

Comparative Morphology and Ethology of Insects with a Specialized Diet, *Rhysodes germari* Ganglb.

This memoir was published in 1955 in the « Bollettino » of our Institute (Grandi 1955). I give now a translation into English, because I think that what I have shown about this beetle is worth to be known by a large group of persons.

The Rhysodidae, including ancient isolated aberrant species exhibiting several archaic features and other specialized characters, form, as everybody knows, a small family of Coleoptera Adephaga comprising throughout the World no more than 125 described species, which are grouped in only two genera, *Rhysodes* Dalm. and *Clinidium* W. Kirby; its members are distributed especially in the Indo-Australian Region, where about two thirds of the known species occur. The catalogue of Hinks (1950) indeed, lists 10 Palearctic, 2 Nearctic, 2 Neotropical, 8 Ethiopian and 57 Indo-Australian species of *Rhysodes* Dalm. and also 3 Palearctic, 2 Nearctic, 24 Neotropical and 17 Indo-Australian species of *Clinidium* W. Kirby. Therefore, 13 species live in the Palearctic Region (10 *Rhysodes* and 3 *Clinidium*). Of these only three species, *Rhysodes sulcatus* F. and *Germari* Ganglb., and *Clinidium canaliculatum* Costa occur in Europe and Italy. Luigioni (1929) mentioned *R. sulcatus* F. from Lombardy, Tuscany, Latium, Campania and Basilicata; *R. Germari* Ganglb. from Latium, Campania, Apulia and Basilicata; *C. canaliculatum* Costa from Campania, Calabria and Sicily.

The members of the family Rhysodidae are rare and of small size; they are brown or blackish, somewhat thin and flattened, exhibiting highly sculptured integuments. Their eyes are well developed, but, in some cases, reduced or sub-atrophic; the methatoracic wings are present or wanting. Their larvae are soft-bodied and, essentially, white straw-coloured; they, too, are subdepressed, anophtalmic, polypneustic, exhibiting six short legs and devoid of urogompha. They live gregariously in the dead and rotting trees of forests, their habits being little known.

The colony found by us had settled down and developed in a rotting trunk of a fallen beech, the wood of which was disintegrated and smelling of Fungi. The *Rhysodes*, however, were found in the not yet completely decayed sectors splitting in the direction of the annual rings and in layers not frequented by other Insects. Imagoes and preimaginary stages lived mixed together.

The adults are sluggish and slow-moving. They very frequently assume the state of thanatosis and in this case withdraw their legs keeping, however, their antennae straight and directed forward. I kept some of them for several weeks within Petri dishes in an environment not very unlike from their natural abode, but at any time I observed them, they appeared gathered closely together quite motionless and contracted in the state of thanatosis, or walking very slowly and cautiously. Mating occurs inside hollows of the wood. The male places himself upon the female, lying in the same direction and keeping himself slightly inclined with the hinder part of his body downward. The larvae, also, appear strangely sluggish and slow moving.

The morphology of adults was known in that taxonomists had mentioned it often incompletely, superficially or erroneously. As the structure of the mouth-parts, modified and interesting, requires a deeper examination, I have devoted myself to the study only of the organs and appendages deserving more attention. Indeed, I have not extended my research to a wider morphologic and anatomic field owing to the inadequacy of the material (utilizable for this kind of research) at my disposal.

As regards the larvae, the situation was a little better. My dear friend Paul de Peyerimhoff de Fontenelle published in 1903 the description of the larva of a *Rhysodes* from Sumatra (according to Grouvelle (1903) referable to *R. philippensis* Cher. or to *R. pilosus* Grouv., according to Arrow (1942) assignable to *R. malaicus* Arr.), fundamentally well done as all the works of this famous coleopterist, but, of course, founded on the principles and means in use over half a century ago. In their synopsis on the larvae of Coleoptera Böwing and Graighead (1931) devoted only two lines to the general characters of the family, but they illustrated the larva of *Clinidium sculptile* Newman in a plate with illustrations, which, however correct, are to tell the truth a little schematic. Finally, in 1942 F. I. Emden also wrote only few words on the family considered from a general point of view.

THE ADULT

The Fig. 1 representing a female of *Rhysodes Germari* Ganglb. in a physiologic position gives a sufficient idea of the general constitution of the insect. However, what does not result, or appears only in part, is the peculiar structure of her mouth-parts and the exceptionally armored integument; such armor protects in some way also the articulations (of the antennae and especially of the legs) forming a conspicuous whole of overstrengthened joints complicated in a kind of hypermorphic (or, if you like, hypertelical) artrodia.

The cranium of the imago has a peculiar structure; it is prognathous, almost heart-shaped, somewhat flattened, much sclerotized. In the upper region there are some prominent plates, two of which on either side, very

large and lying latero-posteriorly, are projecting backward, converging together with large tegumentary (likely cellular) prominences.

The upper region of the head extends forwards somewhat farther than the anterior margins of the orbits and ends medially with a rounded (having a reduced curve) epistomal prominence shaped as is shown in the Fig. II, 1. The upper lip posteriorly is a little less wide than such projection, clearly more wide than long, very narrow in its fore part where it is sub-pointed, somewhat sclerotized and strengthened anteriorly by a thick marginal pad. The ventral surface of the head, in turn, extends backwards over the gula (and before the hypostomal plates and the orbits) with a large plate trilobate near the head, reaching, nay a little overpassing, the level of the anterior margin of the upper lip (Fig. II, 2). This plate may be considered (with some reserves) as a much sclerotized postmentum (or submentum) fused with the gular region laying behind, which has become an integrant part of the cranium.

The dorsal (epistomal) and the ventral (postmental) projections converge together forwards and, therefore, limit and enclose (on either side by means also of the mandibles) a cavity which is not intergnathal and virtual as in the more generalized type of the Pterygota, but is gnathal and real. Indeed,

