STUDIES ON THE FAUNA OF SURINAME
AND OTHER GUYANAS: No. 16.

DRAGON FLIES OF THE GENUS ZONOPHORA

with special reference to its Surinam representatives

by

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The genus *Zonophora*, established by DE SELYS (Bull. Acad. Belg. (*2*) *21*, p. 80) in 1854 for BURMEISTER's *Diastatomma campanulata* from Brazil, is represented in Surinam by two species only: *Z. batesi* Selys 1869 and *Z. calippus* Selys 1869. Both species had already been reported as occurring in Surinam, and have again been collected in this country during my researches since 1955. The species *Z. surinamensis* NEEDHAM (Trans. Amer. Ent. Soc. *69*, 1944, p. 219) was collected in Brazil (Matapaoni), close to the border of Surinam, and may for this reason be encountered in Surinam as well.

In 1941 Dr. E. SCHMIDT (D. Entom. Ztschr., p. 76–96) published his "Revision der Gattung *Zonophora* Selys," which contained the then known members of the genus *Zonophora*. However, his treatise was written without examination of the original type specimens; hence, in order to acquire a sounder basis for my study of the subject, I took the opportunity of investigating the original material during my leave in Europe in 1961. In the following pages I present a general view of my explorations, which have been founded chiefly on the material mentioned below, as well as on that from Surinam.

This material is listed together with the sources and the names of those through whose kindness I have been able to investigate it:

Dr. A. COLLART and Dr. G. DEMOULIN, Institut Royal des Sciences Naturelles de Belgique, Brussel – *Zonophora campanulata* (Burmeister 1839), ♂ and ♀; *Z. calippus* Selys 1869, holotype ♂ and allotype ♀; *Z. batesi* Selys 1869, holotype ♂.

Dr. ELLI FRANZ, Natur-Museum Senckenberg, Frankfurt a/Main – *Zonophora*

klugi Schmidt 1941, ♂ and ♀; *Z. supratriangularis* Schmidt 1941, ♂ and ♀.

Dr. D. E. KIMMINS, British Museum (Nat. Hist.), London – *Zonophora spectabilis* Campion 1920, holotype ♂; *Z. bodkini* Campion 1920, holotype ♀.

Dr. K. K. GÜNTHER, Zoologisches Museum der Humboldt-Universität, Berlin – *Zonophora campanulata* (Burmeister 1839), ♂.

Finally I would express my warmest thanks to Dr. M. A. LIEFTINCK of the Rijksmuseum van Natuurlijke Historie, Leiden, who generously helped me with the literature necessary for my study during my stay in Europe.

Zonophora campanulata (Burmeister)

Diastatomma campanulata BURMEISTER 1839, Hand. Ent. *2*, no. 4, p. 833.
Zonophora campanulata, DE SELYS 1854, Bull. Acad. Belg. (2) *21*, p. 80.
Zonophora campanulata, DE SELYS-HAGEN 1858, Monogr. Gomphines, p. 234–236.
Zonophora campanulata, KIRBY 1890, Catalogue, p. 75.
Zonophora campanulata, CALVERT 1898, Trans. Am. Ent. Soc. *25*, p. 52.
Zonophora campanulata, SCHMIDT 1941, D. Ent. Ztschr. *1941*, p. 89–90.

I could not trace the holotype of *Diastatomma campanulata* Burmeister, a male specimen known to be in the collection formerly owned by SOMMER; it is possibly in the U.S.A., although CALVERT (1898) was not able to find it.

Five specimens of *Z. campanulata* have been examined; one is from the Berlin Museum and the four others are from the Brussels Museum. Of the latter, two specimens with labels which are probably in DE SELYS' writing have been taken for the purpose of drawing up the tables. One of these is a male specimen carrying at the pin the labels "122," "122," "Zonophora campanulata B ♂" (probably in DE SELYS' writing) and a label which reads like "Eijuca P.B."; the other one is a female specimen carrying at the pin the labels "A3" and "Zonophora campanulata B ♀" (also probably in DE SELYS' writing). Both specimens are in good condition.

