the front wings and .4 to .5 mm. in the hind wings.

6. *Heteragrion macilentum* Selys

This species seems distinct by the male having a very dark head (apparently darker than *triangulare*) and by lacking a distinct broad black posthumeral stripe. It was described (de Selys 1) from specimens from Porto Cabello, Venezuela, and from Brazil in the Museum of Vienna and the de Selys and Hagen collections. In 1886 (de Selys 2), under the name misspelled *macitentum*, the Venezuela record is repeated, but a question mark, without explanation, follows Brazil. Only the very teneral female has been described (de Selys 1) and its identity with the male was later questioned (de Selys 2). The description of the female contains nothing definite. The same shift in name of author occurs here as I have noted under *triangulare*. The species is no longer represented in the Hagen collection and I have not seen any specimens. In view of its apparent relationships its occurrence in Venezuela, far to the north of the range of its allies, is remarkable.

7. *Heteragrion dorsale* Selys

This species is known from a single male from Nova Friburgo, Brazil, in de Selys' collection. In the key to males of group 1 and 2 it will run out to *triangulare* and *beschkii*; it has head markings similar to *triangulare*, and dorsum of thorax similar to *beschkii*, but the prothorax is almost all black.

8. *Heteragrion ochraceum* Hagen

Figure 19

This species was described (de Selys 1) from both sexes from Nova Friburgo in the collections of Burmeister, Hagen and de Selys. At the present time only a single female is in Hagen's collection. The labels on this specimen are interesting: there is a small written label "Heyer"; a large written label "*Argya cinnamomea* female Hagen"; another written label "*H. ochraceum* female"; a written black-bordered label "*H. ochraceum* Hag."; and a small printed label "Hagen". De Selys (1) has Heyer's name following *Heteragrion cinnamomeum*, but he states that the female of *cinnamomeum* is unknown and later (2) he makes *cinnamomeum* a synonym of *aurantiacum*. For further discussion of this point see text under *cinnamomeum*.

The female character, "un tubercle renflé derrière chaque oeil sur l'occiput, que est jaune", emphasized by de Selys (or Hagen), I do not understand. There is nothing peculiar in the head of the female specimen in the Hagen collection labelled *ochraceum* by Hagen. Otherwise I believe this specimen is the one on which the description (de Selys 1) was based. The hind lobe of the prothorax is not in condition to figure; it has wide wings, similar to figure 142, but with the edges convex. There is a rounded dark central area.

The male of *ochraceum* is described as near *beschki*; the basal third of the labrum, middle lobe of prothorax, a central spot on the posterior lobe, the dorsal thoracic carina and the area below between the fork, black. Apparently the first and last characters above enumerated separate it from *beschki*, and the last character from *dorsale*; the pale thoracic dorsum separates it from *triangulare*. It is also described as having the "base of the abdomen" black with a median yellow line. In this it is apparently different from all other species in group 2 but *obsoletum*. See text under *cinnamomeum*.

The profile of the female in the M. C. Z. is like figure 65. The arculus is distal to the cubito-anal cross-vein about .6 mm., and the anal vein separates from the posterior border .7 to 1.1 mm. distad to the cubito-anal cross-vein.

9. *Heteragrion cinnamomeum* Selys

Figures 123, 124

In the original description (de Selys 1) *cinnamomeum* was doubtfully placed as a race of *aurantiacum*. The material from Bahia consisted only of males, according to the text, and was in the de Selys and Hagen collections. It is not plain from the text whether de Selys or Hagen was the author. At any rate there is some confusion, since, if any male specimens were in the Hagen collection, they have been lost, the species being represented there by a single female which I have discussed at some length under *ochraceum*. In 1886 de Selys (2) apparently regarded *cinnamomeum* as a synonym of *aurantiacum*, but in the text he indicated a difference by stating "C'est probablement à la race *cinnamomeum* qu'il faut rapporter une femelle etc."

In de Selys' collection is a male, figured by Menger (figures 123 and 124, which, among other labels, bears three

labels "*cinnamomeum*" all in de Selys' handwriting. This is clearly specifically distinct from *aurantiacum* in the same collection and also figured by Menger (figures 121 and 122). May not this specimen labelled by de Selys *cinnamomeum* be *ochraceum*? De Selys knew the latter species directly only from a single teneral female. As evidenced by the female in Hagen's collection we know that Hagen, who possibly knew both sexes of both *cinnamomeum* and *ochraceum*, regarded the former as a synonym of the latter.

10. *Heteragrion beschkii* Hagen

Figures 20, 82, 83, 139

A female, doubtfully referred to this species, has been described (de Selys 2) but the description is inadequate. The species is represented by a single male in the Hagen collection. This has two written pin labels "*H. beschkii*", one of which is black-bordered, and another written label, "Brasil-New Freiburg, Beschke—*Argya aurantiaca*." The small printed pin label "Hagen" and written label "penis drawn" by Kennedy are also attached. This specimen, which is in good condition, is the type.

The profile of the male is like figure 65. The arculus is distal to the cubito-anal cross-vein .5 to .7 mm., and the anal vein separates from the posterior border .7 to .8 mm. distad to the cubito-anal cross-vein.

11. *Heteragrion aurantiacum* Selys

Figures 21, 22, 78, 79, 111, 121, 122, 141, 142, 143, 144

This species was recorded from Bahia, Brazil and from Buenos Ayres by de Selys (1 and 2), the specimens from Brazil in his collection, the specimens from Argentina in

Hagen's collection. The latter material consists now of a single female, and there is no way of determining whether or not other specimens formerly existed. The figure of *aurantiacum* by Menger is of the type or one of the type specimens, collected by Clausen. Calvert (4) relying on de Selys' description alone, identified material from Rio de Janeiro, Brazil, and Sapucay, Paraguay, as *aurantiacum*. The Menger figure serves to confirm the correctness of his determination. Later Ris (7) identified specimens from Argentina as *aurantiacum*.

The female in the Hagen collection bears the following written labels: "Von Heyer-Buenos Ayres", "*H. aurantiacum* female", a black-bordered label "*H. aurantiacum* Sel.", and the small printed label "Hagen." I have discussed this specimen briefly in the key to females of groups 1 and 2, and in footnote 6. (See also figures 23 and 140.) It certainly is not the same species as the females identified by Calvert (4) as *aurantiacum*, and, if I am right in believing that Calvert's identification is correct, this specimen must be some other species than *aurantiacum*. If I am correct in thinking *cinnamomeum* is a synonym of *ochraceum*, and if the female in the Hagen collection labelled *ochraceum* is correctly named, then the female, labelled *aurantiacum*, cannot be *ochraceum*.

In pronouncing the Hagen female labelled *aurantiacum* as specifically distinct from the material so determined by Calvert, I have relied largely on the form of the hind lobe of the prothorax. It is improbable but possible that *aurantiacum* in its range varies in this character to the extent shown by figures 140 and 142. That the hind lobe does vary to a considerable length extent however, or that two species are confused under one name is shown by a comparison of the material from Brazil and from Paraguay (Calvert 4), all of which is

before me. The specimens from Brazil differ from the specimens from Paraguay in the hind lobe of the prothorax, especially in the female, where the great lateral wings of the Brazilian specimens are not duplicated elsewhere in the series (see figures 142 and 144). Otherwise I am unable to detect any clear differences. The males from Paraguay are larger than those from Brazil in width of head, size of thorax, and length of wings and abdomen, as shown by the following measurements:

Width of head:	Paraguay, 5.5; Brazil, 5.
Length of abdomen:	Paraguay, 40; Brazil, 38.
Length of hind wings:	Paraguay, 26; Brazil, 25.

But these differences are no more than might be expected between individuals of a species from a single locality. The thoracic dorsum of the Paraguay males is brighter and more definitely marked than in the others but all specimens are in poor coloration.

In addition to the material studied by Calvert (4), I have had for study a single male from the state of Sao Paulo, Brazil, Coll. Cornell University, lot 298, sub 362. This specimen is like the Brazilian specimens.

In both sexes the profile of the head is like figure 65. The arculus is distal .5 or .6 mm. to the cubito-anal cross-vein, and the anal vein separates from the posterior border .6 or .7 mm. distad to the cubito-anal cross-vein in the front wing and .9 to 1.1 mm. in the hind wing.

Before the correct status of the several species of group 2, living between 20° and 40° south latitude can be determined, more and better material must be collected.

12. *Heteragrion amazonicum* Selys

Described. (de Selys 2) as possibly distinct from *cinnamomeum*, which he regarded as a race of *aurantiacum*. In his description he speaks of it as larger than other species of the group (abdomen 34, hind wing 27) but his description of *aurantiacum* (1) gives the same measurements for that species except that the hind wing is 26. There is nothing distinctive in the description and the indefinite locality, "pris par M. Bates sur l'Amazone", will make the identification of this species impossible in the future if the type female is not preserved.

13. *Heteragrion consors* Hagen

Figures 24, 80, 81, 145

The Hagen collection contains a male in a good state of preservation. It bears the printed labels "Hagen" and "Winthem"; and the following written labels: two black-bordered labels, one "*H. consors* Hagen", the other "Bahia", another "*H. consors*", and "penis drawn" by Kennedy. This specimen is the type. The female has not been described.

The profile is like figure 65. The arculus is distal .6 to .8 mm. to the cubito-anal cross-vein, and the anal vein separates from the posterior border 1.0 to 1.3 mm. distad to the cubito-anal cross-vein.

14. *Heteragrion obsoletum* Selys

Described (2) from a single male from Cochambu, southern Brazil. The species seems to have no relatives in the group in which de Selys placed it, though he compared it with *ochraceum*, the male of which, however, he knew only from Hagen's description. It is a small species (abdomen 31, hind wing 25, while other species of the group have the abdomen 37 to 41, and the hind wing from 23 to 30), and seems very distinct by its blue and greenish pale markings and its color pattern.

15. *Heteragrion erythrogastrum* Selys

Figures 1, 30, 31, 58, 64, 71, 84, 85, 125, 126, 146, 147

Calvert (3) and Ris (8) have pointed out that the processes of the male inferior appendages are small and variable. In some specimens they are invisible in a profile view but may be detected in an oblique posterior view. De Selys' reference of the species to his group 2, rather than 3 where it really belongs, was due doubtless to his material having the processes concealed or minute. By venational characters, however, he should have referred it to group 3 as the arculus is distal to the cubito-anal cross-vein from .3 to .5 mm., while the anal vein separates from the posterior border usually near the cubito-anal cross-vein, distad .1 to .2 mm.

Calvert (3) and Ris (8) have briefly described the teneral male. Such specimens, in their abdominal pattern, suggest the adults of allied species (*chrysops*, etc.). The thoracic pattern of such teneral males is similar to that of the adult female. As the male matures the pale stripes, adjoining the middorsal black, blacken and disappear at least in some cases before the pale humerals are lost.

Colombian specimens are larger with a tendency to fewer postnodals than specimens from Central America, as shown by the following data:

Abdomen male, Colombia 35 to 42, average 37, Canal Zone 34 to 35.

Abdomen female, Colombia 30 to 33, average 31; Canal Zone 28.

Hind wing male, Colombia 24 to 26; Canal Zone 22 to 23.

Hind wing female, Colombia 25 to 26; Canal Zone 22.5.

Postnodals front wing male, Colombia 16 to 18; Canal Zone 16 to 18.

Postnodals hind wing male, Colombia 14 to 16; Canal Zone 14 to 15.

Postnodals front wing female, Colombia 15 to 16; Canal Zone 17 to 18.

Postnodals hind wing female, Colombia 13 to 15; Canal Zone 14 to 15.

Thus the difference between the lengths of the abdomen of the largest and smallest males is 8 mm., and of females 5 mm. No other species shows such variation in size. The profile is similar in both sexes.

Under *mitatrum* some habits of *erythrogastrum* are noted. We found it commonly along all the streams at Cristalina excepting the Rio Diez-y-ses where we did not see it during the single day we collected there. It is a relatively conspicuous insect, the blood red abdomen contrasting strongly with the green and browns of its environment, as it rests with half-spread wings on twig tips. The wings vary from clear to brown or dingy tinged. We observed it about Cristalina from about 8 or 9 a.m. till nearly 5 p.m. when the ravines were dark and gloomy. A male, taken at Cristalina, has the abdomen turned once on its long axis at the sixth segment, like a corkscrew. We took a number of *Mecistogasters* similarly malformed. Evidently during emergence from the exuvia, before the apical abdominal segments are released, the soft teneral, agitated by some cause and attached to the exuvia only by the apical segments, is twisted or turned, producing the corkscrew malformation of the adult.

Material Studied: This species is well represented in several collections; I have examined 194 males and 35 females. To the localities recorded by de Selys (2), Calvert (3), and Ris (8), the following may be added: Costa Rica: Bonnefil Farm, Rio Surubres, 700 feet; Rio Siquiaries; Turrucares,

2000 feet; Rio Guapiles; Philadelphia South Farm; Alajuela, 3100 feet; Quebrada de Salas, Atenas Station; East of La Emilia; small stream north of Turrucare; April, June and August to December, inclusive, 1909 and 1910, a teneral in December, a pair in August and October, remarks "creek in woods", "brook in shade", "more open part of quebrada"; a total of 23 males and 10 females all collected by and in the collection of P. P. Calvert: Canal Zone, Rio Sardanilla, December 5, 1916, 27 males and 3 females, Chas. T. Tribolet and E. B. Williamson, collectors, coll. E. B. W.: Colombia, Cristalina, Department of Antioquia, February 12 to 20, 1917, 135 males and 8 females, J. H. and E. B. Williamson, collectors, coll. E. B. W.

