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THE AFRICAN GENUS *RICINOIDES* (ARACHNIDA, RICINULEI)

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ABSTRACT

Seven species of the genus *Ricinoides* (originally *Cryptostemma*) are known. On the basis of some new material of *Ricinoides afzelii* Thor. and type material of all species, new descriptions of the seven species are given. Especially stressed is the taxonomic value of the tubercles and scales on the pedipalps and the detailed structure of the male copulatory apparatus.

INTRODUCTION

The first member ever mentioned of the arachnid order Ricinulei was a specimen described by Guérin-Méneville at the very beginning of his new journal "*Revue Zoologique*" in January 1838, p. 11. He gave it the name *Cryptostemma westermanni*, since it was "envoyée par M. Westermann, comme provenant de la Guinée." The description was repeated and the figures promised in his paper were given by H. L(ucas) in Guérin-Méneville's *Dict. Pitt. d'Hist. Nat.* VII 1838, (according to Thorell 1892; I have not seen this book), and finally both were copied by Gervais in Walckenaër's *Hist. Nat. d'ins. Apteres* III 1844 p. 131 and Pl.47 Fig. 4 and 4a. Unfortunately the specimen does not exist any more to my knowledge, at least not in the Copenhagen or Paris Museum, but from the figure we can see that it must have been a male, and we can say a little more on its origin.

B. W. Westermann was a Danish tradesman. Born in 1781 he went to India and Java and retired in 1817 to Copenhagen with a fortune and a collection of insects from Java and, collected on the way home, from the Cape of Good Hope. From then on, until his death in 1868, he lived mostly for his collection, which at that time was one of the greatest and most beautiful private collections in Europe, comprising about 45,000 species. He was in correspondence and exchanged insects with all known entomologists of his time; this correspondence is now kept together with the collection in the Zoological Museun of Copenhagen. Curiously enough, however, the ricinuleid is not mentioned in the letters from Guérin-Méneville.

After 1820 Westermann did not collect himself, but he had specimens sent from all over the world. When Guérin in his description wrote "provenant de Guinée," that part of West Africa was meant which was then known as Danish Guinea, later Gold Coast, and now Ghana. This country was then a Danish colony, and the colonial officials often sent specimens to the Danish collections. In 1830-1835 J. R. Chenon worked in "Guinea" and sent home to Westermann two cabinets with 26 boxes each, filled with "in-

sects." Among those must have been the specimen of *Cryptostemma westermanni*, but why Westermann happened to send it to Guérin we cannot say. But we can thus state the type locality to be Ghana. Chenon was born in 1806; he travelled around in "Guinea" during the years 1830-1835, but came home ill and died in 1838.

Curiously enough, the next African ricinuleid to be described was collected even earlier. It was sent home to the Stockholm Museum by the naturalist A. Afzelius who was born in 1750, went to England and from there to Sierra Leone in 1789, and returned to Sweden in 1799. He sent collections to London and to Riksmuseet in Stockholm, and among the latter material Thorell found a ricinuleid which, in 1892, he described as *Cryptostemma afzelii.*

In 1904 Hansen and Sørensen described four new species and redescribed *C. westermanni* on the basis of new material and *C. afzelii* on the original and new material.

Finally, H. J. Hansen, in 1921, redescribed a species from 1904 and described a new one, *C. feae*. Millot (1945) gave a detailed and beautiful anatomical description on the basis of new material of this species.

This is what is known at present on the genus *Cryptostemma*, which name, since it was preoccupied by a bug (*Cryptostemma* H.–S. 1833), was changed to *Ricinoides* by Ewing (1929). *Ricinoides* was probably shaped in connection "somehow" with Ricinulei, but means actually "something like *Ricinus*" which is *Ixodes*. As all words ending with -oides, however, it is neuter. Thorell (1876) gives no reason for establishing the name Ricinulei (p. 454: "il quale potrà esser chiamato Ricinulei"), but he probably also had *Ixodes* in mind.

In 1957 a large ricinuleid was sent to the Zoological Museum of Copenhagen by Mr. Sv. Herold Olsen, a Danish collector who has lived since World War II in what was once French Guinea. The specimen was found near manure in an open wood near N'Zérékoré between 10-25 April 1957. It was a male, and I immediately asked for more specimens, but it was not until four years later that another specimen was found, 15 April 1961, at the same place. It was a female, and no other specimen has been sent by him since then.

In an attempt to identify these two specimens which seemed to be very close to both *R. afzelii* and *R. feae*, I realized that I had to see the whole material which Hansen and Sørensen had before them of the genus "*Cryptostemma*." The other genus, *Cryptocellus*, was revised in 1968 by Beck and Schubart. On the basis of material consisting of only 5 males and 5 females of *C. foedus* Westwood they attempted to determine which characters were suitable for distinguishing the species and which were too variable. Unfortunately the material of *Ricinoides* is too small for such a determination. I, therefore, have profited by their results and examined in *Ricinoides* the characters which they found valid for *Cryptocellus*, but I have also added a study of the male copulatory apparatus. The characters examined are the following:

1. The shape of opisthosoma.
2. The ventral side of prosoma.
3. The presence or absence of scales.
4. The shape of cucullus and the size of its tubercles.
5. The chelicerae.
6. The pedipalpi which proved especially valuable with several important characters.
7. The presence or absence of dorsal furrows on the femora of the legs.
8. The shape of the male copulatory apparatus.

The two new specimens are so closely related to, or so similar to, the species *R. afzelii*, of which only the type specimen and a specimen in the British Museum (Natural History),

both females,were known to me that I do not see any reason to describe them as new.

THE CHARACTERS

1. The shape of the opisthosoma may be expressed as a ratio of dorsal length to greatest width. It is in most species oval (length to width ratio, 1.1–1.2), but in *R. feae* and *R. sjostedti* paralled-sided and narrower (length to width ratio, 1.5). This holds true also for the immatures, where they are known.

2. Coxal shape and sternal shape are alike among all species though there may be small differences between male and female as shown in Fig. 2. Coxae I never reach the sternum.

3. The species of *Ricinoides*, to a much higher degree than *Cryptocellus*, are covered by tubercles and in some cases also scales. The tubercles are of several different kinds of shape and size and differently sculptured. Kennaugh (1968) figured some types of tubercles in *R. afzelii* and *R. sjostedti*. Since their distribution on the pedipalpi is of systematic value I shall mention and draw the types. The tubercles of *C. pelaezi* have been described and illustrated by Pittard and Mitchell (1972).

The tibia of the pedipalp carries at the distal fourth, or third, or even half, some tubercles which may be short or long and densely set or scattered. They are shaped as shields raised on a higher or low tapering socle or pedestal, but with the distal apex free. Since they are only found here and are typical of the species, the apex of tibia will be described and drawn for each species.

At the base of tibia and on the proximal segments, as well as on the whole body, several types of tubercles are found, different and differently distributed in the several species. The base of the tibia and apex of the femur will, therefore, be drawn in each species. The types of tubercles are as follows:

a. The corrugated type (Fig. 1, A) mentioned by Kennaugh (1968) is conical, but with furrows in a characteristic pattern, concave posteriorly, and is found in all the species.

b. The saucer-shaped type (Fig. 1, B) mentioned by Kennaugh (1908) is circular, almost level with the surface and built-up of more or less concentric rings which are quite dark or quite light according to the focusing of the microscope, and only found in *R. sjostedti* and *R. karschi*.

c. The mushroom-shaped type (Fig. 1, C) is a fairly high tubercle on a narrower pedestal and found only in *R. karschi.*

d. Big broadly conical spines are present especially in trochanter II of pedipalp, but also on many other limbs and body.

The setae are of different kinds, short and pointed, and long and pointed, in several cases spatulate, in *R. westermanni* and *R. crassipalpe* (Figs. 35, 41), where they may form the transition to the scales, characteristic to these two species. The scales are of two types, very broad with a row of "papillae" all along a hollow trough (*R. crassipalpe*, Fig. 1, E) or narrow with a row of broad papillae or more like a veil on each side of the hollow trough (*R. westermanni*, Fig. 1, D). In *R. crassipalpe* the scales are narrower near the tip of the limbs.

4. The shape of cucullus is given specific value by Hansen and Sørensen (1904) as well as by Beck and Schubart (1968) who further mention the different shape in the two

sexes, which, however, according to Pittard and Mitchell (1972) is not consistent. I have drawn this difference in the case of *R. afzelii* (Fig. 3) but restrain from using it in the descriptions.

The size of the big tubercles may be judged by their numbers in a row over the anterior edge of cucullus. They seem to fall into two groups: 25-30 in the row (*R. feae*, *R. sjostedti*, *R. westermanni*) or 40-45 (*R. afzelii*, *R. karschi*, *R. crassipalpe*) as seen in the drawings of the chelicerae *in situ.*

5. About the chelicerae, Beck and Schubart (1968) state the number of teeth in both fingers to be variable, though the presence or absence of a big tooth distally on the fixed finger or basally on the movable one may be of specific value.

In all species of *Ricinoides* the distal tooth on the fixed finger is perhaps a little larger than numbers 2 and 3, and the one or two proximal teeth are still smaller. The movable finger carries five to seven smaller or larger teeth. Thus no valuable diagnostic characters seem to be found in the number or shape of the teeth of the chelicerae in *Ricinoides*. Still, I have drawn them *in situ* together with cucullus for all species. Of course, the accessory tooth at the base of the fixed finger which distinguishes *Ricinoides* from *Cryptocellus* is always present. This "ricinoides-tooth" is marked with "r" in the figures.

Beck and Schubart (1968) mention as a possible specific character the number of setae located ventrally at the base of the movable finger. In all species of *Ricinoides* there are two setae on this place.

6. The pedipalps consist of a coxa, two trochanters, femur, and tibia with a free finger, the tarsus. This is movable against another finger which is regarded as a tibial process though it is distinguished well from it by a weakly sclerotized line. The segments are covered by scales in some species and tubercles, and their shape and distribution on the tibia, especially, is different among the six species and may be used for identification. The tibia is dark brown in all species as is the whole animal when mature, but the immature specimens are bright yellow, and on these the proximal half of the tibia is yellow, the distal half brown.

