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FIXATION OF THE CONCEPT OF *PARONELLA* SCHÖTT, 1893 [COLLEMBOLA : ENTOMOBRYIDAE]

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The genus *Paronella* was established by SCHÖTT in 1893 from Cameroons, Africa. *P. fusca* became the type-species of the genus by monotypy [again fixed by Börner, 1903]. The genus was placed on the Official List of Generic Names by the International Commission of Zoology in 1958.

The genus at the present moment is the most heterogeneous one and its condition is like the contents of a trash-can. Various species belonging to the widely different genera like *Callyntrura* (Börner, 1906, 1913 ; Imms, 1912 ; Carpenter, 1917, 1924 ; Kinoshita, 1917 ; Folsom, 1924 ; Handschin, 1929 ; Womersley, 1934a ; Uchida, 1938, 1944, 1958 ; Absolon and Kseneman, 1942 ; Denis, 1948 ; Roonwal *et. al*, 1951 ; Baijal, 1955 ; Fernando, 1957 ; Salmon, 1964) ; *Microparonella* (Salmon, 1964) ; *Dicranocentruga* (Börner, 1903 ; Schött, 1903, 1927 ; Wahlgren, 1908 ; Philiptschenko, 1926 ; Handschin, 1924, 1929 ; Denis, 1925, 1931, 1933 ; Womersley, 1934b ; Marlier, 1945 ; Delamare Deboutteville, 1947, 1950a, b, 1951a, b, 1952 ; Paclt, 1959 ; Salmon, 1956, 1964) ; *Pseudoparonella* (Schäffer, 1898, Schött, 1901, 1903, 1917 ; Handschin, 1925 ; Denis, 1933, 1948 ; Womersley, 1937 ; Yosii, 1960) ; *Paronana* (Carpenter, 1924) ; *Trichorypha* (Schött, 1903, 1927 ; Denis, 1933 ; Womersley, 1934a, 1939 ; *Lepidonella* (Schäffer, 1898 ; Schött, 1903 ; Handschin, 1925, 1926, 1928 ; Denis, 1933, 1948) and *Bromacanthus* (Börner, 1903) were either described or transferred to the genus *Paronella* by the workers as mentioned within parentheses against each genus, SALMON (1964) listed 58 species and sub-species belonging to the above-mentioned genera under the genus *Paronella*.

SCHÖTT'S (1893) diagnosis of the genus *Paronella* and the description of *Paronella fusca* were extremely vague and insufficient. He diagnosed the genus on the basis of certain secondary characters and overlooked many important characters of generic importance. Thus diagnostic characters, available from SCHÖTT'S (1893) diagnosis are as follows : (a) antennal length and its colour pattern, (b) nature of body facies, (c) nature of scales clothing body. Such inadequate diagnosis led the latter workers to place the species of widely different genera, as mentioned above, in the genus *Paronella*. Such additions of heterogeneous species belonging to widely different genera by the subsequent workers from almost all the zoogeographical regions let SCHÖTT (1903, 1927) to widen the concept of the genus *Paronella* and thus the placed the species

of *Lepidonella* (*annulicornis*), *Dicranocentruga* (*nigromaculata, penicillata*), *Trichorypha* (*atrofasciata*), *Callyntrura* (*lineata, feae, sumatrana, longicornis, florensis*) and *Dicranocentroides* (*plumicornis*) in his genus *Paronella*. It is to be noted that most of the earlier workers including SCHÖTT relied primarily on the characters like the stout dentes and plump mucrones while placing such heterogeneous species-groups in the genus *Paronella*. SALMON (1964), relying on such poor diagnosis of *Paronella*, synonymised widely different genera like *Microparonella* Carpenter, 1916 and *Callyntrura* Börner, 1906 with *Paronella*. SCHÖTT'S synonmisation of *Trichorypha with Paronella* was also accepted by the subsequent workers, as mentioned above. Present study reveals that these genera have more differences than resemblances to *Paronella*. DENIS (1925) remarked *Paronella* Schött as a heterogeneous one involving species of the most diverse countries like Africa, India, Malayasia, and Australia. BÖRNER (1906), however, understood the difference existing between *Paronella* and species having six teethed mucrones and dentes not heavily clothed dorsally with scales and devoid of spines. He (Börner, 1906), therefore, erected a sub-genus of *Paronella viz.*, *Callyntrura* with the type-species *anopla* from Java possessing such characters. However, the same author (BÖRNER, 1906, 1913) described two new species from Java having the same characters as that of *Callyntrura* under *Paronella*. HANDSCHIN (1925) splitted such heterogeneous species of *Paronella* into four genera mainly on the basis of number of mucronal teeth and presence or absence of dental scale appendage. SCHÖTT (1925) accepted HANDSCHIN'S proposition and remarked that "the difference between *Paronella* s.str. and *Aphysa*, however, appear a bit too vague to adhere to strictly in future if decided only by the number of mucronal teeth". HANDSCHIN'S (1925) splitting of *Paronella* primarily on the basis of the number of mucronal teeth brought many widely different species belonging to widely different genera together. Thus we note in the literature HANDSCHIN'S hesitation with the species like *Paronella dahli* Schäffer [*Pseudoparonella* (*Lawrenceana*) *dahli* n.comb.] and *Paronella picta* Schäffer (=*Lepidonella picta* n.comb.) with longer antennae in placing them in the genus *Paronella* on the basis of number of mucronal teeth. HANDSCHIN (*loc. cit.*), therefore, putforward a queer hypothesis for justifying his action of splitting the genus *Paronella* on the basis of number of mucronal teeth. He conceived that with the complexities of mucronal structure, lengthening of antennae as well as obliteration of dental spines occur and opined that his hypothesis needs verification by examination of concerned forms i.e. *Paronella picta* and *Paronella dahli*. The present investigation proved, as mentioned above, that the former belongs to *Lepidonella* Yossi and the latter to *Pseudoparonella* (*Lawrenceana*) and the hypothesis of HANDSCHIN (1925) is not tenable. DENIS (1933) accepted and followed HANDSCHIN'S (1925) splitting of the genus *Paronella*, but he doubted whether such separation actually would indicate the natural affinities of diverse species. In a key to the species of *Paronella*, Denis (1933), however, included species of distantly related genera like *Pesudoparonella* (*Lawrenceana*) *dahli* (Schäffer), *Lepidonella picta* (Schäffer), *Pseudoparonella* (*Lawrenceana*) *dahli tamarensis*

