STUDIES ON PARAGUS

(Diptera, Syrphidae)

Thesis for the Degree of
Master of Science
Rhodes University

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PREFACE

As several new species are described in this thesis its full value can only be realised by its publication, and it has therefore been prepared with that end in view. The subject matter is divided into two parts, each of which has been treated quite independently of the other. Both parts are presented here in the form in which they have been offered for publication.

The first paper consists of a systematic study of a complex of species within the genus Paragus. It includes descriptions of four new species, a new subspecies, an allotype, and redescriptions of two incompletely defined species. This paper has been offered for publication in the Transactions of the Royal Entomological Society of London. The second part consists of a study of all the Ethiopian species of Paragus except those covered by the first paper. It includes the definition of a new subgenus, and descriptions of two new species and three allotypes. It has been sent for publication in the "Revue Zoologie et Botanique de Africaine" at the invitation of Dr. P. Basilewsky of the Musee du Congo Belge, Tervuren.

THE *PARAGUS SERRATUS* COMPLEX, WITH DESCRIPTIONS OF NEW SPECIES (DIPTERA,SYRPHIDAE).'

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INTRODUCTION.

Paragus serratus was described, as a species of *Mulio*, by Fabricius in 1805 on material from India. At that time it was quite distinct from other species of *Paragus* because of its strongly serrated scutellum and carinate abdomen. A closely related species, *crenulatus*, was then described by Thomson (1868) on material from China. Later workers found that *P. serratus* was widely distributed. Verrall (1898) recorded that Lt.Col. Yerbury had taken it at Aden - he also observed that Yerbury had found the species to be very common in Ceylon. Ricardo (1903) found a male and female in the collection made on Sokotra by W.R.O. Grant. Brunetti (1908) observed that it was common in India. The first record of *P. serratus* in Africa is that of Speiser (1911), who obtained specimens from Eritrea. Bezzi (1912) found *P. serratus* in the Fea collection from Portuguese Guinea - he remarked that

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he had seen specimens from Central Africa and Mozambique in the British Museum, and he commented briefly on a variable form of the species from the Cape Verde Islands - he observed that the species extended from Ceylon to New Guinea and appeared to have originated in the East. Bezzi compared African specimens with some from India and concluded that they were the same species. Specimens of P. serratus were then recorded from the Belgian Congo by Hervé-Bazin (1914) who stated that his record served to show how large the area of distribution of the species was. Bezzi (1915) found specimens in the British Museum collection from Mozambique, Durban, Sierra Leone and Nyasaland - he remarked that P. serratus was widely distributed south of the Sahara. Additional records of its distribution in Africa are those of Bezzi (1920), Efflatoun Bey (1926) and Curran (1938), who recorded specimens from Abyssinia, Egypt and Lourenço Marques respectively. It has also been found in Australia (Ferguson : 1926). Recently Hull (1949) described a third species, azurea, on the female taken in Sokotra by Grant in 1899. Thus three closely related species, P. serratus, crenulatus and azurea, all quite distinct from other species of the genus, have been described. Of these, P. azurea has been recorded only from Sokotra, and crenulatus is known only from China, while serratus has been recorded from most of Africa south of the

Sahara, Egypt, Aden, India, Ceylon, Java, New Guinea and even Australia.

When I commenced a revision of the African species of Paragus I was at once struck by the extreme variation found in colouration and size of individuals of P. serratus. This variation has often been commented on before (Verrall, 1898 ; Brunetti, 1908 ; de Meijere, 1908 ; Bezzi, 1912). I examined the male genitalia of several different colour forms taken in the same locality (Sawmills, Southern Rhodesia), and found that there were distinct, constant differences in structure which could be correlated with constant external features. After further study it became evident that the African forms could, on the material at my disposal, be divided into four distinct species, one of which was P. azurea Hull, on the basis of both external and genitalic characters. It then became necessary to determine the status of these species in relation to P. serratus as described by Fabricius.

The locality from which Fabricius obtained his material was Tranquebar, a town on the sea-coast in the Tanjore district of Madras, India (not Aden, as stated by Efflatoun Bey :1926). An examination of Indian material became essential. A fine collection of P. serratus s.lat. from the Oriental Region, including specimens from the collections of Brunetti and Yerbury, was placed at my disposal by the British Museum.

A study of this material has made it clear that there are four distinct Oriental species, crenulatus, serratus, and two new species, one of which also occurs in Africa. Thus the original serratus of Fabricius has been resolved into a complex of seven species, three of which are African , three Oriental, and one which is common to both regions. P. serratus s.str. is apparently confined to India.

SYSTEMATIC POSITION OF THE PARAGUS SERRATUS COMPLEX

The seven species forming the serratus complex belong to that section of the genus Paragus which has, amongst others, the following characteristics :-

1. The first five abdominal segments are more or less rigidly fused together.
2. The hair on the eyes is usually arranged in vertical stripes.
3. The compound eyes are contiguous for some distance in the male.
4. The spurious vein always ends at or before the point of coincidence of the fourth longitudinal vein and the lower marginal cross-vein.
5. The inferior claspers are of the same size or are better developed than the superior claspers.
6. The second abdominal segment is wider than the first segment.

The subdivision outlined above includes the more robust species which frequently have a red, brown or yellow colouration developed on the abdomen, and sometimes have the apical half of the scutellum yellow. The serratus complex is isolated within this group by the following features :-

1. The scutellum is very deeply serrated, bearing on its outer margin a row of conspicuous, peg-like teeth. A slightly serrated condition is found in many other species of Paragus, but the serrations are usually weak and inconspicuous.
2. The third and fourth abdominal segments are carinate.
3. The second abdominal segment is longitudinally narrower over the middle than the first segment. In other species of the group the second segment is usually considerably longer than the first.
4. There is a distinct, elevated, transverse ridge across the middle of the anterior half of the first abdominal segment.
5. The ventral surface of the scutellum is covered by a dense, white pubescence in all species of the serratus complex. This pubescence is absent in most other species of the group, but is present, though sparse and very short, in a few undetermined species.
6. There are two well developed longitudinal strips of tomentum on the mesonotum - the two inner ends of the transverse suture are filled with linear strips of tomentum.

7. There is a facial stripe in the male - it is not always well developed and is often abbreviated, but seems to occur only within the serratus complex.
8. The penis-sheath is developed on each side into a prominent process for the support of the superior claspers, and is usually produced below into a median, finger-like process.

SPECIFIC CHARACTERS

In each description only those characters which I have found to show the greatest interspecific variation have been used. These may be listed as follows :-

Head. The colour of the face and slightly elevated strip of the epistome surrounding the oral tubercle ; the extent and colour of the facial stripe ; the nature of the facial pile ; the colour and relative lengths of the antennal segments ; the length of the antennae in relation to the distance between their base and the upper margin of the oral tubercle ; the colour of the vertex ; the nature of the stripes of hair on the eyes ; in the females the colour of the frons and nature of the tomentose strips bordering it.

Thorax. The colour of the reflections of the mesonotum ; the degree of puncturation ; the nature of the mesonotal pile and tomentose stripes ; the colouration of the scutellum

and nature of its teeth. The colouration of the legs, especially of the posterior femora. The colour and thickness of the wing veins ; the colour of the stigma ; the presence or absence of suffusion of the membrane.

Abdomen. The shape and size of the abdomen ; its colouration ; the nature of the three pairs of tomentose vittae found on the posterior three segments ; the nature of the transverse troughs on segments three and four, which are occupied by the two anterior pairs of vittae ; the nature of the vestiture of the abdomen ; the degree of development and distribution of a honeycomb-like sculpturation on the tergites of the abdomen. The segmentation of the abdomen and some of the features mentioned above are indicated in fig. 1. Outline drawings of the abdomens of males and females of each species are given, all drawn to the same scale.

Insert fig. 1 here

Male Genitalia. Studies of the male genitalia have proved to be of the greatest use in separating the species. It is unfortunate that systematists have ignored them in the past when dealing with species of Paragus. In describing the genitalia I have used Metcalf's (1921) terminology, which is based on that of Wesche (1906). I have followed

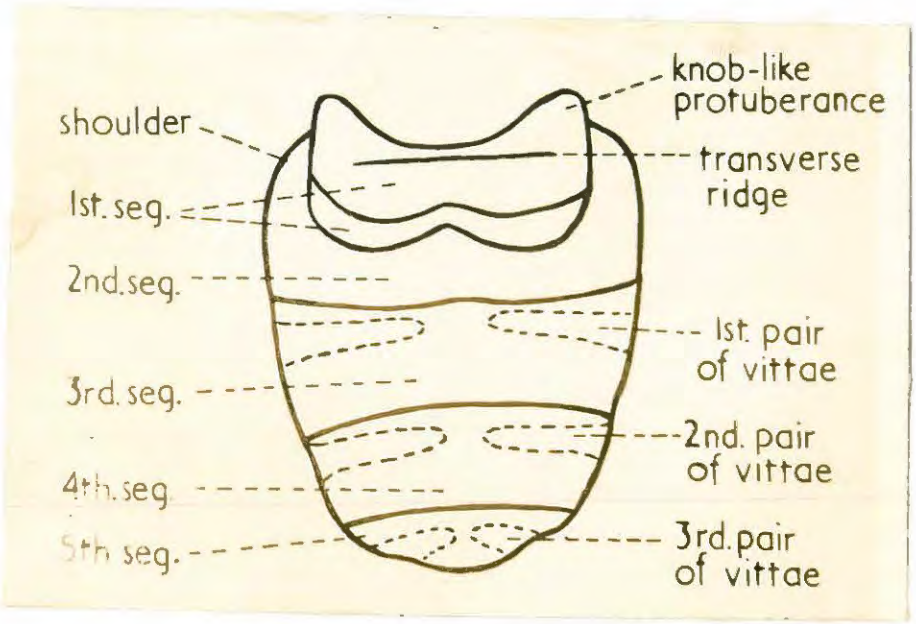

Fig. 1 .- Diagram of abdomen, illustrating those features referred to in descriptions of the species.

Zumpt and Heinz (1949) in calling the large, trough-shaped sclerite which bears the cerci and styles the "epandrium" and not "tergite ten" as Metcalf did. In numbering the segments of the abdomen I have counted the first apparent segment as being number one. All orientations mentioned in the text refer to the original, non-inverted condition of the hypopygium. Unless otherwise stated, the genitalia have been described as seen in lateral view. The different structures which have been of greatest use in separating the species are indicated in fig. 2.

Insert fig. 2 here.

KEY TO THE AFRICAN SPECIES

1 (2). Abdomen with conspicuous reclinate black hairs ; pile of mesonotum distinctly golden-yellow.....auritus sp.n.

2 (1). Black hairs of abdomen inconspicuous ; mesonotal pile white.

3 (6). Pile of mesonotum short ; antennae with the third segment not more than twice as long as the first two together ; the abdomen of the female is narrow when a small, diagonal spot of pollen is present on each side of the anterior ocellus.

4 (5). Abdomen narrow, melani~~stic~~c, with a patch of much lighter colour over the second and third segments ; thorax with cyanescent reflections ; female with a small, diagonal

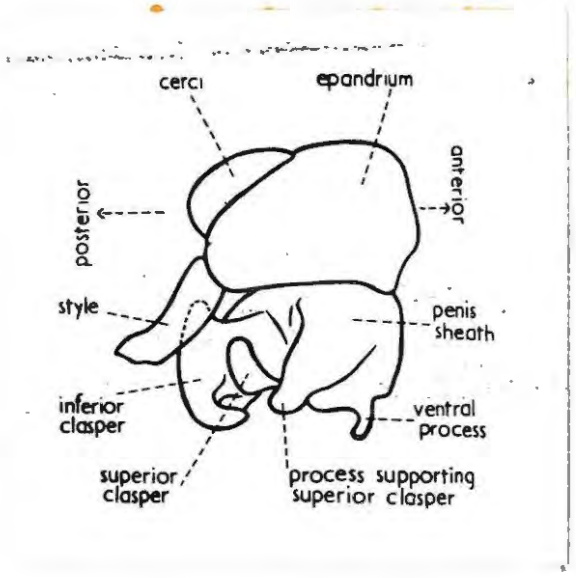

Fig. 2.- Diagram of hypopygium, illustrating those features referred to in descriptions of the species.

spot of pollen on each side of the anterior ocellus, and with the fourth and fifth abdominal sternites blackish...
.....pusillus sp.n.

5 (4). Abdomen broad, uniformly red-brown except for the shoulders which are piceous - sometimes the fourth segment is a little dark - rarely the whole abdomen black - never with a distinct patch of lighter colour over the second and third segments ; thorax dull, rarely with a few blue reflections, and quite heavily punctate ; female without a spot of pollen on each side of the anterior ocellus, and with the fourth and fifth abdominal sternites fuscous.....capricorni sp.n.

6 (3). Pile of mesonotum long ; antennae with the third segment more than twice as long as the first two together ; the abdomen of the female is stout when a spot of pollen is present on each side of the anterior ocellus.

7 (8). Mesonotal stripes abbreviated in the male, absent in the female ; sculpturation of the abdomen very reduced ; thorax with strong metallic blue reflections ; female without a small spot of pollen on each side of the anterior ocellus ; Sokotra. .....azurea Hull

8 (7). Mesonotal stripes complete in the male, complete though narrowed at the posterior ends in the female ; sculpturation of abdomen well developed ; thorax

without very strong reflections ; females with a small, diagonal spot of pollen on each side of the anterior ocellus.....*azurea* sub.sp. *scrupeus* sub.sp.n.

KEY TO THE ORIENTAL SPECIES

1 (2). A transverse band of black across nearly the whole of the first abdominal segment in both sexes ; abdomen of male (figs. 27,28) truncated, each posterior corner prominent, protruding and rounded ; the female with very deep, narrow, transverse troughs on the third and fourth abdominal segments.....*yerburiensis* sp.n.

2 (1). Neither sex with a transverse band of black across most of the first abdominal segment ; abdomen of male not truncated, without prominent posterior corners ; the females without very deep and narrow troughs on the third and fourth abdominal segments.

3 (4). Large species (7.3 - 9.0 mm.) ; antennae longer than the distance between their base and the upper margin of the oral tubercle ; posterior femora with very little or no dark brown ; abdomen of females greatly distended.. .....*auritus* sp.n.

4 (3). Smaller species (5.1 - 6.8 mm.) ; antennae as long as the distance between their base and the upper margin of the oral tubercle ; posterior femora banded with dark brown ; abdomen of females normal.

5 (6). Wings usually suffused with yellow-brown ; posterior femora almost entirely dark brown ; mesonotal pile longish ; many conspicuous, reclinate, black hairs on the abdomen.....crenulatus Thomson

6 (5). Wings hyaline, never suffused with yellow brown ; posterior femora with a narrow band of darkish brown ; mesonotal pile short ; black hairs on the abdomen sparse and very inconspicuous.....serratus (Fabr.)

KEY TO THE AFRICAN SPECIES BASED ON GENITALIC CHARACTERS

1 (4). Penis sheath with a prominent, median, ventral process.

2 (3). Styles foliaceous, ending in points ; epandrium not very elongated ; superior claspers borne on rounded lobes ; ejaculatory apodeme much smaller than the hypopygium (figs. 7-8).....pusillus sp.n.

3 (2). Styles with subparallel margins, not ending in points but bluntly rounded ; epandrium elongated ; superior claspers borne on small pointed processes ; ejaculatory apodeme as large as the hypopygium (figs. 3-4).....
.....capricorni sp.n.

4 (1). Penis sheath completely lacking a median ventral process.

5 (6). Superior claspers borne on long, narrow, protruding processes ; epandrium without a swelling on each side near the anterior corners (figs. 30-31)....auritus sp.n.

6 (5). Superior claspers borne on moderately broad, bluntly rounded processes ; epandrium with a swelling on each side near the posterior corners (fig. 13).....*azurea* Hull

KEY TO THE ORIENTAL SPECIES BASED ON GENITALIC CHARACTERS

1 (6). Penis sheath with a median, ventral process, which may sometimes be rather weak.

2 (3). Superior claspers borne on long, thin, pointed processes ; inferior claspers enormously developed, as long as the epandrium, which is elongated (fig. 26)...*yerburiensis* sp.n.

3 (2). Superior claspers borne on broad rounded lobes ; inferior claspers not enormously developed ; epandrium not elongated.

4 (5). Styles distinctly narrowed in the middle (figs. 21-22).. .....*serratus* (Fabr.)

5 (4). Styles not narrowed in the middle (figs. 17-18)..... .....*crenulatus* Thomson

6 (1). Penis sheath completely lacking a median, ventral process ; superior claspers borne on long, narrow, protruding processes.....*auritus* sp.n.

TAXONOMY

Paragus capricorni sp.n.

A species with an almost entirely reddish-brown abdomen. The thorax is dull black, generally lacks coloured reflections, and is quite heavily punctate. The antennae are short, and the femora are reddish-brown without bands of darker colour. The epandrium is elongated, and there is a large, median, finger-like projection on the ventral surface of the penis sheath. The ejaculatory apodeme is very large.

Male.

Head. Face yellow, evenly covered with distinct punctures, and with a sparse, silvery-white facial pile ; a narrow, median stripe is present, extending from the oral margin almost to the base of the antennae, conspicuously ligneous brown over the facial tubercle and almost colourless on its upper third. The oral tubercle is piceous, and is surrounded by a strip of dark brown. The two basal segments of the antennae are leather brown, the first slightly paler than the second ; the third segment is dull crineous, paler on its lower half, and twice as long as the first two segments together. Vertex black, with pale violaceous reflections. The stripes of hair on the eyes are moderately distinct, and each outer stripe is broadly interrupted in the middle. Thorax. The mesonotum is dull black with colourless reflections, appearing to be the colour of

pencil lead in some positions ; it is irregularly and conspicu--ously punctate. The mesonotal pile is short,erect and yellow. The dorsal stripes are pale ; they just meet at the anterior margin of the prescutum, and diverge posteriorly, each becoming narrower and ending almost in a point at the posterior margin of the scutum. The scutellum is fuscous on the basal half, slightly paler medially, and with the apical half of the same yellow as the face. There are fourteen yellowish-brown, prominent scutellar teeth, each tipped with brown. Laterally the scutellum bears a few longish, silvery-white hairs. Legs. All the femora are reddish-brown, almost dark amber, and transluscent. The apical sixth of each femur and the basal half of each tibia is pale yellow. The tarsi are ferruginous. Wings. The wings are hyaline, with a glossy membrane. The stigma is yellow, slightly tinged with brown ; the subcosta, humeral cross-vein, basal and apical parts of the first longitudinal vein are testaceous ; the remainder of the veins are very dark brown. Abdomen (fig.5). This is a distinctive reddish-brown, almost ferruginous, and is a little dark on the apical segments ; the corners and knob-like protuberances of the first segment are fusco-piceous. The third and fourth segments are distinctly carinate, with somewhat flattened sides. The abdomen is subtruncated apically, with abruptly rounded corners ; its margins diverge, each curving only slightly, then curving rapidly into prominent shoulders ; the greatest width

is across the middle of the first segment. The three pairs of ~~of~~ white vittae are distinct, and do not meet in the median line ; the transverse furrows on the third and fourth segments are narrow and moderately deep. The surface of the second, third, fourth, and to a lesser extent the fifth segments are quite heavily sculptured, and have numerous small, inconspicuous, reclinate, black hairs. The first tergite is smoother but is quite heavily punctate. There are short, white hairs present on all the segments, most noticeably on the fifth where they are quite long ; elsewhere they are reclinate, sparse and inconspicuous. Male Genitalia (fig.3). The epandrium is elongated and rectangular, with its dorsal posterior corner broadly rounded ; it is about twice as long as deep. The cerci are inconspicuous. Seen dorsally the epandrium is as broad as long, with protuberances at each apical corner. The styles have almost parallel margins, with the apex curved slightly forward and bluntly rounded ; each style is about as long as the epandrium is deep. The inferior claspers are moderately developed ; they are drawn dorsally into projecting points, and ventrally they are flattened and truncated ; they are a little shorter than the styles. The superior claspers are borne on bluntly pointed processes of the penis-sheath. The penis-sheath bears a ventral, median, finger-like projection that curves gently forward and which is about three-quarters as long as the inferior claspers. The ejaculatory apodeme (fig.4)

is very large, as large as the hypopygium ; it is shaped like an open umbrella, with a broad flattened handle that is abruptly narrowed at its end ; the "umbrella" portion is about as deep as one-half of the length of the handle, and it is ellipsoidal in shape - its greatest width is approximately equal to the length of the handle.

Length 7.2 mm.

Holotype : Male, in the National Museum of Southern Rhodesia, Bulawayo ; Southern Rhodesia, Sawmills, 26.xii.1919

Insert figs. 3-6 here

Female.

The vestiture is better developed than in the holotype, the white hairs on the abdomen and the stripes on the eyes being more conspicuous. The front is black with bluish reflections, and is bordered by two strips of silvery-white tomentum which broaden at their upper ands. The mesonotum in some positions shows faint blue reflections. There are thirteen scutellar teeth. The abdomen (fig. 6) is darker, the fourth segment entirely fusco-piceous behind the median vittae ; the area between the first two pairs of vittae is blackish laterally with faint blue reflections, and reddish-brown in the centre ; the anterior corners of the third segment and the sides of the second segment are dark, also with faint blue reflections ; The shoulders are pale ; the remainder of the abdomen is

Fig. 3

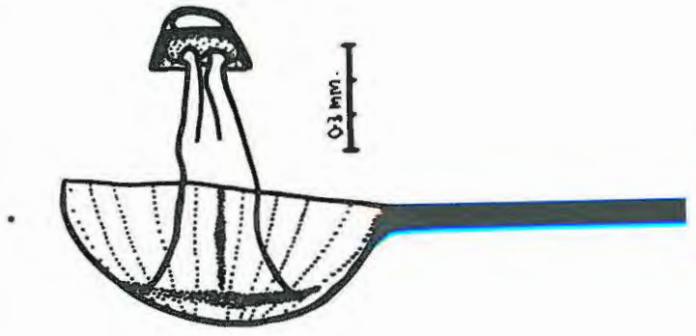

Fig. 4

Fig. 5

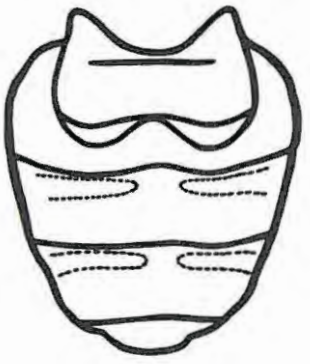

Fig. 6

Figs. 3-6.- Paragus capricorni sp.n.; (3) hypopygiu
holotype; (4) ejaculatory apodeme; (5)
of holotype; (6) abdomen of allotype.

