

The *Phthiracarus* species of C. L. Koch

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Introduction

Koch (1841) described a number of species of *Hoplophora* from Regensburg, Germany, of which nine are currently classified in *Phthiracarus*: *crinita*, *ferruginea*, *globosa*, *laevigata*, *lentula*, *longula*, *lucida*, *straminea* and *testudinea* (Parry, 1979). Apart from the last mentioned species, which appears from Koch's original figure to have a greater affinity with the Euphthiracaroida (but see Jacot, 1936), all are undoubtedly members of the genus *Phthiracarus*. These species are, however, extremely difficult to reidentify since Koch's very brief descriptions are based almost entirely on body shape and colour, two characters now known to be uniform in many species of this genus. Only *globosa* and *laevigata* can be characterized by body shape alone: in comparison with the other *Phthiracarus* species collected at Regensburg, *H. globosa* was said to be very 'globular' while the illustration of *H. laevigata* shows the notogaster to be 'angled' anteriorly.

Several redescriptions of Koch's species have been published, including those of Jacot (1936), Feider and Suciú (1957) and van der Hammen (1963). Jacot collected at more than 20 localities in the Regensburg area, recognizing six of Koch's species (*laevigata*, *testudinea*, *crinita*, *lentula*, *straminea* and *ferruginea*) and one new *Phthiracarus* species, *P. boresetosus*. Localities were chosen based not only on Koch's habitat descriptions but on Fürnrohr's detailed lists of the Regensburg flora published in 1839. Jacot treated the redescriptions in considerable detail, identifying each species on the basis of body shape and size, and setal form and length. However, he neglected to include details of the leg chaetotaxy which are now regarded as being essential for the separation of *Phthiracarus* species. Although Jacot's interpretations of *crinitus* and *lentulus* correspond with those of the present study, his specimens have not been considered for neotype designation, since all are entire, uncleaned and mounted together with one or more other species in Canada Balsam. In this condition, Jacot's material would not easily withstand dismounting, dissection and remounting. Further collecting at Regensburg by van der Hammen in 1959 and 1961 resulted in his description of *P. laevigatus* and the designation of a neotype. A number of other species were tentatively identified by van der Hammen (pers. comm.) as representing Koch's seven other species—this material has been examined as part of the present study. Material collected by the late Dr Max Sellnick at Regensburg, and made available to the author through the courtesy of Dr Gisela Rack, Hamburg, has also been examined in an attempt to determine the identities of Koch's *Phthiracarus* species. Unfortunately, it has not been possible to borrow any of the specimens studied by Feider and Suciú.

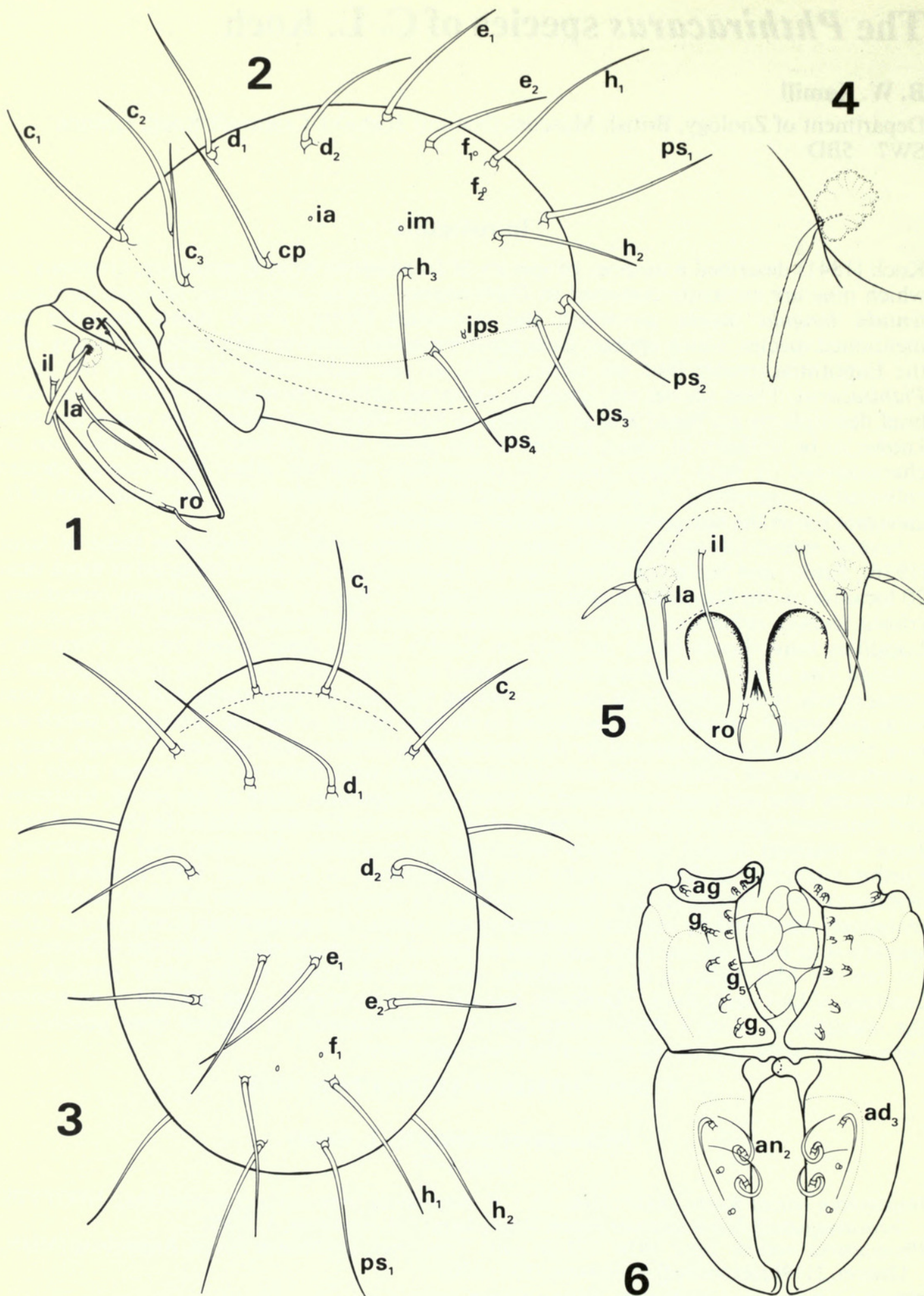
Family PHTHIRACARIDAE Perty, 1841

Phthiracarus crinitus (C. L. Koch)
(Figs 1–7)

Hoplophora crinita Koch, 1841*: Heft. 32, t. 8. Regensburg [type series presumed lost]. NEOTYPE (here designated), Schweighauser Forest, Regensburg (ZM, Hamburg, A30/80).