(Schött) n.comb., *Trichorypha atrofasciata* Schött and the other species to be placed under *Diranocentruga*. Nevertheless, DENIS (1933) could realise the difference between *Paronella* Schött, 1893 and *Aphysa* Handschin, 1925, although not fully, which is indicated by the fact that he felt that *Paronella flava* Carpenter, 1928 [=*Callyntrura* (*Callyntrura*) *flava* n.comb.] better resembles to *Aphysa*. He also sensed the difference between the species of *Paronella* and *Paronella picta* Schäffer, 1898 (=*Lepidonella picta*) which has 3 mucronal teeth. He, therefore, commented that the latter species needs further investigations as regards the number of its mucronal teeth.

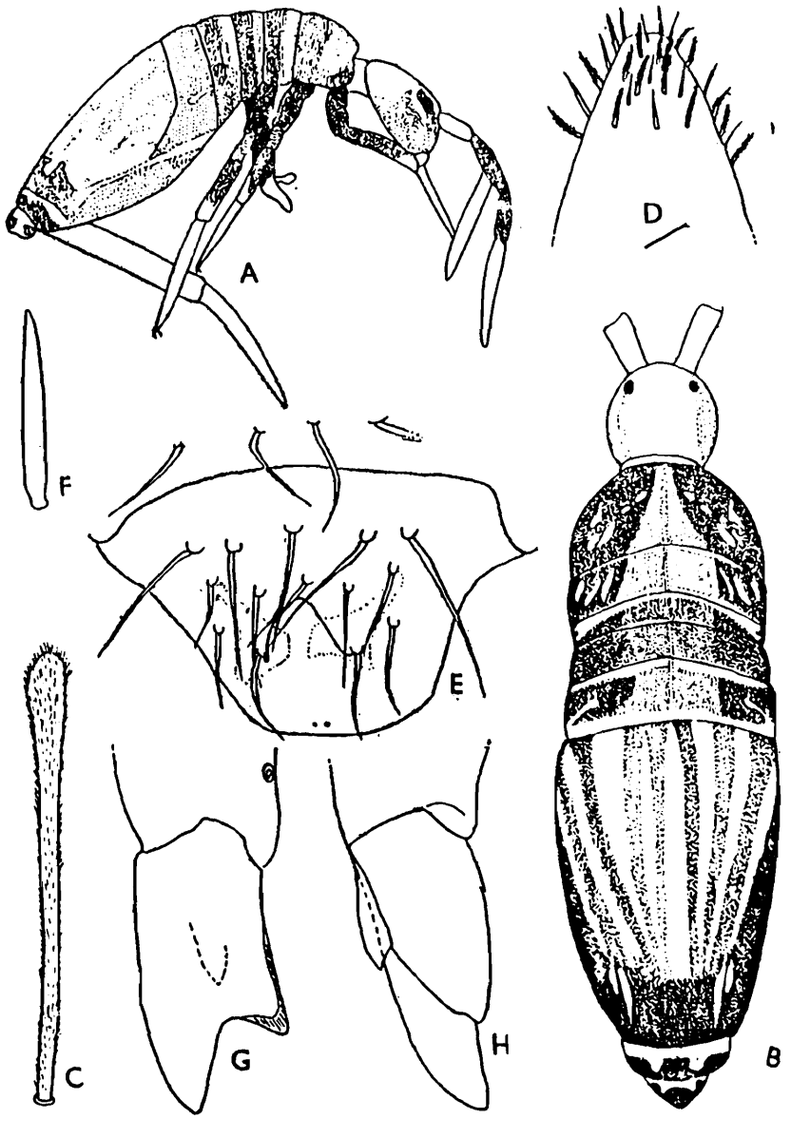


Fig. 1. A, Proffle (lateral), B, Profile (dorsal) showing pigmentation ; C, spathulate seta from the end of Abd. IV ; D, apex of Ant. IV ; E, labral chaetotaxy ; F, a tibiotarsal spine ; G, H, mucrones.