Zonophora batesi Selys

Zonophora Batesi DE SELYS 1869, Bull. Acad. Belg. (2) *28*, p. 198.
Zonophora batesi, HAGEN 1875, Proc. Boston Soc. *18*, p. 54.
Zonophora batesi, KIRBY 1890, Catalogue, p. 54.
Zonophora bodkini CAMPION 1920, Ann. Mag. Nat. Hist. (9) *6*, p. 136–138. (♀).
Zonophora Batesi, SCHMIDT 1941, D. Ent. Ztschr. *1941*, p. 92–94. (Surinam, 1 ♂, in Senckenb. Mus.).
Zonophora batesi, NEEDHAM 1944, Trans. Am. Ent. Soc. *69*, p. 219. (In pl. 16 fig. 19a an error has been made in that the arrow is not pointing to the posterior hamule).
Zonophora batesi, CALVERT 1948, Zoologica *33*, part 2, p. 61–62.

TABLE 3

Verification table: *Zonophora* males

Species	1 Basal subcostal cross veins	2 Cubito-anal cross veins in addition to inner side of Ti	3 Cross veins in supra-triangle	4 Antenodals of first series	5 Postnodals of first series	6 Intermedian cross veins	7 Costal edge of pterostigma in mm	
1. *Z. campanulata* Selys Brussels Museum	0.0 0.0	1.1 1.1	0.0 0.0	19.18 12.14	14.13 14.13	5.6 4.4	5.8 6	
2. *Z. batesi* Selys Holotype Brussels Museum	0.0 0.0	1.1 1.1	0.0 0.0	25.27 20.19	18.17 17.16	9.9 5.6	5.5 5.9	
3. *Z. batesi* Selys Surinam example	0.0 0.0	1.1 1.1	0.0 0.0	23.23 17.15	15.17 17.17	10.9 6.5	5 5.5	
4. *Z. calippus* Selys Holotype Brussels Museum	1.1 1.1	2.2 2.1	0.0 0.0	21.21 13.13	13.14 12.12	9.7 4.4	3.9 4	
5. *Z. calippus* Selys Surinam example	1.1 1.1	2.2 2.1	0.0 0.0	17.19 13.13	11.11 13.12	8.7 4.5	4.5 4.75	
6. *Z. spectabilis* Campion Holotype British Museum	1.1 1.1	1.2 2.2	0.0 0.0	19.20 13.12	10.10 11.10	6.5 4.4	4.5 5	
7. *Z. klugi* Schmidt Lectotype Senckenberg	1.1 1.1	2.2 2.2	1.0 0.0	19.20 14.14	14.15 14.14	8.7 4.4	4.5 5	
8. *Z. supratriangularis* Schmidt Senckenberg	0.0 0.0	2.3 2.2	1.1 1.1	20.19 15.14	13.15 15.13	8.8 4.5	3.8 4	
9. *Z. wucherpfennigi* Schmidt Collection Schmidt	0.0 0.0	1.1 1.1	0.0 0.0	22–25 15–17	15–18 16–17	?	4.8–5.2 5.3–5.8	after Schmidt
10. *Z. surinamensis* Needham Holotype Cornell University	0.0 0.0	2.2 1.1	?	21.24 15.16	14.15 14.15	9.9 4.4	< 5.8 < 6	after Needham