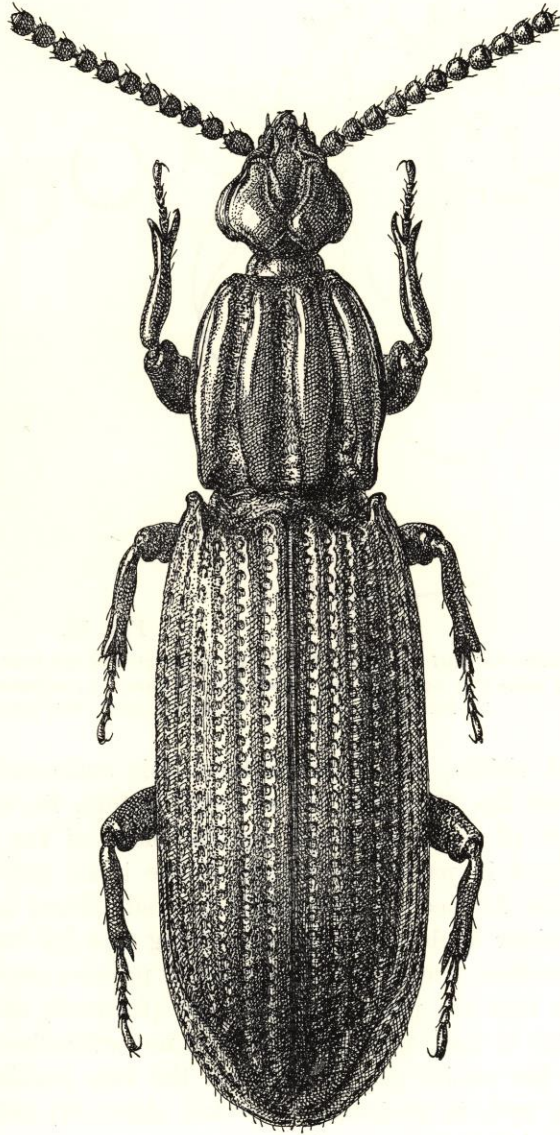


FIG. I.

Rhysodes Germari Ganglb. — Adult female, dorsal view.

it contains (completely) two pairs of gnathites (the maxillae and the second maxillae or lower lip) and gives rise to mouth-parts of the subentognathous type, because the mandibles, the only buccal appendages remaining outside

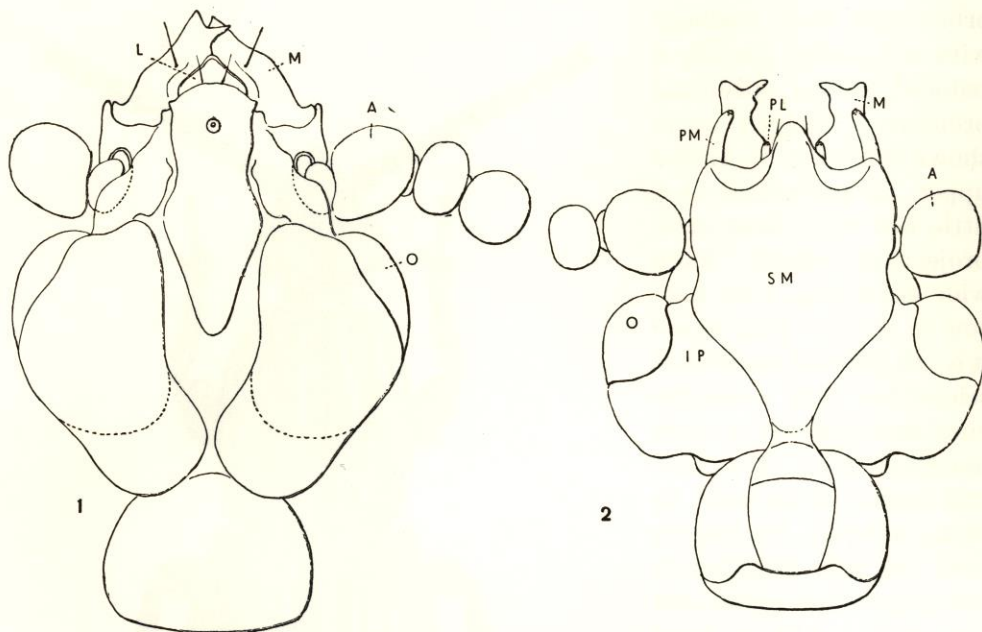


FIG. II.

Rhysodes Germari Ganglb. — Adult: 1. Dorsal view of the head of a female. - 2. Ventral view of the head of a male (the antennae are drawn only in part): A, antennae; IP, hypostomal plates; L, upper lip; M, mandibles; O, eyes; PL, labial palp; PM, maxillary palps; SM, submentum.

and visible, are excluded from this entognathism. The maxillae and the lower lip, therefore, as was said before, lie within the cavity formed by a part of the dorsal and ventral plate of the cranium; these gnathites are lodged in particular niches of the inner (dorsal) surface of the submental plate, formed by submedial and sublateral apodemes having the shape of laminar keels caudally converging two by two (Fig. IV, 2). The maxillae, therefore, are lodged in a kind of pockets (one for each maxilla) and during the rest are projecting outward (forward) only with a portion of the last joint of their palpi; the portion not sclerotized of the lower lip, instead, lies in the cavity placed between the two maxillary pockets and, still during the rest, is projecting outward (forward) only with the distal end of the last joint of its palpi.

Now, we shall examine the structure of these gnathites.

The mandibles are elongated (clearly more long than wide), somewhat flattened, conspicuously tridentate (the medial tooth is pointed and projects noticeably); the oral border is proximally prominent, low-curved and the dorsal surface is grooved, while the ventral surface exhibits a wide

hollow. Owing to the flattened shape of the head capsule the two joints of the mandibles are disposed closely together and, in consequence, such organs have a strictly horizontal movement (Fig. III, 2, 3).