The above review of the genus *Paronella* is given from the existing literature as well as thorough investigations of the type-specimens and other collections of various species to point out its ubiquitous and heterogeneous nature involving several composite

generic groups. In view of such generic confusion in relation to *Paronella*, the investigator felt pertinent to consolidate the actual concept of the genus *Paronella*. The author had an access to the original slide preparations of SCHÖTT (1893) and 3 syntypes of *Paronella fusca* preserved in spirit, in superb condition. The present investigation proves that *paronella fusca* SCHÖTT (1893) is the unique species to be

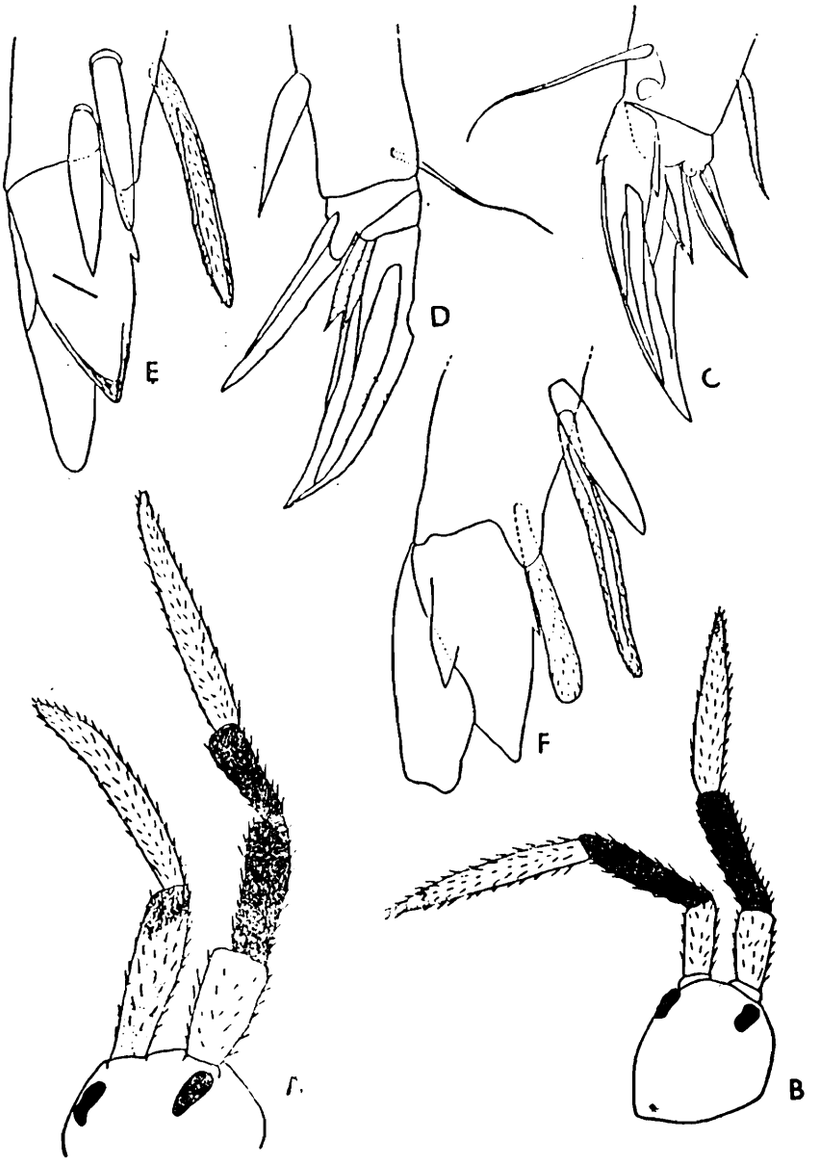


Fig. 2. A, B, anomaly in the segmentation of antennae ; C, footcomplex of leg I ; D, footcomplex of leg II ; E, F, mucrodens.

included in the genus *Paronella* as it does not share any of its principal character with any species, now known under the genus *Paronella*. The principal characters of *Paronella fusca* are given in the diagnosis of the genus. However, a few of such characters, possessed by the type-species *Paronella fusca*, are as follows—body like *Entomobrya* (Fig. 1, A ; PL. I, A) ; presence and nature of extra ocular structure (E. O. S) (MITRA, 1972) ; both manubrium and dentes are armed with two strong rows of nontransiting spines (Fig. 3, D, E, F ; PL. I, C, D) ; body devoid of flexed macrochaetae

(achaetoic body) ; anterior face of ventral tube anteriorly with 7+7 macrochaetae (Fig. 3, C) ; long, setaceous tenent hair ; ungues large with paired inner basal teeth enlarged, distal unpaired tooth reduced, vestigial or absent (Fig. 2, C, D) ; body clothed with round and oval scales (typical scales), no scales with acuminate apices occur (Fig. 4 ; PL. I, B). Such unique combination of characters is possessed only by the type-species *Paronella fusca*. Thus the *Paronella*, the long heterogeneous genus, is represented by its type-species only.