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Figs. 3-6.- Paragus capricorni sp.n.; (3) hypopygium of holotype; (4) ejaculatory apodeme; (5) abdomen of holotype; (6) abdomen of allotype.

reddish-brown. The abdomen is stouter, deeper and less obviously carinate than that of the holotype, with the terga rounded in cross-section and the margins more curved. The fourth sternite is fusco-piceous and the fifth is reddish-brown suffused with black.

Length 7.2 mm.

Allotype : Female, in the collection of the Department of Agriculture of Southern Rhodesia, Salisbury, (no. 6626) ; Southern Rhodesia, Sabi River, iii.1939.

Paratypes :

South West Africa, Kaoko Otavi, iii.1926,1♂, Ombombo, ii.1926, 1♀, in the South African Museum, Cape Town.

Belgian Congo, Elisabethville, 5.iv.1912,1♂, (Dr. Bequaert), in the Musee du Congo Belge, Tervuren, Belgium.

Uganda, Karamoja Province, Lobwor Hills, Aremo, iv.1951,1♂, (T.H.E.Jackson), in the Coryndon Museum, Nairobi.

Southern Rhodesia, Sawmills, 1.iv.1923,1♂, 25.xii.1925,1♀, 27.xii.1920,1♀, in the National Museum of Southern Rhodesia.

Zululand, M'fongosi, iii.-iv.1935,1♀,2♂♂, (W.E.Jones), in the South African Museum, Cape Town.

South Africa, Pretoria, 30.i.1915,1♂, Barberton, 9.x.1919,1♀, P. (Premier ?) Mine, 11.iv.1914,1♀, (H.K.Munro), in the South African National Insect Collection, Department of Entomology, Pretoria. Komati Poort, xi.1918,1♂, (R.W.Tucker), in the South African Museum.

The male from Aremo, Uganda, is of exceptional interest as its abdomen is entirely dull black ; its antennae are almost black ; the sides of the mesonotum have green and cupreous reflections, the pile is brassy, the face is dusky yellow, and the median vitta is very dark and conspicuous. The specimen from Pretoria has amber legs and slight blue-green reflections on the thorax. The abdomen of the male from Elisabethville has a colouration like that of the allotype, except that the sides of the second segment are testaceous. The number of scutellar teeth varies from thirteen to fifteen. The genitalia of each male paratype has been examined and no variation has been noticed. The female from Premier Mine, South Africa, has a distinctly orange abdomen which is broader than that of the allotype and has the fourth and fifth sternites yellowish brown - the legs are amber. Shortest paratype 5.4mm., Longest paratype 7.8 mm..

Remarks.- This species is easily distinguished from the other African species by the shape and colour of the abdomen. The females may resemble those of P. azurea sub.sp. scrupeus, but differ in that they lack the spots of tomentum before the anterior ocellus. The name was suggested by the distribution of the specimens before me, which are grouped approximately across the Tropic of Capricorn. The male paratype from Elisabethville is the one mentioned by Hervé-Bazin (1914) - the female which he records is probably also of this species.

Paragus pusillus sp.n.

A narrow, dark species with very short mesonotal pile. The vertex of the male is closed behind by two posteriorly converging strips of tomentum. The femora are testaceous and lack bands of darker colour. The abdomen is very dark, except for a patch of lighter colour over the second and third segments. The females have a small, oval, diagonal spot of pollen on each side of the anterior ocellus. The styles are foliaceous and there is a prominent, median, finger-like process on the ventral surface of the penis-sheath. The ejaculatory apodeme is smaller than the hypopygium.

Male.

Head. Face creamy-yellow, with indistinct punctures and a sparse short, silvery-white pile ; the facial stripe extends upwards to the base of the antennae, and is almost colourless except over the facial tubercle where it is pale brown. The oral tubercle is piceous and is surrounded by a strip of light brown. The antennae are shorter than the face ; the first segment is badius ; the second is similar but dark above ; the third segment is crineous, becoming brownish below, and is twice as long as the first two together. The vertex is black with an admixture of brown, showing pale blue and cupreous reflections ; it is bordered posteriorly by two small arms of silvery tomentum which converge at the edge of the occiput and extend anteriorly, ending at the sides of the vertex just past

the upper corners of the compound eyes. The stripes of hair on the eyes are indistinct, the outer on each eye being almost absent and the inner two intermingling. Thorax. Mesonotum shining black with metallic blue and grey, and some slight cupreous reflections ; it is conspicuously punctate. The mesonotal pile is very short and scanty - it is bombycinous. The stripes on the mesonotum are moderately heavy, more so than in P. capricorni ; they converge anteriorly for a short distance, and do not end in sharp points posteriorly. The pile on the posterior humeri is slightly longer and paler. The scutellum is creamy on the apical third, colourless on the middle third, and basally black with a strong admixture of brown. There are fourteen long, yellow scutellar teeth. Legs. The femora are testaceous basally, creamy-yellow on the apical fifth. The posterior tibiae are creamy-yellow basally, distally ferrugino-testaceous like the posterior tarsi. The two anterior pairs of tibiae are creamy-yellow on the basal half, testaceous distally. The two anterior pairs of tarsi are testaceous, paler than the femora. Wings. Hyaline, with a yellow stigma that is slightly tinged with brown. The apex of the subcosta is pale, almost the same colour as the stigma. The remainder of the veins are ligneous brown, not as heavy as in capricorni.

Insert figs. 7-8 here.

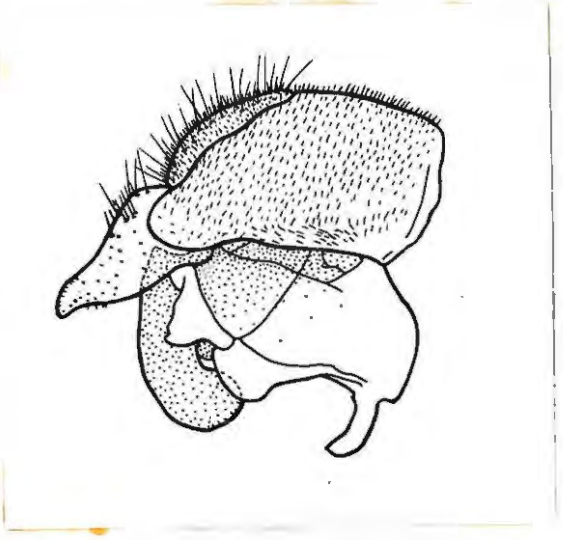

Fig. 7

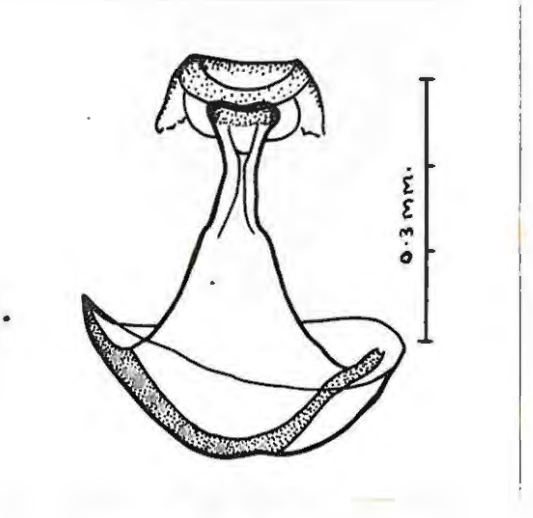

Fig. 8

Figs. 7-8.- Paragus pusillus sp.n.; (7) hypopygium of holotype; (8) ejaculatory apodeme.

Abdomen. The abdomen (fig. 9) of this species is very different ~~to~~ From that of P. capricorni. It is very dark, especially on the first and last two segments. The first segment is almost entirely fusco-piceous except for a small, median, testaceous patch on its posterior margin. The second segment is reddish in the centre, pale amber laterally, then slightly reddish--brown - the margins and shoulders are fusco-piceous with pale blue reflections. The third segment is dark reddish-brown with a darker median area, and becoming very dark on the sides. The fourth segment is entirely fusco-piceous, the fifth similar except that it is margined with reddish-brown. The anterior vittae are distinct, though not clearly defined against the pale colour of the second segment ; the middle and posterior pairs are distinct, and each pair almost meets in the mid-line. The third and fourth segments are distinctly carinate ; their sides are more rounded than in P. capricorni. The abdomen is not robust, and it is narrow, with hardly prominent shoulders and the margins nearly parallel ; its apex is rounded. The transverse troughs in which the vittae of the third and fourth segments lie are large and deep, especially the anterior pair. The tergites are distinctly sculptured, including the first segment ; in addition there are numerous deep, round punctures evenly distributed over all of the tergites. There is a thin covering of short, very inconspicuous, reclinate black hairs, and longer, sparse, thin, white hairs, erect on the first segment and reclinate elsewhere.

Genitalia. (fig. 7). The epandrium is rectangular, with the posterior margin inclined at an angle to the lower margin. The ratio of upper to lower margins is 5 : 8. The epandrium is about as deep as the length of the upper margin ; its lower, posterior corner is broadly rounded and produced. The cerci are long, flattened and moderately prominent. The styles are foliaceous when seen from the side, with the upper and lower margins sinuate, the upper more so than the lower, both coming together at an acute angle and ending in a somewhat deflexed point. The inferior claspers are well developed ; they extend ventrally into rounded lobes that project below the level of the penis sheath and bend cephalad a little ; dorsally they are truncated at about the level of the lower margin of the epandrium, with the dorsal edge concave and meeting the outer margin in a point ; each is about as long as the epandrium is deep. The superior claspers are borne on broad lobes with straightened edges. Ventrally the penis-sheath bears a finger-like projection that has a slightly concave inner surface, and which is about half as long as an inferior clasper. The ejaculatory apodeme is missing in the preparation.

Length 6.2 mm.

Holotype : Male, in the National Museum of Southern Rhodesia, ~~Salisbury~~ Bulawayo ; Southern Rhodesia, Sawmills, 23.x.1922.

Insert figs. 9-12 here.

Fig. 9

Fig. 10

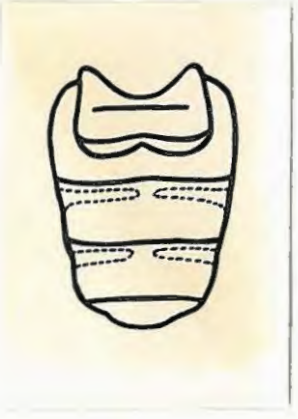

Fig. 11

Fig. 12

Figs. 9-12.- Paragus pusillus sp.n.; (9) abdomen of holo-type; (10) abdomen of allotype; (11,12) abdomens of a small male and a small female from South West Africa.

Female

The facial stripe is as broad as the facial tubercle, and is light ligneous brown. The tomentose strips on the front are linear and uniformly wide, and each bears a short, beak-like, incurved hook of tomentum at the upper end. There is also a small, oval, diagonal spot of pollen on each side of the anterior ocellus. The front is black, with some metallic reflections. The stripes of hair on the eyes are distinct. The apical half of the scutellum is creamy yellow, and there are fourteen scutellar teeth. The abdomen is like that of the holotype, but darker ; it is entirely piceous behind the first pair of vittae and has a very dark fusiform patch in the centre of the second tergite. The abdomen (fig. 10) is rounded in cross-section and slightly carinate. Its shape is similar to that of the abdomen of the holotype, but the margins are very gently curved from the shoulders to the apex. The fourth and fifth sternites are shining black.

Length 6.4 mm.

Allotype : Female, in the South African Museum, Cape Town ; South West Africa, Zesfontein, ii.1925.

Paratypes :

South West Africa, Kaross, 1♂, 1♀ , Zesfontein, 1♂, 2♀♀ , Warmbad, 5♀♀, ii.1925, in the South African Museum, Cape Town.

The males are like the holotype, except that they are smaller and darker, the thorax of each specimen with only slightly coloured reflections. Each has only ten scutellar teeth and the yellow of the scutellum occupies the apical half. Their genitalia differ from the paratype's in having the styles with only slightly sinuate margins. The ejaculatory apodeme (fig. 8) from one paratype is very different ~~to~~ from that of P. capricorni. It is much smaller than the hypopygium, and consists of a stem-like portion which bears a hood. The stem is very broadly flattened at its junction with the hood, expanding laterally into short, flattened flanges, and then tapering off quite slowly for a distance about equal to the greatest width of the hood - at this point it constricts slightly and then becomes cylindrical for a short length, finally dilating into a funnel-shaped apex. The hood is ellipsoidal, slightly distorted, and concave - dorsally it is furrowed over its greatest width along the line of attachment of the stem.

Of the female paratypes, two (Warmbad) are of the same size as the allotype, the rest smaller. They all have the coloured reflections of the thorax very poorly developed. The number of scutellar teeth varies from nine to fourteen. All appear to be almost completely black except for the lighter colouring on the second abdominal segment, and some have very reddish legs. Shortest paratype 4.6 mm., longest paratype 6.8 mm.

Remarks.- This species is distinguished by its small size, generally dark colouration and narrow body. It is easily separated from P. capricorni by the characters given in the key above, and from the other African species by its very short mesonotal pile. It appears to be most closely related to P. serratus (Fabricius). The dark colouration of the specimens from South West Africa may be due to development under the semi-arid conditions usually prevailing there.

Paragus azurea Hull 1949

This species was established by Hull on a female taken at Sokotra by W.R.O.Grant. The male in the same collection was apparently overlooked, although its capture was recorded by Ricardo (1903 : 368), who also noted the bright metallic reflections of the thorax, the abbreviated condition of the mesonotal stripes in the male, and the absence of mesonotal stripes in the female. Grant added a note to the effect that the species was apparently scarce on the island.

A species with very long mesonotal pile and bright metallic reflections on the thorax. The mesonotal stripes are absent in the female, reduced in the male. The femora are banded with brown. The abdomen lacks sculpturation. There is a protuberance on each side of the epandrium near the lower, anterior corners.

Male

Head. The face is yellow, a little creamy, with a quite heavy, silvery-white pile and a few small punctures. The facial stripe is dark ligneous brown, its upper fifth thin and nearly colourless. The oral tubercle is piceous, and is surrounded by a strip of black which merges on each side with the black border of the oral margins. The basal segment of the antennae is brunneus ; the second segment is the darkest, being fuscous dorsally and with a small spot of dark reddish-brown below ; the third segment is light crineous, darker dorsally, lighter on the inner and ventral surfaces - it is rather elongated and cylindrical, and is just over two-and-a-half times as long as the first two segments together. The vertex is fusco-piceous with pale violaceous reflections. The outer two stripes of hair on each eye are distinct - the inner stripe is twice as broad as any of the others are, and is less sharply defined.

Thorax. The mesonotum is shining black with strong blue reflections, and a few violaceous reflections on the sides. There are a pair of pale, abbreviated dorsal stripes - these do not meet anteriorly and end posteriorly just past the transverse suture. The mesonotal pile is long, erect and white. The punctures on the mesonotum are small and widely separated. The basal third of the scutellum is fusco-piceous, the rest is yellow ; these two colours are separated by a narrow, indefinite line of pale brown. There are nineteen

scutellar teeth of unequal length - those in the middle are only half the length of those on the outside ; each is tipped with brown. Legs. The posterior femora are dark brown in the centre ; the basal quarter is dark testaceous and the apical fifth is creamy-yellow. The posterior tibiae are creamy for a little more than the basal third, the remainder tawny with a narrow, dark, median band. The posterior metatarsi are fusco-testaceous but suffused with dark brown, the following segments similar but lighter, the last pale testaceous. The two anterior pairs of femora are reddish-brown, with the distal third creamy-yellow. The two anterior pairs of tibiae are creamy-yellow for a little more than the basal half, pale testaceous elsewhere. The two anterior pairs of tarsi are pale testaceous. Wings. Hyaline, with a slightly clouded, yellow stigma. The subcosta is yellowish-brown, its apex a little paler. The rest of the veins are ligneous brown, darker and a little heavier than in P. pusillus but not as dark or as heavy as in capricorni. Abdomen (fig. 15). The abdomen resembles that of pusillus. The sides and knob-like protuberances of the first segment, and the shoulders and margins of the second segment are all piceous with dull blue reflections - this dark colour proceeds more narrowly down the entire margin of the second segment to end at the apical corners. Both the first and second segments are broadly translucent yellowish-brown over the middle. The area

between the first two pairs of vittae is irregularly dark reddish-brown and fuscous. Behind the last pair of vittae the abdomen is fusco-piceous except for an irregular reddish-brown, translucent patch which occupies about half of the fifth segment and extends a little onto the posterior part of the fourth segment. The abdomen is not carinate ; is it angular, as if a little pinched, between the vittae of the third segment. There is only a trace of a vitta on the fifth segment ; the anterior vittae lie in shallow troughs that broaden very considerably laterally, and they are somewhat indistinct against the pale colour of the second segment. The middle pair of vittae lie in very shallow and narrow troughs that do not widen laterally. The abdomen differs from that of P. capricorni and pusillus in the complete lack of sculpturation - the tergites are smooth except for numerous deep, round, widely separated punctures. Short reclinate black hairs and some longer white hairs are present on the first segment, absent on the following two, and present on the fifth segment and posterior margin of the fourth. Genitalia. (Figs.13) The epandrium is rectangular, a little

Insert figs. 13-16 here.

longer than deep - near the lower, anterior margin it is swollen into an anteriorly-directed protuberance which is better developed on the right side than on the left. The cerci are rounded and prominent. The styles are flattened, with almost

Fig. 13

Fig. 14

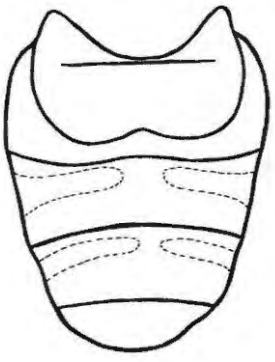

Fig. 15

Fig. 16

Figs. 13-16.- (13) Hypopygium of allotype of Paragus azurea Hull; (14) ejaculatory apodeme of male of scrupeus subsp.n. from Mozambique; (15) abdomen of allotype of P. azurea; (16) abdomen of allotype of scrupeus.

parallel margins, the upper margin sinuous, the lower slightly so - each style is truncated apically and has the upper distal corner produced. The inferior claspers are moderately developed, rather ear-like with a slight ventral lobe, a somewhat pointed dorsal lobe, and a base nearly as broad as the whole. The superior claspers are borne on broad lobes which have irregular margins. The penis-sheath is broadly rounded below, with a slight transverse groove, and it lacks entirely the finger-like projection found in P. capricorni and pusillus. The ejaculatory apodeme is missing in the preparation.

Length 7.4 mm.

Allotype : Male, in the British Museum ; Sokotra, Hadibu Plains, 13.ii.1899, (W.R.O. Grant) ; B.M. 1916-75.

Remarks.- A very distinctive species on account of its long mesonotal pile, bright mesonotal reflections, and modified condition of the mesonotal stripes in both sexes. It is represented in Africa by the following subspecies which seems to extend from Aden down the east coast as far south as Mozambique. The isolation of the typical form has probably accounted for its divergence from the continental stock.

Paragus azurea Hull, sub.sp. scrupeus sub.sp.n.

This subspecies differs from the typical form in having well developed sculpturation on the abdomen. The mesonotal stripes are complete in the male, almost complete in the female.

The mesonotal pile is a little shorter, and the coloured reflections of the thorax are not as bright. The female has a small, diagonal spot of pollen on each side of the anterior ocellus.

Male

Head. The face is a darker yellow, with the oral tubercle piceous but surrounded by a fusco-piceous band. The antennae differ in that the second segment is only slightly dark above, and the third segment is yellowish-brown on its lower half. The stripes of hair on the eyes are all of equal width. Thorax. The mesonotum is a duller black, with some blue and violaceous reflections. The mesonotal pile is shorter, but longer than that of P. capricorni and much longer than that of pusillus - it is bombycinous. The mesonotal stripes are conspicuous and white, and extend to the base of the scutellum - they are quite narrow and taper only slightly, not ending in sharp points. There are twelve subequal scutellar teeth, moderately long and each tipped with dark brown. Legs. The posterior femora are less extensively brown - they are yellowish-testaceous on the basal half, creamy-yellow on the apical sixth and with a brown band between. The basal third of each posterior tibia is creamy-yellow, tawny on the remaining two-thirds. The posterior tarsi are tawny. The two anterior pairs of femora are yellowish-testaceous on the basal two-thirds, a little lighter than on the posterior pair, and creamy-yellow on the rest. The two pairs

of remaining tibiae are creamy-yellow on the basal half and, with their tarsi, are the same colour as the femora elsewhere. Wings. The stigma is pale, clear yellow, and the veins are a light brown - the subcosta and apical part of the first longitudinal vein are yellowish-brown. Abdomen. The abdomen is broader than in the allotype of P. azurea, and the shoulders are more prominent - it has flattened sides and is triangular in cross-section, differing in this respect FROM ~~to~~ P. capricorni and pusillus which have distinctly rounded sides. The third and fourth segments are distinctly carinate. The sculpturation lacking in the allotype is strongly developed on all of the segments. The transverse troughs on the third segment are not quite as deep or as wide. The abdomen is brown, transluscent, a little darker and reddish in places. The sides of the second segment are narrowly fusco-piceous, this dark colour continuing onto the apical corners of the first segment. Genitalia. The hypopygium is similar to that of the allotype of P. azurea described above, including the presence of the protuberances on each side of the epandrium, but differs in some characters. The lower edge of the epandrium is a little arched, instead of being straight. The styles are more produced apically, and are almost straight below, but with a deeply sinuous upper margin. The base of the penis-sheath has a distinct transverse furrow. The ejaculatory apodeme (fig. 14) is larger than the hypopygium. It is made up two parts, an

umbrella-like hood and a handle. The handle is flat, expanded into wide lateral flanges along its basal attachment to the umbrella - it is slightly constricted apically and ends in a rounded knob. The umbrella is ellipsoidal and concave, with a furrow along the line of attachment to the handle, and it is only half as deep as that of P. capricorni.

Length 7.2 mm.

Holotype : Male, in the British Museum ; Arabia, Aden, 28.ii.1895, (Lt.Col. C.G.Nurse), B.M. 1934-8.

