

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 117. SEPTEMBER 1897.

XXV.—*On the Genera and Species of Tropical African Arachnida of the Order Solifugæ, with Notes upon the Taxonomy and Habits of the Group.* By R. I. POCK, of the British Museum of Natural History.

THE Ethiopian Region, or that part of Africa which lies to the south of the Sahara, is singularly poor in genera of Solifugæ. Two at most, namely *Hexisopus* and *Ceroma*, are peculiar. The others are common to the Mediterranean district of the Palæarctic, but of these only *Solpuga* can claim to be regarded as typically Ethiopian, since the rest are to be looked upon as emigrants southwards from the desert tracts of Egypt and Nubia to physically similar areas in the countries of the Somali and Masai. This dearth of genera, however, is largely counterbalanced by richness in the number of species of the genus *Solpuga*, which spreads from Somaliland and the Congo over the whole of South Africa, including Cape Colony. It is with some of the species of this genus that have recently come to hand that this paper largely deals. The notes concerning habits have been principally collected from the material on this subject kindly supplied by Mr. G. A. K. Marshall.

The African genera may be classified according to the following table. Most of the genera not represented in the Ethiopian Region will, I suspect, fall into the Solpuginæ of the family Solpugidæ, though, perhaps, a few subfamilies in addition to the two here recognized will have to be ultimately established.

- a.* Legs short, posterior three pairs very robust, with their distal segments strongly spined; fourth leg subequal to third in length, without claws, its coxa and trochanter (three basal segments) as long as the rest of the limb and furnished with only three malleoli* (according to Simon) Fam. HEXISOPODIDÆ, nov.
- b.* Legs long or short, fourth pair at most weakly spined and considerably longer and stronger than the others, armed with two claws†, its coxa and trochanter much shorter than the rest of the appendage and bearing five malleoli on each side in the adult‡.
- a*¹. Abdominal tracheal stigmata lying behind and under the posterior margin of the second and third sternal plates and protected by comb-like plates; basal segment of claws hairy; tarsus of palp freely movable. Fam. GALEODIDÆ (s. s.).
- b*¹. Abdominal tracheal stigmata visible upon the posterior margin of the second and third sterna, lying in a triangular excision of the plates; claws free from hairs; tarsus of palp immovably fused to the protarsus Fam. SOLPUGIDÆ (s. s.).
- a*². Anal segment small, subcircular, the anal aperture extending from its inferior almost up to its superior edge. Subfam. *Solpuginæ*, nov.
- b*². Anal segment of large size, transversely elliptical, the anal aperture not extending more than halfway from its lower border towards the dorsal border§ Subfam. *Rhagodinæ*, nov.

* I have applied the term *malleolus* to the racquet-shaped organs situated upon the basal segments of the fourth leg.

† The genus *Gnosippus*, Karsch, represented by one species from Egypt, and probably belonging to the Solpugidæ, is described as having no claws on the legs of the fourth pair. It is also said to be peculiar in that the coxa of this limb is nearly as long as the femur. But a glance at the figure of this appendage shows that Karsch has mistaken the coxa for the trochanter. As a matter of fact, the trochanter is scarcely longer than usual; but, if the figure is to be trusted, it presents the unique character of being undivided instead of bisegmented as in the rest of the order. The segment which Karsch refers to as the trochanter is the segmented basal end of the femur.

‡ ? *Zombis* of Simon, based upon a specimen from Jaffa, and said to be characterized by the possession of only three pairs of malleoli, three tarsal segments on the third and fourth legs, and only a pair of setæ on the ocular tubercle. But, as is explained below (p. 258), the number of malleoli, of tarsal segments, and of ocular setæ is often but an indication of immaturity, and that it is probably so in the case of *Zombis* may be inferred from the fact that the type, *pusiola*, is only 9 millim. long.

§ First pointed out by Hansen, Ent. Meddel. iv. p. 191.

Family **Hexisopodidæ**.

This family contains the single genus *Hexisopus*, represented by two species confined, so far as is at present known, to South Africa. The generic synonymy is as follows:—

Aellopus, C. Koch, Arch. Naturg. 1842, pt. i. p. 354; id. Uebersicht des Arach.-syst. pl. v. p. 97 (1850) (nom. præocc.).

Hexisopus, Karsch, Berl. ent. Zeitschr. xl. p. 109 (1879).

The two described species are:—

- (1) *Hexisopus lanatus*, C. Koch, Arch. Naturg. 1842, pt. i. p. 354; id. Die Arachniden, xv. p. 102, fig. 1489 (sub *Aellopus*).

Loc. Cape of Good Hope.

- (2) *Hexisopus fodiens*, Simon, Ann. Soc. Ent. France, 1887, p. 374, pl. vi. figs. 6 & 7.

Loc. Kalahari Desert.

The British Museum has no representative of this interesting Arachnid.

Family **Galeodidæ** (sensu stricto).Genus **GALEODES**, Olivier.

Galeodes, Oliv. Encycl. Méthod. vi. p. 579 (1791).

Rhax, Hermann, Mém. Ins. Aptérol. pp. 13 & 15 (1804).

Type *araneoides*, Pallas.

Olivier established the genus *Galeodes* for the reception of two species, namely *Phalangium aranoïdes* of Pallas and the South-African species which he himself described as *setigera*. C. Koch (Arch. Nat. 1842, pt. i. p. 350 &c.) first dismembered the genus and applied the term *Galeodes* to the *araneoides* section, thus selecting the latter as its type.

Rhax of Hermann is stated by its founder to be synonymous with *Galeodes* of Olivier. Consequently C. Koch had not the power to apply the name to species not included by Olivier under *Galeodes*.

The genus *Galeodes* nearly resembles *Rhagodes* (cf. *infra*) in distribution, being essentially a Palæarctic form, but extending into Somaliland, where it is represented by the Arabian and Egyptian species *G. arabs*, C. Koch.

Family Solpugidæ.

Subfamily RHAGODINÆ, nov.

This group is established for the reception of the single genus hitherto known as *Rhax*, for which I propose the new name *Rhagodes*, the term *Rhax* having been up till now used by myself and others in a sense inadmissible according to the rules of nomenclature I adopt (*vide suprâ* under *Galeodes*).

Like *Biton* and *Galeodes*, *Rhagodes* is also an alien from the Palæarctic Region, being found in abundance all over Persia, Afghanistan, parts of India, and Africa north of the Sahara. On the west of Africa it extends as far south as Gambia and on the east as far as Somaliland, Mombasa, and Masailand.

Subfamily SOLPUGINÆ, nov.