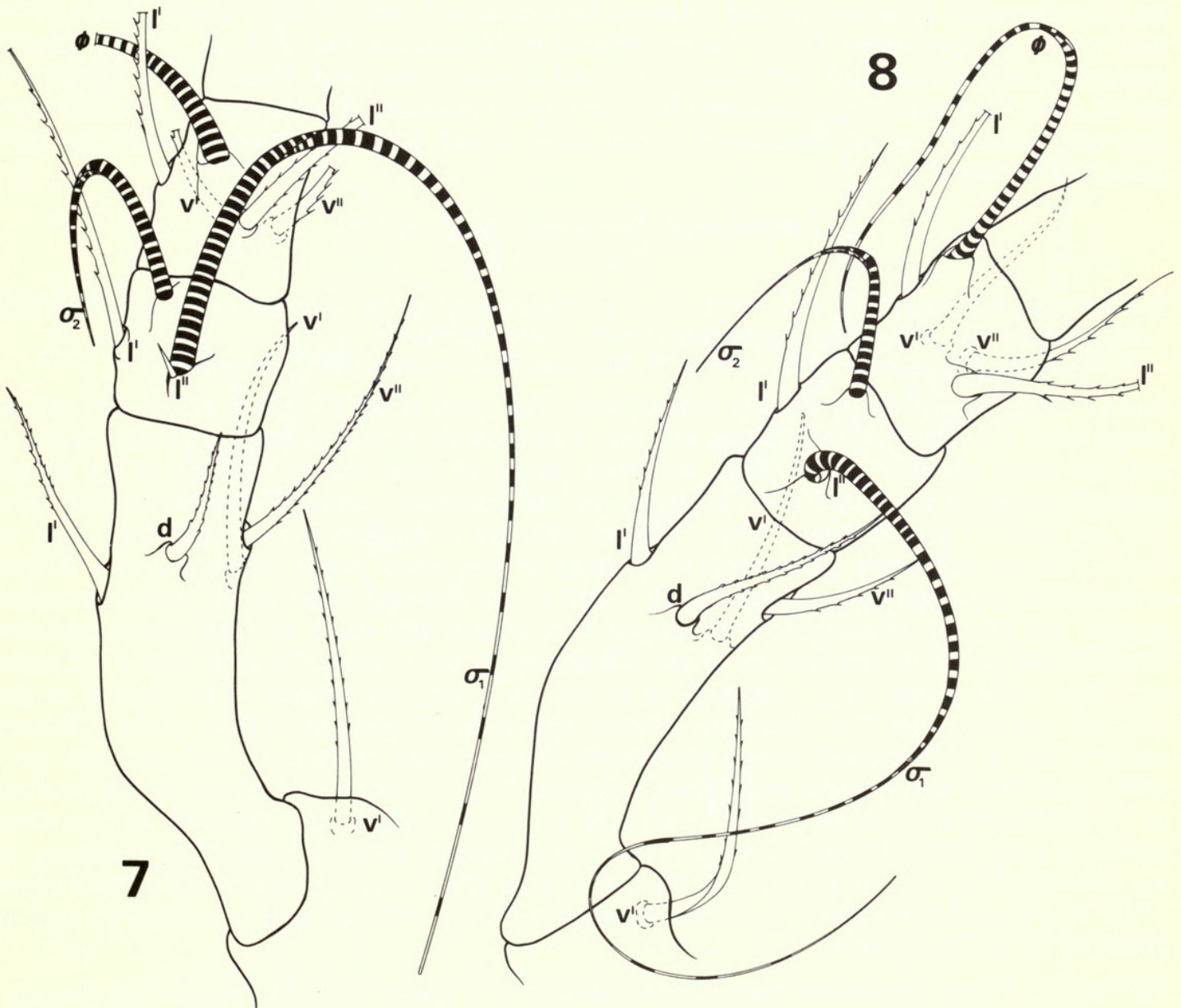
Phthiracarus crinitus: Jacot, 1936 : 172 [in part]. Topotypes, Dechbetten Forest, Regensburg (MHN, Geneva, 3119h) [examined]; Willmann, 1931 : 130.

*The dating for the various Hefte follows Sherborn (1923).



Figs 1–6 *Phthiracarus crinitus*: (1) aspis, lateral; (2) notogaster, lateral; (3) notogaster, dorsal; (4) sensillus; (5) aspis, dorsal; (6) ano-genital region.