TABLE 4

Verification table: *Zonophora* females

Species	1 Basal subcostal cross veins	2 Cubito-anal cross veins in addition to inner side of Ti	3 Cross veins in supra-triangle	4 Antenodals of first series	5 Postnodals of first series	6 Intermedian cross veins	7 Costal edge of pterostigma in mm	
1. *Z. campanulata* Selys Brussels Museum	0.0 0.0	1.1 1.1	0.0 0.0	22.20 16.15	15.16 15.14	8.6 4.4	5.7 6.2	
2. *Z. batesi* Selys Surinam example	0.0 0.0	1.1 1.1	0.0 0.0	23.23 16.16	16.17 16.16	10.9 5.5	5 5.6	
3. *Z. bodkini* Campion British Museum (Nat. Hist)	0.0 0.0	1.1 1.1	0.0 0.0	27.26 18.18	19.18 17.19	9.10 5.4	6 6.5	
4. *Z. calippus* Selys Allotype Brussels Museum	1.1 1.1	2.2 2.2	0.0 0.1	19.18 13.13	10.11 12.11	8.8 4.4	4.5 4.7	
5. *Z. calippus* Selys Surinam example	1.1 1.1	2.2 2.2	1.1 1.1	19.20 14.14	13.14 14.13	8.8 4.5	4.6 5	
6. *Z. klugi* Schmidt Lectallotype Senckenberg	1.1 1.1	3.2 2.2	0.0 0.0	21.23 14.15	14.15 14.15	7.8 4.3	4.5 5	
7. *Z. supratriangularis* Schmidt Senckenberg	0.0 0.0	2.2 2.2	1.1 1.1	20.18 14.15	12.13 14.13	8.9 5.5	4 4.5	
8. *Z. wucherpfennigi* Schmidt Collection Schmidt	0.0 0.0	1.1 1.1	0.0 0.0	24–26 16–17	16–17 16–17	?	6 6.3	after Schmidt

Two males of *Zonophora batesi* Selys are (1961) in the Brussels Museum; one of them, placed under *Zonophora batesi*, carries at the pin the labels "123," "123" and "Zonophora Batesi S ♂" (the last probably in DE SELYS' writing). This specimen, being in perfect condition, is obviously the holotype. The other one is an imperfect teneral male specimen placed under the blue label "Zonophora pallidistyla Selys n.sp. à décrire, race près de Batesi?" and carries at the pin the label "Surinam Fr." (probably FRUHSTORFER; see D. Entom. Ztschr. 1941, p. 92: *Zonophora batesi* Selys, Coll. Ris Senckenberg Museum Frankfurt a/Main, 1 ♂, Surinam, ex coll. Fruhstorfer).

In the collection of the Brussels Museum there is, furthermore, a male specimen of *Zonophora* placed under a blue label which reads like "Z. pri Batesi" and carrying at the pin the label "St. Paolo." However, after examination, this specimen, broken and with terminalia in poor condition, proved to be the *Z. klugi* Schmidt 1941 discussed in the present paper.

Zonophora batesi Selys has come up for discussion several times since H. CAMPION (1920) described its female under the specific name *Z. bodkini*. After suggestions (see D. Entom. Ztschr. *1941*, p. 92–94) had been made by K. J. MORTON (1925) and E. B. WILLIAMSON (1931) that both *Z. batesi* and *Z. bodkini* were conspecific, Dr. E. SCHMIDT (1941) published the latter as a synonym of DE SELYS' *Z. batesi*. This is also in accordance with CALVERT's (1948) view concerning the two species.

In the course of my researches in Surinam, five males and two females of *Zonophora batesi* have been collected (1 ♀ has been deposited in the collection of Dr. GEIJSKES). One of the males was put beside the holotype male for comparison during my visit to the Brussels Museum, and the two specimens proved to be in perfect conformity with each other, though the pterostigmata are shorter in the Surinam example. This male specimen has been used in drawing up the tables; its specific locality and date of collection are: Surinam River, Gansee, 30.IX.1958.

The males of *Zonophora batesi* are generally very timid, and in most cases they fly ten metres or more away when the collector approaches. But on a sunny day, on the upper part of the Coropina

Creek, it was my good fortune to find three males with a female, all resting on twigs and leaves of the lower vegetation at the shore, which were not timid. (A peculiar mode of behaviour in mating time which has also been observed in some other species.) On that occasion the female was collected; and, though it was not captured in copulation, it may be referred to the Selysian species *Z. batesi* because of its behaviour and its correspondence in all respects other than those of sex with the male of that species. On the other hand, the female (hind wing 51 mm; costal edge of pterostigma in front wing 6 mm, in hind wing 6.5 mm) proved to be in agreement with CAMPION's *Z. bodkini*, which I investigated in the British Museum.