The Ethiopian genera may be recognized by the following table:—

- a. Tarsi of second and third legs composed of four segments, of fourth of seven segments.
 - a¹. Ocular tubercle with many bristles; rostrum not deflexed apically; protarsus of palp in ♂ scopulate beneath *Solpuga*.
 - b¹. Ocular tubercle with a few symmetrically arranged bristles, the anterior two very long; rostrum apically deflexed; protarsus and tarsus of palp in ♂ not scopulate but armed below with many short strong spines *Zeriassa*, nov.
- b. Tarsi of second and third legs composed of not more than two segments, of fourth leg of not more than four segments.
 - a². Fourth tarsus four-jointed, second and third tarsi two-jointed *Biton*.
 - b². Fourth tarsus composed of but one or two segments.
 - a³. Tarsi of posterior three pairs of legs two-jointed.. *Ceroma*.
 - b³. Tarsi of posterior three pairs of legs one-jointed.. *Paracleobis*.

Genus PARACLEOBIS, Poc.

Ann. & Mag. Nat. Hist. (6) xvi. p. 95 (1895).

Type *P. dorsalis*, Latreille.

This genus is equivalent to *Gluvia*, C. Koch, as restricted by Simon, who, in 1879, selected *striolata* as its type. Simon, however, believed that *striolata* was synonymous with *dorsalis* of Latreille; but according to Karsch (Arch. Nat. 1880, p. 237) this is an error. Consequently since *Gluvia* has been affixed definitely to *striolata*, the genus typified by

dorsalis was without a name until I applied *Paracleobis* to it in 1895.

Like most of the other genera of Solpuginæ, *Paracleobis* is not typically an African form, its species being found in the countries bordering the Mediterranean basin. A few species, however, have been described from Somaliland and Socotra.

Genus BITON, Karsch.

Arch. Naturg. 1880, p. 234.

The two genera, *Dæsia* (type *præcox*, C. Koch, from Mexico) and *Biton* (type *Ehrenbergi*, Karsch, from Arabia), established by Karsch, are, according to their diagnoses, indistinguishable, as Simon has pointed out (Ann. Mus. Genov. xviii. p. 253, 1883). If this be the case in reality, the name *Dæsia* has the priority; but until the type of *Dæsia* has been thoroughly re-examined it appears to me to be wiser, for geographical reasons, to look upon the two genera as distinct.

Though included in the above table of genera, the genus *Biton* does not, properly speaking, belong to the African—that is to say, the Ethiopian—fauna, being merely an alien from the Mediterranean district of the Palæarctic. The known species have been recorded from Tunis, Egypt, Arabia, Somaliland, &c.

Genus CEROMA, Karsch.

JB. Hamburg. Anst. ii. p. 137, figs. 8, 9 (1885).

Ceroma Johnstonii, sp. n. (Figg. 1–1 a.)

♂.—*Colour* a tolerably uniform fusco-testaceous or greyish-brown tint, not distinctly banded as in *C. ornatum*; mandibles, head-plate, and palpi, with the exception of the base of the femur, palely infuscate; femur, tibia, and distal end of pro-tarsus of legs also more or less infuscate; the terga showing an indistinct fuscous patch on each side.

Head-plate moderately convex, dilated at the angles, with very faint divisional line, furnished with short iridescent hairs and longer fine setæ; tubercle large, bearing fine setæ, especially in front.

Mandible rather strongly convex above and armed with many long bristles, spiniform and slender; upper jaw with a slight sigmoid flexure, the upper edge concave at the base, convex distally, armed below with two large subequal teeth, affixed some distance behind the tip, and followed by an outer and an inner series of four teeth, the first of the inner series

being of considerable size; lower jaw slightly exceeding the upper, armed with three more or less fused teeth; a radiating tuft of spiniform setæ at the base of the flagellum; *flagellum* long, slender, but with its edges tightly folded over, lying close to the upper surface of the mandible, and extending back almost to its base; its basal portion much enlarged, somewhat as in *Solpuga*, but lying backwards, not forwards; stridulating-ridges very small.

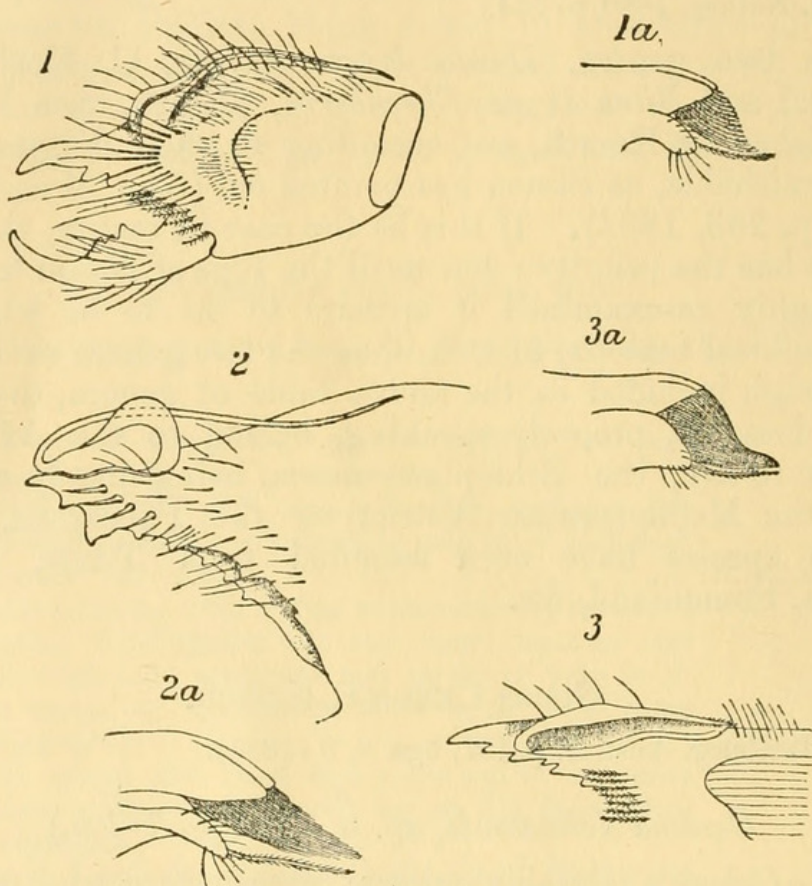


Fig. 1. Inner surface of mandible of *Ceroma Johnstonii*, sp. n.

Fig. 1 a. Side view of rostrum of *Ceroma Johnstonii*, sp. n.

Fig. 2. Flagellum and upper fang of mandible of *Zeriassa bicolor*, Poc.

Fig. 2 a. Side view of rostrum of *Zeriassa bicolor*, Poc.

Fig. 3. Flagellum and upper fang of mandible of *Blossia rufescens*, sp. n.

Fig. 3 a. Side view of rostrum of *Blossia rufescens*, sp. n.

Rostrum as in figure, the upper process surpassing the lower and longer than it, deflexed apically; the lower also somewhat strongly deflexed.

Palpi and *legs* mostly not spiny, covered with short hairs and long setæ; tarsus and protarsus of palp truncate and incrassate, the two almost indistinguishably fused; legs of first pair rather robust, armed with two very distinct claws; tibia of second and third pair with one distal superior spine, protarsus with three superior spines; distal tarsal segment

less than half the length of the proximal. *Arolium* beneath the tarsal claws very large.