16. *Heteragrion albifrons* Ris

Figures 2, 32, 33, 61, 72, 86, 87, 148, 149

This species has recently been described by Ris (8) from a single male from Reventazon, Costa Rica. The species is represented in Dr. Calvert's Costa Rican material by the following specimens: Peralta, August 9, 1909, in low woods, one male; Turrialba, 2300 feet, July 26, 1909, 10 males, 3 females; Guapiles, forest, June 2, 1909, pair; Juan Vinas, 2500 feet, May 3, 1910, 1 female; Reventazon Valley, Juan Vinas, July 23, 1909, 2 males, 1 female; Reventazon Valley, below Juan Vinas, 2500 feet, June 28, 1909, 2 males; Reventazon road, Juan Vinas, 2500 feet, stream in forest, April 28, 1910, 1 male. This is the *Heteragrion* referred to by Dr. Calvert (6) on pages 228 and 251, and probably page 192. The male from Cachí, Costa Rica (Calvert 3), referred to *erythrogastrum*, and the female from the same locality, questionably referred to *chrysops* (Calvert 3), are also very probably this species.

This is one of the handsomest species of the genus. It seems to me the name is not very appropriate as the male, to

which alone the specific name is applicable, has the face bright light gold. It is, however, paler than in any other species. The profile in the male is like figure 63, and in the female like figure 64. As might be expected the female is very similar to the female of *erythrogastrum*; *albifrons* is a slenderer, more delicate insect, with the middorsal thoracic black stripe narrower.

17. *Heteragrion tricellulare* Calvert

Figures 34, 35, 36, 107, 150, 151

This large species is known only from Mexico and Guatemala. I have seen only three imperfect specimens, two males and a female, studied by Dr. Calvert (3) now in the U. S. Museum. The profiles are like those of *albifrons*. The arculus is about .5 mm. distal to the cubito-anal cross-vein, and the anal vein separates from the posterior margin at the cubito-anal cross-vein or distad as far as .2 mm. The following material has not hitherto been recorded: Purulha, Guatemala, July 11, one male, collected by Wm. Schaus, in collection of P. P. Calvert. "Purulha is correct spelling, not Purula as Champion spells it."—Letter from Wm. Schaus to Dr. Calvert.

18. *Heteragrion alienum*, new species

Figures 5, 37, 38, 39, 57, 68, 88, 89, 105, 152, 153

This is the species described by Dr. Calvert (3) and referred to by all authors, excepting de Selys and Hagen, as *chrysopts*. I have not seen the female of the latter species, but a male in the Hagen collection, the type or one of the types of *chrysopts*, shows the distinctness of the two. The hind lobe of the prothorax, as figured, seems specifically distinct, and the tooth on the superior appendages is triangular and more basal in *chrysopts* than in *alienum*, where it is more

slender and acute and more apical. The profiles are like those of *albifrons*. The arculus is .3 to .6 mm. distal to the cubito-anal cross-vein, and the anal vein separates from the posterior border .1 to .4 mm. distad to the cubito-anal cross-vein.

Chrysops is said (de Selys 2) to have the abdomen reddish orange or even carmine; the Hagen specimen has it redder than in any specimens of *alienum* seen by me. The color character used in the key for separating the males of *alienum* and *chrysops* may not prove constant. *Alienum* is known from Mexico, Guatemala, Honduras and Panama.

The following material has not hitherto been recorded: Puerto Barrios, Guatemala, June 23, 1909, E. B. Williamson, collector, four males and two females, one of the males the type and one of the females the allotype, in coll. E. B. W.: Cayuga, Guatemala, March 21 (forest streams), April 5 (forest stream), May 3 (forest), June 4 (forest), six males, all collected by Wm. Schaus, in collection of P. P. Calvert. "Cayuga is 23.4 miles from Barrios; the elevation of station is 107 feet and the forest ridge is about 400 feet higher. The hills in question are on the south side and are covered with dense tropical forest (no pines at all)."—Letter from Wm. Schaus to Dr. Calvert.

19. *Heteragrion chrysops* Hagen

Figures 40, 90, 127, 128, 154

This species is known only from Porto Cabello, Venezuela. The type, or one of the type males, is in the Hagen collection. The face of this specimen is broken and the profile cannot be determined. The arculus is .4 mm. distal to the cubito-anal cross-vein, and the anal vein separates from the posterior border from .1 to .4 mm. distad to the cubito-anal cross-vein. The female is not known. See remarks under *alienum*.

20. *Heteragrion flavidorsum* Calvert

Figures 41, 108, 155

Described (Calvert 4) from a single male from Coroico, Bolivia, May 19, 1899, collected by W. J. Gerhard, coll. Acad. Nat. Sci. Phila. In the pattern of abdominal coloration it is apparently different from all other species in the genus.

21. *Heteragrion majus* Selys

Figures 42, 43, 62, 67, 91, 92, 106, 129, 130, 156, 157

This fine large species was described from males from Chiriqui, Panama. It has also been recorded from Peru (Ris 8). The male studied by Calvert (3) is in the Hagen collection. I have also seen two males and one female from Cachi, Costa Rica, collected in February, March and July, 1910, by Schaus and Barnes, in the Calvert collection, and so identified by Calvert. The profiles are like those of *albifrons*. The arculus is .4 to .5 mm. distal to the cubito-anal cross-vein, and the anal vein separates from the posterior border from .3 to .5 mm. distad to the cubito-anal cross-vein.

22. *Heteragrion aequatoriale* Selys

Figures 44, 45, 93, 113, 131, 132, 160, 161

This species was described (Selys 2) from males from Bogota, Colombia, and from the Rio Bobonaza, Ecuador. In describing the teneral male the abdomen is stated to be 32 mm., this doubtless should be 42 mm. The species has also been recorded from Peru by Calvert (4) and Ris (8). The specimens studied by Calvert are a male and female in the U. S. Museum. Both are in poor condition and the female is so teneral as to be unidentifiable, except by size and association with the male. Menger's drawings (figures 131 and 132) in-

dicates that the specimen in the de Selys collection has the tooth on the superior appendages placed more basally than in the case of the Peru male in the U. S. Museum. Otherwise, as pointed out by Calvert (4), the Peru male agrees with de Selys' description, though it is slightly larger, abdomen over 48 and the hind wing 29 mm. In both sexes the profile is like figure 64. The arculus is .5 to .6 mm. distal to the cubito-anal cross-vein, and the anal vein separates from the posterior border at or as far as .2 mm. distad to the cubito-anal cross-vein.

23. *Heteragrion angustipenne* Selys

Figures 29, 109, 110, 158

Described by de Selys (2) as a possible race of *aequatoriale*. The three last segments were lost from the single male. A very much smaller specimen from Peru (abdomen 42, hind wing 24.5, as compared with abdomen 48, hind wing 29, of de Selys' specimen) has been identified as this species by Calvert (4). The differences in size are probably not incompatible with specific identity. De Selys briefly described the female as resembling *aequatoriale* and *icterops*, but he did not describe *aequatoriale*, except to give abdomen and wing measurements, and the description of *icterops* is brief and contains nothing distinctive.

24. *Heteragrion calendulum*, new species

Figures 46, 94, 159

Abdomen, male 36 mm.; hind wing, male 23.5.

Male.—Rear of head dull orange, darker above; face, frons above and vertex in front bright orange; not so reddish as in *mitratum*; rear of vertex black, the line between black and orange about the level of the lateral ocelli, with a bar for-

ward to the rear edge of the median ocellus; metallic areas, with the granular or hammered-brass like surface, as described for *mitratum*, but yellow, more gold like, and larger in *calendulum*, the median division between them less evident, and, on either side, but not touching the eye, is a rounded area of the same color and metallic surface. Antenna with the first two joints and all of the third but the apex yellow, remainder brown. Profile similar to that of *mitratum*.

Prothorax similar to that of *mitratum*, with the pale color inclining to orange rather than yellow, the dusky area on either side of the middle lobe represented by only a tinge of darker, but the lower border narrowly and more or less completely black.

Thorax above, the mesepimera and the mesinfraepisterna largely rich reddish brown; a black middorsal stripe, on either side of which is a scarcely discernible pale stripe about half as wide; the lower outer area of each mesepisternum is yellow or yellowish and there is a faint paling along the humeral suture (this last pale area being the remnant of the pale humeral stripe of *mitratum*); the area on the thoracic dorsum between the dorsal and humeral paler lines is darker above, shading out below; probably it never becomes entirely black as in *mitratum*; mesinfraepisternum black below in front; metepisternum and metepimeron brownish yellow, with an indefinite reddish brown area, which shades out below, on each sclerite. Beneath and coxae yellow, coxae darker in front.

Abdominal segment 1 yellow, a large dusky median spot above and the lower posterior border black; remainder of abdomen flesh red and black; 2 largely pale, a small basal dusky area on either side above, enclosing between them an incipient longitudinal median stripe, a more indefinite apical

median dusky area, and the extreme lower lateral border black edged; 3 with an indistinct yellow basal ring, followed by red, the apical fifth or slightly less black; 4 and 5 black at base, followed by a larger area of pale, with the apex black to the same extent as 3; 6 and 7, and 9 and 10 black, some traces or suggestions of red in the mid-area of 6 and 7; 8 largely reddish brown, indefinitely darker at base and at apex, the dark color more extensive in the middorsal area, palest on the sides below; 9 and 10 seen from the side are also dull yellowish below; dorsal and lateral color patterns of 3-7 similar. Superior appendages black; inferiors brownish yellow, the spine dark brown or black.

Legs dark brown or black; first femora largely on the inner (lower) side, second femora at the base and on the inner side distally, and third femora entirely, except the apex, light brown.

Wings similar in shape to those of *mitratum*; saffron tinged to the arculus; distal to the arculus with scattered indefinite light brown tinged areas; stigma black, covering from slightly less to slightly more than two cells; two postquadrangular cells in all wings; postnodals of front wing are 18, of hind wing 16; in both wings the arculus is distal to the cubito-anal cross-vein about .3 mm., and the anal vein separates from the posterior border at the cubito-anal cross-vein or very slightly distad in the hind wings.

The following brief color notes were made from the recently killed male: duller than *mitratum*, eyes above black; thorax reddish brown, more reddish than *mitratum*; humeral and first lateral suture yellow; abdomen dull reddish and black.

Type: Described from a single male, taken along the Quebrada Sabaleticus, near Cristalina, Department of Antioquia,

Colombia, February 17, 1917, collected by J. H. and E. B. Williamson, collection of E. B. W.

In the itinerary of our trip to Colombia¹¹ I have described (page 17) the small tributary of the Quebrada Sabaleticus where we found *Mesagrion*. We collected along the Quebrada Sabaleticus only a short distance above this small tributary. On the afternoon of February 17 I heard black howlers up the quebrada as I came out of the small tributary, so followed up stream as much to see the monkeys as to collect dragonflies. After finding the monkeys and seeing one make a splendid leap, I was returning to the tributary about 3:30 p.m. when I saw a *Heteragrion* resting on the twig tip of a small dead bush which had lodged on a bit of sand and debris in mid-stream. It occurred to me that the insect was generally duller than the common *mitratum*. Moreover we were capturing every *mitratum* that came readily to hand to make sure that we were not overlooking some similar species. So the specimen resting on the dead twig was netted, and its specific distinctness was recognized before it was dropped into the cyanide bottle. A brief search in the neighborhood resulted in the capture of specimens of *mitratum* only. Two days later J. W. made a special trip up the Sabaleticus to look for the females of *Mesagrion* and for this new *Heteragrion* but he failed to find either. The brilliant metallic areas on the vertex have suggested the specific name.

25. *Heteragrion mitratum*, new species

Figures 3, 4, 50, 51, 56, 63, 69, 95, 162, 163

Abdomen, male 36 to 40 mm.; female 29 to 30.5; hind wing, male 21.5 to 24; female 23 to 24.5.

Male.—Rear of head light yellow; genae, face and anterior

¹¹A Collecting Trip to Colombia, South America, Mis. Publ. No. 3, Museum of Zoology, Univ. of Mich.

part of vertex brilliant reddish orange; rear part of vertex black; the transverse line between orange and black at approximately the level of the posterior edge of the median ocellus, which is nearly surrounded by black; an anterior spur of black on either side toward the antenna, rarely wanting; the area posterior to the frons and between the antennae brilliantly metallic with a fine granular surface; the area is divided into two by a narrow non-metallic bar from the median ocellus to the frons; rarely the black is reduced in front by withdrawal along the anterior line between the median ocellus and the lateral ocelli and on the outer side of each lateral ocellus. Antenna with the first two joints and the base or more of the third yellow, the remainder brown. Profile as figured, figure 63.

Front lobe of prothorax black, posterior lateral margins yellow; the black posteriorly V-shaped, the apex reaching the black of the posterior lobe; remainder of middle lobe yellow, with a more or less developed brown or black area on each side; posterior lobe black, a more or less distinct posterior pale area on either side. Propleuron yellow, black edged below in front.

