THE ORIBATID FAMILY PHTHIRACARIDAE. II. REDESCRIPTION OF *PHTHIRACARUS LAEVIGATUS* (C. L. KOCH)

BY

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C. L. KOCH's Phthiracaroid mites have been the subject of a special paper by JACOT (1936), in which six species of the genus *Phthiracarus* are redescribed. JACOT's argumentation is, however, not always convincing, whilst his descriptions are rather incomplete because they have been prepared after specimens mounted in balsam. In order to prepare modern redescriptions of some of KOCH's Phthiracaridae, with conclusive identifications, new material has been collected by me in the surroundings of Regensburg in July 1959 and in June 1961 ; especially the second visit proved very successful. A total of 3243 Phthiracaroidea have been collected from 44 samples (the material from the Oberpfalz and from the former " Rheinbayern " not counted), viz., 493 *Phthiracarus* (some 9 species), 1076 *Tropacarus* (*carinatus* and *pulcherrimus*), 1415 *Steganacarus* (*magnus, applicatus, striculus, clavigerus*), 10 *Euphthiracarus* (*cribrarius*), and 249 *Rhysotritia* (*ardua, duplicata*).

Apart from the *Phthiracarus* species described by JACOT (his names are partly not adopted here), at least two additional species have been collected by me, viz., *Phthiracarus globosus* (25 specimens) and a species preliminarily named here *Phthiracarus* cf. *contractilis* (17 specimens) ; the last-mentioned one is related to *P. nitens* NICOLET of which the redescription will be given in the following number of this series.

The present paper deals with KOCH's *Hoplophora laevigata*, characterized by this author as a large species, with a highly arched and shiny notogaster, of which the hairs were invisible to him (so that they are very small), and a short sensillus that is curved to the front ; he described the colour as rust-yellow (in the latin diagnosis defined as ferrugineus = rust-coloured or reddish brown ; the coloured figure which accompanies the text is indeed rather dark brown), the notogaster presenting a black border, and the aspis the usual pair of light spots ; the anogenital region and the legs are described and figured as lighter. There can be

no doubt about the belonging of *laevigata* to the genus *Phthiracarus* because of the smooth cuticle and the absence of a distinct median prodorsal carina.

Among the nine species of the genus *Phthiracarus* collected by me in the surroundings of Regensburg, there is only one of which the notogastral hairs are inconspicuous, all other species having longer notogastral hairs that are much more distinct. This species is, moreover, the largest of all and has a highly arched notogaster, characters that exactly fit in with KOCH's description of *Hoplophora laevigata*, just as the shape of the sensillus and the colour. Consequently, there is sufficient proof for the identity of KOCH's original description and the material collected by me. This own material has served me for the present redescription.

JACOT (1936) was the first to re-identify the species on the same grounds. His description is sufficient for an identification, but several characters that are interesting for a future subdivision of the genus *Phthiracarus* are not mentioned. I point for instance to the number of lyrifissures, and to the number and position of vestiges of hairs. Because JACOT mounted his specimens in balsam, he often could not see the difference between a place of insertion of a hair, a vestige of a hair, and a lyrifissure.

SELLNICK (1928, 1960) identified *laevigatus* with a species of *Steganacarus* ; it is, however, evident that a species described by KOCH as shiny and smooth (the translation of " laevigatus " is moreover, " polished " or " smooth ") cannot belong to *Steganacarus*, a genus with distinctly sculptured cuticle and a distinct median prodorsal carina.

Phthiracarus laevigatus was characterized by JACOT as the only Regensburg species of which the genital valves present a distinct anterior apophysis. This apophysis has afterwards been observed in other species, and is for instance also present in *P. nitens* NICOLET. In the surroundings of Regensburg I discovered another species presenting this character, viz., the species above referred to as *P.* cf. *contractilis*. I do not know whether JACOT confused the two species. *P.* cf. *contractilis* is distinctly different from *P. laevigatus* by the less arched notogaster, the absence of the characteristic angle near c_1, and the longer notogastral hairs. Apparently, it has also a habitat that differs from that of *P. laevigatus*, because I collected it in the large forests of spruce-fir (Schwaighauser Forst, Donaustaufer Forst), where *P. laevigatus* has not been found.

JACOT (1930) considered *P. contractilis* PERTY (the type of the genus *Phthiracarus*) a synonym of *P. laevigatus*. PERTY's figures of the species, published by CLAPARÈDE (1868), show, however, a yellowish brown mite, of which the notogaster is much less arched, without the characteristic angle near c_1. Because PERTY's species was also collected in Bavaria, there is some chance that it is identical with my material from fir-woods. There are, however, still more species of the group in Bavaria, as I collected a third one in München. I hope to return to the important *contractilis* problem in one of the following papers of the series ; a neotype must be designated before the genus *Phthiracarus* can be subdivided.