Beck and Schubart (1968) have discovered some sensory slits ("Sinnesspalten") in the segments of the pedipalps and state them to be intraspecifically constant. This may be correct, though their material (ten specimens) is fairly small. They depict them on the frontal side, but the slits are also present on the opposite side and not distributed in the same way, as Pittard and Mitchell (1972) have shown for *Cryptocellus*. In the specimen I have examined of *R. afzelii* they are even present in different numbers on the right and left pedipalp. I am, therefore, a little in doubt as to their specific constancy, but my material is far too small for a decision. I have drawn them for all six species. I have also indicated the presence of some small pits appearing as round or oval patches in the sculpture which consist of an immense number of regular grains. In some few cases I have been able to see a small sensory (?) hair in these pits, but more intimate exploration is needed to decide whether they are sensorial. They seem to be distributed at random. The distribution of the sensory slits and the pits is stated for each species; Beck and Schubart (1968) especially stress the number of slits on the femur and the presence of slits on tibia. As to the sensory slits Pittard and Mitchell (1972) have demonstrated their presence on all postcheliceral appendages. I have not checked this in *Ricinoides*. In Fig. 1, F one of the tibial slits is drawn in great magnification.

Fig. 1, G shows an organ which is called by Beck and Schubart (1968) a sensory groove ("Sinnesgrube"), by Pittard and Mitchell (1972) simply a "pit." It is present

dorsally on the prolateral side of tibia near the movable finger and is of a long, tubular form with a round opening on the surface. It contains what in *Cryptocellus* (Pittard and Mitchell, 1972) is a spearlike seta, but in *Ricinoides* it resembles a sensory hair which at its base shows signs of a nerve fiber. This sensory pit is depicted on the schematical drawings of the pedipalps showing the slits; it is present in *R. afzelii*, *R. feae*, *R. sjostedti*, and *R. crassipalpe*, but missing in *R. karschi* and *R. westermanni.*

The fixed finger is crenulated or with teeth. In *Cryptocellus* the movable finger is said (Pittard and Mitchell, 1972) to carry similar teeth, but this is an optical illusion. The "teeth" in *Ricinoides* are clear areas (with some fluid ?) representing canals going from the interior of the tarsus (movable finger) through its integument (Fig. 4) resembling

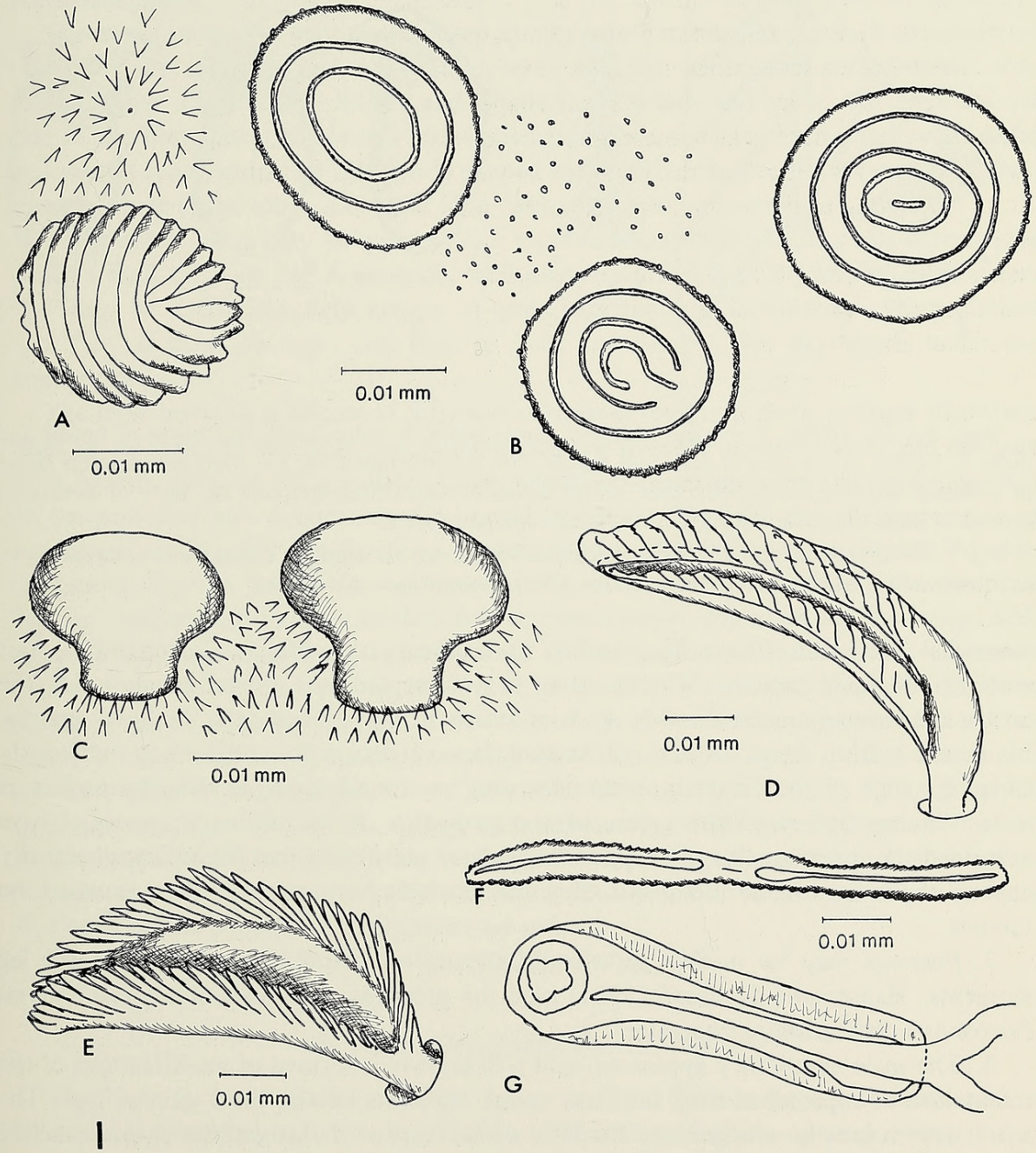
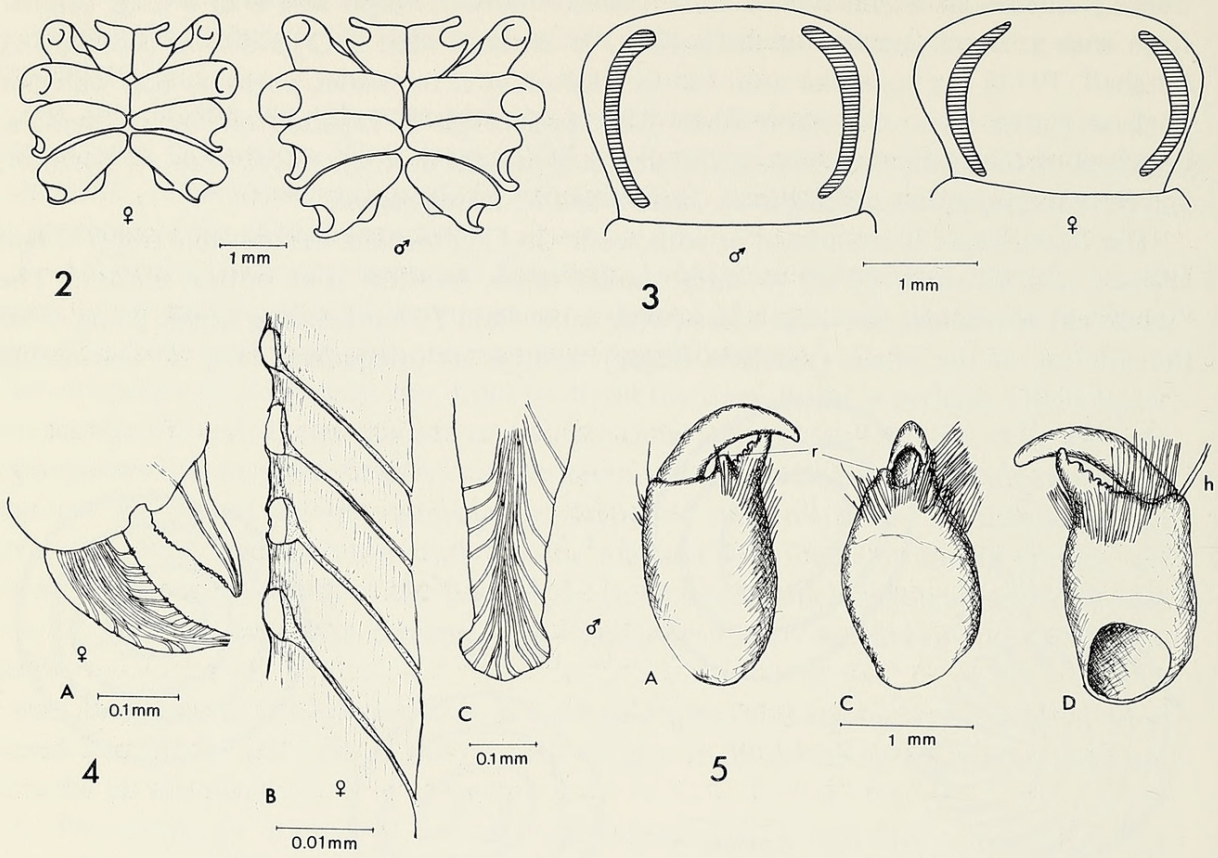


Fig. 1.–Tubercles, scales, and sense organs: A, corrugated tubercle of *R. afzelii*, above one of the very small sensory (?) pits; B, three saucer-shaped tubercles of *R. sjostedti*, sculpturing between partially indicated; C, mushroom-shaped tubercles of *R. karschi;* D, scale of *R. westermanni,* E, scale of *R. crassipalpe*, both in half profile; F, sensory slit; G, sensory pit ("Sinnesgrube") of *R. sjostedti.*



Figs. 2-4.–*R. afzelii,* Zoological Museum, Copenhagen; 2, tritosternum and coxae of female and male; 3, outline of cucullus of male and female with furrows indicated; 4A, fixed and movable finger of pedipalp showing canals; 4B, some of the canals in higher magnification; 4C, apex of metatarsal process of male copulatory organ showing canals and their opening.