Thorax rich black above, sides yellow, a narrow orange line on either side of the middorsal carina, disappearing below and joined above with a wider humeral stripe which ends on the mesinfraepisternum but does not cross it; the humeral stripe is posthumeral above and antehumeral below; mesepimeron with a wide black bar, parallel to the yellow humeral stripe and hence occupying the posterior part of the sclerite above and the anterior part below; near its upper end this black area is more or less distinctly joined with the dorsal black, thus dividing the humeral pale stripe which is joined above and behind with the pale area of the metathorax; below the mes-

epimeral black extends across the mesinfraepisternum, the posterior lower portion of which is yellow, and joins the black area of the mesepisternum; metepisternum with a black bar, wider above, not reaching the wing base, tapering and ending below at or near the stigma; metepimeron broadly livid along its anterior suture; some small black spots and lines at wing bases. In darker, and presumably older individuals, the dorsal and humeral pale stripes darken and, in extreme cases, entirely disappear; the dorsal stripes go first, and they may be scarcely discernible, except at the extreme upper end, in individuals in which the humeral stripes remain bright yellow. Beneath and coxae yellow, the latter more or less darkened in front.

Abdomen above reddish orange and black; 1 yellow with a median black or brown spot, more or less divided in the median line; 2 black or brown, paler apically with a longitudinal median yellow stripe; 3-6 with a narrow basal pale ring, followed by a brown or black area shading out into pale, followed by a narrow apical black ring; 3 with a median longitudinal pale line, continuous with the basal ring and disappearing posteriorly in the subapical pale area; 7-9 reddish brown, 7 the darkest and dullest; 10 black without definite pattern. Seen from the side, 1 yellow, lower posterior border black; 2 black or dark brown above, shading out below into brown, wider basally, which shades out leaving about the lower half or more yellow, the extreme lower border and apex black; 3-6 similar to dorsal view, the subbasal brown on 3 paler than on 4-6, not reaching the lower border; on 4-6 the pale basal ring is lengthened or expanded below thus shortening the subbasal dark area; this dark area suffers a greater reduction posteriorly by the lengthening of the subapical pale area which is shortest on the middorsum and longest in the

midventrum, but 3 or 4-6 are as definitely four-banded in ventral as in dorsal view; 7-10 as in dorsal view, except that 10 is like the preceding segments, the black being confined to the dorsum. Superior appendages black; inferiors dull yellow or orange.

Legs brown or black; the femora paler, yellowish, or brownish, the hind femora the palest, sometimes entirely pale except apex.

Wings bright saffron tinged at base to the first or second antenodal, remainder of wing usually hyaline, rarely tinged light brown or dingy yellow; stigma black, covering scarcely one and one-half to two cells; two or two plus postquadrangular cells in the front wing, two minus to two plus in the hind wing; postnodals of front wing 16 to 18, of hind wing 14 to 16; in both front and hind wings the arculus is distal to the cubito-anal cross-vein about .4 mm., and the anal vein separates from the posterior border about .2 mm. or less distad to cubito-anal cross-vein.

A number of teneral were taken which show the changes in coloration with maturity. In the most teneral the face is light lemon yellow, darker on the vertex, the black on vertex reduced, and paling to brown over considerable areas; the pale markings of thorax and abdominal segments 1 and 2 are almost white, cream colored, and there is a dark indefinite area above on the metepimeron. This dark area is found on all the teneral; all of them have the thorax equally pale, and the pale color of the abdomen varies from light lemon yellow to lemon, but the color pattern is preserved in all. In all the teneral the wings are entirely hyaline, no saffron tinging at base. In a teneral, slightly more mature than the youngest one, the face is yellow and the vertex in front is orange, the black of the vertex not reduced in area but with some obscure or pale

areas. In a still more mature teneral the face, as well as frons above and vertex in front, is orange, though the pale thoracic markings remain cream colored or rather livid, with scarcely a trace of yellow; the black of the vertex is not reduced in area or density.

Female.—Pale markings of head, prothorax and the thorax, and to a lesser extent of abdomen, pale dingy cream color; genae brighter, lemon yellow; labrum, nasus, frons at either extremity, first joint of antenna in front, a large area against the eye opposite each antenna, and more or less of the vertex, black; frons brown or dark green, more or less distinctly pale in front; labrum with a large basal median pale spot and sometimes the general color brown instead of black; vertex black posterior to the frons and in front of the median ocellus over approximately the area which is metallic orange in the male; the region of the ocelli and the rear of the vertex is black, sometimes with obscure brown or pale areas especially along the eyes, leaving a large and variably shaped pale area between the region of the ocelli and the eye. Antenna with second joint brown or black, distal joints brown. Profile similar to figure 64.

Prothorax patterned as in the male, except that the lateral pale areas on the hind lobe are more extensive, isolating the median black as a large more or less rounded spot. Propleuron pale, tinged lemon yellow.

Thoracic pattern similar to that of the male, the light and dark pattern never lost above by darkening as it often is in the males; the humeral pale stripe crosses the mesinfraepisternum, and the black stripe on the mesepimeron fades out indefinitely below but continues as a variable brown or dusky area on the mesinfraepisternum; a dusky area above on the mes-

epimeron is sometimes present. Beneath white, coxae tinged lemon yellow.

Abdomen seen from above largely brown or black, the pale markings except on 1 more or less yellow; 1 dingy white, a median dusky area; 2 dark brown or black with a narrow median longitudinal pale stripe of varying length; 3-7 each with a more or less distinct pale basal ring, followed by dark brown which at the apex shades into black, and with a thread-like median longitudinal pale line which starts in the pale basal ring and ends at or near the apex of the segment; the above pattern dullest, sometimes obscured, on 7; 8 largely black or dark brown, darkest at base and apex; 9 with a large black basal spot on either side, one-half to two-thirds the length of the segment, separated in the median line by a broad longitudinal bar of dull yellow which, at its distal end, meets a broad subapical oblique transverse pale bar which terminates on either side on the lower basal margin of the segment; 10 narrowly black at base and in the median line, remainder of dorsum pale, or this obscured and darkened so the dorsum, at the other extreme, may be largely dark brown or black. Seen from the side, 1 white, lower posterior margin black; 2 black above, lower half or more dull lemon yellow; 3-7 similar to 2 but the pale area does not reach the apex, which is black, and there is an indefinite longitudinal inferior bar or streak of dark brown which begins near the base of each segment and extends posteriorly to or beyond the middle of each segment; 8 obscurely pale below; 9 dark brown with a broad oblique bar from near the apex above to the basal inferior margin, the lower margin largely pale; 10 dull yellow below shading out into brown or black above. Appendages black.

Legs similar to those of the male, but paler and duller, the colors light and dark brown.

Wings slightly tinged with brownish; stigma brown, covering slightly less to slightly more than two cells; slightly less than two to slightly more than two postquadrangular cells in both front and hind wings; postnodals of front wing 16 to 19, of hind wing 15 to 17; in both front and hind wings the arculus is distal to the cubito-anal cross-vein .3 to .4 mm., and the anal vein separates from the posterior border .2 to .3 mm. distad to the cubito-anal cross-vein, the greater distance being more usual in the hind wings.

A teneral female has the head much paler, brown replacing black, except the spots opposite the antennae next the eye, and the brown areas less extensive than the black areas of the mature females; the thorax is slightly paler, and the abdomen much paler, the subbasal brown areas reduced both on the dorsum and sides, in density of color only on the dorsum and in both density and extent on the sides; 9 and 10 are largely pale, with the dark areas indicated but dim.

Material Studied: Maraquita, Department of Tolima, and Cristalina, Department of Antioquia, Colombia, February 3 to 20, 1917, 17 males and 1 female at Maraquita, and 184 males and 14 females at Cristalina, collected by J. H. and E. B. Williamson. Type male and allotype female, Cristalina, February 18, 1917, in coll. E. B. W.

This species was the only Heteragrion observed at Maraquita where it was found along the upper San Juan and more rarely along the lower San Juan. We found it along every stream we visited about Cristalina but it was very rare along the Quebrada Cristalina. It was most abundant along the Quebrada La Camelia, so far as our experience went, a little more than one-half our material in both sexes being taken during the single day we spent on that creek.

At Maraquita we made the following note: "Rests on twig

tips and occasionally on leaf edges with the body horizontal or slightly hanging (not hanging like *alienum*), wings half-spread; always in shade." And at Cristalina: "Males of this species and *erythrogastrum* in the afternoon come out from the jungle to open places along the creek, and from some advantageous perch catch their prey like fly-catchers, returning again and again to the same resting place. Males of the same species frequently fight, dancing rapidly and pugnaciously, heads on, before each other. Females of both species oviposit unattended by the males." As the males of *mitratum* fight each other, the only part of the insect visible to the observer may be the brilliant metallic areas on the vertex, which, even in the scanty light of late afternoon, flash like minute golden flames against the green of the jungle, turning and darting here and there, and disappearing to flash again. The same little head-light, more often than anything else, betrays the resting insect to the collector. Though I noted that the female oviposits unattended by the male, I unfortunately failed to record the place of oviposition, and I have no recollection of the matter. The black posterior vertex of the male with its two anterior prongs or angles makes the specific name appropriate.

One female specimen has the head of a bee firmly attached to the tarsus of the right front leg. Through the kindness of Mr. Currie, this head was identified by Mr. J. C. Crawford as a Trigona. I have previously recorded¹² a similar occurrence in *Archaeogomphus hamatus*.

A male of *mitratum* was sent to Dr. Ris who wrote: "Similar to what I have considered *H. aequatoriale* but specifically distinct without question; unknown to me."

¹² II, A New Species of *Agriogomphus* (Odonata), Occ. Papers, Mus. of Zool., Univ. of Mich., No. 59, p. 16.

Heteragrion species.—In Dr. Calvert's material, collected by himself, is a very teneral male taken at La Emilia, Costa Rica, November 16, 1909. The species is distinct from anything known to me though it is doubtless closely related to *mitratum*. The specimen is however so teneral that the form of the appendages cannot be determined. Its most distinctive character is the coloration of the head, in which it resembles *angustipenne* (figure 29), the vertex being black to the frons, and to the same level on either side between the antenna and the eye, with a small indentation of pale color posterior to each antenna. The metathoric dark stripes are better developed than in teneral specimens of *mitratum*; the abdominal markings and wings are apparently identical in the two, though the stigma may be slightly shorter in *mitratum*. While it is certainly an addition to the known Central American fauna, more material is necessary for its description.

26. *Heteragrion simulatum*, new species

Figures 48, 49, 70, 97, 98, 164, 165

Abdomen, male 34 mm.; female 29; hind wing, male 21.5; female 22.5.

Male.—Rear of head, genae, face, frons and vertex to level of the median ocellus, bright yellow; remainder of vertex black; small obscure brown areas on the genae and a small brown spot on each side between the antenna and eye. First two joints of antenna and basal half of third bright yellow, remainder brown. Profile like figure 64.

Prothorax bright yellow, front lobe with a median black spot, and on either side, an indefinite dusky area; middle lobe with the merest trace of dusky on either side; hind lobe with a large rounded median black spot which encroaches on the middle lobe but does not quite reach the posterior border; ex-

treme lateral margins of the hind lobe dusky. Propleuron bright yellow.

Thorax above similar to *ictericum*, but brighter, clearer yellow, the two pale stripes, the one adjoining the middorsal black and the antehumeral, equally bright; the dark area is darker above, the inner and outer borders equally dark (thus differing from *ictericum*), and shading out below, especially on the outer border, leaving the outer half or more of the sclerite below yellow; doubtless when more specimens are known this dark area will be found to be variable in extent; sides bright yellow; mesepimeron dusky, especially along the humeral suture and below, indefinite and obscure but carried across the mesinfraepisternum as a brown line; metepisternum with a narrow stippled line from near the top to the stigma; a small dusky stippled area above on the metepimeron. Beneath and coxae yellow.

Seen from above abdominal segment 1 is largely yellow, dusky at the base in the median line; 2 brown above with a longitudinal median yellow line, which does not reach the extreme base or apex; 3-6 brown above, apex broadly black, a narrow yellow basal ring from which a narrow longitudinal middorsal yellow line runs posteriorly to, but not across, the black apex; this longitudinal yellow line widest on the anterior segments; the brown, adjoining the basal yellow ring, grows progressively darker posteriorly, so on 6 the remaining brown, adjoining the apical black, appears as a relatively light colored area; 7 brown, a basal yellow ring, the extreme apex very narrowly black; 8 similar but paler, the subbasal brown shading out at once posteriorly into dull orange; 9 similar to 8 but darker, a narrow median longitudinal yellow line from the base for about three-fourths the length of the segment, the narrow apical black of 8 wanting;

10, like 9, dark orange or reddish brown, a median longitudinal black line. Seen from the side 1 is entirely yellow except a narrow postero-inferior border of black; 2 is largely yellow, with the extreme lower border narrowly dark or black; 3 broadly yellow below, except at the apex where the black encircles the segment; 4-6 similar, but the subbasal brown spreads down to the lower margin, thus dividing the pale into a basal and a subapical area; 7 same as from above; 8-10 similar to 7, but 9 darker, and 10 brighter and paler, especially beneath. Superior appendages largely dark brown; inferiors yellow, shading apically into brown.

Legs dull yellow, obscurely blotched and lined with brown, especially the femora, the first femora the darkest.

Wings clear; stigma dark brown, slightly oblique, covering one and one-half to scarcely two cells; two postquadrangular cells in front wing, two minus to two in hind wing; 15 postnodals in front wing, 12 or 13 in hind wing; in the front wing the arculus is distal to the cubito-anal cross-vein about .5 mm., in the hind wing about .4 mm.; in front and hind wings the anal vein separates from the posterior border from .2 to .3 mm. distad to the cubito-anal cross-vein.