Abdomen without accessory spinules on its lower surface.

Measurements in millimetres.—Total length 16; width of head-plate 3·5; length of mandible 3·5; length of palp 11, its tibia 3·5, tarsus and protarsus 4; of third leg 9; of fourth leg 17, its tibia 3·5, protarsus 3*.

Loc. Nyika plateau (6000–7000 feet), in Nyasaland. A single example collected by Mr. Whyte, and dedicated to Sir H. H. Johnston.

This specimen seems to be referable to the genus *Ceroma* of Karsch, there being nothing in the diagnosis of the latter to prohibit such a belief, and much that is in its favour. It is possible also that it may prove to be the male of the typical and only known species, namely *ornatum*†, which was obtained in Masailand. But there is no evidence to support this, and some, apart from geographical reasons, to show its improbability. For example, in *ornatum* the abdomen is ornamented above with three longitudinal black bands: these are not observable in the type of *Johnstonii*, nor are the legs and head-plate marbled with black.

Genus ZERIASSA, nov. (Figg. 2–2 a.)

Differing from *Solpuga* in that the ocular tubercle is provided with a pair of long setæ in front and a few symmetrically disposed shorter setæ behind, and the extremity of the rostrum is bent downwards instead of being horizontal. The protarsus and tarsus of the palp of the male are armed with short stout spines beneath and not scopulate.

Type *Z. bicolor*, Poc.‡

So far only one species of this genus has been discovered.

Genus SOLPUGA, Licht.

Solpuga, Lichtenstein, Cat. rerum nat. iii. p. 216 (1796); Licht. & Herbst, Nat. ungeflügelt. Insekten, i. p. 22 (1797); C. Koch, Arch.

Naturg. 1842, pt. i. p. 351, and of recent authors.

Gætulia, Simon, Ann. Soc. Ent. France, 1879, p. 107 (nom. præocc.).

Cærellia, id. Bull. Soc. Ent. France, 1879, p. clx.

Zeria, Simon, Ann. Soc. Ent. France, 1879, p. 118.

Type *S. chelicornis*, Licht.

This genus was primarily equivalent to *Galeodes* of Olivier,

* The measurements of the limbs in this and all cases in this paper are taken along the outer side of the limb, and include the trochanter but not the coxa. The total length includes the mandible.

† JB. Hamburg. Anst. ii. 1885, p. 137, figs. 8, 9.

‡ *Zeria bicolor*, Pocock, from Somaliland, is described in Dr. Donaldson Smith's 'Through unknown African Countries,' p. 392 (London: Arnold, 1897).

since the species it contained were *araneoides* of Pallas, *fatalis*, Licht., congeneric with it, and *chelicornis* congeneric with *setigera*. C. Koch was the first to assign to the genus the significance it now bears, his action being tantamount to selecting *chelicornis* as the type.

I have added the genus *Zeria* to the list of synonyms of *Solpuga* under the belief that it was based upon a young specimen of *Solpuga*. The type *persephone* from Algeria measures only 9 millim. long, and is said to differ from *Solpuga* in having a pair of ocular setæ instead of a cluster of them and no spines on the fourth protarsus. But in an example in the British Museum from the same country and closely resembling the description of the type there are spines on the fourth protarsus. Moreover, in an immature specimen of what I believe to be *Solpuga*, sent with many other examples of the genus from the Umfuli River in Mashunaland by Mr. G. A. K. Marshall, the ocular tubercle has but two setæ, a further resemblance between this specimen and the Algerian being noticeable in the presence of a distinct long *third* claw on the second, third, and fourth legs and the presence of only *three* malleoli on each side. Both these characters are, I am persuaded, signs of immaturity. Lastly, it may be added that the example from the Umfuli (measuring 7 millim. in length) has the tarsus of the fourth leg with only five, instead of seven, differentiated segments, while those of the second and third have only two, or at most three, instead of four segments. In the British Museum example of *persephone* the tarsal segments are as in *Solpuga*.

The following species of the genus are represented in the British Museum.

Solpuga dentatidens (Simon).

Gætulia dentatidens (Simon), Ann. Soc. Ent. France, 1879, p. 115.

Described from the White Nile. The Museum possesses two male examples from inland of Berbera in Somaliland (*E. Lort Phillips*).

Solpuga brunnipes (L. Dufour).

Galeodes brunnipes, Dufour, Hist. Nat. *Galeodes*, p. 52, pl. ii. fig. 6 (1861); Simon, *op. cit.* p. 113.

Of this species, which seems to range from Algeria to Abyssinia, the Museum possesses a single female example obtained on the north-eastern shore of Lake Stephanie by Dr. Donaldson Smith.

Solpuga Keyserlingii, Poc.

Solpuga Keyserlingii, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 86.

Based upon a specimen from an unknown locality, but probably an inhabitant of Somaliland or Masailand, seeing the nearness of its relationship to *S. Parkinsoni* (see p. 263).

Solpuga nigrescens, Poc.

Solpuga nigrescens, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 88 (1895).

Loc. Lower Zambesi (*J. Grant*: type).

The Museum also possesses specimens of apparently the same form from the north-eastern region of Victoria Nyanza (*Dr. Ansorge*).

Solpuga paludicola, Poc.

Solpuga paludicola, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 84, pl. iv. fig. 4 (1895).

Loc. Nyasaland.

The British Museum has several specimens of this species obtained on the shores of Lake Nyasa by the members of the Universities Mission and from Zomba by Sir Harry Johnston.

Solpuga Monteiri, Poc. (Fig. 6.)

Solpuga Monteiri, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 87 (not pl. iv. fig. 6) (1895).

Loc. Delagoa Bay (*Mrs. Monteiro*).

Owing to an unaccountable error, fig. 6 on pl. iv. of the above paper, though assigned to this species, does not represent the mandible of the male. I take the opportunity of publishing an accurate figure of the organ in question (see fig. 6).

Solpuga Marshalli, Poc.

Solpuga Marshalli, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 91.

Loc. Salisbury, Mashonaland, 5000 ft. alt. (*G. A. K. Marshall*).

Solpuga hostilis, White.

Solpuga hostilis, White, Appendix to Methuen's 'Life in the Wilderness,' p. 317, pl. ii. fig. 5 (1846); Pocock, Ann. & Mag. Nat. Hist. (6) xvi. p. 89, pl. iv. fig. 7 (1895).

The only locality ascribed to this species by White was "S. Africa, near the tropic of Capricorn." Mr. Guy Marshall has, however, recently sent me a series of nicely preserved specimens from Estcourt in Natal (4000 feet).

The head and mandibles are a uniform reddish yellow, the two eyes alone being black; the legs also are yellowish red, though slightly infusate distally, the posterior pair being strongly tinted with a blood-red colour; the posterior terga are uniformly black all over, but the anterior are paler in the middle; and on each side of the sterna there is a blackish spot.

In both sexes the palpus is longer than the third leg and its tibia is longer than the protarsus of the fourth, which is distinctly shorter than the tibia of the same limb.

