THE HOMOCALIGIDAE, A NEW FAMILY OF MITES (ACARI : RAPHIGNATHOIDEA), INCLUDING A DESCRIPTION OF A NEW SPECIES FROM MALAYA AND THE BRITISH SOLOMON ISLANDS

BY

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INTRODUCTION

The genus *Homocaligus* was erected by BERLESE (1910) to accommodate *Stigmaeus scapularis* Koch 1838. BERLESE'S (1886) earlier illustrations of the species, which at that time he included in the genus *Caligonus* (family Raphignathidae), indicated that it possessed features unlike those of other members of this genus and family. OUDEMANS (1923) extended the description of *Homocaligus* and synonymised *Raphignathus tumidus* Grube with *Homocaligus scapularis*, the only known species. OUDEMANS (1931 a) did not include *Homocaligus* in either the Raphignathidae or his new family the Stigmaeidae, but later (OUDEMANS, 1931 b) included it in the Stigmaeidae. Due to lack of material and adequate descriptions, acarologists currently working on Raphignathoidea (GONZALEZ, 1965 ; SUMMERS, 1966 a, 1966 b ; WOOD, 1967) have accepted OUDEMANS' classification without commenting on the systematic position of *Homocaligus* within the Stigmaeidae. Since OUDEMANS' (*loc. cit.*) publications only two species have been referred to *Homocaligus* : *Homocaligus aquatius* Habeeb, 1961, which was obviously not related to *Homocaligus scapularis* and was transferred to a new genus, *Calighomus* Habeeb, 1966, and *Homocaligus muscorum* Habeeb, 1962 which was transferred to a new genus *Paludocaligus* Habeeb, 1966.

A few mites from Malaysia and the British Solomon Islands examined by the author appeared to be closely related to *Homocaligus*, but possessed features which placed them outside any of the known families of Raphignathoidea (SUMMERS, 1966 a). By kind permission of Dr. L. VAN DER HAMMEN, I was able to examine specimens from the OUDEMANS collection in the Rijksmuseum van Natuurlijke Historie, Leiden, labelled *Homocaligus scapularis*. Although these specimens were

in poor condition it has been possible to redescribe *Homocaligus scapularis* making the assumption that OUDEMANS' specimens were conspecific with *Stigmaeus scapularis* Koch. As will be noted in the following description of *Homocaligus scapularis* this assumption may not be correct. In addition Dr. H. HABEEB and Dr. M. K. P. MEYER kindly forwarded specimens of *Paludocaligus muscorum* and *Ledermuelleria lineolata* Meyer and Ryke respectively, and on the basis of these four species it has been possible to define a new family of raphignathoid mites, the Homocaligidae.

Homocaligidae, new family.

The Homocaligidae is included in the superfamily Raphignathoidea Grandjean, as defined by GRANDJEAN (1944) and later by SOUTHCOTT (1957) and SUMMERS (1966 a). Its distinguishing features are as follows. Chelicerae with inflated basal segments which are completely separated ; movable digits stylet-like ; length less than combined femur-genu-tibia of leg I. Short peritremes arise laterally at base of chelicerae and end above the first pair of coxae. Palps 5-segmented, not particularly elongate, reaching as far as tibia I and terminating in distinct " thumb-claw complex " ; tibial " claw " about as long as tarsal " thumb ", latter bearing distally two simple setae and a stalked trifid seta. Gnathosoma visible from above, not enclosed in a camerostome or covered by a hood. Empodia of legs consisting of an axial rod bearing three Y-shaped prongs as in Stigmaeidae. Tarsi with long claws. Chaetotaxy of legs similar to that of Stigmaeidae with special sensory setae on all tarsi and tibiae, on genua I and II and special sex-associated solenidia on all tarsi of males. Dorsum almost hemispherical, in contrast to other raphignathoid mites which are to some extent dorso-ventrally flattened. Dorsum, venter and appendages well sclerotised with minimal area of membranous cuticle between the various plates. Plates consist of a single hemispherical dorsal plate bearing 10 pairs of setae, of which the post-ocular (*be*) pair are minute, and a pair of eyes ; a pair of elongate humeral plates situated laterally above the coxae, each bearing a single seta ; fused suranal and paragenital plate covering the whole of the venter posterior to the coxae and bearing 3 pairs of paragenital setae and 2 pairs of suranal setae ; genital plates with 4 pairs of setae ; anterior intercoxal plates may be fused or paired and posterior intercoxal plates are partly or entirely fused to a mid-ventral plate — intercoxal setae *3a* absent. BERLESE (1886) illustrated and OUDEMANS (1923) described the dorsal plate overlapping onto the venter. In fact they were observing specimens squashed on microscope slides and the true arrangement of plates is as shown in Figs. 1 A, B ; 2 D ; 3 A ; 4 B. Coxae I and II are elongate, partly fused, almost meeting the opposite pair in mid-line and are narrowly separated from coxae III and IV which are more widely separated from each other than are the anterior pair. Superficial observation of uncleared specimens indicates separate paragenital, mid-ventral and intercoxal plates. However, in most adults examined these plates are partly connected by secondary chitin, the degree of fusion possibly depending on the age of the individual.

The dorsum has a narrow, transverse groove in the propodosomal — hysterosomal region. Internally the lateral extremeties of the groove open into flask- or funnel-shaped structures giving rise to sacs (females of all four known species) or tubes (males of the one species from which males are known). In past literature (BERLESE, 1886 ; OUDEMANS, 1923 ; HABEEB, 1962) the dorsal groove has either not been observed or has been confused with the propodosomal-hysterosomal suture prevalent among raphignathoid mites. OUDEMANS (1923) noted the pair of internal sacs in *Homocaligus scapularis*, which with the associated dorsal groove, he aptly likened to a " pair of spectacles ". Oudemans supposed that the sacs were used for respiration and that they would be of advantage to a species living in water. The presence of " air sacs " in the other three known species of Homocaligidae and the fact that they have all been collected from aquatic or wet habitats supports OUDEMANS' suggestion.

The habits of these mites can only be surmised from their morphology and scanty knowledge of their habitat. With the exception of a few species of Stigmaeidae described by HABEEB (1958, 1961) the Homocaligidae include the only known aquatic or semi-aquatic raphignathoid mites. Their relatively long legs and tarsal claws suggest that they are better adapted to clinging to and locomotion on aquatic vegetation than to a free aquatic existence. Relative to the Homocaligidae, other raphignathoid mites are less sclerotised, have a greater surface area to volume ratio, are terrestrial and probably respire either through rudimentary peritremes or cutaneously. If the function of the internal sacs of Homocaligidae is respiratory, such an additional respiratory system could be advantageous to a semi-aquatic, well-sclerotised mite with a low body area to volume ratio. This supposition is supported by the fact that in the smaller males, with a greater surface area to volume ratio the system consists of simple tubes and in the nymphs, which are thinly sclerotised and have large areas of membranous cuticle, it is entirely absent. The only apparant respiratory system in the nymphs are the cheliceral-coxal peritremes.