ADULT: Large and strongly sclerotized. The *aspis* (Figs 1, 4–5) ranges in length from 255–330 μm with a maximum width of 220–270 μm . All the dorsal setae are long, simple and procumbent. The interlamellar setae (*il*) which are inserted just posterior to the bothridia, are about 1.5 times the length of the lamellars (*la*) and extend to the rostral bases. Setae (*ro*) almost reach the anterior aspal margin. The sensilli are 60–100 μm in length and expanded basally—the distal portion is slender, serrated and blunt terminally. The exobothridial setae (*ex*) are short. The *notogaster* (Figs 2–3), 480–550 μm long (measured along a line through c_1 – ps_1) and with a greatest depth of 330–390 μm , is elongate in lateral aspect. All the notogastral setae are long (greater than the distance c_1 – d_1) and simple, the *c* and *d* series being erect while those in the *e*, *h* and *ps* series are recurved. Seta c_1 is situated on the posterior margin of the collar and setae c_{2-3} submarginally. Vestigial f_1 is located just dorsal to the seta h_1 while the fissures *ip* and *ips* are situated between setae h_2 and h_3 and between setae ps_3 and ps_4 respectively. On each *anal plate* (Fig. 6) there are three setae of more or less equal length (an_{1-2} and ad_3). The nine genital setae are arranged in two rows, an anterior marginal row of five setae (g_{1-5}) and a posterior submarginal row of four (g_{6-9}). A single aggenital seta *ag* is located antiaxially in the genital furrow. The genital papillae are typically phthiracaroid in form, the anterior pair being considerably smaller than the two posterior pairs. The *chelicerae* are 180–210 μm long with about 20 sharply pointed spines on the paraxial surface



Figs 7–8 Leg I, trochanter to tibia, dorsal aspect: (7) *Phthiracarus crinitus*; (8) *Phthiracarus globosus*.

of the principal segment and about 25 conical spines antiaxially. The *leg chaetotaxy* is of the 'complete type' (see Parry, 1979) with four setae on femur I and a single seta on genu IV. All the solenidia are long and more or less straight. On tarsus I the seta coupled with solenidion ω_2 is short and barely discernible. Setae (*tc*) and (*u*) on this segment, and (*tc*), (*u*), (*p*) and *s* on tarsi II–IV are ribbon-like, hooked distally and covered with whorls of spicules in the middle third. The four setae on femur I (Fig. 7), *d*, (*v*) and *l'*, are all located at about the same level on the segment. Seta *d* which is the shortest of the four (about two-thirds as long as *l'*), is thickened, bluntly serrated and somewhat curved.

MATERIAL: Three specimens from a sample (no. 59015) of moss and bilberries (*Vaccinium myrtillus*), Schweighauser Forest, Unterkaulhausen, Regensburg, 19.vii.1959 (M. Sellnick), deposited in the collections of the Zoological Museum of the University of Hamburg. One of these specimens (A30/80) is hereby designated as the *neotype*. Other material was examined from rotten wood and litter beside a brooklet (sample no. 61 R45), Donaustauer Forest, Regensburg, 27.vi.1961 (L. van der Hammen) (RNH, Leiden). *P. crinitus* was not widespread in the Regensburg material, being present only in small numbers in the above two samples.

REMARKS: Koch recorded *crinita* predominantly in mosses, Regensburg. Although the original description of the species was rather incomplete, *crinita* appeared to be characterized by unusually long notogastral setae—a feature which was noted by Jacot (1936) in his description of specimens which he considered to be conspecific with *H. crinita*. Jacot's specimens are for the most part conspecific and in good condition. However, as mentioned above, they have not been considered for neotype designation. A neotype was selected from amongst Sellnick's spirit specimens which were found to be conspecific with the mite described by Jacot.

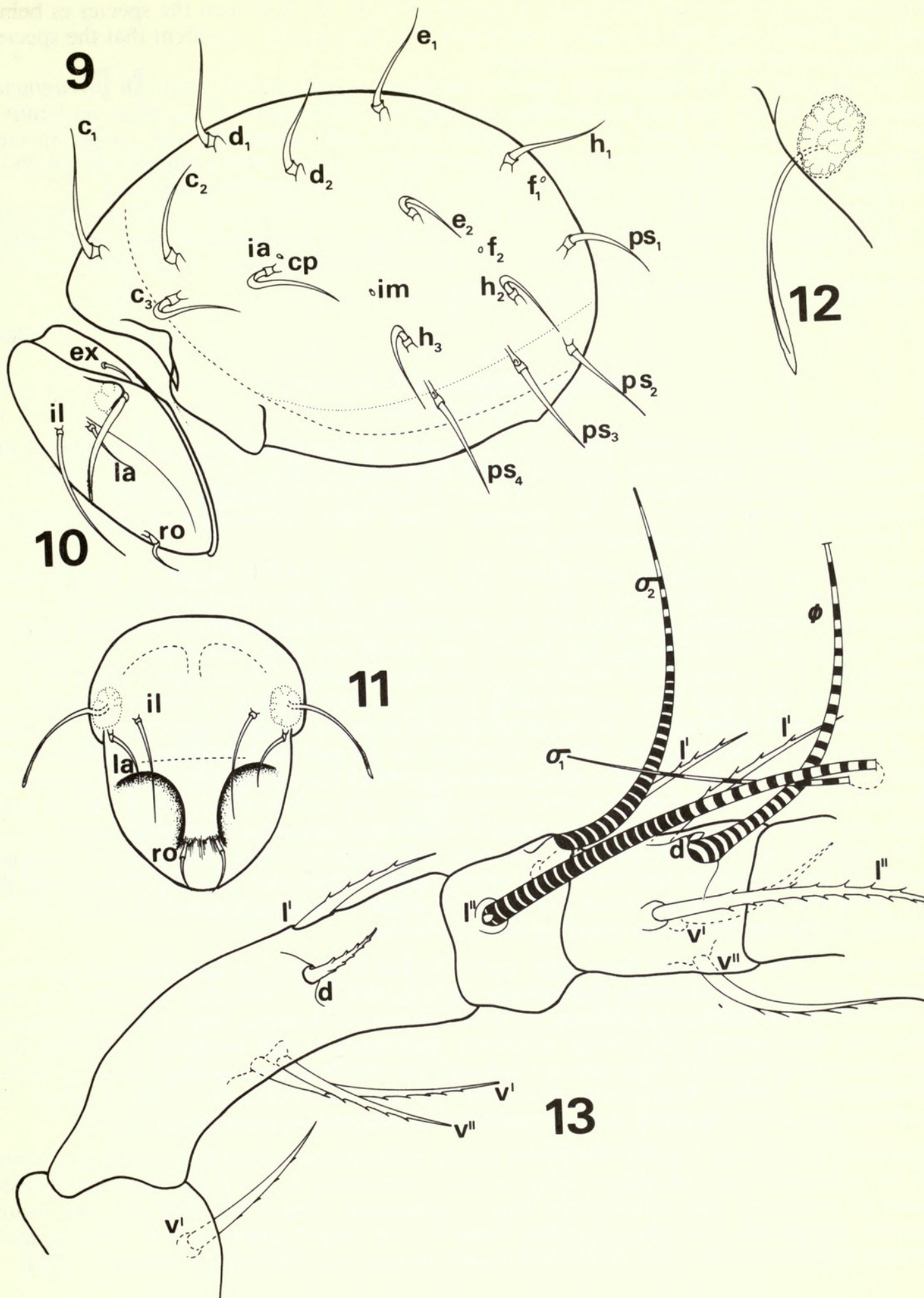
***Phthiracarus ferrugineus* (C. L. Koch)**
(Figs 9–13)