Fig. 5.–*R. afzelii*, chelicera of type specimen, Stockholm Museum: A, dorsal view; B, medial view; C, ventral view; r, the ricinoides tooth; h, the setae at base of movable finger.

somewhat the canals I have described in the chelicera of Solifugae (Tuxen, 1956), but without the sense-papillae. Whether they are connected into longer canals inside the tarsus, as I have schematized in Fig. 4, A, or whether they just enter the "hollow" interior I cannot say from direct inspection. At least these canals are not confined to the "tooth-carrying" edge of the finger in *Ricinoides*, but are found scattered over the surface as shown in the figures of the apices of the pedipalps of the different species. I have examined the question also in *Cryptocellus pelaezi* and found that these "cups" actually appear as flat or conical teeth, but they are all of them connected with a canal to the interior.

7. Furrows may be present on the dorsal and/or ventral side of some of the leg segments. Hansen and Sørensen (1904) used the presence or absence of a dorsal femoral furrow as a distinguishing character.

8. The male copulatory apparatus, as is well known, is formed of modifications of the metatarsus and proximal two or three tarsal segments of the third pair of legs. The metatarsus is greatly enlarged and carries a dorsal furrow. To its anterior side is attached a process, which is movably adjoined in a separate pit independent of the dorsal furrow. This metatarsal process is differently shaped and more or less hooked at the apex. The hook is flattened and contains canals opening the same way as mentioned previously for the tarsus of the pedipalp (Fig. 4, C).

The second tarsal segment is dilated retrolaterally forming the *lamina cyathiformis*, the cup- or spoon-shaped blade which protects the tarsal process. It is said to be differently shaped in the species ("which varies not a little in shape" Hansen and Sørensen, 1904, p. 134; "the shape of the lamina cyathiformis varies to accommodate the different types of tarsal process in different species," Cooke, 1967, p. 36). This may be the case within *Cryptocellus* in which the *lamina* is very different from that of *Ricinoides*, but in the latter genus the interspecific difference is negligible. Also, the first tarsal segment may bear an extension similar to the *lamina cyathiformis* (*R. afzelii*, *R. feae*, *R. karschi*), but even where it is missing there is a cavity in the first segment which together with the protected one of the second segment conceals the movable tarsal process originating from the first segment.

The tarsal process is very complicated in construction, but may be said to consist of two portions (Hansen and Sørensen, 1904, p. 135) which are not movably connected. They are called by Pittard and Mitchell (1972) base and body. On the prolateral side of the body there is a broad, leaf-shaped extension, the lateral lobe, and at the distal end several lobes which are differently shaped in the different species. We may in general speak of three apical lobes, a broader lobe flanked by two narrower ones.

These apical lobes may be quite soft or more or less sclerotized. The retrolateral lobe which I shall call lobe "a" is generally well sclerotized and light brown; the middle one, "b," may be sclerotized, light brown, or quite soft, but with indentations; the prolateral one, "c," is generally soft, and may be long and narrow. See the figures under the separate species.

The most interesting feature at this process is, however, a system of stronger sclerotizations in its wall. In the proximal portion (base) a stronger sclerotization runs helically from base to apex on the retrolateral side, whereas two straight sclerotizations support it on the prolateral side (against the first tarsal segment). The helix gives the impression of a tightened spring carrying the distal portion (body). And also in this portion the sclerotizations form a sort of a tightened spring. From the point where the posterior "spring" reaches this portion, another bowed sclerotization departs along the margin and, distal to the base of this, a sclerotization is "rolled up," as it would appear. The most curious thing about this sclerotization which is called by Pittard and Mitchell (1972) the accessory piece, is that it is free of the rest of the process and may be bent out ("released") after which it immediately snaps into the process again. I have drawn this accessory piece in released position (s') as well as in normal position (s). This rod, which thus has the shape of a watch spring, adds immensely to the whole impression of an apparatus meant for being suddenly released and thrown against or into something else, but how is still unknown, even after the meticulous (unpublished) observations by Jerry W. Cooke on the copulation in *Cryptocellus pelaezi.*

The copulatory organ is depicted in detail for each species.

1. *Ricinoides afzelii* (Thorell, 1892)

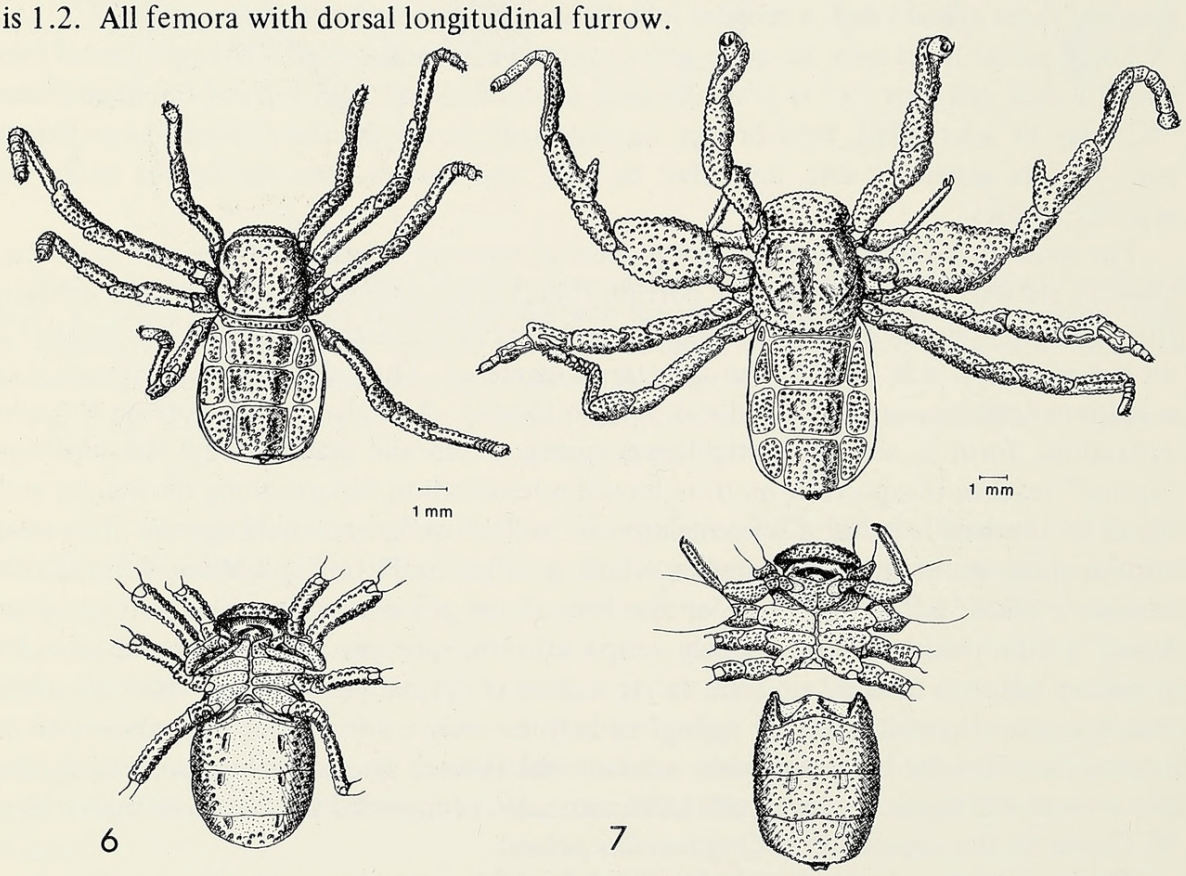
The type specimen found in Sierra Leone in the 1790's is kept in Naturhistoriska Riksmuseet, Stockholm. It was described in 1892 with some fairly rough drawings, but at present both pedipalps are missing as well as cucullus and most tarsi, so that a new description cannot be given on the basis of this specimen. The left chelicera is free, however, and I have drawn it from three sides as typical of a *Ricinoides* chelicera with the big dorsal "ricinoides tooth" (Fig. 5, r). The fixed finger carries five teeth, the distal one

hardly larger than the others. The movable finger is weakly crenulated. There are two strong setae ventrally on the proximal joint at the base of the movable finger (h). The length to width ratio of the opisthosoma is 1.15. It is a female.

It is evident that Hansen and Sørensen (1904) based most of their description not on this specimen, but on another female from the British Museum, also from Sierra Leone but without date, collected by E. E. Austen. The chelicera (plate VIII, 2, d), however, must have been drawn from the type specimen, because the specimen from the British Museum has six to seven distinct teeth on the movable finger, and the distal tooth on the fixed finger is larger than the others and coniform, not flattened (Fig. 8). I have examined and also drawn the pedipalp; it exhibits the same characters as my new material.

The Copenhagen material of *Ricinoides afzelii* consists of a male and a female from N'Zérékoré, Guinea, collected by S. Herold Olsen in 1957 and 1961, respectively (see the introduction).

Female—Length of animal without cucullus and pygidium, 8.0 mm, i.e., a little shorter than the female from the British Museum. Fig. 6 shows the animal from the dorsal and, with only the base of the legs, the ventral side. The length to width ratio of opisthosoma is 1.2. All femora with dorsal longitudinal furrow.



Figs. 6-7.—*R. afzelii*, Zoological Museum, Copenhagen: 6, female, dorsal and ventral views; 7, male, dorsal and ventral views.

The chelicera (Fig. 9) has five distinct teeth on the movable finger and four, plus a very small basal one, on the fixed finger. The distal one is not larger than the others. This is important, since it is distinctly larger in the female from the British Museum, and since Beck and Schubart (1968) state this character to be the only reliable one in the dentition of the chelicera. Pittard and Mitchell (1972) follow them in their study of a large sample of *C. pelaezi*. I would be tempted to consider not even this character reliable.