To summarise, the identity of the family rests on the possession of a propodosomal-hysterosomal groove leading internally to a pair of sacs (females), or tubes (males) ; the presence of a large paragenital-suranal plate and a mid-ventral plate. Nymphs and larvae can be recognised by the fused paragenital and suranal plates, although they still have the characteristic body shape. The chelicerae, " thumb-claw complex ", peritremes, empodia and leg chaetotaxy indicate that the Homocaligidae are most closely related to the Stigmaeidae. The four known species are included here in two genera, *Homocaligus* Berlese and *Annerossella* Habeeb.

Key to the Homocaligidae (females).

1. Dorsum with longitudinal cuticular ridges ; air sacs reticulated..... *Annerossella* Habeeb. 2

— Dorsum without cuticular ridges ; air sacs minutely punctate..... *Homocaligus* Berlese. 3

2. Cuticle between ridges ornamented with shallow dimples ; lateral reticulation not extending as far as dorso-lateral ridges..... *A. pacifica* n. sp.
— Cuticle between ridges reticulated ; lateral reticulation extending to dorso-lateral ridges..... *A. lineolata* (Meyer and Ryke)
3. Longest dorsal setae 250 μ ; paragenital setae subequal ; coxal setae more or less subequal..... *H. muscorum* Habeeb
— Longest dorsal setae 140 μ ; paragenital setae $pg_1 > pg_2 > pg_3$; coxal setae 2*c* nearly twice as long as other coxal setae..... *H. scapularis* (Koch)

Terminology

Nomenclature follows that used by Wood (1967) for Stigmaeidae. The mid-ventral plate, which has no parallel in Stigmaeidae, is the only new term used in the present paper. In the following descriptions inter-setal distances are given by *a-a* etc., ratios by *a/b* etc. Lengths of setae and body measurements are given in microns (μ) and the number of specimens on which the measurements are based is indicated by n = 10 etc.

Genus *Annerossella* Habeeb.

Annerosella Habeeb, 1966. *Leafl. Acadian Biol.* 42 : 1.

Type species : *Ledermuelleria lineolata* Meyer and Ryke, 1959 ; monotypic.

Recognition : In erecting the genus Habeeb (1966) relied on Meyer and Ryke, (1959) somewhat inaccurate description and illustration of a species they named *Ledermuelleria lineolata*. Having studied this species and a new species described below, the distinguishing features of this genus are hereby defined as the longitudinal cuticular ridges on the dorsum and the reticulate internal sacs associated with the dorsal propodosomal-hysterosomal groove.

Distribution : Two species are known, one from South Africa and one from Malaya and the British Solomon Islands.

Annerossella pacifica n. sp.

(Fig. 1 A-F ; 2 A-D ; 3 A, D).

Female (n = 7) : Length of idiosoma 345 (340-350), maximum width 280 (270-285), height of dorsal plate at coxae III 190 (185-195).

Dorsum : Completely covered by a single helmet-shaped plate (Fig. 2 D). Four cuticular ridges run longitudinally from just behind the eyes and merge with the cuticle just above the postero-ventral margin of the plate ; exteriorly the ridges run into an arc-shaped ridge associated with the posterior margin of the propodo-

somal-hysterosomal groove. Cuticle between the ridges ornamented with shallow, roughly oval, dimples ; ventral margins of dorsal plate distinctly reticulated, the cells of the reticulum being elongate ; laterally the reticulum is more open but does not extend upwards onto the dorsum so that there is a non-reticulate area immediately anterior to the propodosomal-hysterosomal groove and lateral to the longitudinal ridges (Fig. 2 A, B). The cuticle within the reticulum is minutely punctate (Fig. 3 D). The dorsal plate carries a pair of large convex eyes (maximum diameter 60) situated anterolaterally and 10 pairs of setae, 4 pairs in the propodosomal region and 6 pairs in the hysterosomal region. Half the surface of the eye is minutely punctate (appearing striated on the strongly down-curved margins), the other half is smooth. A pair of narrow, elongate, reticulated humeral plates, bearing a single seta each, occupy the area between the dorsal plate and the coxal bases, their ventral margin intruding between the anterior and posterior pair of coxae. Setae long, apart from *ce* which are minute, acicular, with a few minute barbules along their margins, somewhat flexed, and borne on tubercles ; their lengths as follows : *ae* 130 ; *ce* 15 ; *he, li* 80 ; others 135-155.

Internal sacs : The dorsal propodosomal-hysterosomal groove opens at its lateral extremeties into a pair of large (length 120), globular, reticulated sacs. Reticulum on walls of the sacs with large cells (maximum diameter 25), noticeably larger than cells of the reticulum on the dorsal plate (Fig. 2 A).

Venter : Maxillicoxae, intercoxal plates, mid-ventral plate and paragenital-suranal plate distinctly reticulated ; cuticle within the reticulum minutely punctate. Setae *m* (41) slightly longer than *n* (34) ; *n-n* = *m-m* ; external rostral setae (*re*) longer than internal rostrals (*ri*). Setae *1a* (28) on single, narrow, intercoxal plate fused to coxae I and II ; setae *3a* absent, *4a* (31) between coxae IV on intercoxal plates separated by a wedge-shaped mid-ventral plate which extends laterally between the anterior and posterior pair of coxae ; in all specimens examined the mid-ventral plate is partly fused to the posterior intercoxal plates and to the paragenital-suranal plate by relatively thin secondary chitin (Fig. 3 A). Three pairs of subequal (37) paragenital setae, pg_2 closer to pg_3 than to pg_1. Two pairs of suranal setae, *e* (38) and *le* (34). Four pairs of setae on posterior half of ano-genital covers : g_1 (16) ; g_2, g_3 (19) ; g_4 (25).

Appendages : Cheliceral stylets 75. Coxae of legs and pedipalps reticulated. Legs relatively long and slender : I and IV 370, II and III 300. Numbers of setae on leg podomeres (special sensillae in parentheses) as follows : tarsi 14(ω) — 10(ω) — 8(ω) — 8(ω) ; tibiae 7(*ø*, *øp*) — 6(*øp*) — 6(*øp*) — 6(*øp*) ; genua 4(*k*) — 4(*k*) — 1 — 1 ; femora 6-5-3-3 ; trochantera 1-1-2-1 ; coxae 2-1-2-2. Coxal setae more or less subequal (30), setae *3b* located in proximal apex on coxae III. Spine *k* I slightly more than $\frac{1}{2}$ as long as associated dorsal seta *d* I, *k* II $\frac{1\text{-}1}{5\ 6}$ as long as *d* II. Sensory setae *øp* long and slender, subequal on all tibiae, longer than *ø* on tibia I. Solenidion ω long and slender, and on tarsus I reaching beyond base of setae *tc* ;

