Rec. zool. Surv. India : **101** (Part 1–2) : 67-86, 2003

ON *LEPIDONELLA* YOSII, 1960 AND *BROMACANTHUS* SCHÖTT, 1925 COMPLEX (COLLEMBOLA : ENTOMOBRYIDAE : PARONELLINAE)

S. K. MITRA

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

The species belonging to the genus *Bromacanthus* long ago were confused with the species of the genus *Paronella* (Schäffer, 1898; Börner, 1906). Handschin (1925), however, splitted the complex *Paronella* Schött, 1893 into two broad groups : (a) species having 2 mucronal teeth and (b) more than 2 mucronal teeth and established the genus *Pseudoparonella* for the species having 2 mucronal teeth and transferred the species *Paronella setigera* Börner, 1906 with 2 mucronal teeth to his new genus. He (Handschin, 1925) also fixed an aberrant and widely different species, viz., *Paronella appendiculata* Schött, 1917 as the type-species of *Pseudoparonella* as it possesses 2 mucronal teeth. The same paper (Handschin, 1925) contains description of a new species viz., *Pseudoparonella incerta,* which possesses 4 mucronal teeth.

Although, Handschin (1925) fixed *Paronella appendiculata* as the type-species of his genus, it seems that Handschin (1925) did not examine the type material or representative material of *P. appendiculata* Schött and the concept of his new genus was based on composite generic groups. Thus Handschin's diagnosis of *Pseudoparonella* actually reveals the characters of the species having distinctly round scales on body, dental spines and achaetoic body. Such characters, though common for *Pseudoparonella setigera* (Börner, 1906) *sensu* Handschin and *Pseudoparonella incerta* Handschin, 1925, do not conform to the characters actually present in *Paronella appendiculata* Schött, 1917.

Thus, it appears that the diagnosis of the genus *Pseudoparonella* given by Handschin (1925) was derived from *P. setigera* and *P. incerta* and such diagnosis is not tenable at all for the *appendiculata*-like species-group.

This study on the basis of type material as well as representative material of other species proves that *P. appendiculata* Schött is a good number of the tribe Callyntrurini and phylogenetically widely different from the species like *setigera* and *incerta* which are members of tribe Bromacanthini. It is unfortunate that presently we had to accept the name *Pseudoparonella* for a different group of species (*i.e.*, for *appendiculata* and *appendiculata*-like species and also for *queenstandica* and *queenstandica*-like species) having few *Paronella* like characters, although Handschin (1925) most appropriately proposed the name *Pseudoparonella* for the species (*incerta* and *setigera*) having some *Paronella*-like characters. It is, however, due to Handschin's (1925)

misconception of the species *Paronella appendiculata* Schött, 1917 and fixing the same as the type-species of the genus *Pseudoparonella.*

Subsequently, many species related to *setigera* and *incerta* were described under *Pseudoparonella* (Handschin, 1928, 1930; Womersley, 1937). Schött (1925) proposed a new generic name viz., *Bromacanthus* for his species *handschini* which is related to *setigera* and *orientalis.* The diagnosis of *Bromacanthus,* given by Schött (1925), is not fully conclusive and misleading in the sense that he could neither depict not describe the important structures like femoral organ, nature of dental spines and mucrones properly. Examination of the syntypes of *B. handschini* from the Swedish Museum Natural History, Stockholm, reveals such discrepancies. To describe femoral organ, Schött (1925) used certain ambiguous language which does not reveal the actual nature of the structure, thus to quote Schött (1925) : "The hind legs consisting of rows of skin pieces. In most of the individuals examined they are spiral shaped and their edges undentate. Only in one specimen they seem to be spoon-shaped with serrated margin" In the syntype of *Bromacanthus handschini* examined, the femoral organ is similar to that what has been depicted by Handschin (1930) in *orientalis* and Yosii (1959) in *Handschinella setigera* (Börner, 1906), although the femoral spines (in the syntype have flattened considerably and the ciliation of those spines have rendered obscure due to preservation on slide (No. 878) for a long time Fig. 1., G, H). It is now evident that "skin pieces" mentioned by Schött (1925) are actually the blunt femoral spines of femoral organ. Börner (1906), although did not name and illustrate the organ on hind femur in *Paronella setigera*, nevertheless, he noted and described the structure very precisely. The description of the organ given by Börner (1906) is as follows : "Hinterschenkel basalwärts auf der Hinterseite mit einer längeren Reihe gröberer and 3 kurzen Reihen kleinerer Dornen; davor noch zwei sehr lange, borstenartige Dornen" Schött (1925) described the dental spines in *B. handschini* as "split up at the base in such in a way, that they strikingly remind one of an open ear oats (hence the name)" In the syntype along with other examples from Biak, the dental spines do not appear to be such splitted at the base. Instead, each spine in with some complex longitudinal striations on the surface which apparently provide it a sort of serated appearance. "Splitting up at the base" of spines what Schött (1925) depicted has not been observed in any specimen (Fig. 2, D, E). Womersley (1937) in a species viz., *Pseudoparonella papuanus* related to *incerta* Handschin, mentioned the dental spines distinctly tridentate. The informations and depictions which are now available from the holotype [preserved in the British Museum (Natural History), London, through curtesy of Mr. P. N. Lawrence] indicate that the spines are in reality simple. The edges of the sockets from which spines have fallen give an appearance of "tridentatedness" to the existing adjoining spines (Figs. 3, E, F).

Schött (1925) described the mucro as being tridentate, which is, however, bidentate like *P. setigera* Börner (1906) and *P. orientalis* Handschin (1930). Schött (1925) could not note properly the number of teeth in mucro and mistook the spoon-shaped process of dentes, projected beyond dentes, as one of the teeth of mucro (Figs. 2, E, F).

Yosii (1959b) redescribed the species *setigera* Börner, 1906 and placed it in a new genus viz., *Handschinella.* He discriminated his new genus from *Pseudoparonella* on the basis of round hyaline scales, minutely striated and in the presence of special femoral organ. The characters used by Yosii (1959) exactly conform to the characters present in *Bromacanthus handschini*. Therefore, it is beyond doubt that *Handschinella* Yosii (1959) is a synonym of *Bromacanthus* Schött (1925) **[Mitra, 1971]**. Yosii (1981) also confirmed *Handschinella* as a synonym of *Bromacanthus*. It is further to be noted, though Yosii (1959) differentiated *Handschinella* from *Pseudoparonella* s. str. on the basis of round scales present in *H. setigera* (Börner, 1906), Handschin himself (1925) in a 'footnote' (Treubia, 6 : p. 253) mentioned the presence of larger round scales in *Paronella* and *Pseudoparonella.* Such mention of larger round scales in *Pseudoparonella* by Handschin (1925) is obviously due to the reason, as mentioned earlier, that Handschin (1925) derived the diagnosis of *Pseudoparonella* from the species like *setigera* and *incerta* which possess this typical scales (Fig. 1, A-D).

Handschin (1930) considered the species, like *setigera, handschini* and *orientalis*, as belonging to the same group and he criticised the genus *Bromacanthus* Schött, 1925. He also noted that *Bromacanthus* differs from the species like *setigera* Börner, 1906, *appendiculata* Schött, 1917 and *incerta* Handschin, 1925 only in the nature of dental spines. He further observed that all these species (*i.e., setigera, appendiculata* and *incerta*) possess identical mucrones, dental spines and scales which clothe the general surface of body. Handschin (1930), however, did not make any mention of the femoral organ found in *Bromacanthus setigera* n. comb. Association of *appendiculata* with the above mentioned species appears to be due to Handschin's nonacquaintance with the specimens of *Paronella appendiculata* Schött (1917) and further as both the species (viz., *appendiculata, setigera*) possess similar mucronal ends, Handschin (1925) most probably thought both the species as congeneric. As mentioned earlier, *P. appendiculata* is widely different from the above-mentioned species in many salient and fundamental characters and belongs to an altogether different tribe (Callyntrurini).

Handschin (1925) was able to recognise that some species of *Paronella* possess dental spines while others do not. He, however, was unable to detect other important differences in accordance with the presence and absence of dental spines. It is most possibly for this reason, he (Handschin) was unable to solve the problems of diverse composite generic groups of the Oriental Region related to African *Paronella* Schött. Such confusion seems to have perpetuated in the later works. Thus Womersley (1937) included a species viz., *papuanus* (a member of *Lepidonella*) under *Pseudoparonella*, relying on Handschin's (1925) diagnosis of *Pseudoparonella.* Carpenter (1932) places a species of *Microparonella* under *Pseudoparonella* as the species possesses bidentate mucrones, typical scales and dental spines.