Later on in the same locality a second female specimen was collected which is doubtless conspecific with the first one, but the size is smaller, the ante- and postnodals are fewer, and the pterostigmata shorter. This female specimen, being in the author's collection, has been used for compilation of the tables; its locality and date of collection are: Suriname, Boven Coropina, Dauwdropkamp, 9.XI. 1955.

All specimens of *Z. batesi* but one have been collected or observed near Zanderij, in the savannah zone, which is apparently the most favourable environment for the species. Outside this zone, only one specimen has hitherto been observed (and collected) more in the interior of the country (Gansee). The months in which the species was collected were September, October and November (dry season).

Zonophora calippus Selys

Zonophora calippus DE SELYS 1869, Bull. Acad. Belg. (2) *28*, p. 199–200.
Zonophora calippus, HAGEN 1875, Proc. Boston Soc. *18*, p. 54.
Zonophora calippus, KIRBY 1890, Catalogue, p. 75.
Zonophora calippus calippus, SCHMIDT 1941, D. Ent. Ztschr. *1941*, p. 84–85.
Zonophora calippus, NEEDHAM 1944, Trans. Amer. Ent. Soc. *69*, p. 219. (Surinam, 2 ♂♂ and 1 ♀ in Cornell Univ. Collection).

One of the three specimens placed under *Zonophora calippus* Selys in the Brussels Museum carries (1961) at the pin the labels "Paulo" and "Z. calippus," but proved after examination to be *Z. spuratriangularis* Schmidt discussed in this paper. The other two specimens are a male with the labels "124," "124," "129," "129 Z. calippus B." and "Zonophora calippus Bates ♂" (the last probably

in DE SELYS' writing), and a female with the labels "129" and "Z. calippus B. ♀" (the latter probably also in DE SELYS' writing). The two specimens can unquestionably be regarded as the holotype male and the allotype female, especially in view of the indications "Bates" in ♂ and "B" (doubtless Bates) in ♀ and, taken in conjunction with these labels, the addition "par M. Bates" to the locality stated in DE SELYS' original description. Finally, both the specimens fit the original description in every detail. The terminalia of the holotype male are in poor condition, the inferior and right superior appendages being missing.

In SCHMIDT's *Zonophora*-paper of 1941 *Z. klugi* and *Z. spectabilis* are considered to be no more than subspecies of *Z. calippus*, though *Z. spectabilis* is quite distinct as regards general coloration. Both *Z. klugi* and *spectabilis* are discussed in this paper.

In 1944, NEEDHAM reported *Zonophora calippus* from Surinam; the two males and the female have been collected by Dr. GEIJSKES in the course of his excellent field work in this country. Furthermore, males and females have been collected several times during my own researches in Surinam. One of these males was put beside the holotype for comparison during my visit to the Brussels Museum.

In the Surinam examples of *Z. calippus*, abdominal segment 8 has a narrow anterior band of yellow, which has not been noticed in the type specimens (possibly due to discoloration). The Surinam specimens show a stronger tendency towards having the supratriangles crossed. This tendency is much stronger in the females than in the males; in most cases the supratriangles are crossed in the wings of the females but not crossed in the wings of the males. The appendages of the genital pocket on the second abdominal segment of the male, as well as the subgenital plate of the female, are in agreement with those in the type specimens. Little differences are noticed in the conformation of the superior caudal appendage; in the Surinam example the inferior tooth at the base is less stoutly produced, but the median swelling is somewhat better and more prominent than in the remaining left superior appendage of the holotype.

The specific localities and dates of the Surinam examples taken

for compilation of the tables are: Boven Coropina, Dauwdropkamp, 30.XII.1959, male; Zanderij, Bos Bivak, 15.II.1959, female.