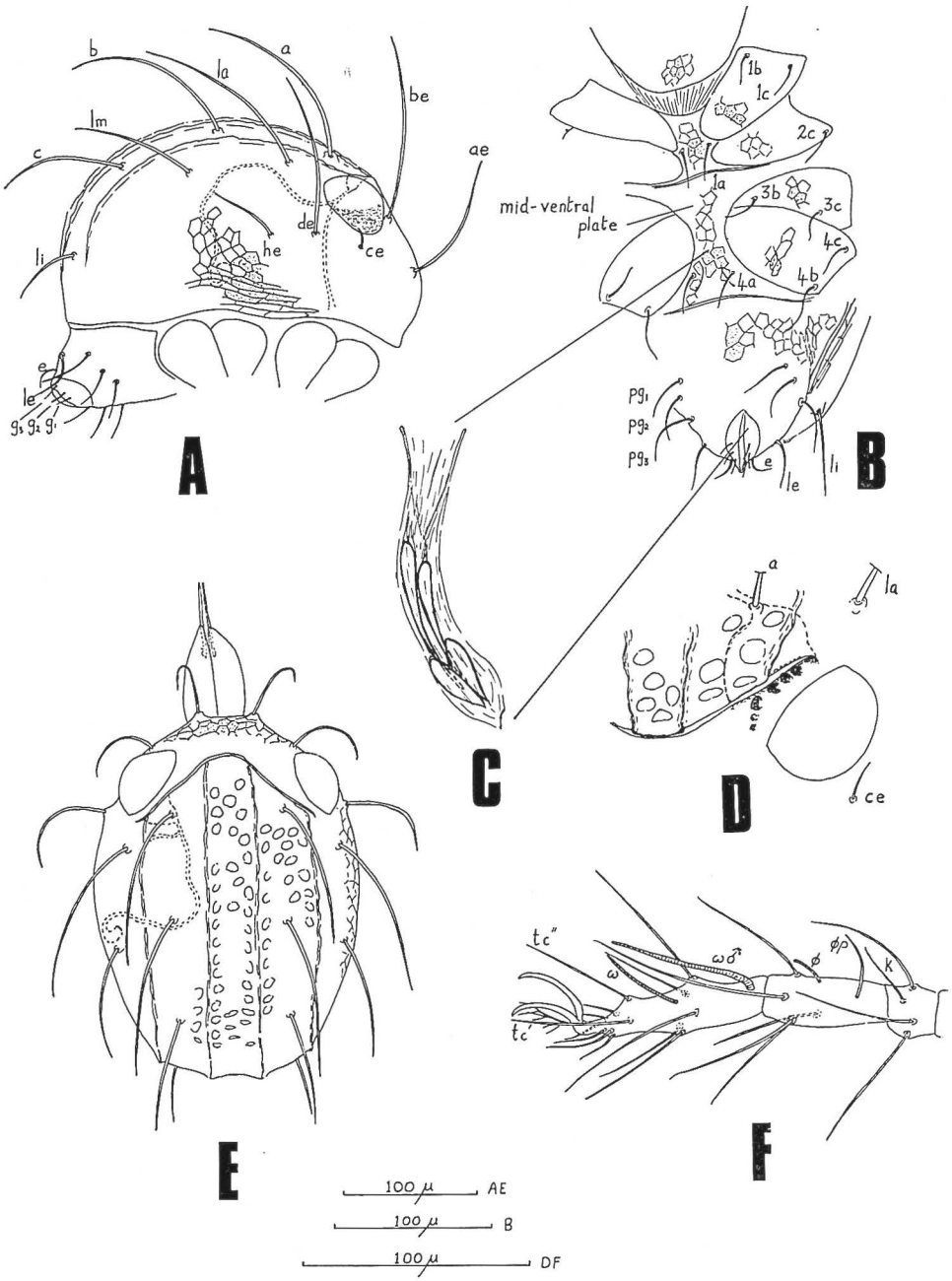

FIG. 1 : *Annerossella pacifica* n. sp., male (allotype).
A. — Lateral. B. — Ventral. C. — Aedeagus.
D. — Left side of propodosomal-hysterosomal groove. E. — Dorsal. F. — Right leg I.

ω I and II only slightly longer than ω III and IV. Numbers of setae on pedipalps : femora 3, genua 2, tibiae 4 (including " claw " and accessory seta), tarsi 7 (including one lateral, peglike solenidion and a stalked, trifid seta).

MALE (n = 2) : Length of idiosoma 275-285, maximum width 200-205, height of dorsal plate at coxae III 150-155.

Dorsum : Differs from female in that there are no separate humeral plates (Fig. 1 A), the humeral setae being borne on the sides of the dorsal plate close to setae *de*. Eyes, ornamentation of dorsal plate and nature of setae as described for female. Immediately posterior to the eyes and adjacent to the anterior margin of the propodosomal-hysterosomal groove are a number of small tubercles, the larger ones being situated along the margin of the groove (Fig. 1 D). Lengths of dorsal setae as follows : *be, de, a, b, la* 125-135 ; *ae* 105 ; *c, lm* 95 ; *he, li* 55 ; *ce* 17.

Internal tubes : The dorsal propodosomal-hysterosomal groove gives rise at its lateral extremities to a pair of small sac- or flask-like structures. At their lower end these sacs give rise to a tube which forks near the sac. The anterior tubes are short and appear to end above coxae II ; the posterior tubes run under the dorsum before leading ventrally into an apparently blind diverticulum above coxae III (Figs. 1 A, E).

Venter : Reticulate ornamentation and arrangement of ventral plates as in female except that in the only two specimens available for study, the midventral plate is completely fused to the intercoxal plates apart from a faint line of demarcation near setae *4a*, and is narrowly separated from the paragenital-suranal plate (Fig. 2 B). Three pairs of paragenital setae, pg_3 (38) longer than other two pairs (31). Two pairs of suranal setae, *e* (22) distinctly shorter than *le* (31). Three pairs of subequal (10) ano-genital setae.

The aedeagus is fairly simple and consists of an elongate membranous sheath enclosing two pairs of appendages ; one pair is elongate and extends to about half the length of the sheath, the other pair are shorter, broader and terminal (Fig. 1 C).

Appendages : Coxae of legs and pedipalps reticulated. Numbers and distribution of setae on leg podomeres as in female except for additional sex-associated solenidia ω♂ on tarsi I to IV ; ω♂ on all tarsi is long and reaches just beyond setae *tc* (Fig. 1 F). Coxal setae more or less subequal (26) except for *4b* which are longer (34).

NYMPH ; stage unknown (n=1) : Length of idiosoma 220, maximum width 140.

