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LISBOA • LOURENÇO MARQUES • LUNDA • RIO DE JANEIRO

A NEW SPECIES OF PSEUDAGRION (ODONATA: ZYGOPTERA) WITH DESCRIPTIONS OF THE LARVAE OF FIVE OTHER SPECIES BELONGING TO THE GENUS *

by

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In the course of an ecological survey of the macro-invertebrate fauna of the streams and rivers in the catchment of the Vaal Dam the author found a new species of *Pseudagrion* which is described here. The author's colleagues, engaged in similar work in other parts of South Africa, have been gracious enough to collect *Pseudagrion* larvae for him. Some of these have been reared to imagines, thus correlating imagines and larvae. The larval descriptions are based primarily on this material but account has also been taken of material preserved in the larval stage.

The National Institute for Water Research keeps several catalogues of the freshwater invertebrate fauna of South Africa and most of the material on which this paper is based comes from these catalogues. The catalogue numbers of the material used for the descriptions are given where possible.

The larval descriptions include several features which require explanation. The median lobe of the labial prementum is bent downwards in *Pseudagrion* larvae and the ratio between the width and length of the median lobe has been used in the larval descriptions. The measurements of the width and length of the median lobe were made from the ventral aspect with the labium tilted so that the median lobe was parallel to the plane from which it was observed. Figure 1, a diagram of a *Pseudagrion* larval labium, shows where the width (line AB) and the length (line CD) were measured. All measurements were made using an eye-piece graticule in a binocular dissecting microscope at a magnification of 40X with the points A, B and C (fig. 1) in focus at the same time. Data on the lengths of the femora of the species described are given in Table 3. The measurements were made on the anterior surface of the femora and the exact position of the points taken as the limits of the femora are shown in figure 2.

The methods of mounting the various larval parts illustrated and of measuring the larvae were those previously used by the author (CHUTTER, 1961).

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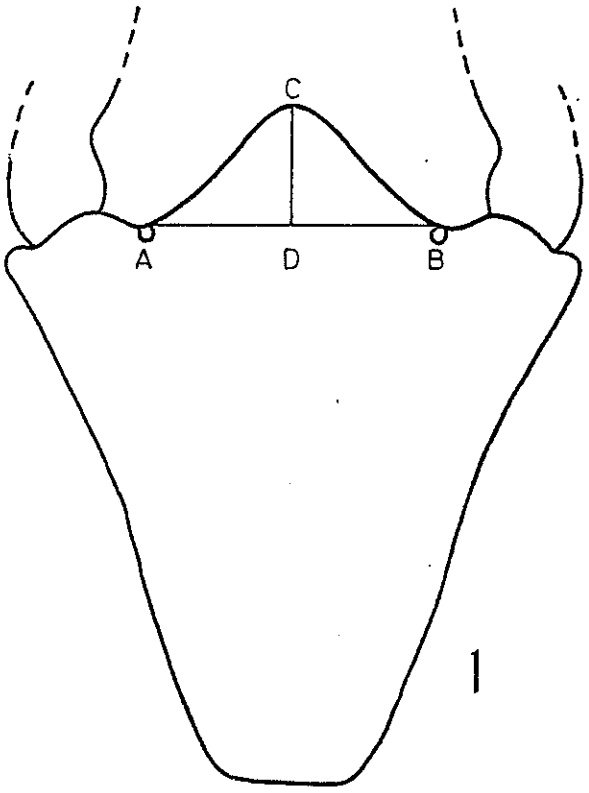
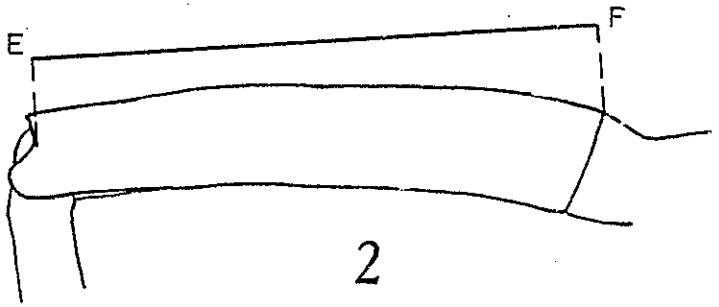
* To Prof. QUINTANILHA at his 70th birthday.





Figs. 1-2 — Diagrams of labium (1) and femur (2) of *Pseudagrion* larva to show where width (line AB) and length (line CD) of the median lobe of the prementum and the length of the femur (line EF) were measured.

PSEUDAGRION VAALENSE n. sp.,
figures 3 to 18, 23 to 26.

IMAGO

Holotype male (mature, dried and pinned).

Colours in life. Labium orange; labrum red-orange; anteclypeus orange. Postclypeus orange with a pair of small black markings separated by about half the width of the postclypeus and lying about half way between the anteclypeus and the frons. Frons orange with a curved black line, thickened in the middle, covering half the distance between the bases of the antennae. Vertex: dorsally black; anteriorly orange; with a bisinuous orange line between the posterior and anterior ocellae so that the anterior ocellus lies in a laterally elongated black patch. Postocular spots large, a browner orange than frons and clypeus, and bordered with black except for the interior third of the posterior margin: occipital plate with a light brown-orange bar separated from the postocular spots. Vertex very thinly pruinose. Eyes anteriorly bright red-orange both dorsally and ventrally, posterior dorsal area brown, posterior ventral area light blue-green. Occiput ventrally light blue-green.

Prothorax with very thin whitish pruinosity; mainly black with two pairs of ochre markings, a posterior longitudinally elongated pair narrowly separated and an anterior laterally elongated pair more widely separated. Synthorax dorsally brownish red, laterally gradually changing through brown to light blue: above metacoxae light ochre with light greenish patches. Black synthoracic markings as in fig. 3. Synthoracic pruinosity whitish, very thin dorsally increasing laterally to very heavy ventrally. Femora black exteriorly, ochreous interiorly, lightly pruinose; pro- and mesotibiae light ochreous with a thin black longitudinal line exteriorly, metatibiae without this black line. Wing bases and the area between them strikingly pruinose blue. Pterostigma light rose red; wings hyaline; venation black.

Abdomen (fig. 5): 1 light blue with no visible dorsal black, heavily pruinose (but see below — colours after drying); 2 light blue green with black markings; 3 to 7 with black markings, non-black dorsal and lateral areas light green, 3 to 5 without pruinosity, 6 and 7 very thinly pruinose; 8 and 9 laterally blue, dorsally bright blue, each with a distal black band; 10 thinly pruinose, dorsally black, laterally light blue. Superior anal appendages exteriorly black, inferiors black with a proximal blue spot on the dorsal surface.

Colours after drying. Similar to colours in life with the following exceptions: eyes a uniform brown; orange of face less brilliant; green tinges

on sides of thorax and abdomen vanished leaving a light yellowish colouration; black markings on abdomen 1 visible (fig. 5); bright blue of abdomen 8, 9 and 10 changed to dark brown; blue spot on inferior anal appendage no longer apparent.

Forewing with $11\frac{1}{2}$ Px, hindwing with $9\frac{1}{2}$; Ac in forewing and hindwing distal to petiole by the length of Ac; Ac nearer first than second Ax; Arc at 2nd Ax; 1A reaching 7th Px in left wings, 8th Px in right wings; IR_2 rises at 10th Px in forewings, 9th Px in hindwings; in forewing 6th Px and in hindwing 5th Px nearest to origin of R_3. Wingtip venation closer in hindwing than in forewing. Pterostigma elongated on costal margin, less than one cell long on R_1.

Hindwing 21.3 mm, abdomen 30.6 mm.

Anal appendages (figs. 23 to 26): superiors divergent when viewed from above, longer than inferiors, with an inward-turned ventral process bearing a small sclerotised facet (best seen in dorso-lateral aspect, fig. 24), distally with a sclerotised hook-like structure (best seen in lateral and dorso-lateral aspects, figs. 25 and 24); inferiors pointed distally when viewed from above or below (figs. 23 and 26) and dorsal surface (lateral aspect, fig. 25) only slightly inclined away from the horizontal.

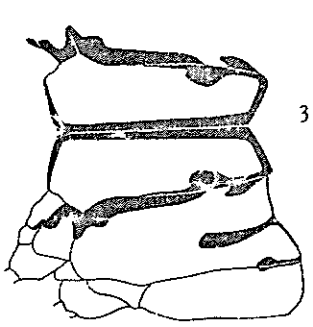
Allotype female (mature, dried and pinned).

Colours in life. Labium very pale greenish-cream; labrum light yellow; face darkening dorsally from labrum to light greenish brown on vertex and postocular spots. Black markings of face similar to male but reduced. Eyes light cream below, darkening to brown above, with a distinct horizontal dorso-lateral brown band. Occiput ventrally similar to eyes ventrally.