A young specimen of this species, measuring 10 millim. in total length, has only three malleoli on each side—two on the coxa and one on the basal segment of the trochanter of the fourth leg—as described in the so-called genus *Zombis*, Simon. But in an example 15 millim. in length the two additional malleoli have appeared.

Solpuga ferox, Poc.

Solpuga ferox, Poc. Ann. & Mag. Nat. Hist. (6) xvi. p. 83, pl. iv. fig. 3 (1895).

Loc. Port Elizabeth (*I. L. Drège*).

Solpuga Derbiana, Poc.

Solpuga Derbiana, Poc. loc. cit. p. 90, pl. iv. fig. 8.

Loc. "Interior of S. Africa" (*Earl of Derby*).

The Museum has only a single male example of this species.

Solpuga lethalis, C. Koch.

Solpuga lethalis, C. Koch, Arch. Naturg. 1842, pt. i. p. 352; id. Die Arachniden, xv. p. 70, fig. 1465.

The British Museum has several specimens referred to this species ticketed "S. Africa" (*Dr. Smith*).

Solpuga Butleri, Poc.

Solpuga Butleri, Poc. loc. cit. p. 88.

Loc. Congo.

Solpuga venator, sp. n. (Fig. 7.)

Colour of head, jaws, palpi, and legs a uniform yellow, without any black pigment; abdomen furnished with long silky greenish-yellow hairs.

Head furnished on each side in front with spiniform setæ, its width about $\frac{3}{5}$ the length of the tibia of the palp and a little more than $\frac{2}{3}$ the length of the tibia of the fourth leg.

Mandible armed above, throughout its length, with setiform spines protecting the flagellum. Basal lamina of flagellum moderately high, rounded, the terminal portion curving backwards on a level with the first tooth of the upper fang, lying close to the basal lamina and extending almost back to the ocular tubercle, its apex simple, undivided, its distal third strongly sinuate. Only one small tooth between the second and third largest teeth on the upper fang.

Palp with its tibia a little longer than the tarsus and protarsus (15·5 : 15) and excelling the length of the tibia of the fourth leg (15·5 : 14), which also exceeds the length of the fourth protarsus (14 : 13); third leg shorter than the palp, its protarsus equal to the width of the head; fourth leg longer than the palp by half its protarsus and the tarsus.

Measurements in millimetres.—Total length 53; length of mandible 12·8; width of head 9; length of palpus 48, of first leg 40, of second 35, of third 43, of fourth 66.

Loc. Kleinpoort, in the Eastern Karroo; taken in a house (*Miss Anna Howarth*: type). Also damaged specimens of apparently the same species from South Africa (*Dr. Quain*) and Port Elizabeth (*J. M. Leslie*).

This species seems to differ from *S. lethalis*, Koch, in having no tooth near the apex of the flagellum, such as is found in the male of *lethalis* according to Karsch and according to a specimen identified as *lethalis* in the collection of the British Museum.

Solpuga Darlingii, sp. n. (Fig. 5.)

♀.—*Colour.* Prevailing tint an ochre-yellow, the head-plate infuscate; femora and tibiæ of the posterior legs, especially the fourth pair, as well as the tibia and distal end of the femur of the palpus, also infuscate; legs of first pair pale; tergal plates of abdomen not noticeably darker than the lateral portions.

Cephalic plate about equalling in width the length of the protarsus of the palp, distinctly less than that of the tibia, also a little less than the length of the tibia or of the protarsus of the fourth leg; width of ocular tubercle less than length of tarsus of palp; the setæ on the tubercle spiniform.

Mandibles armed as in *S. ferox*, Poc. (Ann. & Mag. Nat. Hist. (6) xvi. p. 83), from Port Elizabeth; legs also clothed and armed as in *ferox*; *malleoli* small, with the inner angle nearly rectangular. Genital operculum with its posterior border transverse, the inner angles of each half not produced, but rectangular.

♂.—Resembling female in colour, but with smaller head, much longer legs, &c.; the head-plate only a little more than half the length of the tibia of the palp and one third less than the length of the tibia or protarsus of the fourth leg. Protarsus of palp scopulate beneath; palp longer than third leg, its tibia considerably longer than the tibia or protarsus of fourth leg.

Mandible with dentition much resembling that of the female, though the teeth are smaller and the upper fang less strongly curved distally; the flagellum with its basal part rising into a high crest with upright posterior border, rounded extremity, and convex anterior border; the distal portion short, curving upwards and backwards at a point on a level with the second tooth of the upper fang, and passing a little beyond the posterior border of the upstanding basal lamella, becoming gradually attenuated at the tip.

Measurements in millimetres.—♀. Total length (including mandibles) 56, length of mandible 15; width of head 11; length of palp 39, of first leg 32, of second leg 30, of third leg 38, of fourth leg 58; tibia of palp 12, protarsus and tarsus 13; tibia and protarsus of fourth leg 11·5.

♂. Total length 54, length of mandible 11; width of head 9·5; length of palp 50, of first leg 39, of second leg 36, of third leg 46, of fourth leg 67; tibia of palp 17, protarsus and tarsus 15·5; tibia and protarsus of fourth leg 13·5.

Loc. Gadzima, on the Umfuli River (4200 feet alt.), in Mashonaland. An adult male and female sent by Mr. G. A. K. Marshall.

I have great pleasure in dedicating this species to Mr. James ffolliott Darling, whose labours as a collector have added considerably to our knowledge of the natural history of Mashonaland.

Solpuga sericea, sp. n. (Fig. 4.)

Colour, when dry, of a greyish tint, owing to the clothing of white, yellow, or greyish-white hairs on the limbs and body, the limbs, especially the posterior pair, being furnished in addition with long silky white setæ; in alcohol the head and mandibles are of an ochre-yellow, the mandible adorned with three black stripes, whilst on the head the tubercle is black and there is a black patch on each side, from whence a black curved line passes back to the middle point on the posterior margin of the head, this point being joined to the tubercle by a fainter median longitudinal line; the terga of the abdomen are black, but its sides are broadly white;

limbs mostly black above, but the femora and basal joints largely yellow, the femur of the palp having merely a median longitudinal dorsal stripe; lower surface of abdomen and of basal segments of legs pale.