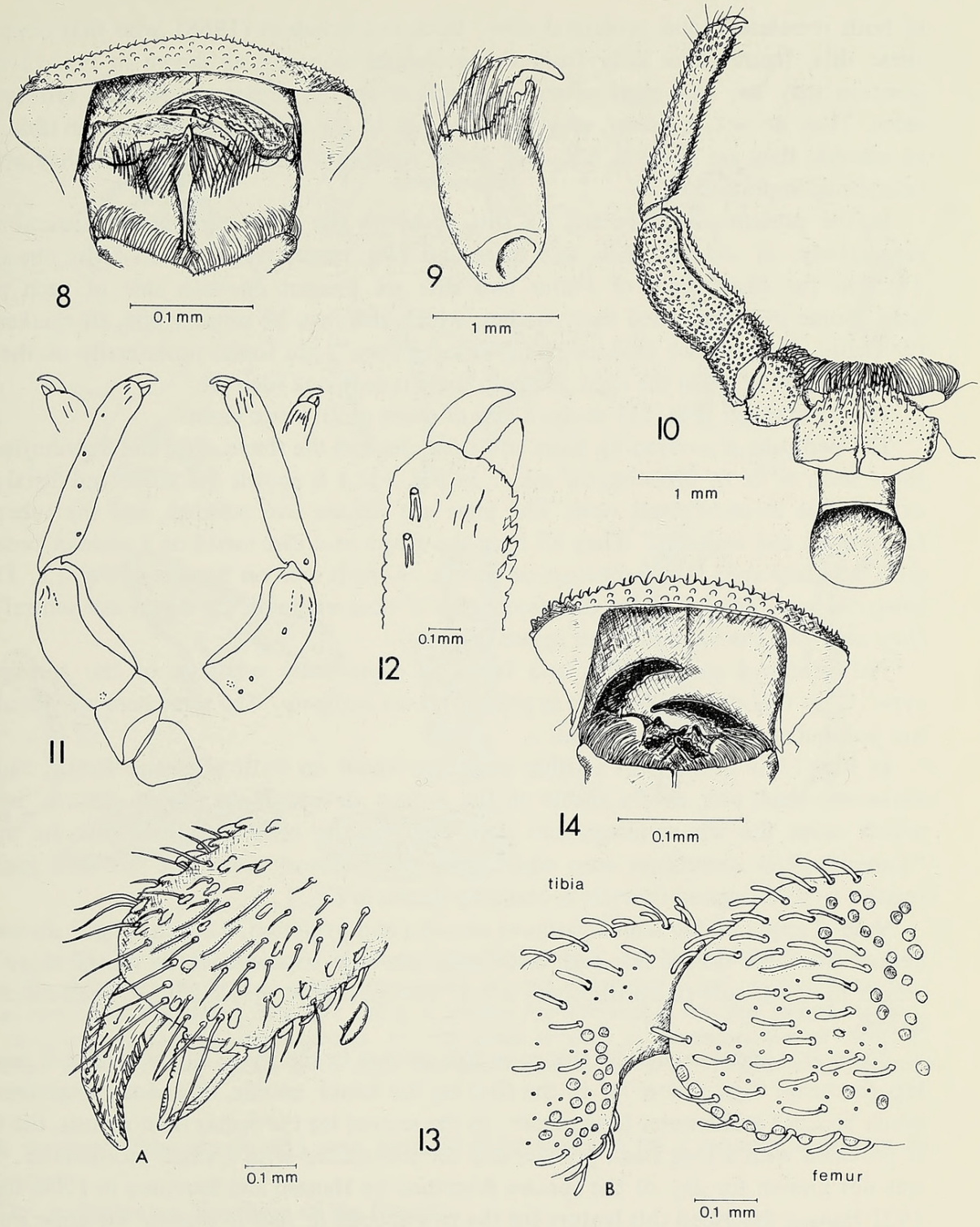


Fig. 8.–*R. afzelii*, British Museum, female, chelicerae and cucullus *in situ*.

Figs. 9-14.–*R. afzelii*, Zoological Museum, Copenhagen: 9, female, right chelicera, ventral view; 10, female, right pedipalp, retrolateral view; 11, female, position of sensory slits and bare patches on pedipalp; 12, female, position of sensory pits ("Sinnesgrube")(exceptionally two) and slits on left pedipalp, prolateral view. 13, female, pedipalp: A, apex of tibia; B, base of tibia and apex of femur; 14, male chelicerae and cucullus *in situ*.

In the pedipalp the tibia and tarsus show the features of greatest interest and probably of the greatest value to taxonomy. The pedipalp is drawn in retrolateral aspect in Fig. 10 to show the relative length of the segments, coxa, the two trochanters, femur, tibia and tarsus (movable finger). Fig. 11 shows the position of the sensory slits on both sides and

in both retrolateral and prolateral view. Beck and Schubart (1968), who first observed these slits, figure them only from the prolateral side and as shown in Fig. 11 their position may be, and most often is, different on the prolateral and the retrolateral sides. They do not, however, attach importance to the number of the slits on tibia, just to whether they are there or not. But to the number of slits on the femur, they attach taxonomic importance.

In the present case, five and six slits occur on the retrolateral and prolateral side, respectively, of the left tibia, and three and two, respectively, on the right one (Fig. 11). On the distal part of femur two slits are present on each side of each pedipalp. Some small, rounded bare patches, which also may be sensory pits, are marked on the figure. Finally, two sensory pits ("Sinnesgruben") are found prolaterally on the left pedipalp (Fig. 12). On the right pedipalp there is only one such pit.

The fixed finger (Fig. 11) carries a row of many small acute teeth.

The pedipalp is covered by hairs and tubercles and the shape, size, and distribution of these seem to be of taxonomical value. In Fig. 13, A is shown the tarsus and distal part of the tibia in retrolateral view. The setae are slender and pointed, and the tubercles fairly small and scattered. They all have the shape of a disc raised on a socle or pedestal with the distal apex free; a schematical profile of one is seen on the side of Fig. 13. These tubercles are confined to the distalmost part of tibia where on the dorsal and ventral side they may take the form of larger spines (Fig. 10).

The proximal part of tibia and femur is covered by tubercles of the corrugated type. Only this type of tubercle is present on the pedipalp. The setae here are spatulate, not pointed as at the apex of tibia.

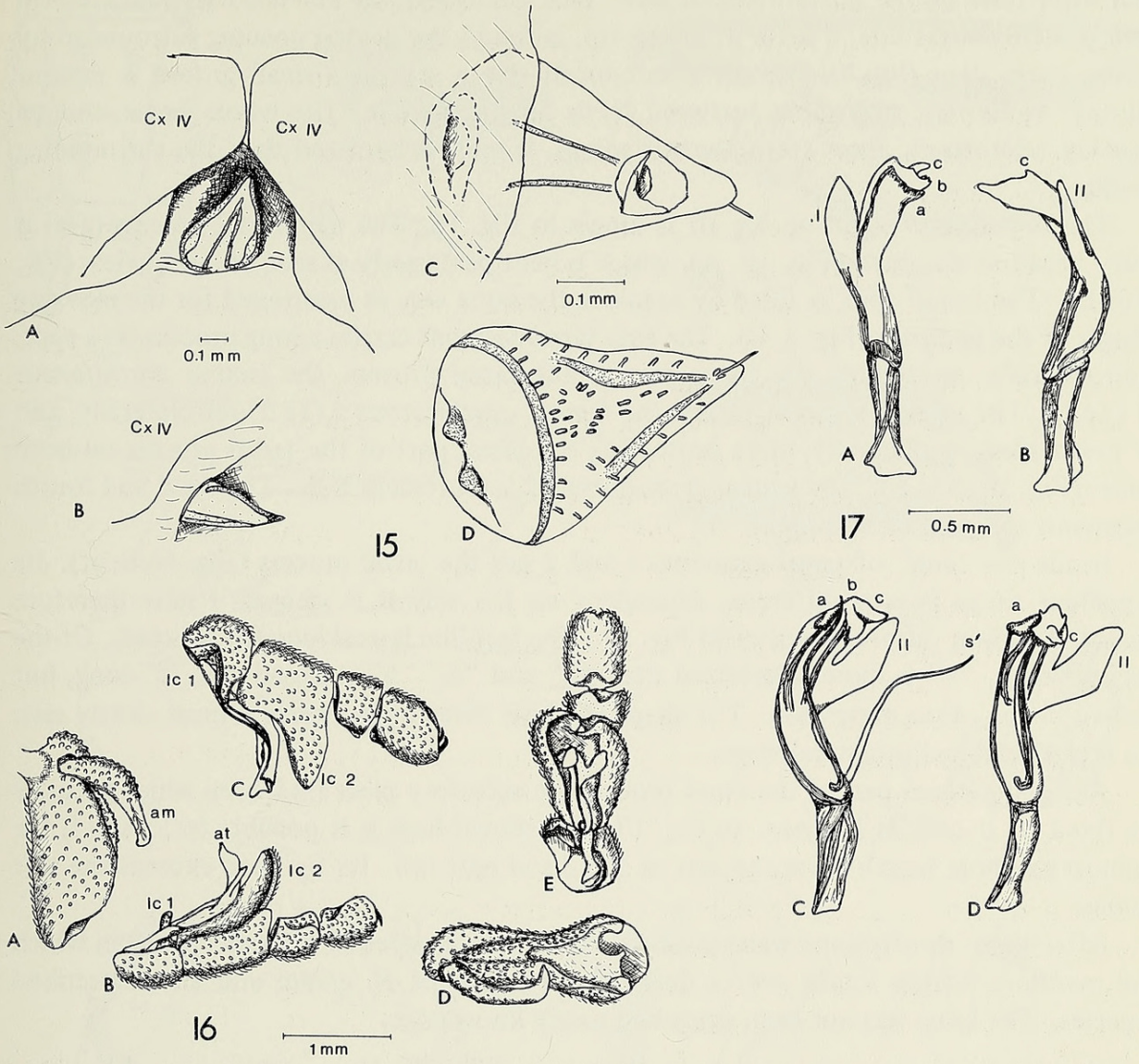
In Fig. 13 is shown still another structure found on both tibia and femur, namely extremely small pits, hardly visible on the surface, devoid of the minute conical "teeth" which cover the whole integument as a rasp. In the center of these pits the tip of "something" is sometimes seen which may be a sensory seta. The size and position relative to a corrugated tubercle is correctly drawn in Fig. 1, A.

Male—Length of the animal without cucullus and pygidium, 9.3 mm. Fig. 7 shows the animal from the dorsal side and, with only the base of the legs, the ventral side. The length to width ratio of opisthosoma is 1.2. The male of *R. afzelii* has not been described before.