The study of *P. laevigatus* is thwarted by the behaviour of the specimens in

lactic acid. Notwithstanding the fact that the species looks rather solid, heating with lactic acid causes serious deformation of the cuticle, whilst gass- and oil-bubbles are formed in the interior. The results with slow heating in diluted lactic acid proved to be only little better. Among twenty specimens treated in this way, a few appeared to be completely suited for the preparation of detailed figures.

In the present paper those structures which show little differences from *Hoplophthiracarus pavidus* (cf. VAN DER HAMMEN, 1963), such as the gnathosoma and the coxisternal region, are not described again. Especially such characters are emphasized here, that will possibly prove to be important for a future subdivision of the genus *Phthiracarus*.

Phthiracarus laevigatus (C. L. KOCH, 1841).

Hoplophora laevigata C. L. KOCH, 1841, fasc. 38 (16) ; 1842, p. 117, pl. 12, fig. 66.
Phthiracarus laevigatus, JACOT, 1936, p. 167, figs. 1-6.

Material. — The topotypic material from the surroundings of Regensburg (Bavaria, Germany) dealt with here, comprises the following specimens (localities arranged from West to East, and from North to South).

Keilstein near Keilberg, June 15, 1961 ; deciduous forest mixed with pines ; litter : 6 specimens (sample 61 R 23). Idem, deciduous forest ; litter and moss from stones and stubs : 20 specimens (sample 61 R 24).

Donaustauf, June 27, 1961 ; hedge of elder along brooklet ; decaying wood, leaves, and branches : 21 specimens (sample 61 R 45).

Dechbetten, July 17, 1959 ; small moist wood, mainly consisting of elder ; moss : 3 specimens (sample 59 R 1). Idem, June 18, 1961 ; small deciduous wood on a slope (Koch's " Feldhölzchen ") : 2 specimens (sample 61 R 32).

Königswiesen, June 18, 1961 ; village-park ; litter and moss : 9 specimens (sample 61 R 31).

Hohengebraching, July 20, 1959 ; forest named " Argle " (spelled by Koch as " Arklee ") ; mixed forest ; moss and litter : 1 specimen (sample 59 R 10). Idem, part of the forest with beech ; litter : 2 specimens (sample 59 R 11). Idem, June 17, 1961 ; small, moist, open part in the forest, with grass and herbs ; moss, roots, and decaying grass : 29 specimens (sample 61 R 28).

Total : 93 specimens from 9 samples.

Because the type-material of Koch's Oribatid mites is no more in existence, a female from sample 61 R 45 is designated here as neotype ; it is preserved in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden.

Occurrence. — From the above-mentioned data it appears that the species has been found in moss and decaying material (wood, leaves, grass, roots), collected in forests, small woods, and hedges of mainly deciduous trees. The distribution around Regensburg is local ; with some additions it still corresponds with the data

given by Jacot (1936). The species is apparently absent in the large forests of spruce-fir North of Regensburg (Schwaighauser Forst, Donaustaufer Forst ; although in the last-mentioned region it is found in the parts with deciduous trees). The occurrence reasonably corresponds with Koch's description of it : " An Feldrainen in Erdmoos, unter Hecken und Gebüsch, hier ziemlich selten ".

Measurements. — 19 specimens from sample 61 R 45 (Donaustauf) have been measured (2 had been damaged during the observations), of which 6 are males, and 13 females. The measurements in the two sexes are the following :