Female

The single female before me differs from the holotype of P. azurea in many features. The lower half of the front is reddish-brown, lighter just above the base of the antennae - this light patch is bordered on each side by a strip of tomentum which widens dorsally and which is enlarged inwards at the upper end, the enlargement of each side not touching the other but separated narrowly. The dorsal part of the frons is bluish-black. On each side of the anterior ocellus there is a small, oval, diagonal spot of pollen. Thorax black, with cyanescent and violaceous reflections. The mesonotal pile is moderately long. The mesonotal stripes are silvery-grey - they just meet anteriorly, and narrow very abruptly posteriorly midway between the transverse suture and the scutellum, continuing to the margin of the scutellum as faint, broken, greyish lines. The posterior femora are translucent and testaceous except for the apical

seventh which is pale yellow. The wing veins are light brown and thin. The scutellum is fusco-piceous with a strong admixture of brown on the basal half, yellow on the rest. There are fourteen scutellar teeth which are conspicuously tipped with red-brown. The abdomen (fig. 6) is very strongly carinate, deep and bowl-like - it is very broad and enlarged. The sides curve strongly backwards from the prominent shoulders. The whole abdomen, including the shoulders, is dark red-brown - there are some fusco-piceous patches on most of the segments, which are apparently due to consolidation of the contents of the abdomen and their adherance to the tergites. There is a well developed sculpturation on the posterior four segments - the first segment is coarsely punctate. The transverse troughs on the third segment are narrow and quite deep, and the outer end of each curves backwards. The troughs on the fourth segment are likewise narrow and quite deep, but are linear. The vittae are white and prominent. The fourth and fifth sternites are brown, irregularly marked with black.

Length 7.2 mm.

Allotype : Female, in the National Museum of Southern Rhodesia, Bulawayo ; Southern Rhodesia, Sawmills, 25.xii.1925.

Paratypes :

Arabia, Aden, 5.iii.1895,1♂, (Lt.Col. C.G.Nurse), in the British Museum, B.M. 1934-8.

Zanzibar, nr. Mazi Moja, 20.viii.1924,4♂♂, (H.J.Snell), in the British Museum.

Portugese East Africa, Masiene, xii.1924,1♂, (R.F.Lawrence), in the South African National Insect Collection, Department of Entomology, Pretoria. Delagoa Bay, Inhaca Island, 29.iv.1953, 2♂♂, (E.Giddy).

The male from Aden has very heavy, silvery-white mesonotal stripes. The specimens from Zanzibar have the thorax more intensely black, with very dark blue reflections - two of the specimens have a creamy-yellow face, the other two are typical but have a very dark and conspicuous facial stripe. There is considerable variation in the colour of the abdomen, one specimen from Zanzibar being entirely fusco-piceous behind the first pair of vittae and over most of the first segment - the same specimen has has pale antennae, the third segment being yellowish-brown. The male from Masiene has a very broad abdomen, shorter than in the other specimens, and which is dark fusco-piceous on the sides of the first three segments and entirely so on the fourth and fifth segments, translucent reddish -brown elsewhere. The genitalia of each male paratype has been examined and all are similar to that of the allotype of P. azurea - in each case the lower edge of the epandrium is straight, the condition found in the ~~a~~no allotype of scrupeus apparently being unusual. The number of scutellar teeth varies from eleven to fourteen. Shortest paratype 5.4 mm., longest paratype 7.8 mm.

Remarks.- Specimens from the more southern part of the range of this subspecies may possibly be confused with P. capricorni as they tend to be darker than those from the north and have slightly shorter mesonotal pile. The males may be distinguished by the genitalia and by the longer antennae, while the females have a spot of pollen on each side of the anterior ocellus. The nine specimens taken at Aden by Yerbury (Verrall : 1898) probably belong to this subspecies. The specimens from Eritrea determined by Speiser (1911) as P. serratus almost certainly belong here, probably also the specimens from Egypt referred to by Efflatoun Bey (1926), and those from Lourenço Marques recorded by Curran (1938).

Paragus crenulatus Thomson 1868

This species was erected by Thomson on material from unspecified localities in China. From his description it would seem to differ from P. serratus as then understood in having extensively dark femora, longish antennae, the mesonotal stripes narrowed behind, and the wings yellowish at the base.

I have specimens before me from the following localities :-
Sarawak, foot of Mt. Dulit at Junction of rivers Tinjar and Lejok, 22.viii.1932, 11.x.1932, 3♂♂, 1♀, (B.M.Hobby, A.W.Moore), B.M. 1933-254.
Hong Kong, Hong Kong Peak, 22-24.ix.1937, 1300-1600 ft., University Grounds, 1-10.xii.1937, 2♂♂, 4♀♀, (Miss Hurford), B.M. 1938-426.

Java, Pekalongan, iv.1907,1♂, C.H. Curran Collection, Acc. 31144. Dutch New Guinea, Cyclops Mts., Sabron, 930 ft., iv.1936,1♀, (L.E. Cheeseman), B.M. 1936-271.
Ceylon, Colombo, 14.vi.1891,1♂, (Lt.Col. Yerbury), B.M. 1892-192. Celebes, Molino, 4000 ft., i.1936,1♀, L.E. Cheeseman), B.M. 1936-271. India, Calcutta, xi.1908,1♂, 20.xii.1908,2♂♂, ex coll. Brunetti, B.M. 1927-184.
Malaya, Serdang, 17.xii.1923,1♀, (G.H. Corbett, B.A.R. Gater), B.M. 1924-436. Singapore, 23.v.1911,1♀, (R. Hamitsch), B.M. 1936 - 173. Selangor, Kuala Lampur, 12.xi.1924,1♀, (H.M. Pendlebury), B.M. 1926-56.
Siam, Bangkok, 19.vi.1929,1♂,1♀, (W.R.S. Ladell), B.M. 1930-215. All except the male from Java are in the British Museum.

This is one of the most widely distributed species of the complex. It ranges over the whole of the Oriental Region and Austro-Malayan Subregion. The species which Fred Keiser (1952) recorded from Sumba, Sumbawa, Flores and Timor as P. serratus, and which he notes to occur also in the Philippine Islands, Formosa and China, is almost certainly P. crenulatus. It is probably the species which occurs in Australia.

There is considerable variation within the species. Each of the larger islands has a slightly different form, and there are small differences between specimens from Malaya, Siam, India and Hong Kong. P. crenulatus could probably be devided into several subspecies - I lack sufficient material to attempt this.

The following description is based on the specimens from Hong Kong.

Males

Head. Thomson states that the face of P. crenulatus is whitish - one of the males which I have has a flavescent face, translucent, and in some positions with very pale blue reflections - the other male has a yellow face. The facial pile is thin. The median stripe is restricted in one specimen to the oral tubercle, in the other it reaches half-way to the antennae - it is pale brown in both. The oral tubercle is conspicuously black, and is surrounded by a dark brown strip. The two basal segments are very dark brown, almost piceous above. The third segment is paler - it is subcylindrical and is a little more than twice as long as the first two segments together. The vertex is entirely black with violaceous reflections. The two middle stripes of hair on each eye tend to merge, but the outermost is distinct, though narrow.

Thorax. The mesonotum is black, with quite strong violaceous reflections and a few faint blue reflections. The mesonotal pile is quite long, erect, and shining yellow - it is pale yellow on the anterior humeri and shining brassy-yellow behind the attachment of the wings. The mesonotal stripes are pale, rather purplish when seen from above - when viewed obliquely they are brassy-yellow. The stripes unite in front - they are almost uniformly wide as far back as midway between the transverse suture and the scutellum, and then they narrow rapidly, almost ending in points. The basal third of the scutellum is piceous, the

remainder is yellowish. One male has eleven, the other twelve pale, subequal scutellar teeth (Thomson mentions twelve teeth). The scutellar pile is decidedly longer than that of the rest of the mesonotum. Legs. The posterior femora are testaceous on the basal seventh, yellow on the apical quarter, the rest conspicuously dark brown. The posterior tibiae are yellow on the basal half, then banded with dark brown, and with the apical fifth tawny with a grey sheen. The posterior metatarsi are dark crineous, the rest of the tarsal segments similar but more yellow. The two anterior pairs of femora are yellow on the apical half, luteous on the basal half. The two anterior pairs of tibiae are yellow on the basal half, testaceous on the rest - the two anterior pairs of tarsi are reddish-brown. Wings. The membrane is suffused with yellowish-brown on the basal half, becoming paler apically. The microtrichia on the membrane are very dark and conspicuous, and the wing is bordered posteriorly by a line which is darker than in the other species. The stigma is yellowish-brown, distinctly darker than the subcostal cell. The veins are heavy and very dark, almost piceous. Abdomen. This is broad and rather flattened - it is subcarinate. Over the second segment it is triangular in cross-section, less so over the succeeding segments. The shoulders are prominent, and the sides curve gradually backwards, forming sharply rounded corners behind. The shoulders are dark fusco-piceous, with some violaceous reflections - this dark colour extends down the margin to the apex of the second

segment, from whence it extends diagonally across the segment to the posterior margin of the first segment. The anterior corners and knob-like protuberances of the first segment are fusco-piceous. The remainder of the abdomen is brownish-amber, a little reddish behind. There are prominent, reclinate, black hairs arising from distinct punctures on the second, third, and to a lesser extent the fourth segment. White hairs are present on the first segment where they are thin and erect - they are better developed and reclinate on the fourth segment, and very well developed on the fifth segment. The transverse troughs of the third segment are well developed, rather deep, with flattened sides. The troughs on the fourth segment are very shallow and inconspicuous. The vittae which normally occupy these troughs are almost absent in one specimen, sparingly developed in the other. Sculpturation is present on the second to fifth segments. Genitalia (fig. 17). The epandrium is not very elongated, and its lower posterior corner is bluntly rounded. The cerci are rounded and prominent. Each style consists of an enlarged base and a narrow, elongated apical portion which ends in a point and has sinuous upper and lower margins. The inferior claspers are produced above into a moderately curved lobe which has a truncated end - ventrally they are produced into small, anteriorly directed lobes. The superior claspers are borne on well developed, broadly rounded processes. There is a thin ventral projection on the penis-

sheath.

Insert figs. 17-20 here.

Females

The colour of the face is variable, being either flavescent, very smoky, translucent yellow, or almost yellow-green. The front is black with some bluish reflections - it is bordered by narrow, linear strips of tomentum that expand at the upper end into a small, inwardly directed, triangular patch. The vertex is black with violaceous reflections between the ocelli and cyanescent reflections on the side and behind. The number of scutellar teeth varies from eleven to thirteen. The colouration of the abdomen (fig. 20) is considerably different from that of the males described above, and is practically the same in each female. The first segment, including the knob-like protuberances, is black before the transverse ridge. The second segment is wholly black on the sides, this dark colour extending diagonally across to the posterior margin of the first segment. The remainder of the first and second segments, and the narrow anterior margin of the third segment are brownish-amber. In the middle of the second segment there is a small, black triangular patch whose arms in one specimen extend narrowly around the entire posterior border of the segment. The third segment is completely fusco-piceous behind and between the vittae. The fourth segment is a little brownish before its

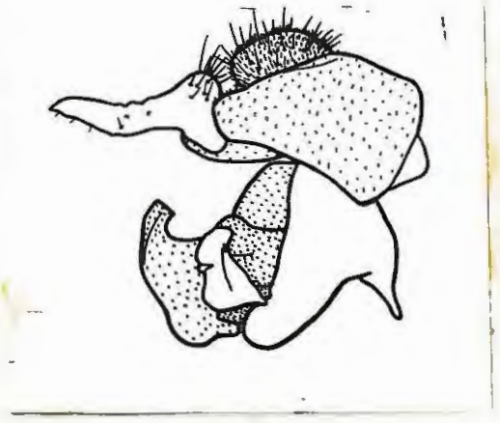

Fig. 17

Fig. 18

Fig. 19

Fig. 20

Figs. 17-20.- Paragus crenulatus Thomson; (17) hypopygium of a male from Hong Kong; (18) hypopygium of a male from Calcutta; (19) abdomen of a male from Java; (20) abdomen of a female from Hong Kong.

vittae - the remainder of the segment is black. The fifth segment is dark brown, with irregular dark patches. All three pairs of vittae are distinct and complete, though the anterior margins of the first pair are not clearly defined against the pale colour of the anterior part of the third segment. The abdomen is almost uniformly broad as far back as the beginning of the third segment. It is very deep, incompletely carinate, and with slightly flattened sides. The fourth and fifth sternites are dark fusco-piceous.

The specimens from Sarawak have yellow faces and prominent facial stripes. The antennae are paler, and the front of the females and vertex of both sexes show strong cyanescent reflections. The thorax has violaceous and metallic, cyanescent reflections. The mesonotal stripes, when seen from above, appear as two faint, purplish strips, scarcely discernable. When the thorax is viewed obliquely the stripes appear to be brassy or slightly cupreous - in all the specimens they fade out just behind the transverse suture. The number of scutellar teeth varies from twelve to fifteen. In two specimens the wings are only moderately suffused with yellow-brown - otherwise they are heavily suffused. The genitalia differ in that the styles are more strongly arched on the upper margin, the epandrium is a little more elongated, and the processes supporting the superior claspers are not as well developed. Two of the males have the abdomen red-brown behind the first

pair of vittae.

The female from Celebes has a darker face that is slightly tinged with brown. There are very strong cyanescent reflections on the front and vertex. The mesonotal pile is long, fine and bombycinous. The mesonotum is black and shining, with deep cyanescent reflections on the sides. The mesonotal stripes are complete though very thin over their posterior third - they are not very heavy, and are dark brassy yellow. The abdomen is greatly enlarged, almost as broad as long, and nearly circular in outline. The first segment is almost entirely yellowish-brown, except for a small, dark patch below each knob-like protuberance. The area behind the vittae on the third segment is brownish medially, fusco-piceous on the sides. The fourth segment is fusco-piceous except for a narrow, median strip of dark brown. The anterior pair of vittae are inconspicuous, while the two posterior pairs are well developed. The troughs on the third and fourth segments are very shallow.

The female from Dutch New Guinea has a broad, rather flattened abdomen, with sides that curve strongly backwards. The third and fourth segments are conspicuously sculptured. The whole abdomen is a slightly reddish brown, except for the sides and shoulders of the second segment which are piceous. The fourth and fifth sternites are yellowish-brown. The mesonotal pile is only faintly yellow, and the mesonotal stripes are silvery. The front, vertex and entire mesonotum have deep

cyanescent reflections. The tomentose strips of the vertex are linear and lack inward projections at the upper ends. The tarsi are rather ferruginous. There are eighteen scutellar teeth which are very short except for a few on each side of the scutellum.

The male from Java has very heavy mesonotal stripes which are silvery-white. The sides of the abdomen (fig. 19) are not so curved, and the abdomen is rather carinate. The knob-like protuberances of the first abdominal segment are fusco-piceous with quite strong blue reflections. The sides of the second segment are dark brown. The remainder of the abdomen is a slightly yellowish brown. The troughs on the third segment are narrow and quite deep. The hypopygium is very similar to that of the Hong Kong form, except that the penis-sheath is not so deeply curved below, and the ventral process is very weak.

The hypopygium of the male from Ceylon differs in certain respects from that of the Chinese specimens. The styles are not pointed apically, but bluntly rounded - the upper lobe of the inferior claspers is more attennuated and almost ends in a point - the process supporting the superior claspers is much broader.

The three specimens from Calcutta are rather dark. The abdomen is marked like those of the females from Hong Kong. The mesonotal pile is white, and the mesonotal stripes are complete and silvery. The wings in each case are without any

suffusion. The thorax is more coarsely punctate, and has dull violaceous and a few cupreous reflections. The genitalia (fig. 18) differ in having the penis-sheath more broadly curved below, and the styles rounded apically and not enlarged at the base.

The male from Bangkok has no suffusion on the wings, and the veins are not as heavy as in the Chinese form. The thorax has some cyanescent reflections, and the mesonotal pile is pale yellow. The mesonotal stripes are complete and silvery. The abdomen is coloured like that of the male from Java. The epandrium is about as long as deep, the styles are enlarged at the base, and the upper lobe of the inferior claspers is more produced. The female from the same locality has moderately suffused wings, heavier mesonotal pile and a darkish face - the tomentose strips of the front are enlarged at the upper end into stout, hatchet-like projections that almost meet in the mid-line. The posterior femora of both specimens are only moderately dark.

Of the females from Malaya, those from Kuala Lumpur and Singapore have almost clear wings. All have the tomentose strips of the front narrow, with stout, inwardly projecting, beak-like extensions at the upper ends, which almost meet in the mid-line. The specimen from Serdang has heavily suffused wings and has the fourth and fifth abdominal sternites brown. Shortest specimen 5.6 mm., longest specimen 6.8 mm.

Remarks.- This species can usually be recognised by its suffused wings, and by the extensively dark posterior femora. It may be confused with P. serratus (Fabricius) when the wings are clear, but the longer mesonotal pile and darker posterior femora distinguish it from that species. The shape of the abdomen is often characteristic.

Paragus serratus (Fabricius) 1805

I have material from the localities given below - all the specimens are in the British Museum.

North-west India, Jubblepore, 24.ix.1907,1♂, (C.G. Nurse), B.M. 1934-38, 15.xi.1907,1♀, ex coll. Brunetti, B.M. 1927-184. Deesa, viii.1901,1♂, (C.G. Nurse), B.M. 1934-38.

North-East India, Delhi, x.1936,1♂, (T. Jermyn), B.M. 1949-53.

India, Poona, 19-27.ii.1907,1♂, ex coll. Brunetti, B.M. 1927-184. Coimbatore, 13.viii.1912,1♂, (R.S.V.). Hasi, 17.xi.1907,1♀, ex coll. Brunetti, B.M. 1927-184. Mysore, Bangalore,1♀, (Capt. E.Y. Watson).

Males

Head. The face varies from sulphur-yellow to creamy-yellow. The facial stripe is undeveloped except for a colourless or slightly brown patch over the facial tubercle. The oral tubercle is piceous, and is surrounded by a narrow strip of slightly reddish brown. The facial pile is short and thin. The two basal ~~joints~~ segments of the antennae are dark red-brown, the

second blackish above. The third segment is pale crineous above, tawny on the basal half - it is nearly twice as long as the first two segments together, and is moderately stout. The vertex is fusco-piceous around the ocelli, with some violaceous reflections - posteriorly it is black with metallic azureous reflections. The stripes of hair on the eyes are quite distinct - the outer stripe on each eye is narrowed in the middle. Thorax. The mesonotum is black with strong violaceous reflections dorsally and strong blue reflections on the sides. The mesonotal pile is short and pale, golden-yellow. The mesonotal stripes are heavy and broad - they are almost uniformly wide throughout their length, and do not end in sharp points - they are yellowish. The basal half of the scutellum is fusco-piceous, the remainder is yellow. The scutellar teeth are variable in length, those towards the centre of the row being the shortest - they vary in number from ten to fourteen. Legs. All the femora are testaceous basally, creamy-yellow apically - there is a narrow, dark-brown band on the posterior femora. The tibiae are creamy-yellow on the basal half, pale testaceous on the rest. The posterior tarsi are ferrugino-testaceous, the two anterior pairs are pale testaceous. Wings. The membrane is hyaline and shining. The veins are dark brown, and the stigma is a dirty yellow. Abdomen (figs. 23-24). The corners of the first segment and shoulders and sides of the second segment are piceous, sometimes admixed with brown,

and usually with bluish reflections. The remainder of the first and second segments and the anterior margin of the third segment are amber. Posterior to the anterior vittae the abdomen is brown, sometimes a little reddish, and rarely entirely amber. The abdomen is moderately carinate on the third and fourth segments. The anterior vittae are indistinct and pale ; the posterior vittae are moderately distinct and silvery-grey. The troughs on the third segment are wide and deep, sometimes rather narrow and moderately deep - those of the fourth segment are narrow and moderately deep. The sculpturation of the fourth segment is reduced ; it is present, though inconspicuous, on the second and third segments. The vestiture of the abdomen is poorly developed - the middle three segments have many short, black, reclinate hairs - on the first segment there are some short, thin, erect, white hairs, and on the fourth segment there are a few similar hairs, only reclinate - there are some longer, silvery-white hairs on the fifth segment. Genitalia (figs. 21-22). The epandrium is nearly one-and-a-half times as long as deep. Its anterior margin is produced forwards on each side into triangular projections. The cerci are flattish and quite prominent. The styles are very characteristic - they are flat and wide apically, narrowly constricted over the middle, and dilated basally into a "head". The inferior claspers are well developed - ventrally they are produced into small, pointed, suboval lobes -

dorsally they extend into long, laterally flattened lobes. The superior claspers are borne on broad lobes. The penis-sheath is very narrow ventrally, and bears a weak, short, median, ventral process.

Insert figs. 21-25 here.

Females

The three females of this species before me are rather variable, and it is possible that the one from Hasi does not belong here. The front is black with cyanescent reflections - in the female from Bangalore it is fusco-piceous like the vertex. The tomentose strips of the front are well developed - each is broad and linear, and is inwardly expanded at the upper end into stout, triangular patches, both almost meeting in the mid-line - the specimen from Hasi lacks these projections of the tomentose strips. The vertex is fusco-piceous around the ocelli ; there are cyanescent reflections posteriorly, except in the female from Bangalore. The number of scutellar teeth varies from fourteen to seventeen. The fourth and fifth abdominal sternites are fusco-piceous, with a strong admixture of red-brown in places.

Longest specimen 6.8 mm., shortest specimen 5.1 mm.

Remarks.- The short mesonotal pile and male genitalia distinguish this species. The antennae are shortish, and the posterior femora are only narrowly dark.

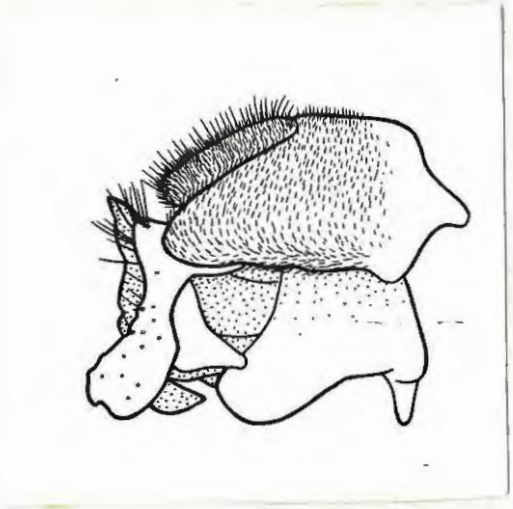

Fig. 21

Fig. 22

Fig. 23

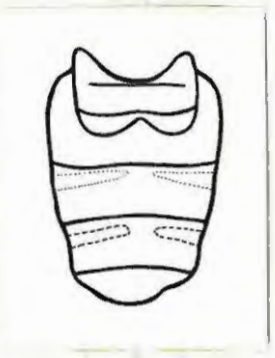

Fig. 24

Fig. 25

Figs. 21-25.- Paragus serratus (Fabricius); (21) hypopygium of a male from Poonah, India; (22) hypopygium of a male from Delhi, India; (23) abdomen of a male; (24) abdomen of a small male; (25) abdomen of female.