Yosii (1960) described a new genus viz., *Lepidonella* from Solomon islands. Present investigation reveals that though *Lepidonella* has many characters in common with *Bromacanthus*, it is distinctly different from the latter in many salient features.

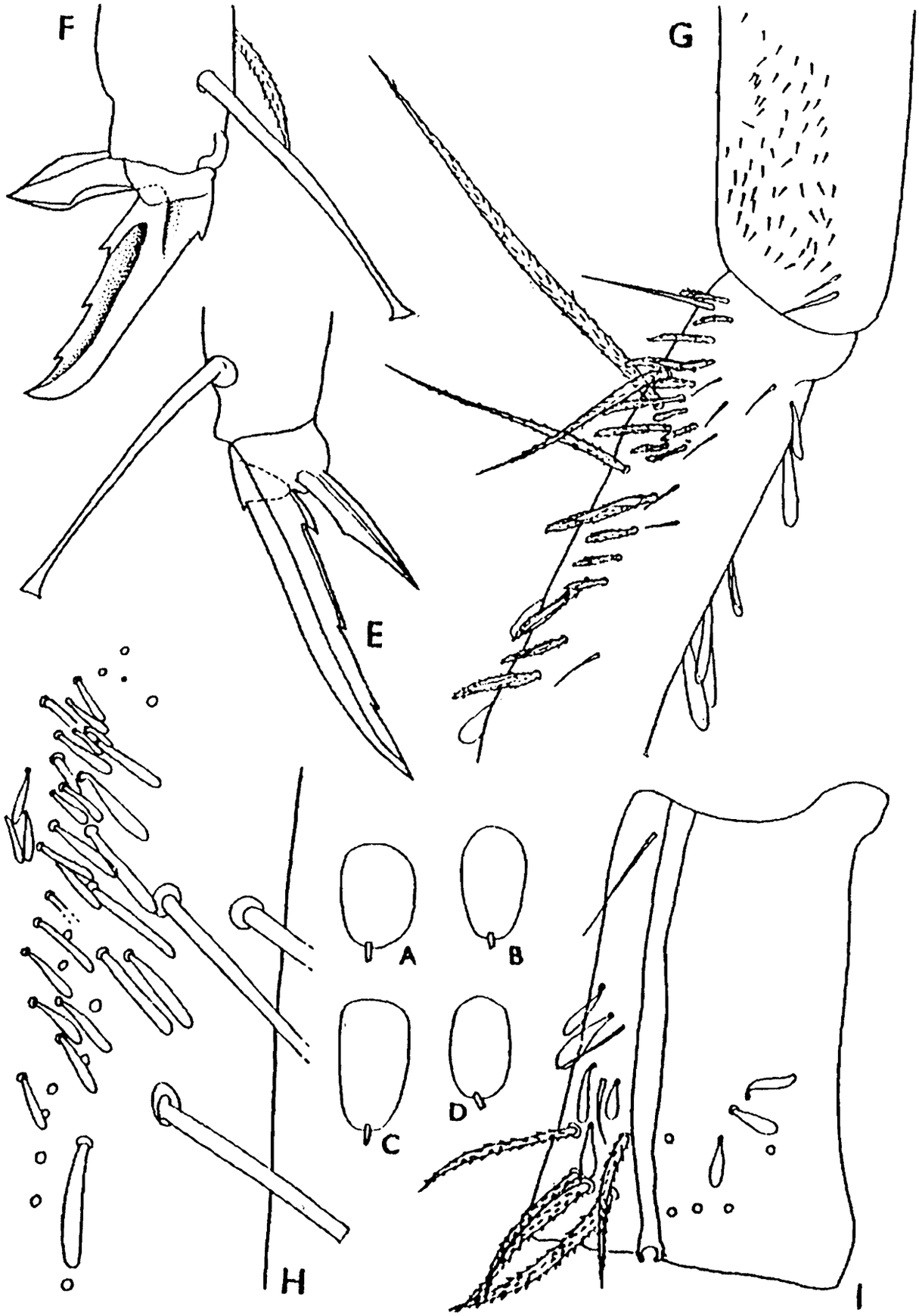

Fig. 1. : *Bromacanthus handschini* Schött. A, C, D : scales from had of the lectotype; B : scales from antennae of the lectotype; E : footcomplex of leg II; F : footcomplex of leg III; G : trochanteral and femoral organ; H : femoral organ of the lectotype; I, chaetotaxy of the anterior face of ventral tube.

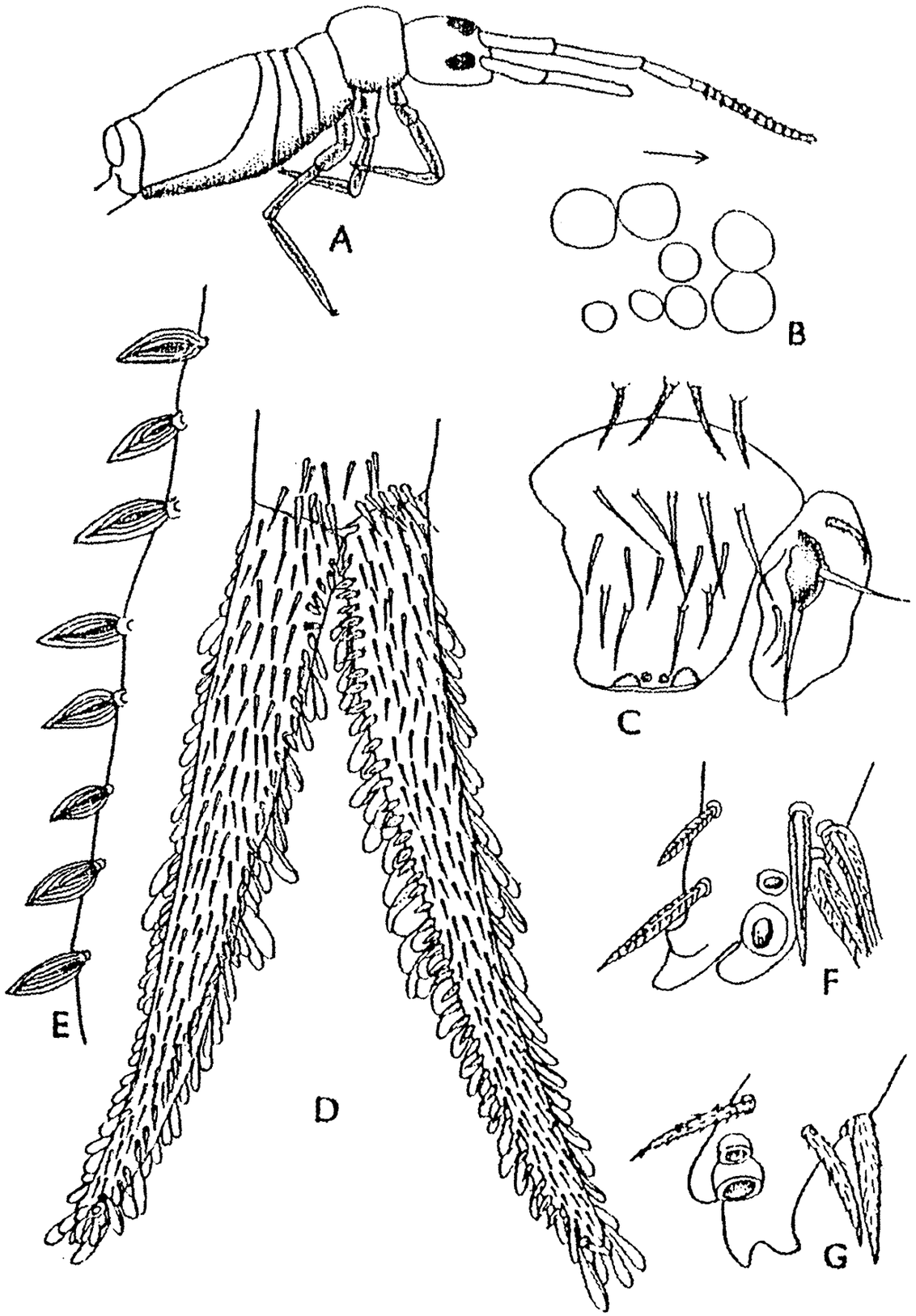

Fig. 2. : *Bromacanthus handschini* Schött. A : profile; B : arrangement of ocelli (from Lectotype); C : labral and labial chaetotaxy; D : distal portion of manubrium with dentes; E : a few dental spines (mangified); F, G : mucrones.