In my collection, *Zonophora calippus* is represented by fifteen males and four females, all from the creeks which run through the woods of the savannah zone, near Zanderij. Like *Z. batesi*, the species generally lives in trees, but in sunny weather the male, and more rarely the female, can be found on the lower vegetation in partly shady places of creeks. The species is not so timid as *Z. batesi* and has therefore been collected in greater numbers than the latter; the males in the months of November to May (beginning of the rainy season) and the females only in the months of February and March.

Zonophora spectabilis Campion

Zonophora spectabilis CAMPION 1920, Ann. Mag. Nat. Hist. (9) *6*, p. 138–140.
Zonophora calippus spectabilis, SCHMIDT 1941, D. Entom. Ztschr. *1941*, p. 86–88.

Male (holotype, Brit. Museum), more slender and much more yellow in colour scheme than *Z. calippus*, with yellow markings on abdominal segments 8, 9 and 10. Face greenish yellow, frons included, but upper surface of frons with a basal band of black, and labrum with a black anterior border. Superior caudal appendages slender, yellowish, but blackish at their extreme basal and apical ends; the median swelling well-produced and prominent. Branches of the inferior appendage widely divergent. Side view of genital appendages on second abdominal segment most like that of *Z. klugi* Schmidt (D. Entom. Ztschr. 1941, fig. 9b, p. 90), but posterior border of hind lobe rounder. The dimensions are: abdomen 43 mm (caudal appendages included); hind wing 34.5 mm.

In his *Zonophora* paper of 1941, SCHMIDT published a second specimen of *Z. spectabilis* from the same locality (Paraguay) and the same collector (W. FORSTER). This specimen, however, seems to be blacker than the holotype in having a blackish T-spot on the frons and in having the yellow marking on the dorsum of abdominal segment 10 not extended on to the sides of the segment.

In the hind wing of the holotype the triangle is distant from the arculus by half the length of the inner side of the triangle. In *Z. batesi* and in the Surinam congener *Z. calippus* there is also a tendency for the distance between triangle and arculus to be half the length of the inner side of the triangle. In other species of *Zonophora*,

the distance between triangle and arculus is commonly between half and two-thirds the length of the inner side of the triangle.

Zonophora klugi Schmidt Plate III–IV

Zonophora calippus Klugi SCHMIDT 1941, D. Entom. Ztschr. *1941*, p. 86.

Male and female (lectotype and lectallotype, by present designation) both collected by KLUG on 10.III.1930 in Peru (Mishiyacu, Iquitos, Amazon) and now in the collection of the Natur-Museum Senckenberg, Frankfurt a/Main, under cat. no: 24000 (♂) and cat. no: 24015 (♀).

The *Zonophora* material loaned from the Senckenberg Museum consisted of two species, one of which, "*Z. calippus klugi* Schmidt", was represented by a male (cat. no: 24000) and two females (cat. no: 24015 and 24017). SCHMIDT had all these specimens before him when he described them in 1941; they all bear on the envelopes the printed label "det. Dr. Erich Schmidt 1939."

This species (or subspecies) is closely allied to *Z. calippus* Selys. It is somewhat larger and stouter-bodied than typical *Z. calippus*, with a blacker colour scheme and recognizable by the two oblong light-coloured spots on the antero-superior surface of the black frons; these spots are more widely separated in the female than in the male (distance between the spots in male one-fifth the width of the frons, in female half the width of the frons. DE SELYS' *Z. calippus* holotype male bears a complete cross band of green on the antero-superior surface of the frons.

In the lectallotype female the subgenital plate is longer than figured by SCHMIDT (D. Entom. Ztschr. 1941, p. 95, fig. 12a); its divided tip extends to the apex of the sternum of segment 9.

The dimensions are: abdomen (caudal appendages included) 44 mm and hind wing 41 mm in lectotype male; abdomen (caudal appendages included) 47 mm and hind wing 43 mm in lectallotype female. Other features have been stated in the tables.