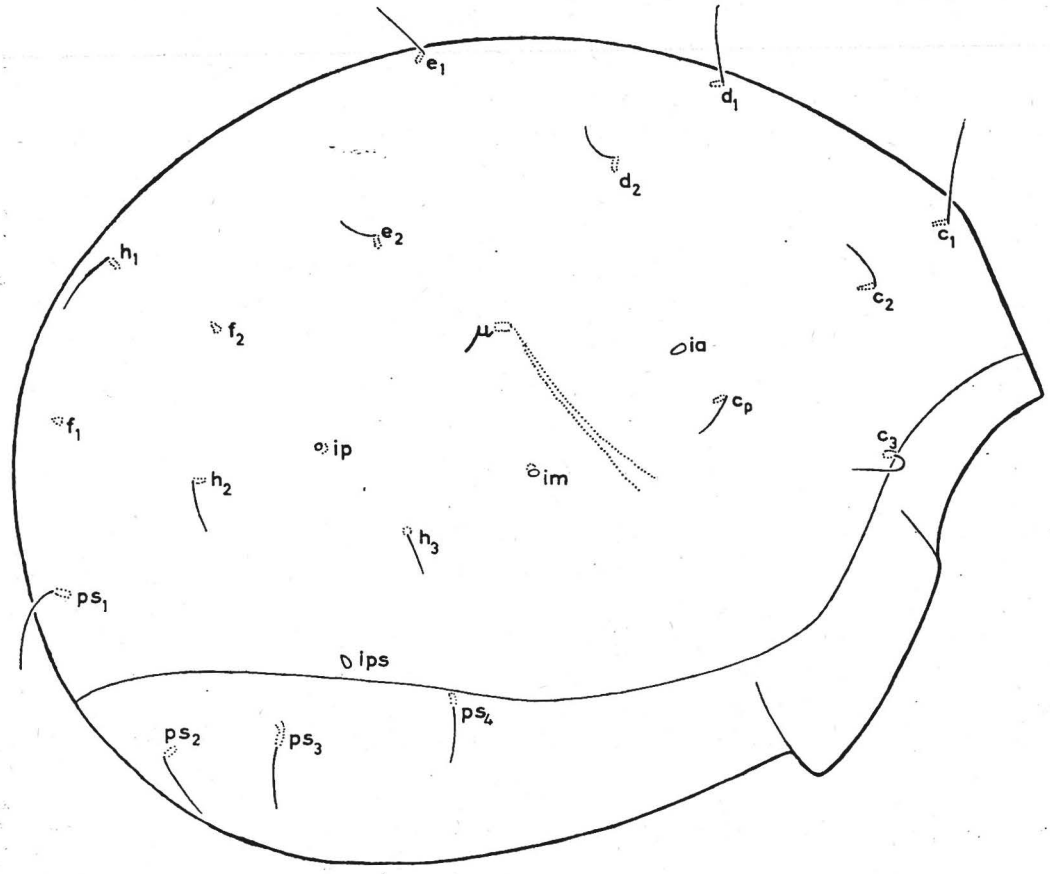

FIG. 1. — *Phthiracarus laevigatus* (C. L. KOCH), ♀ ; lateral view of notogaster, × 150.

Male : length of prodorsum 0.345-0.415 mm (average 0.395) ; length of notogaster 0.625-0.760 (average 0.720), height 0.465-0.620 (average 0.550).

Female : length of prodorsum 0.390-0.540 mm (average 0.475) ; length of notogaster 0.705-1.05 (average 0.890), height 0.540-0.870 (average 0.705).

Habitus and colour. — The species is a relatively large *Phthiracarus* wit ha characteristic shape which sometimes can even be recognized without any magnification at all. The notogaster is highly arched and presents a distinct angle near c_1. The surface is very shiny. The notogastral hairs are small and extremely thin. As a rule the specimens are rust-coloured to chestnut-brown. The notogastral limb is much darker, whilst the ano-genital region is lighter except for a dark transverse band ; the aspis presents the usual pair of light spots.

Cerotegument. — A cerotegument-layer is nearly absent ; some vague granulations can be seen in the lateral part of the notogaster. I observed small white granular masses in the projecting part of the anterior notogastral limb.

Cuticle. — When observed in a dry condition on a carbon block, the cuticle is extremely shiny, and nearly completely smooth. A faint superficial structure is, however, present, although nearly indistinguishable ; it seems to be vaguely shagreened, but in fact it is punctate.

The cuticle is very thin and can be easily damaged when preparing a specimen for study. After heating with lactic acid, the mites often show a distinct swelling, consisting in a partial separation of epiostracum and ectostracum, a phenomenon of osmotic origin. In these cases the brown ectostracum shows partial fractures, whilst the pale epiostracum is still entire. The epiostracum is distinctly punctate ; each small circular area contains a point. The ectostracum shows a structure of fine points.

Prodorsum (fig. 4 A). — The prodorsum or aspis presents a distinct lateral ridge, and a pair of anterior light spots which are in fact sunken areas separated by an indistinct median carina The sensillus is represented in fig. 4 C ; it consists of a slightly eccentric core and a surrounding border which is pointed towards the apex. The bothridium is crenate with about eight segments ; in lateral view the posterior upper part appears to be covered by a fold. The thin interlamellar, lamellar, rostral, and exobothridial hairs are lying rather close to the surface of the aspis. The first-mentioned three pairs of hairs have distinct canals at the place of insertion ; especially those of the rostral hairs are strikingly long.

Notogaster (fig. 1). — The notogaster is highly arched. The outline presents a characteristic angle near c_1, whilst the part between c_1 and the anterior border is steeply sloping (these characters are already mentioned by JACOT, 1936, p. 167). The notogastral hairs are very small and thin ; their disposition is represented in fig. 1 ; f_1 and f_2 are vestiges, just as in *Hoplophthiracarus*, f_1 being situated still more posteriorly of h_1. There are four pairs of lyrifissures (instead of two pairs in *Hoplophthiracarus pavidus* and *Phthiracarus anonymum*), indicated here as *ia, im, ip, ips* ; I am not certain as to the notation of the last-mentioned two fissures. The usual mark μ of a muscle is easily visible.