Female.—A very teneral and poorly colored female is referred to this species. Head light brown, obscurely and indefinitely marked with darker. Prothorax very light brown, almost white, patterned as in the male, with obscure brown more extensive. Thorax patterned about as the female of *ictericum*, due to teneral condition light and darker brown in color; a well defined streak above on the metepimeron. Abdomen similar to the male, very light brown or cream replacing the yellow, and brown replacing the richer darker brown of the male; 1-7 similar to the male, less darkening of the subbasal dark color, and dark brown replacing the apical

black; 8-10 uniform brown; appendages brown. Legs dull cream and brown, patterned as in the male. Wings similar to those of the male, but stigma light brown; two minus to two plus postquadrangular cells in the front wing, two in the hind wing; 15 or 17 postnodals in front wing, 14 or 15 in hind wing; in front and hind wings the arculus is distal to the cubito-anal cross-vein about .4 mm., and the anal vein separates from the posterior border about .3 mm. distad to the cubito-anal cross-vein.

Material Studied: Tumatumari, British Guiana, February 11, 1912, one male and one female, the male the type, coll. E. B. W. The specific name refers to the superficial resemblance of this species to certain species in group 2.

Below the falls in the Essequibo at Tumatumari, on the left bank of the river opposite Sprotson's rest house, is a small slow muddy stream. We collected here one day, February 11, taking, among a number of other things, only two specimens of this Heteragrion, which proved to be specifically different from specimens of the same genus taken on the opposite side of the river where most of our collecting was done.

27. *Heteragrion inca* Calvert

Figures 47, 114, 166

Described by Calvert (4) from a male and female in the Hagen collection. The female has since been lost or misplaced. The male is in good condition, but the face is broken so I can not determine the profile. In both front and hind wings the arculus is distal to the cubito-anal cross-vein about .4 mm., and the anal vein separates from the posterior margin from .2 to .3 mm. distad to the cubito-anal cross-vein. The specimens were from Iquitos, Peru. The species is discussed under the next, *icterops*.

28. *Heteragrion icterops* Selys

Figures 117, 118

This species was described by de Selys (1) from a single teneral male from Santarem, Brazil, which lacked the superior appendages. This is the type specimen. Later (2) he noted differences and additional characters of the adult male, and briefly described the female from material from Venezuela, Ecuador, and Peru. Menger's drawings of a male in the de Selys collection is of one of these specimens, but the drawings do not indicate which one. Were it certain that the specimen figured by Menger is conspecific with de Selys' type of *icterops*, I should conclude that *inca* Calvert is a synonym of *icterops*. But I doubt very much that the material from Brazil, Venezuela, Ecuador, and Peru, associated by de Selys under the name *icterops*, is all conspecific. The certain solution of this matter, like other similar questions in the genus, awaits the collecting of more material.

In de Selys' description (2) the abdominal measurement of the female should certainly be 27 instead of 37 mm., unless de Selys referred a female, certainly not conspecific, to this species. Students should not overlook "additions et corrections" to de Selys (2, page 220).

29. *Heteragrion peregrinum*, new species

Figures 6, 7, 52, 53, 59, 73, 96, 167, 168

Abdomen, male 30.5 to 35 mm., average 34; female 31 to 33.5, average 32; hind wing, male 20.5 to 23, average 22 or 22.5; female 23 to 24.

Male.—Rear of head dingy white; genae and pale markings on face, yellow; labrum light to dark reddish brown, anterior edge and a large round median spot, light orange; rhinarium pale, darker above; nasus black, more or less pale

at base and at the outer posterior angles; frons pale in front, with a median dark area and dark along the angle; head above variable, due to darkening with age; in even the darkest specimens there are three small pale areas, one in front of the median ocellus on or near the suture between frons and vertex, and one on either side of the median ocellus, not touching the ocellus and extended laterally only to the level of the antenna, the remainder of vertex and frons above black; if a curved line be drawn from either side, beginning at the outer extremity of the pale area on either side of the median ocellus, and curving backward and inward to meet on the median line just anterior to the occipital crest, the roughly semicircular area enclosed is that in which the black is reduced in less mature specimens; this reduction is most conspicuous between and posterior to the lateral ocelli, this area becoming largely reddish brown in some specimens. First joint of antenna black in front; second and third joints light brown, more or less darkened in older specimens, especially on the inner face of the second joint and the apex of the third; remainder brown. Profile similar to figure 64.

Prothorax bright yellow, conspicuous; the front and hind borders black, the latter widened at the lateral extremities and with a large median black spot the length of the hind lobe, or the hind lobe may be black with a yellow anterior spot on either side, or entirely black; a short longitudinal median thread of black on the middle lobe. Propleuron bright yellow, only slightly paler than the middle lobe.

Thorax rather dull colored, black above; on either side of the black middorsal stripe is a dingy white stripe often slightly more than half as wide as the middorsal black, but sometimes reduced to a line; an antehumeral pale, yellowish tinged stripe, about as wide as the dorsal pale stripes, widened on

and extending across the mesinfraepisternum; mesepimeron with a wide black bar on its upper two-thirds, not reaching the wing base; remainder of sclerite a livid purplish of varying intensity, often yellowish above, and always darker below, where it is usually a purplish brown, extended across the mesinfraepisternum; remainder of side of thorax varying from purplish flesh to pale dingy yellow; metepisternum with a black bar from the stigma up about half the distance to the wing base; from the stigma a more or less distinct stippled line runs down between the second and third coxae; a more or less distinct line above on the metepimeron. Beneath, coxae and wing bases and immediately adjacent areas lemon yellow, the wing bases with black markings.

Abdomen brown or black marked with dingy white or lemon yellow; segment 1 yellow, the merest trace of a dorsal median dusky spot, lower posterior border black; 2 brown or black above, a pale longitudinal median dorsal line; 3-6 each with a narrow basal pale ring, followed by an extensive dark area, with a more or less distinct pale narrow longitudinal dorsal stripe, which originates in the pale basal ring and is best developed on the proximal segments; the extensive dark area followed by a reduced pale area, which in turn is followed by an apical black area which is more extensive than the pale area proximal to it, the two apical areas equalling about one-third the length of each segment; 7 is more or less definitely patterned like 6, but the extensive subbasal black area usually shades out indefinitely posteriorly so the apical pattern is lost, that part of the segment being like the following segments; 8-10 dull reddish or yellowish brown, usually progressively darkening posteriorly. Seen from the side, 2 with dorsal third dark, remainder pale, the extreme inferior border dark; 3 similar to dorsal view but the basal and sub-

apical pale areas are joined along the inferior border; 4-6 similar to 3, but in each the basal and subapical pale areas are separated by the lateral extension of the subbasal dark area, this separation progressively longer (i. e., the pale areas below more reduced) posteriorly; 7-10 as in dorsal view, 8-10 with the lower border paler than the dorsum, most distinct on 9 and 10. Superior appendages brown, paler at base, darkening sometimes to black at apex; inferior appendages dull yellow.

Legs light brown or gray, very lightly clouded or shaded with darker; a more or less distinct brown subapical area on each femur.

Wings clear or brownish tinged; stigma dark brown or black, covering from two minus to two plus cells; two to two plus postquadrangular cells in the front wing and two minus to two plus in the hind wing; postnodals in front wing 15 to 18, in hind wing 14 to 16; in the front and hind wings the arculus is distal to the cubito-anal cross-vein from .3 to .5 mm.; in the front wing the anal vein separates distad to the cubito-anal cross-vein from about .4 to .6 mm., in the hind wing from .6 to .8 mm.

Female.—Head similar to that of the male, especially the younger and paler males, and variable as in that sex; the frons above is never black, but varies from light to very dark brown, except at the lateral extremities which are black; the vertex is largely brown, a black area on each side opposite the antenna, a black area in front of and on either side of the median ocellus, between the antennae, and a black occipital crest are always present; the pale area on either side of the median ocellus varies in extent and clearness but is always present; the same is true of the median pale area in front of the median ocellus, except that it is apparently want-

ing in one specimen; in older specimens the area between the ocelli is largely black. Antenna and profile similar to the male.

Prothorax dingy white to lemon yellow, patterned as in the male, the hind lobe as described for the palest males; the posterior half or more of the middle lobe is more or less indefinitely stippled brown or black. Propleuron white to light yellow.

Thorax patterned exactly like that of the male and only slightly paler, in fact a bright colored female may be brighter than a dull colored male, but in no females does the yellow of coxae and under parts become as bright as in the brightest males.

The abdomen also is practically as described for the male, except that it is slightly duller, the pattern not quite as definite; segment 2 has the lower lateral border pale, not black edged as in the male; 8-10 instead of being progressively darker posteriorly, as in the male, are progressively paler; in some specimens 8 and 9 are more or less black on the sides. Appendages unusually long, .8 to .9 mm., slender, dull yellow or light brown at base, shading apically to dark brown.

Legs as described for the male.

Wings and stigma as in the male; the postquadrangular cells in the hind wings very variable, in the front wings, 15 wings have two postquadrangular cells, and 10 wings have two plus, but in 25 hind wings, 19 have from one to one and a half cells, 6 have two minus and 9 have two cells; postnodals 15 to 18 in the front wing, and 13 to 16 in the hind wing; relations of the cubito-anal cross-vein to the arculus and the separation of the anal vein from the posterior border as in the male.

Material Studied: Cristalina, Department of Antioquia, Colombia, February 12 to 19, 1917, 33 males and 17 females,

J. H. and E. B. Williamson, collectors, coll. E. B. W. Type male and allotype female, February 17, 1917.

We found this species at Cristalina only along the smallest creeks. About half the material of both sexes came from the Quebrada Cristalina and the other half from the small tributary of the Quebrada Sabaleticus, mentioned under the discussion of *Heteragrion calendulum*. It was not taken along Quebrada La Camelia where we took many specimens of *mitratum*. The latter inhabits small streams but gives place to *peregrinum* on the small tributaries and on the headwaters of these streams. *Peregrinum* rests on twig tips or leaf edges. For a Heteragrion it wanders far from water and is found in the brush in shallow short dry gullies between low hills. It is remarkable that the bright yellow prothorax of the male is the conspicuous color area of the insect. This color area is less conspicuous, of course, than the bright yellow "head-lights" of the males of *mitratum*, *calendulum*, etc. *Peregrinum* is an aberrant member of group 3 of the genus, but it can not be placed in any other group. This fact and its habit of wandering from the streams make the specific name doubly appropriate.

A male was sent to Dr. Ris for examination. He wrote: "I have not seen anything similar to this."

30. *Oxystigma petiolatum* Selys

Figures 10, 25, 26, 55, 66, 99, 100, 101, 102, 115, 116, 169, 170

Male.—Labrum black. Prothorax black, extreme anterior border of front lobe bluish and the lateral margin greenish blue; middle lobe with a large anterior indefinite greenish-blue spot on either side reaching the lateral margin; hind border of posterior lobe lavender. Propleuron light yellow, bluish in front, darker behind. The narrow lines on either side of

the middorsal thoracic black are clear lemon yellow or yellowish; the antehumeral stripe is bluish with yellow tinges; the mesepimeron is largely brown; the metepisternum is blue above to the stigma, white below and along the anterior border above, a stippled black bar from near the wing base to the stigma; metepimeron almost white, traces of a dark area above. Beneath white, coxae cream. Abdomen black above, including 1, pale basal rings not evident; seen from the side there are more or less distinct pale basal inferior spots on 3-7. Superior and inferior appendages black.

Female.—Prothorax largely light brown, hind lobe darker. Abdomen as described for *cyanofrons*.

Wings in both sexes about as described for *cyanofrons*; the distance from cubito-anal cross-vein to arculus and to the separation of the anal vein from the posterior border slightly greater in all wings in both sexes of *petiolatum*; postnodals in front wing 19 or 20, in hind wing 15 to 18. In the male there are one to one and two-thirds postquadrangular cells; in the female less than one to one postquadrangular cell.

The above notes are intended to supplement de Selys' description of both sexes from Santarem, Brazil. As might be expected some differences in color between the British Guianan and Brazilian specimens are indicated.

Material Studied: Tumatumari, one male, February 9, 1912, and Wismar, one female, January 31, 1912, British Guiana, collection E. B. W.: Tamanoir, Mana River, one male and four females, May, 1917, and Cayenne, two males and one female, February and March, 1917, French Guiana, S. M. Klages collector, collection Carnegie Museum: Igarapi Assai, Para, Brazil, December, 1911, two males, Parrish collector, collection Cornell University: one female, collection E. B. W., without data.

The male taken at Tumatumari was resting on a twig tip in a dry flat near the river where I also took *Metaleptobasis mauritia*.¹³ One of the females from Tamanoir, French Guiana, has a remarkable left front wing. The wing is slightly shorter than the opposite wing and there are some abnormalities in the stigma and in veins near the apex of the wing. But the rest of the wing superficially appears normal. However the first antenodal is distal to the first antenodal of the opposite wing about one-fifth or sixth the distance from wing base to antenodal; the second antenodal and the arculus are still more distal; and the nodus still more distal, being distal to the nodus of the opposite wing a distance equal to about one-half the distance from the second antenodal to the nodus: M_3 arises slightly distad to the nodus, at the nodus in the opposite wing; R_s arises near the eighth postnodal, near the sixth in the opposite wing; and M_2 arises near the thirteenth postnodal, near the ninth in the opposite wing. From this point distally the wing area has irregular cell structure and evidences of abnormality. Is there any connection between this apical injury and the relatively apical position of the otherwise normal basal wing structures?

31. *Oxystigma cyanofrons*, new species

Figures 11, 27, 28, 60, 103, 104, 171, 172

Abdomen, male 33 to 36 mm.; female 26 to 27: hind wing, male 22 to 23.5; female 22 to 22.5.