Prothorax similar to male but with black markings considerably reduced, light coloured areas ochre brown; hindlobe and stylets ochre brown. Synthoracic black markings (fig. 4) very reduced compared to male. Synthorax dorsally a slightly greenish light brown becoming more green at sides, non-pruinose dorsally but with increasing white pruinosity laterally so that ventrum is pruinose white. Femurs similar to male; tibiae greenish brown without black lines. Wing bases and the area between them only slightly pruinose blue. Pterostigma ochre; wings hyaline; venation black.

EXPLANATION OF FIGS. 3-22

Figs. 3-22 — 3-4 *P. vaalense.* Synthorax of holotype ♂ and allotype ♀.
5-6 *P. vaalense.* Dorsal aspect of abdomen, holotype ♂ and allotype ♀. — 7-13 *P. vaalense.* Range of pigmentation variation in paratype ♂♂, abdominal segment 2. — 14-16 *P. vaalense,* allotype ♀, right lateral lobe of the mesostigmal lamina. Posterior, dorso-lateral and lateral aspects. 17-22 Penes lateral aspect of whole organ and ventral aspect of apical lobe. — 17-18 *P. vaalense* paratype number 26. — 19-20 *P. pseudomassaicum.* — 21-22 *P. acaciae.*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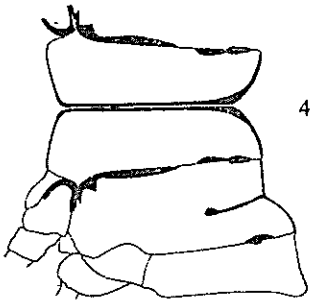
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0·5 mm Figs 14–16


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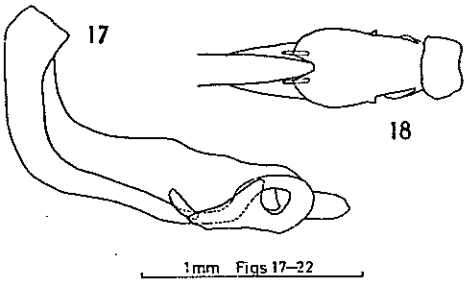
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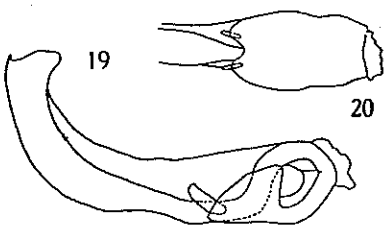
1 mm Figs 17–22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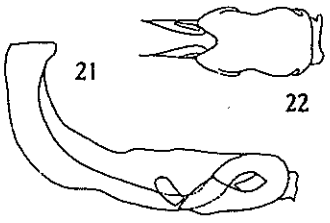
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Abdomen with black markings as in fig. 6; 1 lightly whitish pruinose on sides and ventrum; 2 to 7 light brown dorsally fading to light green laterally; 2 to 6 not pruinose, 7 thinly pruinose; 8 and 9 with non-black areas light green dorsally, light bluish-green laterally, thinly pruinose. Superior anal appendages black; inferiors and ovipositors very light cream coloured.

Colours after drying. Apart from a fading of the areas tinged with green to a light brown, similar to colours in life.

Forewings with $10\frac{1}{2}$ Px, hindwings with $9\frac{1}{2}$; Ac in forewing distal to petiole by length of Ac, in hindwing distal by less than length of Ac; Ac nearer first than second Ax; Arc at 2nd Ax; 1A reaching 8th Px in both wings; IR_2 rises at 9th Px in left forewing, 8th in right forewing and in hindwings; in forewing 6th Px and in hindwing 5th Px nearest to origin of R_5. Wingtip venation no more close in hindwing than in forewing. Pterostigma elongated on costal margin, less than one cell long on R_1.

Hindwing 22.6 mm, abdomen 29 mm.

Prothoracic stylets weakly-developed thickenings of the posterior margin of the prominent prothoracic hind lobe. Lateral lobe of the mesostigmal lamina (figs. 14 to 16) with a well-developed ridge running transversely to the body axis; this ridge considerably raised and curving over towards the synthorax laterally; a second ridge along the dorsal margin of the mesostigmal lamina; dorsal to the sharply raised part of the transverse ridge a sclerotised slight concavity, best seen in dorso-lateral aspect (fig. 15), mostly concealed in strictly lateral aspect (fig. 16). Ovipositor reaching as far as superior anal appendage.

LARVA

Described by CHUTTER (1961) under *P. pseudomassaicum* PINHEY.

TYPE SERIES

Holotype male, Allotype female, 20 Paratype males and 5 Paratype females mounted dry on pins, 12 Paratype males and 7 Paratype females preserved in separate specimen tubes in 80% alcohol. The Paratypes have been numbered from 1 to 44.

Holotype male, Allotype female, 16 male and 3 female pinned Paratypes, 10 male and 6 female Paratypes preserved in alcohol have been placed in the Transvaal Museum, Pretoria. 3 pinned male, 1 pinned female and 1 male and 1 female Paratypes in alcohol have been sent to the National Museum, Bulawayo, Southern Rhodesia, and 1 male and 1 female pinned Paratypes have been sent to the British Museum (Natural History), London.

THE PARATYPES

The penis of the species has been drawn and is described (below) from Paratype male number 26 which is preserved in alcohol and is in the Transvaal Museum. It has not been removed from the body. The apical hook of the penis, bilobed; lateral aspect (fig. 17) with a long, very slightly concave anterior dorso-lateral margin; dorsal angle of apical lobe visible from below (fig. 18).

The colouration of the immature male differs from the mature male as follows. Black markings considerably reduced (but see next paragraph). No pruinosity. Labium pale creamy white; face and eyes light brown; prothorax similar to female; synthorax dorsally light brown, laterally paling to light yellowish brown and whitish ventrally; legs as in mature female. All pale areas of abdomen, including segments 8 and 9, light brown. Pterostigma pale ochreous: wing bases not bluish pruinose. Superior anal appendages black, inferiors light creamy white. Immature female colouration is similar to that of immature males but with a greater reduction of synthoracic black markings and female type black markings on abdominal segments 2, 8, 9 and 10.

INTRASPECIFIC VARIATION

Amongst the male Paratypes there are specimens which show notable differences from the colouration of the Holotype male. In some specimens the synthoracic black line on the humeral suture is wider than in the Holotype (fig. 3) and the posterior black of this humeral stripe on the mesepimeron extends forward to meet the more anterior black on the mesepimeron, so that the humeral stripe is greatly thickened where it extends onto the metepisternum in the Holotype. Where this is the case there is usually, but not always, a pale stripe along the humeral suture in the middle of this thickened area. Considerable variation occurs in the distribution of the black on abdominal segment 2 and some examples of this variation, taken from Paratype males, are shown in figs. 7 to 13. In some Paratype males the black near the posterior margin of abdominal segments 8 and 9 is wider than in the Holotype and extends forward laterally. None of these variations in the extent of the black markings found in the Paratype males could be associated with the age of the specimens, some of the immature males showing greater development of these markings than were found in the Holotype.

Arc is at the second Ax, Ac nearer the first than the second Ax and the wingtip venation denser in the male hindwings than in the male forewings and female wings throughout the type series. In other respects there is considerable variation in the wing venation. The right and left wings of a single

specimen are often dissimilar. A summary of the variation of venation with respect to certain important veins is shown in Table 1, which is based on data taken from the whole type series. The main points to be read from Table 1 are as follows:

1. The last Px of forewings usually extends only to R_1 (i. e. is $\frac{1}{2}$), but is often complete in hindwings.
2. There are usually $11\frac{1}{2}$ Px in the forewings of both sexes, $9\frac{1}{2}$ to $10\frac{1}{2}$ in the hindwing of males and $9\frac{1}{2}$ or 10 in the hindwing of females.
3. In both sexes the 6th Px in the forewings and the 5th Px in the hindwing are usually nearest the origin of R_5.
4. In the forewings of both sexes usually the 9th but often the 10th Px is nearest the origin of $1R_2$, but in the hindwings the 9th and often the 8th Px are nearest the origin.
5. 1A usually reaches the level of the 7th or 8th Px in both wings of both sexes.
6. The distance of Ac from the petiole is usually equal to the length of Ac in the forewing, but is usually less than the length of Ac in the hindwing, particularly in the females. The fact that this distance was greater than the length of Ac in several male forewings should be noted.

The measurements of the size of the specimens making up the type series are summarised in Table 2. This table shows that the size of the specimens depends on the method by which they have been preserved in addition to natural variation, as might be expected. Mr. R. G. NOBLE has kindly tested the significance of the differences between the mean abdomen/hindwing ratios of the sexes and found that the difference is significant in both the pinned and alcohol preserved specimens.