There is a great sexual difference in this species in the shape of the first and second legs (compare Figs. 6 and 7). In the first leg the femur, patella, tibia, and metatarsus are much broader and stouter in the male. In the second leg the femur is enormous, the tibia is provided with a long basal process and the metatarsus with a small prominence. This was not known for any of the species described by Hansen and Sørensen in 1904, but in 1921 Hansen described this feature for the new species *R. feae* in exactly the same way as I have drawn it for *R. afzelii*. Beck and Schubart (1968) mention some apophyses in the males of some species of *Cryptocellus* (p. 73), but they are partly on other parts of the legs.

A small sexual difference is seen on the ventral side (Fig. 2), the third coxae being relatively shorter than in the female; and then, on the whole, the male is stouter than the female. Another difference is found in the shape of cucullus (Fig. 3), but Pittard and Mitchell (1972) emphasize the variability of the shape of cucullus also within the sexes.

The chelicerae (Fig. 14) show a just crenulated or finely toothed movable finger and four teeth on the fixed finger, the distal not being larger than the others. In this figure is also shown the tubercles at the border of cucullus; they are fairly large in *R. afzelii*, and



Figs. 15-17.–*R. afzelii*, Zoological Museum, Copenhagen, male: 15, penis: A-B, tip turned anteriorly; C, posteroventral view; D, anterodorsal view. 16, left copulatory organ: A, metatarsus prolateral view; B, tarsus, dorsal view. lc 1 and lc 2, *laminae cyathiformes* of first and second segment; am, metatarsal process; at, tarsal process. 17, left tarsal process: A, retrolateral-ventral views; B, prolateral view; C-D, two dorsal views. a,b,c, the apical lobes; ll, lateral lobe; s, accessory piece; s', accessory piece released.

their number (here about 45) may indicate their size and be a valuable character in taxonomy.

The pedipalps are like those of the female.

The male genital aperture is described by Hansen (1921) in *R. feae* and *R. crassipalpe* as "much smaller than in the female"; "the sternite of first segment is produced downwards as a freely protruding, triangular plate about as long as broad and with the end subacute"; "the sternite of second segment is . . . semicircular . . . ." He gives, however, no drawings. In 1972, Pittard and Mitchell gave drawings of the structure, calling it penis, in *C. pelaezi*, where it is a "tubelike piece formed by the fusion of extended sternite 8 and slightly shorter sternite 9." In the drawings it is a long conical, apparently weak structure.

In *R. afzelii* (Fig. 15), the penis is a cone, very broad at its base, weak, but with two stiffenings in the wall almost to the tip on the anterodorsal side and two shorter and

narrower ones on the posteroventral side. This side is flat, the anterodorsal concave. On the posteroventral side, a little from the tip, is found the genital opening surrounded by some loose flaps (lips ?). On the anterodorsal side a seta in a small groove is present almost at the tip, and some scattered teeth on the surface. The whole penis, though weakly sclerotized, apart from the stiffenings, is more sclerotized than the surrounding pedicel.

The copulatory organ on leg III is drawn in Fig. 16. The metatarsal process (am) is very broad at the apex (Fig. 16, A), which is bent posteriorly as seen in dorsal view (Fig. 16, D). The broad apex is filled by canals in the same way as mentioned for the movable finger of the pedipalp (Fig. 4, C). The first tarsal segment carries a long process, as a spur, retrolaterally, protecting the inner part of the tarsal process, the *lamina cyathiformis* 1 (1c,1). The second segment carries the *lamina cyathiformis* 2 (1c 2) retrolaterally, and a lower blade prolaterally, thus protecting the distal part of the tarsal process on both sides (Fig. 16, B,C,E). The *lamina cyathiformis* 2 is extremely high. The third and fourth segments are but little changed.

Inside the "cup" of tarsal segments 1 and 2 lies the tarsal process (Fig. 16 B, at). Its apparent shape is very different, dependent on the way it is viewed. I have therefore drawn it in four different aspects in Fig. 17. The leaf-like lateral lobe (ll) is broad. Of the apical lobes, "a" is more sclerotized than "b" and "c," "b" is broad and "c" long, but broad in the other dimension. The shape of these three apical lobes is most clearly seen in retrolateral and prolateral views.

Along the distal part of the tarsal process the accessory piece (s) is seen which actually is fixed to it only at its base. In Fig. 17, C is shown how it is possible to loosen it for almost its whole length from the rest of the distal part (s'). Its tip even exceeds the soft lobes.

After these descriptions were finished I have seen a paper by Pollock (1967) in which he mentions having found over a hundred specimens of *R. afzelii* and an undescribed species. The latter has not been described to my knowledge.

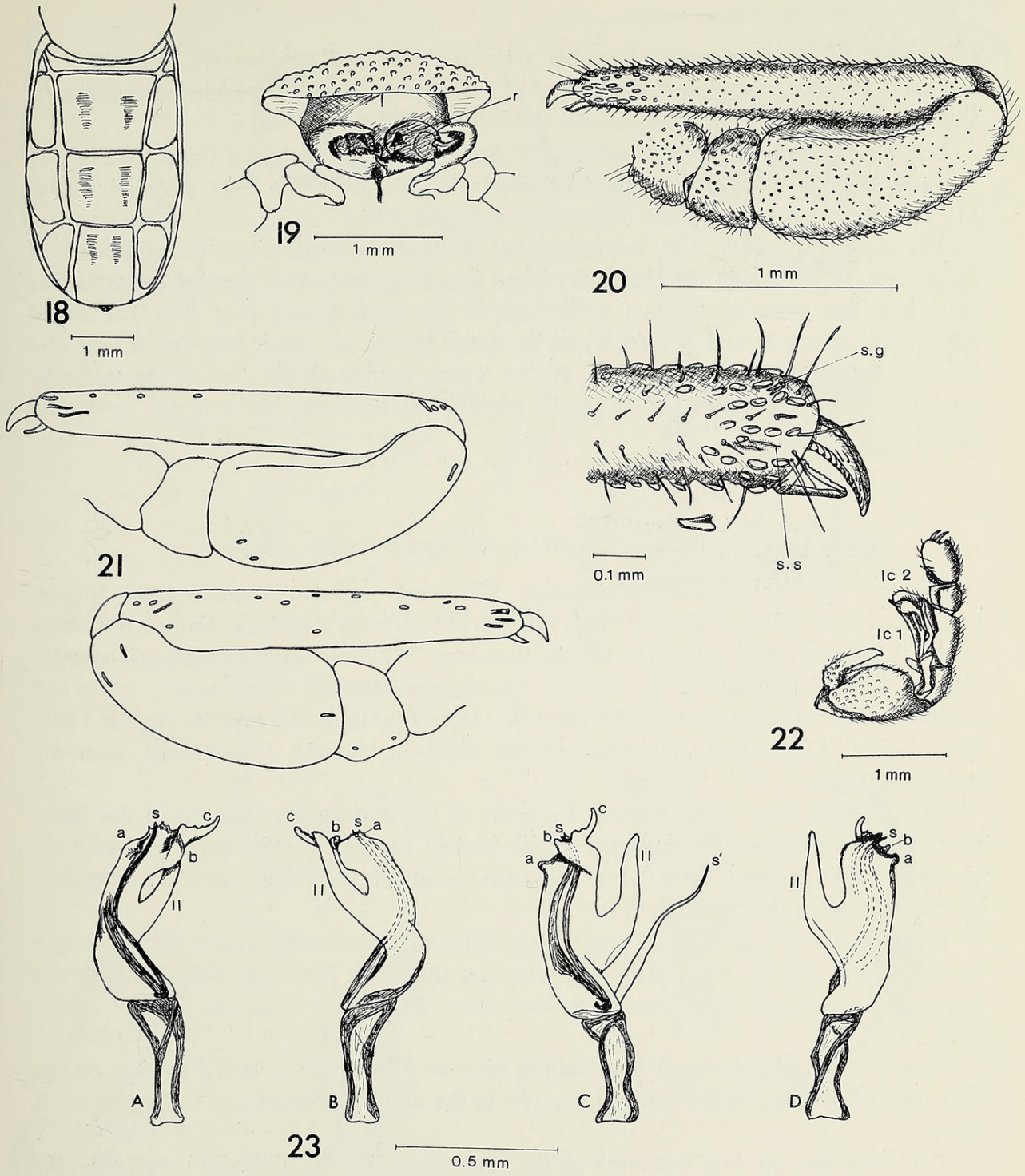
2. *Ricinoides feae* (Hansen, 1921)

Described on the basis of material from Portuguese Guinea (near lat. 12 degrees N) at Bolama June-December, 1899, "many specimens," and at Rio Cassine January-April, 1900, "numerous specimens." Hansen did not select a holotype. The whole material was handed over to him for study by the Museo Civico di Storia Naturale in Genova. Some of the material was given to the Zoological Museum of Copenhagen and my descriptions are based on this, but a lectotype must be selected from the Genova material, and this I have not seen.

Millot (1945) made his admirable study on the internal anatomy of Ricinulei on specimens of *R. feae*.

This species is very closely related to *R. afzelii*, but it is smaller; length without cucullus and pygidium is about 6.5 mm. The shape of opisthosoma is very different from that of *R. afzelii,* almost parallel-sided; length to width ratio is 1.5 (Fig. 18). The tubercles on cucullus are larger and more dispersely set, only about 25 in a row behind its anterior margin (Fig. 19). All femora are with a dorsal longitudinal furrow.

The chelicerae are with about six teeth on the movable finger, five on the fixed one, of which the two basal ones are quite small, but the distal one not remarkably larger than the other. Two setae are situated ventrally at the base of the movable finger.



Figs. 18-23.–*R. feae*, Zoological Museum, Copenhagen, male: 18, opisthosoma; 19, chelicerae and cucullus *in situ*, left chelicera fully opened. r, the ricinoides tooth; 20, right pedipalp, prolateral, and apex of left pedipalp, prolateral view. sg, sensory pit ("Sinnesgrube"), below a tubercle in higher magnification; 21, pedipalp showing position of sensory pit ("Sinnesgrube"), sensory slits and sensory (?) patches in retrolateral (above) and prolateral view; 22, left metatarsus and tarsal segments of leg III, prolateral view. lc 1 and lc 2, *laminae cyathiformes* of first and second tarsal segment; 23, left tarsal process: A, retrolateral view; B, prolateral view; C, dorsal view; D, ventral view. a,b,c, the apical lobes; ll, lateral lobe; s, accessory piece; s', accessory piece released.