Male.—Rear of head light cream, darker shaded above; genae, labrum, nasus and frons bright blue, labrum more or less bordered with black, stipple-edged; rhinarium largely black with blue areas on either side; vertex black, shining ad-

¹³ Notes on Neotropical Dragon-flies, Proc. U. S. Nat. Mus., Vol. 48, 1915, p. 603.

joining the eye, opposite the antenna; a short dull blue line or bar from each lateral ocellus toward the antenna, wanting in one male. First joint of antenna more or less blue in front; second joint and basal two-thirds of third, black; remainder brown; the third joint short and robust. Profile similar to figure 66.

Prothorax dark reddish brown to black; anterior border of first lobe narrowly pale; posterior border of middle lobe pale on either side and small indefinite pale areas, sometimes wanting, on either side near the anterior border. Propleuron largely dark or black, some indefinite pale markings above.

Thorax above very dark reddish brown or black, the pale line on either side of the narrow middorsal black, which is almost universal in *Heteragrion* and *Oxystigma*, is discernible only as a slightly lighter brown line or is wanting; the same is true of the antehumeral pale stripe; sides dark, obscure and indefinitely patterned; mesepimeron and metepisternum largely dark reddish brown; the lower ends of these sclerites, the adjacent parts, including the coxae, and the metepimeron pale, stippled and clouded with brown or black to a varying degree and in an indefinite pattern; the pale color of the metepimeron is light dull blue or grayish, the other pale parts tinged with yellowish; beneath almost white, bluish.

Abdomen above black, a small subapical pale spot on either side of 1; more or less distinct traces of a longitudinal middorsal pale stripe on 2; scarcely discernible traces of pale basal areas on 3-6. Sides of 1 and 2 with obscure pale markings; 3 with the extreme lower edge pale; 4-7 with an inferior marginal basal pale spot, followed by a dark inferior margin which is followed in turn by a longer narrow pale inferior margin which does not reach the apex; this pattern

more or less distinct on 8 which approaches the uniform black of 9 and 10. Appendages black.

Legs dark brown or black; femora more or less obscurely lighter brown, the hind femora the palest.

Wings almost clear or tinged with yellowish brown; stigma brown, very oblique, covering two and one-half to slightly more than three cells; one, or slightly more than one post-quadrangular cell; postnodals of front wing are 20 to 23, of hind wing 17 to 19; in the front wing the arculus is distal to the cubito-anal cross-vein about 1.2 mm., in the hind wing about 1.5; in the front wing the anal vein separates from the posterior wing border about 1.5 mm. distad to the cubito-anal cross-vein, in the hind wing about 2 mm. distad.

Female.—Rear of head light cream, darker shaded above; genae and frons dull yellow, the frons the duller; labrum dull green, front border darker; rhinarium black or very dark brown; nasus light dull green, yellowish at the margins and darker in front; vertex as in the male, the pale spots larger and dull yellow. Antenna black or dark brown, only faint traces of paler on the first joint in front. Profile similar to that of the male.

Prothorax reddish brown; first lobe with its anterior border pale edged; an anterior yellow or bluish spot on either side of the middle lobe, and the posterior border on either side yellow or bluish (scarcely discernible in one specimen); hind lobe narrowly pale edged on the posterior border. Propleuron largely cream, a dark superior area.

Abdomen brown above; a more or less distinct narrow median longitudinal pale line on 2; apex of 2-6 more or less distinctly black, and 3-7 with more or less distinct narrow basal pale rings. Seen from the sides 1 and 2 largely pale, darker at apex; 3-6 or 7 with sides below pale, continuous

with the pale basal rings and terminating against the apical black areas; on 4-6 this pale area is encroached on subbasally by an indefinite inferior dark brown area, just posterior to the inferiorly dilated basal pale ring, which dark area occupies about one-fourth to one-third the length of each segment; 8-10 largely brown, apex of 8 darker, 9 with a large central area, paler, and 10 shading out below to yellow. Appendages brown.

Legs similar to the male, but paler, the lighter brown more extensive.

Wings similar to those of male, stigma a lighter brown; postnodals of front wing 18 to 21, of hind wing 16 to 17.

Material Studied: Wismar and Tumatumari, British Guiana, February 5 to 16, 1912, three males and two females, collection E. B. W. Type male, Tumatumari, February 5, 1912; allotype female, Wismar, February 16, 1912.

The female taken at Wismar was flying in a dry woods and resting on the tips of twigs. The other specimens were found singly in the woods along the Tiger Creek trail at Tumatumari. They rested on twig tips and were seen with difficulty.

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2. De Selys, Revision du Synopsis des Agrionines. Première Partie, comprenant les legions Pseudostigma—Podagrion-Platycnemis et Protoneura, 1886. (Additions et Corrections, p. 220, of this paper should not be overlooked.)
3. Philip P. Calvert, Biol. Centr.-Amer., Neuropt., pp. 62-65 and p. 357.
4. Philip P. Calvert, Odonata of the Neotropical Region. Annals of the Carnegie Museum, 1909.

5. Philip P. Calvert, The Fossil Odonate Phenacolestes, with a Discussion of the Venation of the legion Podagrion Selys. Proc. Acad. Nat. Sci. Phila., May, 1913.

6. A. S. and P. P. Calvert, A Year of Costa Rican Natural History. The McMillan Company, 1917.

7. F. Ris, Neuer Beitrag zur Kenntnis der Odonatenfauna von Argentina. Mem. Soc. Ent. Belg., 1913.

8. F. Ris, Odonata from the Region of the American Cordilleras between Costa Rica and Catamarca. "An entire installment of the Archiv f. Naturgeschichte." (Letters from Dr. Ris, December 30, 1917, and April 10, 1918. The paper includes a catalogue of the Odonata of Colombia. Dr. Ris had seen proofs of some plates of wing photos when he wrote me in 1917. I have not seen the paper, but Dr. Ris has sent me a copy of that part of the manuscript dealing with Heteragrion.)

9. Helen T. Higgins, The Development and Comparative Structure of the Gizzard in the Odonata Zygoptera. Proc. Acad. Nat. Sci. Phila., January, 1901.

10. George H. Carpenter, The Geographical Distribution of Dragonflies. Scientific Proc. Royal Dublin Society, April, 1897.

A few other references to the genus or to certain species are not of interest in the present study.

APPENDIX

Several weeks after the above paper was completed and sent to Dr. Ruthven for publication, I received a package of separates from Dr. Sjöstedt, one of which¹⁴ contained matter of special interest in this connection. In this paper

¹⁴ Wissenschaftliche Ergebnisse der—Schwedischen Entomologeschen—Reise des Herrn Dr. A. Roman—in Amazonas 1914-1915—1 Odonata—von Yngve Sjöstedt. Arkiv för Zoologi, Band 11, N. 15.

Dr. Sjöstedt describes three new species of *Heteragrion*. Unfortunately at this time I had returned the borrowed material upon which much of my own work had been based, and I am therefore unable to study this material again in the light of this new literature.

The species described by Dr. Sjöstedt may be briefly discussed as follows:

Heteragrion silvarum Sjöstedt. One male and two females, Amazonas, Manaos.

Dr. Sjöstedt compares his species with *aurantiacum*, separating it from the latter by its smaller size (a negligible difference), by the relatively longer male superior appendages, each with a relatively larger inferior tooth and with a smaller number of apical spines (this last character probably without value), and by the excavated posterior border of segment 10, which is nearly straight in *aurantiacum*. Unfortunately I cannot now determine how valuable this last character may prove in the genus. The differences noted in the color of head and prothorax of the two species are probably of value in the case of the prothorax only. But in a venational character, pointed out by Dr. Sjöstedt, *silvarum* is entirely distinct from *aurantiacum*,—the cubito-anal cross-vein near the arculus in *silvarum*, and much more proximal in *aurantiacum*.

Dr. Sjöstedt also points out differences in size and color between *silvarum* and *cinnamomeum*, *macilentum* and *beschki*. Of the other species of the group not mentioned by Sjöstedt there are none I think to which *silvarum* might be referred, though there is the unidentified but probably larger *amazonicum* to reckon with.

In my key to males of groups 1 and 2 *silvarum* will run out to *aurantiacum* but from Dr. Sjöstedt's description and figure I believe it is more closely related to *ictericum* and

melanurum. The males of the three species may be separated at once by the color of the apical abdominal segments and the form of the superior appendages.

Heteragrion speciosum Sjöstedt. One male, Peru.

As Dr. Sjöstedt points out, *aequatoriale* and *angustipenne* are the closest relatives of this species. In addition to the darker abdomen it seems to differ from the others also in having a larger ventral tooth on the male superior abdominal appendage. It is certainly different in this latter character from the species so determined and figured by Calvert, but it is not certain that Calvert's *aequatoriale* is that species, and *speciosum* may really be a synonym of *aequatoriale*. The description and the figure of the abdominal pattern of *speciosum* do not agree well.

Heteragrion romani Sjöstedt. One male, Amazonas, Manaos.

Simulatum is very near, possibly the same as this species, but *simulatum* shows only the usual widening of abdominal segments 9 and 10 (the unusual widening may be an accident, due to drying, in the type of *romani*) and these segments are colored as described and are not entirely black above as described for *romani* which moreover seems to be a much duller colored species than *simulatum*. However, Sjöstedt's description is not detailed (the prothorax, brightly colored and sharply patterned in *simulatum*, is entirely omitted) and positive determination is impossible.

On page 5 of Dr. Sjöstedt's paper, eleventh line from bottom, for *Antenodalen* read *Postnodalen*; on page 9, tenth line from the top insert *Flügel* before *Reicht*, and, in the third line above the table of measurements, for *Postcostalen* read *Postnodalen*.

CORRECTION: III, *Archaeogomphus*, a New Genus of Dragon-flies (Odonata). Occ. Papers Mus. of Zool., Univ. of Mich., No. 63. After *hamatus*, fourth line, page 1, insert the following sentence: a female of another closely related species belonging to the same genus as *hamatus* was briefly described but was not named as the material was considered inadequate.

PLATE I

Wing photographs by C. H. Kennedy.

Figure 1, *Heteragrion erythrogastrum*, male, Cristalina, Colombia, February 14, 1917.

Figure 2, *Heteragrion albifrons*, male, Reventazon Valley below Juan Vinas, Costa Rica, June 28, 1909, P. P. Calvert.

Figure 3, *Heteragrion mitratum*, male, Cristalina, Colombia, February 19, 1917.

Figure 4, *Heteragrion mitratum*, female, Cristalina, Colombia, February 14, 1917.

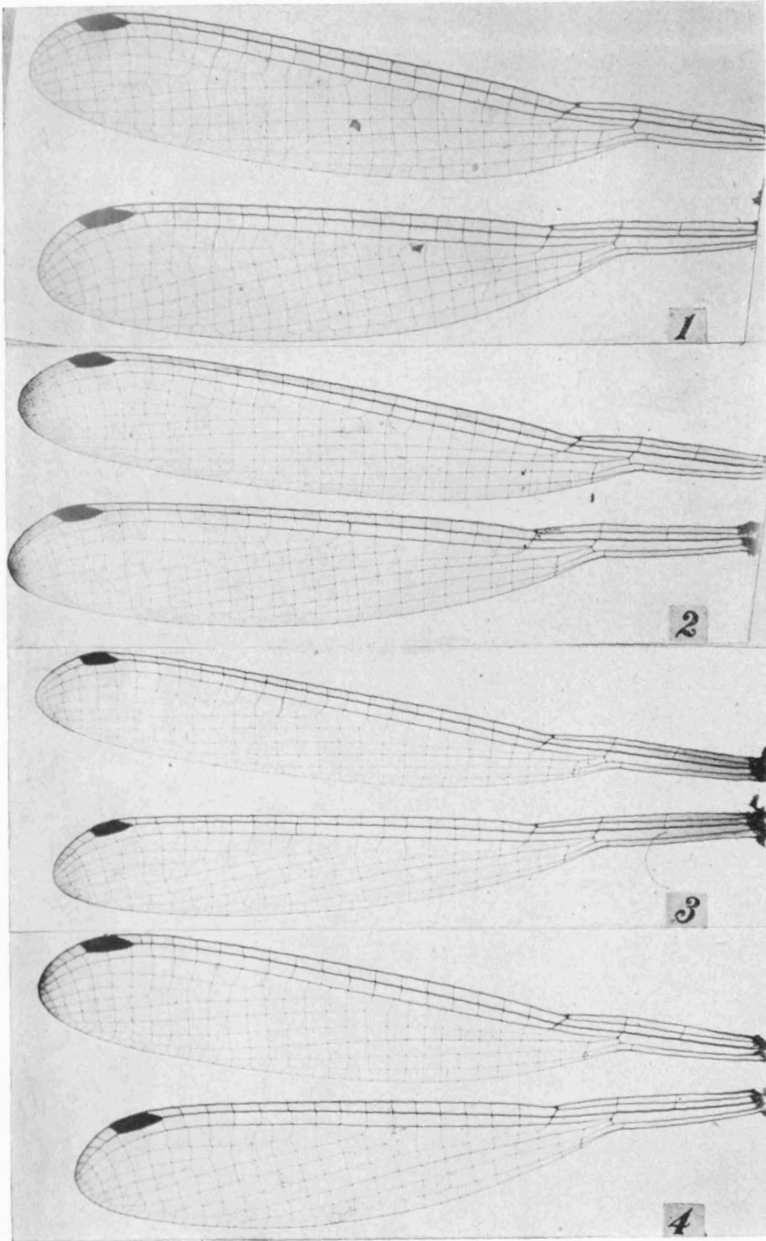


PLATE II

Wing photographs by C. H. Kennedy.