Hoplophora ferruginea Koch, 1841: Heft. 32, t. 10. Regensburg [type series presumed lost]. NEOTYPE (here designated), Taimering, Regensburg (RNH, Leiden, P2005–7).

[*Phthiracarus ferrugineus*: Jacot, 1936: 179. Misidentification, see under *P. longulus*.]

ADULT: Rather small and weakly sclerotized. The *aspis* (Figs 10–12) is about 225 μm in length with a greatest width of about 160 μm . The rostrals (*ro*) are short and do not reach the anterior aspal margin. Setae (*il*) are twice the length of setae (*la*) and extend to the rostral bases. The sensilli are long (70–80 μm), slender and distally serrated. The exobothridial setae (*ex*) are short. The *notogaster* (Fig. 9), about 350 μm in length, has a maximum depth of about 270 μm and bears moderately long (more or less equal to the distance c_1-d_1), simple setae which are erect to recurved. Setae c_1 and c_3 are inserted close to the posterior collar margin and seta c_2 submarginally. Vestigial f_1 is located one-third of the distance between setae h_1 and ps_1 . Only the fissures *ia* and *im* appear to be present. On each *anal plate* there are three setae (setae ad_{1-2} vestigial) of which an_{1-2} are the longest. The *chelicerae* are 135–140 μm long with 9 to 10 sharply pointed spines on the paraxial surface of the principal segment and 6 to 10 conical spines antiaxially. The *leg chaetotaxy* is of the 'complete type' with rather short and straight solenidia. On femur I (Fig. 13) seta *d* is short (about half as long as *l'*), thickened and, as in *crinitus*, this seta is curved and bluntly serrated. In the three available specimens, the setal arrangement on this segment shows considerable variation. In the neotype (Fig. 13) seta *d* is located on a level with seta *l'* and anterior to the ventral setae, while in a second specimen *d* is located anterior to the lateral seta, and in a third specimen, posterior to the lateral seta.

MATERIAL: Three specimens from rotten material in a moist hayfield, Taimering, Regensburg, 19.vi.1961 (L. van der Hammen) (sample no. 61 R34), deposited in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden. One of these specimens (P2005–7) is hereby designated as the *neotype*.



Figs 9–13 *Phthiracarus ferrugineus*: (9) notogaster, lateral; (10) aspis, lateral; (11) aspis, dorsal; (12) sensillus; (13) leg I, trochanter to tibia, dorsal aspect.

REMARKS: Koch recorded *ferruginea* in mosses on trees. He described the species as being very small with long, fine notogastral setae and from his figure it is evident that the species possessed rather long and prominent sensilli.

The smallest of the Regensburg species examined in the present study, *P. ferrugineus* (notogastral length 350 μm) is somewhat unusual in its possession of four setae on femur I and a single seta on genu IV, two features which are associated with larger species (notogastral length 500–1000 μm) of the genus. Smaller species with a notogastral length of less than 500 μm are generally characterized by a 'reduced' form of leg chaetotaxy.

Although rather smaller, *P. ferrugineus* bears considerable resemblance to *P. membranifer* Parry (notogastral length 310–500 μm) recorded from the fermentation layer under Sitka spruce, Tintern Forest, Monmouthshire. In comparison with the latter, *P. ferrugineus* differs only in having a 'complete' form of leg chaetotaxy.

Phthiracarus globosus (C. L. Koch)

(Figs 8, 14–18)

Hoplophora globosa Koch, 1841 : Heft. 32, t. 12. Regensburg [type series presumed lost]. NEOTYPE (here designated), Burgweinting, Regensburg (ZM, Hamburg, A31/80).

Phthiracarus globosus: Willmann, 1931 : 193; Feider & Suciu, 1957 : 5; Sellnick, 1960 : 131.

Phthiracarus globus Parry, 1979 : 341. Holotype, Rydal Water, Westmorland, England (BMNH, London, 1976.2.18.3.) [examined]. **Syn. nov.**