In the pedipalps there are small differences from that of *R. afzelii*. It is comparatively broader, not tapering towards the middle, and the tubercles are comparatively larger in size and fewer in number (Fig. 20). On the ventral and dorsal side they have even the character of spines in one or two rows along the whole length of tibia. Two prolateral and three retrolateral sensory slits on the distal part of tibia and one prolateral sensory pit

("Sinnesgrube"). At the base of tibia and on femur and trochanters, the setae are spatulate and the tubercles all corrugated as in *R. afzelii*. The distribution of sensory slits and small rounded sensory (?) patches is seen in Fig. 21.

The male has the same extreme enlargement of femur and tibia of the second pair of legs as *R. afzelii* and exactly in the same shape (Fig. 7, and Hansen 1921, plate III, Fig. 1, b). This is not known from any other species of *Ricinoides*.

The copulatory organ, too, resembles that of *R. afzelii* in the shape of metatarsus and its process as well as in the first and second tarsal segments with *laminae cyathiformes* (Fig. 22). But there are distinct differences in the tarsal process (Fig. 23). The lateral lobe (ll) is narrower and pointed (seen in dorsal view), the apical lobe "c" is long and narrow and with small soft teeth at the upper margin. Lobe "a" is more firmly sclerotized than the other two, as in *R. afzelii*. The accessory piece is not so heavily curled at the basis.

3. *Ricinoides sjostedti* (Hansen and Sorensen, 1904)

Material for the original description: Male and immature female from N'dian, Cameroun, June 1891, collected by Y. Sjöstedt (Stockholm Museum). Hansen has noted on the label that they are "types for the drawings." "Pullus" from Bibundi, Cameroun, August, 1891, collected by Y. Sjöstedt (Zoological Museum, Copenhagen). Male and female and immature female (?) from Joh. Albrechts-Höhe, 21 July-31 August 1897, collected by L. Conradt (Naturhistorisches Museum, Berlin). I have only seen the immature female.

According to these data, I select the male in the Stockholm Museum as the lectotype. On it were based the drawings in the original description, and on it are based my drawings in the present paper. Some few other specimens have been found since the days of the description (Kennaugh, 1968).

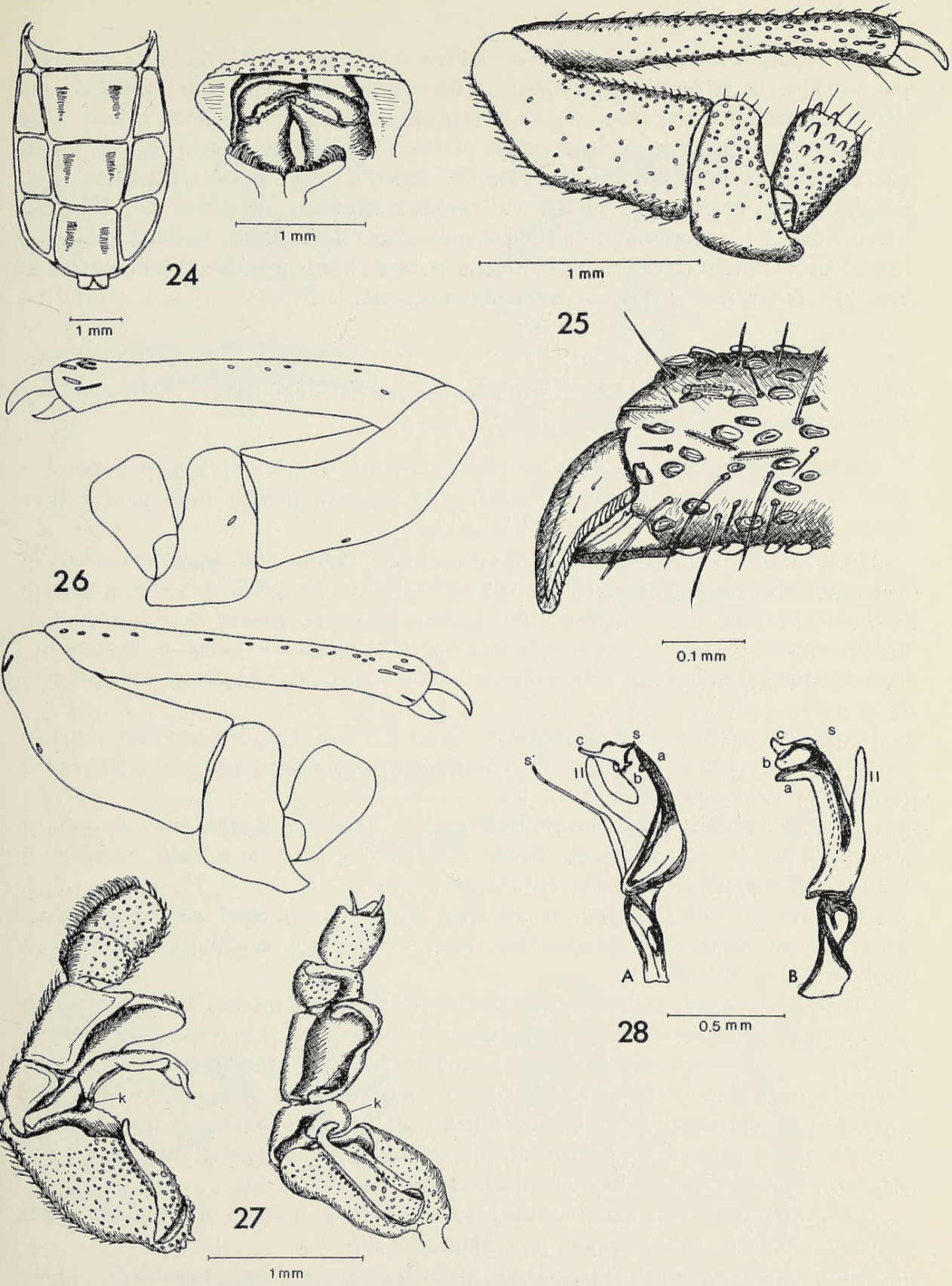
Length without cucullus and pygidium is 7.0 mm. Opisthosoma rather narrow, length to width ratio is 1.45, but a little more rounded than in *R. feae* (Fig. 24). The tubercles in cucullus are smaller than those of *R. feae*, about 30 in a row behind its anterior margin (Fig. 24).

Femora are without dorsal longitudinal furrows. The male is with a process on the first tibia in the Stockholm material, but not in the Berlin material (only those two males known).

The chelicerae are with five teeth on the fixed finger, the apical hardly longer than the others. The movable finger is with five to six conspicuous teeth (Fig. 24).

The pedipalps are very different from those of the two preceding species. The tibia is more slender, narrowed somewhat in the middle, and the tubercles are dispersed in another way (Fig. 25). At the apex there are many fairly long tubercles which look like fishes' otoliths (Fig. 25). At the dorsal and especially ventral sides are strong spines like those in *R. feae*. The "otoliths" continue, dispersing, mostly on the dorsal side, until the narrowed middle of the tibia where they are replaced by saucer-shaped tubercles. The tubercles thin out towards the base of tibia, where some of the corrugated type occur. On femur both saucer-shaped and corrugated tubercles are found, intermingled. On the first trochanter are several strong spines.

The distribution of the sensory slits and the sensory pit ("Sinnesgrube") is seen in Fig. 26.



Figs. 24-28.–*R. sjostedti*, Stockholm Museum, male: 24, lectotype, opisthosoma and chelicerae with cucullus *in situ*; 25, lectotype, right pedipalp, retrolateral and apex of tibia, prolateral view; 26, lectotype, pedipalp showing position of sensory pit ("Sinnesgrube"), sensory slits and sensory (?) patches in prolateral (above) and retrolateral view; 27, lectotype, metatarsus and tarsal segments of right leg III, prolateral with tarsal process and dorsal with tarsal process removed. lc 2, *lamina cyathiformis* 2. *k* a knob replacing *lamina cyathiformis* 1; 28, right tarsal process: A, dorsal view; B, retrolateral view. a,b,c, the apical lobes; ll, lateral lobe; s, accessory piece; s', accessory piece released.

The copulatory organ (Fig. 27) is different from that of the two preceding species. There is no *lamina cyathiformis* on the first tarsal segment, only a rounded knob (k) to protect the tarsal process. The metatarsal process is more pointed at the curved apex. Metatarsus with some large spines at base. The tarsal process (Fig. 28) differs especially in the shape of the apical lobe "b" which is bipartite and smaller than in *R. feae*, as well as in the shape of lobe "a" which is narrower and darker than the other lobes. Lobe "c" is shorter than in *R. feae* and without dorsal teeth. In Fig. 28, A I have figured the accessory piece *in situ*, and as if withdrawn from the body. It is broader in its basal half. The lateral lobe is narrower and not pointed.

4. *Ricinoides karschi* (Hansen and Sørensen, 1904)

Cryptostemma westermanni, Karsch 1892, p. 25, ff.

Material for the original description: Male and female from Kribi, Cameroun, October, 1888 (Naturhistorisches Museum, Berlin). Male and two females from Benita River, Congo, collected by G. L. Bates (British Museum).

The material in the Berlin museum was identified by Karsch as *R. westermanni* Guérin. This is the reason why Hansen and Sørensen (1904) gave the species its name, so actually the lectotype might be selected here. But the tarsal process is missing on both sides in the male, and since I think the most important specific character is found in this process I have selected the male in the British Museum as the lectotype and base my description on it.

Length without cucullus and pygidium about 6.0 mm. Opisthosoma oval, rounded, length to width ratio is 1.10 (Fig. 29). Tubercles on cucullus are small, about 30 in a row behind its anterior margin (Fig. 29).