REMARKS

P. vaalense has in the past been confused with *P. pseudomassaicum* PINHEY (CHUTTER, 1961). In order that differences between the anal appendages of the two species may be clearly distinguished the anal appendages of *P. pseudomassaicum* are shown next to those of *P. vaalense* (figs. 27 to 30). The *P. pseudomassaicum* used for these figures is from the author's collection and has been compared with the type in the Transvaal Museum. The superior anal appendage of *P. vaalense* has a larger inwardly-turned ventral process than *P. pseudomassaicum* and the inferiors are distally pointed from above, whereas they are rounded in *P. pseudomassaicum*. The superior anal appendage of *P. vaalense*

TABLE 1. A summary of the variation in the wing venation found in the type series of *Pseudagrion vaalense* n. sp.

	Number of wings			
	Males		Females	
	Forewings	Hindwings	Forewings	Hindwings
Number of postnodal cross veins: 12½	9	—	1	—
12	6	—	2	—
11½ + ½*	6	—	2	—
11½	31	—	10	—
11	7	—	2	—
10½ + ½	1	—	1	—
10½	5	22	6	1
10	—	14	—	12
9½ + ½	—	2	1	—
9½	—	23	—	10
9	—	4	—	—
8½	—	1	—	3
Number observed	65	66	25	26
Px nearest origin of R_3:				
7	1	—	1	—
6	57	5	20	2
5½*	1	—	—	—
5	6	60	2	24
4	—	1	—	—
Number observed	65	66	23	26
Px nearest origin of IR_2:				
11	—	—	1	—
10	20	4	5	—
9½*	1	—	—	—
9	41	35	12	15
8	3	27	7	9
7	—	—	—	2
Number observed	65	66	25	26
Vein 1A reaches level of Px:				
10	—	1	—	—
9	4	9	—	1
8	36	38	10	17 e
7	18	17	12	7
6½*	1	—	—	—
6	6	1	3	1
Number observed	65	66	25	26
Distance of Ac from petiole:				
a) greater than length of Ac	10	—	—	—
b) Ac & distance subequal	44	24	18	2
c) Less than length of Ac	12	42	8	24
Number observed	66	65	26	26

* One male had an extra ½ postnodal cross vein between the node and the origin of R_3.
Uneven numbers of observations are due to malformed wings, which were omitted.

TABLE 2. The size of specimens in the type series of *Pseudagrion vaalense* n. sp.

	Males		Females	
	Dried	In spirit	Dried	In spirit
HINDWING maximum	22.4	22.0	22.6	22.8
minimum	19.8	20.7	21.6	21.5
mean	21.18	21.31	22.20	22.21
99 % confidence limit ±	1.52	1.18	1.44	1.55
Number measured	21	12	6	7
ABDOMEN maximum	31.0	31.2	29.0	30.2
minimum	27.6	29.5	26.7	27.5
mean	29.74	30.12	27.88	28.73
99 % confidence limit ±	2.81	1.71	3.45	3.84
Number measured	18	12	6	7
Abdomen/Hindwing Ratio				
maximum	1.46	1.45	1.28	1.34
minimum	1.31	1.38	1.21	1.25
mean	1.41	1.42	1.26	1.29
99 % confidence limit ±	0.11	0.07	0.10	0.13
Number of specimens	18	12	6	7

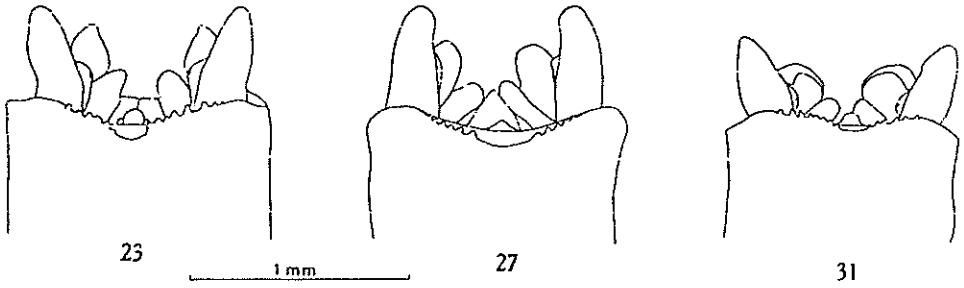
1) All the measurements above are in millimetres.
2) The length of 3 paratype male abdomens were not measured as they were broken and repaired.
3) The 99 % confidence limits were calculated using $t(\%)$, the t values being taken from HALD (1952).

is rather similar to that of *P. acaciae* FÖRSTER and the anal appendages of this species are also shown (figs. 31 to 34) so that the new species may be more easily separated from *P. acaciae*. The penes of the three species may be compared by reference to figures 17 to 22. The colouration of mature adults of *P. vaalense* and *P. pseudomassaicum* is distinctive in several respects, noteworthy being the far less dense pruinosity of *P. vaalense*.

The behaviour of adult males of *P. vaalense* is distinctive. They are strong fliers and are usually found sweeping low over the water where it is flowing fast, but is not broken. They settle on supports as far into the stream as are available, and settle very near the water surface. This behaviour is

EXPLANATION OF FIGS. 23-34

Figs. 23-34 — Anal appendages of the ♂ of *P. vaalense*, *P. pseudomassaicum* and *P. acaciae* in dorsal, dorso-lateral, lateral and ventral aspects. — 23-26 *P. vaalense* holotype ♂. 27-30 *P. pseudomassaicum*. — 31-33 *P. acaciae*.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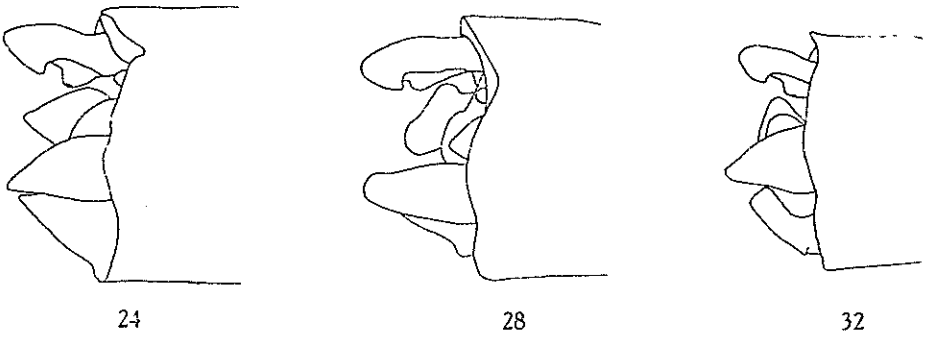
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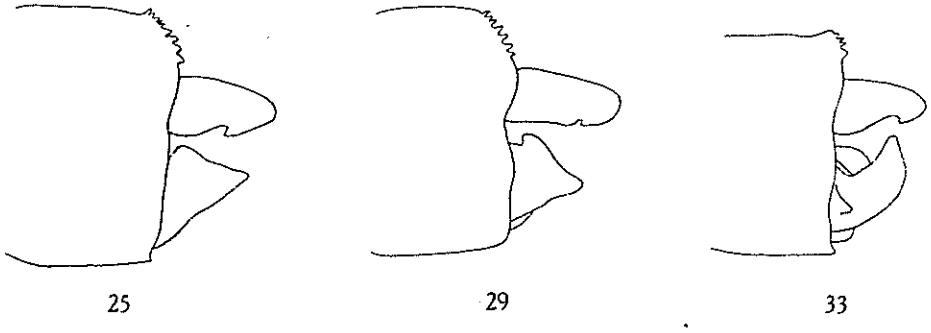
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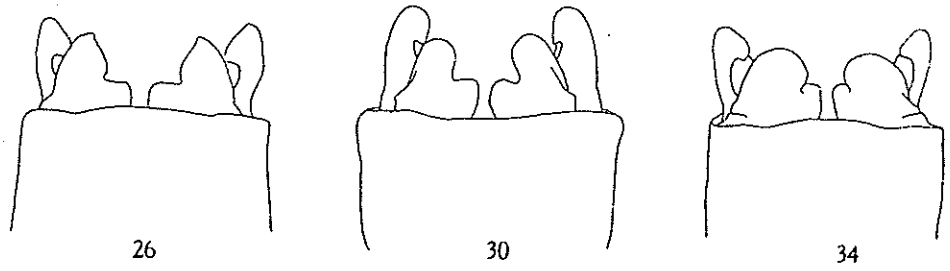
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very different from that of *P. salisburyense* Ris and *P. citricola* Barnard which where also found at the type locality of *P. vaalense.*

Other records of the occurrence of this species are as follows:

1. Vaal River where crossed by the road from Morgenzon to Amersfoort (South East Transvaal).
   Imagines. October (Val 430B), November 1958 (Val 455), November 1959, January, October (Val 1189D), December 1960 (DRA 44A).
   Larvae. October 1958, January, September, November, December 1959.
2. Vaal River below Standerton Sewage Works (type locality).
   Imagines. January (Val 901C) and December 1960 (DRA 46A).
3. Vaal River where crossed by the road from Standerton to Villiers (Southern Transvaal).
   Larvae. October 1959, August, September, October 1960.
4. Vaal River at Villiers.
   Imagines. December 1958 (Val 482A), February 1959.
5. Wilge River (a large tributary of the Vaal) at Frankfort, Orange Free State.
   Imagine. December 1958 (Val 490).
6. Wilge River where crossed by the road from Warden to Reitz (North Eastern Orange Free State).
   Images. October 1958 (collected at emergence) (Val 423A), February 1959 (Val 540B).
7. Vaal River below the Vaal Barrage.
   Imagines. October 1956 (V. B. 27G).
   Larvae. August (V. B. 5), November 1956 (V. B. 40).
8. Orange River at Prieska.
   Imagines and Larvae. December 1960 (DRA 52).
9. Professor B. I. Balinsky has told me that he has found this species at the Augrabies Falls on the Orange River.