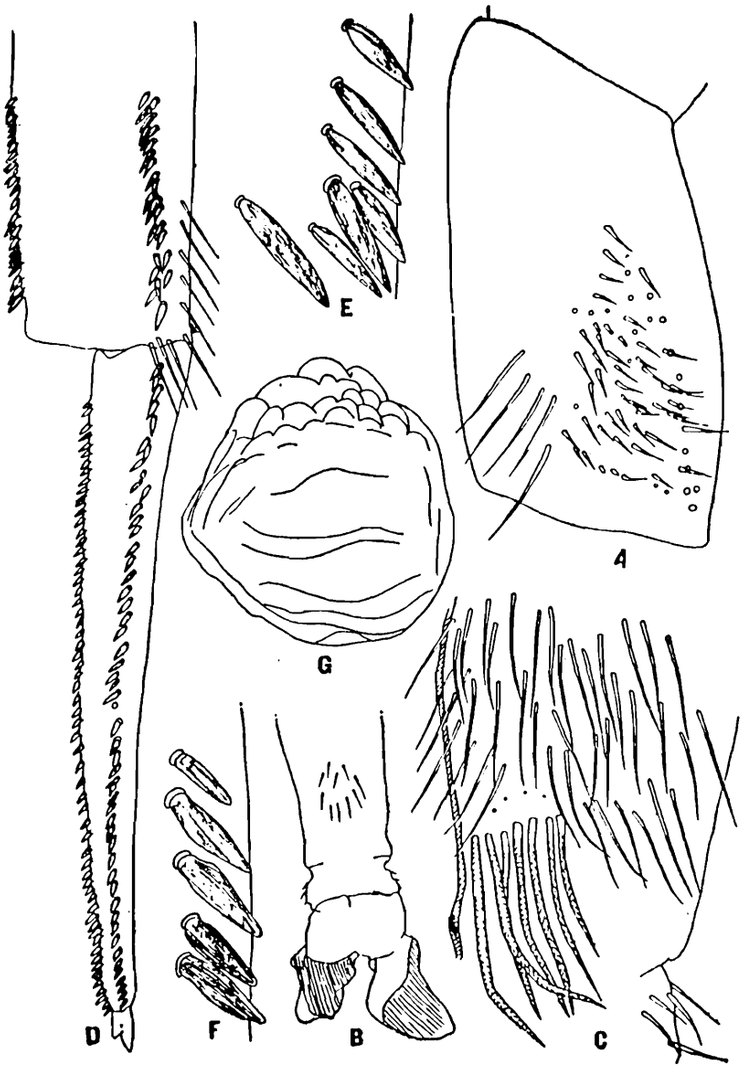
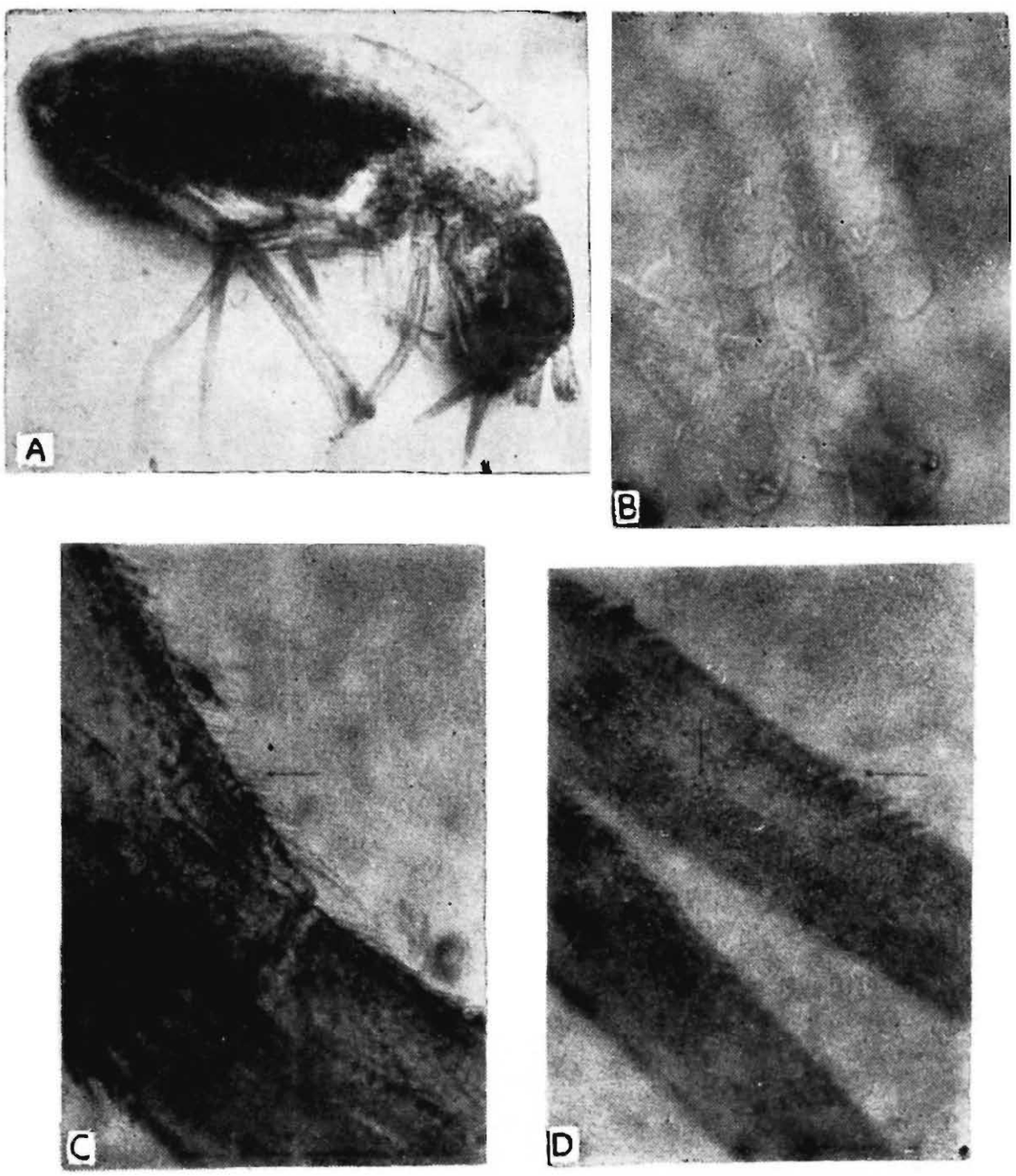


Fig. 3. A, trochanteral organ ; B, ventral tube ; C, chaetotaxy of the anterior face of ventral tube ; D, distal portion of manubrium with dentes (left) showing nontransitional spines ; E, manubrial spines ; F. dental spines ; G, male genital field.