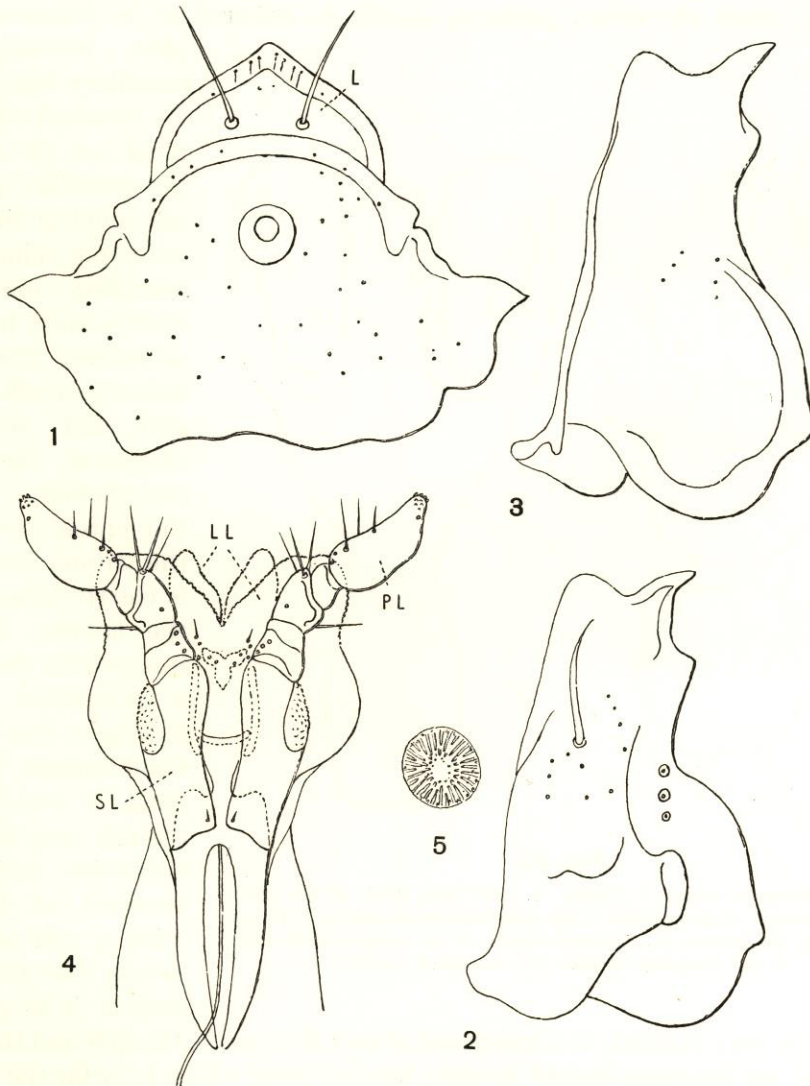


FIG. III.

Rhysodes Germari Ganglb. - Adult: 1. Anterior portion of the head and upper lip of a male. - 2. Mandible (dorsale aspect) of a male. - 3. id. (ventro-oral aspect). - 4. Portion of the lower lip of a male. 5) Cuticular outgrowth (taken at random among those scattered on the cuticle): L, upper lip; LL, labial palps; SL, labial stipites.

The maxillae exhibit a very interesting structure. Their form is correlated with their quality of endo-cranial appendages and, of course, with their peculiar way of functioning. The cardo, well developed in length, is

a little less long than the maxillary body, which seen from above appears clearly divided into two portions. The proximal external portion, which is much smaller than the other and exhibits three macrochaetae (the outermost of them is very long), must probably be referred to the stipes «sensu stricto», while the other, perhaps, should be referred to an enormous pal-

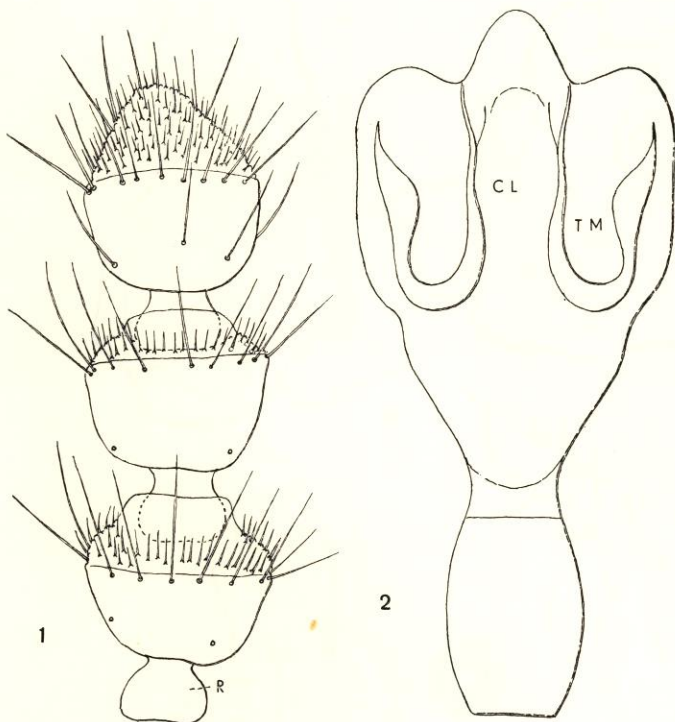


FIG. IV.

Rhysodes Germari Ganglb. — Adult: 1. Last three joints of the antennae of a male. - 2. Dorsal view of the gular submental complex: CL, cavity bearing the labium; R, proximal radicle of an antennomere fitting in the foregoing article; TM, maxillary pockets.

pifer. Dorsally the maxillary body bears an external sub-marginal row of cuticular toothlike processes looking like microscopic spines. The maxillary lobes exhibit a quite peculiar structure; they are, indeed, much elongate and stiliform, obviously correlated (functionally) with the entognathism of the trophi. The galea is clearly longer than the lacinia; distally it is slender and bears a submedial areola having a less sclerotized cuticle. The lacinia is rod-shaped, distally very little attenuated and subrounded at its end with a pair of little hooks. The maxillary palpus is large and,

therefore, very evident; it is composed of four free joints, the first and the third of which are the most limited in size; the first joint which is by far the largest of all is nearly as long as the three foregoing joints taken together. The third of these palpomeres, however, deserves a particular attention, because distally it exhibits clear vestiges of another joint, obviously in course of disappearance by fusion with the same third joint (Fig. V, 6). As regards the lower lip, its endocranial portion would be composed, «si vera sunt exposita», of the prementum together with the mentum. It exhibits actually a well developed stipital region, that is, is formed of two long labio-stipites, four lobes (two on either side are large, medially adjoining, slender at the