Head flattish, furnished in front with a few symmetrically arranged stout spiniform bristles; bristles on the tubercle

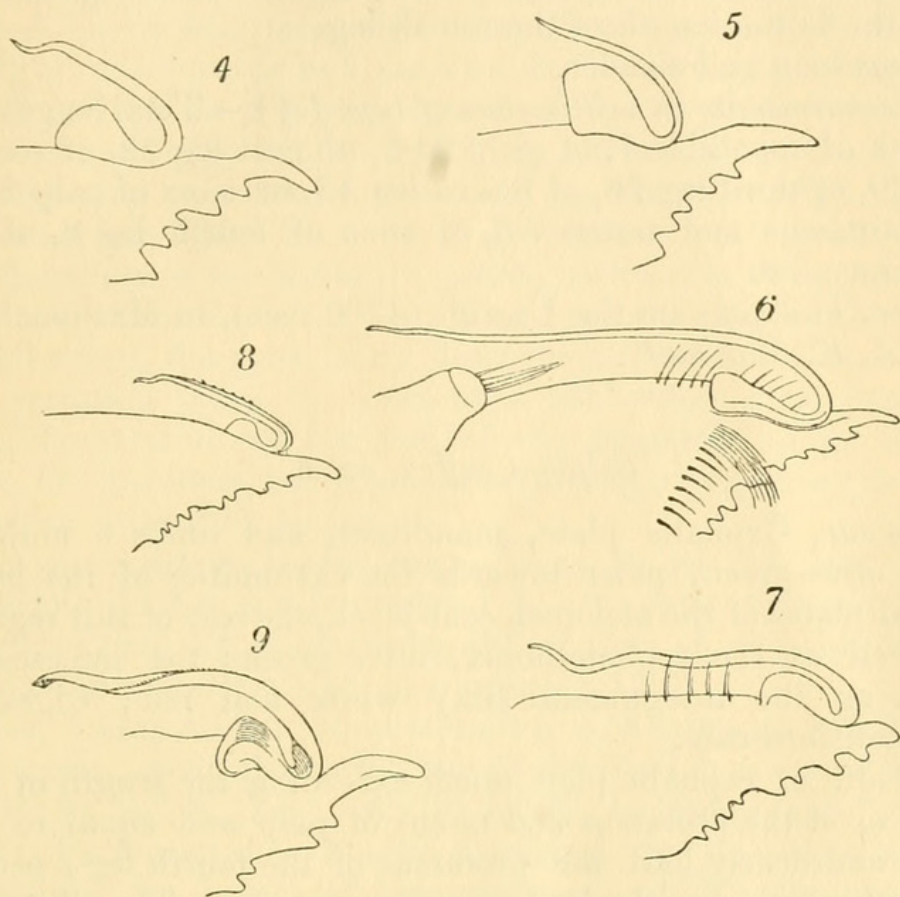


Fig. 4. Flagellum and upper fang of mandible of *Solpuga sericea*, sp. n.

Fig. 5. Ditto of *S. Darlingii*, sp. n.

Fig. 6. Ditto of *S. Monteiroi*, Poc.

Fig. 7. Ditto of *S. venator*, sp. n.

Fig. 8. Ditto of *S. Keyserlingii*, Poc.

Fig. 9. Ditto of *S. Parkinsoni*, sp. n.

also spiniform and symmetrically placed; head-plate more than half but less than two thirds the length of the tibia of the palp.

Mandible with relatively a small number of spiniform setæ above; the upper fang long, carinate above, curved downwards at the apex; teeth of the upper jaw strong, sharp, and normal; two small teeth intervening between the second large tooth and the next largest; flagellum with moderately elevated basal lamina, the terminal portion smooth, taking its backward curve at a point just behind the line of attachment of the second tooth of the fang, running backwards and

upwards at an angle of 45° , straight throughout the greater part of its length, but with the slender apex curved downwards.

Palp with its tibia a little longer than the tarsus and protarsus, the latter only lightly curved, scopulate beneath; tibia of palp just about equal to that of fourth leg, shorter than protarsus of latter; palp shorter than third leg and not two thirds the length of the fourth leg.

Legs long and slender.

Measurements in millimetres of type (σ).—Total length 30, length of mandible 7, of palp 24.5, of first leg 22, of second leg 20, of third leg 26, of fourth leg 43, of tibia of palp 8, of its protarsus and tarsus 7.5, of tibia of fourth leg 8, of its protarsus 8.8.

Loc. Gadzima on the Umfuli (4200 feet), in Mashonaland (G. A. K. Marshall).

Solpuga caffra, sp. n.

Colour. Cephalic plate, mandibles, and limbs a uniform deep olive-green, paler towards the extremities of the legs; tergal plates of the abdomen coal-black, the rest of this region, as well as the cephalothorax, olive-green; the pubescence covering the integument silky white and red; edges of malleoli infusate.

Width of cephalic plate much exceeding the length of the tibia or of the protarsus and tarsus of palp and equal to the tibia and nearly half the protarsus of the fourth leg; ocular tubercle clothed with slender, not spiniform, setæ. Tibia of fourth leg exceeding protarsus by about half the length of the first segment of the tarsus.

Measurements in millimetres.—Total length 52, length of mandible 16; width of head-plate 12.3; length of palp 30, of fourth leg 47, of tibia of palp 9.3, of its tarsus and protarsus 10; tibia of fourth leg 9.2, protarsus 7.8.

Loc. Estcourt, in Natal (4000 feet alt.).

Two adult females obtained by Mr. G. A. K. Marshall, who informs me that he saw but failed to capture a third specimen at the junction of the Blue Krantz and Tugela Rivers.

In the uniformly dark infusate tint of its head, jaws, limbs, and abdomen this species resembles the two species *Butleri* and *nigrescens*, which were described in Ann. & Mag. Nat. Hist. (6) xvi. p. 88 (1895).

Solpuga Parkinsoni, sp. n. (Fig. 9.)

Colour. Carapace, limbs, mandibles, &c. a uniform ochre-yellow, only the ocular tubercle black.

Closely related to *S. Keyserlingii*, Poc. (*loc. cit.* p. 86), from which it differs hardly in anything apart from the form of the flagellum. In *Keyserlingii* the flagellum is abruptly curved backwards from the base, then passes as a nearly straight rod upwards and backwards, becoming slenderer at the tip, which is delicate, sinuate, and curved downwards; in the middle of its length it is finely serrate below, the serration showing as a row of fine teeth on the outer edge of the upper surface* (fig. 8). In *S. Parkinsoni*, on the contrary, the flagellum is less abruptly curved backwards, rising nearly vertically from the basal portion and passing backwards with a bold curve, the apex being downcurved and lamellar, while the serration takes the form of a denticulate crest passing from the anterior convex side of the flagellum to its inner edge, the flagellum being somewhat strongly geniculate in the posterior fifth of its length.

Measurements in millimetres.—Total length 43, length of mandible 10·3; width of head 8, of ocular tubercle 2·5; length of palp 43, of fourth leg 60, of tibia of palp 14, of its tarsus and protarsus 13·5, of fourth leg 12·5.

Loc. "Gol Addeh (3000 feet alt.), 11¼ miles to the S.W. of Arregir, which lies at the foot of the Burdab range of hills, lat. 9° 10' 16" N., long. 46° 10' 35" E., in Somaliland."