A translation of the original description of P. serratus is as follows, for which I am indebted to Mr. Whitely :-

"With a black thorax, the edge of the scutellum yellow and serrate.

It has the small stature of the preceding species (P. bicolor). Head yellow, antennae dusky ; a black thorax with two shortened grey dorsal lines. Scutellum black, with extensive yellow on the rim, saw-like with many little teeth. Abdomen black on the first segment, red on the rest, with a whitish edge. Clear, unspotted wings ; rust-red tarsi."

The description is very brief, but I believe that it can be referred to the species described above for several reasons. It is unlikely that Fabricius described a specimen of P. crenulatus as he would have noticed the suffused wings ; his type could not have been a specimen of P. yerburiensis as in that species the abdomen is not extensively reddish ; finally, P. auritus is much larger than bicolor, and does not have rust-red tarsi. It seems probable that the species described above is P. serratus as it is the only Oriental species that agrees with his description on all points.

It is interesting to note that a Danish factory was opened at Tranquebar, the type locality, in 1620 ; Danish influence continued until 1845, except for a brief period of British Occupation from 1801 to 1814 (Encyclopaedia Britannica,

vol. 22, 14 th. Edit., 1929). Fabricius probably came by his material of P. serratus through the efforts of these settlers. The species seems to be confined to India.

Paragus yerburiensis sp.n.

This species has a transverse band of black across most of the first abdominal segment. The posterior corners of the abdomen are very much produced, and the abdomen appears to be truncated, in the males. The epandrium is elongated, the inferior claspers are greatly enlarged, and the superior claspers are borne on long narrow processes.

Male

Head. The face is dark yellow, with distinct punctures and a silvery-white pile. There is no median stripe - the facial tubercle is brown. The oral tubercle is piceous, and is surrounded by a dark brown strip. The two basal segments of the antennae are very dark brown, the second segment suffused with black above. The third segment is elongated and cylindrical, crineous above and tawny on the lower surface at the base - it is twice as long as the first two together. The vertex is fusco-piceous with dull violaceous reflections - the tomentum of the occiput extends for a short distance past the upper corners of the compound eyes, closing the vertex from behind. The stripes of hair on the eyes are distinct and quite heavy - the outermost on each eye is the widest, and is

broadly interrupted in the middle. Thorax. The mesonotum is rather dull black, with pale violaceous reflections - it is quite heavily punctate. The mesonotal pile is short and yellowish. The mesonotal stripes are heavy and conspicuous, yellowish in front and grey behind - each is broad, and they meet in the region of the transverse suture. The scutellum is dark fusco-piceous on the basal half, dark yellow on the remainder. There are sixteen long scutellar teeth, each tipped with black. Legs. The posterior femora have a very dark brown band on their median half - the basal quarter is testaceous, and the apical quarter creamy-yellow. The posterior tibiae are yellowish on the basal half; ferrugino-testaceous with a dark median band on the remainder. The whole tarsus is missing from the left posterior leg, and the two apical segments are missing on the right leg - the remaining three segments are red-brown with a grey suffusion. The two anterior pairs of femora are testaceous on the basal two-thirds, pale yellow on the rest. The two anterior pairs of tibiae are pale yellow on a little more than the basal half, pale testaceous on the remainder and on the tarsi. Wings. These are narrower than in the other species. The membrane is hyaline and a little glossy. The stigma is pale yellow, and the veins are very dark brown, almost black, and rather thin. The microtrichia on the membrane are sparse. The subcosta and apical part of the first longitudinal vein are brown. Abdomen (fig. 28).

The first segment is piceous across more than its anterior half - this dark colour extends diagonally across each side of the second segment, ending at the apical corners of that segment. The second segment has a median, fusco-piceous, triangular patch. The third segment is entirely fusco-piceous behind the first pair of vittae - this colour extends forward between the vittae, stopping at the margin of the second segment in alignment with the triangular patch mentioned above. The remainder of the first three segments is yellow-brown. The fourth segment is fusco-piceous and the fifth segment is similar. The anterior margin of each anterior vitta is inconspicuous against the paler colour of the third segment, but the posterior margin is distinct against the dark colour of that segment. The middle and posterior pairs of vittae are distinct, and a little creamy. The abdomen has a characteristic shape. The sides are almost parallel, diverging a little anteriorly - each curves gently backwards from the moderately prominent shoulders. The second segment is subtriangular in cross-section - the third segment is decidedly more rounded - the sides of the posterior part of the fourth segment are vertical, a little curved above. The posterior corners of the abdomen are markedly produced and broadly rounded and swollen, and they give the abdomen a rather truncated appearance. The margins of the abdomens curve under these swellings. The troughs on the fourth segment are deep and narrow - those of

the third segment are deep, but have shallow sides. The area between the first two pairs of vittae is strongly curved longitudinally as well as transversely. The abdomen is a little carinate from between the median to between the anterior vittae. The dark part of the first segment is coarsely punctate, and has a thin covering of short, white hairs which curve outwards from the median line on each side - the remainder of the segment is impunctate. The triangular patch on the second segment is covered with large, close punctures which superficially resemble sculpturation, but out of which no hairs arise - there are a few punctures and some sparse, reclinate, black hairs on the remainder of the segment. Towards the anterior corners of the third segment there are a few punctures out of which arise fine, sparse, reclinate, white hairs - the rest of the segment, behind the anterior vittae, lacks sculpturation. There are some reduced punctures present, especially towards the sides - hairs are lacking over the median half but some reclinate black hairs are present on the sides. The fourth segment is similar to the third, but has very few punctures, appearing very smooth as a result - there are some reclinate, black hairs on the sides. Genitalia (fig. 26). The epandrium is elongated and is about twice as long as deep - its lower posterior corner is broadly rounded. The cerci are very prominent, and stand well above the upper margin of the epandrium. The styles are about one-and-a-quarter times as long

as the epandrium is deep - they are quite broad and flattened, with subparallel margins, a bluntly pointed distal end and a slightly swollen base. The inferior claspers are greatly enlarged and are as long as the epandrium is deep - dorsally they are produced into very long, flat, blade-like lobes which twist inwards a little at the tip. Ventrally they are produced into short, sharply truncated lobes which are broadened on the inner surface into distinct, almost horizontal faces. The superior lobes are borne on thin, sharply pointed processes. The lower surface of the penis-sheath bears a median, ventral projection that is flattened laterally and subrectangular in shape.

Length 7.0 mm.

Holotype : Male, in the British Museum ; Ceylon, Velverry, 18.i.1891, (Lt.Col. Yerbury), B.M. 1892-192.

Insert figs. 26-29 here.

Female

Head with a black front having blue-grey reflections. The strips of tomentum are widened above, and the upper ends bend inwards, are pointed and hook-like. The antennae stand on a dark brown base - their two basal segments are very dark, and the third segment is darker than in the holotype. The vertex is black with strong cyanescent reflections. The scutellum is yellow on a little more than the apical third. The abdomen (fig. 29)

Fig. 26

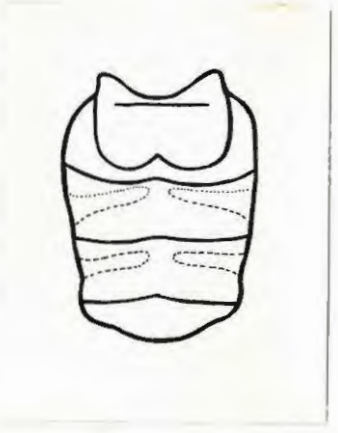

Fig. 27

Fig. 28

Fig. 29

Figs. 26-29.- Paragus yerburiensis sp.n.; (26) hypopygium of holotype; (27) abdomen of a small male; (28) abdomen of holotype; (29) abdomen of allotype.

is coloured like that of the holotype, with the following differences - the triangular patch on the second segment is extended on both sides into thin, long, curved arms which follow the border of the first segment, and which are not quite complete, continuing apically as a series of about ten dark spots around some punctures - the dark areas on the sides of the second segment do not extend diagonally across the segment to end in its corners, but are uniformly wide throughout, ending on the posterior margin of the second segment - the abdomen is piceous behind the first pair of vittae. The shoulders are prominent, and the margins of the abdomen are parallel as far back as the first pair of vittae. The troughs on the third and fourth segments are very deep, narrowish and distinct. The abdomen is triangular in cross-section through the second segment, more rounded through the third segment, and much more rounded through the fourth segment. A moderately developed sculpturation is present on the third and fourth segments. The fourth and fifth sternites are black and shining.

Length 7.6 mm.

Allotype : Female, in the British Museum ; Ceylon, Mahagany, 30.xi.1890, (Lt.Col. Yerbury), B.M. 1892-192.

Paratypes :

India, Jubblepore, 15.xi.1907,1♂, ex coll. Brunetti, B.M. 1927-184.
Ceylon, Mahagany, 30.xi.1890,1♂, (Lt.Col. Yerbury), B.M. 1892-192,
Trincomali, 20.iii.1891,1♂, (Lt. Col. Yerbury), B.M. 1892-192.

The head of the paratype from Trincomali is missing. The dark colour of the antennae, especially of the two basal joints which are almost black, is a noticeable feature of the other two paratypes. All three specimens differ from the holotype in having the abdomen with a strong admixture of brown behind the first pair of vittae - in the specimen from Trincomali this region is almost pure brown. They differ too in having distinct punctures on the third and fourth segments. There are some slight differences in the genitalia of each specimen - these involve the styles, which may be bluntly truncated or a little rounded apically, and which in all three paratypes have the upper margin a little sinuous.

Remarks.- This species is easily distinguished by the characters given in the key above. From the nature of the abdomen of the male and of the male genitalia, it seems that P. yerburiensis is a rather isolated species within the complex. There seems to be considerable variation in size between individuals of this species.

Paragus auritus sp.n.

This is a large species with elongated antennae. The abdomen is unusually broad in relation to the thorax, the females especially with greatly distended abdomens. There is no median, ventral projection on the penis-sheath, and the inferior claspers are produced into large ventral lobes. The

superior claspers are borne on long, narrow processes.

Male

Head. The face is yellow, with small punctures and a short, moderately thick facial pile. The oral tubercle is piceous and is surrounded by a strip of light brown. The third segment of one antenna is missing. The segments of the other antenna are very elongated, especially the third, and the antenna as a whole is longer than the distance between the base of the antennae and the upper margin of the oral tubercle - the third segment is tapering and cylindrical. The basal segments are reddish-brown, the second darker than the first - the apical segment is dark crineous above, somewhat orange below. The vertex is black with strong violaceous reflections. The stripes of hair on the eyes are distinct, the outermost on each eye being the broadest. Thorax. The mesonotum is black with pale blue and violet reflections above, and quite strong blue reflections on the sides - it is heavily punctate, the punctures rather small. The mesonotal pile is quite short and thick - it is fine, erect and yellow. One of the mesonotal stripes has been obliterated by the pin on which the specimen is mounted - the other stripe is distinct and quite heavy, yellow in front and silvery-grey behind. The scutellum is fusco-piceous on the basal half and slightly creamy yellow on the apical half - between these two areas there is a narrow intermediate band of brown. There are sixteen scutellar teeth, each tipped with

orange - the middle six teeth are only half the length of those on the outside. Legs. The posterior femora are brown on the middle half, pale testaceous on the basal quarter, and yellow on the apical quarter. The posterior tibiae are pale yellow, almost white, on the basal half, the remainder yellowish testaceous. The hind tarsi are brown with a slight admixture of yellow. The two anterior pairs of femora are pale testaceous, except for their distal fifth which is yellow. The middle and anterior pairs of tibiae are pale yellow on their basal two-thirds, very pale testaceous on the remainder. The two anterior pairs of tarsi are brown with a strong admixture of yellow, almost orange. Wings. The membrane is hyaline and moderately glossy, slightly suffused on the basal half. The stigma is yellow, and the veins are ligneous brown and moderately heavy. The subcosta and apical part of the first longitudinal vein are light brown. Abdomen. The abdomen is conspicuously large in relation to the thorax. It is slightly carinate, rather rounded and deep, a little flattened on each side of the median line, and has prominent shoulders. It is a translucent brown. The corners of the first segment and shoulders of the second are suffused with dark brown, also the fourth segment behind the median vittae. There is a fine sculpturation present on the fourth segment and that part of the third segment behind the anterior vittae. The remainder of the abdomen is covered with punctures. The middle three segments have a conspicuous

covering of quite long, stout, reclinate, black hairs which are distinct against the pale colouration of the abdomen. White hairs are present on the fifth segment and there are a few on the fourth. The anterior vittae are rather indistinct, and lie in shallow troughs - the middle and posterior vittae are distinct - the troughs on the fourth segment are shallow and narrow.
Genitalia (fig. 30). The epandrium is trapezoid, with the upper and lower sides parallel - it is not quite twice as long as deep. The ventral posterior corners are broadly rounded. The cerci are rounded and prominent. The styles are shaped somewhat like the blade of a pen-knife, only with a broadened base and with the upper and lower margins a little notched. The inferior claspers are ear-like and well developed - the upper lobe is slight, but the lower lobe is very large and produced ventrally. The penis-sheath is narrow, and completely lacks any median, ventral projection. The superior claspers are borne on long,narrow, curved, ventrally-directed projections of the penis-sheath - these projections are very characteristic.
Length 8.2 mm.
Holotype : Male, in the British Museum ; Ceylon, Kandy, 29.vi.1892, (Lt.Col. Yerbury), B.M. 1892-192.

Insert figs. 30-33 here.

Female

The third segment of the antennae is conspicuously darker than

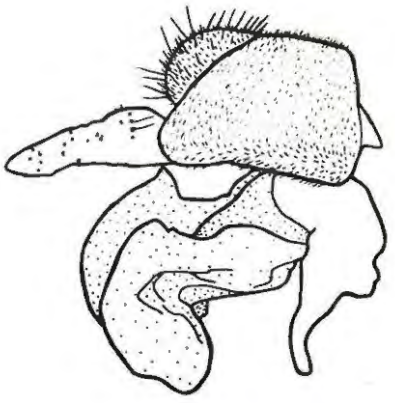

Fig. 30

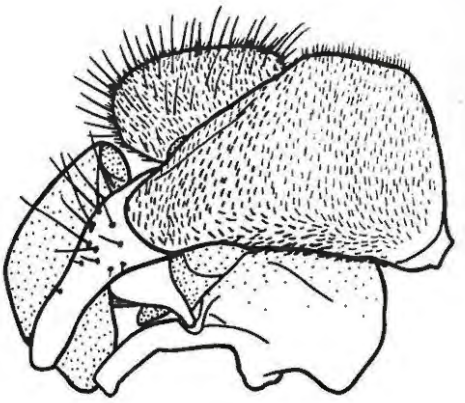

Fig. 31

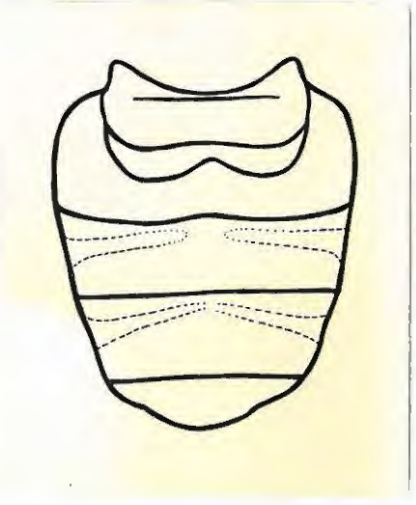

Fig. 32

Fig. 33

Figs. 30-33.- Paragus auritus sp.n.; (30) hypopygium of holotype; (31) hypopygium of male from Kanthalia, Ceylon; (32) abdomen of holotype; (33) abdomen of allotype.

the two basal segments. The front is black with dull cyanescent reflections. The two tomentose strips are broad and have irregular inner margins - each has a thin inward projection at the upper end. The vertex is fusco-piceous with violaceous reflections. There are fifteen scutellar teeth. The wings are quite strongly suffused with yellow-brown, more strongly so on the basal half. The abdomen is very broad and greatly enlarged in relation to the thorax - it is very deep and rounded, with prominent shoulders. The sides curve rapidly backwards under the bulge of the abdomen (fig.33). The fourth and fifth segments are piceous except for a narrow strip of brown along the anterior margin of each median vitta. The third segment has a fusco-piceous strip on each side of the median line. The black hairs which were present on the abdomen of the holotype are well developed and conspicuous, perhaps a little longer and thinner. The fourth and fifth sterna are dark, shining fusco-piceous.

Length 8.2 mm.

Allotype : Female, in the British Museum ; Ceylon, Anuradhapura, 10.xii.1890, (Lt.Col. Yerbury), B.M. 1892-192.

Paratypes :

Ceylon, Kanthalia, 31.vii.1890, 17.x.1890,2♂♂, Trincomali, 19.ii.1892,1♀, Pankullam, 1.i.1891,1♀, (Lt.Col. Yerbury), all B.M. 1892-192.

India, Calcutta, 1-17.xii.1908,1♂, ex coll. Brunetti, B.M. 1927-184.

Kenya, Teita Hills, Lumi River, xii.1912,1♂, in the Coryndon Museum, Nairobi.

One male from Kanthalia has a paler abdomen than that of the holotype, especially the first segment which is amber - the same specimen has the dark band on the posterior femora very much reduced. The male from Calcutta completely lacks the dark band on the posterior femora, which are pale amber. The male from Kenya has ten quite long scutellar teeth, each tipped with brown - the mesonotal pile is longer than in the holotype - the posterior femora are dark brown and the other legs are generally darker.

There are some rather puzzling differences in the genitalia, the typical form being illustrated in fig. 30 and an atypical form, which is commoner, shown in fig. 31. The typical form is only repeated in one of the males from Kanthalia. It seems that the typical form represents a more weakly sclerotised condition of the hypopygium - this weakness has apparently led to distortion involving extension of the parts during maceration in hot caustic potash.

The genitalia of the male from Kenya are almost identical ~~to that~~ WITH THOSE of the males from Ceylon (fig. 31), but differ in that the apex of each style is broader, and the penis-sheath is not strongly angled below. The presence of this species in Africa is unexpected, and the unique specimen may represent a distinct subspecies which would be identified by the differences

mentioned above. Unfortunately the specimen is in poor condition.

Shortest paratype 7.3 mm., longest paratype 9.0 mm.

Remarks.- All the specimens that I have of this species are strikingly large. It may be distinguished from the other species in the complex by the elongated antennae.

SUMMARY

An extraordinary species of Paragus, P. serratus, was described from India by Fabricius in 1805 - a closely related species, P. crenulatus, was described from China by Thomson in 1868 - a third species, P. azureni, also closely related to serratus, was described from Sokotra by Hull in 1949. P. serratus has been thought to be distributed over most of the Oriental and Ethiopian Regions - a great variation in colouration has often been commented on. I have resolved serratus into serratus s.str. and four new species, yerburiensis, auritus, pusillus and capricorni. These are described, together with the allotype of azurea, and with scrupeus, a new subspecies of azurea. P. serratus (Fabricius) and crenulatus Thomson are redescribed. The male genitalia of each species are described and figured. P. yerburiensis and serratus s.str. are apparently confined to India ; auritus is found in Ceylon, India and Africa ; capricorni, pusillus and scrupeus are African ; azurea is apparently confined to Sokotra ; crenulatus is widely distributed

through the Oriental Region and Austro-Malayan Subregion. A note is included on the position of the complex within the genus. Keys are given, based on external and genitalic characters. A list is given of those characters which have proved to be of greatest taxonomic use.

ACKNOWLEDGEMENTS

I wish to thank Professor J. Omer-Cooper and Dr. E.McC. Callan for their invaluable criticism, advice and constant encouragement. I am most indebted to African Explosives and Chemical Industries Limited, and to the Council for Scientific and Industrial Research, for the award of grants enabling me to undertake this study. I wish also to express my appreciation to the following Institutes for placing their material at my disposal, and for the generous assistance which I have received :- The British Museum (Natural History); The National Museum of Southern Rhodesia, Bulawayo ; The South African Museum, Cape Town ; Musee du Congo Belge, Tervuren ; The Coryndon Museum, Nairobi ; The Department of Entomology, Pretoria.

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STUDIES ON *PARAGUS*, WITH DESCRIPTIONS OF NEW SPECIES (DIPTERA, SYRPHIDAE).

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INTRODUCTION

This study is based almost entirely on material which has been placed at my disposal by the following institutions, to whom I wish to express my gratitude :-

Museé du Congo Belge, Tervuren
South African Museum, Cape Town
British Museum, London
Transvaal Museum, Pretoria
National Museum of Southern Rhodesia, Bulawayo
American Museum of Natural History, New York
Coryndon Museum, Nairobi
Department of Entomology, Pretoria
Department of Agriculture of Southern Rhodesia

It is well known that many species of *Paragus* vary considerably in size and colouration, this variation in certain cases having led to the creation of numerous synonyms and varieties. It seems evident that such characters as colour markings, though often used as distinguishing features, may vary to a degree where they become inadequate for taxonomic purposes, unless the extent of such a variation is thoroughly

investigated. A search for more stable characters appeared to be desirable. Metcalf (1921) has, in this connection, stressed the value of studies of the genitalia of Syrphidae, and demonstrated that the structural features of the male genitalia provide reliable taxonomic characters. His findings have been confirmed by Fluke (1950). In the latter's extensive study of the male genitalia of the genera allied to Syrphus the figures show clearly that there are differences adequate for the separation of closely related species. Fluke was able to arrive at important conclusions as regards the nature and extent of certain genera. Thus a comparative taxonomic study of the male genitalia in Paragus seemed to offer an interesting and profitable field of research. This study was undertaken in the hope of establishing a dependable basis for species definition and of obtaining an idea of true relationships within the genus, and in both of these respects it has been entirely successful. A multitude of most valuable characters has been found in the hypopygium and its associated structures. These are almost completely constant, and exhibit great interspecific variation. It is unfortunate that systematists have ignored them in the past when dealing with species of Paragus.

I have used Metcalf's terminology, which is based on that of Wesche (1906), but I prefer to use the term "epandrium" for what Metcalf has called "tergite ten" of the abdomen, as the

true nature of this sclerite has not yet been proved. In numbering the segments of the abdomen I have counted the first apparent segment as being number one. All orientations mentioned in descriptions of the genitalia refer to the primitive, non-inverted condition of the hypopygium. The various sclerites and appendages comprising the hypopygium are indicated in fig. 1.