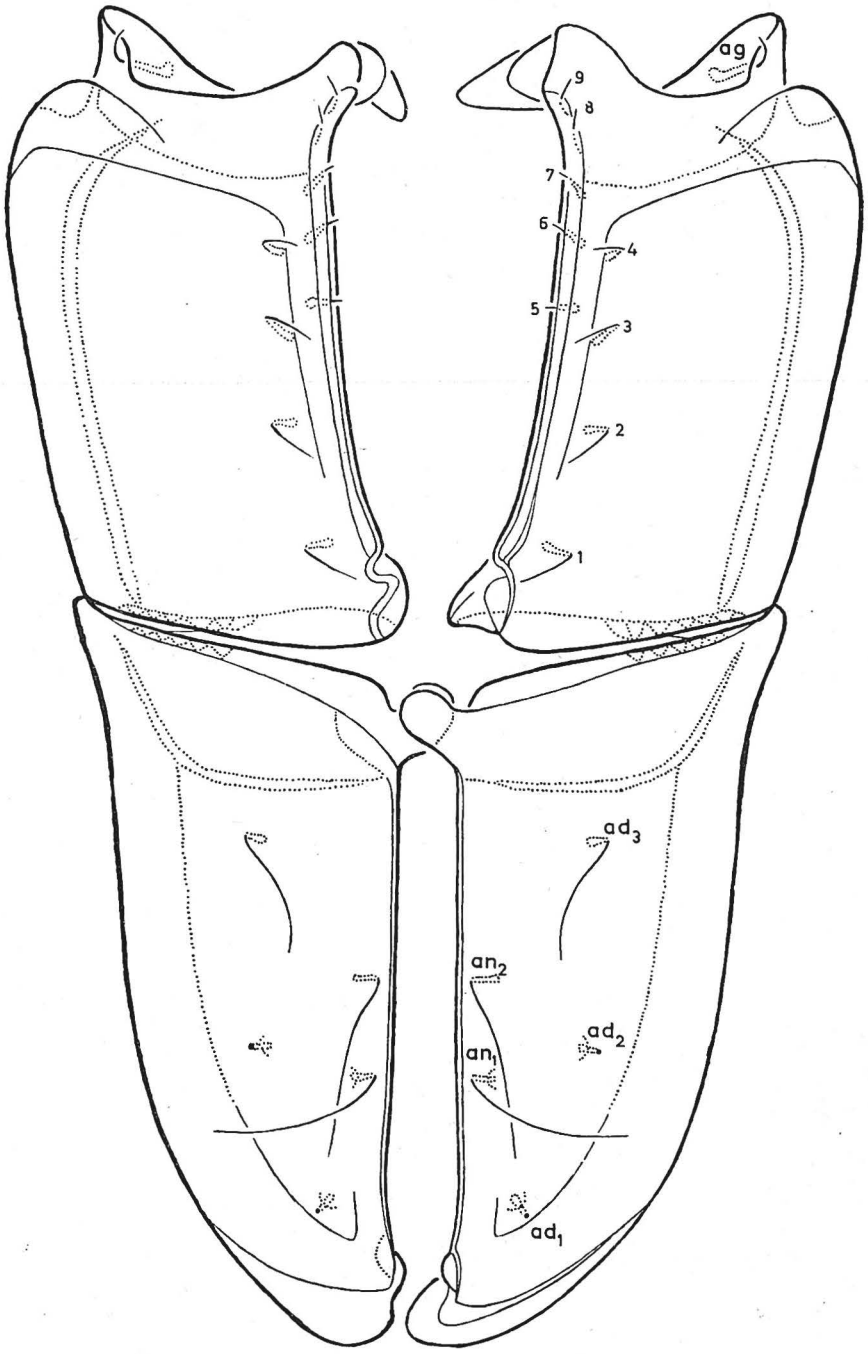

FIG. 2. — *Phthiracarus laevigatus* (C. L. KOCH), ♀; ano-genital region, × 320.

Ano-genital region (figs. 2, 3 A-B). — Although the ano-genital region must be considered a fusion of anal, adanal, genital, and aggenital shields, the covers are simply indicated here as anal and genital valves.

The hairs of the ano-genital region have the number usual for Phthiracaridae : 9 genital hairs (of which those numbered here by 5-9 are small and marginal, especially 5-7), 1 aggenital hair (with an anterior lateral position, its base covered by the overhanging anterior border of the valve), 2 marginal anal hairs, and 3 adanal hairs (of which ad_1 and ad_2 are vestiges, whilst ad_3 is curved backwards). The vestigal condition of two adanal hairs will perhaps prove to be a useful character for the subdivision of the genus *Phthiracarus*.