Figure 5, *Heteragrion alienum*, male, Puerto Barrios, Guatemala, June 23, 1909.

Figure 6, *Heteragrion peregrinum*, male, Cristalina, Colombia, February 19, 1917.

Figure 7, *Heteragrion peregrinum*, female, Cristalina, Colombia, February 16, 1917.

Figure 8, *Heteragrion ictericum*, male, Wismar, British Guiana, January 31, 1912.

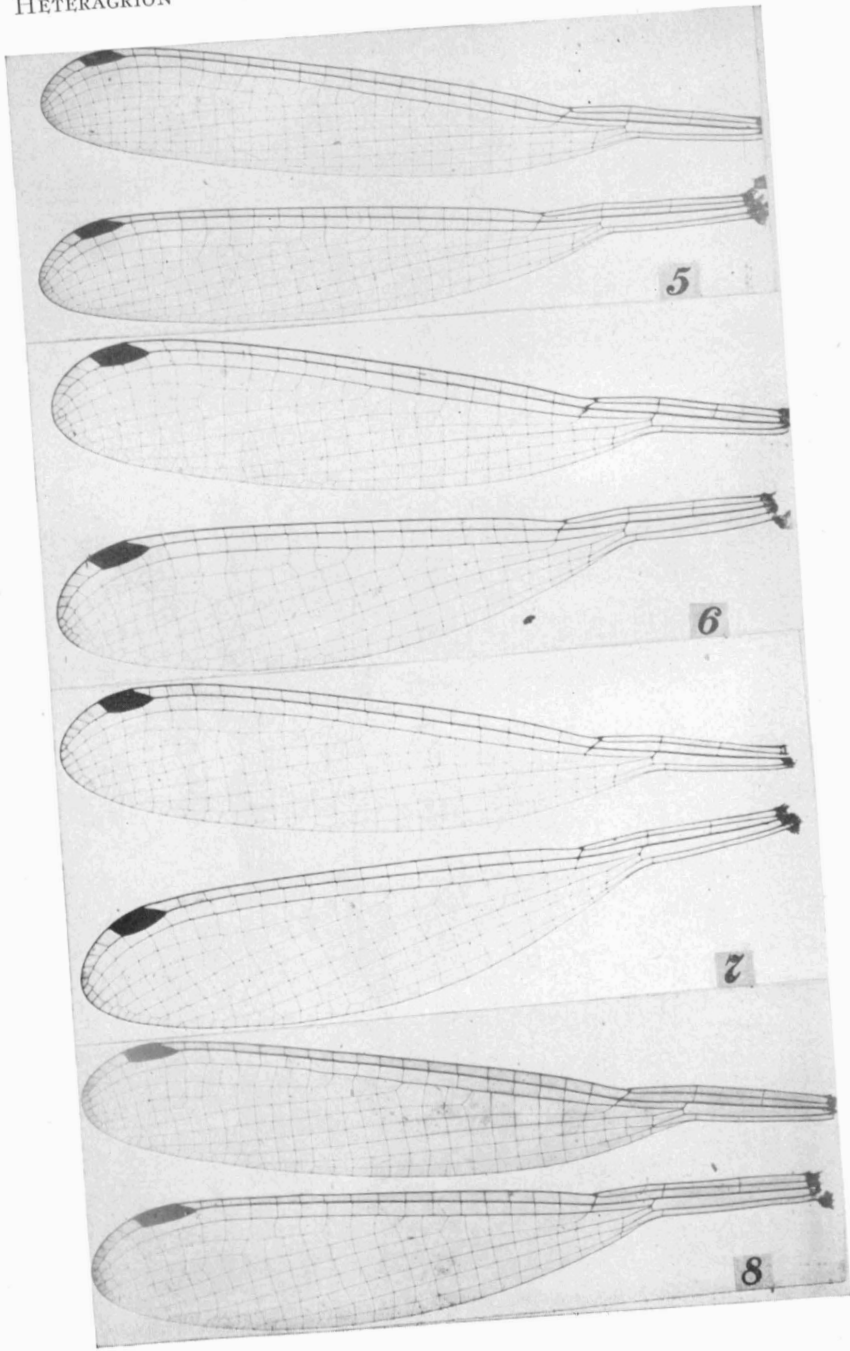


PLATE III

Wing photographs by C. H. Kennedy.

Figure 9, *Heteragrion melanurum*, male, Wismar, British Guiana, January 30, 1912.

Figure 10, *Oxystigma petiolatum*, male, Igarapi, Assei, Para, Brazil, collection Cornell University.

Figure 11, *Oxystigma cyanofrons*, male, Tumatumari, British Guiana, February 5, 1912.

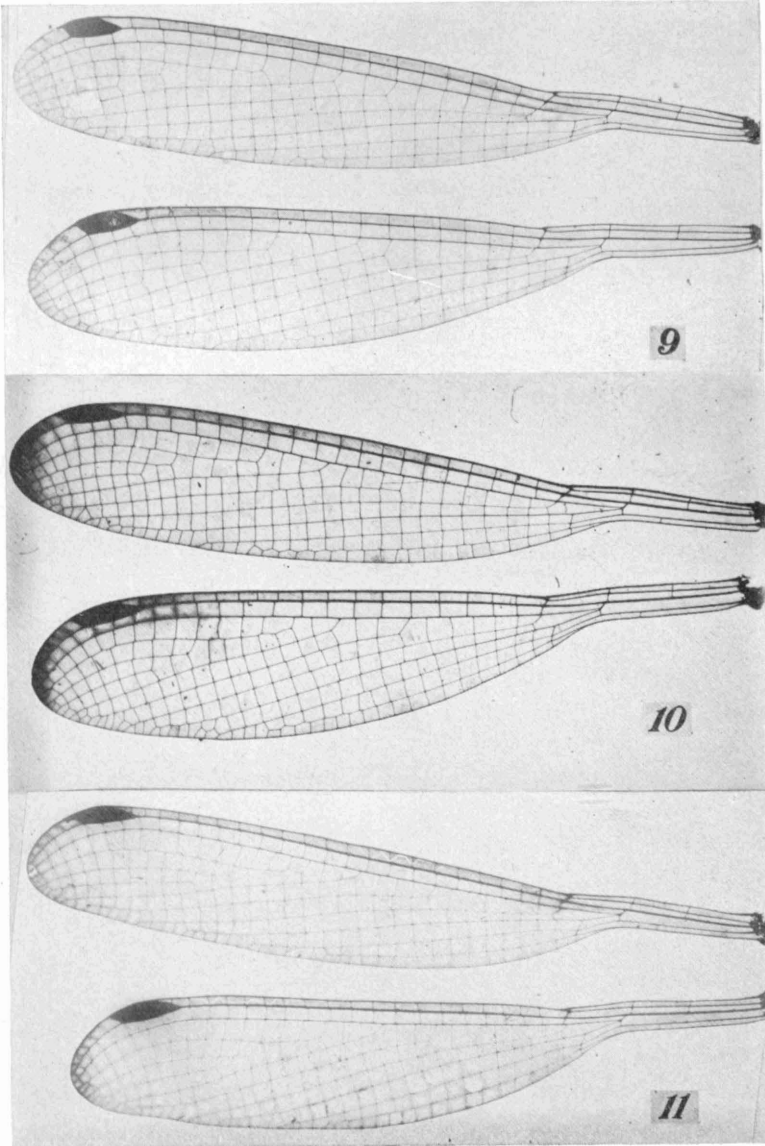


PLATE IV

Diagrammatic patterns of head coloration; figure 29 by Dr. Calvert.

Figure 12, *Heteragrion flavovittatum*, male, and figure 13, female, collection M. C. Z.; figure 14, *Heteragrion ictericum*, type male, and figure 15, allotype female; figure 16, *Heteragrion melanurum*, type male; figure 17, *Heteragrion triangulare*, male, figured by Calvert (4), and figure 18, female, both sexes, collection Carn. Mus.; figure 19, *Heteragrion ochraceum*, female, collection M. C. Z.; figure 20, *Heteragrion beschkii*, male, collection M. C. Z.; figure 21, *Heteragrion aurantiacum*, male, figured by Calvert (4), and figure 22, female, both sexes collection Carn. Mus.; figure 23, *Heteragrion* sp., female, labelled *aurantiacum*, but not that species, collection M. C. Z., see footnote 6; figure 24, *Heteragrion consors*, male, collection M. C. Z.; figure 25, *Oxystigma petiolatum*, male, Tumatumari, British Guiana, February 9, 1912, and figure 26, female, Wismar, British Guiana, January 31, 1912; figure 27, *Oxystigma cyanofrons*, type male, and figure 28, allotype female; figure 29, *Heteragrion angustipenne*, male, figured by Calvert (4).

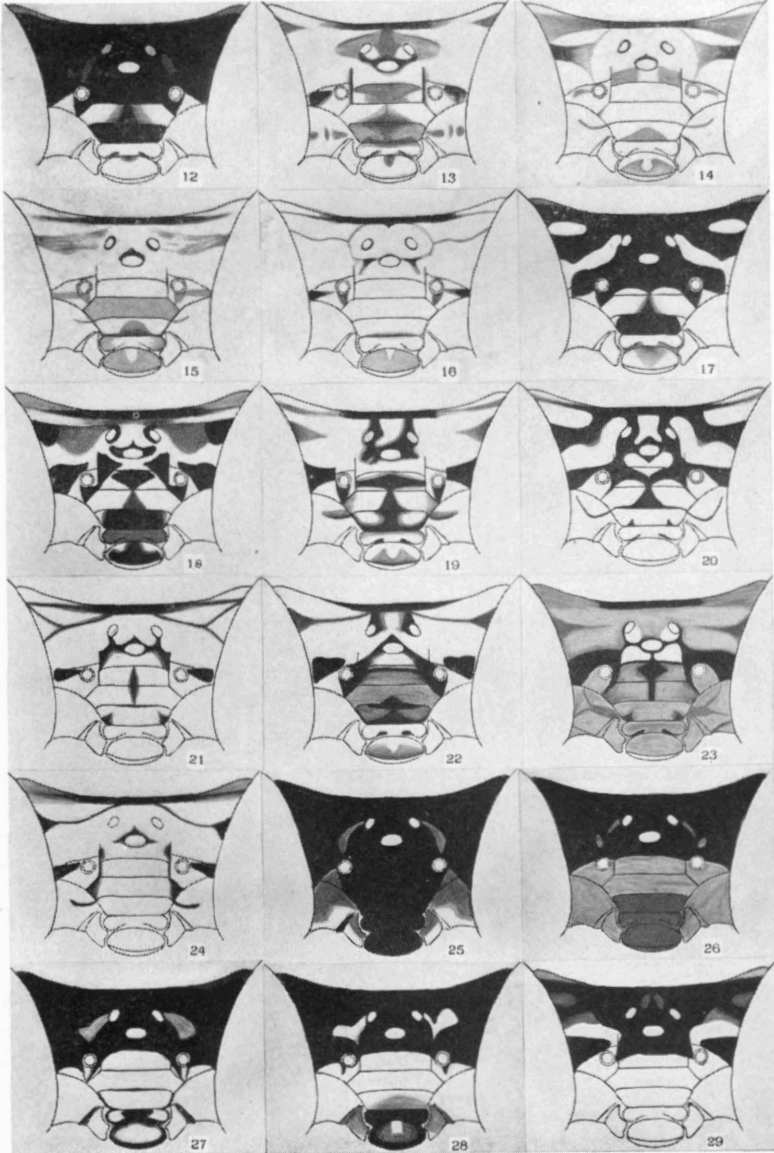


PLATE V

Diagrammatic patterns of head coloration; figures 34 and 41 by Dr. Calvert.

Figure 30, *Heteragrion erythrogastrum*, male, Cristalina, Colombia, February 18, 1917, and figure 31, female, Rio Sardanilla, Canal Zone, December 5, 1916; figure 32, *Heteragrion albifrons*, male, and figure 33, female, both sexes Turrialba, Costa Rica, July 26, 1909, P. P. Calvert; figure 34, *Heteragrion tricellulare*, male, San Geronimo, Guatemala, Champion, collection P. P. C., and figures 35 and 36, male and female, respectively, collection U. S. Nat. Museum; figure 37, *Heteragrion alienum*, type male, figure 39, allotype female, and figure 38, male, Atoyac, Vera Cruz, April, H. H. Smith, collection U. S. Nat. Museum; figure 40, *Heteragrion chrysops*, male, collection M. C. Z.; figure 41, *Heteragrion flavidorsum*, type male; figure 42, *Heteragrion majus*, male, and figure 43, female, both sexes, Cachí, Costa Rica, collection P. P. C.; figure 44, *Heteragrion aequatoriale*, male, and figure 45, very teneral female, both studied by Calvert (4), and in the collection U. S. Nat. Museum; figure 46, *Heteragrion calendulum*, type male; figure 47, *Heteragrion inca*, type male.