The other female of *Z. klugi* Schmidt, which came to hand (at Leiden) from the Senckenberg Museum (cat. no: 24017), has longer pterostigmata but otherwise the same bodily measurements (costal edge of pterostigma in front wing 5 mm, in hind wing 5.5 mm).

Zonophora supratriangularis Schmidt

Zonophora supratriangularis SCHMIDT 1941, D. Ent. Ztschr. *1941*, p. 88.

In all species of *Zonophora* Selys, the proximal part of abdominal segment 7 is yellow except in *Z. wucherpfennigi* Schmidt (D. Ent. Ztschr. *1941*, p. 94–96), in which segments 7 to 10 are entirely black. In *Z. surinamensis* Needham and the Surinam specimens of *Z. calippus*, there are also yellow markings on segment 8; but *Z. spectabilis* and *Z. supratriangularis* have yellow on segments 8, 9 and 10. However, in *Z. supratriangularis* the yellow markings on segments 8, 9 and 10 are confined only to the sides, with an extra little mid-dorsal spot of yellow on segment 10 in the male.

In *Z. surinamensis* and *Z. supratriangularis* the light-coloured anterior cross band on the labrum is medially interrupted with black.

In the *Zonophora* material loaned from the Senckenberg Museum, *Z. supratriangularis* was represented by a male (cat. no: 24026) and a (teneral) female (cat. no: 24029). In these specimens the supratriangles are crossed, without exception; the tendency to have crossed supratriangles is apparently much stronger here than in *Z. calippus*.

The dimensions of the borrowed specimens are: abdomen (caudal appendages included) 43 mm in both male and female; hind wing 35 mm in male and 38 mm in female. The specimens have been taken for compilation of the tables.

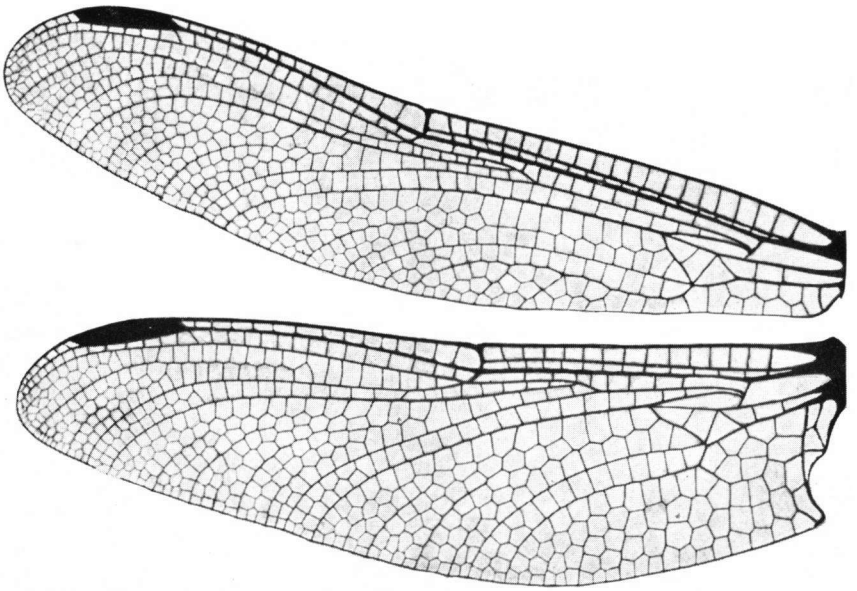

Plate IIIa. *Zonophora klugi* Schmidt, lectotype male; Natur-Museum Senckenberg no: 24000. Enlarged photographs of right pair of wings (transposed).