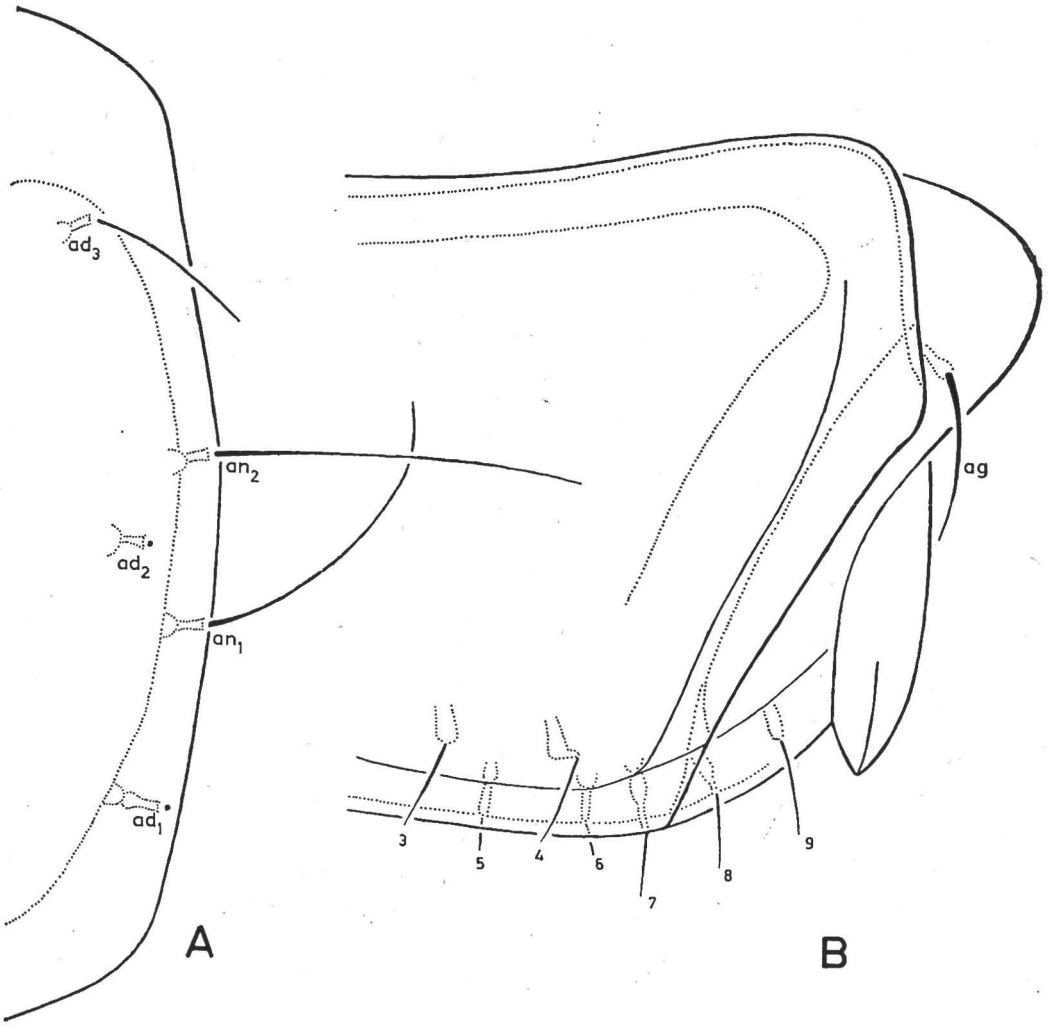

FIG. 3. — *Phthiracarus laevigatus* (C. L. KOCH), ♀ ; A, lateral view of part of anal valve ; B, lateral view of anterior part of genital valve ; A-B, × 470.

The anterior border of the genital valves presents a median apophysis which is especially distinct in lateral view (fig. 3 B). The posterior border of the genital valves, and the anterior border of the anal valves present a row of some 6 teeth which constitute a lock.