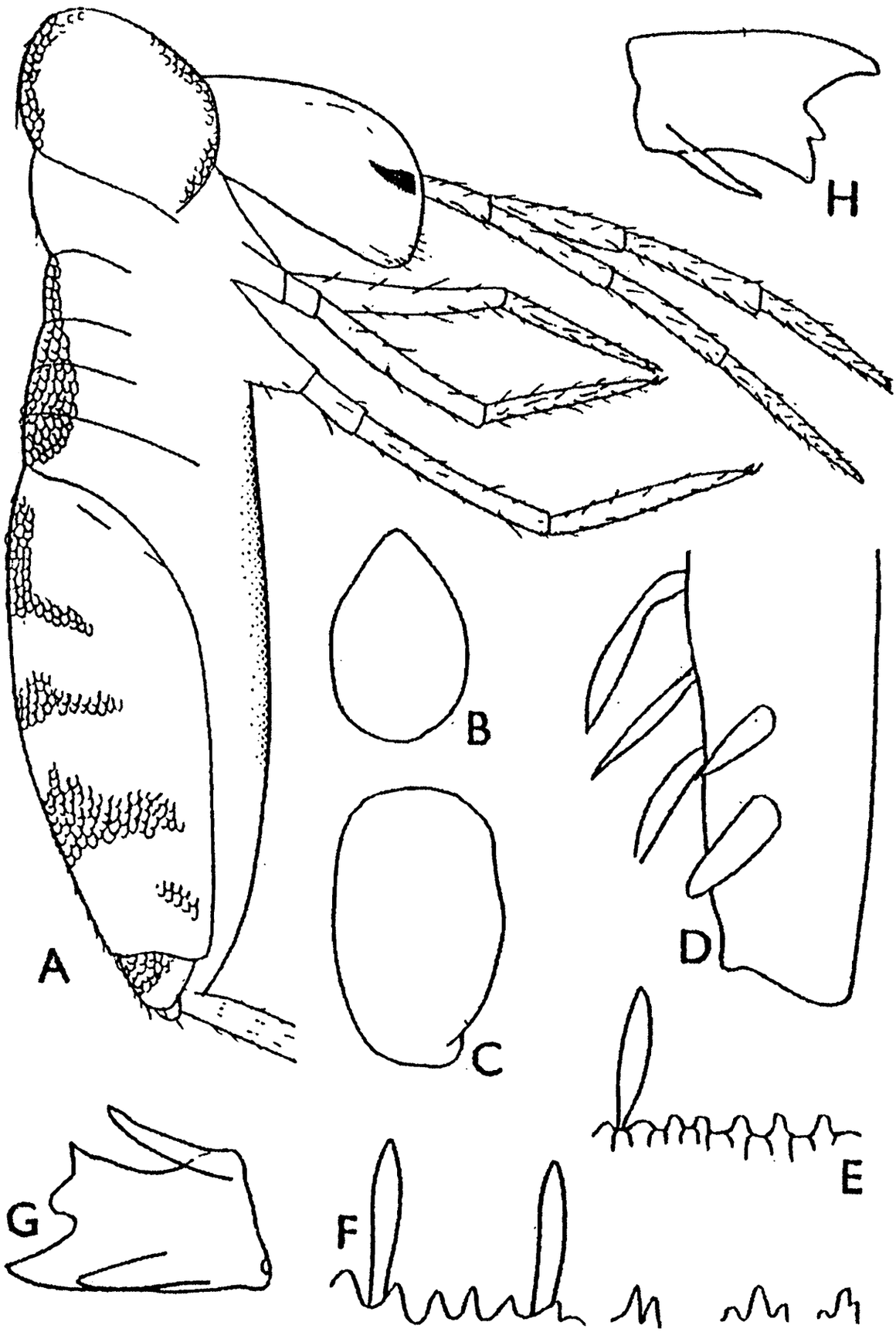

Fig. 3. : *Lepidonella papuanus* (Womersley) New Combination. A : profile; B, C : scales from holotype; D : distal portion of dentes from holotype; E, F : portions of dentes showing spines and adjoining empty sockets of the detached spines (from holotype); G, H : mucrones (from holotype).

Yosii (1960) established *Lepidonella* with the type-species *Lepidonella tokiokai* from Bougainville Island of Solomon islands. He distinguished his new genus from *Paronella* Schött in the achaetoic nature of its body and the nature of arrangement of its ocelli. Nature of arrangement of ocelli in *Lepidonella* is a character which it shares with *Bromacanthus*. It is although distinct from *Paronella* in the arrangement of ocelli, other characters cited by Yosii (1960) like achaetoic body and structure of scales (*i.e.*, typical scales) in *Lepidonella* are also found in *Paronella*. The nature of mucrones, the dental spines and other characters found in *Lepidonella tokiokai* correspond well to the characters of certain species previously described either under *Paronella, Pseudoparonella* or *Microparonella* from the Oriental Region. These species are as follows *Paronella picta* Schäffer, 1898; *Pseudoparonella incerta* Handschin, 1925; *Pseudoparonella nigrofasciata* Handschin, 1928; *Pseudoparonella papuanus* Womersley, 1937; *Microparonella* Yosii, 1966a; *Paronella subcarpenteri* Denis, 1948; and *Paronella annulicornis* (Oudemans, 1890) Schött (1903), Denis (1948)]. Although Yosii (*l. cit.*) recognised *L. tokiokai* as different from the species of the genera like *Pseudoparonella, Paronella* and *Microparonella*, nevertheless his comparison of *Lepidonella* with its related genera, as it appears now, needs further clarification. In this investigation a detailed comparative study of *Lepidonella* with its related genera is made with a view to finding out the exact relationship of the genus *Lepidonella* Yosii (1960) with its related ones.

Handschin (1925) confused *Lepidonella incerta*, n. comb. with *Bromacanthus setigera* (Börner, 1906) owing to some common features possessed by both the species belonging to two different genera. A few of such characters are : nature of scales clothing body (typical scales), presence of dental spines and arrangement of ocelli. He, however, either overlooked or neglected the nature of mucronal structures and its nature of articulation with dentes and the presence of femoral organ in *setigera*. As mentioned earlier in this study, *Pseudoparonella* Handschin with its type-species *P. appendiculata* Schött (1917) is a good member of the tribe Callyntrurini and thus it is widely different from *Lepidonella,* a member of the tribe Bromacanthini. Schäffer (1898) placed *picta* in the genus *Paronella* relying on the diagnosis of *Paronella* given by Schött (1893). Present comparative study on the basis of type-species of these genera reveals that *Lepidonella* is widely different from *Paronella* and other genera of the tribe Paronellini in the absence of extra ocular structure, nature of arrangement of ocelli, in the nature of mucrones and foot-complex. Over and above, it is specially distinct from *Paronella* in the absence of manubrial spines. *Lepidonella* is distinct from *Microparonella* in the absence of manubrial spines. *Lepidonalla* is distinct from *Microparonella* in the presence of full complement of ocelli which are arranged in a circular pattern, in the presence of simple dental spines and moderately striated brownish scales (Hyaline scales in *Microparonella* cf. those of *Cyphoderus* and its other related genera). Furthermore, the nature of mucrones together with ungues and unguiculi in the two genera are different. Yosii (1966) described *Microparonella ceylonica* and proposed that *Lepidonella tokiokai* may be included in *Microparonella*. The genus *Lepidonella* is distinct from *Microparonella* in many salient features as mentioned above and, it is at any rate, can not be considered as a synonym of the latter genus

(Mitra, 2001a, in press). *Lepidonella* has many characters in common with *Bromacanthus*, like the general body facies, nature of arrangement of the ocelli, nature of scales clothing body and the general nature of ungues and unguiculi. It is distinct from *Bromacanthus* in the absence of femoral organ and in the nature of mucrones which are always with more than two teeth and apically located on dentes, in the absence of dental spiny appendages and in the presence of 2 rows of distinct dental spines. Moreover, the nature of dental spines and the nature of chaetotaxy of the anterior face of ventral tube and head are distinctly different in the two cited genera. Denis (1948), however, altogether missed the gulf of difference that exists between *Paronella*-like species of Indochina (now placed under *Lepidonella*) and *Paronella*-like species of the Ethiopian Region. He (l. cit.) most convincingly placed his new species *subcarpenteri* from Indochina in the genus *paronella* Schött and noted that the former group of species from Indochina differs from the latter only in their dark pigmented body. He, therefore (as he stated), named the new species from Indochina as *subcarpenteri* to recall its close phylogenetic affinity with *carpenteri* and other forms (CR I and CR II) of Costa Rica now placed under *Dicranocentruga* (Mitra, 2001b, in press). This investigation records that the two groups of species belong to two different genera which in turn belong to two different tribes. (Mitra, 1992a) stabilised the concept of *Paronella* on the basis of examination of the syntypes of the type-species *Paronella fusca* Schött, 1893 and it was concluded that the long heterogenous *Paronella* is represented by the type-species only. He also resolved the *Pseudoparonella* complex after examination of the type-specimens and other representative collections of the various species involved in this complex (Mitra, 1992b).