distal end, where they are a little diverging, membranaceous, bearing

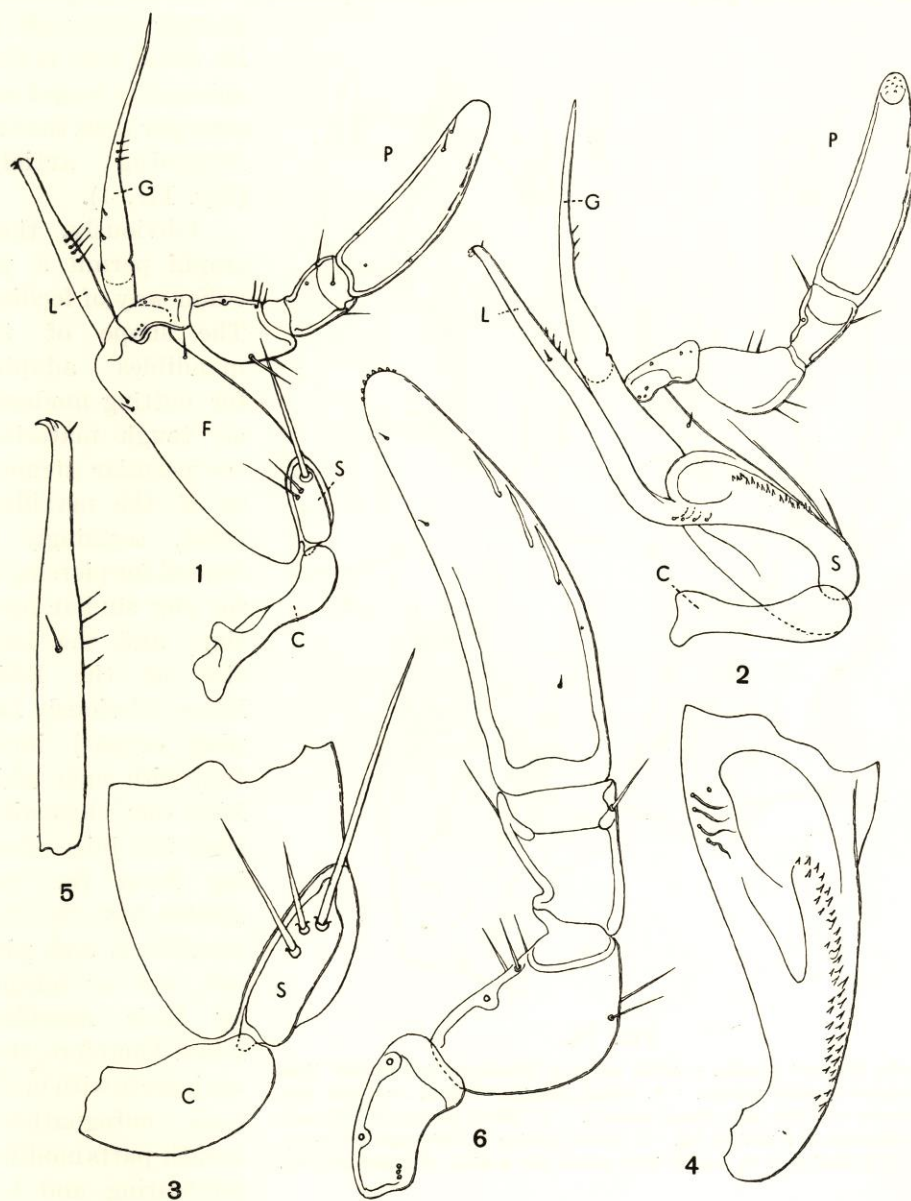


FIG. V.

Rhysodes Germari Ganglb. — Adult male: 1. Maxilla (ventral aspect). - 2. Maxilla (dorsal aspect). - 3. Proximal portion of the Fig. 1 more enlarged. - 4. Proximal portion of the Fig. 2 more enlarged. - 5. Lacinia more enlarged: C, cardo; F, palpifer; G, galea; L, lacinia; P, palpus; S, stipes.

articular thornlike processes; the other two in the middle, fused together

in a bilobed complex lying above the former and bearing likewise similar microprocesses), and a subtriangular portion posterior to the stipital region. The labial palps of noticeable size are 3-jointed; their last palpomere, sharply attenuate at its distal end, is conspicuously longer and stronger than the two foregoing articles (Fig. III, 4).

Obviously, these trophi permit a peculiar way of feeding. The shape of the mandibles adapted for cutting moderately tough materials, the peculiar structure of the maxillary lobes, seemingly adapted for piercing or for any similar function, and the large size of the labial lobes (obviously lapping organs) imply that with such labial lobes our *Rhysodides* suck the juices flowing from the substrates torn by their mandibles, and pierced, cut or scraped by their maxillary lobes. Therefore, they are insects with biting (sub-entognathous) mouth-parts modified for tearing and lapping

and, likely, with a sapro-xylophagous, perhaps also mycetophagous, diet.

The antennae are moniliform; their joints exhibit a particular trichochaetotaxis (see Fig. IV, 1). They, moreover, do not bear only a proximal (scapobasal) radicle of articulation with the scape, but this radicle is present in all the joints of the antennae, so that they are articulated with one another in a characteristic way.

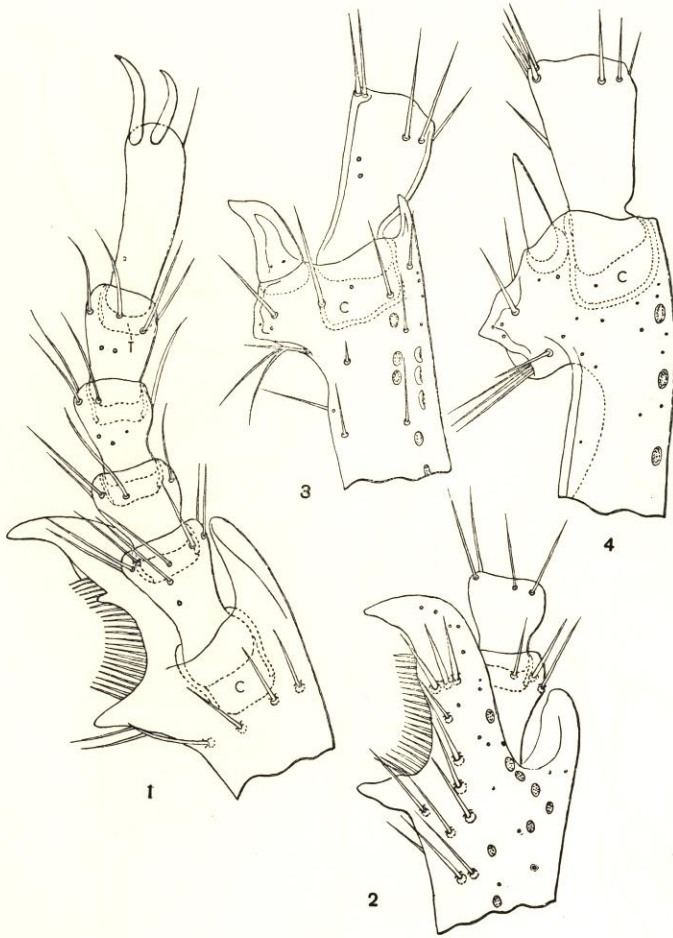


FIG. VI.

Rhysodes Germari Ganglb. - Adult male: 1. Distal portion of fore tibia and tarsus (ventral aspect). - 2. Distal portion of tibia and first two tarsomeres of a fore leg (dorsal aspect). - 3. Distal portion of tibia and 1st tarsomere of a middle leg. - 4. Distal portion of tibia and 1st tarsomere of a hind leg: C, socket into which the radicle of tarsomere fits.