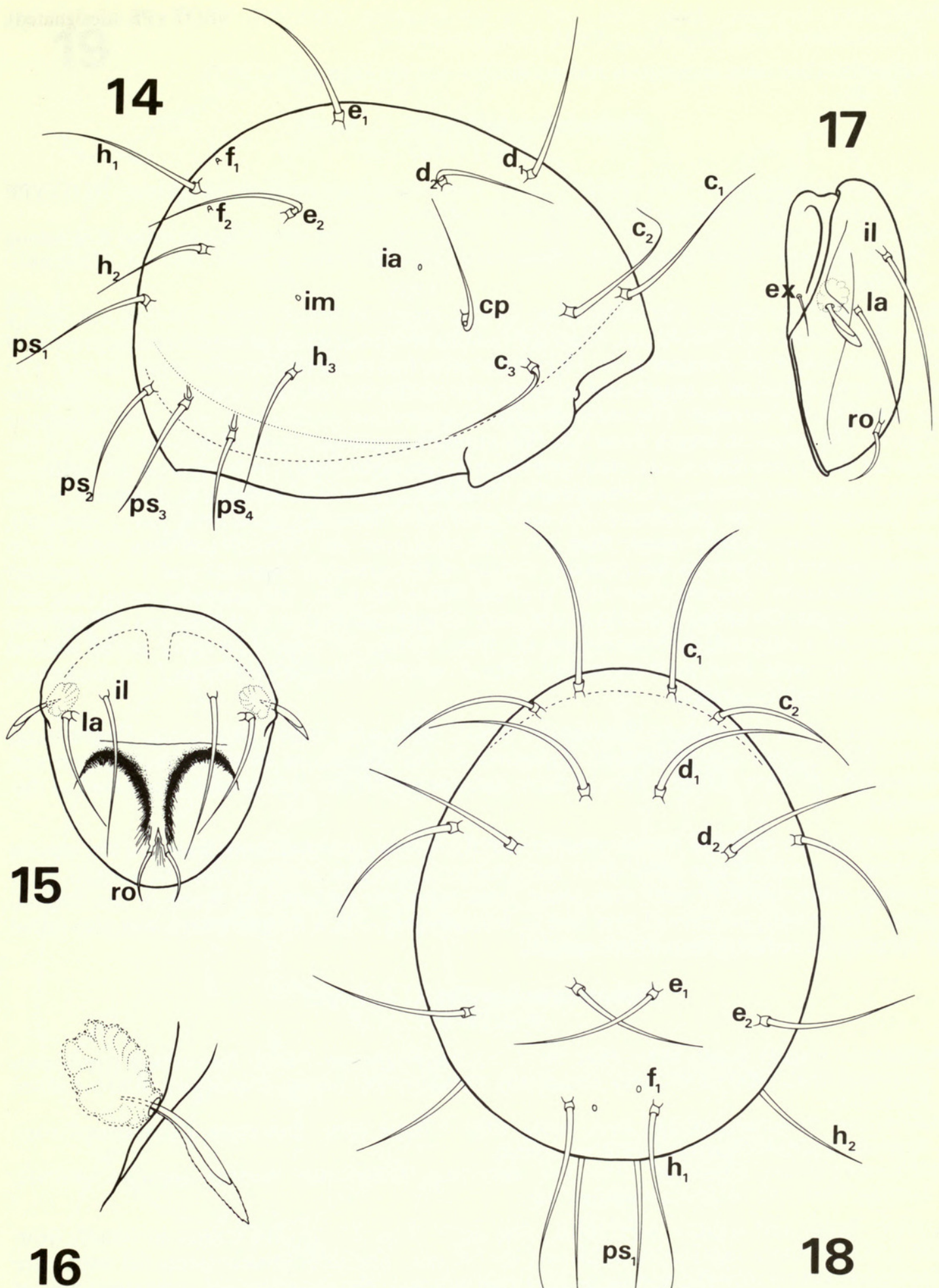
ADULT: Large and strongly sclerotized. The *aspis* (Figs 15–17) ranges in length from 240–310 μm with a maximum width of 180–250 μm . All the dorsal setae are very long, simple and procumbent. Setae (*il*) and (*la*) are more or less equal in length and both pairs of setae reach the rostral bases. The sensilli are 40–55 μm long, lanceolate and serrated marginally. The exobothridial setae (*ex*) are moderately long. The *notogaster* (Figs 14, 18), 500–640 μm long and with a maximum depth of 300–460 μm , is rather globular in comparison with other species of the genus. All the setae are long (greater than the distance c_1 – d_1), simple and almost erect. Seta c_1 is inserted on the posterior margin of the collar and setae c_{2-3} submarginally. Vestigial f_1 is located adjacent and just dorsal to the seta h_1 , towards the mid-dorsal line. The fissures *ip* and *ips* are absent. On each *anal plate* there are five long setae; an_{1-2} and ad_3 being more or less equal in length and somewhat shorter than setae ad_{1-2} . The *chelicerae* are 170–190 μm long. The principal segment carries 12–26 sharply pointed spines on the paraxial surface and 22–25 conical spines antiaxially. The *leg chaetotaxy* is of the 'complete type' and on femur I (Fig. 8) the dorsal seta is long (equal in length to l'), slightly curved and covered in whorls of blunt serrations.

MATERIAL: Two specimens from litter under 'broom (*Genista*)' [= *Sarothamnus*] growing under willows, Burgweinting, Regensburg, 16.viii.1959 (M. Sellnick), deposited in the collections of the Zoological Museum of the University of Hamburg. One of these specimens (A31/80) from sample no. 59059 is hereby designated as the **neotype**. A further ten specimens were examined from rotten wood and litter beside a brooklet (sample no. 61 R45), Donaustaufer Forest, Regensburg, 27.vi.1961 (L. van der Hammen) (RNH, Leiden). *P. globosus* was always recorded in small numbers in the Regensburg samples examined.

REMARKS: *P. globosus* is a very distinctive species being characterized by the 'globular' form of the notogaster. In comparison with German specimens, it was found that the British material examined was considerably larger (notogastral length 570–850 μm) and more heavily sclerotized. It is interesting that Jacot did not regard *globosus* as a *Phthiracarus* species, but rather as the male of *Hoplophora decumana* (= *Oribotritia decumana*).

Phthiracarus laevigatus (C. L. Koch)

Hoplophora laevigata Koch, 1844 : Heft. 38, t. 16. Regensburg [type series presumed lost].



Figs 14–18 *Phthiracarus globosus*: (14) notogaster, lateral; (15) aspis, dorsal; (16) sensillus; (17) aspis, lateral; (18) notogaster, dorsal.

Phthiracarus laevigatus: Jacot, 1936 : 167; van der Hammen, 1963 : 704. NEOTYPE (designated), Donaustauer Forest, Regensburg (RNH, Leiden) [examined].

This species has been adequately redescribed by van der Hammen (1963).

***Phthiracarus lentulus* (C. L. Koch)**
(Figs 19–24)

Hoplophora lentula Koch, 1841 : Heft. 32, t. 16. Regensburg [type series presumed lost]. NEOTYPE (here designated), Taimering, Regensburg (RNH, Leiden, P2001–4).