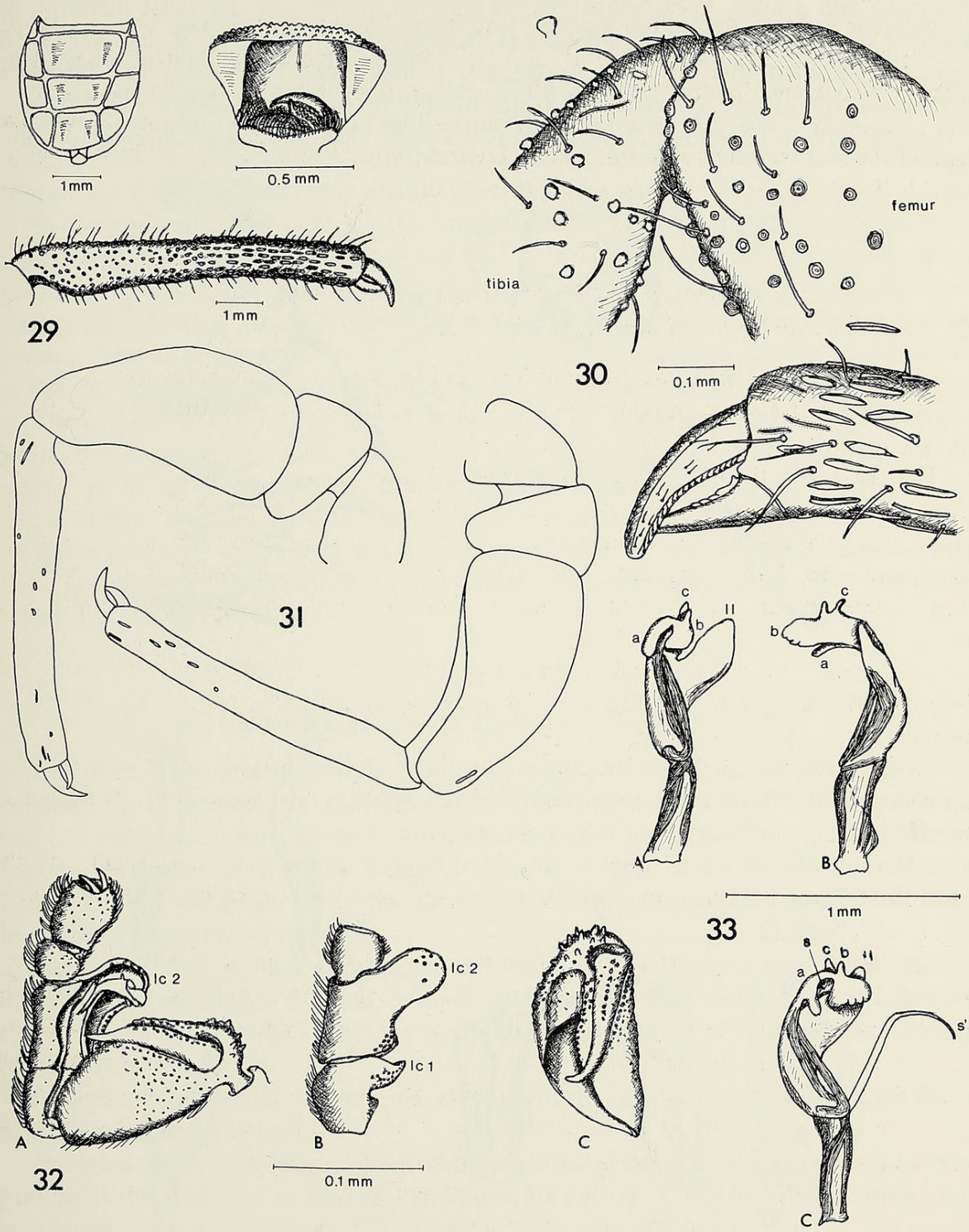
Femora are without dorsal longitudinal furrows. Tibia of first leg in the male are with an enlargement in the middle and femur of second leg much broadened, as shown in Hansen and Sørensen (1904, plate VIII, 4a, cf. IX 1a).

Chelicerae are with five teeth on the fixed finger, the two basal ones small, and the apical one not longer than the next two. The movable finger is with six to seven fairly small teeth (Fig. 29).

The pedipalp is very different from that of the preceding species. It is only sparsely provided with hairs, some very long and curved and some short in between. The tubercles on the apex of tibia are very long, narrow, and low, not very densely set and cover about the distal two-fifths or half. At the base of tibia there are some mushroom-shaped tubercles. At the distal part of femur almost all tubercles are saucer-shaped except ventrally where some of the corrugated type are found. At the base of femur corrugated and saucer-shaped tubercles are mingled among each other (Fig. 30).

The distribution of the sensorial slits is seen in Fig. 31. There is only one slit at apex of femur, prolateral, and no sensory pit ("Sinnesgrube").

In the copulatory organ (Fig. 32) the metatarsal process is bent towards the middle line, but more pointed than in *R. afzelii*. Metatarsus is with several very strong teeth or spines near base. Both first and second tarsal segments carry *laminae cyathiformes*; in the first segment it is a little twined towards the middle line. In the tarsal process the accessory piece is not S-shaped but U-shaped, ending behind the apical lobe "b." This lobe is very broad and "fleshy," with indentations. Lobe "a" is soft and lobe "c" fairly small. The accessory piece is drawn also in released position in Fig. 33, C.

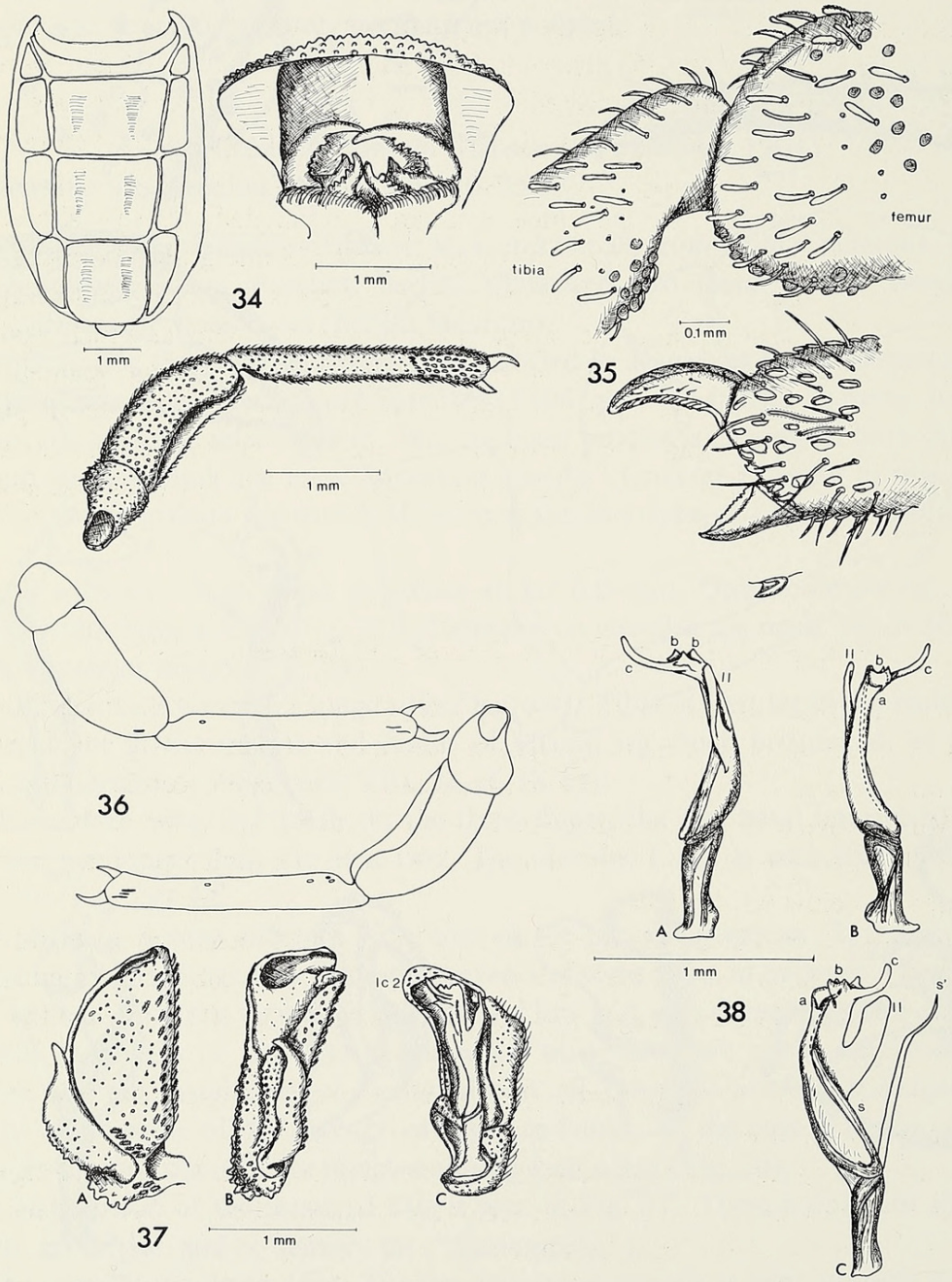


Figs. 29-33.–*R. karschi*, British Museum: 29, female, opisthosoma, chelicerae and cucullus *in situ*, and left pedipalp, prolateral view; 30, female, left pedipalp, apex of tibia and base of same plus apex of femur, retrolateral view; 31, female, pedipalp showing distribution of sensory slits and sensory (?) patches, prolateral (left) and retrolateral view; 32, male, lectotype, right copulatory organ: A, prolateral view; B, tarsal segments 1-3, retrolateral view; C, metatarsus, dorsal view. lc 1 and lc 2, *laminae cyathiformes* of tarsus 1 and 2; 33, male, lectotype, tarsal process of right leg III: A, dorsal view; B, prolateral view; C, dorsal-retrolateral view. a,b,c, the apical lobes; ll, lateral lobe; s, accessory piece; s', accessory piece released.

5. *Ricinoides westermanni* (Guérin-Méneville, 1838)

The type specimen, a male, is lost, but Hansen and Sørensen (1904) described a specimen, also a male, in Naturhistorisches Museum, Berlin, and this must therefore be regarded as a neotype. It was collected in Bismarcksburg, Togo, by R. Büttner on 16 January 1893. Another specimen, immature, is mentioned by Hansen and Sørensen (1904) and seen by me; collected in the same locality by the same collector July 1891.