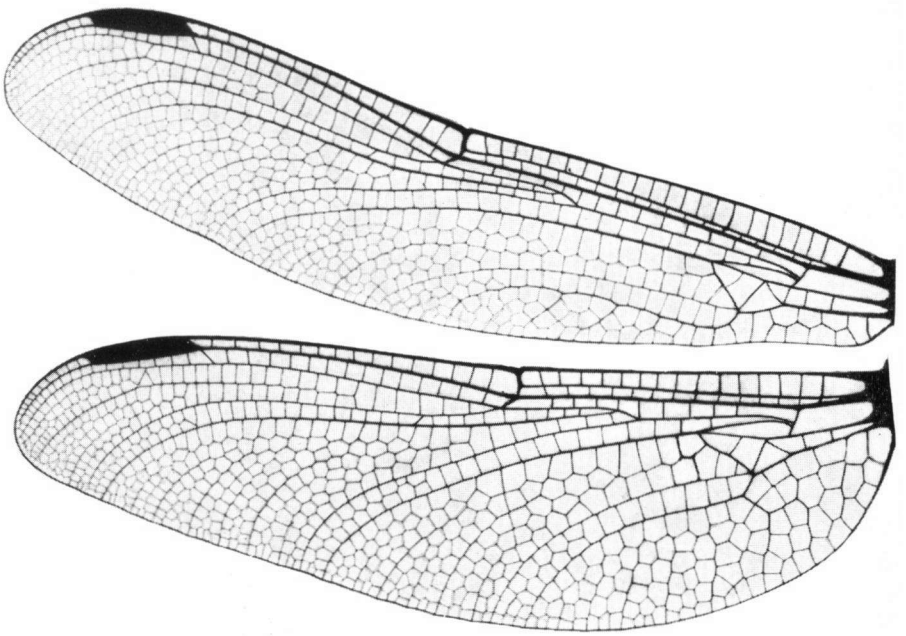

Plate IIIb. *Zonophora klugi* Schmidt, lectallotype female; Natur-Museum Senckenberg no: 24015. Enlarged photographs of right pair of wings (transposed).

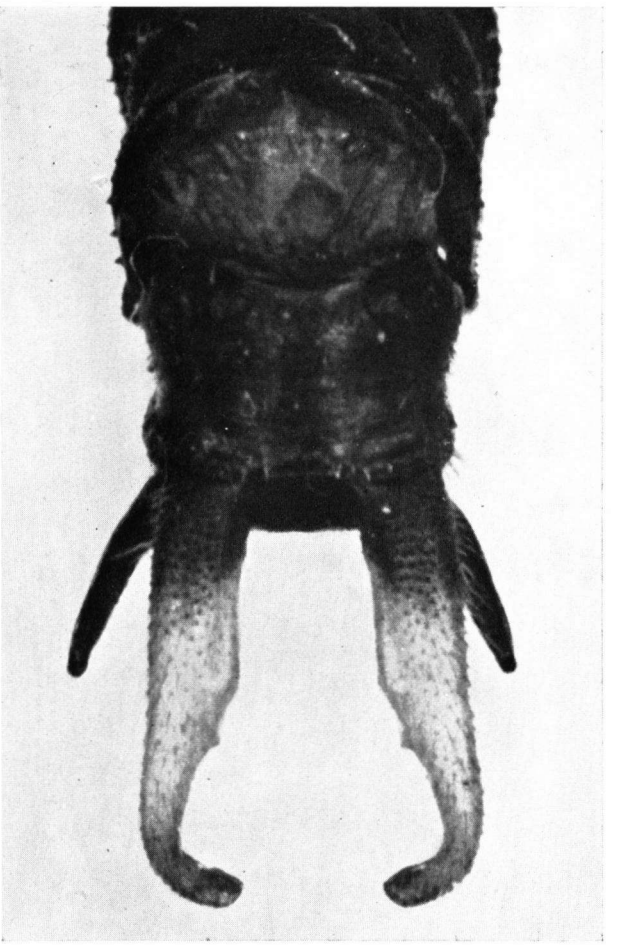

Plate IV. *Zonophora klugi* Schmidt, lectotype male; Natur-Museum Senckenberg no: 24000. Enlarged photograph of male caudal appendages, dorsal view.