Phthiracarus lentulus: Jacot, 1936 : 175 [in part]. Topotypes, Unter-Isling/Burgweinting, Regensburg (MHN, Geneva, 3135h) [examined]. [*Phthiracarus lentulus*: Feider & Suciu, 1957 : 5. Misidentification.]

ADULT: Medium-sized. The *aspis* (Figs 21–23) ranges in length from 270–310 μm with a maximum width of 220–240 μm . Setae (*il*) and (*la*) are about equal in length and both pairs of setae extend half the distance *il-ro*. The rostral setae (*ro*) reach the anterior aspal margin. The sensilli are 70–90 μm in length and slender; proximally the sensillar margin is smooth while the distal part is serrated. The exobothridial setae (*ex*) are moderately long. The *notogaster* (Figs 19–20) ranges in length from 500–580 μm with a greatest depth of 400–440 μm . All the setae are short (less than c_1-d_1), stout and more or less erect. Seta c_3 is located on the posterior collar margin and setae c_{1-2} submarginally. Vestigial f_1 is located anterior to the seta h_1 while the fissures *ip* and *ips* are absent. On each *anal plate* there are three setae (ad_{1-2} vestigial); setae an_{1-2} being slightly longer than ad_3 . The *chelicerae* are 190–200 μm long with 18–26 sharply pointed spines on the paraxial surface of the principal segment and 17–35 conical spines antiaxially. The *leg chaetotaxy* is of the ‘complete type’, the solenidia being long and almost straight. On tarsus I the distal seta coupled with solenidion ω_2 is long and divided into two parts by a longitudinal constriction. On femur I (Fig. 24) setae d , (*v*) and l' are all located at about the same level on the segment. Seta d , which is almost as long as l' , is thickened, curved and bluntly serrated.

MATERIAL: Four specimens from moist wood, moss and litter, Taimering, Regensburg, 19.vi.1961 (L. van der Hammen), deposited in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden. One of these specimens (P2001–4) is hereby designated as the *neotype*.

REMARKS: Koch recorded *lentula* predominantly in moss in woods and described the species as being of medium size with short notogastral setae. It is evident that the sensilli were probably either short or very fine, since these were not included by Koch in his original figure. The sensilli are indeed very fine in *lentulus* (Fig. 23), a feature which was also noted by Jacot in his redescription of this species.

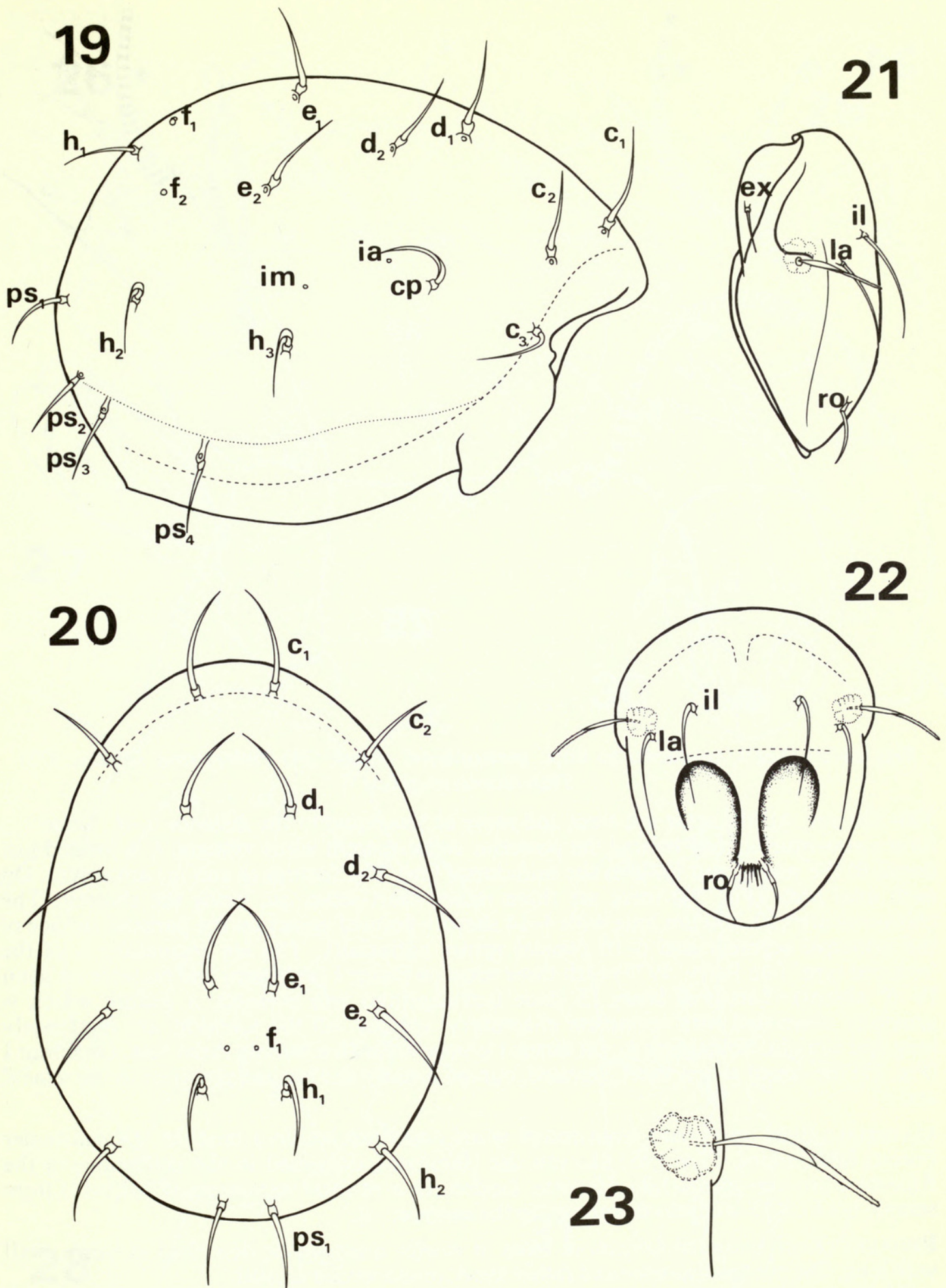
***Phthiracarus longulus* (C. L. Koch)**
(Figs 25–31)

Hoplophora longula Koch, 1841 : Heft. 32, t. 17. Schweighauser Forest, Regensburg [type series presumed lost]. NEOTYPE (here designated), Donaustauer Forest, Regensburg (RNH, Leiden, P2012–15).