Dorsum : The cuticle is very slightly sclerotised. There are no ridges on the dorsal plate which is smooth, without dimples or reticulations. The eyes are relatively much smaller than in the adults. There is no propodosomal-hysterosomal groove, nor are there any internal sacs or tubes. The dorsal plate does not cover the sides of the body as in the adults but is separated from the coxae and the para-

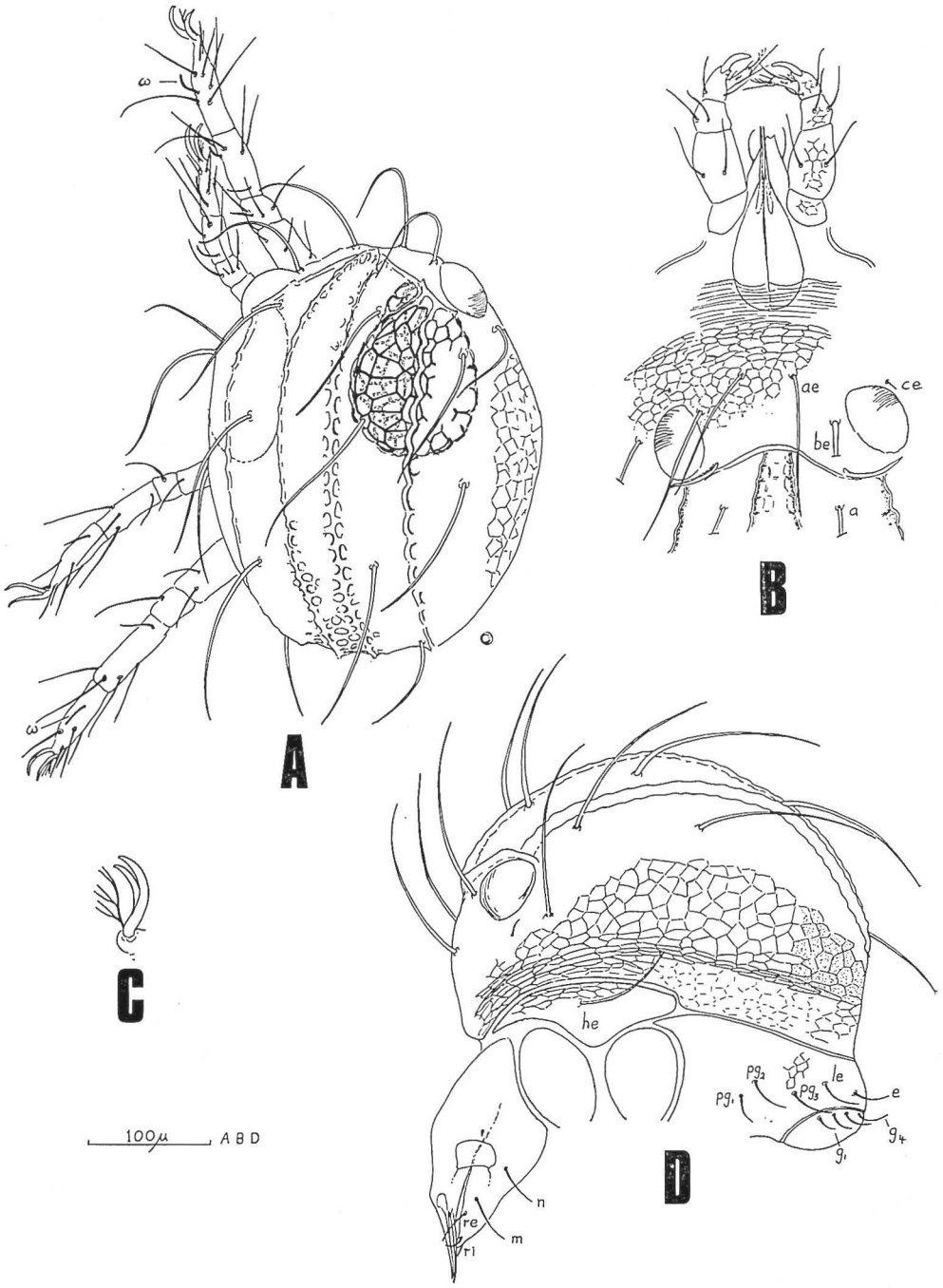

FIG. 2 : *Annerossella pacifica* n. sp., female (holotype).
A. — Dorsal. B. — Gnathosoma and propodosoma frontal view.
C. — Tarsal claws and empodium. D. — Lateral.

genital suranal plate by a considerable area of striated membranous cuticle. The humeral plates are small, smooth and widely separated from the dorsal plate and coxae by striated cuticle. The arrangement of setae on the dorsal plate is similar to that in the adult female, and their relative lengths are similar with the exception of the humeral setae, *he*, which are relatively longer in the nymph ; *he/li* = 1.0 in the adult and 2.0 in the nymph, *he/ae* = 0.6 in the adult and 12 in the. nymph.

Venter : The maxillicoxae and paragenital-suranal plate are smooth ; there are no intercoxal plates nor a mid-ventral plate, these areas being occupied by striated cuticle. Only one pair of setae on the maxillicoxae, setae *1a* situated on striated cuticle, setae *4a* absent. One pair of paragenital setae, three pairs of ano-genital setae and two pairs of suranal setae on a small paragenital suranal plate which does not cover the whole of the venter posterior to the coxae.

Appendages : Numbers of setae on leg podomeres differs from adult as follows : tarsus IV 7(ω) ; genu II 3(*k*), genua III and IV with no setae ; femur I 5, femur II 4 ; trochantera I to IV 0-0-1-0 ; coxae IV with no seta. Coxae I and II not particularly elongate, unlike these coxae in the adult.

The only other immature Homocaligidae observed is a single nymph of *Homocaligus muscorum*. The relationship between the leg and paragenital chaetotaxy of the respective nymphs and adults of these two species suggests that the nymph of *A. pacifica* described above is an earlier stage (? protonymph) than the nymph (? deutonymph) of *H. muscorum* described later in this paper.

The presence of the suranal setae on a fused paragenital-suranal plate instead of on a separate suranal plate is the only feature by which nymphs of Homocaligidae can be distinguished from Stigmaeidae.

Distinguishing features : This species is readily distinguished from *A. lineolata* by the presence of cuticular dimples between the dorsal ridges, nonreticulated areas lateral to the ridges and anterior to the dorsal groove and smaller body size. Less obvious differences are larger eyes and air sacs, the subequal paragenital setae and the more or less subequal solenidia ω I to IV on the tarsi.

Collection data : Holotype (adult female) and allotype (adult male) taken from under cover crops in young rubber plantation, Masai, Johore, Malaya, 28.vi.64 (D. H. Murphy). Other collections : Malaya — 1 ♀, wet, low forest behind beach ridge, Mersing, Johore, 19.x.64 (D. H. M.) ; 1 ♀ lnymph, swamp forest litter, Jason's Bay between Sedili and Sedili Kechil, Johore, 4.xii.65 (D. H. M.) ; British Solomon Islands — 3 ♀, forest litter, Vasu river, Choiseul, 16.xi.65 (P. J. M. Greenslade, 19726).

Material : Holotype ♀, allotype ♂ and one paratype ♀ in British Museum (Natural History) ; paratypes also sent to United States National Museum and South Australian Museum.