Lepidonella is a valid genus of Bromacanthini occurring chiefly in the Oriental South East Asian Islands and in some islands of the Australian Region and is distinct from the genera now placed under Bromacanthini. All the species described or placed under *Micrparonella* by Yosii (1981, 1983, 1989) are to be placed under *Lepidonella.* All the species described or placed under *Micrparonella* by Yosii (1981, 1983, 1989) are to be placed under *Lepidonella* Yosii, 1960.

Lepidonella Yosii, 1960

Lepidonella Yosii, 1960b, *Bull. Osaka Mus. Nat. Hist.*, **12** : 9-38.

Material examined : Lepidonella picta (Schaffer, 1898), n. comb. : 40 exs. in spirit in a vial, labelled as "Bismark island, Mussau Talumalus, 23 Jan, 1962, Noona Dan Expedition, 61-62 (caught in Malaise trap)", from the Zoological Museum, Copenhagen. 1 ex. On a slide, labelled as "Forest litter. Solomon is. Unsani River nr. Monitor Creek. 5.VII.1965. Mr. P. N. Lawrence. 43 Roy. Soc. Exped. Brit. Mus. 1966-I. "; 1x. on a slide, labelled as "Leaf litter. Solomon is. Guadalcanal. Umasani River. 2-6.VII.1965. P. N. Lawrence. Roy. Soc. Exped. Brit. Mus. 1966-I. "; 2 exs. on a slide, labelled as "Salomon Is. Guadalcanal. Umasani River. 2-6.VII.1965. P. N. Lawrence. Roy. Soc. Exped. Brit. Mus. 1966-I. P. N. Lawrence"; 1ex. On a slide, labelled as "Forest litter. Solomon Is. Umasani River. Guadalcanal. 2-6.VII.1965. P. N. Lawrence. Roy. Soc. Exped. Brit. Mus. 1966-I."; 1 ex. On a slide, labelled as "thick litter on matted roots. Solomon Is. Guadalcanal. Monitor Creek. Umasani River.

8.VII.1965. 73-86. P. N. Lawrence. Roy. Soc. Exped. Brit. Mus. 1966-I"; 1 ex. On a slide, labelled as "Solomon Is. Guadalcanal. Tenaru River. 24.X.1965. P. N. Lawrence. Roy. Soc. Exped. Brit. Mus. 1966-I."; from the British Museum (Nat. Hist.), London 1 ex. On a slide, labelled as "Solomon Is. Guadalcanal. Mt. Austen. 20.XII.1963. P. Greenslade. 11439"; 1 ex. On a slide, locality as above, date, 28.IV.1966. 22990; 1 ex. on a slide, locality as above, date, 15.IX.1963, 11259; 1 ex. on a slide, labelled as "Solomon Is. Guadalcanal Kukun. 26.II.1963. P. J. Greenslade. 4622."; 1 ex. on a slide, labelled as "Solomon is. Guadaloanal. Mt. Austen. 23.IV.1963, P. J. G. 6890."; 1 ex. on a slide, locality as above, 22.VI.1963. P. J. G. 6783. P. J. G. 6890."; 1 ex. on a slide, locality as above, 22.VI.1963. P. J. G. 6783.", from the Bernice P. Bishop Museum, Honolulu, Hawaii.

Lepidonella tokiokai Yosii (1960) : 1 ex. mounted on a slide, loabelled as "Solomon Is. Guadalcanal. Mt. Austen. 20.XII.1963. P. J. G. 11439."; 1 ex. mounted on a slide, labelled as "Solomon Is. Guadalcanal, Kukun. 21.I.1965 P. J. G. 15512."; 1 ex. mounted on a slide, labelled as "Solomon Is. Guadalcanal. Mt. Austen. 7.V.1963. P. J. G. 6277."; 1 ex. on a slide, labelled as "Solomon Is. Guadalcanal. Mt. Austen. 20.V.1963. P. J. G. 6160."; 1 ex. on a slide, labelled as P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I."; 1 ex. on a slide, labelled as "Thick litter on matted roots"; other details as above, from the British Museum (Nat. Hist.), London. 1 ex. on a slide, labelled as "Solomon Is. Guadalcanal. Mt. Austen. 20.XII.1963. P. J. G. 11439."; 1 ex. on a slide, labelled as above. 9.VII.1963. P. J. G. 1118; 1 ex. labelled as above, 9.VII.1963. P. J. G. 1118; 1 ex. on a slide, labelled as above, 23.IV.1963. P. J. G. 6890, from the Bernice P. Bishop Museum, Honolulu Hawaii.

**Lepidonella* sp. (b) : 2 exs. on a slide, labelled as "Leaf litter. Solomon Is. Guadalcanal. Umasani River. 26.VII.1965. P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I."; 2 exs. on a slide, labellede as above, date 2-6.VII.1965; 1 ex. on a slide, labelled as bove; 1 ex. on a slide, labelled as above, Petero coll. 8.VII.1965, from the British Museum (nat. Hist.), London.

**Lepidonella* sp. © : 4 exs. on a slide, labelled as "Forest litter. Solomon Is. Guadalcanal. Nubu. 28.X.1965. P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I (1001-1006)"; 1 ex. mounted on a slide, labelled as "Forest Litter. Solomon is. Guadalcanal. Umsani River. 2-6.VII.1965. P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I.", from the British Museum (Nat. Hist.), London. 1 ex. on a slide, labelled as "Solomon is. Guadalcanal. Mt. Austen. 28.IV.1966. P. Greenslade. 22990.", from the Bernice P. Bishop Museum, Honolulu, Hawaii.

**Lepidonella* sp. (d) : 2 exs. on a slide, labelled as "Forest litter. Solomon Is. Guadalcanal. Nubu, 28.X.1965. 1001-1056. P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I.", from the British Museum (Nat. Hist.), London.

**Lepidonella* sp. (e) : 2 exs. mounted on a slide, labelled as "Forest litter. Solomon Is. Guadalcanal. Tenaru River. 24.X.1965, P. N. L. Roy. Soc. Exped. Brit. Mus. 1966-I.", from the British Museum (Nat. Hist.), London.

(*New species).

Pseudoparonella papuanus Womersley Holotype from the British Museum Natural History, London., mounted on a slide.

Pseudoparonella incerta Handschin Holotype, mounted on a slide, from Natural History Museum, Basel, Switzerland.

Redifinition Body may be lepidocyrtiform or normal; usually darkly pigmented; antennae sub-equal or shorter than body; trochanteral organ consists of a few well developed spines; hind femur without any specialised setae on inner surface (*i.e.*, femoral organ absent); Ant. II without sensory pegs; ventral tube anteriorly on anterior face with five macrochaetae on either side of the ventral groove, insertion of which characteristic for the genus; dentes with two rows of simple spines, outer row sometime feeble; mucro small, apically located on dentes and not clearly demarcated from it, with 3-4 teeth; dentes does not continue as a spoon-shaped process beyond mucro; dental spiny appendages not distinct; clothed with larger round to elongate typical scales (cf. *Bromacanthus*); flexed macrochaetae on body absent (achaetoic body); lasiotrichia present as on Abd. II (2+2), Abd. III (3+3), Abd. IV (2+2); bases of lastotrichia with some specialised accessory scales, number and arrangement of which fixed.

Type-species : *Lepidonella tokiokai* Yosii, 1960, by original designation.

DESCRIPTION OF THE TYPE-SPECIES

Lepidonella tokiokai Yosii, 1960

(Figs. 4–6)

1960b. *Lepidonella tokiokai*, *Bull. Osaka Mus. Nat. Hist.*, **12** : 9-38.

Material As mentioned above under genus.

Colouration : Ground colour of body whitish when denuded off scales, brownish when scales retained; purple to blue-black pigment present on the tergal margins of Ths. II, III and Abds. I, II in the form of two interrupted stripes; Abd. IV with two pairs of characteristic patches–1 pair located medially covering the bases of lasiotrichia, always conspicuous and the other pair posteriorly near the margin of the segment; the posterior pair of patches on this segment (Abd. IV) often reduced (Yosii, 1960b, although, in illustration indicated the presence of a pair of small patches posteriorly on Abd. IV, he, however, in the description mentioned only a pair of median patches on this segment); median and posterior patches on Abd. IV sometime tend to confluent with each other; Abd. V with a pair of patches, one on either side; Abd. VI devoid of any darker patch; head with two almost circular ocellar patches, interantennal surface dark-black, region posteriorly each ocellar field with a faint blue patch; Ant. I without pigment, Ants. II and III distally and on margins with deep purploe pigment, Ant. III may be entirely dark, Ant. IV all along with deep purple pigment; coxae and sub-coxae with purple pigment, trochanter, femur and tibiotarsus usually devoid of pigment, tibiotarsus rarely on inner margin with faint violet pigment; furcula not pigmented.