Mr. Parkinson has kindly furnished the following notes respecting the habits of this *Solpuga* and of a specimen of *Galeodes arabs* which he obtained at Arregir:—"About 8 P.M., as I was adjusting the theodolite to take the observations which determined the above position [*i. e.* of Arregir], I heard a slight noise as of a mouse scuttling about, and upon turning the lantern in the direction of the sound saw the spider [*G. arabs*], which, upon my attempting to approach, darted some three yards away with a velocity difficult to follow with the eye. After repeating this manœuvre several times, it stopped in a hollow between three stones, and was secured. I have only seen these animals on stony ground at the base of these hills, and they may be heard at night as I have

* N.B.—In the figure of the mandible and flagellum of this species published on pl. iv. fig. 5 of Ann. & Mag. Nat. Hist. (6) xvi. (1895), the flagellum lies too close to the upperside of the mandible and the teeth of the fang are too large, the terminal fang being not sufficiently prolonged. Moreover, in the description no mention is made of the serration of the flagellum.

described. In such places many remains of beetles may be seen in the morning; and although I have not actually observed the spiders devouring the insects, I suspect that they feed largely upon them, for the sound of the spider's dash is generally followed by a crumpling noise, such as would be produced by the crushing of a beetle between the spider's jaws. Their speed and energy is tremendous; but the natives do not consider them noxious, and, Somali-like, tell me there is no name for things so unimportant."

The following tables will show some of the differential features of the species known to me:—

Males*.

- a. Upper mandibular fang furnished on the inner side or above at the base of the flagellum with a tooth against which the lower fang closes.
 - a¹. Flagellum long, slender, simple, extending past the ocular tubercle; protarsus of palp fuscous. *dentatidens*, Sim.
 - b¹. Flagellum short, stout, toothed internally near the slender apex, which scarcely surpasses the basal lamina; palp wholly ochraceous. *ferox*, Poc.
- b. Upper mandibular fang without supernumerary tooth.
 - a². Upper mandibular fang with a long untoothed interval between the tip and the basal tooth-armature (flagellum reaching to the eye).
 - a³. Flagellum taking its backward curvature some distance behind the tip of the upper fang . . . *Derbiana*, Poc.
 - b³. Flagellum taking its backward curvature close to the tip of the fang.
 - a⁴. Upper fang stout, nearly parallel-sided, distinctly toothed apically; the flagellum lying close to its upper edge *Marshalli*, Poc.
 - b⁴. Upper fang slender, concave above, scarcely toothed apically; flagellum rising high above its upper edge *hostilis*, White.
 - b². Upper fang continuously toothed from base to apex, strong.
 - a⁵. Flagellum short, stout, apically truncate, scarcely surpassing lamina *paludicola*, Poc.
 - b⁵. Flagellum long or short, but slender and apically pointed.
 - a⁶. Flagellum distinctly serrated, of medium length.
 - a⁷. Flagellum curving abruptly backwards close to the basal lamina, sinuous only at tip *Keyserlingii*, Poc.

* The males may be always distinguished from the females by the presence on the upperside of the mandible of that curious horny organ of unknown function called the *flagellum*. They also have longer legs, smaller mandibles, &c.

- b*⁷. Flagellum rising more vertically with an open curvature, sinuous in the distal fourth of its length *Parkinsoni*, sp. n.
- b*⁶. Flagellum not serrated, long or short.
- a*⁸. Flagellum short, only just surpassing the basal lamina.
- a*⁹. Of large size: prevailing colour ochre-yellow, though partially infusate; palpus much longer than third leg .. *Darlingii*, sp. n.
- b*⁹. Of small size: head, mandibles, and limbs striped with black; palpus not longer than third leg *sericea*, sp. n.
- b*⁸. Flagellum long, reaching back to the ocular tubercle.
- a*¹⁰. Apex of flagellum not distinctly sinuate, its basal portion lying high above the lamina..... *Monteiri*, Poc.
- b*¹⁰. Apex of flagellum strongly sinuate, its basal portion lying close to the lamina.
- a*¹¹. Apex of flagellum simple *venator*, sp. n.
- b*¹¹. Apex of flagellum bifid *lethalis*, Koch.

Females.

- a*. Head, mandibles, and limbs black or deep olive-green above and below.
- a*¹. Width of cephalic plate less than the length of the tibia of the palp or of the fourth leg, equal to their protarsi *Butleri*, Poc.
- b*¹. Width of cephalic plate greater than tibiæ or protarsi of palp and of fourth leg.
- a*². Colour almost black, edges of malleoli pale; width of cephalic plate only slightly exceeding length of tarsus and protarsus of palp and about equal to the tibia and one fourth of the protarsus of the fourth leg; tibia of fourth leg equal to protarsus in length *nigrescens*, Poc.
- b*². Colour olive-green; edges of malleoli infusate; width of cephalic plate exceeding length of protarsus and tarsus of palp by at least the length of the tarsus, and equalling the length of the tibia and almost one half the protarsus of the fourth leg; tibia of fourth leg exceeding protarsus by half the first segment of the tarsus..... *caffra*, sp. n.
- b*. Head-plate, mandible, and limbs mostly pale, though sometimes partially infusate.
- a*³. Inner angle of each half of the genital operculum produced.
- a*⁴. Angles of operculum with strong lobate prominence; colour redder, distal segments of posterior legs red. *hostilis*, White.
- b*⁴. Angles of operculum not strongly produced; distal segments of posterior leg fuscous *Marshalli*, Poc.
- b*³. Inner angles of operculum not produced, rounded.
- a*⁵. Legs longer; width of head-plate less than
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- length of tarsus and protarsus or tibia of palp,
and about equal to length of protarsus of
fourth leg.
- a*⁶. Head, palpi, and limbs mostly of a uniform
yellow tint *paludicola*, Poc.
- b*⁶. Head partly infusate; palpi and limbs
with femora and tibiæ infusate *Darlingii*, sp. n.
- b*⁵. Legs shorter; width of head-plate about equal
to that of tarsus, and protarsus of palp greater
than protarsus of fourth leg.
- a*⁷. With two teeth on upper mandibular fang,
between second and third largest teeth;
width of head barely exceeding length of
tibia of palp *Monteiri* and
ferox, Poc.
- b*⁷. With only one tooth on upper mandibular
fang between the second and third largest
tooth.
- a*⁸. Abdomen with a broad black dorsal band. *brunnipes*, L. Duf.
- b*⁸. Abdomen without a broad black dorsal
band *lethalis*, Koch.

The following South-African species of this genus that have been established are unknown to me, and I am unable to locate them by the figures and descriptions:—

S. chelicornis, Lichtenstein, Cat. rerum nat. iii. p. 218 (1796); Licht. & Herbst (Nat. ungeflügelt. Insekten, i. p. 40, pl. ii. fig. 1), from South Africa (*cf. infra*, under *jubata*).

S. setigera, Oliv. (Encycl. Méthod. vi. p. 580, 1791), from the Cape of Good Hope.

S. rufescens, C. Koch (Arch. Naturg. 1842, pt. i. p. 382, and Die Arachniden, xv. p. 72), from the Cape of Good Hope, is based upon a female showing some resemblance to that of *S. hostilis*, White.