Redifinition : Body facies like *Entomobrya* ; antennae shorter than half the length of body ; frontal spines absent, apex of Ant. IV wiihout a distinct sense-knob ; prelabral setae 4, long, slender, smooth, labral setae, 5, 5, 4, smooth, long and slender ; labral margin without distinct ledges or tubercles, sometime 2 minute tubercles visible ;



Paronella fusca Schött : A, lactotype, selected (in Swedish Museum National History, Stockholm) ; B, typical scales from body (from a paralectotype) ; C, distal portion of manubrium showing presence of distinct spines ; D, distal portion of dentes showing to rows of nontransitional spines.

ocelli 8+8, G and H vestigial and appear nonfunctional, extra ocular structure well developed, 4 lobed, outer lobe is drawn into a slender process (MITRA, 1972) ; ungues and unguiculi large ; lanceolate, nondentate, fore unguiculi shorter than the mid and hind ones ; unguis with inner paired basal teeth considerably enlarged, distal unpaired tooth vestigially developed or totally absent, external basolateral teeth well developed ;

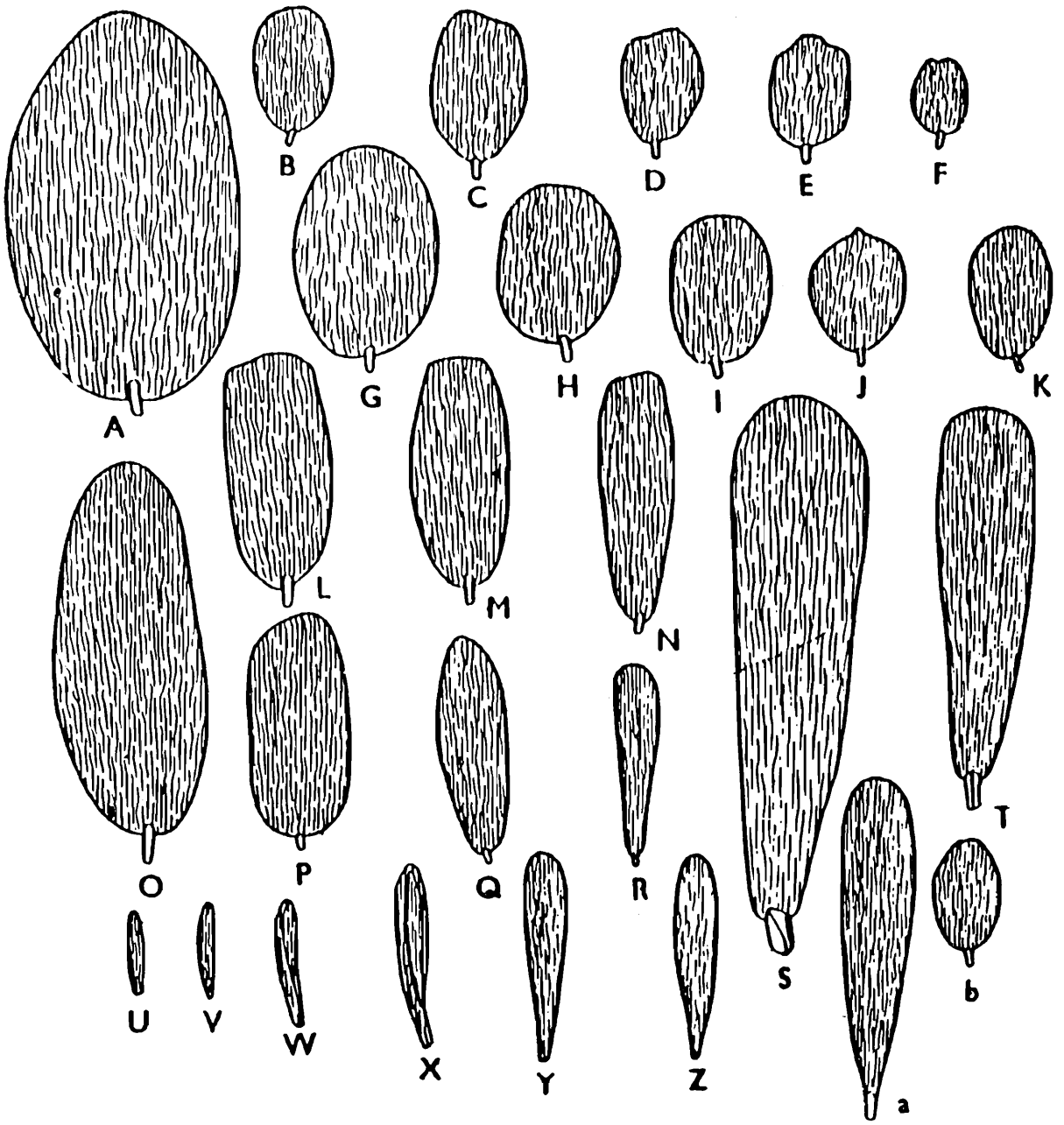


Fig. 4. Typical scales in Paronellini. A-Q, scales from body ; R-Z, scales from dentes ; a, b, scales from dorsal region of manubrium.

tenent hair setaceous ; trochanteral organ well developed ; tibiotarsi with strong spiniform setae ; ventral tube well developed, with protrusible vesicles everted, anterior face anteriorly with 7+7 macrochaetae, coarsely ciliated, general surface of anterior and posterior faces with long, slender setae (Fig. 3) ; manubrium upto three-fourth of its length distally and dentes all along its length with two rows of nontransiting, nonciliated

and highly developed dark apines ; mucro large, plump with 3-4 teeth ; apical tooth round or truncated ; dental scale appendage and dental spiny appendage absent ; body clothed with large round, oval and elongate typical scales, scales mostly hyaline, distinctly pedicellate ; body devoid of any flexed macrochaetae (achaetoic body).