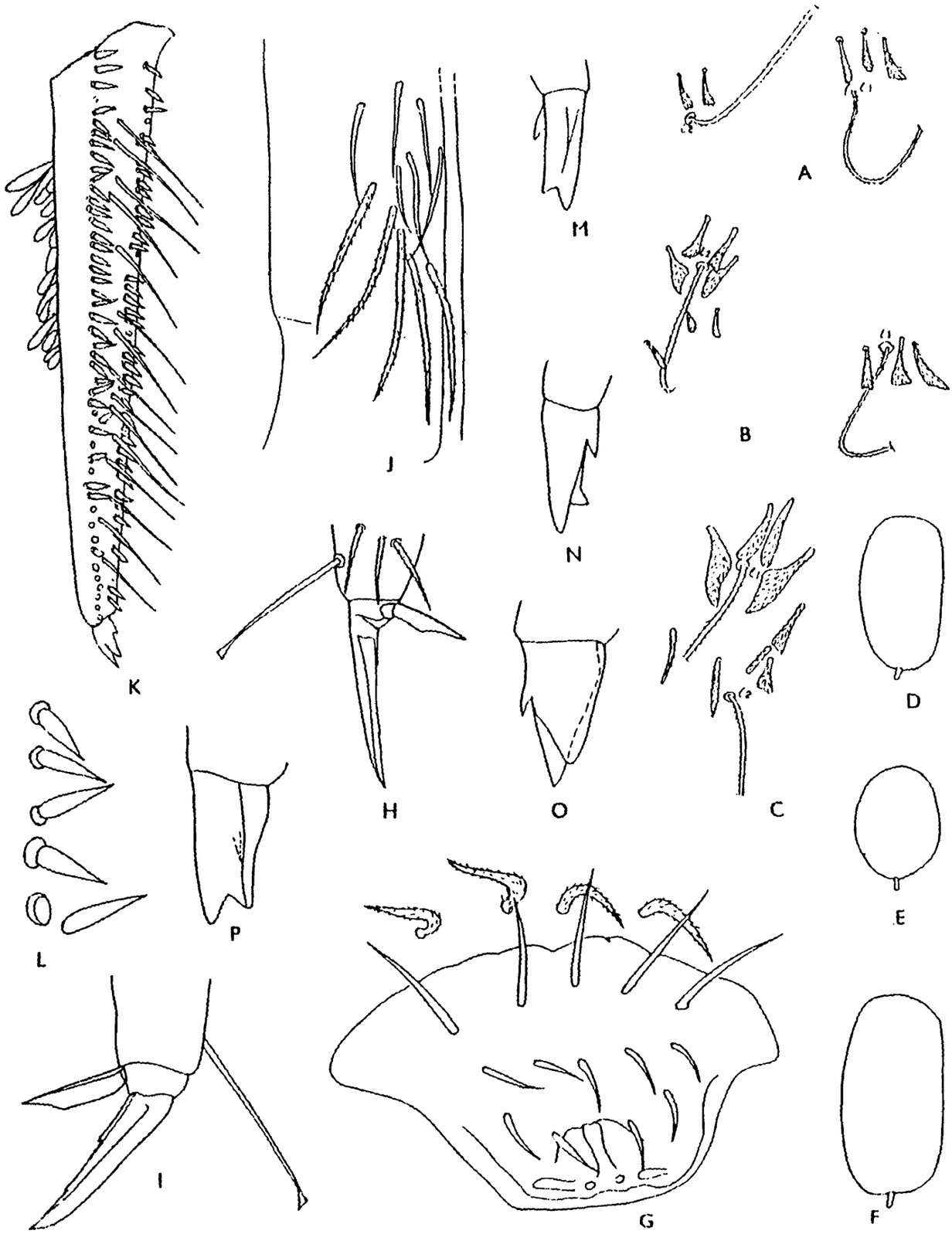

Fig. 4. : *Lepidonella tokiokai* Yosii. A : lasiotricha and accessory scales from abd. II; B : lasiotrichia and accessory scales from abd. III [13 not shows]; G : lasiotricha and accessory scales from abd. IV; D, E, F : scales from body; G : labral chaetotaxy; H : footcomplex of let I; I : footcomplex of leg II; J : chaetotaxy of the anterior face of ventral tube; K : dentes showing arrangement of spines; L : dental spines (mannified); M-P : mucrones in different views.

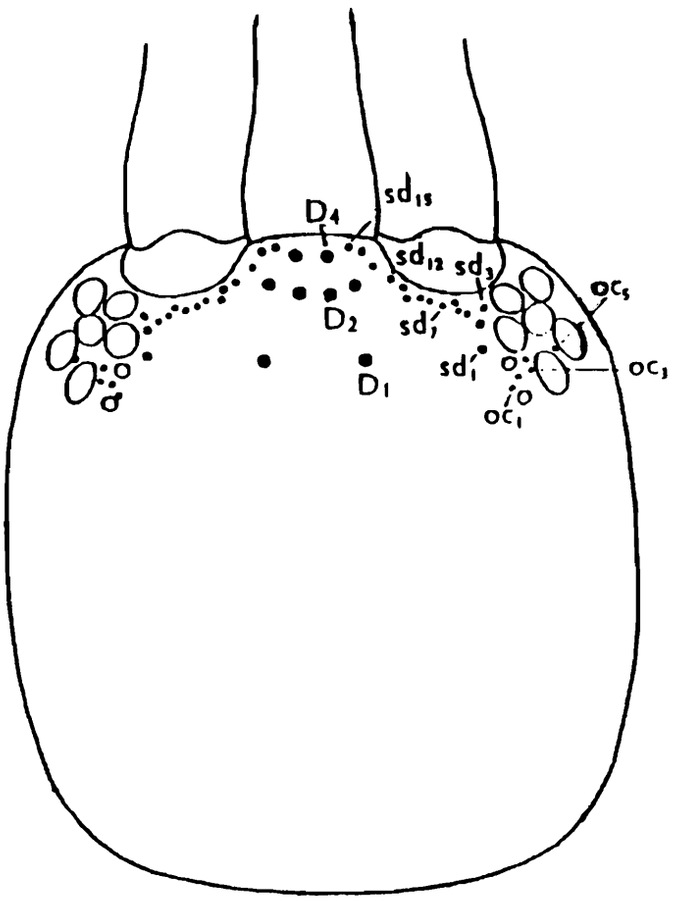

Fig. 5. : *Lepidonella tokiokai* Yosii. Cephalic chaetotaxy.

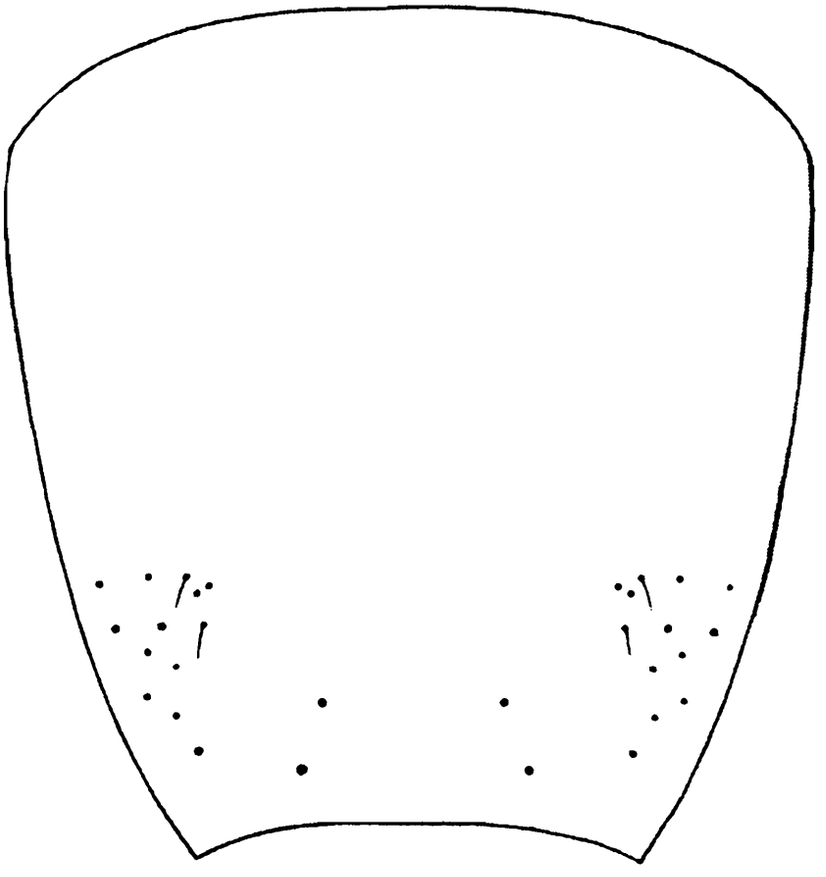

Fig. 6. : *Lepidonella tokiokai* Yosii. Chaetotaxy of Abd. IV.