The legs show some characteristics which deserve our attention. Their

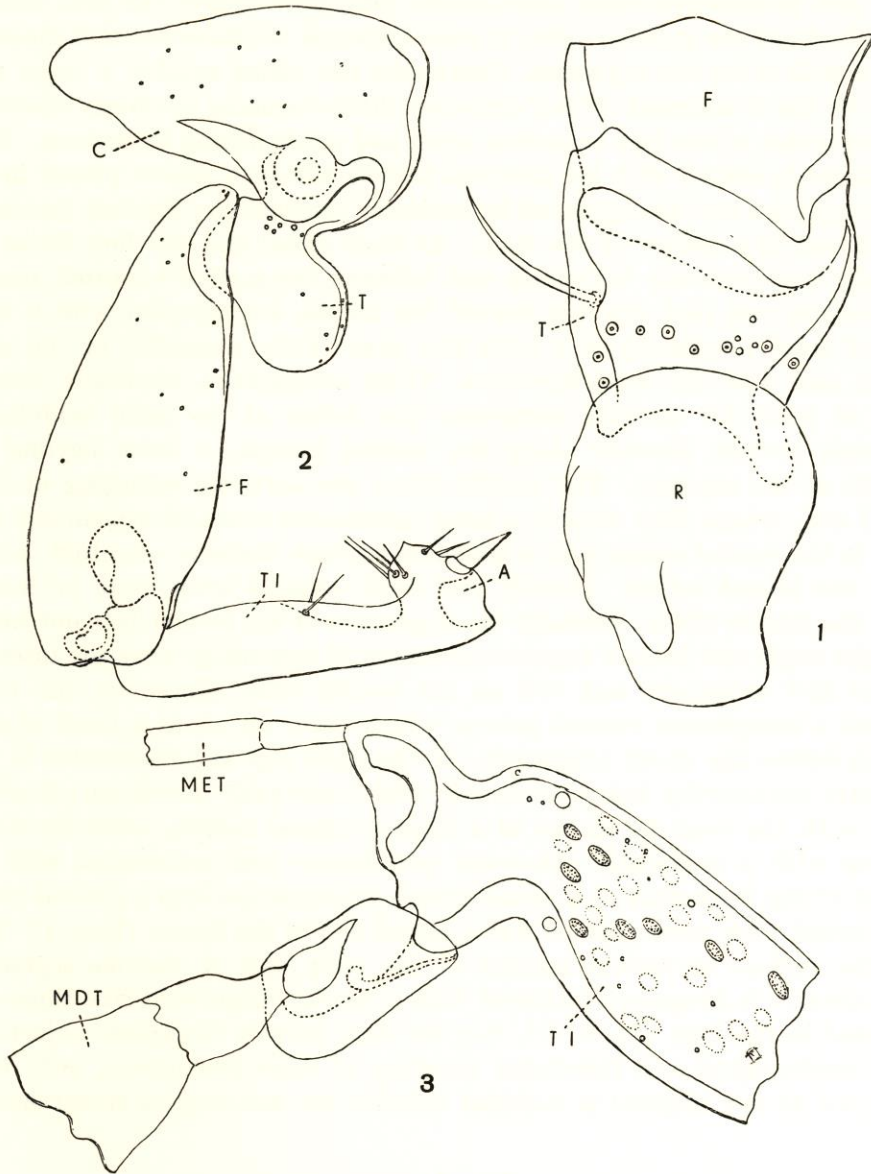


FIG. VII.

Rhysodes Germari Ganglb. - Adult male: 1. Proximal portion of femur and trochanter of a fore leg. - 2. Hind leg (excluding the tarsus). - 3. Proximal portion of tibia of the same leg more enlarged: A, socket, where the 1st tarsomere articulates; C, coxa; F, femur; MDT, depressor muscle of tibia; MET, levator muscle of tibia; TI, tibia.

parts, also, the tarsomeres, the tibia, the femur, as well as the trochanter are more or less sharply enlarged at their proximal ends to form a kind of

radicle (enormous in the trochanters) fitting in the foregoing segment or subsegment for articulating in its socket. The tibio-femoral, femoro-trochanteric and trochantero-coxal articulations (and particularly the first and the second joints) are massive owing to some cuticular reinforcements of the articulated ends of the two segments. Proximally the tibiae exhibit a large apodeme for the attachment of their depressor (flexor) muscle, obviously related to the retraction of the legs occurring again and again during thanatosis. Each tarsomere is lodged with its proximal radicle within a socket placed in the foregoing joint and strengthened by cuticular thickenings; the first tarsomere is situated in a hollow of the tibia. At their distal end the fore tibiae are dorsally conspicuously tridentate and between the medial odontoid process (the larger) and that directed toward the middle are supplied with a thick row of setae (consisting of a little less than thirty elements) of the same length and with the same direction. These outgrowths, obviously, form a kind of comb for cleaning purposes. The femur of the male exhibits an odontoid process situated along the ventral margin, a little beyond the middle of the segment. The middle tibiae are abruptly enlarging at their distal end, where they exhibit a large tegumental odontoid appendage situated in the medial corner and a moderate process likewise odontoid arising from the lateral corner. Distally the tibiae expand even more noticeably than the middle tibiae; medially the expansion of the former juts out nearly at right angle and bears a tegumental odontoid appendage near the insertion of the first tarsomere and still on the medial side. Moreover, the tibiae exhibit a conspicuous ventral groove, which takes up about a third of their length before the distal expansion. In the hind legs the trochanter is particularly noteworthy being abnormally and enormously developed; it articulates with the coxa by means of a large proximal radicle, ventrally is projecting with a noticeable sub-ovate prominence and articulates with the femur fitting by means of a broad dorsal diverticulum into a ventral-proximal socket with strengthened walls, placed also in the femur (Figs. IV-VII).

The surface of various regions of the body and of various segmental appendages is irregularly scattered with articular outgrowths like those represented in the Figs. III, 5; VI, 2-4; we shall be able to explain objectively the morphological and functional meaning of these formations, only when we have at our disposal a material suitable for histological researches.

THE LARVA

Larva oligopodous, campodeiform, shortly six-legged, anophthalmous, elongate, sub-cylindrical (noticeably flattened), slightly attenuate at the cephalic and caudal ends, pale cream-coloured with head and notal plates a little sclerotized, honey-coloured and the most sclerotized areas of the head and appendages dusky (Fig. VIII).

The *Head*. - Head capsule (Figs. IX-X) of moderate size, sclerotized, slightly

flattened, sub-prognathous, noticeably less wide than the prothorax, more wide than long, much narrowed anteriorly (and, therefore, its lateral margins are conspicuously diverging backwards), broadly hollowed posteriorly. Marginal-dorsal and-ventral sclerotized areas as in the mentioned illustrations. The diverging suturae begin almost from its caudal end, somewhat spaced from each other; at first they are slightly diverging, successively almost parallel. We have said that the head becomes much narrower forwards. Now, its epistomal region is medially projecting with a kind of rounded, marginally sclerotized diverticulum under and beyond which a small rigid plate extends. Probably such plate somewhat broader than the diverticulum is derived from the palate (epipharynx «sensu Auct. »), if we do not want to consider it, more comprehensively, as a transformation of the upper lip. One thing is certain, that also in the larva, as in the adult, we notice a cranial structure related to the particular biotope and habits of the insect: that is, a kind of sclerotized snout for digging in the partially decaying wood; the head bearing such anterior prolongation tends towards the prognathous condition and ventrally is enclosed between maxillo-labial complex and occipital foramen by means of the two ipostomal plates fast strengthened by sclerotized margins joining together along their medial line. Chaeto- and trichotaxy as in the mentioned illustrations. The antennae (Figs. IX; X; XI, 1) are somewhat long, robust, four-jointed and the cuticle of their joints is largely sclerotized. Therefore, they look like well protected organs, without giving up for this feature to their characteristic function made pos-