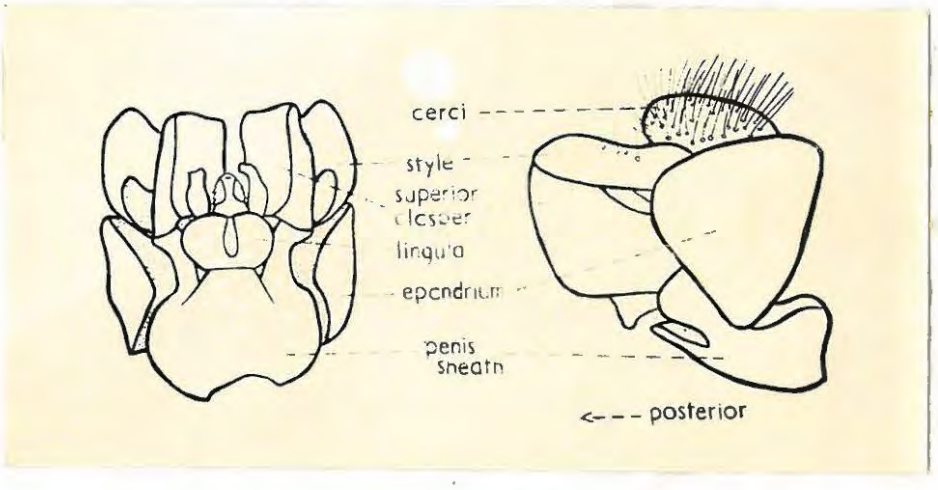

Fig. 1.- Diagram of hypopygium in ventral and lateral view, indicating the sclerites and appendages that are referred to in the descriptions of the genitalia.

TAXONOMY

Paragus Latreille 1804

Type species Syrphus bicolor Fabricius 1794, p.297

non Mulio Latreille 1796, p.155 (Bombyliidae)

Mulio Fabricius 1798, p.548

Paragus Latreille 1804, p.194, 1805, p.359, 1825, p.1 ; Meigen, J.W., 1822, p.176 ; Schiner, J.R., 1862, p.256 ; Montbeillard, M.G.de, 1872, p.346 ; Williston, S.W., 1886, p.17 ; Verrall, G.H., 1901, p.149 ; Chagnon, G., 1901, p.21 ; Efflatoun Bey, H.C., 1922, pp.21-22 ; Hull, F.M., 1949, pp.301-302. (Kertész, C., 1910, p.1, is incorrect in referring to Latreille, 1805, as the original description of the genus.)

These are small, usually dark flies. The face is flattened and scarcely tuberculate in nearly all of the species. The eyes are short pilose, rarely bare, the pile evenly distributed or arranged in stripes. The eyes in the male touch for a short distance , or are rarely separated. The antennae are shortish, porrect, occasionally with the third segment elongated. The arista is dorsal, bare, short, and situated before the middle of the third segment. The mesonotum and abdomen are often punctate, sometimes heavily so, rarely hardly at all. The upper and lower marginal cross-veins are not

parallel with the wing margin, and are at some distance from it. The first two abdominal segments are immovably fused - occasionally more, and up to five segments, may be fused. The fifth abdominal sternite of the male is incorporated within the postabdomen - its sclerotised portion is confined to a narrow, often weak, transverse strip which may be expanded at each end into a subtriangular piece. The fifth, sixth and seventh tergites are membranous. The hypopygium is small to moderately large, and the ejaculatory duct terminates in a wide, sessile opening at the apex of the chitinous box.

The genus belongs to the Syrphinae. Its affinities are uncertain.

Hull (1949) does not mention any subdivision of Paragus into subgenera, and I have been unable to trace any attempt at such a subdivision in the literature. I have concluded, from a study of the African species and some Oriental species, that Paragus may be split into two subgenera. These are Paragus s.str. and Pandasyopthalmus subgen.n.

Paragus s.str.

The pile on the eyes is arranged in vertical stripes, or else the eyes are bare. The spurious vein ends before the point of coincidence of the lower marginal cross-vein and the fourth longitudinal vein. Frequently more than the first two abdominal segments are fused. The epandrium is trough-shaped, and articulates on the anterior corners of the penis-sheath.

The penis-sheath is broader than long. The chitinous box lacks projecting arms. Subgenotype : Paragus bicolor (Fabricius).

The species of Paragus s.str. that I have seen are the subgenotype, P. serratus (Fabricius), P. borbonicus Macquart, P. aegyptius Macquart, and P. atratus Meigen. In this subgenus the scutellum is often yellow on its apical half, and frequently a red, brown or yellow colouration is developed on the abdomen. The abdomen is often distended, with curved sides, or else normal. A variable number and sometimes all of the segments of the pre-abdomen may be fused. The posterior margin of the fourth sternite is often curved backwards at each end in the male. The epandrium is trough-shaped, rather shallow, and often elongated. The cercal emargination is usually less than half of the length of the epandrium. The penis-sheath is broad, and often ornamented with processes and spines - its lingula is either absent, or else large and complicated. The styles are elongated, sometimes flattened, broad to narrow, often ending in a point, usually directed downwards, and often curving inwards. The superior claspers articulate with the penis-sheath on small, condyle-like processes, and are thin and never large. The inferior claspers are sometimes very well developed, and frequently have spines and protuberances. The chitinous box (see figs. 2,3) is frequently elongated and usually has a collar-like ridge at its apical third. The sustentacular apodeme is usually T-shaped, with the long arm

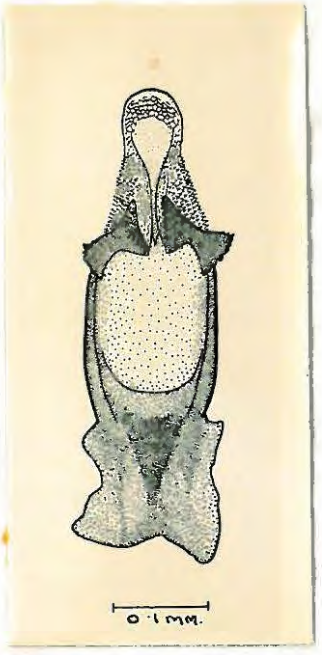

Fig. 2

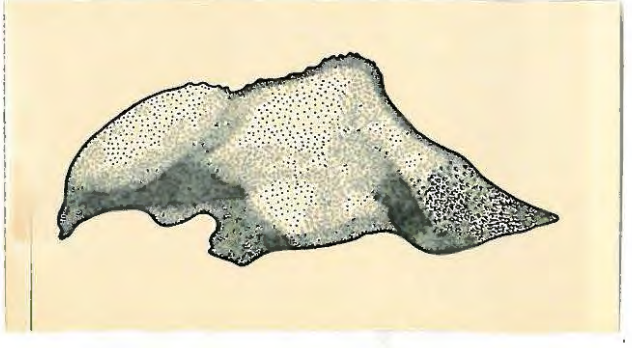

Fig. 3

Figs. 2-3.- (2) ventral view, (3) lateral view, of chitinous box from hypopygium of Paragus bicolor (Fabricius).

flattened laterally, the short arms horizontally flattened and often with short spines.

Pandasyopthalmus subgenus n.

The pile on the eyes is evenly distributed, often sparse, and not arranged in stripes. The spurious vein ends at or beyond the point of coincidence of the lower marginal cross-vein and the fourth longitudinal vein. Only the first two abdominal segments are fused. The epandrium is saddle-shaped and articulates on the middle of the sides of the penis-sheath. The penis-sheath is trough-shaped, and longer than broad. The chitinous box has two short, spinous, projecting arms. Subgenotype : Paragus longiventris Loew.

The species of this subgenus that I have seen are P. longiventris, P. tibialis (Fallen), P. marshalli Bezzi, P. dolichocerus Bezzi, P. minutus Hull, P. punctatus Hull, and P. gracilis and P. naso which are described below. I have also been able to examine several undetermined Oriental species. In these species the scutellum is never apically yellow, and the general body colour is black, though sometimes reddish markings may be developed on the abdomen. The abdomen is usually rather narrow, and is often subpetiolate. The posterior margin of the fourth sternite in the male is always straight. The epandrium is saddle-shaped and deep. The cercal emargination is always extensive. The penis-sheath is elongated and trough-like - it is simple, and the lingula that is usually present

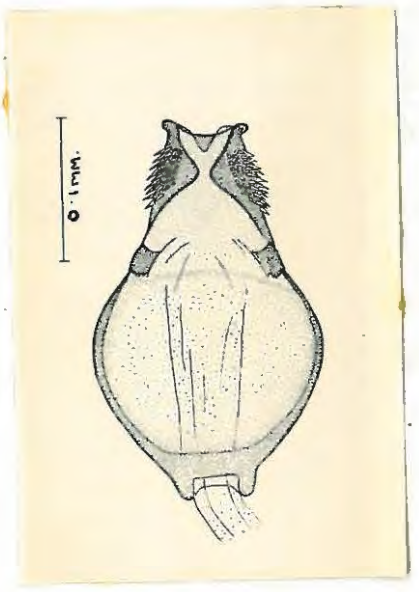

Fig. 4

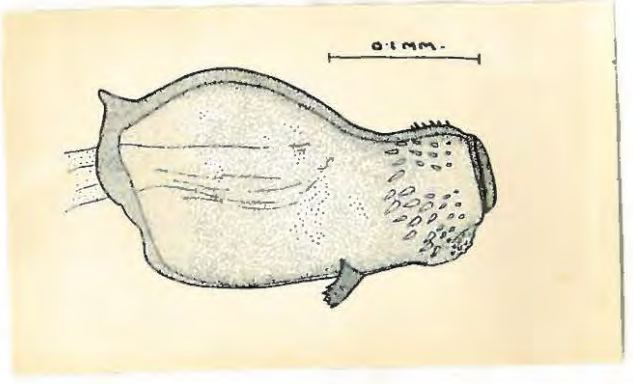

Fig. 5

Figs. 4-5.- (4) ventral view, (5) lateral view, of chitinous box from hypopygium of Paragus longiventris Loew.

is simple. The styles are oblong and broad, bluntly rounded apically, flattened, and never curved. The superior claspers are broadly attached to the penis-sheath - they are stout and well developed. The inferior claspers are small and simple. The chitinous box (see figs. 4,5) is subpyriform, and bears two short arms that are produced apically into many short spines. The sustentacular apodeme is Y-shaped and simple, and its arms are not flattened.

The Ethiopian Species of Pandasyopthalmus

This subgenus is well developed in the Ethiopian Region. Six endemic species are known, and a further two are described in this paper. The species are easily divided into two groups on both external and genitalic characters, as I have indicated in the keys below.

Key to the species, based on external features.

1 (10). Face flattened, not produced and scarcely tuberculate ; only the female with a facial stripe ; frons of female with a small spot or line of tomentum, as well as some silvery hairs, bordering each orbit ; abdomen subpetio-late in both sexes, petiolate in one species. (longiventris group).....

2 (3). Abdomen strongly petiolate in both sexes (figs. 14,15) ; wings a little suffused, with conspicuous microtrichia

that extend onto the apical parts of the costal and two basal cells ; stigma brown and elongated ; frontal triangle of male black ; slender, rather elongated, Baccha-like species.....gracilis sp.n.

3 (2). Abdomen subpetiolate in both sexes, sometimes hardly constricted in the female (figs. 6,9,20,24) ; wings hyaline, with inconspicuous microtrichia that do not extend onto the costal and basal cells ; stigma not elongated ; frontal triangle of male yellow, or else coloured like the face.

4 (5). Thorax and abdomen lightly punctate ; abdomen distinctly subpetiolate in both sexes (figs. 6-9) ; thorax and abdomen with well developed vestiture ; second abdominal segment in male distinctly longer than wide ; usually a slender species.....longiventris Lw.

5 (4). Thorax and abdomen coarsely punctate ; abdomen only moderately constricted at the base, sometimes hardly so in females (figs. 20,23,24) ; vestiture usually poorly developed ; second abdominal segment in the male never longer than wide ; mostly stouter species.

6 (7). Mesonotal pile very short ; femora reddish, the posterior pair very rarely dark brown ; mesonotum and abdomen very coarsely punctate ; fifth abdominal tergite and post-abdomen of male always reddish.....minutus Hull

7 (6). Mesonotal pile quite long ; femora very dark basally, only very rarely pale ; mesonotum and abdomen coarsely punctate ; fifth abdominal tergite and postabdomen of male only exceptionally reddish.

8 (9). Third segment of antenna very elongated, cylindrical, and rather pointed apically, reaching to or past the tubercle when lying against the face ; abdomen markedly flattened in the female.....dolichocerus Bezzi

9 (8). Third segment of antenna not elongated, not reaching the tubercle when lying against the face ; abdomen not markedly flattened in the female.....marshalli Bezzi

10 (1). Face produced, with a prominent tubercle ; facial stripe present in both sexes ; frons of female without tomentum, though a strip of silvery hairs may border each orbit ; abdomen never subpetiolate, but with parallel sides. (tibialis group).....

11(12). Thorax almost apunctate, those punctures that are present minute ; wing membrane with conspicuous micro--trichia, and wing veins heavy ; eyes in the male distinctly separated, the orbits markedly angulate at their closest approximation.....naso sp.n.

12(11). Thorax distinctly and often quite heavily punctate ; microtrichia inconspicuous, and the wing veins moderate ; eyes not separated in the male, and the orbits not markedly angulate.

13(14). Stigma pale yellow ; the middle three segments of the abdomen without many reclinate, short, black hairs ; ratio of narrowest width of vertex to width of head in female about 1:4.2 ; pile on vertex pale in both sexes.....tibialis (Fal.)

14(13). Stigma brownish-yellow ; small but dense patches of short, black, reclinate hairs on the posterior half of each of the third, fourth and second abdominal segments ; ratio of narrowest width of vertex to width of head in female about 1:5.4 ; pile on lower part of frons of female silvery-white.....punctatus Hull

I have not included P. nigrocoerulea Hull in the key as I am unable to distinguish it from P. tibialis.

Key to the species, based on genitalic characters.

1 (10). Penis-sheath at most as long, usually a little shorter, than the epandrium is deep - in profile its ventral margin is smooth and slightly convex ; the lower margins of the epandrium form an acute angle (see figs. 10,16, 18,25). (longiventris group).....

2 (5). Penis-sheath either completely lacking a lingula and emargination on its posterior rim, or with only a lingula present that is large and much broader than long ; superior claspers enlarged basally, rather quadrate, with a pointed apical extension (see figs.

18,19,21,22).

3 (4). Posterior rim of penis-sheath simple, completely lacking a lingula, semicircular in outline, and with only a trace of a break in the median line - on the ventral surface there are two vertical flanges which support the superior claspers (figs.21,22)...dolichocerus Bezzi

4 (3). Posterior rim of penis-sheath differentiated into a very wide lingula that is distinctly grooved in the mid-line ; the superior claspers are supported on lateral processes of the penis-sheath (figs. 18.19)...
.....marshalli Bezzi

5 (2). Penis-sheath deeply emarginate, and with a well defined lingula on its posterior rim that is usually elongated and never more than slightly broader than long ; superior claspers subtriangular or very large (figs. 10, 16,26).

6 (7). Superior claspers enormous in relation to the hypopygium, boomerang-shaped, of almost uniform width throughout, and with a broadly rounded end (figs. 25,26).....
.....minutus Hull

7 (6). Superior claspers not enormous in relation to the hypopygium, not boomerang-shaped, not uniformly wide throughout their length, but tapering to a rather or very acute apex (figs. 10,16).

8 (9). Superior claspers very acute at apex - their outer and lower margins meet in a decidedly obtuse angle, and the inner margin is almost straight - the superior claspers are triangular in outline when viewed ventrally ; the lingula is arch-shaped (figs. 16,17).....*gracilis* sp.n.

9 (8). Superior claspers blunt apically, the outer and lower margins meeting almost in a rectangle, and the inner margin a little concave - when seen ventrally the superior claspers are of almost uniform width throughout ; lingula subelliptical or subrectangular (figs. 10-13)..
.....*longiventris* Lw.

10 (1). Penis-sheath at least 1½ times as long as the greatest depth of the epandrium - in profile its ventral margin is distinctly concave below ; the lower corner of the epandrium is rectangular or a little obtuse (figs. 27,29, 32). (*tibialis* group).....

11(14). Superior claspers not well developed, reduced, much shorter than the penis-sheath, and not projecting much beyond or above the apices of the styles ; lingula undivided (figs. ~~27~~ 31,29).

12(13). Lingula triangular ; the styles broadest apically in lateral view ; the superior claspers lie in a vertical plane (figs. ~~27~~ 29, ~~28~~ 30).....*tibialis* (Fal.)

13(12). Lingula quadrangular ; the styles are broadest across the basal quarter in lateral view ; the superior

claspers lie in inclined planes (figs. ~~29~~ 31, ~~30~~ 32).....

.....punctatus Hull

14(11). Superior claspers well developed, very large in relation to the hypopygium, about as long as the penis-sheath, and projecting well above and beyond the apices of the styles ; lingula divided down the median line into two lobe-like halves (figs. ~~32~~ 34, ~~33~~ 35).....naso sp.n.

Paragus longiventris Loew 1857

Loew, 1857, p.376 ; Verrall, 1898, p.413 ; Kertesz, 1910, p.5 ; Bezzi, 1908, p.74 ; Speiser, 1910, p.114 ; Bezzi, 1912, p.402 ; Hervé-Bazin, 1914, p.280 ; Bezzi. 1915, p.13 ; Bezzi, 1920, p.132 ; Curran, 1927, p.51, 1938, p.20.

This is a variable and sometimes troublesome species whose identification often can only be established by a study of the male genitalia. In the key provided by Curran (1938) some individuals of this species run down to marshalli. This is because the character which Curran uses to separate marshalli and longiventris viz. the shape of the second abdominal segment, is variable to the extent of overlapping in both of these species. One of the characters which Bezzi (1915) uses in his key to separate longiventris and marshalli is the colour of the stigma, which he says is subhyaline in the former species and black or much infuscated in the latter. This can be most misleading, as

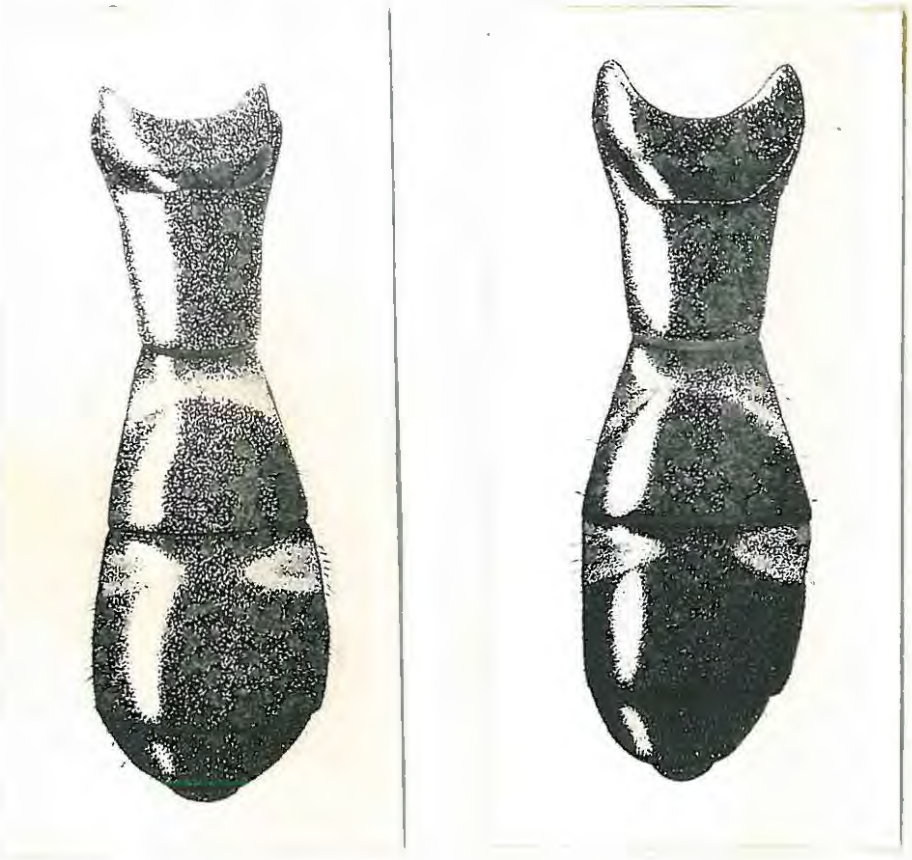

Fig. 6 Fig. 7

Figs. 6-7.- Paragus longiventris Loew, abdomen of male ; (6) normal male ; (7) atypical form, in which the second segment is stouter.

in many specimens of longiventris the stigma is very dark brown. Size and build are also sometimes unreliable criteria for distinguishing these two species - some specimens of longiventris are quite as large and robust as the largest individuals of marshalli - on the other hand, a male marshalli before me from the Belgian Congo is slender and very like a typical longiventris.

Variation occurs in this species in the following characters :-

Size. The smallest specimen which I have is a minute male from South West Africa, which measures only 4.2 mm. The largest specimen is a female from Grahamstown, which measures 7.2 mm. The average size is approximately mid-way between these two extremes.

Colouration. The typical colouration is uniform, shining black. As in many other species of Paragus, a reddish-brown colour is sometimes developed on the abdomen. It is rare in longiventris, and I have seen it only in a few specimens from Zululand, the Belgian Congo and South West Africa. The colour of the face also varies. Bezzi (1920) has described a variety, nigrifacies, in which the face is very dark and may have bluish or greenish reflections. Of 64 specimens of longiventris which I have caught in Grahamstown, eight (five males and three females) are of this variety - a pair were caught in copulo, and a female was found in copulo with a normal male. The face is usually a slightly greenish yellow, rarely creamy-white.

Antennae. These vary in the length, colour and shape of the third segment. In the female this segment is invariably suboval, and 1½ times as long as the first two segments together, occasionally longer. In the male this segment may be short and suborbicular to moderately long and suboval. The colour varies from light brown, which is rare, to dark brown and black. This variation appears to be correlated with the colour of the stigma. In all but two specimens with a dark stigma the third segment is black, and in those specimens with a yellow or subhyaline stigma the third segment is light or dark brown.

Stigma. This may be dark brown, brown, yellowish-brown, yellow, pale yellow, or subhyaline. Of 64 specimens of longiventris which I have caught in Grahamstown, 27 have the stigma dark, opaque brown. There seems to be some connection between size and colour, as all the largest specimens have a dark stigma, and only a few specimens with a dark stigma are small. There is no specimen with a dark stigma among the material of this species from the Belgian Congo.