P. vaalense has therefore been recorded only from the Vaal — Orange River system and only in the early and midsummer months. It is definitely absent in the winter in the area covered by the survey of the streams and rivers of the catchment of the Vaal Dam. In this area it is found only in the large rivers and never near standing waters or where the Vaal River is held back by storage reservoirs (Chutter in the press). It may be that some aspect of the adult behaviour prevents the species invading the smaller streams. The larvae are certainly tolerant of a wide range of habitats in rivers. In the catchment of Vaal Dam they have been recorded from marginal vegetation, submerged willow tree roots, stony backwaters and occasionally from stony runs. They have never been found on the mud or sand banks in the rivers.

TABLE 3. The size of various parts of the larvae of four species of *Pseudagrion*

Species	*acaciae*				*angolense*				*gigas*				*pseudomassaicum*			
	maximum	mean	minimum	Number measured	maximum	mean	minimum	Number measured	maximum	mean	minimum	Number measured	maximum	mean	minimum	Number measured
Length, living, excluding lamellae	14.0	14.0	14.0	3	17.4	17.1	16.8	3	25.0	22.4	21.1	6	14.5	14.3	14.0	2
Maximum head width	3.5	3.2	3.0	10	3.4	3.3	3.2	6	4.3	4.1	3.7	18	3.6	3.3	3.1	11
Antennae length	2.7	2.5	2.4	10	2.9	2.7	2.6	10	2.9	2.7	2.5	18	2.9	2.6	2.4	14
Length of foreleg femur	1.8	1.7	1.6	11	2.0	1.9	1.8	10	2.2	2.0	1.6	19	1.8	1.7	1.5	15
Length of midleg femur	2.4	2.2	2.1	11	2.6	2.5	2.3	10	3.0	2.8	2.4	19	2.4	2.2	2.0	15
Length of hindleg femur	2.9	2.8	2.7	11	3.2	3.1	2.9	10	3.7	3.4	3.1	19	3.1	2.8	2.5	14
Length of median caudal lamella	6.2	5.4	4.6	9	7.1	6.6	6.2	4	8.8	7.8	6.8	17	6.4	5.8	5.3	9
Width of median caudal lamella	1.2	1.0	0.8	9	1.3	1.2	1.2	3	1.5	1.4	1.2	13	1.7	1.4	1.2	9
Length of median caudal lamella divided by width	6.4	5.6	5.1	9	5.5	5.3	5.2	3	6.9	5.9	5.4	13	4.9	4.1	3.5	9

All the above measurements are in millimetres

TABLE 4. The ratios between the width and the length of the median lobe of the larval prementum in 5 species of *Pseudagrion*

Species	*acaciae*	*angolense*	*gigas*	*pseudo-massaicum*	*massaicum*
Mean	2.24	2.18	1.78	2.29	2.96
99% confidence limits:					
Upper	2.16	1.91	1.48	2.00	2.69
Lower	2.35	2.45	2.09	2.58	3.23
Number of median lobes measured	10	9	18	13	33

The confidence limits were calculated using $t(\theta)$, t values being taken from *Hald* (1952).

PSEUDAGRION ACACIAE FÖRSTER

FINAL INSTAR LARVA

Description

Small (Table 3). Antennae (fig. 35): first flagellar segment longer than the pedicel and second flagellar segment, which are subequal in length and longer than the scape. Labium: distal margin of median lobe of prementum (fig. 39 and Table 4) moderately convex; inner margin of palpus (fig. 43) unevenly serrated with larger protuberances at irregular intervals; distal margin of palpus (fig. 47) narrow; 1 premental, 3 palpal setae on each side. Median caudal lamella (fig. 51): node beyond mid-point; widest antenodally; postnodal colouration, a dark patch spreading forwards from the apex along the dorsal and ventral margins and a less dark pigmented area along both sides of the main tracheal axis; antenodal colouration, a darkening along the main tracheal axis, widened at the node; pigmented tracheoles numerous antenodally, few postnodally; spiniform setae on the dorsal antenodal margin moderately developed anteriorly, strongly developed at the node; piliform setae dense on the dorsal and, except near the node, on the ventral postnodal margins; ventral antenodal margin with small spiniform setae. Lateral aspect of anal cercoids (fig. 55): in the male, small and pointed with an evenly convex dorsal and ventral outline; in the female, small with outline at first convex and then straight to the pointed apex both dorsally and ventrally.

Material

The material on which the above description has been based was collected from the following localities:

1. Komati River at Komatipoort, Eastern Transvaal. (DRA 37A, DRA 40A, DRA 40B, DRA 40D, DRA 40E, GEN 286B, GEN 326).
2. Limpopo River at Beit Bridge, Northern Transvaal. (DRA 102B, GEN 158B).

Remarks

The pattern of pigmentation on the caudal lamellae of this species makes it easily separable from any of the other known larvae. However the author has seen uncorrelated larvae in the collections of the National Institute for Water Research in which the caudal lamellae are rather similar in their pattern of pigmentation, though these larvae are easily separated from *P. acaciae* larvae by a very great elongation of the antenodal part of the lamellae, which occupies about two-thirds of the total length of the lamellae.

PSEUDAGRION ANGOLENSE SÉLYS

FINAL INSTAR LARVA

Description

Moderately large (Table 3). Antennae (fig. 36): first flagellar segment longer than the pedicel and the second flagellar segment, which are subequal in length and longer than the scape. Labium: distal margin of median lobe of prementum (fig. 40 and Table 4) strongly convex; inner margin of palpus (fig. 44) with uneven serrations, but without larger protuberances; distal margin of palpus (fig. 48) broad; 1 premental, 4 or 5 palpal setae on each side. Median caudal lamella (fig. 52): node nearer base than apex; widest postnodally; postnodal colouration, three dark patches along the main tracheal axis, the apical patch somewhat lighter and spreading to the margin; antenodal colouration a uniform pigmentation of the whole area; pigmented tracheoles numerous near the margins; spiniform setae on the antenodal margins and piliform setae on the postnodal margins very feebly developed and widely spaced, particularly on the ventral margin where they are extremely few. Lateral aspect of anal cercoids (fig. 56): in the male, distinctive, large and blunt with a dorsal outline at first concave, then convex to the dorsal apex, ventral and distal outline convex to below the apex where there is a slight concavity; in the female, more pointed with a nearly straight dorsal margin and an evenly convex ventral margin.