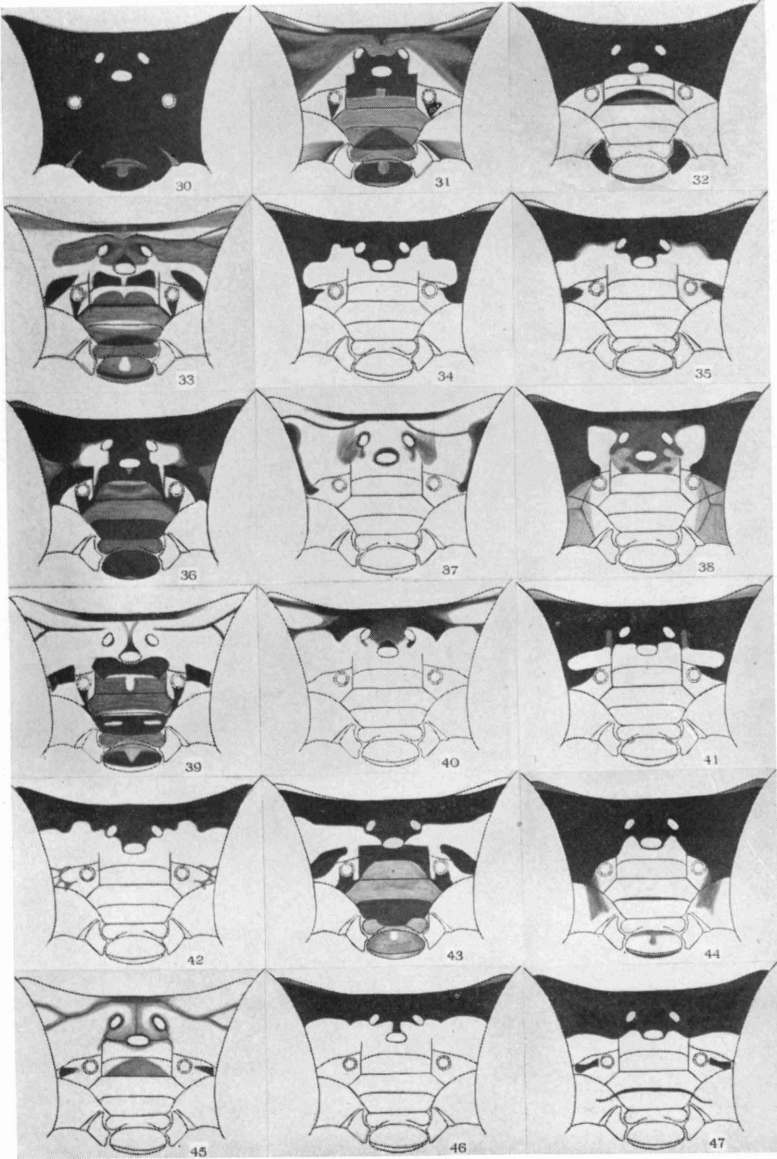


PLATE VI

Figures 48 to 53, inclusive, diagrammatic patterns of head coloration; figures 54 to 62, inclusive, ventral view of genital valves and ovipositors.

Figure 48, *Heteragrion simulatum*, type male, and figure 49, allotype female, very teneral; figure 50, *Heteragrion mitratum*, type male, and figure 51, allotype female; figure 52; *Heteragrion peregrinum*, type male, and figure 53, allotype female.

Figure 54, ventral view of genital valves and ovipositor of *Heteragrion ictericum*, female, Tamanoir, Mana River, French Guiana, June 17, Klages, collection Carn. Mus.; figure 55, same of *Oxystigma petiolatum*, female, Wismar, British Guiana, January 31, 1912; figure 56, same of *Heteragrion mitratum*, female, Cristalina, Colombia, February 13, 1917; figure 57, ventral view of ovipositor of *Heteragrion alienum*, allotype female; figure 58, same of *Heteragrion erythrogastrum*, female, Cristalina, Colombia, February 15, 1917; figure 59, same of *Heteragrion peregrinum*, female, Cristalina, Colombia, February 12, 1917; figure 60, same of *Oxystigma cyanofrons*, allotype female; figure 61, same of *Heteragrion albifrons*, female, Turrialba, Costa Rica, July 26, 1909, P. P. Calvert; figure 62, same of *Heteragrion majus*, female, Cachí, Costa Rica, collection P. P. C.

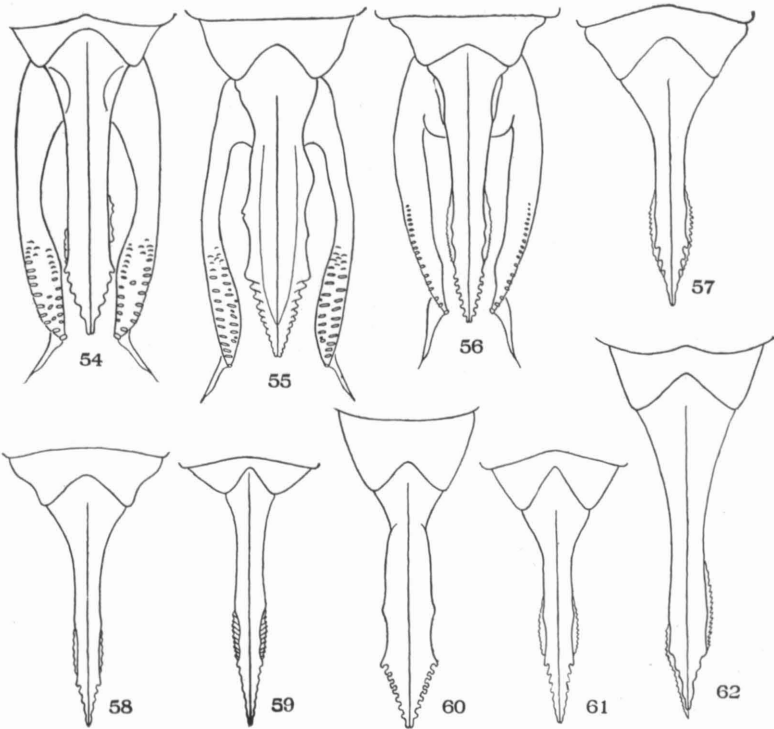
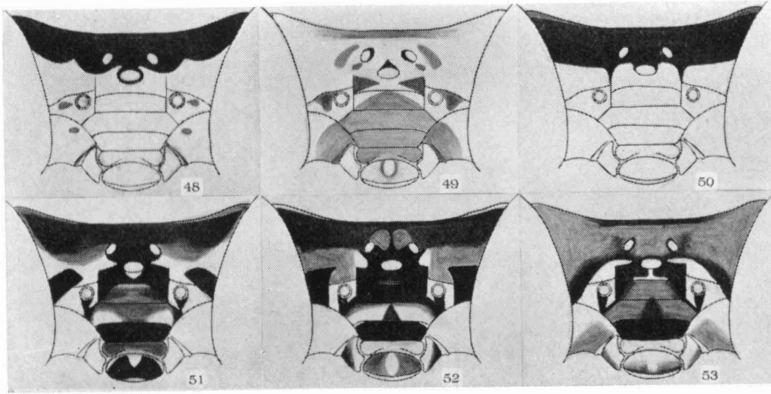


PLATE VII

Figures 63 to 66, inclusive, head profiles; figures 67 to 73, inclusive, female genital valves in profile; figures 74 to 79, inclusive, male abdominal appendages. Figures 74 to 79, inclusive, drawn by C. H. Kennedy.

Figure 63, head profile of *Heteragrion mitratum*, male; figure 64, same of *Heteragrion erythrogastrum*, male; figure 65, same of *Heteragrion ictericum*, male; figure 66, same of *Oxystigma petiolatum*, male.

Figure 67, profile of right genital valve of *Heteragrion majus*, female, Cachí, Costa Rica, collection P. P. C.; figure 68, same of *Heteragrion alienum*, allotype female; figure 69, same of *Heteragrion mitratum*, female, Cristalina, Colombia, February 13, 1917; figure 70, same of *Heteragrion simulatum*, allotype female; figure 71, same of *Heteragrion erythrogastrum*, female, Rio Sardanilla, Canal Zone, December 5, 1916; figure 72, same of *Heteragrion albifrons*, female, Turrialba, Costa Rica, July 26, 1909, P. P. Calvert; figure 73, same of *Heteragrion peregrinum*, Cristalina, Colombia, February 12, 1917.

Figures 74 and 75, oblique dorsal and profile views respectively of the abdominal appendages of *Heteragrion ictericum*, type male; figures 76 and 77, same of *Heteragrion melanurum*, type male; figures 78 and 79, same of *Heteragrion aurantiacum*, State Sao Paulo, Brazil, collection Cornell University.

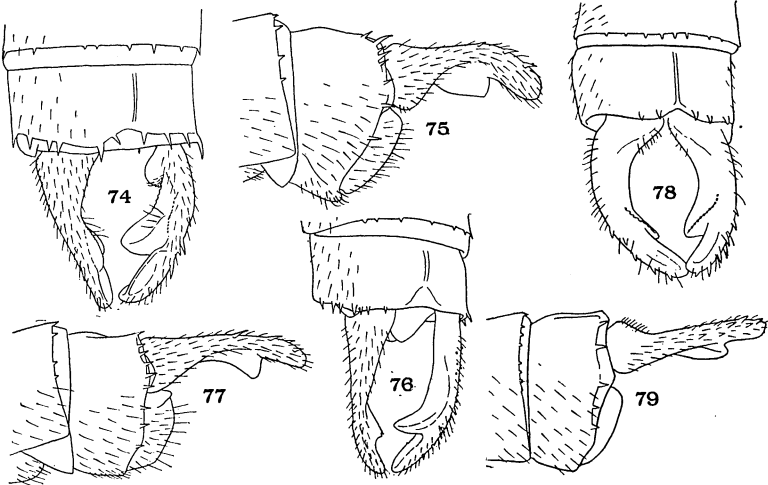
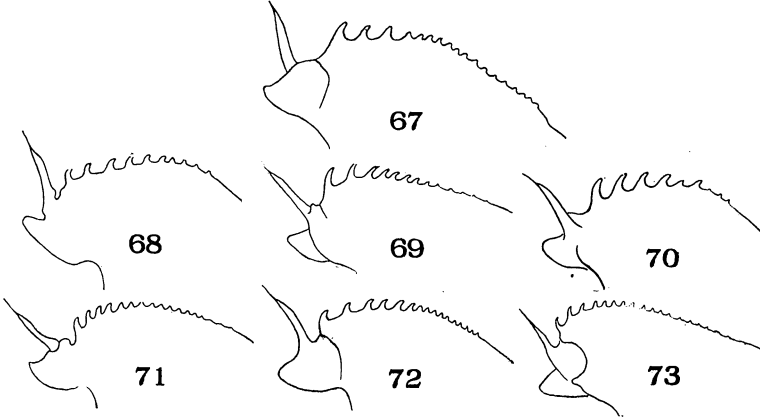
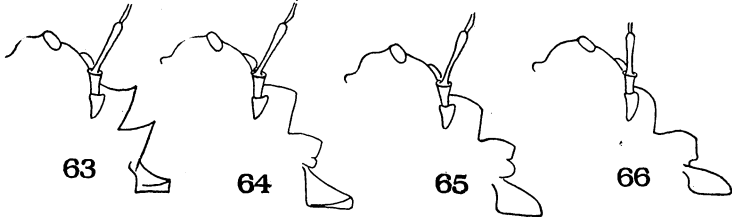


PLATE VIII

Male abdominal appendages; all figures drawn by C. H. Kennedy but figures 90 and 93.

Figures 80 and 81, oblique dorsal and profile views respectively of the abdominal appendages of *Heteragrion consors*, male, collection M. C. Z.; figures 82 and 83, same of *Heteragrion beschkii*, male, collection M. C. Z.; figures 84 and 85, same of *Heteragrion erythrogastrium*, male, Alajuela, Costa Rica, 3100 feet, September 2, 1909, P. P. Calvert; figures 86 and 87, same of *Heteragrion albifrons*, male, Peralta, Costa Rica, September 9, 1909, P. P. Calvert; figures 88 and 89, same of *Heteragrion alienum*, type male; figure 90, oblique dorsal view of the abdominal appendages of *Heteragrion chrysops*, male, collection M. C. Z.; figures 91 and 92, oblique dorsal and profile views respectively of the abdominal appendages of *Heteragrion majus*, male, Cachí, Costa Rica, collection P. P. C.; figure 93, dorsal view of left superior appendage of *Heteragrion aequatoriale*, male, collection U. S. Nat. Museum, for comparison with Menger's drawing, figure 131.