S. jubata, C. Koch (ibid. p. 73), is, according to Karsch (*op. cit.*), identical with *chelicornis*, Licht., the type of the genus. Whether this be the case or not, the two will apparently fall under *a*³ of the above table (males), though they differ from *Derbiana* apparently in the much greater elevation of the flagellum.—*Loc.* Cape of Good Hope.

S. vineta, C. Koch (ibid. p. 74), will probably fall under *a*³, but it has the flagellum short and angulate above. Both this species and the preceding are brown in colour, with a median black abdominal band and a silvery-white stripe on each side of it.—*Loc.* Cape of Good Hope.

S. badia, C. Koch (ibid. p. 75), based on a female from the Cape of Good Hope.

- S. fusca* and *hirtuosa*, C. Koch (*loc. cit.* pp. 76 and 78), from the Cape, are two small black-legged species about half an inch in length. The former probably will fall under a^3 and the latter perhaps under b^3 .
- S. lineata*, C. Koch (*ibid.* p. 80), is perhaps related to *sericea*; it is a small yellow species, with the mandibles, trunk, and posterior three pairs of legs striped with black, the palpi and first legs being a uniform yellow.—From the Cape of Good Hope.
- S. lateralis*, Koch (*loc. cit.* p. 82), also from the Cape, will fall under a^1 , but certainly differs from *dentatidens* in being only just over half an inch long and in having all the limbs fuscous.
- S. producta*, Karsch (*Arch. Naturg.* 1880, p. 236) (= *vincta*, Simon, *Ann. Soc. Ent. France*, 1879, p. 110, not *vincta* of Koch), from Lessouto to the north of the Cape, appears to be most nearly related to *S. hostilis*, White, but the flagellum does not reach to the base of the mandible.
- S. merope*, Simon (*Ann. Soc. Ent. France*, 1879, p. 112), from Zanzibar, is based upon a female.
- S. niassa*, Karsch (*loc. cit.* p. 237), from N'yassi (? Nyassa), has the flagellum short, as in *ferox*, but strongly toothed at the base, and there appears to be no supernumerary tooth on the upper fang.
- S. nasuta*, Karsch (*loc. cit.* p. 238), from Zanzibar, has the flagellum of medium length, but not reaching the ocular tubercle; its tip is both expanded and bifid.
- S. Schweinfurthi*, Karsch (*loc. cit.* p. 239), from Djur, has the flagellum of much the same length and shape as in *Keyserlingii*; it is not said, however, to be serrate.
- S. scopulata*, Karsch (*loc. cit.* p. 239), is based upon a female from Hantam. Differs from all the species known to me in having the front tooth of the lower jaw double.

Notes on Habits.

Mr. G. A. K. Marshall, who within the last few years has discovered in South Africa no fewer than four new species of *Solpuga*—namely, *S. Marshalli* from Salisbury, *S. Darlingii* and *sericea* from Gadzima, on the Umfuli, and *S. caffra* from Estcourt, Natal—has from time to time sent to me various

notes upon the habits of the species of *Solpuga* he has observed. Many of these I take the liberty of quoting verbatim. Mentioning in a letter that his attention had been attracted to a specimen of a Natal species [probably *S. hostilis*] by the sound it produced when burrowing, he replied as follows to a question of mine touching the stridulation of these animals:—"Until the arrival of your letter I had never thought of attributing the sound to stridulation, but merely to the trituration of the creature's powerful jaws against the hard ground in which they seem to prefer to dig their holes, the operation being performed with the jaws, and the sound ceasing when the spider stops digging. When walking into Hartley the other day I captured an example of a small species [probably *S. sericea*] which was running on the path in the hot sunshine, apparently searching for insects. The same evening I secured a specimen of yet another species [probably *S. Darlingii*], which came into my hut attracted by the light. I kept them alive for a day or two, but failed to detect any stridulating sounds whatever, though they both made a considerable noise by energetically biting at the sides of the boxes, one of them in a cardboard box nearly succeeding in gnawing its way through at one spot. The evidence, so far as it goes, only tends to increase my belief that the sounds made by the Natal species were caused by trituration, not stridulation. . . . But, unfortunately, owing to their lightning-like activity it is impossible to keep these creatures in an open vessel, and as the above specimens were both new to me, I was afraid to experiment with them while free, for fear of losing them." In a subsequent letter he adds:—"I was interested to learn from you that the noise made by *Solpuga* is really stridulation. I noticed the grooving on the mandible in a very large nocturnal species which I came across on the Umfuli River [*S. Darlingii*], but it never stridulated at all while I was examining it before putting it into the cyanide bottle. By the way, it is curious how much more rapidly these creatures succumb to the effects of this poison than either spiders or scorpions"*.

* On the tenacity of life of scorpions Mrs. Monteiro ('Delagoa Bay: its Natives and Natural History,' p. 192) makes the following remark:—"A large black scorpion was eight hours in my strongest poison-bottle before it succumbed to the deadly fumes. When I touched him with a stick after seven hours he elevated his wicked tail and opened his claws wide in a most savage manner." The greater susceptibility of the *Solpuga* to the fumes as compared with the scorpion is doubtless connected with the much richer development of its respiratory system, which consists of an elaborate system of tracheal tubes, branching throughout the body, that of the scorpion being composed of four pairs of small sacs.

of this year from Natal, he says:—"With regard to the stridulation of *Solpuga*, I must admit that I am almost becoming sceptical about it, at least in the species with which I am acquainted, for, though I have examined them carefully, on no occasion have I been able to detect any signs of stridulation, even when they have been persistently annoyed. And, moreover, I find it is impossible to produce it artificially by rubbing the chelæ together. Is it not possible that the striæ [fine upstanding ridges] might be useful in compressing food for the extraction of the juices?"

Touching the function of the palpi, and commenting upon Hutton's observation showing that they are used as suckers in climbing slippery places, he remarks:—"As far as I can see they seem to be used merely as tactile or, perhaps, auditory organs. They are usually carried well forward just off the ground, and appear to be highly sensitive." But in a subsequent letter he adds:—"I have been further investigating the use of the terminal organ on the palpus, and am fully satisfied that Hutton was right in supposing it to be a sucker. I first noticed this when teasing a specimen with a straw and trying to make it stridulate. The creature struck sharply at the straw with its palpi, pulling it slightly towards itself. Wondering how it was able to grasp the object, I tried again, and distinctly saw a gelatinous fan-shaped sucker protruding from the palpal knob and sticking firmly to the straw. . . . I feel tolerably sure that the chief use of the sucker, which is evidently a very delicate organ, is for the purpose of grasping prey and conveying it to the mandibles. Owing to the extreme rapidity of their movements, it is almost impossible to observe exactly how they catch insects, but my general impression has always been that the prey is first caught by the palpi, and not by the mandibles direct." Specimens kept in captivity "devoured all sorts of small insects most voraciously, and, while eating, in addition to moving their nipper-like mandibles vertically, they also moved them alternately backwards and forwards in a horizontal direction."