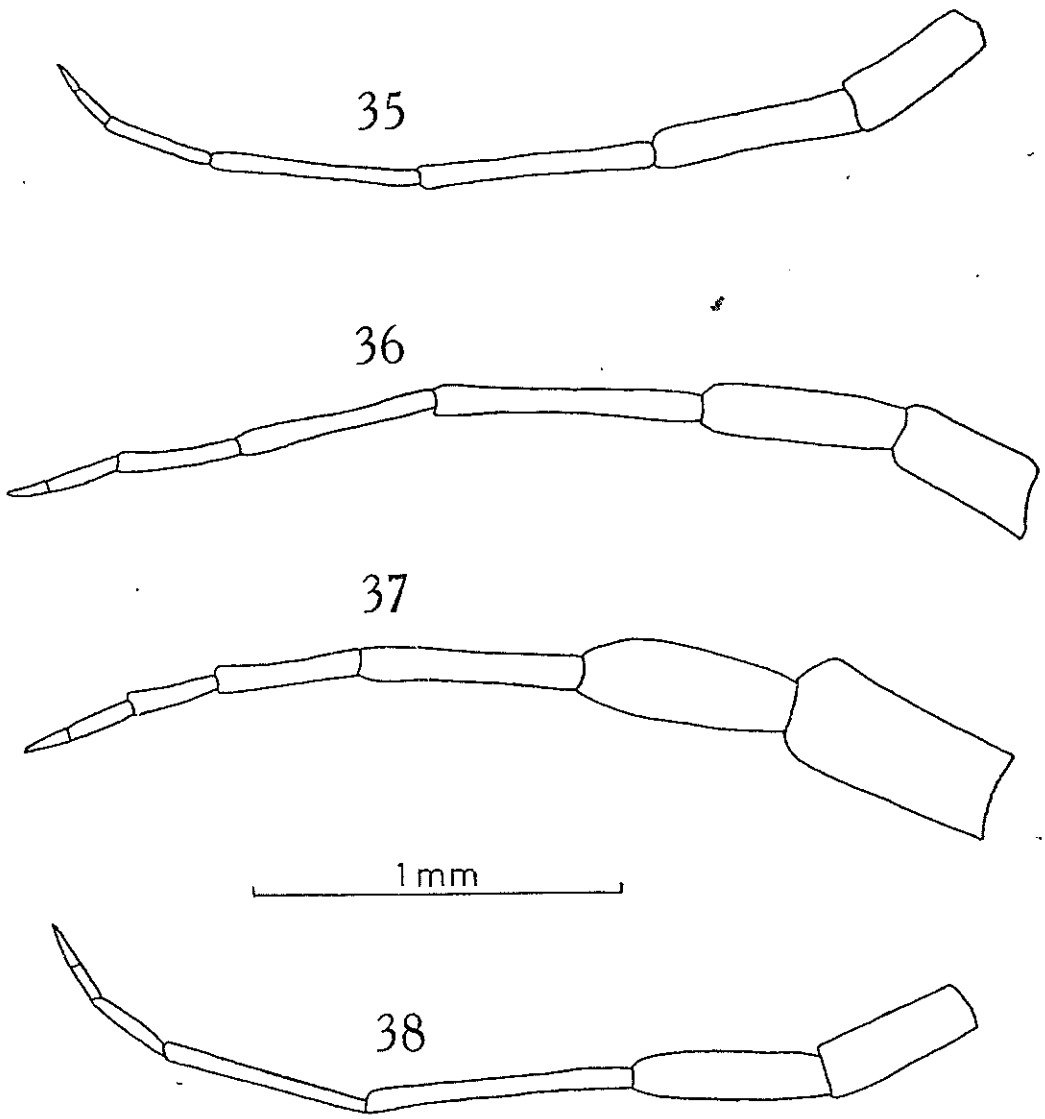
Material

The material on which the above desciption has been based was collected from the following localities:

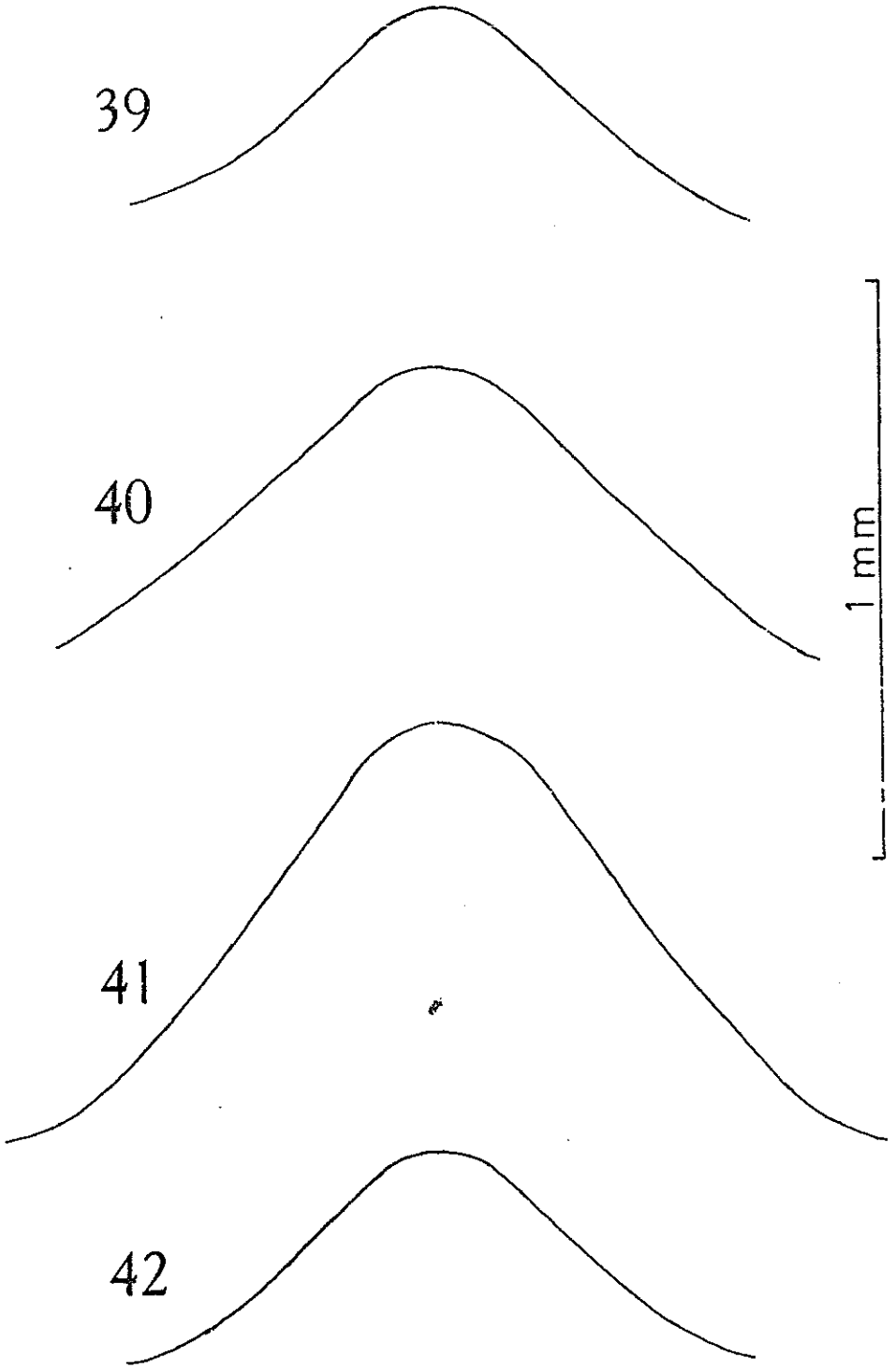
1. Rustenburg Kloof, near Rustenburg, Western Transvaal. (DRA 93C).
2. Retiefskloof, near Rustenburg, Western Transvaal. (DRA 107B, DRA 107F, DRA 107H).
3. Palmiet River near Pinetown, Natal. (DRA 119A, DRA 119B, DRA 120B, DRA 121D).
4. Entebbe, Lake Victoria, Uganda (*Leg.* Dr. P. S. CORBET).

Remarks

Mr. E. C. G. PINHEY of the National Museum, Bulawayo informs the author that there is some doubt whether this insect, ascribed by him (PINHEY, 1951) to *P. angolense,* is in fact *P. angolense.* The larvae of this species may be separated from all described *Pseudagrion* larvae by the number of palpal setae (see Discussion below). The East African larva provides a useful confirmation that the number of palpal setae in this species is consistently unusual.



Figs. 35-38 — The antennae of *P. acaciae* (35), *P. angolense* (36), *P. gigas* (37) and *P. pseudomassaicum* (38) larvae.



Figs. 39-42 — The median lobe of the prementum, drawn with the labium flattened, of *P. acaciae* (39), *P. angolense* (40), *P. gigas* (41) and *P. pseudomassaicum* (42) larvae.