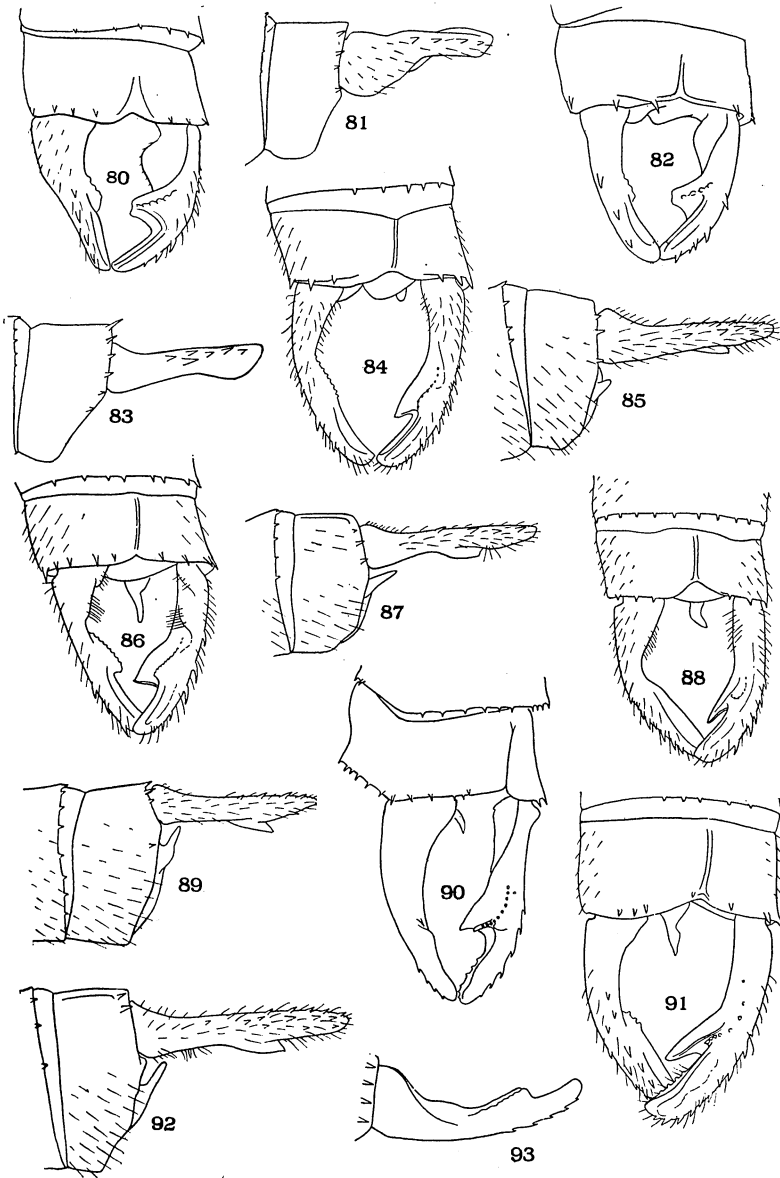


PLATE IX

Male abdominal appendages; all figures drawn by C. H. Kennedy but figures 94, 95 and 96.

Figure 94, oblique dorsal view of the abdominal appendages of *Heteragrion calendulum*, type male; figure 95, same of *Heteragrion mitratum*, type male; figure 96, same of *Heteragrion peregrinum*, type male; figures 97 and 98, oblique dorsal and profile views respectively of the abdominal appendages of *Heteragrion simulatum*, type male; figures 99 and 100, same of *Oxystigma petiolatum*, male, Tumatumari, British Guiana, February 9, 1912; figures 101 and 102, same of same species, Igarapi Assei, Para, Brazil, collection Cornell University; figures 103 and 104, same of *Oxystigma cyanofrons*, type male.

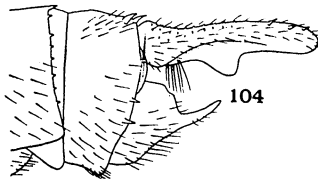
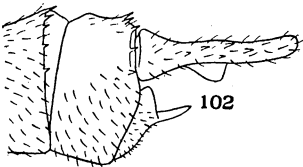
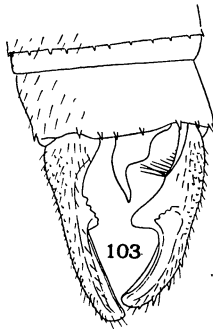
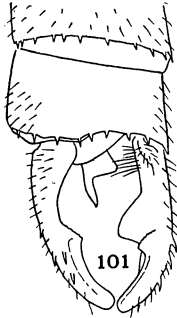
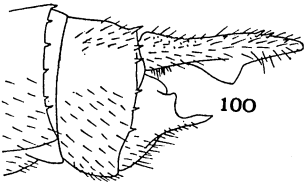
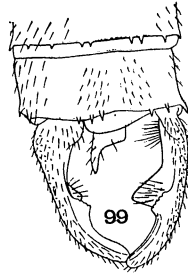
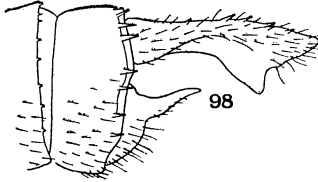
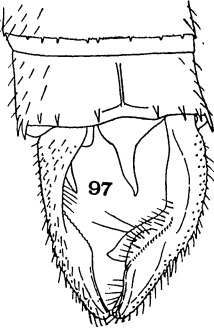
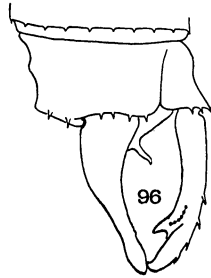
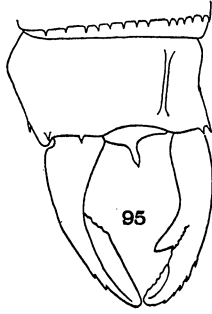
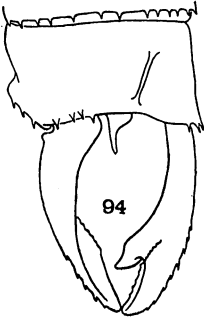


PLATE X

Male abdominal appendages; figures 105 to 107, inclusive, by Mrs. Calvert; figures 108 to 114, inclusive, by Dr. Calvert; figures 115 to 118, inclusive, by Mons. Menger.

Figure 105, oblique dorsal view of the abdominal appendages of *Heteragrion alienum*, male, Calvert's figure 7, plate 5, (3); figure 106, same of *Heteragrion majus*, male, Calvert's figure 6, plate 5, (3); figure 107, same of *Heteragrion tricellulare*, male, Calvert's figure 5, plate 5, (3); figure 108, same of *Heteragrion flavidorsum*, type male, Calvert's figure 41, plate III, (4); figure 109, same, and figure 110, profile of *Heteragrion angustipenne*, male, Calvert's figures 42 and 43, plate III, (4); figure 111, same of *Heteragrion aurantiacum*, male, Calvert's figure 40, plate III, (4); figure 112, same of *Heteragrion triangulare*, male, Calvert's figure 39, plate III, (4); figure 113, same of *Heteragrion aequatoriale*, male, Calvert's figure 37, plate III, (4); figure 114, same of *Heteragrion inca*, type male, Calvert's figure 38, plate III, (4); figure 115 the same, and figure 116, profile view of appendages of *Oxystigma petiolatum*, collection de Selys; figures 117 and 118, the same of *Heteragrion icteroops*, collection de Selys.

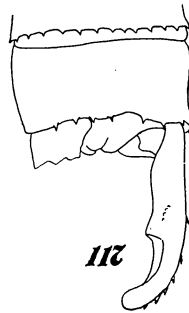
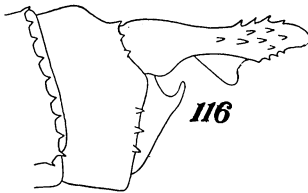
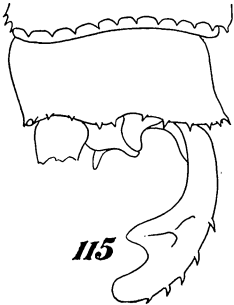
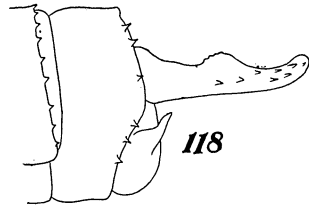
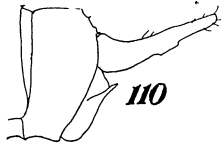
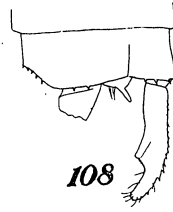
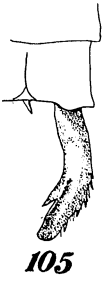


PLATE XI

Male abdominal appendages, all drawn by Mons. Menger from specimens in de Selys' collection.

Figures 119 and 120, dorsal and profile views respectively of the abdominal appendages of *Heteragrion flavovittatum*, male, labelled the same as the male in the M. C. Z.; figures 121 and 122, the same of *Heteragrion aurantiacum*, male, labelled "Cl(Claussen) 3", "*Cinnamomeum?* Hag.", and "*Aurantiacum*, Bresil"; figures 123 and 124, the same of *Heteragrion cinnamomeum*, male, labelled "Schn. Ch. (Schneider-Charpentier)", "Bahia", and "*Heteragrion cinnamomeum* Burm., Bresil"; figures 125 and 126, the same of *Heteragrion erythrogastrum*, male, labelled with species label and "Veragua"; figures 127 and 128, the same of *Heteragrion chrysops*, male, labelled with species label and "P. Cabello"; figures 129 and 130, the same of *Heteragrion majus*, male, labelled with species label, "*crocops*", and "Chiriqui"; figures 131 and 132, the same of *Heteragrion aequatoriale*, male, labelled with species label and "Ecuador."

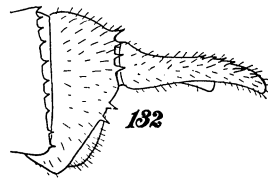
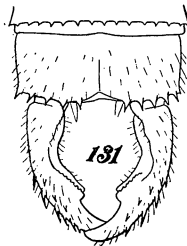
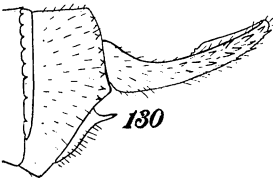
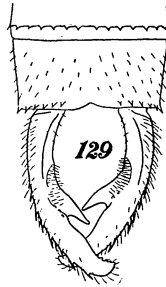
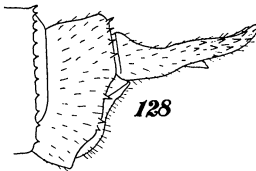
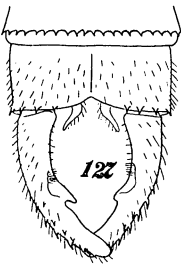
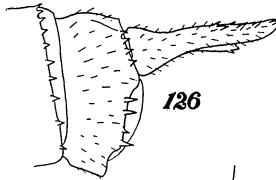
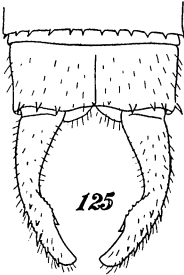
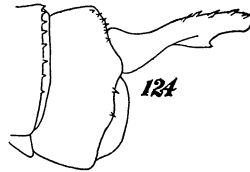
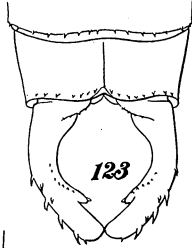
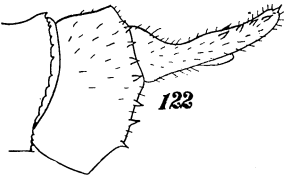
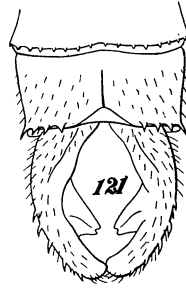
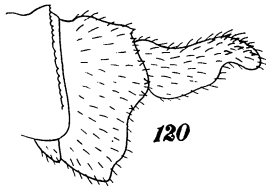
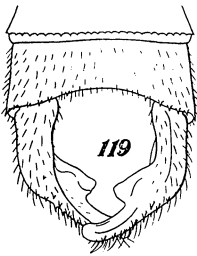


PLATE XII

Hind lobes of the prothorax in dorsal view; figures 155 and 158 by Dr. Calvert. The curve, forming the anterior border of the hind lobe, varies according to the angle at which the lobe is viewed and has no specific significance in the figures.

Figure 133, *Heteragrion flavovittatum*, female, collection M. C. Z.; figures 134 and 135, *Heteragrion ictericum*, type male and allotype female, respectively; figure 136, *Heteragrion melanurum*, type male; figures 137 and 138, *Heteragrion triangulare*, male and female, respectively, both in collection Carn. Mus.; figure 139, *Heteragrion beschkii*, male, collection M. C. Z.; figure 140, female labelled "*aurantiacum*, von Heyer, B. Ayres", in collection M. C. Z., see footnote 6; figures 141 and 142, *Heteragrion aurantiacum*, male and female, respectively, both in collection Carn. Mus.; figures 143 and 144, *Heteragrion aurantiacum*, male and female, respectively, both Sapucay, Paraguay, in collection U. S. Nat. Museum; figure 145, *Heteragrion consors*, male, collection M. C. Z.; figures 146 and 147, *Heteragrion erythrogastrum*, male and female, respectively, male, Cristalina, Colombia, February 18, 1917, and female, Rio Sardanilla, C. Z., December 5, 1916; figures 148 and 149, *Heteragrion albifrons*, male and female, respectively, both Turrialba, Costa Rica, July 26, 1909, P. P. Calvert; figures 150 and 151, *Heteragrion tricellulare*, male and female, respectively, both collection U. S. Nat. Museum; figures 152 and 153, *Heteragrion alienum*, type male and allotype female, respectively; figure 154, *Heteragrion chrysops*, male, collection M. C. Z.; figure 155, *Heteragrion flavidorsum*, type male; figures 156 and 157, *Heteragrion majus*, male and female, respectively, Cachí, Costa Rica, collection P. P. C.; figure 158, *Heteragrion angustipenne*, male, figured by Calvert (4); figure 159, *Heteragrion calendulum*, type male; figure 160, *Heteragrion aequatoriale*, male, figured by Calvert (4), and figure 161, female, same species, both in collection U. S. Nat. Museum; figures 162 and 163, *Heteragrion mitratum*, type male and allotype female, respectively; figures 164 and 165, *Heteragrion simulatum*, type male and allotype female, respectively; figure 166, *Heteragrion inca*, type male; figures 167 and 168, *Heteragrion peregrinum*, type male and allotype female, respectively; figures 169 and 170, *Oxystigma petiolatum*, male and female, respectively, male, Tumatumari, and female, Wismar, British Guiana; figures 171 and 172, *Oxystigma cyanofrons*, type male and allotype female, respectively.