Type-species : *Paronella fusca* Schött, 1893, by monotypy [Also fixed by Börner (1903)].

DESCRIPTION OF THE TYPE-SPECIES

Paronella fusca Schött, 1893

1893. *Paronella fusca* Schött, *Bih. Tillk. Svenska. Akad. Handl.*, **19** (2) : 1-23 ; Schött, 1903, *Redögorelse für Allmänna Läroverken I Linköping. Eksö och Vadstena, Underläsaret* 1902-1903, pp. III-IV ; Schött, 1927, *Medd. Linköpings högre allm. läroverks redögorelse*, pp. 1-39 ; Denis, 1933, *Boll. Lab. Zool. Portici*, **27** : 222-322.

Material : On slides (original preparations of Schött)—Slide No. 1248, labelled as "*Paronella fusca* H. S. Kamerun. Furca". Slide No. 1249, labelled as "*Paronella fusca* Schött Tjall". Slide No. 1250, labelled as "*Paronella fusca* Schött. Ogen-Tjall". Slide No. 1251, labelled as "*Paronella fusca* H. S. Kamerun. Furcula Tydl. tagg-ruder". Slide No. 1252, labelled as *Paronella fusca* H. S. Kamerun. Extromiteter o furka". Slide No. 1253, labelled as "*Paronella fusca* H. S. Kamerun. Tajall und.....". Slide No. 1254, labelled as "*Paronella fusca* H. S. Kmerun. Furca. Tydl. mucro nos o manubrialtaggar".

In alcohol—1 vial containing 3 syntypes, labelled as "*Paronella fusca*. Schött. Kamerun, Bonge. Colleg. Y. Sjöstedt, Determ. H. Schött".

Above materials were studied from the Swedish Museum Natural History, Stockholm, Sweden.

Colouration (Fig. I, A, B ; PL. 1, A) : Males distinct from females in darker colour pattern and larger, bulky body facies ; ground colour of body and appendages pale yellow to brown ; Ths. II, III, Abds. I, II, III with darker blue pigment laterally and paler medially, Abd. IV laterally and posteriorly with intense dark blue-black pigment, faint brown to violet strands descend from the anterior margin of Abd. IV and unite with the patches posteriorly, such strands very faint and not visible in 1 syntype ; Abd. V with a characteristic patch with two symmetrical notches, one one either side, Abd. VI with characteristic dark blue-black pigment dorsally and laterally ; females always lightly pigmented in contrast to males, coxae and trochanter well pigmented in males, femora pigmented proximally upto half of its length, tibiotarsi nonpigmented ; ventral tube with dark blue-black pigment ; Ants. II, III with dark violet pigment, Ants. I and IV nonpigmented in individuals with 4-segmented antennae, in others with 3-segmented antennae, Ant. II. with very deep violet pigment, in individuals with 2-segmented antennae first segment violet distally (Fig. 2, A, B) ; head with dirty brown pigment on genae and anteriorly to each ocellar field.

Clothing : Clothed mainly with typical scales (Fig. 4 ; PL. 1, B) and some stiff, dark, nonflexed setae ; flexed macrochaetae totally absent, frontal spines absent ; a few short, dark brown setae present at antennal bases and anteriorly on frons ; antennae clothed with ciliated microchaetae, interspersed occasionally with certain outstanding feeble acuminate setae on Ants. I, II ; Ant. IV in addition to ciliated microchaetae, with apparently smooth erect microchaetae ; lasiotrichia present as 2, 3, 2 on Abds. II,