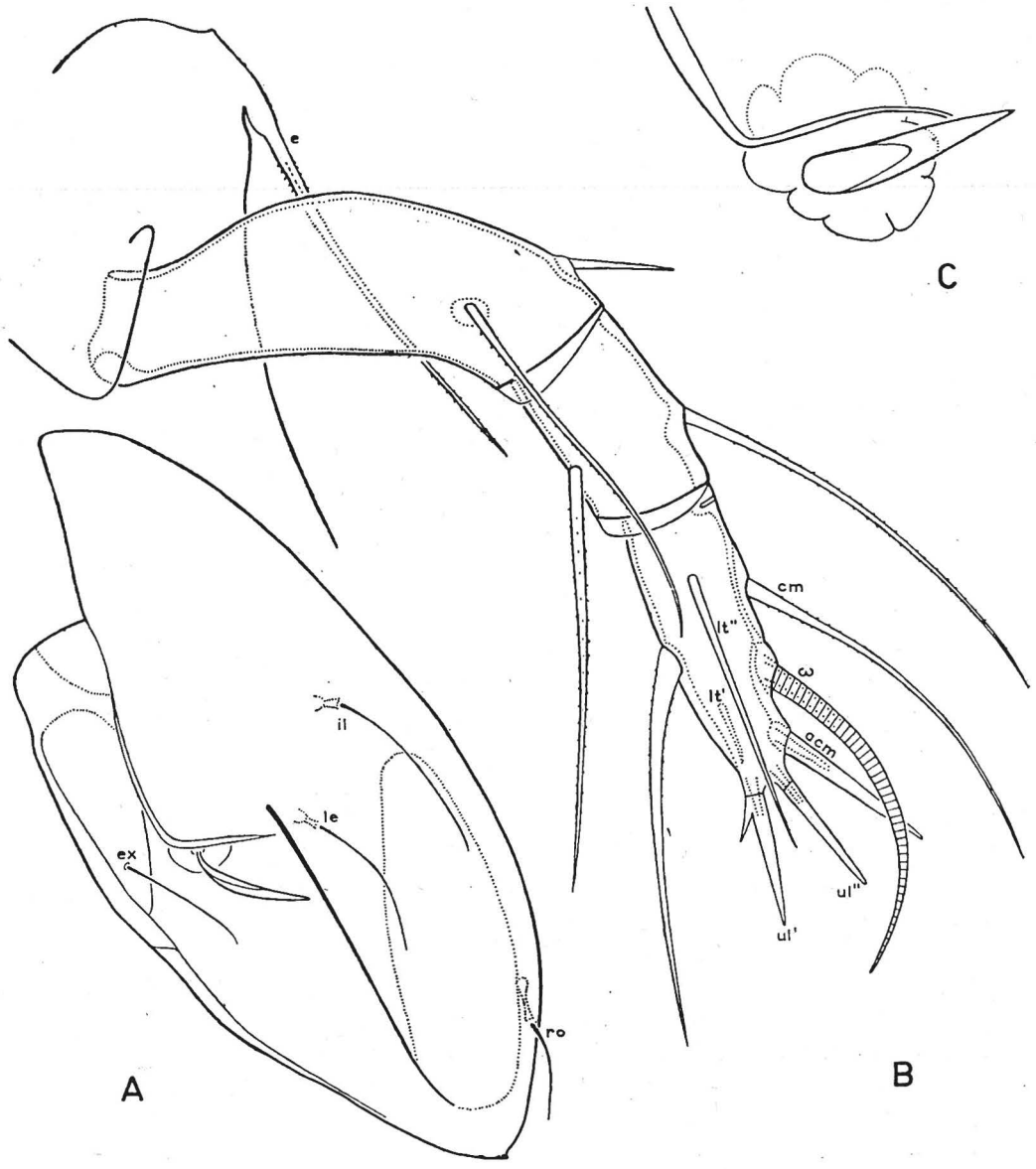

FIG. 4. — *Phthiracarus laevigatus* (C. L. KOCH), ♀ ; A, lateral view of aspis ; B, lateral (antiaxial) view of right palp and part of infracapitulum ; C, sensillus and bothridium ; A, × 240 ; B-C, × 730.

The anterior median lock of the anal valves is the reverse of the condition in *Hoplophthiracarus*. In *P. laevigatus* the left lobe is the external one which fits in a corresponding lock in the right valve ; the right lobe is underlying. I name this condition right-fitting, in contradistinction to the condition in *Hoplophthiracarus*, which consequently must be named left-fitting. Possibly these conditions will prove to be characters of generic value.

I have found no specimens with extended ovipositor. It is not impossible that only those specimens which drop in alcohol during their search for suitable spots for egg-laying, have the ovipositor extended. The number of genital papillae is apparently 2 ; vestiges of a third pair could not be established with certainty.

Palp (fig. 4 B). — The palp consists of three joints. The formula is 2-2-7. The solenidion ω is free. The tarsus has three distinct eupathidia : *acm*, *ul″*, and *ul′* ; the last-mentioned eupathidium has a relatively large basal ventral tooth, probably representing the remainder of the subultimal hair *su* which has joined *ul′*.

In fig. 4 B a small part of the infracapitulum is also represented, showing the long pectinate supracoxal hair *e*.

Legs. — Just as in *Hoplophthiracarus pavidus* (cf. VAN DER HAMMEN, 1963) the number of hairs on the legs is considerably reduced, so that consequently the correct notation is difficult to establish. In some cases, the hairs are, moreover, not placed in distinct pseudo-symmetric pairs, by which condition the identification is thwarted. The long solenidions, especially φ, are unfavourable for a correct orientation, and must be cut off if necessary ; *s* and consequently the plane of pseudosymmetry should preferably be orientated exactly horizontally in the slide.

Legs I and IV are completely represented in respectively figs. 5 A-C and 6 A-C ; I have, moreover, added figures of tarsus II (fig. 5 D) and tarsus III (fig. 6 D). In my opinion the notation given in these figures is reasonably certain. The difficulties concern the tarsi, especially of the posterior legs.