PSEUDAGRION GIGAS Ris

FINAL INSTAR LARVA

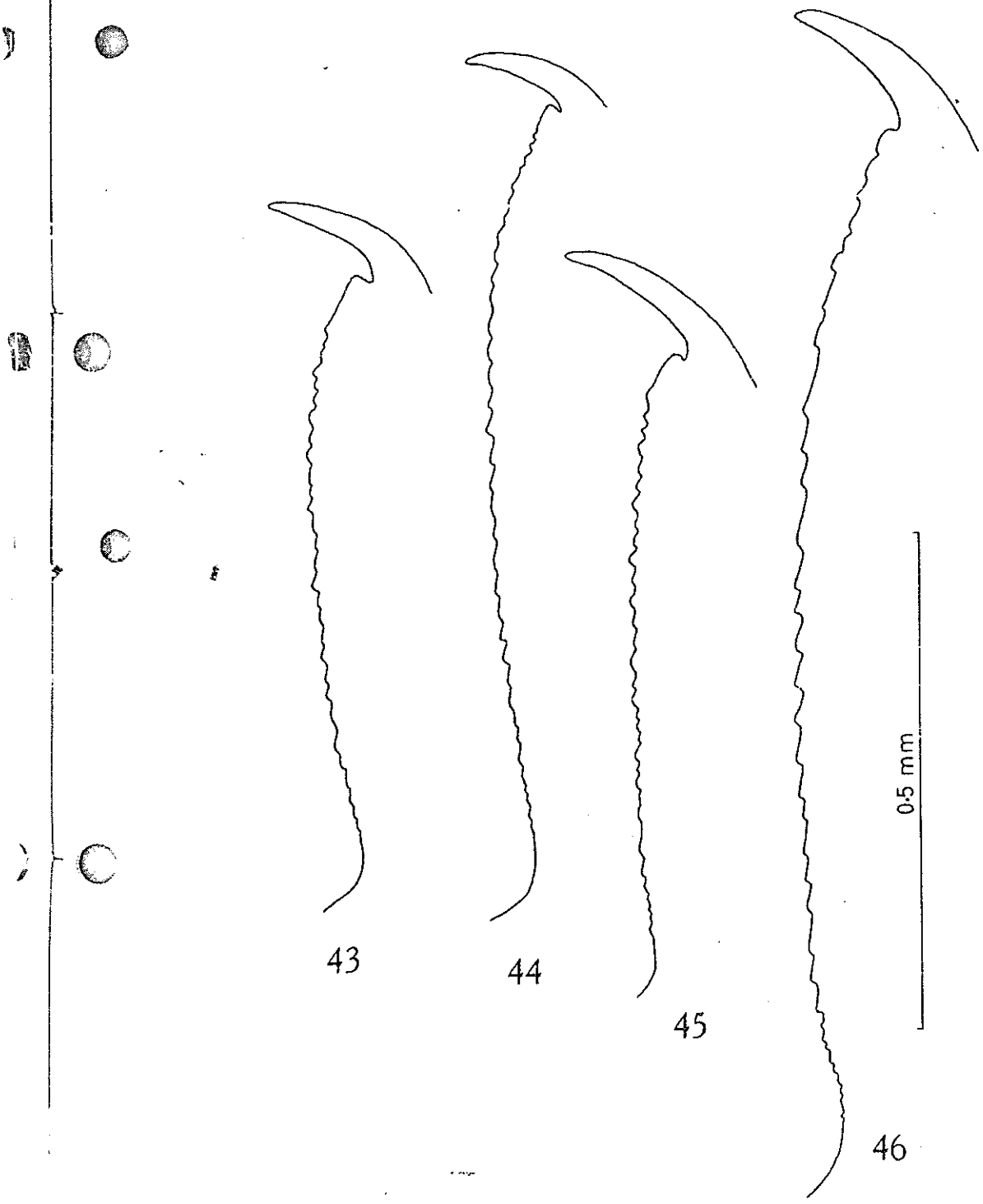
Description

A large bodied larva (Table 3). Antennae (fig. 37): first flagellar segment longer than scape and pedicel which are subequal in length and longer than the second flagellar segment; scape and pedicel robust. Labium: distal margin of median lobe of prementum (fig. 41 and Table 4) strongly convex and rather pointed; inner margin of palpus (fig. 46) unevenly serrated, but without larger protuberances; distal margin of palpus (fig. 49) wide; 1 premental, 3 palpal setae on each side. Median caudal lamella (fig. 53): node midway between base and apex; slightly wider immediately postnodally than elsewhere; no distinct pattern of pigmentation though the whole lamella is lightly and evenly pigmented; no pigmented tracheoles; spiniform setae strongly developed on the dorsal antenodal margin near the node, but rather small near the base and along the ventral antenodal margin; piliform setae dense and strongly developed on the postnodal margins. Lateral aspect of anal cercoids (fig. 57): in the male, large, blunt, dorsal margin slightly convex then straight to the apex which is dorsal, ventral margin at first slightly convex then straight to below the apex where there is a slight kink accentuating the apex; in the female, long and slender with dorsal and ventral margins slightly convex.

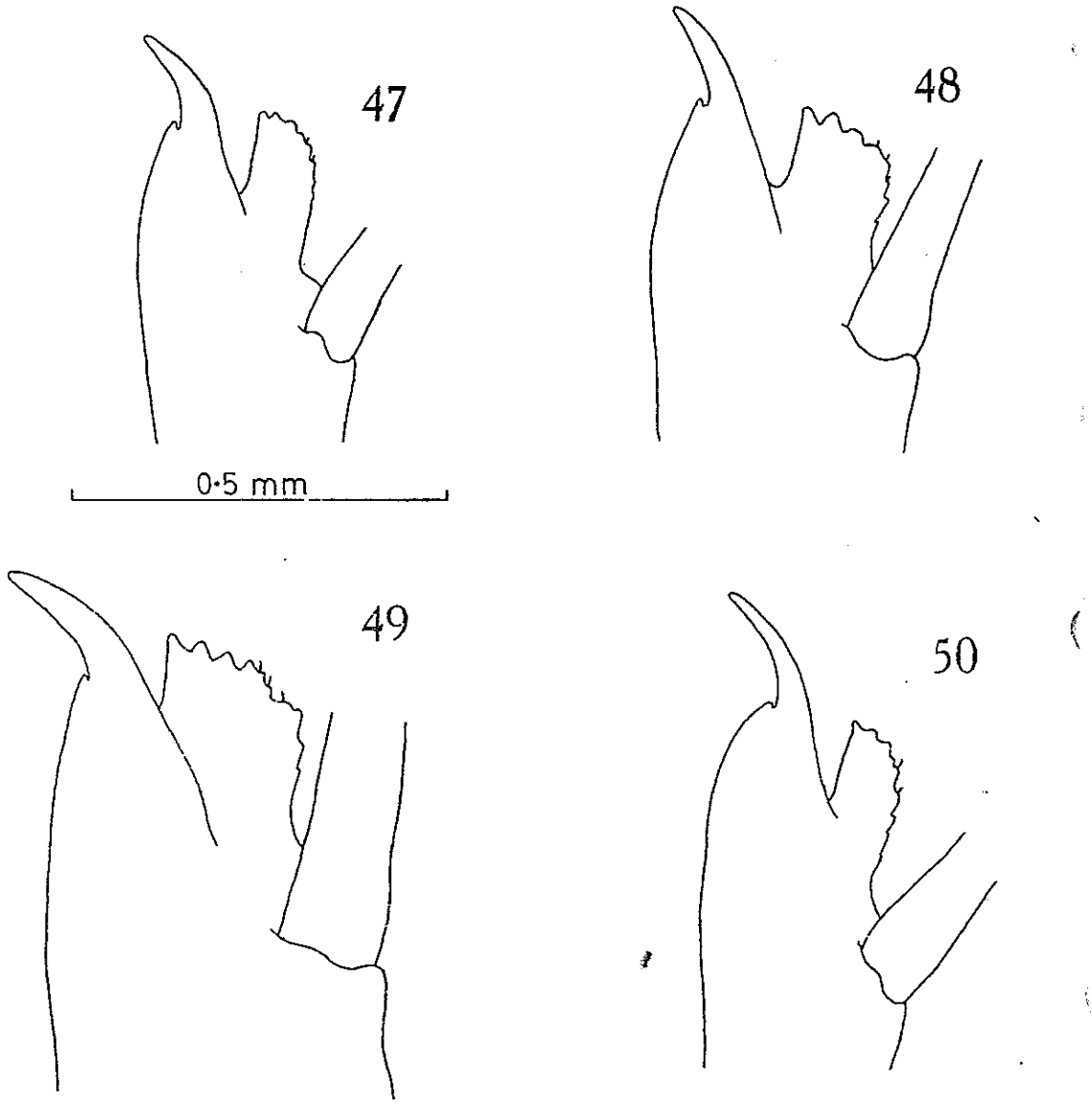
Material

The material on which the above description has been based was collected from the following localities:

1. Crocodile River below the weir at Dickon Hall, Nelspruit, Eastern Transvaal. (DRA 5A, DRA 5B).
2. Crocodile River at Crocodile Bridge, Eastern Transvaal. (DRA 39).
3. Komati River at Komatipoort, Eastern Transvaal. (DRA 56A, DRA 56B, DRA 56C, DRA 56F, GEN 569F).
4. Sabie River at Lower Sabie Rest Camp, Kruger National Park, Eastern Transvaal. (GEN 250F, GEN 308C).
5. Suidkaap River where crossed by the road from Nelspruit to Barberton, Eastern Transvaal. (GEN 145B, GEN 545D).
6. Ishlelo River near Pongola Settlements, South Eastern Transvaal. (GEN 31E).
7. Mogol River where crossed by the road from Vaalwater to Ellisras, Northern Transvaal. (DRA 66T).



Figs. 43-46 — The inner margin of the right labial palpus of *P. acaciae* (43), *P. angolense* (44), *P. pseudomassaicum* (45) and *P. gigas* (46) larvae.



Figs. 47-50 — The tip of the right labial palpus of *P. acaciae* (47), *P. angolense* (48), *P. gigas* (49) and *P. pseudomassaicum* (50) larvae.

Remarks

The larva of this species is far larger than that of any other *Pseudagrion* species whose larva is known. All the larvae seen have been an ochre colour. The size, median lobe of the prementum, the gill lamellae and anal cercoids of this species all serve to distinguish it from any other known *Pseudagrion* larva.