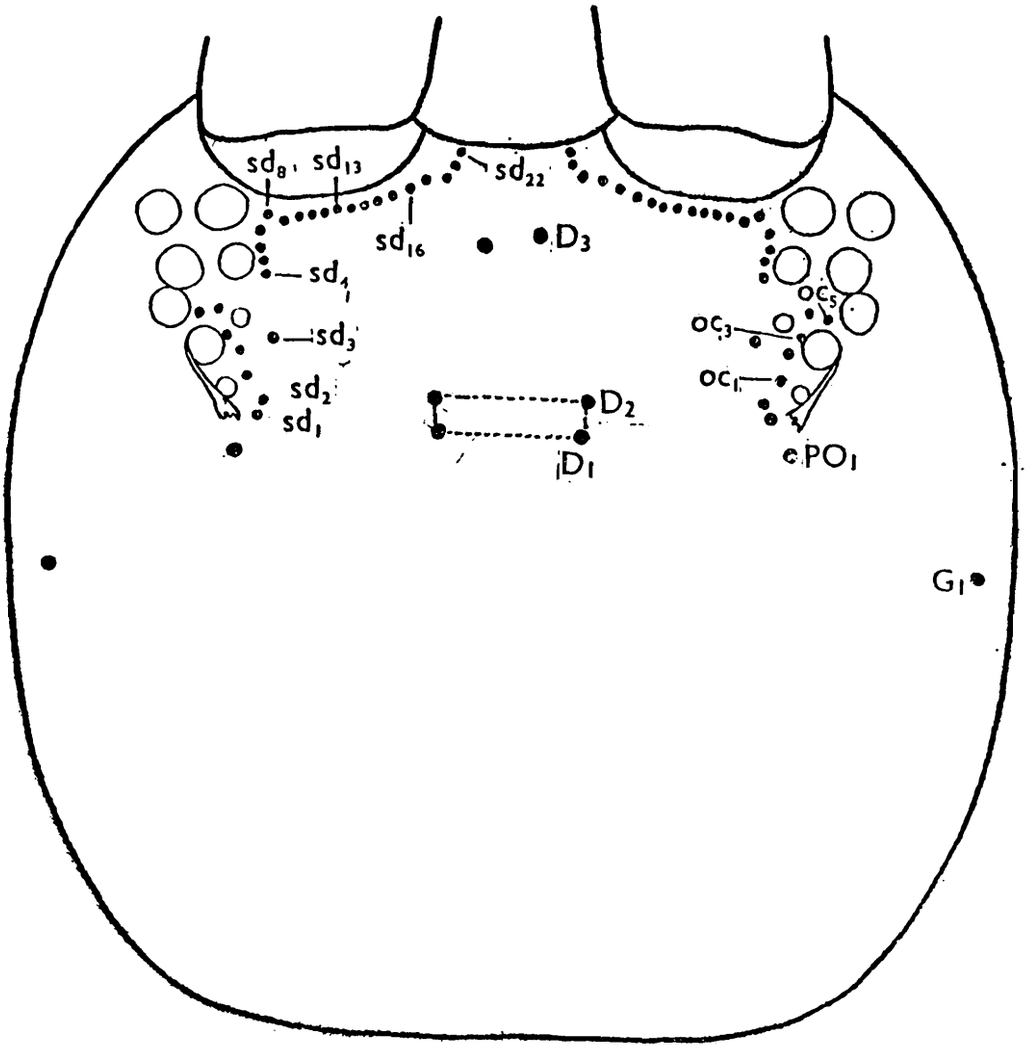


Fig. 5. Cephalic chaetotaxy.

III and IV, respectively ; Abds. V, VI with acuminate microchaetae ; Abd. VI ventrally on each side with a cluster of long, ciliated, spathulate setae (Fig. I, C) ; tibiotarsi in addition to usual acuminate ciliated setae, with 8-10 strong spiniform setae on inner margin and 3 distally on the antero-medial region of tibiotarsi (Fig. 1, F) ; furcula densely clothed dorsally with longer claviform scales, setae scarce ; manubrium dorsally with scales, scales on its lateral margin calviform, laterally and distally certain long acuminate setae occur ; dentes dorsally with very long calviform scales, setae almost lacking on dentes.

Chaetotaxy : Chaetotaxically, the genus is interesting in the absence of flexed macrochaetae on body.

Head : Vertex devoid of any setae and scales ; dorsal region represented by D_{1-3}, distance between D_1 and D_2 on each side closely approximated and their joining forms a narrow rectangle, right D_5 located slightly above the left ; subdorsal satae *c.* 22, extremely variable in number and nature ; ocular region with 5 microchaetae (oc_{1-5})

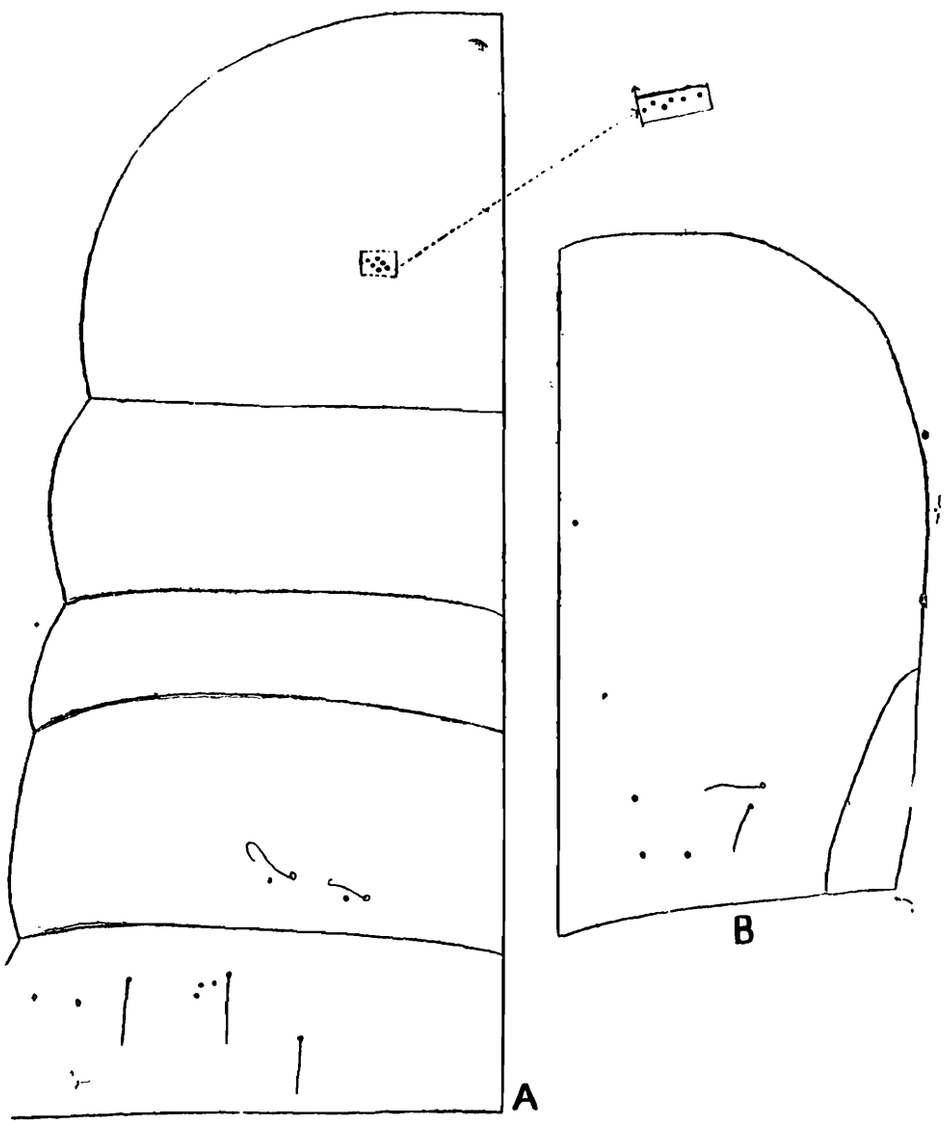


Fig. 6. Chaetotaxy of body ; A, Ths. II, III and abds. I-III ; B, Abd, IV.

on each side ; parietal region without setae ; postocular region with a single macrochaeta (PO_1) on each side ; occipital and cervical regions without macrochaetae ; area genalis represented by a single macrochaeta (G_1) on each side, a characteristic feature of *Paronella* (Fig. 5).