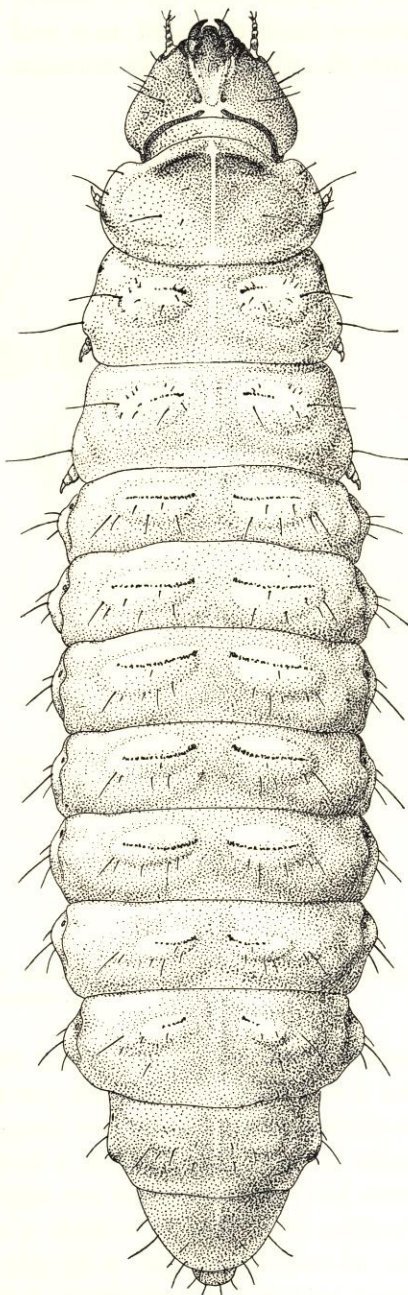


FIG. VIII.

Rhysodes Germari Ganglb. — Dorsal view of a full-grown larva.

sible by the occurrence of several, sometimes conspicuous, sensillae. The antennae arising from the sub-anterior and lateral regions of the head articulate in their respective toruli by means of a broad membranous collar, which some authors have regarded as a real antennomere. The shape of the joints appears clearly in the illustrations. As can be seen, the last segment is much

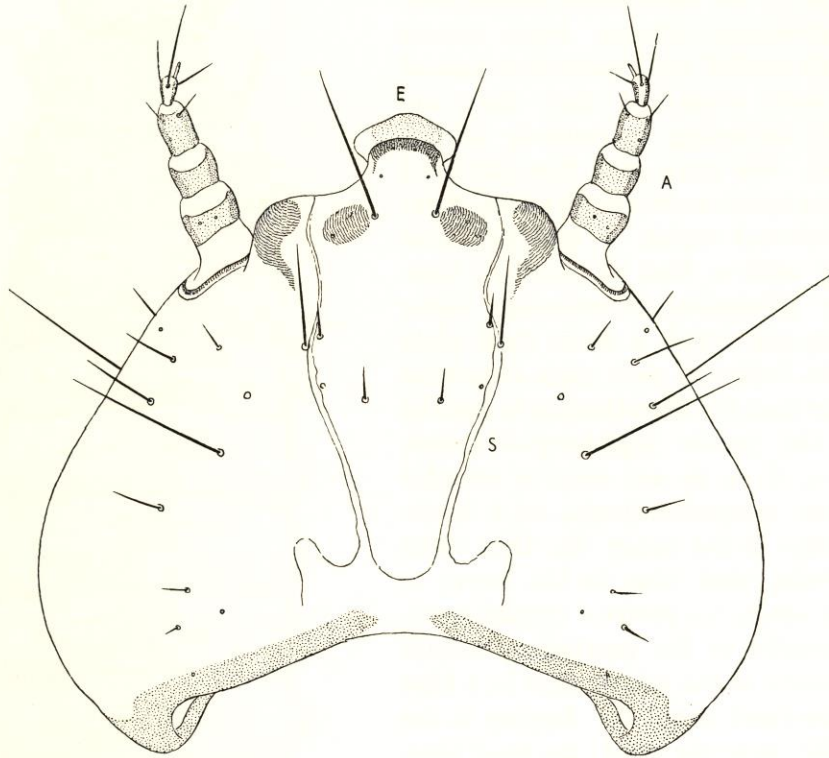


FIG. IX.

Rhysodes Germari Ganglb. — Larva: Dorsal view of the head. The mouth appendages are not drawn: A, antenna; E, palatine plate.

smaller than the others, being narrow proximally and broadly round at its free distal end. The mouth-parts are adapted for biting and sucking. The mandibles (Fig. XI, 2) are large, strong, more long than wide, bearing no molar surface; they exhibit a large apical tooth and another subapical (oral) tooth less noticeable and are supplied with a powerful adductor muscle. The maxillae (Fig. XI, 3) exhibit a large sclerotized stipes; a cardo, sclerotized too, of noticeable size; a largely membranous lobarium well supplied with round articular prominences; a four-jointed palpus of considerable size and strength owing to the shape and sclerotization of its palpomeres, supported by a conspicuous membranous palpifer. The lower lip (Fig. XI, 3) is very elongate and consists of a short, somewhat broad prelabium (bearing the

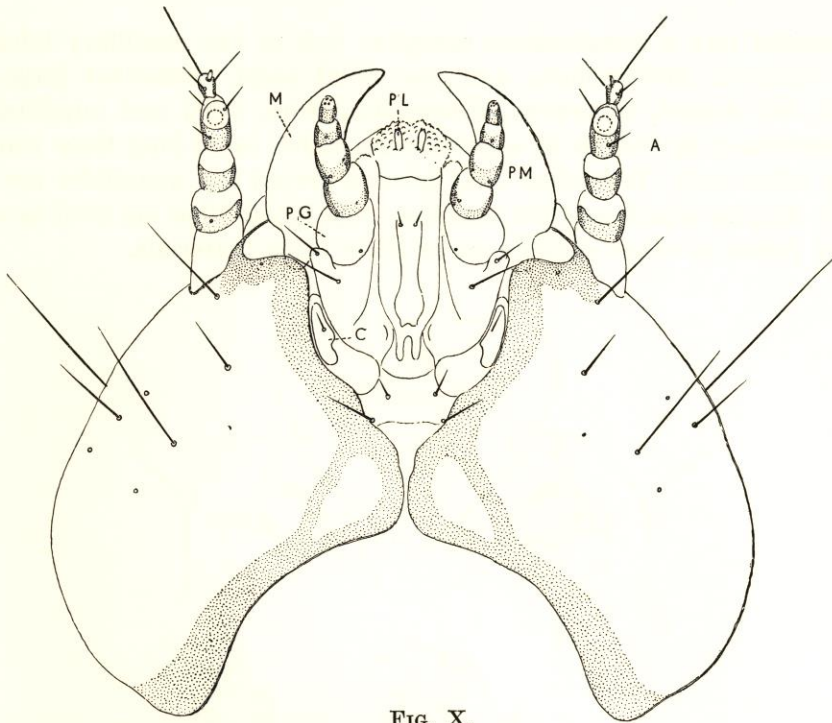


FIG. X.