Tarsus I has 6 eupathidia : (*it*), (*p*), *s*, and *a′*. The antelateral pair of hairs (*a*), which is here regarded as consisting of an eupathidium (*a′*) and an ordinary hair (*a″*), is not placed pseudosymmetrically : *a″* has a lateral (antiaxial) position, *a′* (the eupathidium) is nearly in the plane of pseudosymmetry. A similar orientation of the antelateral hair *a″* is found in tarsus II ; here it is directed even upwards. Tarsus II lacks the iteral hairs (which are also absent on tarsi III and IV) and the primiventral hair *pv′* (unless the hair indicated here as *a′* will prove to be *pv′*). The numbers of hairs on tarsi III and IV are still more reduced. The identification of the hairs is here especially difficult because (*tc*), (*p*), and (*u*) are not placed in distinct pairs. There is only one antelateral hair on III and IV, viz., *a′*. Just as in *Hoplophthiracarus pavidus* tarsus III has a pair of fastigial hairs (*ft*) but no primiventral hairs (*pv*), whilst tarsus IV has one fastigial and one primiventral. The formulae from I to IV are the following.

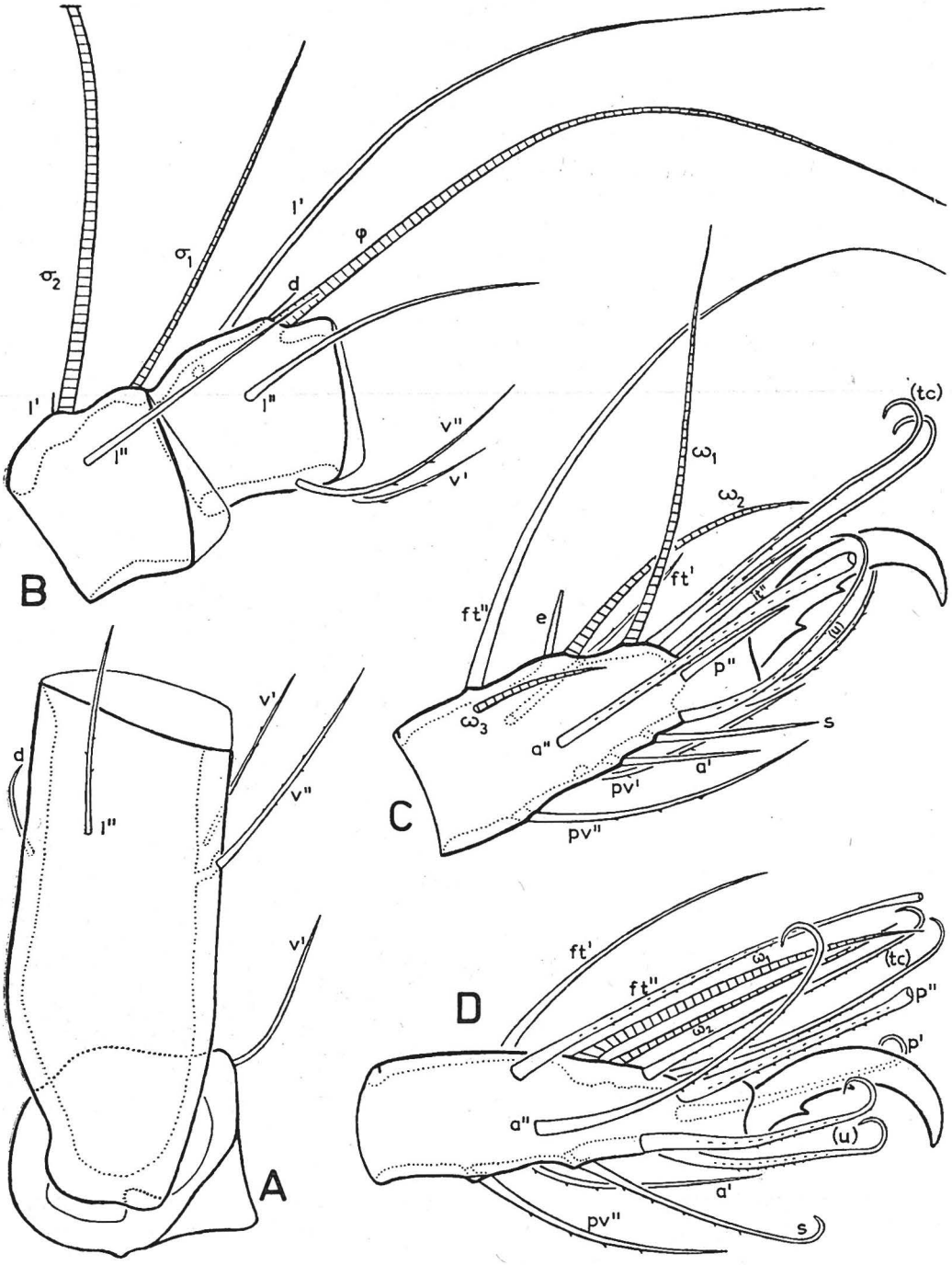

FIG. 5. — *Phthiracarus laevigatus* (C. L. KOCH), ♀ ; A-C, lateral (antiaxial) view of right leg I ; A, trochanter and femur ; B, genu and tibia (the greater part (more than half of the total length) of σ_2 is omitted) ; C, tarsus ; D, lateral (antiaxial) view of right tarsus II ; A-D, × 500.