Clothing : Body clothed with elongate and oval true or typical scales with faint, short striations (Plate Nos, 15, 16, 84); in general achaetoic, Abd. III laterally and Abd. IV posterolaterally with a few long, acuminate setae; lasiotrichia present as on Abd. II (2 + 2), Abd. III (3 + 3) and Abd. (2 + 2), each at its base with some specialised accessory scales, number and arrangement of which fixed thus on Abd. II : 1 (3), 1 (7); Abd. III : 1 (3), 1 (7), 1 (not noted); Abd. IV : 1 (4) (Figs. 4, A, B, C); head with a few short, broad, acuminate setae anterodorsally; antennae clothed with short, acuminate setae, arranged in the form of whorls, apical sense-knob on Ant. IV inconspicuous, Ant. IV in addition to the usual ciliated setae with certain apparently smooth setae; legs clothed with short, acuminate, ciliated setae; furcula clothed with setae similar to those on legs and claviform scales dorsally; chaetotaxy of head and body as in Figs. 5 and 6.

Head : Almost circular when viewed dorsally, frontal spines absent; ocelli 8 + 8, arranged in a circular pattern with ocellus B located almost centrally within each field, ocelli G and H reduced; prelabral setae 4, ciliated, labral setae, 5, 5, 4, smooth (Fig. 4, G); antennae shorter than half the length of body, relative length index of Ants. I : II : III : IV = 3 : 5 : 7 : 6 : 8.

Thorax : Th. II slightly elevated anteriorly, relative length index of Ths. II : III = 35 : 12; ungues and unguiculi on fore legs shortest, those on hind legs longest; each unguis on inner margin with paired basal and a distal unpaired teeth in between paired basal and distal unpaired teeth on fore ungues which, however, not noted in the specimens examined in this study), tenent hair long, elevate (Fig. 4, H, I); trochanteral organ consists of a few (c. 30) well developed spines.

Abdomen : Relative length index Abds. I : II : III : IV : V : VI = 6 : 11 : 10 : 71 : 8 : 5; ventral tube long with protrusible vesicles retracted or everted, anterior face or ventral tube anteriorly with five macrochaetae on either side of the ventral groove, rest of the surface of anterior and posterior faes with microchaetae only (Fig. 4, J); remi of retinaculum each with four teeth, corpus with a median seta; manubrium and dentes sub-equal, dentes does not taper distally, with two rows of nontransiting, simple spines (Figs. 4, K, L); mucrones demarcated or nondemarcated from dentes, principally with two teeth apical and anteapical, innerbasal tooth well developed, a prominent ridge runs from the apex of the anteapical tooth toward the base of mucrone, dental spiny appendages absent (Figs. 4, M-P).

Length (excluding appendages) : c. 1.5 mm.

Type-locality : Bouin, Bougainville, Solomon Islands.

Comparisons : The present investigator examined a number of specimens of the species from many localities of Guadalcanal, Solomon Islands, collected by Mr. P. N. Lawrence of the British Museum (Nat. Hist.), London, during the Royal Society Expedition (1965-66) and Mr. P. J. Greenslande of the Bernice P. Bisho-p Museum, Honolulu, Hawaii. The species is characterised by the presence of darker patches on targal margins of thoracic and abdominal segments and also in the presence of two pairs of symmetrical patches on either side of Abd. IV Colour forms of the

species having reduced patches posteriorly on Abd. IV, resemble to some extent to *Lepidonella picta* (Schäfer), n.comb. and *Lepidonella annulicornis* (Oudemans), n.comb. Such colour forms of the type-species, however, retain the darker patches on tergal margins which are absent in *L. picta.* Schäffer (1898) although, did not make a direct mention of the presence of dental spines in his *P. picta,* he however, clearly indicated the presence of very strong obliquely standing hairs on upper side of dentes upto mucrones. Now examination of the topo-types of the species proves it to be good member of the genus *Lepidonella,* Yosii (1960) himself also compared the type-species with *L. picta.* Further, the type-species appears very close to *Lepidonella subcarpenteri* (Denis, 1948), n.comb. from Indochina in colour pattern; the lanceolate unguiculi in the latter species is the only character which separates the two species. Nature of unguiculi appears to be group-specific in this genus. The type-species differs from *Lepidonella incerta* (Handschin, 1925), n.comb., *Lepidonella nigrofasciata* (Handschin, 1928), n.comb. by its characteristic mucrones which lack the intermediate tooth (i.t.) and in the nature of body facies which is not strongly lepidocyrtiform.

Interrelationships : *Lepidonella* is related to *Bromocanthus* by virtue of certain common characters which are not found in any other genus under Paronellinae. The arrangement of ocelli appears to be a common primitive character retained by both the genera and thus hints at their probable common ancestry. Moreover, the structure of ungues and unguiculi in the two genera are also similar. *Lepidonella,* however, is distinctly different from *Bromacanthus,* as mentioned earlier, in the nature of its mucrones which are always with more than two teeth and apically located on dentes. Further, the absence of distinct dental spiny appendages and femoral organ also clearly make *Lepidonella* distinct from *Bromacanthus.* It is related to *Paronella* and its allied genera in the nature of scales clothing body (typical scales) and achaetoic body. It is, however, phylogenetically quite distinct from them in the absence of E.O.S. and in other fundamental features. *Lepidonella* differs from *Microparonella* in the nature of mucrones and dental spines, in the structure of ungues and unguiculi and in the presence of full complement of ocelli. Further, the species of *Microparonella* as a result of some sort of cavernicolous or euedaphic adaptation do not have dark pigmentation on body. The contrary, the species of *Lipedonella* are usually dark pigmented.

Distribution : The genus is chiefly distributed in the Oriental South East Asian Islands and in the islands of the Australian Region. Its presence in Ceylon, Indochina and India (Bombay) [*L. ceylonica* (Yosii) 1966 and *L. subcarpenteri* (Denis) 1948] indicates its possible wide distribution in the Oriental and Australian Regions.

Species included : *Lepidonella tokiokai* Yosii, 1960. *Lepidonella picta* (Schäffer) 1898. New Combination. *Lepidonella incerta* (Handschin) 1925. New Combination. *Lepidonella nigrofasciata* (Handschin) 1928. New Combination. *Lepidonella papuanus* (Womersley) 1937. New Combination. *Lepidonella ceylonica* (Yosii) 1966. New Combination. *Lepidonella annulicornis* (Oudemans). New Combination. *Lepidonella subcarpentari* (Denis) 1948. New Combination. *Lepidonella oudemansi* (Yosii) 1983. New Combination.

Bromacanthus Schött, 1925

Bromacanthus Schött, 1925. *Sarawak Mus. Jour.*, **3** : 107-127

Pseudoparonella s. str. Handschin, 1925. *Treubia*, **6** : 225-270 (in press).

Handschinella Yosii, 1959b. *Contr. Biol. Lab., Kyoto Univ.*, **10** : 1-65.

Redefinition : Body often conspicuosly lepidocyrtiform; usually devoid of dark pigmented patches; antennae shorter or sub-equal to body; trochanteral organ consists of large number of smaller spines; each of hind femora with c. 3 rows of blunt, specialised, ciliated setae ("femoral organ", Yosii, 1959b); ventral tube anteriorly on anterior face with 5 macrochaetae on either side of the ventral groove, arranged in 2 distinct rows, a characteristic feature of the genus; dentes with an inner row of well developed striated spines, due to such striations the spines often look serrated on surface, outer row poorly developed (more setiform than spiniform); mucro bidentate, sub-apically located on dentes tip of dentes projects beyond mucrone in the form of a spoon-shaped process ("loffelartig" of Börner, 1906 in *P. setigera*) of mucronal end of the sub-genus *Pseudoparonella*; 2 large ciliated dental spiny appendages present dorsally near base of each mucrone, 1 located apically and the other sub-apically; macrochaetae absent on vertex and on area dorsalis of head.