Rhysodes Germari Ganglb. — Larva. Ventral view of the head: A, antennae; C, maxillary cardines; M, mandibles; PG, palpifers; PL, labial palpi; PM, maxillary palpi.

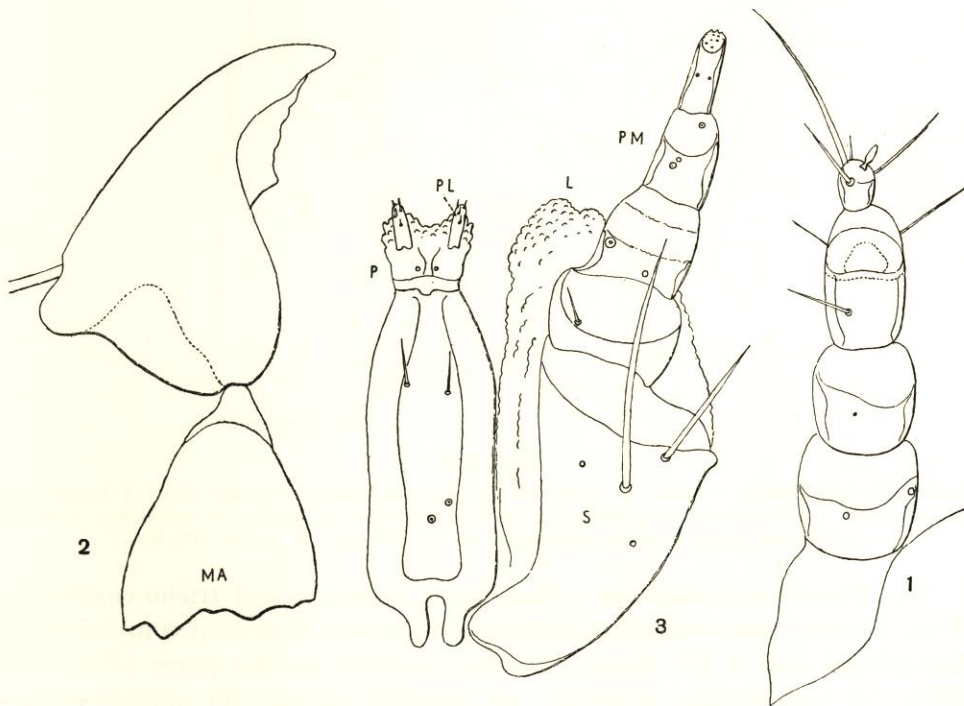


FIG. XI.

Rhysodes Germari Ganglb. — Larva: 1. Antenna (ventral aspect). - 2. Mandible (ventral aspect). - 3. A maxilla and lower lip: L, maxillary lobarium; MA, adductor muscle of the mandible; P, prementum; PL, labial palpi; PM, maxillary palpus; S, maxillary stipes.

lobes united into a membranous complex, rich as the maxillary lobaria in round cuticular prominences, and the labial palpi, somewhat large, one-jointed, rod-shaped, somewhat distant from each other and supplied with some sensillae), as well as of a postlabium much more long than wide and largely sclerotized. It is clear that in such trophi the mandibles are functionally digging organs and the maxillary and labial lobes are used as organs sucking juices or other semi-liquid or little thick materials.

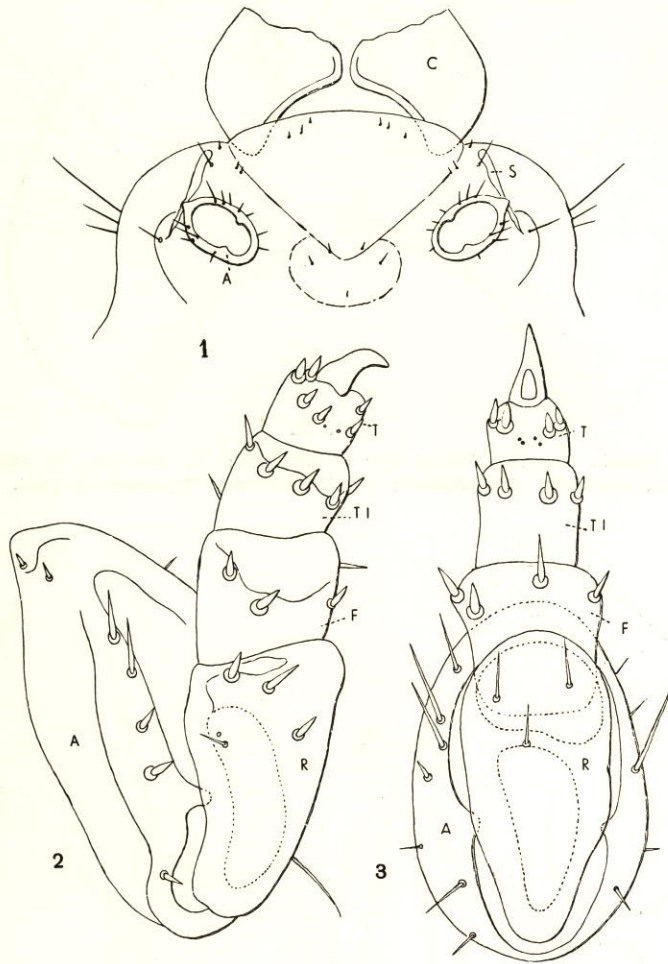


FIG. XII.

Rhysodes Germari Ganglb. - Larva: 1. Portion of the head and prothorax, ventral view. - 2. Lateral view of a middle leg. - 3. Ventral view of a fore leg: A, coxa; C, cranium; F, femur; R, trochanter; S, pleural rod-shaped sclerites for the articulation of the fore legs; T, tarsus; TI, tibia.