With regard to general habits it is interesting to note that species of the same genus, *Solpuga*, are either diurnal or nocturnal. For example, Mr. Marshall was informed by a man "that when he was recently encamped at Hartley Hills he was forced to move his tent on account of its being overrun by a number of enormous spiders, evidently, from his description, a large *Solpuga* [probably *S. Darlingii*], which came in at night one at a time, attracted apparently by the light, and simply flew about it at lightning speed." On the other hand, Mr. Marshall writes: "When walking into Hartley

one day I captured an example of a small species as it was running on the path in the hot sunshine, investigating the external tunnelling of some termites. It seems probable that these insects will prove to be their chief food." And, again, "I frequently watched the diurnal species of *Solpuga* [*S. sericea*] on the Umfuli, while they were out hunting. They run along at a great pace, but if undisturbed rarely keep up the speed for more than 30 to 60 seconds, when they will rest for a few seconds, usually in the shade of a tree-trunk or under a projecting stone or dead leaf. If there happens to be a small hollow where they stop, they always depress their bodies into it so as to keep the abdomen flat on the ground. After a short rest they suddenly rush off again without the least warning. Often they will stop in mid-course and suddenly begin hunting and feeling round a small spot. This behaviour always reminds me of a dog checked in its course by the scent of some bird or other animal, and I have often wondered if these Solpugas hunt by scent, for their eyes, though well adapted for seeing an enemy from above, would hardly seem to be of much use in detecting small insects on the ground. When running this species [*S. sericea*], with its grey colour and the very long white hairs on the hind legs, looks like a bit of thistle-down blown along the ground. I have several times seen them ascend the trunks of trees to a height of ten to fifteen feet, and have often noticed them catching those small thick-set jumping spiders [*Attidæ*], and less frequently small moths and beetles. But, in accordance with my anticipation, I find that they are very fond of termites. The only ones I have seen them eat belong to a small species which makes no mound, but builds mud tunnels along the surface of the ground among dead leaves, sticks, &c. When the *Solpuga* comes across such tunnelling it examines along it carefully, then suddenly breaks through the mud and extracts a termite, the presence of which it detects, I suppose, by either hearing or touch."

Concerning the venom of these creatures the evidence is conflicting. "A Kafir boy declared them to be very poisonous, and said he had known of Kafirs dying from the bite. One of my Kafirs recently showed me his hand, which he declared had been bitten by the large brown nocturnal species [*S. Darlingii*]; it was very much swollen and painful and did not subside until the fourth day. On the other hand, Mr. J. M. Hutchinson, of Estcourt, Natal, has kindly made experiments on the bite of the common *Solpuga* there [*S. hostilis*, White] and finds it to be quite harmless, the forceps being unable to pierce the tenderest skin."

I take this opportunity of publishing the description of a new species, apparently belonging to the genus *Blossia*, one of the Solpuginæ:—

Blossia rufescens, sp. n. (Figg. 3–3 a.)

♂. *Colour* of mandibles, head-plate, and abdominal terga a rich purplish brown; palpi, with the exception of the basal half of the femur, of the same colour; first and second legs almost entirely pale yellow, slightly infusate at the extremity of the femora; femur, tibia, and proximal end of protarsus of third and fourth legs also purplish brown; the entire lower surface of the body, as well as the coxæ and trochanters of all the appendages and the tarsi of the legs, clear pale yellow.

The entire upperside of the body and limbs covered with a coating of very short, close-set, usually erect stiff hairs; the lower side of the abdomen clothed with longer silky white hairs. The ocular tubercle furnished with thick pale-coloured bristles; similar bristles present on the sides of the head-plate and on its upper surface in small numbers, on the upperside of the mandible, and on the sides of the thoracic and anterior abdominal terga.

Mandibles elongate, somewhat as in *Cleobis*, the stridulating-ridges long and strong; the lower fang armed with three teeth, the median of which is small; the upper armed with eleven sharp teeth, the third from the apex being small, the outer series at the base of the mandible composed of three teeth; flagellum membranous, its margins curled over, pointed posteriorly (fig. 3).

Palpi long and stout, much longer than the third leg, its trochanter armed above with a few spines; femur spinous internally at the apex; tibia and protarsus armed below with two rows of short spines. *Legs* with their trochanters spinous above; the femora with a few short scattered spinules; tibiæ and protarsi, except of the first leg, also spiny; claws of the first leg long; all the tarsi one-jointed, curved.

Second abdominal segment with two clusters of four or five bacilliform hairs, one cluster on each side of the stigmatic apertures.

Measurements in millimetres.—Total length 19; length of mandible 4, of palp 19, of first leg 11.5, of second 10, of third 13, of fourth 24.

Loc. Shaik Othman near Aden (type), also Aden. Two examples obtained by Colonel Yerbury in the winter of 1894–95.

This new species certainly differs from *B. spinosa*, Simon, the type, and hitherto the only known representative of the genus, at least in having the legs strongly rufescent. *B. spinosa* (Ann. Soc. Ent. France, 1880, p. 400) was obtained near Alexandria. It must be added that Simon gives as a character for his genus the fact that the tarsi of the fourth leg are bisegmented. I cannot, however, distinguish two joints on these tarsi in my specimen.

XXVI.—*Contributions from the New Mexico Biological Station*.—No. II. (continued). *On a Collection of Diptera from the Lowlands of the Rio Nautla, in the State of Vera Cruz*. II. By C. H. TYLER TOWNSEND, F.E.S.

[Continued from p. 33.]

TRICHOPODA.

At least eight species of *Trichopoda* were secured by me, one of which has already been described in Section I. (*T. tegulata*, Towns., No. 15). In separating these forms, it was discovered that the males, especially in the smaller species, frequently have the tips of the foot-claws broken off, some specimens not having a single claw-tip remaining. But they are always broken evenly and at a uniform length, so that the specimens present the appearance of being a distinct form with peculiar claws. Such is, of course, not the case. An examination shows that the male claws become abruptly more slender just before the black hook-like tips, and it is at this point that they break, leaving a straight yellow claw perfectly blunt at the tip. These injuries are perhaps received in pairing.

It should be mentioned that in most *Trichopodas* the female claws are quite evenly curved and not greatly elongate, with a hook-like curve at extreme tip, and yellow with tips rather widely black. In the male the claws are elongated, almost straight, less conspicuously black at tips, which are abruptly bent hook-like at extreme ends. The leverage of the claws on the bent tips causes the fracture of the latter. *T. phasiana*, sp. n., is a notable exception in colour of claws, which are black, while the form of the claws is the same as above described. In *T. histrio*, on the other hand, the claws are not so elongate, yet nearly straight, while their coloration agrees with that of the other species of the genus.

The yellow colouring of the wings, which I had previously considered to be a distinctive sexual character in the male, I



Pocock, R. I. 1897. "XXV.—On the genera and species of Tropical African Arachnida of the order Solifugæ, with notes upon the Taxonomy and habits of the group." *The Annals and magazine of natural history; zoology, botany, and geology* 20, 249–272. <https://doi.org/10.1080/00222939708680624>.

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