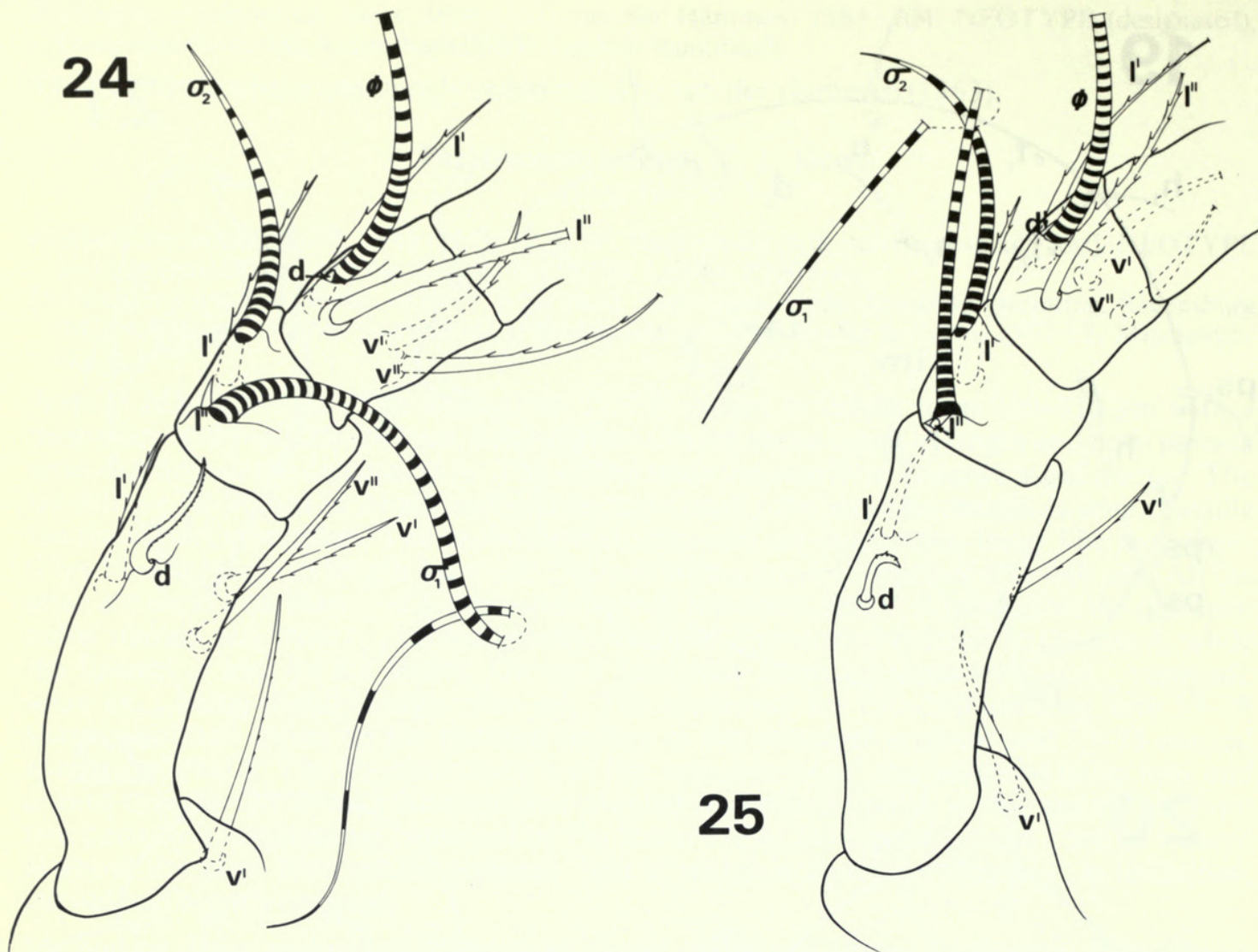
Phthiracarus ferrugineus (Koch) *sensu* Jacot, 1936 : 179 [in part]. Topotypes, Dechbetten Forest, Regensburg (MHN, Geneva, 3119h) [examined].

Phthiracarus tardus Forsslund, 1956 : 216. Holotype, Västerbotten, Sweden (paratype, BMNH, London, 1964.7.13.78) [examined]. **Syn. nov.**

ADULT: Small and weakly sclerotized. The *aspis* (Figs 27, 29–30) ranges in length from 220–255 μm with a maximum width of 170–190 μm . The interlamellar setae (*il*) which are inserted on a level with the bothridia, are twice as long as the lamellars (*la*) and extend almost to the rostral bases (*ro*). The sensilli are lanceolate, serrated marginally, and range in length from 30–40 μm . The exobothridial setae (*ex*) are short. The *notogaster* (Figs 26, 28) is somewhat elongate and ranges in length from 430–490 μm with a maximum depth of



Figs 19–23 *Phthiracarus lentulus*: (19) notogaster, lateral; (20) notogaster, dorsal; (21) aspis, lateral; (22) aspis, dorsal; (23) sensillus.