PSEUDAGRION PSEUDOMASSAICUM PINHEY

FINAL INSTAR LARVA

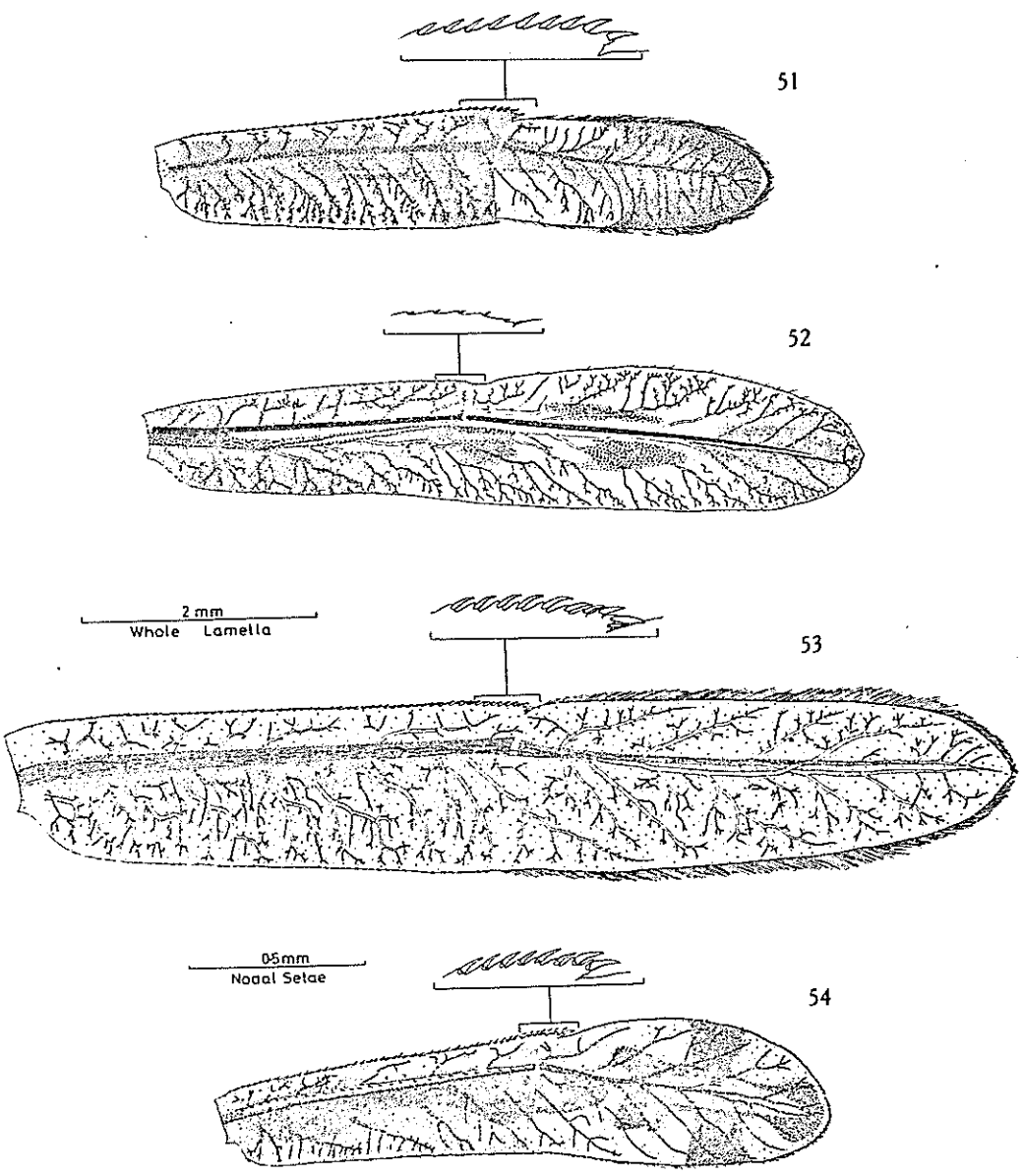
Description

A small larva (Table 3). Antennae (fig. 38): first flagellar segment longer than second flagellar segment, second flagellar segment longer than pedicel and pedicel longer than scape. Labium: distal margin of median lobe of prementum (fig. 42 and Table 4) moderately convex; inner margin of palpus (fig. 45) unevenly serrated with larger protuberances at irregular intervals; distal margin of palpus (fig. 50) narrow; 1 premental, 3 palpal setae on each side. Median caudal lamella (fig. 54): node nearer apex than base; widest postnodally; lamella distinctly bent at the node so that the ante- and postnodal parts are not in the same horizontal plane; postnodal colouration a basal median patch followed by a more or less triangular median pigmented area which tapers towards the apex, an apical dark patch and a subapical vertical band of pigmentation extending from the dorsal to the ventral margin; antenodal colouration a dark band along the main tracheal axis widened near the base and at the node, but not reaching the base; pigmented tracheoles few and scattered, mainly in the antenodal region; spiniform setae, strongly developed on the dorsal antenodal margin, particularly at the node, small on the ventral antenodal margin; piliform setae, short, rather more closely spaced on the ventral than on the dorsal postnodal margin. Lateral aspect of anal cercoids (fig. 58): in the male, dorsal margin almost straight to near the apex where it is strongly convex, ventral margin at first convex, then straightening to near the apex where it is more strongly convex; in the female, dorsal margin almost straight, ventral margin basally convex, later straight, apex rather blunt.

Material

The material on which the above description has been based was collected from the following localities:

1. Komati River at Komatipoort, Eastern Transvaal. (DRA 37B, DRA 56E, GEN 286B, GEN 326).



Figs. 51-54 — The median caudal lamella, and the setation at the node drawn on a larger scale, of *P. acaciae* (51), *P. angolense* (52), *P. gigas* (53) and *P. pseudomassaicum* (54) larvae.

2. Komati River in Swaziland 1 mile from Transvaal border. (GEN 268D).
3. Nanetsi Wenda River, east of Satara, Kruger National Park, Eastern Transvaal. (GEN 541E).
4. Limpopo River at Beit Bridge, Northern Transvaal. (DRA 102A, DRA 102C, DRA 102D, GEN 735C).
5. Mogol River where crossed by the road from Vaalwater to Ellisras, Northern Transvaal. (DRA 28G).
6. Crocodile River 15 miles north-west of Thabazimbi, North-Western Transvaal. This is not the same river as the Crocodile River of the Eastern Transvaal mentioned under *P. gigas*. (DRA 73C).

Remarks

Very similar to the larva of *P. massaicum* SJOSTEDT. May best be separated from *P. massaicum* by the shape of the median caudal lamella which is straight in *P. massaicum* and by the shape of the median lobe of the prementum.

As mentioned above the larva described under this species (CHUTTER, 1961) is that of *P. vaalense* n. sp.