Hairs : I (1-4-2-5-16-1) ; II (1-3-2-3-12-1) ; III (2-2-1-2-10-1) ; IV (2-1-1-2-10-1).

Solenidions : I (2-1-3) ; II (1-1-2) ; III (1-1-0) ; IV (0-1-0).

The solenidions of the tarsi are free. On all tibiae φ is coupled with *d*. On genu I σ_2 is coupled with *l'*, whilst σ_1 is free ; *d* is absent.

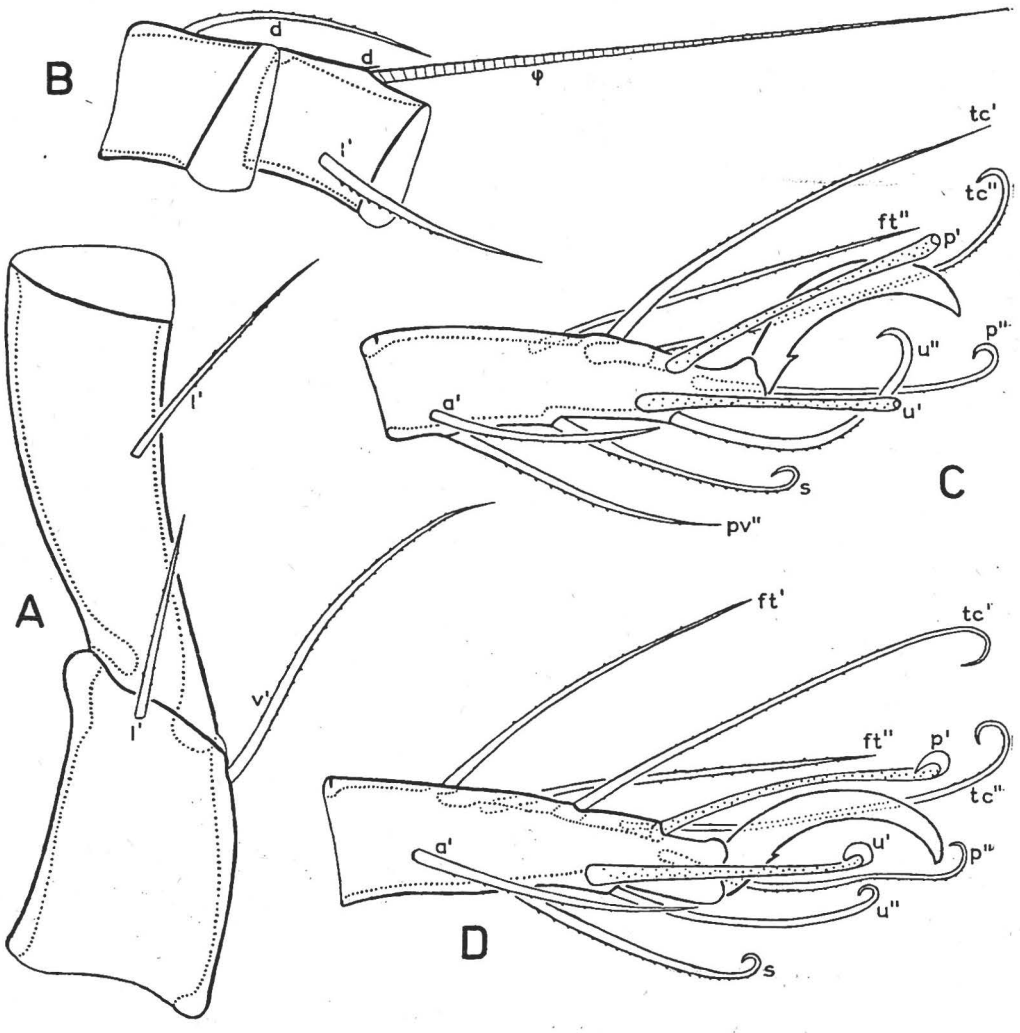

FIG. 6. — *Phthiracarus laevigatus* (C. L. KOCH), ♀ ; A-C, lateral (antiaxial) view of left leg IV ; A, trochanter and femur ; B, genu and tibia ; C, tarsus ; D, lateral (antiaxial) view of left tarsus III ; A-D, × 500.

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1. According to Dr. E. PIFFL (in litt.) fasc. 38 of KOCH's CMA appeared in 1844, because the wrapper has a subscript which mentions October 1844 as date of completion. It is not impossible that this is a misprint, because fasc. 38 is already cited in the " Ubersicht ".