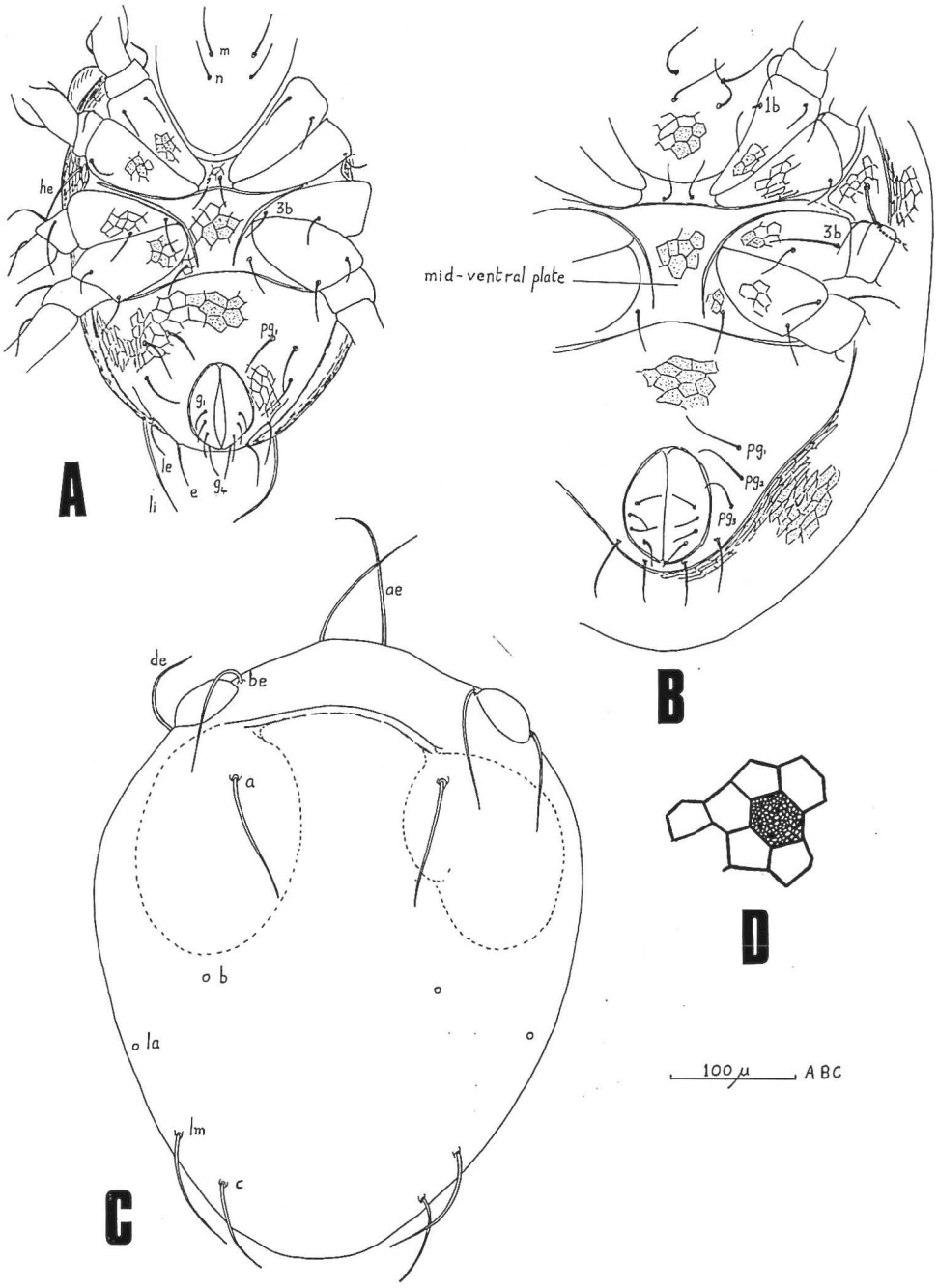

FIG. 3 : *Annerossella pacifica* n. sp., female (holotype).
A. — Ventral. D. — Details of reticulum.
Homocaligus scapularis (Koch), female from Borkum Is. (Oudemans collection) :
B. — Ventral. C. — Dorsal.

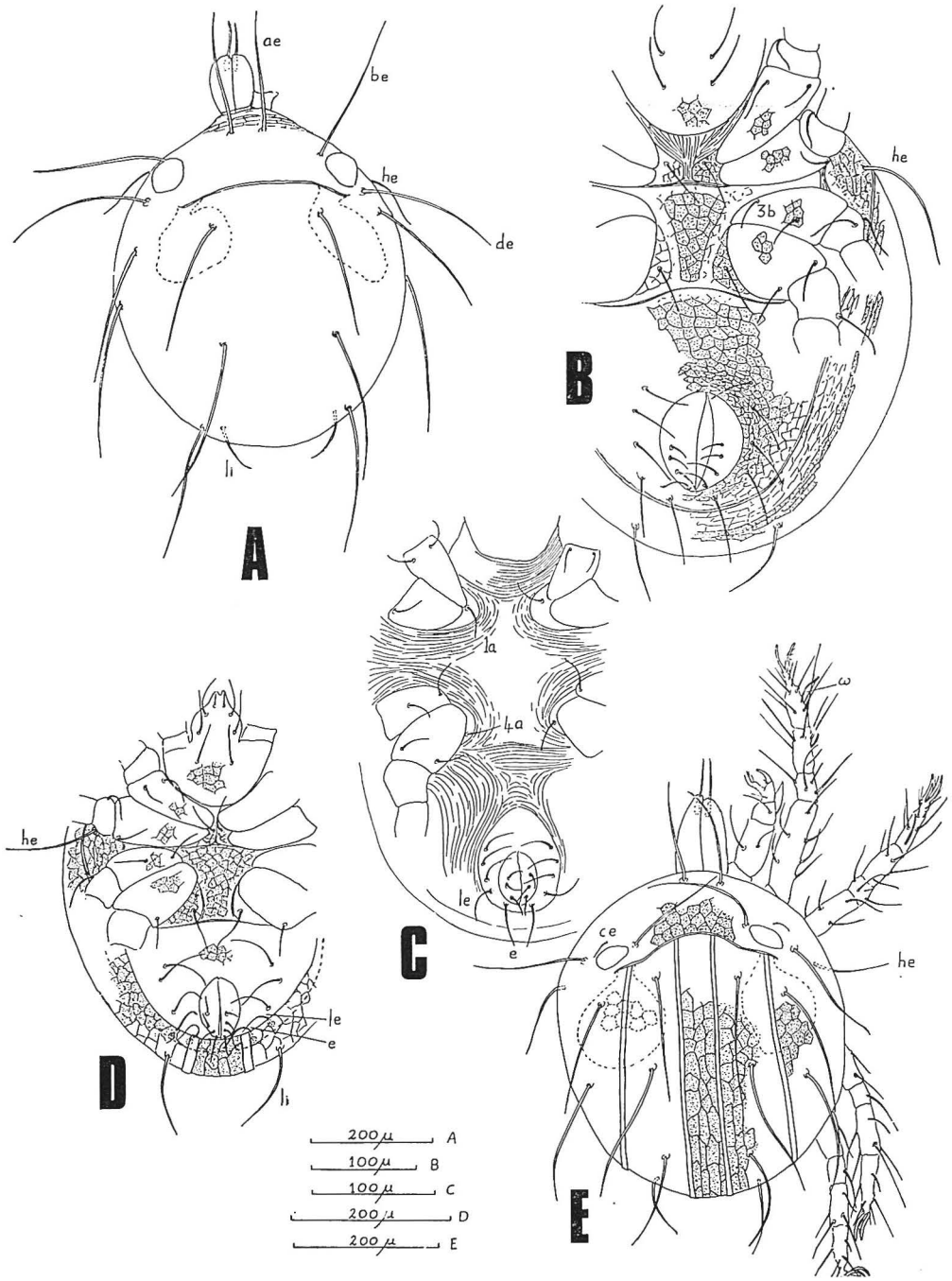

FIG. 4 : *Homocaligus muscorum* Habeeb, from New Brunswick.
A. — Female, dorsal. B. — Female, ventral. C. — Nymph, ventral.
Annerossella lineolata (Meyer and Ryke), female from Duiwelskloof.
D. — Ventral. E. — Dorsal.