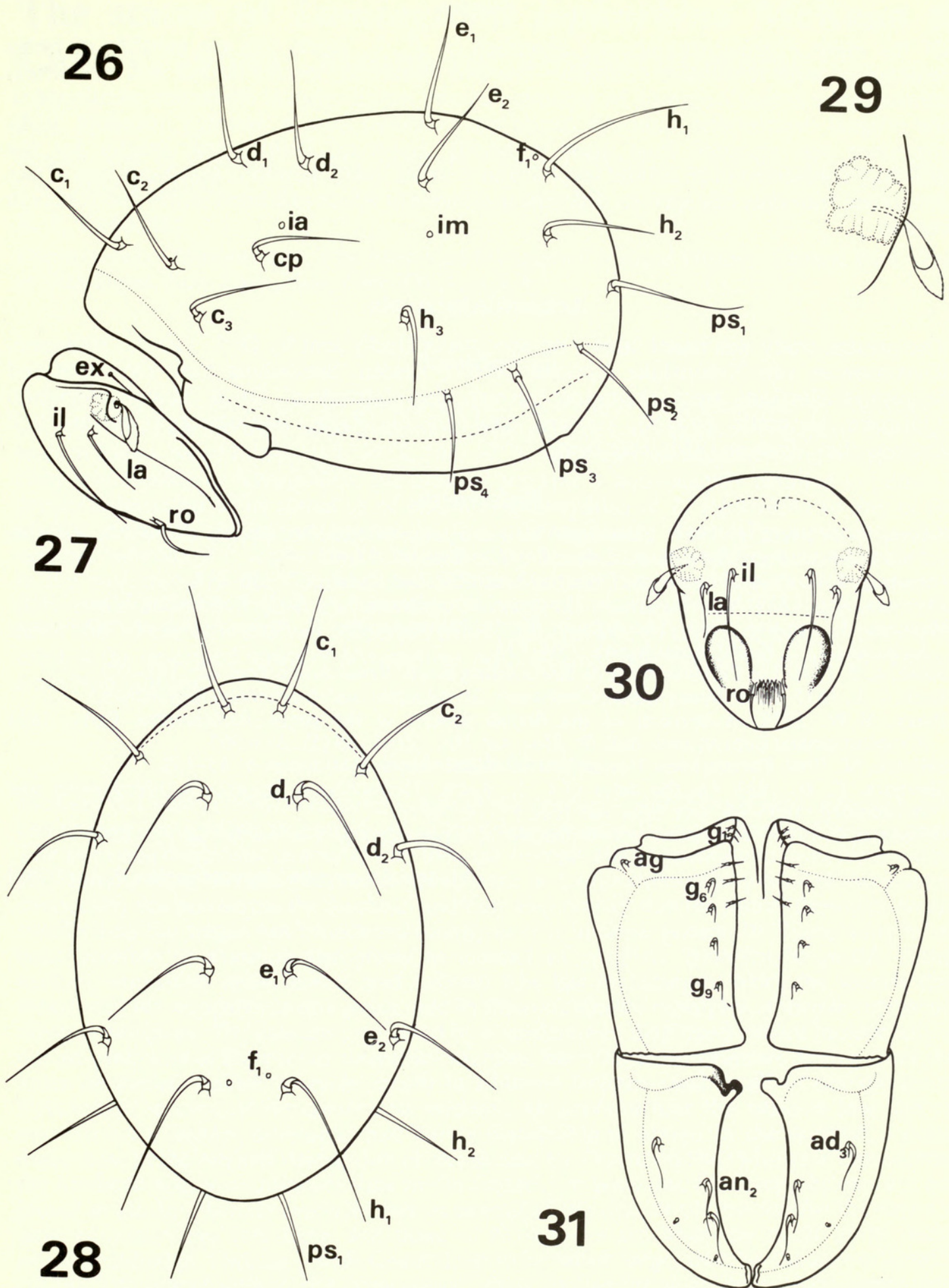
Figs 24–25 Leg I, trochanter to tibia, posterolateral aspect: (24) *Phthiracarus lentulus*; (25) *Phthiracarus longulus*.

300–320 μm . All the setae are erect and more or less equal to the distance c_1-d_1 . Setae c_{1-3} form a row immediately behind the posterior collar margin while vestigial f_1 is located just dorsal to the seta h_1 and towards the mid-dorsal line. The fissures ip and ips are absent. On each *anal plate* (Fig. 31) there are three rather short setae, ad_3 being the shortest. The *chelicerae* are 150–200 μm long with 4–14 sharply pointed spines on the paraxial surface of the principal segment and 6–10 conical spines antiaxially. The *leg chaetotaxy* is of the ‘reduced type’ (see Parry, 1979) with three setae on femur I (v' absent) and no setae on genu IV (l' absent). Tarsus II bears 12 setae (subunguinal seta present), a feature which is generally associated with ‘complete chaetotaxy’ species. All the solenidia are moderately long and straight. Solenidium ω_2 on tarsus I is coupled with a minute distal seta. On femur I (Fig. 25) the dorsal seta is short, serrated, curved distally and located posterior to the setae l' and v' .

MATERIAL: Eight specimens from rotten wood and litter beside a brooklet, Donaustauer Forest, Regensburg, 27.vi.1961 (L. van der Hammen), deposited in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden. One of these specimens (P2012–15) from sample no. 61 R45 is hereby designated as the *neotype*.

REMARKS: Koch recorded *longula* in moss in woods, a species he described as being small with long, fine notogastral setae and rather short, round-ended sensilli.

Of the species here described, *P. longulus* appears to be the most abundant in all the Regensburg samples. The species has been recorded only rarely in the British Isles but in Sweden the author has found it to be extremely widespread.



Figs 26–31 *Phthiracarus longulus*: (26) notogaster, lateral; (27) aspis, lateral; (28) notogaster, dorsal; (29) sensillus; (30) aspis, dorsal; (31) ano-genital region.

Survey

Of the eight *Phthiracarus* species described by C. L. Koch, six are capable of being reidentified with reasonable certainty. The two remaining species (*lucida* and *straminea*) cannot in the author's opinion be separated by any morphological characters mentioned in the original descriptions, although *lucida* was collected from a 'swampy' meadow, while *straminea* was recorded from moss in woods. However, *Phthiracarus* species are not generally considered to be habitat specific and it seems likely therefore, that Koch was in fact concerned with only one species, different specimens of which exhibited minor differences in colour.

Acknowledgements

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