The Thorax and Abdomen. - The shape, structure and tricho-chaetotaxy of the thoracic and abdominal segments are shown in several comprehensive illustrations and in the figures in detail enclosed in this paper (Figs. XII-XIV). Of the thoracic segments, as generally occurs, the prothorax is a

little different from the two following segments, which, instead, are similar. The pronotum bears two adjoining plates of slightly sclerotized and pigmented integument; in a narrow anterior portion such features are much

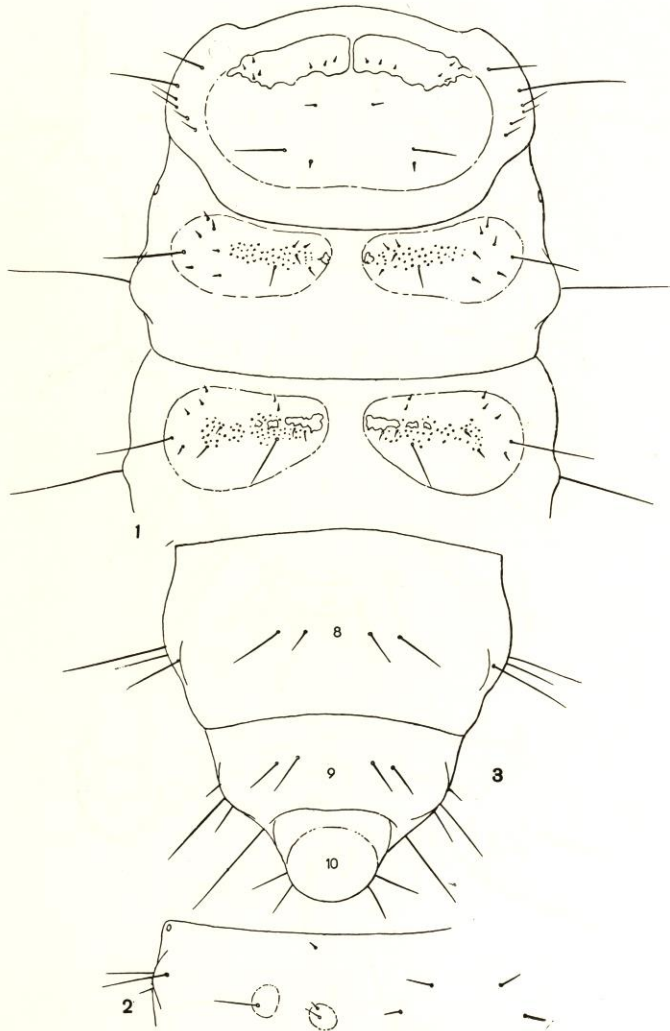


FIG. XIII.

Rhysodes Germari Ganglb. - Larva: 1. Dorsal view of the three thoracic segments. - 2. A portion of the 1st urosternum. - 3. 8th to 10th urites (ventral aspect).

more emphasized. In the meso- and meta-notum these plates are somewhat reduced in size and less sclerotized, but, conversely, are very rich in cuticular outgrowths having the shape of microscopic denticles. Moreover, particular outgrowths irregularly denticulate and much sclerotized (with the tooth-shaped prominences bent backward) begin to appear in the meso-notum

within the limits of these areas. These processes, slightly outlined in this segment are more and crosswise diffused in the metanotum and much more in the tergites of the first five urites, where they appear as continuous trans-

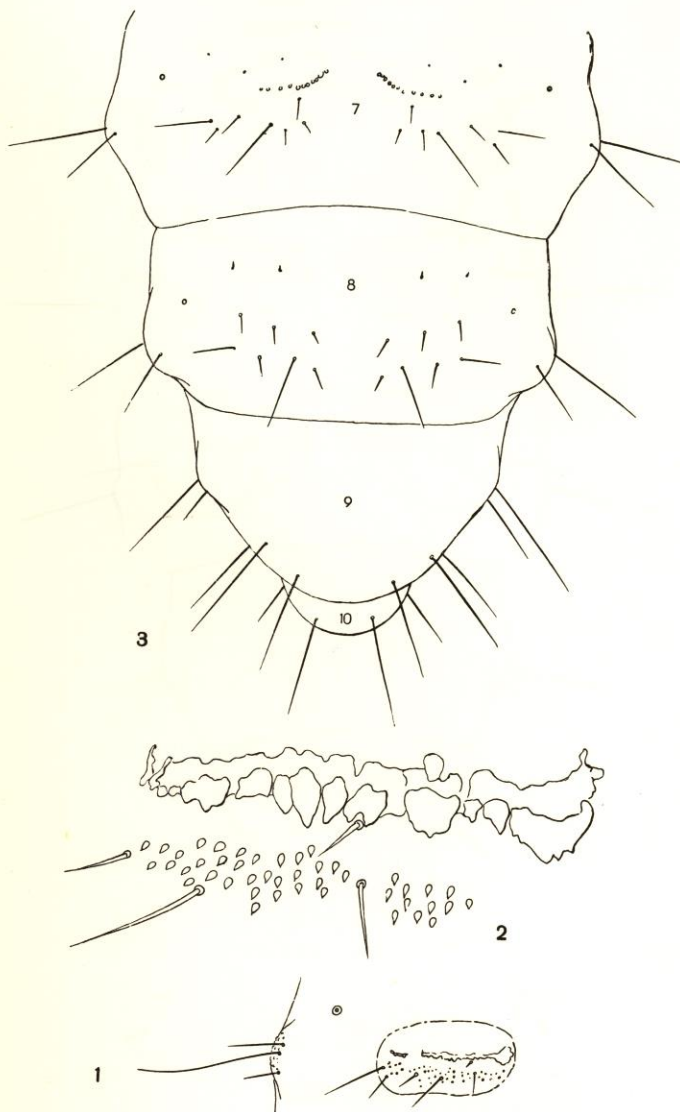


FIG. XIV.

Rhysodes Germari Ganglb. - Larva: 1. Left portion of the 1st urotergum. - 2. Sclerotized outgrowths of the same much more enlarged. - 3. 7th to 10th urites (dorsal aspect).

verse and sub-anterior series occupying a portion of each antimeric half of their respective tergum; then, in the 6th and particularly in the 7th urotergum they become reduced and, at last, disappear from the 8th urotergum onwards.

The legs are short and consist of five segments; the coxa transverse,

articulating (anteriorly and laterally) with a pleural rod-shaped sclerite; the trochanter, the largest segment of the leg, articulating by two opposite processes of the coxa (bicondyloid joint); the femur, the tibia and the tarsus of decreasing size. The claw is about of the same length as the tarsus and noticeably bowed. Setae short and thorn-shaped arranged as in the Figs. XII,2 and 3.

The *respiratory system* is polypneustic, bearing a pair of spiracles in the mesothorax and in each of the first eight urites, all being anterior and sub-lateral (those pertaining to the mesothorax somewhat ventral, the others somewhat dorsal).

(Translated from Italian by Dr. Grazia Principi, Firenze, Italy).

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