Annerossella lineolata (Meyer and Ryke) (Fig. 4 D, E).

Ledermuelleria lineolata Meyer and Ryke, 1959. *Ann. Mag. nat. Hist.* 2 (13) : 217.
Mullederia lineolata : Wood, 1964. *N.Z. J. Sci.* 7 : 583.
Annerossella lineolata : Habeeb, 1966. *Leafl. Acadian Biol.* 42 : 1.

FEMALE (n=1) : Length of idiosoma 450, maximum width and height of dorsal shield unknown.

Dorsum : Whole of dorsal plate reticulated, cuticle within cells of the reticulum finely punctate. Arrangement of setae, eyes, propodosomal-hysterosomal groove and dorsal ridges as in *A. pacifica*, except that the ridges in *A. lineolata* are more flattened and not as elevated as in *A. pacifica* (Fig. 4 E). The posterior reticulum between the median ridges is made up of distinctly elongate cells ; elsewhere the cells are more regular-sided, except perhaps along the ventral margins of the plate bordering the paragenital-suranal and humeral plates although this region is difficult to observe due to extreme dorso-ventral flattening of the specimen. The eyes are not as convex as in *A. pacifica* ; half their surface is minutely punctate. Dorsal plate bears ten pairs of setae ; paired humeral plates bear a single seta each. All setae borne on tubercles, acicular, somewhat flexed and bearing a few minute barbules along their margins. Lengths of setae as follows : *ae, be, de, c* 135-145 ; *a, he, lm* 155-165 ; *b* 175 ; *ce* 25. Setae *a* were lost from the specimen studied ; their length was estimated from Meyer and Ryke's (1959) illustration.

Internal sacs : As in *A. pacifica* and distinctly reticulated ; length about 110 ; and therefore relatively smaller than in *A. pacifica.*

Venter : Maxillicoxae, intercoxal plates, mid-ventral plate and paragenital-suranal plate distinctly reticulated ; cuticle within the reticulum minutely punctate. Setae *n* and *m* subequal (52), *n-n* = *m-m* ; *re* 3 to 4 times longer than *ri.* Due to squashing of the specimen resulting in distortion of the coxal and intercoxal regions the degree of fusion of the various ventral plates is difficult to elucidate. Of the relationships shown in Fig. 4 D the divisions between the anterior intercoxal plates and between the mid-ventral and paragenital-suranal plates could be artefacts. Setae *4a* (52) slightly longer than *1a* (47). Paragenital setae pg_1 and pg_2 (58) longer than pg_3 (48). Suranal setae *e* (56) longer than *le* (48). Anogenital setae g_2 and g_3 (20) shorter than g_4 and g_1 (33). The illustration of the venter (Fig. 4 D) shows the dorsal plate apparantly overlapping onto the venter and partly covering the paragenital-suranal plate but this is due to the specimen having been distorted by squashing.

Appendages : Cheliceral stylets 70, relatively shorter than in *A. pacifica.* Coxae of legs and pedipalps reticulated. Numbers of setae on leg podomeres and pedipalps as in *A. pacifica.* ω I long and slender reaching beyond base of setae *tc* ;

ω III and ω IV about half as long as ω I and ω II. *k* I about half as long as associated dorsal seta *d* I, *k* II about $\frac{1}{5}$ as long as *d* II.

MALE : Not known.

DISTINGUISHING FEATURES : Given under *A. pacifica.*

COLLECTION DATA : Holotype female and one paratype female from an unidentified hydrophyte, Duiwelskloof, South Africa, July 1958, collected by H. SCHOONBEE (MEYER AND RYKE, 1959).

MATERIAL : Dr. MEYER informs me that the holotype was lost at Potchefstroom University. The only known specimen, the one examined by the author, was collected from the same habitat at the same time as the holotype. It is hereby designated as the neotype and has been deposited in the Plant Protection Research Institute, Pretoria, South Africa.

Genus *Homocaligus* Berlese.

Homocaligus Berlese, 1910. *Redia* 6 : 203. Type species : *Stigmaeus scapularis* Koch, 1838 ; monotypic.
Homocaligus : Oudemans, 1923. *Ent. Ber., Amst.* 6 (130) : 146.
Paludocaligus Habeeb, 1966. *Leafl. Acadadian Biol.* 42 : 1 (new combination).

RECOGNITION : The absence of longitudinal cuticular ridges on the dorsum and the punctation of the dorsal plate (except along its ventral margin which is reticulated) and internal sacs are diagnostic.

DISTRIBUTION : Two species are known, one from Europe and one from north America.

Homocaligus scapularis (Koch) (Fig. 3 B, C ; 5 A-G).

Stigmaeus scapularis C. L. Koch, 1838. Deutschlands Crustaceen, Myriapoden und Arachniden, 17, 1.
Raphignathus tumidus Grube, 1859. *Arch. Nat. Liv. Ehst, Kurl.* 2 (1) : 457.
Caligonus scapularis : Berlese, 1886. Ac. Myr. Scorp. Ital. 30 : 5, 6.
Homocaligus scapularis : Berlese, 1910. *Redia* 6 : 203.
Homocaligus scapularis : Oudemans, 1923. *Ent. Ber., Amst.* 6 (130) : 147.

FEMALE (n=7) : Length of idiosoma 500 (480-510) ; maximum width and height of dorsal shield unknown.

Dorsum : Dorsal plate smooth, punctate except along ventral margins where elongate reticulum is evident, with distinct punctation within the reticulum. No cuticular ridges on dorsum (Fig. 3 C). Humeral plates reticulated, intruding between anterior and posterior pair of coxae. Eyes large, convex and with half

of their surface punctate. Setae borne on tubercles, acicular with a few minute barbules along their margin and not particularly long, their lengths as follows (none of the specimens examined possessed setae *b*, *la* or *li* and most specimens had lost other setae) : *ae* 140 ; *ce* 25 ; *be, de, a, lm* 110 ; *c* 80 ; *he* 65 ; *a* shorter than *a-a* or *a-b*.

Internal sacs : The dorsal propodosomal-hysterosomal groove leads at its lateral extremeties into a pair of oval sacs (length 175) which have a minutely punctate surface.