Second Abdominal Segment. This is broader in the female than in the male. In the male it is usually markedly longer than broad (fig. 6), occasionally only a little longer than broad (fig. 7). In the female it is as wide, or distinctly wider, as it is long (figs. 8,9).

Vestiture. Some individuals have conspicuous bands of silvery or golden hairs on the second and third abdominal segments, and

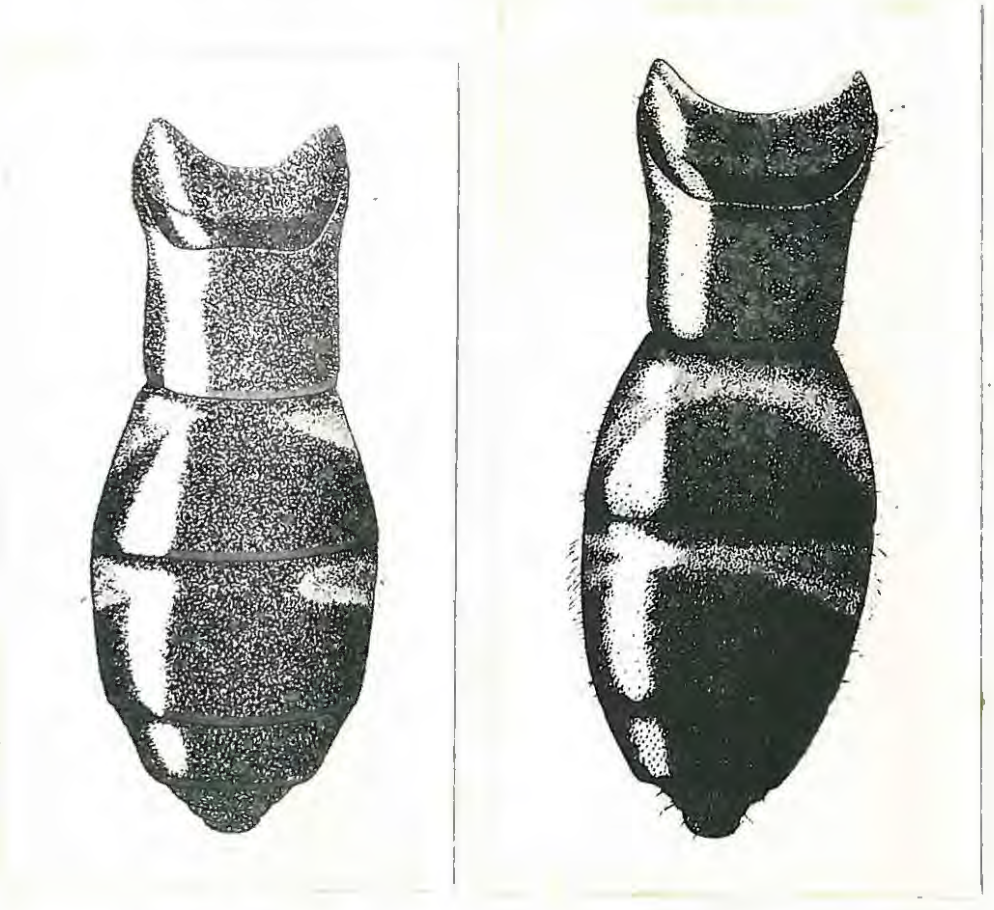

Fig. 8 Fig. 9

Figs. 8-9.- Paragus longiventris Loew, abdomen of female ; (8) typical female ; (9) atypical form, in which the abdomen is more robust.

quite dense mesonotal pile. Others almost completely lack vestiture on the mesonotum and abdomen. It is difficult in such cases to determine whether this is natural or due to rubbing and mishandling.

Description of Male Genitalia. (Figs. 10-13)

There is some variation in the hypopygium, which mainly affects the superior claspers and lingula. The more usual form is that shown in fig. 10.

The epandrium is saddle-shaped, a little deeper than long, with bluntly rounded lower corners - its margins are only very slightly sinuous. The styles are oblong, with subparallel sides, truncated, and finely serrated along the apical edge. The superior claspers are subtriangular, and are attached by a broad base - they extend up to and sometimes beyond and above the apices of the styles. Their inner margin is a little concave, and the outer may be almost straight or a little convex. The lower margin is straight, and may be from a third to two-thirds as long as the outer margin. The apex of each clasper is pointed but not acute. The superior claspers are as long as the penis-sheath. The penis-sheath is as long as the epandrium is deep - it is rather convex below in profile. The lingula may be either ellipsoidal (fig. 10), or subquadrangular and slightly broader than long, with rounded corners (fig. 12) - in both cases it is deeply grooved in the mid-line.

Distribution.

Africa south of the Sahara, and Aden.

Arabia, Aden (Verrall, 1898)

Abyssinia, Morako (Bezzi, 1920) ; Cara, Mulata, Wagira (Curran, 1938)

Tanganyika, Kilimanjaro (Speiser, 1910) ; Mto-ja-Kifaru, Moshi (Bezzi, 1920)

Uganda, Nile Province (Bezzi, 1915)

Belgian Congo, Leopoldville (Hervé-Bazin)

Portugese Guinea, Bolama (Bezzi, 1912)

Gabon, Fernan Vaz (Bezzi, 1912)

St. Thomas Island, Ribeira Palma (Bezzi, 1912)

Gold Coast, Ashanti, Obuasi (Bezzi, 1915)

N. Nigeria, Zungeru (Bezzi, 1915)

Liberia, Gbanga, Lenga Town, Reppo's Town (Curran, 1938)

South Africa, Durban (Bezzi, 1915)

I have determined the following specimens :-

South Africa, Grahamstown, at all times of the year, 45♂♂, 19♀♀, in my collection. Ottoshoop, x.1916, 1♀, coll. H.G. Breyer, Louis Trichardt, i-ii.1928, 1♀, coll. R.F. Lawrence, Zululand, M'fongosi, iv-v.1934, 2♂♂, 3♀♀, v.1935, 1♀, ii.1917, 3♂♂, coll. W.E. Jones, in collection of South African Museum. Pondoland, Port St. Johns, 1♂, coll. R.E. Turner, in collection of British Museum.

South West Africa, Hoarusib Otshu, iii.1926, 1♂,4♀♀, Mus. Expdt., in collection of South African Museum.

Southern Rhodesia, Trelawny, 21.xii.1952, 1♀, coll. N.J. Myers, in my collection. Salisbury, 1♀, coll. D. Dodds, in collection South African Museum. Salisbury, 10.ii.1935, 1♀, coll. A. Cuth--bertson, 13.xi.1936, 1♂, in collection Department of Agriculture, Salisbury.

Northern Rhodesia, Laite Bangwelu, Chiluwi Island, Santa Maria Mission, 10.xi.1946, 1♀, coll. M. Steele, in collection British Museum.

Kenya, Nairobi, vii.1930, 1♂, coll. van Someren, Kasete, 9.v.1918, 1♂, coll. T.J. Anderson, in collection Coryndon Museum.

Belgian Congo, Uele, Gangala na Bodio, 14,iv.1936, 1♂, 1♀, coll. L. Lippens ; Basoko, i,iv,v,ix.1949, 6♂♂,2♀♀, coll. P.L.G. Benoit ; Kivu, Rwankwi, 15.xii.1950, 2♀♀, coll. J.V. Leroy ; Rutshuru, 11.v.1936, 1♂, coll. L.Lippens, Kibirizi, 6.ii.1936, 1♂, coll. L. Lippens, loc. not given, 15.vi.1937, 1♂, vii.1937, 2♀♀, coll. Miss. Prophylactique ; Elisabethville, 27.v.1920, 1♂, 1♀, 24.vii. 1932, 1♀, coll Dr. M. Bequaert ; Ituri, Bunia, ii.1934, 1♂, coll. J.V. Leroy ; Bumba, xii.1939-i.1940, 1♀, coll. H.de Saeger ; Bambesa, 17.iii.1933, 1♂, 1♀, coll. J. Vrydagh ; Gandajika, 20.iii.1947, 2♂♂, coll. P. Henrard, Terr, Yahuma, xii.1948, 1♂, coll. P.L.G. Benoit, Bufarasende, xi.1945, 1♀, coll. Mme.L. Lebrun; Sankuru, Komi, iv.1930, 1♂, coll. J. Ghesquiere ; Lulua, Kapanga, xi.1932, 1♂, coll. F.G. Overlaet. In collection Congo Museum.

Fig. 10

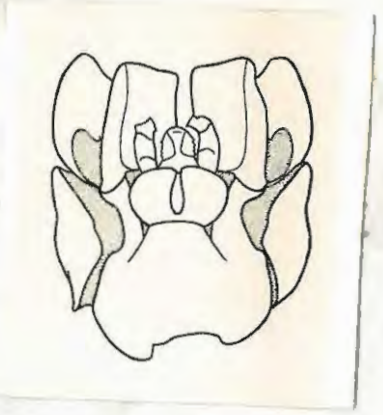

Fig. 11

Fig. 12

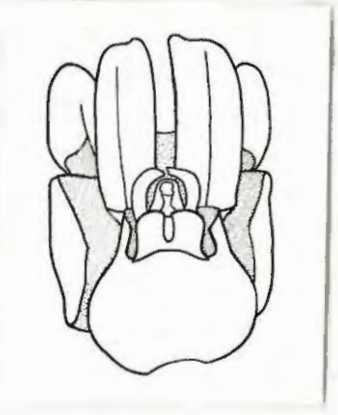

Fig. 13

Figs. 10-13.- Paragus longiventris Loew ; (10)(12) lateral view of hypopygium ; (11)(13) ventral view of hypopygium.

Paragus gracilis sp.n.

A slender, black species with a petilate abdomen, resembling a small Baccha. The stigma is elongated and dark yellow-brown. The microtrichia on the wing membrane are very conspicuous, and extend onto the apical parts of the basal cells and costal cell. The frontal triangle of the male is black, and the vertex is very narrow in both sexes. The superior claspers are sharply pointed apically. This species is related to P. longiventris in the petiolation of the abdomen, reduced puncturation, and other features. It is easily distinguished from longiventris by the shape of the abdomen, the slight suffusion of the wings and distribution of the microtrichia, and the black frontal triangle of the male.

Male. Length 6.6 mm.

Face yellow, without a median stripe ; there is a triangular, colourless patch over the lower part of the tubercle ; tubercle moderately developed, the face distinctly concave above ; facial pile very sparse, thin, and white ; oral margin quite broadly shining fuscous, this colour extending in a narrow strip across the face above the oral tubercle. Frontal triangle black with a few short, dark hairs. Eyes just contiguous. Vertex elongated and very narrow, its width at posterior ocelli about one-tenth of greatest width of head ; it is shining black, with

some longish black hairs behind and a few shorter hairs on the ocellar triangle. There is a small, wedge-shaped patch of tomentum below the anterior ocellus. Ocellar triangle elongated, each side about twice as long as the base - each posterior ocellus almost touches an orbit. Antennae elongated, the third segment subcylindrical and bluntly pointed - it is about 1½ times as long as the first two segments together ; two basal segments very dark brown, with a superficial grey sheen ; third segment crineous, slightly reddish below at the base ; arista brown. Eyes practically bare, with only a few extremely short, scattered hairs.

Thorax black ; mesonotum strongly shining, with very small, scattered punctures above which are slightly more concentrated towards the sides ; mesonotal pile short, sparse and bombycinous ; a strip of bright, silver hairs extends across the mesopleuron and sternopleuron on each side. Scutellum shining black, a little more punctate than the dorsal part of the mesonotum.

Wings slightly suffused ; wing veins very dark brown and heavy ; upper and lower marginal cross-veins only a little sinuous ; stigma brown, elongated ; the microtrichia are numerous, quite long, dark and very conspicuous - they extend over the whole wing including the apical parts of the two basal cells and the costal cell ; the hairs fringing the posterior

Fig. 14

Fig. 15

Figs. 14-15.- Paragus gracilis sp.n. ; (14) abdomen of holotype ; (15) abdomen of allotype.

margin of the wing are unusually long.

Posterior and middle femora dark, resinous brown, pale yellow on the apical eighth and fifth respectively ; the anterior femora are similar but paler, and pale yellow on their apical third. Posterior tibiae dark brown like the femora on a little more than their apical half, and a little reddish at their extreme apex - the basal portion is pale yellow ; middle and anterior tibiae similar but yellow on almost their basal two-thirds, and paler brown on the remainder. Posterior metatarsi dark reddish-brown, with short, closely appressed, golden hairs on the lower surface - the remainder of the segments are tawny ; middle tarsi fulvid ; anterior metatarsi stouter than middle metatarsi, and a little darker above, the other segments fulvid.

Abdomen (fig. 14) petiolate, shining black. First segment broadly rounded behind, with a prominent protuberance at each anterior corner ; second segment forming the petiole, anteriorly narrower than the first segment - the sides taper a little over the anterior half, and are subparallel on the posterior half - the segment is dorsally concave - its posterior end is noticeably swollen ; third segment rather bell-shaped, its anterior end strongly arched - the sides are subparallel for a short distance anteriorly, then diverge rapidly, the posterior part of the segment being slightly wider than the first segment - the anterior half is flattened, but there is a

marked increase in depth over the posterior half ; the fourth segment is of uniform depth throughout its length - its sides diverge a little posteriorly, and the abdomen is widest at its posterior margin - it is more flattened than the third segment ; the fifth segment is transverse and narrow, slightly asymmetrical, and with convergent sides. There is an admixture of brown on the posterior rim of the third segment, the sides and posterior margin of the fourth segment, and most of the fifth segment. There is a slight transverse depression across each side of the fourth segment at about its anterior quarter. The first segment is moderately punctate, except for a broad strip around its posterior margin - the remainder of the segments have small, quite widely spaced punctures, from which arise inconspicuous, reclinate black hairs. The sternites are fusco-piceous.

Holotype.- Male, Belgian Congo, Rutshuru, 11.v.1936, coll. L. Lippens ; in collection of Musee du Congo Belge.

Female. Length 7.2 mm.

Face creamy, with a complete, narrow, brown stripe. Vertex narrow, narrowest just behind the posterior ocelli, where it is one-ninth of the greatest width of the head. Frons fusco-piceous, this colour extending a little below the insertion of the antennae, on each side. Along each orbit is an indistinct strip of silvery tomentum and some scattered silvery hairs.

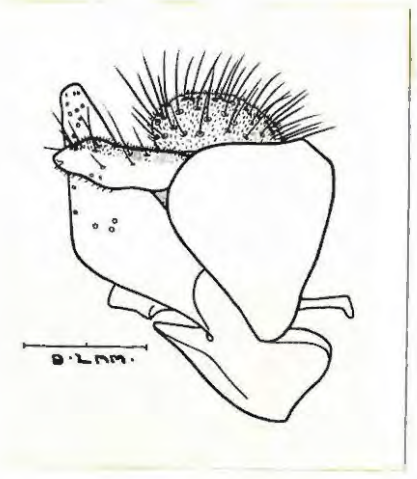

Fig. 16

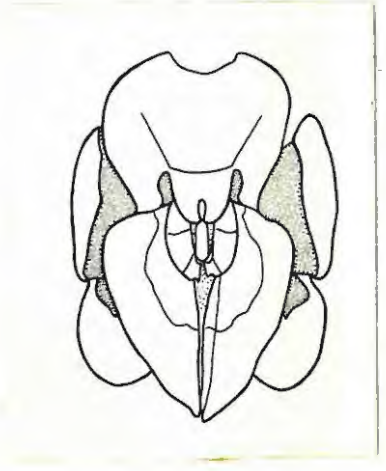

Fig. 17

Figs. 16-17.- Paragus gracilis sp.n. ; (16) lateral view of hypopygium of paratype male ; (17) ventral view of same.

Vertex shining black with a slight admixture of brown. Ocellar triangle almost equilateral, each posterior ocellus a short distance from the orbit on its side.

Mesonotum with some pale violaceous reflections.

Wing veins dark brown ; wing membrane not as suffused as in holotype ; microtrichia not quite as dark as in holotype.

Abdomen (fig. 15) similar in shape to that of the holotype, but the second segment is a little shorter and stouter ; the third segment is subtriangular with an indistinct fold across its anterior third in which there are pale blue reflections ; fourth segment of almost uniform width throughout ; segments five to eight inclusive with a noticeable admixture of brown, and with long, dark, backwardly-directed hairs.

Allotype.- Female, Kenya, Naivasha, vii.1937, coll. H.J.A.Turner; in collection of British Museum ; bears the label "Paragus n.sp.? not in B.M. - van Emden det. 1938."

Paratypes

I have another male and female with same particulars as the holotype, except that the date of capture of the female is 15.v.1936. Both are in the collection of the Musee du Congo Belge. The male is similar to the holotype in every respect, except that the face is dark yellow, and the wings are more heavily suffused, being distinctly brownish. A description of

the genitalia of this specimen follows (see figs. 16,17) :-

Epandrium saddle-shaped, deeper than long, with the lower corner bluntly rounded, though with the lower margins at quite an acute angle. Styles oblong in lateral view, the upper margin slightly curved, the lower a little sinuous. Superior claspers subtriangular, very acute apically, the angle between the outer and lower margins decidedly obtuse - the inner and outer margins are straight - the lower margin is about as long as the outer margin ; the claspers end well above the upper margins of the styles and a little above the level of the cerci - they do not extend horizontally beyond the apices of the styles. each superior clasper is subtriangular in ventral view, the inner margins parallel. Penis-sheath small, not quite as long as the epandrium is deep. Lingula arch-shaped, broadest at its base, and quite deeply grooved in the mid-line.

The female paratype is similar to the allotype except that the sides of the face are yellow and the wings are a little suffused.

Distribution

Central Africa.

Paragus marshalli Bezzi 1915

Bezzi, 1915, p.13, 1920, p.132 ; Curran, 1938, p.20.

A robust, black species with quite coarse puncturation on the thorax and abdomen. The mesonotal pile is moderately long and usually rather sparse - there are sometimes bands of silver and golden hairs on the third and fourth abdominal segments. The antennae are moderately long, rarely quite elongated, usually blackish and rarely with the third segment yellowish-brown. The abdomen is quite elongated, but not markedly subpetiolate - the second segment in the male is as broad or a little broader than long, in the female it is distinctly broader than long and sometimes not much narrower than the rest of the segments.

This species is closely related to P. dolichocerus, from which it is separated by its shorter antennae, longer and less flattened abdomen, and slightly more reduced puncturation.

I have four specimens before me. One of these is a male topotype, from the collection of C.H. Curran. It agrees in every respect with the description given by Bezzi. The vertex, thorax and abdomen are shining black, the former two with some bluish reflections. In shape the abdomen is rather like that of dolichocerus. The second abdominal segment is just a little wider than long. The puncturation on the thorax and abdomen is quite coarse. The vestiture is moderately developed, and there are no distinct bands of white hairs on the abdomen.

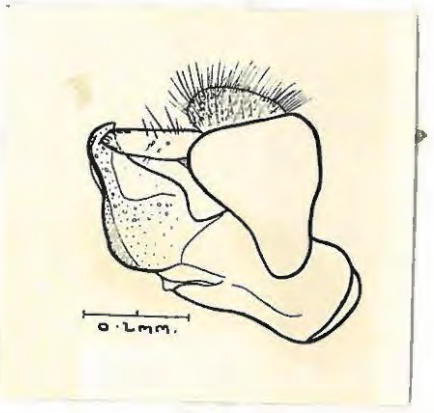

Fig. 18

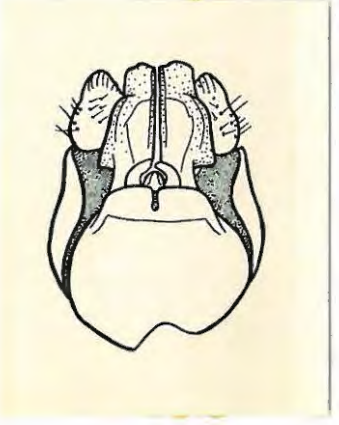

Fig. 19

Figs. 18-19.- Paragus marshalli Bezzi ; (18) lateral view of hypopygium ; (19) ventral view of hypopygium.

The male from Haenertsberg has noticeably well developed vestiture. On each of the second, third and fourth abdominal segments there are broad, irregular bands of golden hairs. The second abdominal segment is as broad as long, and its sides converge posteriorly. The antennae are moderately long - the third segment is very dark brown, and the basal two segments are black. The stigma is brown, and the wing veins are dark brown and heavy.

The female from Willowmore is the largest of the specimens, measuring 7.4 mm. The tomentose strips bordering the orbits on the frons are elongated and silvery. There are pale blue reflections on the thorax and colourless reflections on the abdomen. The second abdominal segment is distinctly broader than long, and distinctly narrower than the third segment. The vestiture on the abdomen is well developed, and there are short, irregular bands of silver and golden hairs on the third and fourth segments. The abdomen is more elongated than in the female of dolichocerus . The stigma is brown, and the wing veins are very dark brown. The face is creamy-white on each side of the median stripe.

The male from the Belgian Congo is the smallest, measuring 5.7 mm. It is slender, and resembles a small Baccha or longiventris. It is remarkable because of its antennae, which are very elongated and yellow-brown. Although the puncturation is quite heavy there is hardly any vestiture on the mesonotum and abdomen. The second abdominal segment is as broad as long.

This seems to be a variable species. Bezzi (1915) states that it is variable in the color of the abdomen and legs. The specimen which he refers to as having completely red femora and reddish genitalia is probably a minutus; he records a female from West Africa with the sides of the third and fourth abdominal segments reddish, and another specimen from the same locality with a clear stigma. The type specimens lack bands of hair on the abdomen, and in the female the second segment is hardly narrower than the remaining segment.

Description of Male Genitalia. (Figs. 18,19)

The epandrium is saddle-shaped, distinctly deeper than long, its lower corner produced and blunt, and its posterior margin sinuous. The styles are oblong, bluntly rounded and slightly serrated apically. The superior claspers are quite large and rather similar in shape to those found in dolichocerus. They are stout and subquadrangular over their basal two-thirds - over the apical third they narrow abruptly, and end in a somewhat reflexed point. They extend a little beyond and above the apices of the styles. The penis-sheath is as long as the epandrium is deep. It is quite deep, and there is no emargination on its posterior rim. The lingula is very broad, but does not project much - its posterior rim is almost straight, and it is quite deeply grooved in the mid-line.

Distribution.

Most of the Ethiopian Region.