Body clothed with larger, round, elongate and oval scales, scales always with round apices (typical scales); flexed macrochaetae on body absent (achaetoic body).

Type-species *Bromacanthus handschini* Schött, 1925, by monotypy.

DESCRIPTION OF THE TYPE-SPECIES

Bromacanthus handschini Schött, 1925

(Figs. 1–3; 7, 8)

1925. *Bromacanthus handschini*, Schött, *Sarawak Mus. Jour.*, **3** : 107-127.

Material : 2 slide-preparations of Schött : Slide No. 878, labelled as "Bromacanthus handschini n. sp. Borneo, H.S." Slide No. 879, labelled as "Bromacanthus handcini n. sp. Borneo, H.S."— From Swedish Museum Natural History, Stockholm, Sweden, 15 exs. in 1 vial labelled as "Biak : Mangrowawa, 30-31-V.1959, Gressitt. Coll. Rotton Leaves" from the Bernice P. Bishop Museum, Honolulu, Hawaii.

Colouration : Ground colour pale yellow; darker pigment if present localised along tergal margins, Ants. I, II, III mostly non-pigmented, IV occasionally with dark bluish pigment; appendages with faint blue pigment, ventral tube and furca without pigment (Fig. 2, A).

Clothing : Body achaetoic, clothed heavily with scales nearly spherical in shapes and secondarily may be of other configurations, but always with rounded apices. (Fig. 1, A-D). 2 + 2 lasiotrichia

on Abds. II and IV, 3 + 3 on Abd. III; bases of lasiotrichia with certain specialised, small club-shaped scales, Abd. IV with certain non-flexed macrochaetae; Ants. III and IV in addition to the usual ciliated setae, with certain erect smooth setae, microchaetae on Ant. IV arranged in distinct whorls which make the segment appear annulated; appendages clothed with scales and setae, manubrium and dentes dorsally clothed with elongate, claviform scales and ventrally with spines and setae; chaetotaxy of head and body as in Figs. 7 and D.

Head : Somewhat oval in outline when viewed dorsally; without frontal spines; ocelli 8 + 8, G and H reduced, arrangement of ocelli characteristic, ocellus B displaced occupying a more or less central position in each ocellar field (Fig. 2, B); prelabral setae 4, ciliated, labral setae, 5, 5, 4, anterior margin of labrum with 4 tubercles (Fig. 4, C); antennae shorter or sub-equal to the length of body; relative length index of Ants. I : II : III IV = 10 14 9 : 21, Ant. IV apically without distinct sense knob, but with some apparently smooth setae.

Thorax : Th. II convex, little overarched anteriorly; relative length index of Ths. II : III = 37 : 15; ungues and unguiculi of fore and middle legs more elongate than the hind legs (Fig.), hind ungues more curved than fore and middle ones; ungues with paired inner basal teeth moderately developed, followed by two conspicuous unpaired distal teeth; unguiculi of all legs appear truncate or sub-lanceolate type, inner truncated angles not much prominent; tenent hair long, well developed, clavate (1, E, F); tibiotarsal lobes not conspicuous; trochanteral organ with many (c. 65) very short

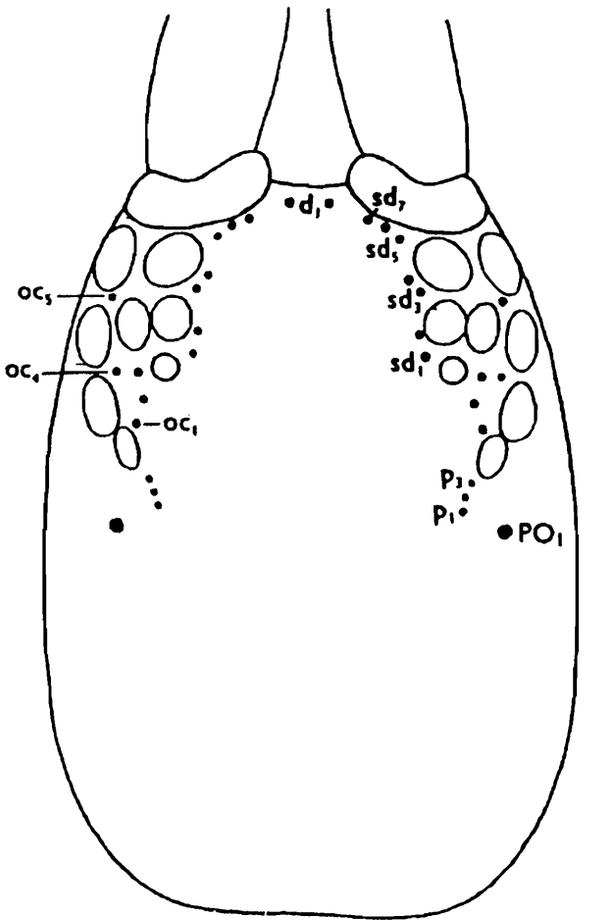

Fig. 7. : *Bromacanthus handschini* Schött. Cephalic chaetotaxy.

spines, 2 apical spines being longer than the rest (Fig. 1, G), femoral organ well developed consisting of c. 20 peculiar club-shaped minutely ciliated spiny setae, arranged in 3 indistinct rows, each such seta with a depression on inner surface, guarded on outer side with 3 longer and 1 smaller setae and on inner margin with a few simple setae (Fig. 1, H).

Abdomen : Relative length index of Abds. I : II : III : IV : V : VI = 11 : 4 : 7 : 10 : 86 : 7 : 5; ventral tube moderately long, anterior face of ventral tube anteriorly with 5 + 5 macrochaetae, inserted in a characteristic manner (Fig. 1, 1), general surface of anterior and posterior faces clothed with scales and simple microchaetae; rami of retinaculum each with 4 teeth, corpus with a median seta; furcula shorter than body, scarcely tapers distally; dentes longer than manubrium, relative length index of manubrium : mucrodens = 21 : 24; each dentes armed with an inner row of spines, each such spine with some longitudinal straitions on the surface which give it an appearance of serrations, outer margin of dentes without spines (Fig. 2, D, E); dentes anteriorly projected beyond mucro in the form of a spoon-shaped process; mucro not clearly demarcated from dentes, bidentate, teeth being curved apically in may examples (2, F, G).

Length : (excluding appendages) : upto 2 mm.

Type-specimens : Schött (1925) based the description of his new genus and species on 3 exs., which came from Borneo. He did not select any type of the type-species. Two slides available from the Swedish Museum Natural History, Stockholm, Sweden, indicate the locality of the

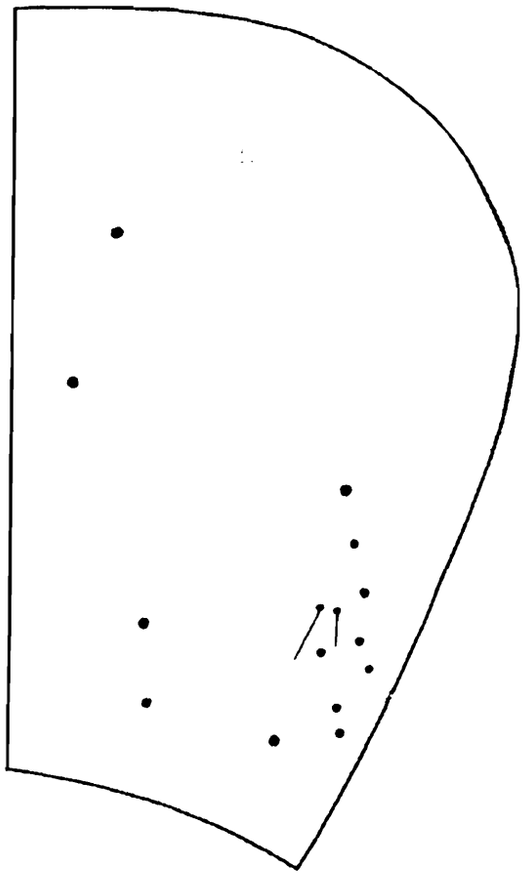

Fig. 8. : *Bromacanthus handschini* Schött. Chaetotaxy of Abd. IV.

specimens as that of the locality mentioned by Schött (1925) in the text. Thus these slides should be regarded as the syntypes of *Bromacanthus handschini*. Unfortunately, no entire specimen is mounted on any of the 2 slides and the investigator takes opportunity to label the Slide No. 878 as the lectotype which represents the femoral organ, a most characteristic feature of the genus.

Type-locality : Mount Dulit, North Sarawak, Borneo.