Venter : Maxillicoxae reticulated with distinct punctation within cells of reticulum ; setae *m* 50 possibly slightly longer than *n* ; *n-n* = *m-m* ; external rostral setae longer than internals. Intercoxal, mid-ventral and paragenital-suranal plates reticulated. Setae *1a* (34) situated on single, narrow intercoxal plate fused to coxae I and II. Setae *4a* (34) on intercoxal plates which are fused posteriorly to the mid-ventral plate ; the latter occupies the whole of the area between the posterior pair of coxae and extends between the anterior and posterior pair of coxae and its whole surface is reticulated although the margins are only thinly sclerotised (Fig. 3 B). The paragenital-suranal plate appears to be fused to the mid-ventral plate although there is a faint line of demarcation ; setae pg_1 (50), pg_2 (44), pg_3 (32), *e* (38), *le* (50) and four pairs of subequal (22) anogenital setae are borne on this plate.

Appendages : Coxae of legs and palps faintly reticulated. Numbers of setae on leg podomeres as in *Annerossella pacifica* ; ω I slender reaching just beyond setae *tc* ; *k* I a slender spine $\frac{1}{5}$ to $\frac{1}{6}$ as long as associated dorsal seta, *k* II short about $\frac{1}{12}$ as long as associated dorsal seta. Coxal setae *3b* (56) distinctly longer than *1b* (48) and other coxal setae (34) ; setae *3b* located near distal margin of coxae III. Setae on pedipalps as in *A. pacifica.*

DISTINGUISHING FEATURES : The recognition of *H. scapularis* is difficult. Firstly, recognition of any mites described by KOCH is doubtful unless the original or reliably identified specimens are available. Secondly there is some conflict between KOCH's (1838) description of *Stigmaeus scapularis* and the subsequent descriptions of the species by BERLESE (1886) and OUDEMANS (1923). KOCH's illustration indicated that the cuticle was reticulated ; neither BERLESE nor OUDEMANS mentioned this, although the specimens in OUDEMANS' possession were reticulated laterally and ventrally as described above, and OUDEMANS illustrated this in his own drawings (Fig. 5). KOCH also mentioned, and illustrated, two longitudinal bands on the posterior half of the dorsum connected anteriorly with a transverse band which laterally gave rise to a black spot. Neither BERLESE (1886) nor OUDEMANS (1923) commented on this although OUDEMANS (1937) said that the black spots were internal organs and were not apparent in some specimens. They were not observed in the specimens examined by the author. In addition, BERLESE's

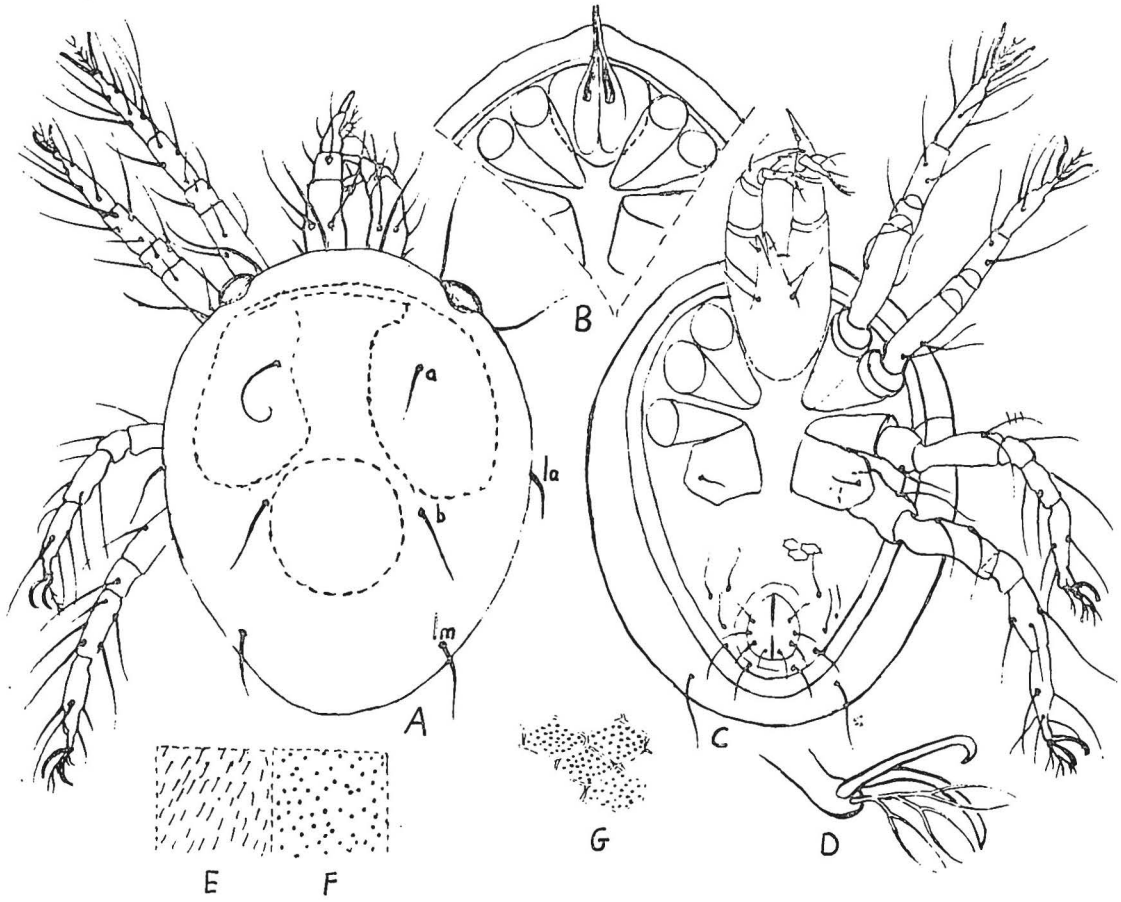

FIG. 5 : Previously unpublished drawings by OUDEMANS of *H. scapularis* (Koch).
A. — Dorsum. B and C. — Venter. D. — Tarsal claws and empodium.
E, F and G. — Ornamentation of cuticle.

(1886) illustrations, for the most part accurate in their detail, show 9 setae on the palp-femur ; the number of setae on the palp-femur of raphignathoid mites is usually 3, and one must conclude that BERLESE's illustration is inaccurate in this respect or that he had an unusual specimen of *Homocaligus*. BERLESE (1886) illustrated a specimen with shorter dorsal setae than the specimens observed by OUDEMANS ; OUDEMANS (1923) attributed these differences in length of dorsal setae to intraspecific variation and on the basis of this synonomised *Raphignathus tumidus* Grube with *Homocaligus scapularis*. Although raphignathoid mites do occasionally exhibit wide variation in lengths of dorsal setae (for example *Mecognatha hirsuta* Wood, 1967), in many species the lengths of these setae are fairly constant, and, in combination with other less obvious features, are often useful for recognising species. In fact, length of dorsal setae is the most useful character for distinguishing the OUDEMANS specimens of *Homocaligus scapularis* from *H. muscorum* ; other distinguishing features, such as the relative lengths of the paragenital setae, genital setae and position and length of setae *3b* on coxae III, are less obvious and were neither illustrated nor described in the days of BERLESE and OUDEMANS. The best that can be done with the available specimens and literature is to assume that OUDEMANS was correct in naming his specimens while bearing in mind that the synonomy indicated above may be incorrect.