Southern Rhodesia, Salisbury ; Melsetter District, Chirinda Forest (Bezzi, 1915)
West Africa, Ashanti, Obuasi (Bezzi, 1915)
Tanganyika, Moshi (Bezzi, 1920)
Liberia, Memeh Town, Reppo's Town (Curran, 1938)

I have determined the following specimens :-
Southern Rhodesia, Salisbury, iv.1901, 1♂, coll. F.L. Snow , in collection of C.H. Curran, Acc. 31144.
South Africa, Haenertsberg, 5.xii.1909, 1♂, coll. C.J. Swierstra, Willowmore, 1♀, coll. Dr. Brauns, in collection South African Museum.
Belgian Congo, Uele,,Gangala na Bodio, 15.iv.1936, 1♂, coll. L. Lippens, in collection Musee du Congo Belge.

It seems to be an uncommon species.

Paragus dolichocerus Bezzi 1915

Bezzi, 1915, pp.13-14 ; Curran, 1938, p.20.

This entirely black species was described on a single female in the British Museum from Marsabit, Kenya. It is related to P. marshalli from which it may be distinguished by its very elongated antennae. Bezzi (1915, p.12), in his key to the

Ethiopian species of Paragus, incorrectly states that the third antennal segment is almost four times as long as the first two segments together - measurements taken from his figure of the antenna of this species, and from the specimens which I have indicate that the third antennal segment is only twice as long as the first two segments together.

Females. Length 6.4-7.6 mm.

Face quite broadly sulphur yellow on the sides, dark yellow in one specimen only. A fusco-piceous stripe present. Facial pile very short and sparse. Frons and vertex shining black - on each side of the frons there is a small strip of silvery tomentum, which is absent in one specimen - there are a few short, pale hairs on the lower part of the frons, and a few short, dark hairs on the upper part of the vertex. Vertex narrow, only about one-eighth of the greatest width of the head. Antennae with the two basal segments blackish, admixed with brown, dark brown in one specimen - the third segment is blackish with a superficial grey sheen above, dark reddish-brown below. Ocellar triangle equilateral. Pile on the eyes short and sparse.

Mesonotum quite heavily punctate. Mesonotal pile quite short and rather thin. Colourless reflections present.

Stigma variable, from dark brown to yellowish-brown except for a darker spot at the base, to almost colourless with a dark spot at the base. Veins dark brown or black. Microtrichia

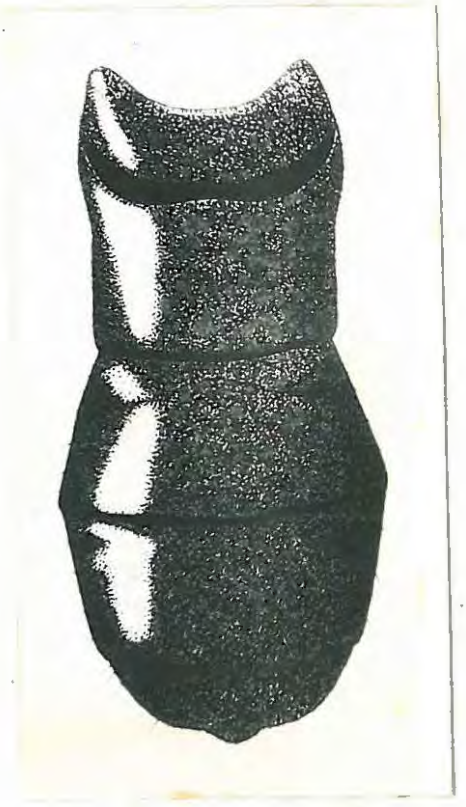

Fig. 20

Fig. 20.- Paragus dolichocerus Bezzi ; (20) abdomen of female.

moderately heavy, giving the wings of some specimens a slightly sooty appearance.

Posterior femora dark fuscous except for the apical fifth or sixth - middle and anterior femora fuscous on the basal half, testaceous in one specimen, yellow on the remainder of the femora. All the tarsi and the apical halves of the tibiae reddish-brown, the remaining halves of the tibiae yellow.

Abdomen (fig. 20) dull black with colourless reflections, quite heavily punctate. All the segments are distinctly flattened. Second segment broader than long, with parallel sides. Sides of third segment divergent posteriorly, the third segment at its posterior margin considerably wider than the second segment. Sides of fourth segment a little convergent posteriorly. The middle three segments are all of equal length. Fifth segment short and broad, its sides quite strongly convergent posteriorly - there is a transverse depression running across this segment. The abdominal vestiture is sparse.

There does not seem to be a description of the male of this species, and so one of the males which I have is described below as the allotype.

Male. Length 7.4 mm.

Face uniformly sulphur yellow. Eyes contiguous for a short distance. Vertex quite narrow, shining black, with a few short, dark hairs. Ocellar triangle with the sides a little

longer than the base.

Left wing missing. Stigma of right wing brown. Wing veins very dark brown.

Femora brown at base.

Second segment of abdomen a little broader than long, its sides slightly convergent posteriorly. Segments three to five not flattened as in the female, but like the condition found in P. marshalli - shape as in female.

Puncturation, vestiture and colouration as in female.

Male Genitalia. (Figs. 21,22).

The epandrium is approximately as long as deep - its lower corner is somewhat produced and acute - its posterior margin is sinuous. The styles have a bluntly pointed and serrated apex. The superior claspers are roughly quadrate, with their upper posterior corner very much produced and projecting above but not beyond the apices of the styles. The lower margin of the superior claspers is deeply arcuate, the outer margin irregularly sinuous. The penis-sheath is about as long as the epandrium is deep - it completely lacks an emargination on its posterior rim, or a lingula of any description. Its posterior margin is subelliptical and entire. The penis-sheath is also peculiar in this species in that the superior claspers are supported on it by projections which arise from its inner ventral surface - normally the superior claspers articulate on lateral processes of the penis-sheath.

Fig. 21

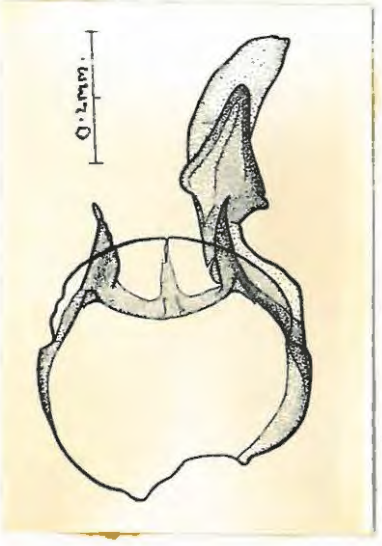

Fig. 22

Figs. 21-22.- Paragus dolichocerus Bezzi ; (21) lateral view of hypopygium ; (22) ventral view of penis-sheath, with one superior clasper attached.

Allotype, Male, Kenya, Naivasha, ix.1939, coll. H.J.A. Turner ; in collection of Coryndon Museum.

Distribution.

East, Central and Southern Africa.

Tanganyika, Marsabit (Bezzi, 1915)

I have determined the following specimens :-

Kenya, Naivasha, ix.1939, 1♂, coll. H.J.A. Turner, in collection of Coryndon Museum.

Belgian Congo, Faradje, 29 40'E. 30 40'N., xii.1912, 1♀, coll. Long and Chapin, in collection American Museum of Natural History. Lomami, Katompe, 20.xii.1923, 1♀, coll. Dr. M. Bequaert ; N. Kivu, riv. Kabarazo, 12.v.1936, 2♀♀, coll. L. Lippens ; E. Rutshuru, Kibirizi, 6.ii.1936, 1♀, coll L. Lippens, in collection Musee du Congo Belge.

South Africa, Zululand, M'fongosi, iv-v.1934, 2♂♂, coll. W.E.Jones, in collection South African Museum.

Paragus minutus Hull 1938

Hull, 1938, pp.124-125, fig.2, pl.viii.

It is rather surprising that this widely distributed and apparently common species was not described until 1938. I have found it in nearly every collection of Paragus that I have been able to examine. Dr. G.E. Wallace of the Carnegie Museum,

Pittsburgh, has kindly compared a male captured in Grahamstown with the holotype of minutus, and has confirmed my identification.

P. minutus is most closely related to P. marshalli and P. dolichocerus, and resembles both rather closely in certain features. It is distinguished by its very coarse puncturation and by its extremely short mesonotal and abdominal pile. The femora are nearly always light reddish-brown - this is the only African species of Paragus that I know of in which they are consistently pale. In the specimens before me from the Belgian Congo the femora are dark, rather resinous brown, but this seems to be exceptional. The shape of the abdomen of the female is rather like that of the female of dolichocerus. though it is not so flattened (Fig. 24). The fifth tergite and postabdomen of the male (see fig. 23) are nearly always dark reddish. There is only rarely some obscure reddish on the whole abdomen. The eighth sternite of the male is large and somewhat conical, and projects prominently from below the fifth tergite, frequently giving the abdomen a rather distinctive appearance. If the abdomen is macerated in hot potash the sclerites become pale brown except that around each puncture there is a conspicuous black spot - these are very numerous, and give the sclerites a rather mottled appearance. The male genitalia are very distinctive, and are characterised by the enormous development of the superior claspers. Specimens from South Africa are on the whole small, while those from the Belgian Congo and Kenya

Fig. 23

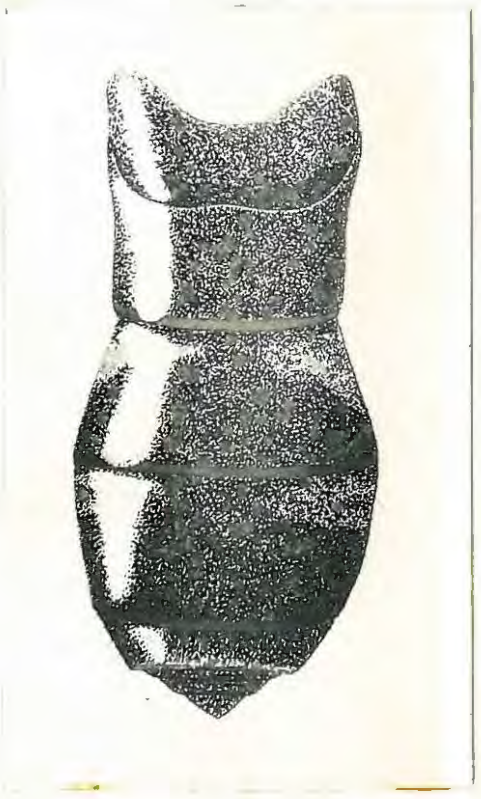

Fig. 24

Figs. 23-24.- Paragus minutus Hull ; (23) abdomen of male ; (24) abdomen of female.

are larger. The largest specimen which I have measures 6.0 mm., and the smallest 4.3 mm.

Hull described only a male. I have selected a female from my own collection for description as the allotype.

Female. Length 4.4 mm.

Face shining creamy-white. A pale median stripe present. Facial pile thin, erect and shining. Basal two segments of the antennae brown, third segment crineous above, pale yellow-brown below. Frons and vertex fusco-piceous, with strong violaceous reflections. An indistinct patch of whitish tomentum present next to each orbit - between these are some short silvery hairs.

Mesonotum black with dark violaceous reflections, coarsely punctate, and with extremely short vestiture.

Stigma brownish-yellow, with a brown spot at the base. Wing veins black.

The legs are testaceous, except for the basal parts of the tibiae and apical extremities of the middle and posterior femora, which are pale creamy.

Abdomen black, with quite strong violaceous reflections. It is very coarsely punctate, especially on the first two segments. Many very short, appressed black hairs are present on all of the segments. A sparse but broad band of short, reclinate, white hairs is present on each side of both the third and fourth segments. The abdomen is a little subpetiolate, the second segment narrower than the others though much broader than

wide. The sides of the third segment are divergent, and the sides of the fourth segment are a little convergent. There is a slight admixture of brown on the sides of the fifth segment. Allotype, female, South Africa, Grahamstown, 3.ix.1952, coll. B. Stuckenberg ; to be deposited in the British Museum.

Description of Male Genitalia. (Figs. 25,26)

Epandrium saddle-shaped, a little deeper than long, with the lower corner bluntly rounded, its margins quite acute. The cerci are unusually prominent. The styles, when viewed laterally, have swollen and somewhat quadrangular apices - over their basal two-thirds the upper and lower margins are parallel. The superior claspers are enormously developed and highly characteris--tic. They are boomerang-shaped, apically broadly rounded, and of uniform width throughout. They extend horizontally well above and beyond the apices of the styles. When viewed ventrally they are elongated and rectangular, the outer margin a little sinuous, the apices narrowly rounded. The penis-sheath is a little shorter than the epandrium is deep. The lingula is arch-shaped, broadest at its base, and longer than in P. gracilis. It is deeply grooved in the mid-line.

Distribution.

Probably the greater part of the Ethiopian Region.

Fig. 25

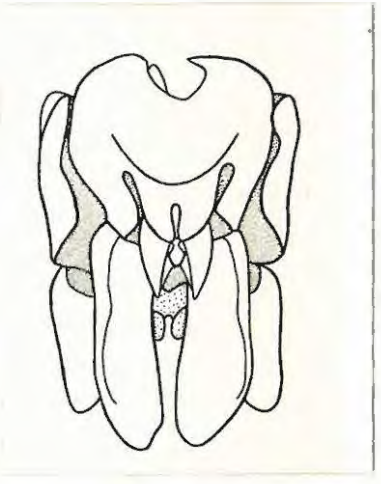

Fig. 26

Figs. 25-26.- Paragus minutus Hull ; (25) lateral view of hypopygium ; (26) ventral view of hypopygium.

Cameroon, Lolodorf (Hull, 1938)

I have determined the following specimens :-
South Africa, Cape Province, Ceres District, 15-30.x.1934, 1♂, coll. M. Versfeld, Ottoshoop, iv.1906, 1♂, coll. H.G. Breyer, Cape Town, i.1915, 1♂, coll. Lightfoot ; Transvaal, Pretoria, 15.ii.1915, 1♂, coll. A. Roberts ; Zululand, M'fongosi, iv-v.1916, 3♂♂, iv-v.1934, 4♂♂, 1♀, iv-v.1935, 1♂, coll. W.E. Jones, in collection of South African Museum. Cape Province, Mossel Bay, iv.1921, 2♂♂, vi.1921, 1♂, 5-31.vii.1921, 1♂, i.1922, 1♂, 1-13.iii.1922, 1♂, 1♀, iii.-iv.1930, 1♂, coll. R.E. Turner, in collection British Museum. Cape Province, Grahamstown, in every month, many specimens of both sexes with males predominating, in my collection.
Kenya, Naivasha, ix.1939, 4♂♂, 2♀♀, iii.1937, 1♀, vii.1937, 2♂♂, iv.1940, 1♂, v.1940, 1♂, coll. H.J.A. Turner, in collection of Coryndon Museum.
Belgian Congo, Ruanda, Gite de Nkuli, 17.iii.1936, 1♂, coll. L. Lippens ; Bomboma, 20.vii.1935, 1♂, coll. A. Bal ; Basoko, iii.1949, 1♀, coll. P.L.G. Benoit, in collection of Musee du Congo Belge.

Paragus tibialis (Fallen) 1817

For synonomy and bibliography up to 1922 see Efflatoun Bey, 1922, pp.22-24 ; Curran, 1938, p.19.

This is probably the commonest and most widely distributed species of Paragus in Africa. It is an extremely variable species, particularly with regard to the colouration of the abdomen, and in consequence numerous synonyms and varieties have been created. Most of these are based on differences in colour markings, and have little value. The species is not endemic to Africa. It also occurs in Europe, Asia Minor, the Oriental Region, Australia, and North and Central America.

A special study has been made of the variation in colouration of the abdomen. In all, 146 specimens of tibialis have been examined. These were graded according to the degree of development of testaceous markings on the abdomen, on the following arbitrary scale :-

1. Abdomen entirely black
2. The third tergite just showing a trace of testaceous colour
3. The third tergite almost entirely testaceous (fig. 28)
4. Tergite three and part of tergite four testaceous (fig. 27)
5. Tergites three, four and five completely testaceous

The division of the specimens on this basis was as follows (Table 1) :-

Table 1

Category	Number of males	Number of females
1	7	8
2	7	12
3	20	25
4	21	21
5	21	4
total	76	70

The typical condition ie. category 1, is apparently rare, as the abdomen is marked to some degree in approximately 90% of the specimens examined. In the greater majority of the specimens the abdomen is conspicuously reddish. This is in agreement with Efflatoun Bey's (1926) remarks on Egyptian specimens of tibialis. The difference in development of testaceous markings is not sexual, as in both sexes the entire range of colouration occurs in roughly equal proportions.

An unsuccessful attempt was made to correlate the development of testaceous markings with the size of the individual (Table 2) :-

Table 2

Category	Average length (mm.)	
	Males	Females
1	4.4	5.0

Fig. 27 Fig. 28

Figs. 27-28.- Paragus tibialis (Fallen) ; (27) abdomen of male ; (28) abdomen of female.

2	4.6	5.1
3	4.75	5.1
4	4.9	5.1
5	4.7	4.9

It is suggested that the causes of this variation in colouration in tibialis and other species of Paragus are comparable with those which Arnold (1946, pp.49-50) believes bring about differences in colour and pubescence patterns in certain so-called races of Mutillidae. He has put forward the idea that these differences are dependent on the quality of the food which the wasp larvae receive. Each species of Paragus whose life history is known has been recorded attacking aphids of several genera found on a wide range of host plants, and this may have some effect on pigmentation in the adult flies. The quantity of food does not seem to be significant, because in the case of tibialis a certain colour form is not restricted to individuals of a certain size. Arnold (1944) found that in those species of Sphecids exhibiting xanthochroism there is a definite relationship between colour and size.

The ground colour appears to vary in specimens of tibialis. It is more usually black with purplish reflections, more uncommonly black with steel blue reflections. These differences do not appear to be correlated with either size, sex or geographical distribution of the individuals.

Bezzi (1920) has described a variety of tibialis, nasutus,

from Kenya. He distinguishes it by its small stature, more produced and very dark face, and black third antennal segment. I have found this variety in Grahamstown. A black third antennal segment is not uncommon in specimens that have the sides of the face yellow.

Description of Male Genitalia. (Figs. 29,30)

I have compared the genitalia of African specimens with that of topotypical material, and can see no variation apart from slight differences in the shape of the styles.

The epandrium is distinctly longer than deep - it is subrectangular, and has the lower corner produced and rather acutely rounded. The styles are oblong, stouter at the distal end, with the lower margins almost straight, and the upper sinuous and irregular. Apically the styles are truncated. The superior claspers are small, subquadrate, and inconspicuous. They do not extend beyond or above the apices of the styles. In ventral view the superior claspers are subrectangular, with the outer margins a little concave. The penis-sheath is twice as long as the epandrium is deep. The emargination on its posterior rim is quite widely open. The lingula is very characteristic - it is like an equilateral that has each side slightly concave. It is supported within the emargination on a short projection of the rim of the penis-sheath. There is a short but quite broad groove in the mid-line.

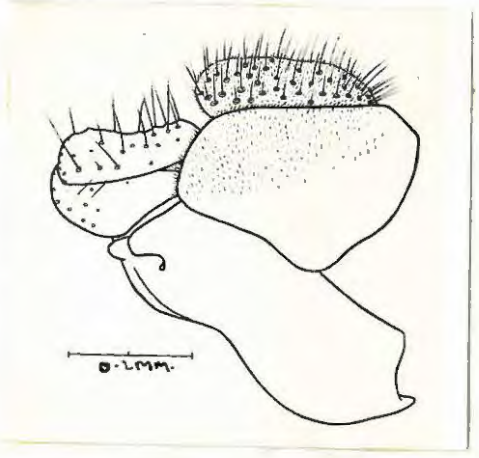

Fig. 29

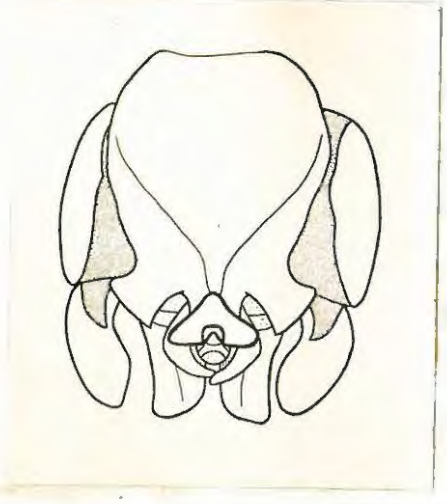

Fig. 30

Figs. 29-30.- Paragus tibialis (Fallen) ; (29) lateral view of hypopygium ; (30) ventral view of hypopygium.

Distribution

The distribution of this species outside Africa has been mentioned above. In Africa it has been recorded over most of the continent, except in those regions that are very arid. Hence it would be of little value to summarise the known records of tibialis. I have it from many places in South Africa, and also from South West Africa, Kenya, and Southern Rhodesia.

Paragus nigrocoerulea Hull 1949

Hull, 1949, pp. 731-732.

This species is based on a single female in the British Museum, which was captured in South West Africa by R.E. Turner. Hull distinguishes it from tibialis, with which he related it, by the presence of distinct bluish reflections on the thorax, and by the very wide frons.

I am unable to distinguish it from tibialis. As I mentioned above, numerous specimens of tibialis show bluish reflections on the thorax and abdomen. I have found a female of this variety amoxng unnamed material from the British Museum, which was taken in South West Africa by Turner at the same time as the holotype was found. It, and several other similar specimens from South West Africa have been compared with Hull's description, and the only character in which they differ is the width of the frons. Mr. H. Oldroyd of the British Museum has kindly compared

a female showing blue reflections, from Grahamstown, with the holotype of nigrocoerulea. He has confirmed that the only difference between them is the wider frons of tha latter species. The status of nigrocoerulea must remain in doubt until further specimens are obtained.

Paragus punctatus Hull 1949

Hull, 1949, pp. 732-733

This apparently rare species was described on a single female taken at Swellendam, Cape Province, South Africa in November 1933 by R.E. Turner. I have a female from Grahamstown (30.viii.1952). It agrees very well with Hull's description, except that it is larger than the holotype, measuring 7.2 mm. The vestiture is conspicuously well developed, the mesonotal pile in particular being quite dense and very long on the scutellum. There are many long, black, erect hairs on the vertex, and on the lower part of the frons there are some shorter, very silvery hairs. The antennae are completely black and rather elongated, noticeably more so than in tibialis. The vertex is narrow and is about one-fifth of the greatest width of the head as against one-quarter in females of tibialis. The face is not as produced as in tibialis. The stigma is pale brownish-yellow.

I have found a male which I believe is of this species amoung unnamed material of Paragus from the British Museum. This specimen is labelled exactly as the holotype is. It is described below as the allotype.

Male. Length 5.0 mm.