Comparisons The genus is known by two more species *viz., Bromacanthus setigera* (Börner, 1906), n. comb. and *Bromacanthus orientalis* (Handschin, 1930), n. comb. *Bromacanthus handschini* Schött although appears identical with *B. setigera,* further investigations are needed to establish their actual relationship. *B. orientalis* always have dark pigmented hind trochanter (as mentioned by Handschin, 1930) unlike the other two species. Studies on chaetotaxy of Abd. IV, as done by Snider (1961) in *Lepidocyrtus*, may perhaps reveal the actual relationship of these species.

Interrelationships Phylogenetically, *Bromacanthus* has close affinity to *Lepidonella* Yosii (1960b) in the presence of 8 + 8 ocelli which are arranged in a circular pattern with ocellus B located almost centrally in each ocellar field, in the general body facies and in the nature of ungues and unguiculi. However, it is distinct from *Lepidonella* in the nature of mucrones which is always bidentate and sub-apically located, in the presence of 2 distinct dental spiny appendages and specialised femoral organ. Furthermore, nature of dental spines, chaetotaxy of the anteiror face of ventral tube and head also distinctly separate in out from *Lepidonella. Bromacanthus* is also distinct from *Microparonella* Carpenter and *Trichorypha* Schött in the characters, as mentioned above.

Bromacanthus appears to have a distinct relationship with the genera under Lepidocyrtini. This is indicated by the general body facies, nature of scales clothing body (typical scales), achaetoic body ("lepidosis", Yosii, 1961) and in the arrangement of ocelli.

Distribution : The members of the genus are so far known to be chiefly distributed in the Oriental South East Asian Islands including Malayan Archipelago. Handschin (1926) recorded a member of this genus *viz., Bromacanthus setigera*, n.comb. (Börner, 1906) from Philippines and not from New Caledonia as Salmon (1954b) mentioned. Its present record from Biak (an oceanic island in the Australian Region) stands, therefore, as the first record of this genus from this Region.

Species included : *Bromacanthus handschini* Schött, 1925; *Bromacanthus setigera* (Börner) 1906. New Combination; *Bromacanthus orientalis* (Handschin) 1930. New Combination; *Bromacanthus elongatus* Yosii, 1981, *Bromacanthus flavidulus* Yosii, 1981; *Bromacanthus palawanicus* Yosii, 1983; *Bromacanthus halmaherae* Yosii, 1983; *Bromacanthus seramensis* Yosii, 1989.

SUMMARY

The concepts of *Lepidonella* Yosii, 1960 and *Bromacanthus* Schött, 1925 are precised in this investigation on the basis of examination of type-specimens and other representative material of the related species.

Lepidonella Yosii, 1960 is a valid genus and the *Paronella*—like species of Oriental South East Asian Islands (predominantly now known under *Pseudoparonella*) are to be placed in this genus. *Lepidonella* is distinct from *Microparonella* Carpenter, 1916 (Mitra, 2001a, in press).

Bromacanthus Schött, 1925 is a specialised genus having a very conspicuous femoral organ, occurring both in the Oriental South East Asian Islands and islands in the Australian Region. On examination of the type-specimens, it is now proved that femoral organ of Handschinella Yosii, 1959 is identical to the characteristic structures of hind femora, described by Börner (1906), Schött (1925) and Handschin (1930). It is, therefore, conclusively proved that *Handschinella* Yosii, 1959 is a synonym of *Bromacanthus* Schött, 1925.

ACKNOWLEDGEMENTS

The author is grateful to the authorities of the British Museum (Natural History), London and Bernice P. Bhishop Museum, Honolulu, Hawaii for providing me an opportunity to study the extensive collections of the species made during Noona Dan Expedition from the South East Asian Islands as well as providing me valuable informations and opportunity to study the type-specimens.

I am also grateful to the authorities of the Natural History Museum, Basel, Switzerland for permitting me to resurrect and study the type-specimens of the species, described by Prof. Handschim.

Thanks are due to the Director, Zoological Survey of India, for providing laboratory facilities.

REFERENCES

Börner, C. 1906. Das System der Collembolan, nebst Beschreibungen neuer Collem-Bolen des Hunburger Naturhistorischen Museums. *Mitt. Nat. Mus., Hamburg*, **23** 147-188.

Carpenter, G. H. 1932. Fauna of the Batu Caves, Selangor. XVII, Apterygota. *J.F.M.S. Mus. Kuala Lampur*, **17** : 217-221.

Denis, J. R. 1948. Collemboles d' Indochine récotés de M.C.N. Dawydoff. *Mus. Heude Notes Ent. Chin*, **12**(17) 183-317.

Handschin, E. 1925. Beiträge zur Collembolenfauna der Sundainseln. *Treubia*, **6** : 225-270.

Handschin, E. 1928. Collembolen aus Java nebst eineim Beitrag zur einer Monographie der Gattung *Cremastocephalus* Schött, *Treubia*, **10** : 245-270.

Handschin, E. 1930. Phillipine Collembola, II. *Philip. Journ. Sci.*, **42** : 411-428.

Mitra, S. K. 1971. A critical study on the taxonomy of Paronellinae (Collembola : Entomobryidae). *D. Sc. Thesis, submitted to the Faculty of Science, university of Burdwan*, pp. 1-

Mitra, S. K. 1992a. Fixation of the concept of *Paronella* Schött, 1893 (Collembola Entomobryidae). *Rec. Zool. Surv. India*, **92**(1-4) : 211-224.

Mitra, S. K. 1992b. Concept of *Pseudoparonella* Handschin, 1925 (Collembola : Entomobryidae : Paronellinae). *Rec. Zool. Surv. India*, **92**(1-4) 265-284.

Mitra, S. K. 2001a. Status of *Microparonella* Carpenter, 1916 (Collembola : Entomobryidae : Paronellinae). *Rec. Zool. Surv. India*, **100** (in press).

Mitra, S. K. 2001b. Status of *Dicranocentruga* Wray, 1953 with the description of a new species (Collembola : Entomobryidae). *Rec. Zool. Surv. India*, **100** (in press).

Oudemans, J. T. 1890. Apterygota des Indischen Archipels. *Zool. Ergeb.*, **1** 73-91.

Schäffer, C. 1898. Die Collembolen des Bismark Archipel nach der Ausbeute von Prof. F. Dahl. *Archiv. Naturg.*, **64**(1) : 393-425.

Schött, H. 1893. Beträge zur Kenntnis der Insectenfauna von Kamerun, I Collembola. *Bih. Tillk. Svenska Vet. Akad. Handl.*, **19**(2) : 1-28.

Schött, H. 1903. Über zwei Gattungen der Apterygoten Insekten. Redögorelse, für Allmänna Läroverken I. Linköping. Eksö och Vadstena. Underläsaret 1902-1903 : III-XVI.

Schött, H. 1917. Results of Dr. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-1913, (15) : Collembola. *Ark. Zool.*, **11**(8) : 60 pp.

Schött, H. 1925. Collembola from Mount Murud and Mount Dulit in Northern Sarawak. *Sarawak Mus. Journ.*, **3** : 107-127.

Womersley, H. 1937. On some Apterygota from New Guinea and New Hebrides. *Proc. Roy. Ent. Soc., London*, (B) **6**(11) : 204-210.

Yosii, R. 1959. Studies on the collembolan fauna of Malaya and Singapore with special Reference to the genera : *Lobella, Lepidocyrtus* and *Callyntrura. Contr. Biol. Lab. Kyoto Univ.*, (10) 1-65.

Yosii, R. 1960. On some Collembola of New Caledonia, New Britain and Solomon Islands. *Bull. Osaka Mus. Nat. Hist.*, **12** : 9-38.

Yosii, R. 1961. On some Collembola from Thailand. *Nature and Life in Southeast Asia*, **1** : 171-200.

Yosii, R. 1966. On some Collembola from Afghanistan, India and Ceylon, collected by Kuphe Expedition, 1960. *Res. Kyoto Univ. Sci. Exped. Karakaram and Hindukush*, 1955, **8** : 333-405.

Yosii, R. 1981. Entomological Report from the Sabah Forest Research Centre. No. 3 : Paronellid Collembola of Sabah. No. 4 : Neanurid Collembola of Sabah. *Japan International Cooperation Agency*, pp. 1-68.

Yosii, R. 1983. Entomological Report from the Sabah Forest Centre. No. 7 : Studies on Paronellid Collembola of East Asia. *Japan International Cooperation Agency*, 1-28.

Yosii, R. 1989. Notes on the Collembolan Fauna of Indonesia and its vicinities. I. Miscellaneous Notes, with special references to Seirini and Lepidocyrtini. *AZA*, **1** : 23-90.