Body : Th. II medially with 6 short, stiff and localised setae, arrangement asymmetrical ; Th. III and Abd. I without any setae ; Abd. II with 2 setae on each side in

close proximity of lasiotrichia Abd. III with 8 setae on either side ; no distinct transverse row of setae occurs in the anteromedial region of Abd. IV, general surface of the segment with 6 setae on either side (Fig. 6).

Head: 2 dark pigmented ocellar patches, one on each side of the headcapsule, each containing 3 ocelli, G and H reduced and appear nonfunctional : frontal spines absent ; much anomaly and asymmetry observed in the number of annennal segments, e. g. 1 syntype with right antenna four segmented (9 : 16 : 11 : 24) and left two segmented (17 : 28.5) (Fig. 2, A) ; in other both right and left antennae 3 segmented (8 : 6 : 21) (Fig. 2, B) ; the relative length index of segments of the third syntype with both 3 segmented antennae, right, 14 : 25 : 38 and left, 14 : 23.5 : 36 ; antennae characteristically shorter in length and can be compared with the antennae of *Entomobrya* (Fig. 1, A) ; ratio of head diagonal/Ant. I varies from 8-17/22-26 ; Ant. IV apically without distinct sense-knob, 4 smooth setae present ; prelabral setae 4, apparently smooth, labral setae 5, 5, 4, smooth ; anterior margin of labrum with two small tubercles which may be absent, median intrusion of labrum in the form of an inverted "U" ; mandible with 4 apical teeth and a well developed molar plate, maxillae with semicircular fringed lamellae.

Thorax : Relative length index of Ths. II ; III=16 : 9 ; legs all similar, each with 10 stout strong spiny setae on inner lateral margin, and 3 anteromedially ; tenent hair long, setaceous, present on all legs ; tibiotarsal lobes not distinct ; unguis large, slightly curved, inner margin with enlarged paired basal teeth ganulate, medial and distal teeth absent, seldom a vestige of medial tooth observed at two-thirds of the inner margin, external basolateral teeth well developed ; unguiculus large, lanceolate, nondentate, inner margin, sometime with irregular deepenings (Fig. 2, C, D) ; trochanteral organ well developed with *c.* 71 short spines arranged Abds. I : II : III : IV : V : VI=6 : 8 : 9 : 45 : 5 : 3 ; manubrium : dens=40 : 41 ; lightly pigmented. Length : 3 mm. Lectotype is mounted on a slide (Pl. I, A) and paralecthtypes in spirit and on slides, reposited in the Swedish Museum Natural History, Stockholm, Sweden.

Type-locality : Bonge, Cameroons ('Kamerun' of Schött), Africa.

Comparisions : The genus is represented by the type-species only. Variations in the number of antennal segments do not cause any change in other morphological features and such variations are infra-specific ones.

Interlationships : The genus *Paronella* phylogenetically is closest to *Dicranocentruga* and *Campylothorax* in the possession of extra ocular structure. Absence of any prominent hump on metathorax and multilobular extra ocular structure in *Paronella* and *Dicranocentruga* indicate their closest relationship. The genus exhibts characteristics of cave dwelling forms in the presence of reasonably enlarged paired inner ungual teeth, setaceous tenent hairs and absence of unpaired distal tooth in most examples. It appears from the structure of foot complex of *P. fusca* that it is adapted to live on wet clay.

Christiansen (1965) indicated such foot complex to be a characteristic feature of the forms living on wet clay in cave. However, the presence of pigmentation on body, well developed ocelli together with the complex extra ocular structure do not indicate it to be a full-fledged troglobiont. Characteristics of stage 2 in cave adaptation as indicated by Christiansen (1961) quite agree with the foot complex of *Paronella fusca* and at any rate it possesses at least some of those troglophilic adaptative characters. In the species of *Dicranocentruga*, however, the unpaired inner distal ungual tooth and tenent hair are normal like that of non-cavernicolous forms. Such differences in foot complex indicate the distinct differences in behavioural and ecological adaptations existing between *Paronella fusca* and the species of its related genus *Dicranocentruga*.

Distribution : The genus is known so far from the Cameroons, West Africa,. Uptil now the type-species is known from its type-locality only. BARRA (1969) described a new species, *viz.*, *Paronella* (*Paronella*) *purpurea* from Gabon which as some of its features suggest, may be a member of *Paronella* s. str. Further investigation on the type material of this species, not presently available for examination, is required to ascertain its actual identity.

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SUMMARY

In this study, the concept of *Paronella* Schött, 1893 is fixed and precised on the basis of the examination of the syntypes of the type-species, *Paronella fusca* Schött and other species known under *Paronella* so far. Lectotype of *P. fusca* is selcted from the syntypes examined. It is noted that *Paronella*, a long heterogeneous genus, is represented by the type-species only.

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