Entirely black with colourless reflections. It differs from the holotype in that the third antennal segment is not black but dark reddish-brown, and the arista is brown. The face is only weakly tuberculate. The eyes are just contiguous, the orbits straightened for a short distance at their closest approximation. The ocellar triangle is equilateral, and each posterior ocellus is close to an orbit.

The thorax and abdomen are rubbed, and most of the vestiture is missing. The remaining mesonotal pile is long, especially that on the scutellum. The puncturation on the thorax and abdomen is quite well developed, the punctures being distinct and quite widely separated from one another - the puncturation is uniform over the whole abdomen.

The stigma is dirty brownish-yellow. The veins are very dark, almost black, and heavy. The microtrichia are conspicuous and extend over the whole wing except for the basal cells and costal cell.

Male Genitalia. (Figs. 31,32).

The epandrium is trapezoid, a little longer than deep, with the lower corner not produced but broadly and bluntly rounded.

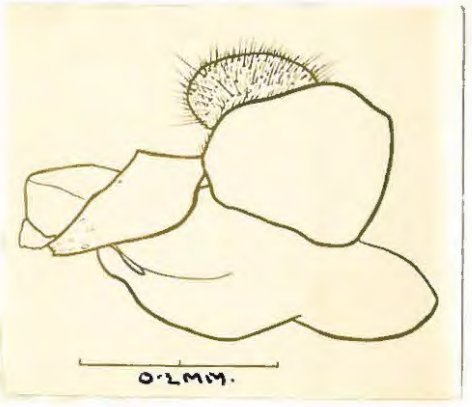

Fig. 31

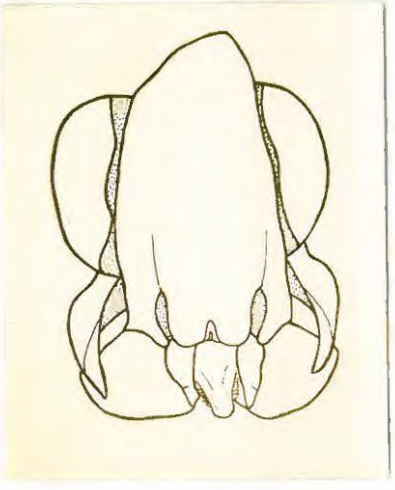

Fig. 32

Figs. 31-32.- Paragus punctatus Hull ; (31) lateral view of hypopygium of allotype ; (32) ventral view of same.

The styles are unusually well developed and prominent - they expand rapidly outwards from a narrow base, and are widest across their basal quarter - over their apical three-quarters they narrow steadily, ending in a truncated apex that is slightly serrated. Their upper margin is drawn out into a sharp corner at the widest part of the style - the lower margin is arcuate. The styles curve inwards. The superior claspers are subquadrate and are unusual in that they do not lie in vertical but in inclined planes, their lower edges directed inwards. They are inconspicuous in lateral view but prominent in ventral view - they project beyond but not above the apices of the styles. The penis-sheath is very elongated - it is twice as long as the epandrium is deep. The lingula is subrectangular, not constricted at the base, the corners rounded, and with a moderately deep groove in the mid-line.

Allotype, male, South Africa, Cape Province, Swellendam, xi.1933, coll. R.E. Turner ; in collection of British Museum.

Distribution.

South Africa

Paragus naso sp.n.

This species belongs to the tibialis group. It is related to punctatus, from which it may be separated by the more pronounced facial tubercle (see fig. 33), the reduced puncturation,

and the broader vertex. It is easily distinguished from tibialis by the colour of the stigma, the longer mesonotal pile, and the reduced puncturation. The compound eyes are not contiguous in the male. The male genitalia are characterised by the enormously developed superior claspers.

Male. Length 5.4 mm.

Most of the face below the tubercle missing, that remaining a dirty yellow. Tubercle prominent, reaching forward almost as far as the apex of the porrect antennae. Facial pile silvery-white, and thin. A quite broad black median stripe present, extending to the base of the antennae. The antennae are inserted in the centre of a strongly shining, fusco-piceous patch which extends from orbit to orbit. Frontal triangle dark yellow. Eyes not contiguous, but separated by a space approximately equal to the distance between the anterior ocellus and one of the posterior ocelli. The orbits are sharply angulate at their closest approximation. Vertex quite broad, entirely dull black - anteriorly this colour ends abruptly in a straight line between the angles of the orbits, sharply differentiated from the yellow of the frontal triangle. Some quite long, pale hairs are present on the vertex behind the ocelli, and some slightly shorter black hairs on the ocellar triangle and upper part of the frons. There are a few short, silvery hairs on the frontal triangle. Ocellar triangle placed quite far forwards,

its base a little longer than the sides. The basal two segments of each antenna are dull black. The third segment is dull reddish-brown with a slight superficial grey sheen - it is distin--ctly paler than the basal segments, it is suboval, broadest at the anterior third, and about 1½ times as long as the first two segments together. Arista brown. Eyes with some scattered white hairs, mostly on the anterior part of the lower half. Oral margin bordered below by silvery hairs which are as long as those on the posterior part of the vertex.

Thorax pitchy black, with rather dull, colourless reflections. Mesonotum very smooth, almost apunctate, those punctures that are present minute and widely spaced. Mesonotal pile very long, thin, and pale, shining yellow - it is shortest in front, longest on the posterior margin of the scutellum. Scutellum piceous with strong colourless reflections.

Wings rather narrow, hyaline, with some coloured reflections. Stigma brown, veins very dark brown and quite heavy. Microtrichia small but dark and numerous - they cover all of the cells except the first basal and costal cells, only sparsely present on the second basal cell.

Posterior femora rather dull black, except for the apical seventh which is yellow - they have some very long, pale hairs on their outer surface. Anterior and middle femora similar, but with a slight admixture of brown - the apical third of each anterior femora is pale testaceous. Posterior tibiae yellowish-

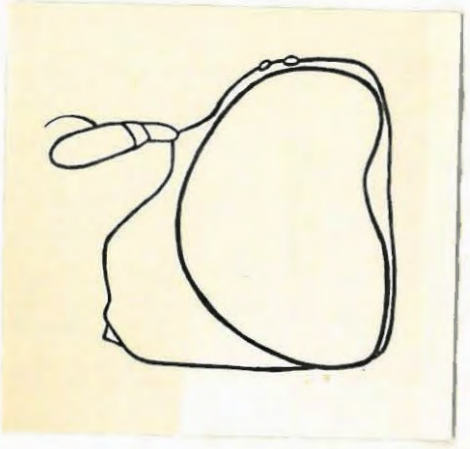

Fig. 33

Fig. 33.- Paragus naso sp.n. ; (33) profile of head.

testaceous on almost the basal half, then with a quite extensive band of brown, finally the apical fifth tawny. Middle and anterior tibiae tawny, slightly paler at the base. All the tarsi tawny, the posterior pair slightly darker than the others.

First abdominal segment black with dull,colourless reflections. Second segment similar. Third segment a dark, transluscent reddish-brown, almost completely black on its anterior margin, and with some darker areas over the sides. Anterior margin of fourth segment a similar dark, reddish-brown, this colour extending down the left side of the segment, and merging rapidly into fusco-piceous on the remainder of the segment. Fifth segment transluscent testaceous. The sides of the second segment are straight, and converge a little posteriorly so that the posterior rim is narrower than the anterior part of the segment. The widest part of the next three segments taken together is across the posterior margin of the third segment, which is a little wider than the second segment at its posterior margin. The second segment is a little concave above. There is a trace of a transverse depression on each side of the third segment at the anterior third, and a distinct transverse trough on each side of the fourth segment at the anterior third. The first two segments are moderately punctate - some punctures on the second segment are arranged in rows. The punctures become progressively smaller and more widely spaced on each of the next three segments - on the fourth segment they are minute, and on

the fifth segment they are hardly noticeable. Vestiture of abdomen white. On the posterior margin of the second segment is a semicircular area of short, stiff, semi-erect, black hairs.

Male Genitalia. (Figs. 34,35)

The epandrium is a little longer than deep. The styles are flattened, and lie in a horizontal plane - seen laterally they are long and narrow, and truncated apically - each style is about as long as the greatest depth of the epandrium. The superior claspers are enormously developed - they are very long and broad, as long as the epandrium, aurate, projecting backwards and upwards. The apex is broad and rounded. The upper margin is concave, the outer margin somewhat convex - ventrally there is a short but prominent, rounded lobe. Seen ventrally the superior claspers are rather like pen-knife blades in profile - the outer margin is strongly sinuous, the inner a little so. The penis-sheath is about 1½ times as long as the greatest depth of the epandrium. The lingula is split into two halves, each half is directed away from the median line.

Holotype, male, Kenya, Chyulu Hills, 5200 ft., Mus. Expdt., iv.1938; in collection of Coryndon Museum.

Female. Length 5.4 mm.

The facial pile is moderately thick. The face is produced forwards (fig, 33) conspicuously - it is vertical for a short distance below the antennae, then it is abruptly angled at about 45 from the vertical into the tubercle which is large and laterally

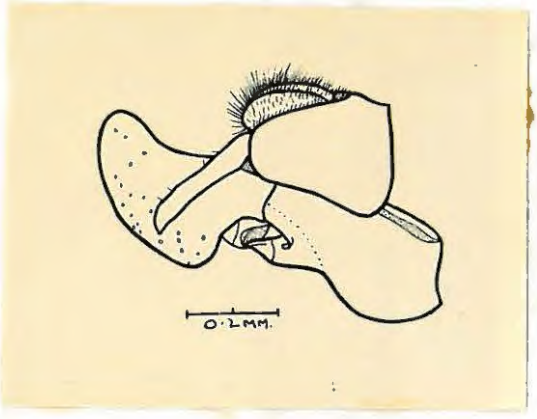

Fig. 34

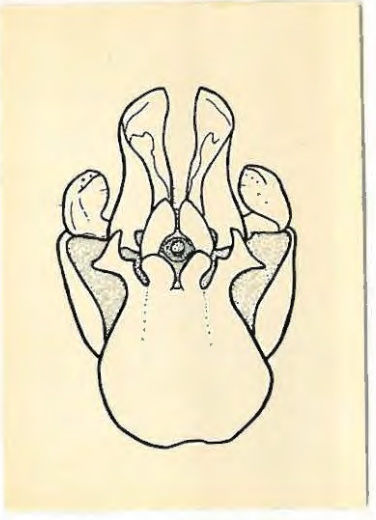

Fig. 35

Figs. 34-35.- Paragus naso sp.n. ; (34) lateral view of hypopygium of holotype ; (35) ventral view of same.

narrowed - between the tubercle and the oral margin the face is not concave. The facial stripe is broad and fusco-piceous, merging below with a broad fusco-piceous strip that borders the oral margins - above it expands into a large fusco-piceous area surrounding tha base of the antennae, extending to the orbits on each side - just above the antennae this colour merges suddenly into the darker of the frons. The lower half of the frons, immediately above tha antennae, is flattened and shows strong blue-grey reflections - this area has many minute punctures from which arise short, erect, white hairs. Above this flattened area the frons dilates a little and with the vertex becomes slightly convex. The vertex has quite strong, bluish reflections and a few pale cupreous reflections. It is approximately one-quarter of the width of the head.

Abdomen entirely black, with quite strong colourless reflections. The second segment is of uniform width throughout and a little narrower than the third segment at the latter's posterior margin. Puncturation as in holotype. Vestiture similar, but there are a few suberect, short, stiff, black hairs on the third and fourth segments aswell as on the second segment. On the fifth segment there are many long, backwardly-directed, white hairs. On each side at about the anterior third of both the third and fourth segments is a distinct transverse furrow which ends in a lateral crease.

The Ethiopian Species of *Paragus* s.str.

Four species of this subgenus occur in the Ethiopian Region. Three of these are related to *P. serratus* (Fabricius), and are to be described in a later paper. The fourth species is *P. borbonicus* Macquart. *P. aegyptius* Macquart, though common in Egypt (Efflatoun Bey, 1922), has not been recorded in the Ethiopian Region.

The male genitalia are complex and show very great interspecific differences in this subgenus. They are characteri--sed by the small but often complex superior claspers, and the articulation of the epandrium on the corners of the penis-sheath. A description of the genitalia of the subgenotype is given below :-

Description of Male Genitalia of *Paragus bicolor*. (Figs. 36-38)

The epandrium is elongated and trapezoid, deeper anteriorly than posteriorly, and over $1\frac{1}{2}$ times as long as deep at the anterior end. The lower, posterior corners are rounded. The cerci are small, and are placed at the extreme end of the epandrium. The styles are stout and short - they are subrect--angular, with the upper, distal corner prolonged into a sharp point which is slightly deflexed at the tip - the upper margin is almost straight, and the lower is angulate. The styles are approximately as long as the greatest depth of the epandrium.

Fig. 36

Fig. 37

Fig. 38

Figs. 36-38.- Paragus bicolor (Fabricius); (36) lateral view of hypopygium ; (37) ventral view of same ; (38) superior clasper.

The superior claspers (fig. 38) consist of a rather rounded base which is produced into a short, bluntly-pointed spine at one end - attached to the base immediately above the attachment of this spine is an upright, elongated arm, which is enlarged at its base but which is of approximately uniform width over its apical two-thirds. The outer surface, apex and upper edge of this upright process bears numerous prominent, short, sharp spines. This arm is dorsal and points cephalad *in situ*. There is no distinct emargination on the penis-sheath, but there is a well developed lingula. The lingula is subrectangular, deeply excised on the apical margin, with numerous small, sessile spines on its apical rim. There are two very prominent, posteriorly directed spines on each side of the posterior rim of the penis-sheath.

Paragus borbonicus Macquart 1842

Macquart, 1842, p.106 ; Loew, 1860, p.296 ; Bezzi, 1908, p.73 ; Kertesz, 1910, p.4 ; Bezzi, 1912, p.402 ; Hervé-Bazin, 1914, p.281 ; Bezzi, 1915, p.12 ; Bezzi, 1920, p.132; Curran, 1927, p.51 ; Curran, 1938, p.20.

This is a widely distributed and common species. It was described on material from Mauritius and Reunion. It is easily recognised by its very broad, shield-shaped abdomen that is

usually conspicuously banded with yellow, and by the golden hairs on the mesonotum. As Macquart noted, the abdomen of the male is much more broadly yellow than that of the female. In the male (fig. 39) there is typically a broad, yellow band extending over the entire third segment, and most of the second and fourth segments as well. This fascia is narrow in the female (fig. 40), extending across the posterior half of the second segment and the anterior third or half of the third segment. In some specimens the yellow may be tinged with brown, or exceptionally the whole abdomen may be dull reddish-brown. Intermediate forms, in which the yellow band is a little more extensive than the condition found in the typical female, are found, and exceptionally males occur with the abdomen coloured like a typical female, and visa versa. I have examined 164 specimens of this species, and grouped them as follows (Table 3):-

Table 3

	Number of males	Number of females
1. Typical male condition (fig. 39)	79	1
2. Typical female condition (fig. 40)	4	57
3. Intermediate form	18	5
	101	63

P. borbonicus is very variable in size, the smallest specimen which I have measuring 3.5 mm., and the largest 5.4 mm. The average size is about 4.8 mm.

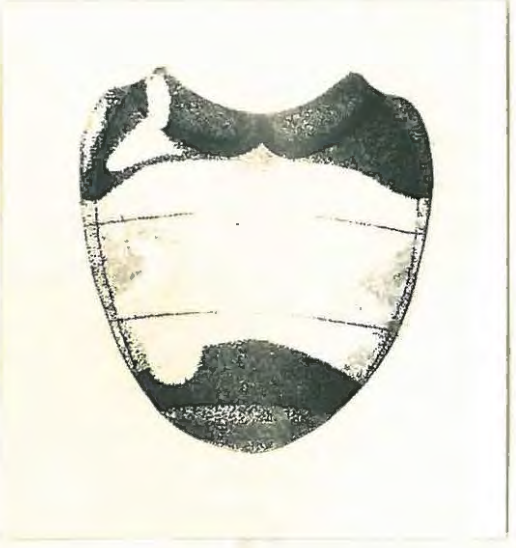

Fig. 39

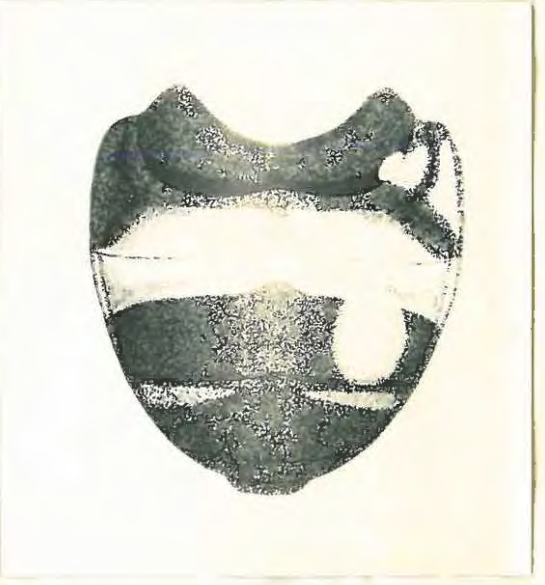

Fig. 40

Figs. 39-40.- Paragus borbonicus Macquart ; (39) abdomen of typical male ; (40) abdomen of a typical female.

Description of Male Genitalia. (Figs. 41-43).

The epandrium is trapezoid, with the upper and lower margins subparallel and rather sinuous - its greatest length is about twice its greatest depth. The styles are large and rather falciform - they are angulated over their middle, forming approximately a right-angle, the apex attaining the lower rim of the penis-sheath - they taper distally and end in points. Each superior clasper consists of a flattened, four-lobed base (fig. 43) - one of the anterior lobes is developed into an almost recurved hook, and the other anterior lobe is pointed - the two remaining lobes are large and irregular. Attached to this base, just above the base of the pointed lobe is an upright, elongated, flat, apically rounded process that is inflexed over a little more than its distal third - it has sinuate margins. The penis-sheath is shallowly U-shaped in transverse section - its posterior rim is simple and almost straight - there is no emargination and no lingula. On the ventral surface of the penis-sheath (fig. 42) there is a roughly rectangular area where the sclerite is thinner and more transparent - this involves most of the lower anterior margin, but does not extend to the posterior margin.

Distribution.

This species occurs over most of the Ethiopian Region. It has been recorded from Mauritius, Reunion, Sierra Leone, Liberia, Kenya, Belgian Congo, and South Africa. I have specimens

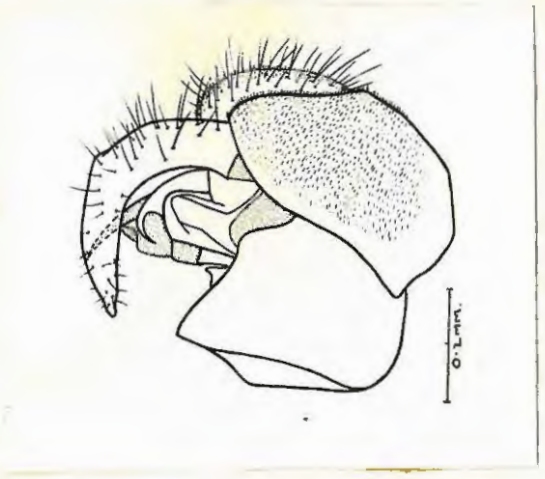

Fig. 41

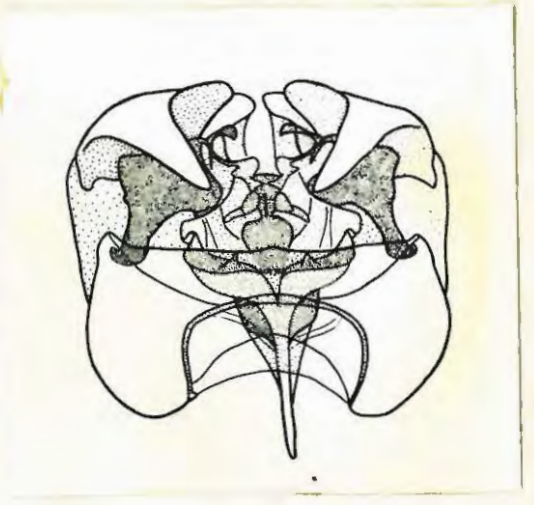

Fig. 42

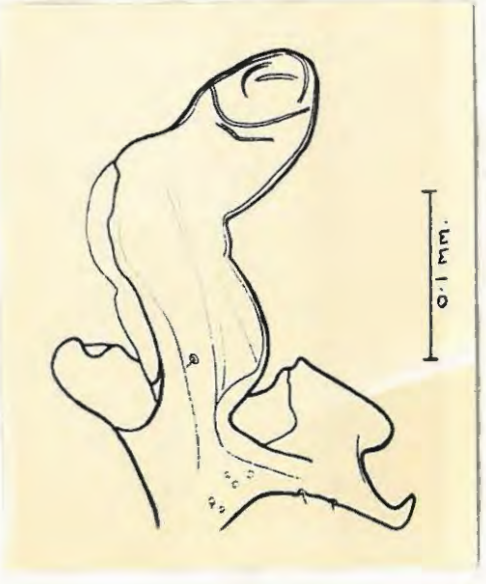

Fig. 43

Figs. 41-43.- Paragus borbonicus Macquart ; (41) lateral view of hypopygium ; (42) ventral view of hypopygium ; (43) superior clasper.

from South West Africa, South Africa, and Zululand. A puzzling feature of the distribution of borbonicus in South Africa is the fact that it does not occur south of Durban, but ranges everywhere else in Africa south of the Sahara.

SUMMARY

Most species of Paragus are very variable, sometimes difficult to identify, and easy to confuse one with another. Because of this a special investigation was made of the taxonomic value of the male genitalia. It was found that a multitude of characters are available in the genitalia. These show great interspecific differences, but are very constant within a species.

A subdivision of Paragus Latreille into two subgenera is proposed. These are Paragus s.str., for P. bicolor, and Pandasyopthalmus subgen.n. for P. longiventris. The former includes those species that have the hair on the eyes arranged in vertical stripes, and in which the epandrium articulates on the corners of the penis-sheath. Pandasyopthalmus includes those species in which the hair on the eyes is not arranged in stripes, and which have the epandrium articulating on the sides of the penis-sheath.

Two new Ethiopian species of Paragus, P. gracilis and naso,

are described, together with allotypes of *minutus* Hull, *punctatus* Hull, and *dolichocerus* Bezzi. The known Ethiopian species of *Paragus* are discussed, and figures and descriptions of the male genitalia are given for each species. The validity of *P. nigro-coerulea* Hull is queried.

Keys to the species are given, based on external and genitalic characters.

ACKNOWLEDGEMENTS

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