COLLECTION DATA : The specimens I examined from the Oudemans collection came from the Isle of Borkum, Germany. OUDEMANS (1923) also mentioned specimens from Bremen, Germany. KOCH's (1838) *Stigmaeus scapularis* came from a pond at Neumarkt, Ober Pfalz, Germany. The habitat of BERLESE's *Caligonus scapularis* was " in agri Tridentini muscis ", Italy.

MATERIAL : Location of types unknown. There are five slides, with several specimens on each slide, in the Oudemans collection in the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

Homocaligus muscorum Habeeb (Fig. 4 A, B, C).

Homocaligus (*Paludocaligus*) *muscorum* Habeeb, 1962. *Leafl. Acadian Biol.* 27 : 1.
Paludocaligus muscorum : Habeeb, 1966. *Leafl. Acadian Biol.* 42 : 1.

FEMALE (n=1) : Length of idiosoma 560, maximum width 460, height of dorsal plate at coxae III 310.

Dorsum : Dorsal plate smooth, punctate except along ventral margins where elongate reticulum is evident with distinct punctation within it. No cuticular ridges on dorsum. Humeral plates reticulated, intruding between anterior and posterior pair of coxae. Eyes large, convex and with half of their surface punctate. In the above features (Fig. 4 A, B) it resembles *H. scapularis*. Setae acicular with a few minute barbules along their margin, fairly long (*a*, *b* and *c* being longer

than *a-a*, *b-b*, *c-c*, *a-b* or *b-c*) and borne on tubercles, their lengths as follows : *ae* 200; *a, la* 210 ; *li* 100 ; *he* 110 ; *be* 25 ; others 240-250.

Internal sacs : The dorsal propodosomal-hysterosomal groove leads at its lateral extremeties into a pair of sacs (length 175) which have a minutely punctate surface.

Venter : Maxillicoxae reticulated with distinct punctation within cells of reticulum ; setae *n* and *m* subequal (42), *n-n* = *m-m* ; external rostral setae longer than internals. Intercoxal, mid-ventral and paragenital-suranal plates reticulated (Fig. 4 B). Setae *1a* (42) borne on paired intercoxal plates ; setae *4a* (42) borne on intercoxal plates which are almost entirely fused to the midventral plate and narrowly separated from the paragenital-suranal plate ; midventral plate narrowly separated from anterior intercoxal plates, intruding between anterior and posterior pair of coxae and partly fused to the paragenital-suranal plate. Superficially the mid-ventral, posterior intercoxal and paragenital-suranal plates appear to be distinctly separated, as the main body of these plates is well-sclerotised and distinctly reticulated whereas their areas of fusion along the margins are poorly selerotised and only faintly reticulated. Three pairs of subequal (46) paragenital setae ; four pairs of genital setae, g_2 and g_3 (22) shorter than g_4 and g_1 (30). Suranal setae *e* (65) longer than *le* (58).

Appendages : Coxae of legs and palps reticulated. Numbers of setae on leg podomeres as in *Annerossella pacifica* ; ω I slender reaching just beyond setae *tc*, ω III and IV about half the length of ω I and II ; *k* I slender $\frac{1}{4}$ to $\frac{1}{5}$ as long as associated dorsal seta *d* I, *k* II short about $\frac{1}{12}$ as long as *d* II. Coxal setae *1b* (44) longer than other coxal setae (36-40) ; setae *3b* located proximally in apex of coxae III. Setae on pedipalps as in *A. pacifica.*

NYMPH : Stage unknown (n=1) : Length of idiosoma 390, maximum width 270.

Dorsum : As in the nymph of *Annerossella pacifica* the cuticle is slightly sclerotized and the dorsal plate is smooth without reticulation and does not cover the sides of the body. The eyes are small and there is no propodosomal-hysterosomal groove. The humeral plates are small, smooth, borne on the sides of the body and separated from the dorsal plate and coxae by a considerable area of striated cuticle. The arrangement of setae on the dorsal plate is similar to that in the adult, and their relative lengths are similar with the exception of setae *he* which are long (200) ; *he/li* = 1.1 in the adult and 2.0 in the nymph, *he/ae* = 0.6 in the adult and 1.4 in the nymph.

Venter : The maxillicoxae are smooth and bear setae *n* and *m*. Setae *1a* and *4a* borne on small, paired, smooth intercoxal plates. No mid-ventral plate, this region being occupied by striated cuticle. Paragenital-suranal plate small (Fig. 4 C), surrounded by striated cuticle, bearing three pairs of subequal paragenital setae and two pairs of suranal setae. Ano-genital plate bears three pairs of subequal setae.

Appendages : Numbers of setae on leg podomeres differs from adult as follows : genu II 3 (k), genua III and IV with no setae ; femur I 5, femur II 4. Coxae I and II not particularly elongate, unlike these coxae in the adult. Tarsal empodia with only two Y-shaped raylets.

DISTINGUISHING FEATURES : *H. muscorum* can be readily distinguished from *H. scapularis* by the much longer dorsal setae, subequal paragenital setae, g_3 and g_1 being longer than g_4 and g_2, *e* being longer than *le* and the length and position of setae *3b*.

COLLECTION DATA : The specimens described above were collected from a pasture swamp, Blue Bell Station, Victoria Co., New Brunswick, U.S.A., 3.vi.58 (H. HABEEB). Other collections (all U.S.A., HABEEB, 1962) : on sphagnum in bog water, near Caribou, Aroostook Co., Maine, 5.vi.53 (H. H.) ; pools in sphagnum bog at shore of a small lake, Gillespie, Victoria Co., New Brunswick, 27.v.58 (H. H.) ; from New York state, 1961 and 1962 (H. H.).

MATERIAL : Type material in collections of Dr. H. HABEEB, 2 Boyle Avenue, Auburn, New York, 13021, U.S.A.

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SUMMARY.

A new family of mites, the Homocaligidae, is erected to include the hitherto obscure genera *Homocaligus* Berlese and *Annerossella* Habeeb. New descriptions of *H. scapularis* (Koch), *H. muscorum* Habeeb, *A. lineolata* (MEYER and RYKE) and *A. pacifica* n. sp. enable these genera to be redefined and their relationships to other raphignathoid families to be assessed. The outstanding feature of the Homocaligidae is the presence of a pair of internal sacs (females) or two pairs of internal tubes (males) opening to the exterior at the lateral extremities of a dorsal propodosomal-hysterosomal groove ; they may have a respiratory function. The fusion of paragenital and suranal plates and arrangement of the ventral plates is unique among the known families of Raphignathoidea. Homocaligidae are known only from aquatic and wet habitats.

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