PSEUDAGRION MASSAICUM SJOSTEDT

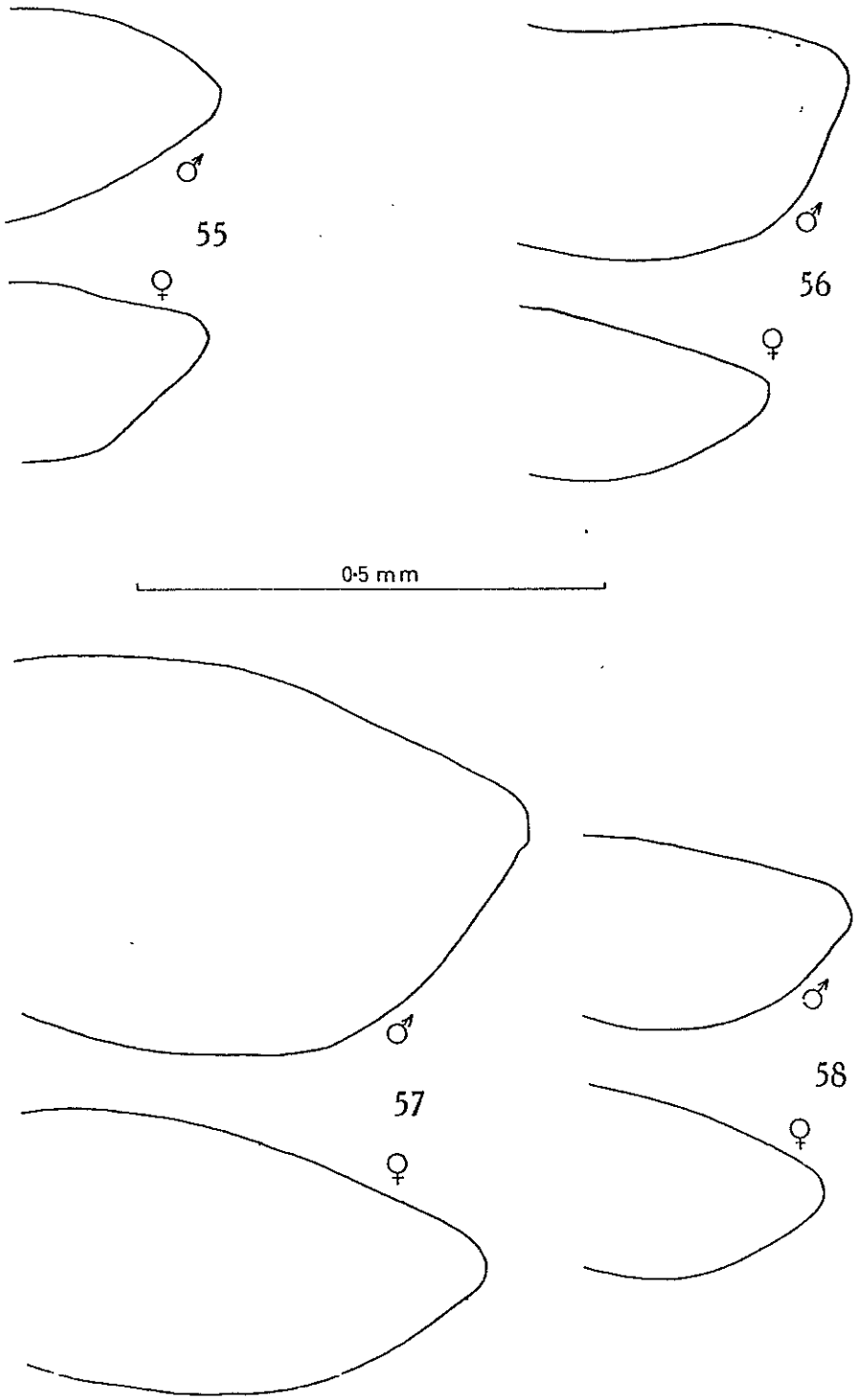
FINAL INSTAR LARVA

The larva of this species has already been described (CHUTTER, 1961). Discovery of the very similar larva of *P. pseudomassaicum* and the difficulty experienced in separating the larvae of the two species reliably, particularly if the caudal lamellae were missing or regenerating, led to a further study of the larva of *P. massaicum*. The shape of the median lobe of the prementum, expressed as the ratio between width and length, is a useful character for separating the two species. This ratio in *P. massaicum* is therefore given here (Table 4) and it differs sufficiently from the ratio for *P. pseudomassaicum* to be a meaningful character.

Material

The material on which the ratio between the width and length of the median lobe of the prementum has been calculated was collected from the following localities:

1. Nyl River at Potgietersrus, Northern Transvaal. (DRA 109A, DRA 109B, DRA 109C, GEN 386A, GEN 386B).



Figs. 55-58 — The outer lateral aspect of the left anal cercoids of ♂ and ♀ larvae of *P. acaciae* (55), *P. angolense* (56), *P. gigas* (57) snd *P. pseudomassaicum* (58).

2. Mogol River where crossed by the road from Vaalwater to Ellisras, Northern Transvaal. (GEN 319).
3. Nwantinlopfu Dam, Kruger National Park, Eastern Transvaal. (GEN 364L).
4. Gudzane stream, Kruger National Park, Eastern Transvaal. (GEN 464D).
5. Kumana Pan, south of Satara, Kruger National Park, Eastern Transvaal. (GEN 534D).
6. Nanetsi Wenda River, east of Satara, Kruger National Park, Eastern Transvaal. (GEN 541E).
7. Vaal River at Schmidt's Drift, east of Kimberley, Northern Cape Province. (GEN 543B).
8. Vaal River near Vereeniging, Southern Transvaal. (VAL 53B, VAL 128A, V. B. 26, V. B. 30, V. B. 34, V. B. 35, V. B. 42, V. B. 43, V. B. 57, V. B. 63).
9. Vaal River below the Vaal Barrage, Southern Transvaal. (V. B. 38).
10. Jukskei River 15 miles north of Johannesburg. (J 21, J 31).
11. Hartbeespoort Dam, Central Transvaal. (J 147).

Remarks

The wide distribution of the localities from which material was examined should ensure that the confidence limits for the ratio between the width and length of the median lobe of the prementum of this species are reliable.

DISCUSSION

The larvae of the genus *Pseudagrion* have previously been described (BARNARD 1937, CHUTTER 1961) as having one premental and three palpal setae on each side of the labium. PINHEY's (1959) description of a *Pseudagrion* larva, tentatively assigned to *P. melanicterum* SELYS, which has 4 palpal setae, and the discovery of the larva of *P. angolense*, with its 4 or 5 palpal setae, necessitate a revision of the relevant part of the description of the larvae of the genus to «1 premental and 3, 4 or 5 palpal setae on each side of the labium». LONGFIELD (1959) mentioned a «*Pseudagrion angolense* group» of species which included *P. melanicterum* and *P. angolense*. It may be that this group of species is characterised by having more than 3 setae on the palpus of the larval labium.

From his descriptions of the larvae of *P. citricola* BARNARD, *P. kersteni* (GERST.), *P. massaicum* SJÖSTEDT, *P. natalense* RIS, *P. salisburyense* RIS, and *P. vaale.se* n. sp. (wrongly identified as *P. pseudomassaicum* PINHEY) and from

BARNARD's (1937) description of the larva of *P. furcigerum* (RAMB). the author suggested (CHUTTER 1961) that these species could be divided, on the basis of larval characters other than the anal cercoids, into two groups, as follows:

Group a.

With a strongly convex median lobe of the prementum, a broad distal margin of the labial palpus, an even serration without markedly larger protuberances of the inner margin of the palpus, antennae in which the second flagellar segment is shorter than the pedicel and caudal lamellae of more or less the same shape (being more than 5 times as long as broad).

The species assigned to this group were *citricola*, *kersteni*, *natalense*, *salisburyense* and *furcigerum*. *P. kersteni* was slightly aberrant with respect to its antennae and the shape of its caudal lamellae.

Group b.

With moderately convex median lobe of the prementum, a narrow distal margin of the labial palpus, an uneven serration with larger protuberances of the inner margin of the palpus, antennae in which the second flagellar segment is longer than the pedicel and caudal lamellae of more or less the same shape (being less than 5 times as long as broad).

The species assigned to this group were *massaicum* and *vaalense*.

This arrangement of the six species into two groups was found to be similar to a grouping, based on the female thoracic structure, put forward by BALINSKY (1957).

The larva of *P. pseudomassaicum* has all the characters common to the species of group b, and is obviously very close to that of *P. massaicum*. The labial characters of *P. acaciae* larva are all of the group b type, but the antennae and more especially the caudal lamellae of this species separate it from the other group b species. The larva of *P. angolense* is of the group a type in all respects except for the number of palpal setae.

The labium of *P. gigas* larva is of the group a type, though the median lobe of the prementum is more developed than in other species of this group. As in *P. kersteni*, which has been included in group a, the antennae in *P. gigas* are robust and the scape is longer than the second flagellar segment. The shape of the caudal lamella of this species approaches the shape of the lamella in *P. kersteni*. The only large differences between *P. gigas* and the other species in group a are its size and lack of a pattern of pigmentation on the lamellae. This similarity of the larva of *P. gigas* to the larvae of group a, and its sharing of common differences with group b, suggests that BALINSKY's (1957, p. 292), conclusion based on the adult stage, that: «It is obvious that

P. gigas occupies a very isolated position in the genus» is not correct when the larval stage is taken into consideration.

PINHEY's (1959) descriptions of the larvae of *P. bicoerulans* MARTIN and *P. melanicterum* SELYS suggest that these species belong to group a, the latter near *P. angolense.*

From this comparison of the larval morphology, leaving out the anal cercoids because they are a feature on which the species have already been grouped in the adult stage, the species of *Pseudagrion* whose larvae are known may be separated into two major groups and five subgroups, as follows:

Group A. Median lobe of prementum strongly convex, distal margin of labial palpus broad, inner margin of palpus serrated without markedly larger protuberances, caudal lamellae more than 5 times as long as broad.
Subgroup 1. With more than 3 setae on each labial palpus. *angolense.*
Subgroup 2. With second flagellar segment of antennae longer than scape. *citricola, natalense, salisburyense.*
Subgroup 3. Antennae robust with scape longer than second flagellar segment. *gigas, kersteni.*

Group B. Median lobe of prementum moderately convex, distal margin of labial palpus narrow, inner margin of palpus serrated with markedly larger protuberances at regular or irregular intervals, caudal lamellae more or less than 5 times as long as broad.
Subgroup 1. Caudal lamellae less than 5 times as long as broad, second flagellar segment of antenna longer than pedicel. *massaicum, pseudomassaicum, vaalense.*
Subgroup 2. Caudal lamellae more than 5 times as long as broad, second flagellar segment and pedicel of antenna subequal in length. *acaciae.*

According to the features described by BARNARD and PINHEY it is likely that *P. melanicterum* would be in group A, subgroup 1 and *P. furcigerum* and *P. bicoerulans* in group A, subgroup 2.

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*
* *

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