Length without cucullus and pygidium is 8.5 mm. Opisthosoma is fairly narrow, but



Figs. 34-38.—*R. westermanni*, Naturhistorisches Museum, Berlin, neotype: 34, opisthosoma, chelicerae and cucullus *in situ*, and right pedipalp, retrolateral view; 35, apex of right pedipalp and base of same plus apex of femur, prolateral view; 36, pedipalp, retrolateral (above) and prolateral view, to show distribution of sensory slits and patches; 37, left copulatory organ: A, prolateral view; B, dorsal view; C, tarsal segments 1 and 2, dorsal view. lc 2, *lamina cyathiformis* of tarsus 2; 38, tarsal process of left leg III: A, prolateral view; B, dorsal view; C, retrolateral view. a,b,c, the apical lobes, ll, lateral lobe, s, accessory piece; s', accessory piece released.

very shrunk, length to width ratio is 1.3, fairly parallel sided (Fig. 34). The tubercles on the cucullus are big and fairly closely set, about 30 in a row behind its anterior margin (Fig. 34).

Femora are with narrow dorsal longitudinal furrows. Since the female is not known, nothing can be said as to sexual differences.

The whole body is covered with scales, which are narrow and have the shape of a hollow trough with two patches of hairs or papillae along the sides (Fig. 1, D).

The chelicerae (Fig. 34) are with five to six rather big teeth on the movable finger and four on the fixed, the distal only slightly larger than the others.

In the pedipalp (Figs. 34, 35) the tibia is slender and with a slight narrowing in its distal third. The distal third is covered with rather short tubercles and mostly short, pointed setae. On the base of tibia the setae are broad, spatulate; ventrally some corrugated tubercles. At the femur all tubercles are corrugated, no saucer-shaped ones are present. The setae are spatulate and some scales are intermingled. Sensory slits as shown in Fig. 36, one slit prolaterally on femur. No sensory pit ("Sinnesgrube") present.

The copulatory organ (Fig. 37). The metatarsal process is very broad in lateral view, a little twined when seen from above, apex tapering and not bent as much against the middle as in the other species. *Lamina cyathiformis* of second tarsal segment of the common size, but that of first segment almost missing (Fig. 37). The tarsal process is very characteristic, with a long and narrow apical lobe "c" and stronger sclerotized lobe "b". Lobe "a" is sclerotized, short, and pointed. The accessory piece is free and drawn released (s') in Fig. 38, C.

6. *Ricinoides crassipalpe* (Hansen and Sørensen, 1904)

Described from an immature and quite young ("pullus") specimen from Cameroun, collected by Y. Sjöstedt, but in 1921 Hansen described it again on five adult specimens and two immatures collected by L. Fea on the Island of Fernando Póo in 1901-1902 and kept in Museo Civico di Storia Naturale, Genova. A male and a female from Musola, Fernando Póo, was presented to the Zoological Museum, Copenhagen, and I have based my description below on the male.

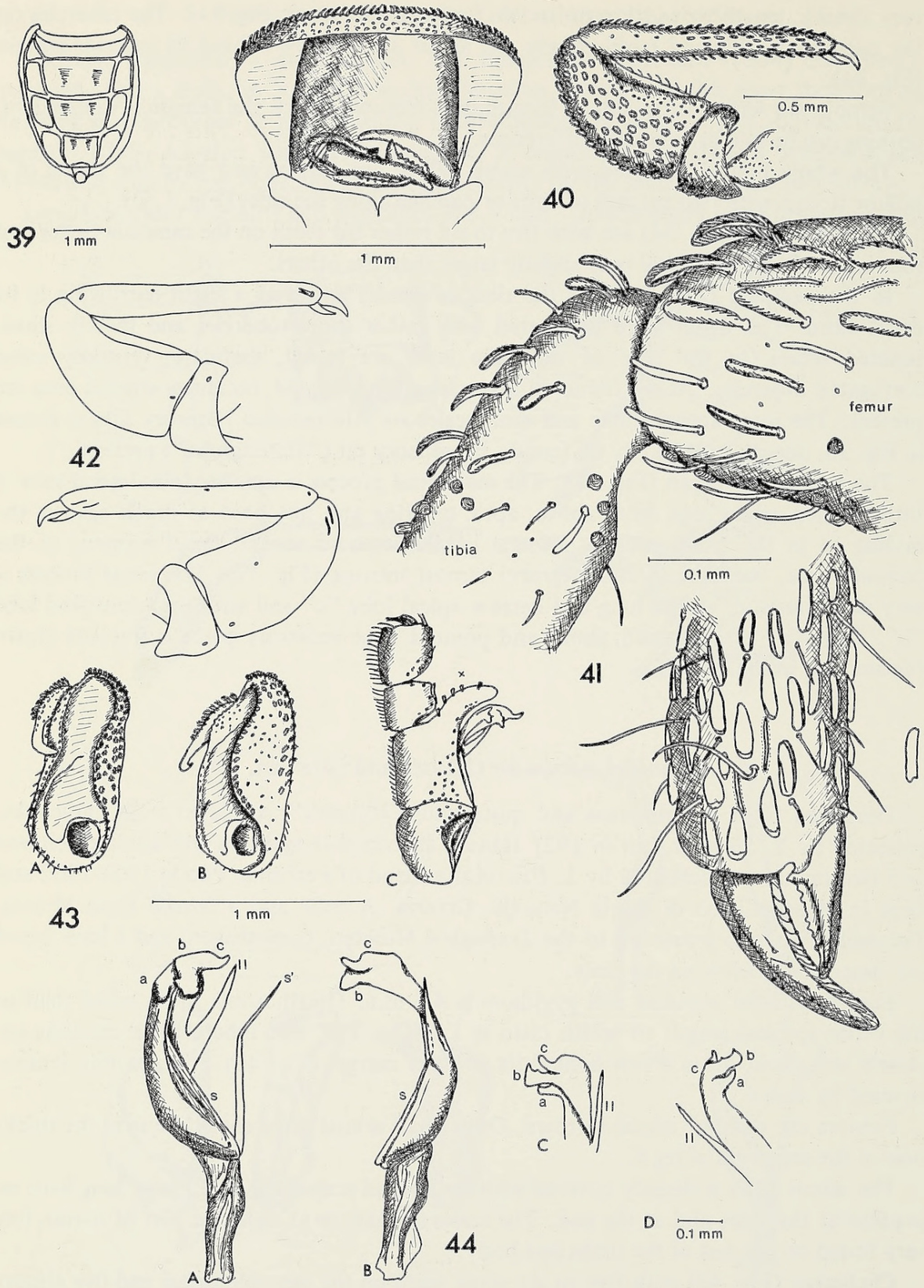
Length without cucullus and pygidium is 4.5 mm. Opisthosoma more ovoid than in the other species, length to width ratio is 1.1 (Fig. 39). The tubercles on cucullus are closely set, about 40 in a row behind its anterior margin (Fig. 40); and cucullus densely covered by scales.

Femora are without dorsal furrows. Only small sexual differences occur in the thickness of the segments of leg I.

The whole body is densely covered with very broad scales (Fig. 1, E) with long hairs or papillae at the sides and at the end. The scales are narrow at tibia and part of femur, but very broad on the rest of the limbs and body.

Chelicerae (Fig. 40) with five to six small teeth on the movable finger and five almost equal, fairly big teeth on the fixed one.

The pedipalps are figured in Figs. 40-42. Tibia is narrow and with a slight narrowing almost at the middle. It is covered with fairly long tubercles for more than the distal half. At its base there are some few corrugated tubercles and some few slender scales. Femur is very broad (thence the name *crassipalpe*) and densely covered with scales, narrow ones at its apex, broader ones towards bases. All the tubercles on the



Figs. 39-44.–*R. crassipalpe*, Zoological Museum, Copenhagen, male: 39, opisthosoma; 40, chelicerae and cucullus *in situ*, and left pedipalp, prolateral view; 41, left pedipalp, apex of tibia and base of same plus apex of femur, retrolateral view; 42, pedipalp prolateral view (above) and retrolateral view, to show distribution of sensory slits and pit ("Sinnesgrube"); 43, left copulatory organ: A, metatarsus, dorsal view; B, retrolateral view; C, tarsus, retrolateral view. x, small, blunt hairs on *lamina cyathiformis* 2; 44, left tarsal process: A, dorsal view; B, prolateral view; C, apical lobes, dorsal-prolateral view; D, ventrolateral view. a,b,c, apical lobes; ll, lateral lobe; s, accessory piece; s', accessory piece released.

pedipalp are of the corrugated type. A sensory pit ("Sinnesgrube") is present at the apex of tibia on the prolateral side of which, however, no sensorial slits are found. Two sensorial slits occur retrolaterally and two prolaterally on the femur (Fig. 42).

Metatarsus of the copulatory organ is densely covered by scales, and the metatarsal process is short and slender, with the tip bent sharply against the middle line. No *lamina cyathiformis* occurs on first tarsal segment; that of the second segment carries distally a few curious short blunt hairs or papillae (Fig. 43). The tarsal process (Fig. 44) is with a very narrow and pointed lateral lobe. The three apical lobes are soft, "b" almost fleshy, but with some characteristic "teeth"; I have therefore drawn it in different positions; "c" has the curious shape of a snub nose.

7. *Ricinoides plebejum* (Hansen and Sørensen, 1904)

This species was described on a single immature specimen from Togo, Misalishe, 24 June, 1894, collected by E. Bauman, and kept in Naturhistorisches Museum, Berlin. Since it is a young stage and the changes from one stage to another is not known for the *Ricinoides* species, except partly for *R. feae*, I restrain from giving a new description, which, I think, should await more material. It is important, however, to notice, that it is covered by scales.

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I also want to thank Dr. Robert W. Mitchell, Texas Tech University, Lubbock, who sent me living *Cryptocellus pelaezi* as well as the then unpublished drawings (without the text, however) by Kay Pittard, which are each a piece of art and wonderfully instructive. At the time my study was almost finished, I received Pittard and Mitchell's (1972) extremely valuable paper on *C. palaezi* which caused many changes in my manuscript especially in anatomical name-giving. Dr. Mitchell has also perused my paper and sent me the still unpublished paper by Jerry W. Cooke on copulation in ricinuleids. I owe him my most heartfelt thanks.

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