

CONTRIBUTIONS TO THE MILLIPEDE FAUNA OF VIETNAM (DIPLOPODA) III. SPIROBOLIDA*

S. I. GOLOVATCH and Z. KORSÓS

A. N. Severtzov Institute of Evolutionary Morphology and Ecology of Animals, Academy of Sciences of the USSR, Leninsky prospect 33, Moscow 117071, USSR
Zoological Department, Hungarian Natural History Museum, H-1088 Budapest, Baross utca 13, Hungary

(Received 17 January, 1989)

Two new species, *Aulacobolus brevipygus* sp. n. and *Physobolus pulvinipes* sp. n., deriving from the collections of the Hungarian Natural History Museum, Budapest, are described from Vietnam. Comments are made on a third species, the widespread *Trigoniulus lumbricinus* (GERSTÄCKER, 1873). With 22 figures.

Introduction — The present paper puts on record additional three diplopod species of the Vietnamese fauna as based on the collection of the Hungarian Natural History Museum, Budapest (HNHM). We treat now all the identifiable members of the order Spirobolida kept there from that country. Out of the three forms concerned, two appear to represent new species and one more a cosmopolitan, which also requires certain notes on its variation and geographical range.

Material treated here has been shared between the collections of the Zoological Department of the HNHM and the Zoological Museum of the Moscow State University, Moscow (ZMMU).

Acknowledgements — We are indebted to DR. H. ENGHOFF for loaning material from the Zoological Museum of the University of Copenhagen, Copenhagen (ZMUC). Many thanks are due to PROFS. R. L. HOFFMAN (Radford) and J.-P. MAURIÈS (Paris) for kindly giving comments on the status of the new species concerned, and to J.-P. MAURIÈS again for both gift material from Guadeloupe and permitting the publication of BRÖLEMANN's sketches.

* Hungarian zoological studies in Vietnam No. 13.

***Aulacobolus brevipygus* sp. n.**

(Figs 1—7)

Locality: Vietnam, Prov. Ninh binh, Cuc phuong, in forest, 7. May 1966, (No. 266—267), leg. G. TOPÁL, 1 ♂ (holotype), 1 ♀ and 2 juveniles. — Material examined: 4 specimens. — Holotype male and two juvenile paratypes are deposited in the HNHM, one female paratype in ZMMU.

Description: Length ♂ 62 mm, ♀ 60 mm, juv. 18—20 mm, midbody width 4.7, 5.0 and 2.5 mm, respectively, number of segments excluding telson 55 (♂), 50 (♀), 40(—7) and 46(—7) (juveniles).

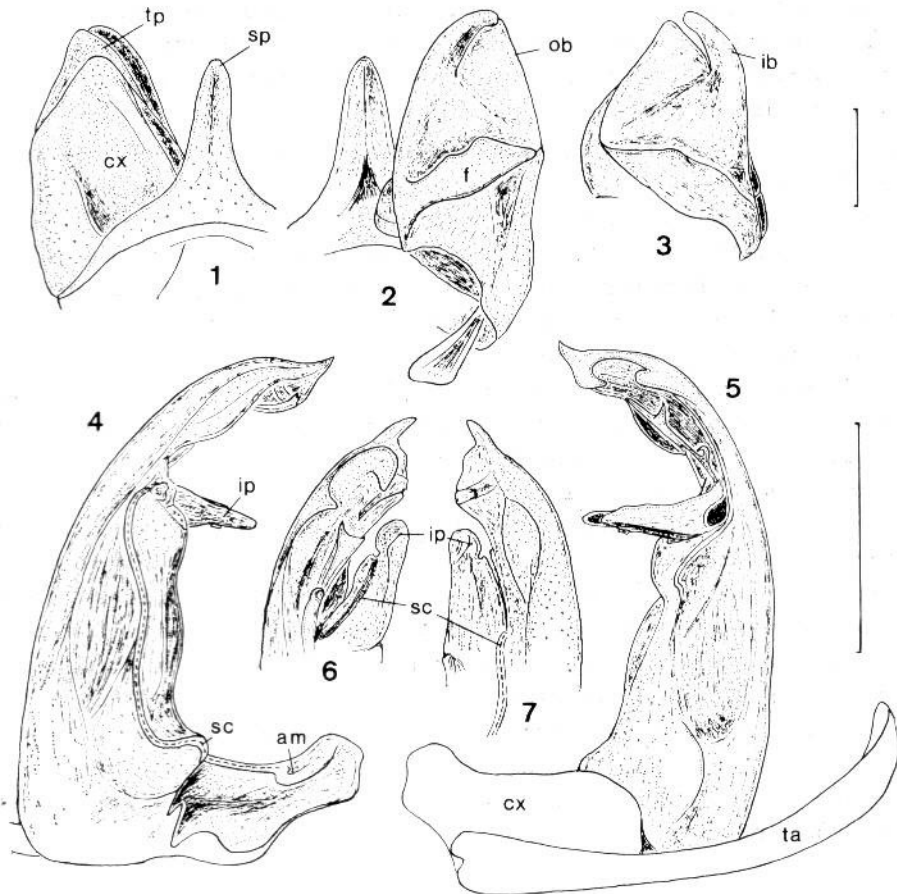
Coloration: holotype rusty brownish-grey, rather dark, more greyish posterior third, pale brownish; hind tergal limbus almost translucent. Prozona marble (especially anteriorly); collum almost entirely marble, head likewise, mottled yellowish-grey. Left antenna whitish, right antenna broken off on joint three (holotype); legs yellowish.

Body cylindrical, anterior postcollar constriction extremely feeble, best expressed on segment 4; till 51st segment body parallel-sided becoming gradually and gently tapering toward telson. Antennae short, clavate, cheeks excavated for antennae to hinge into. Eyes roundly subtriangular, blackish-brown, of ca. 35 compact ocelli. Frontal suture distinct. Labrum typical, deeply concave in the middle of anterior margin, with three medial teeth. Collum dorsally rather narrowly rounded, subrectangular, laterally and antero-laterally up to level of eyes rather distinctly margined, but not striate. Surface rather indistinctly and sparsely punctured. Similar punctures on metazona but not on prozona, body surface generally dull.

Metazonital striation very weak, somewhat better traceable ventro-laterally, never dorsally above pore level. Striation somewhat oblique, tending to grow still weaker toward telson (no more than 3 striae in a square with its length being equal to metazonite below pores). Anterior part of prozona dull, posterior part extremely finely, densely, subtransversally and rather confusedly striate. Prozona, like metazona, practically astriate dorsally above pore level, suture between pro- and metazona feeble. Very poor ring constriction, with a row of smaller, shallow, contiguous round pits (alveolae) in front of suture. Hind tergal limbus very finely crenulate, crenulae being rather well apart from each other. Defensive pores small, inconspicuous, lying just in front of and touching the row of pits, starting from 6th segment, there situated a little below midheight, immediately after that (on subsequent terga) already well above midheight. Anal valves very indistinctly margined, almost entirely regularly convex, subanal scale spindle-shaped, without particulars. Epiproct practically absent, as a simple knob, hanging just a little over the rounded outline of anal valves in lateral view, in dorsal view rather narrowly rounded, triangular, caudal angle about 100 degrees.

All legs rather stout, pregonopodal coxae about twice as high as wide, tarsi invariably with pads, claws slightly curved, sharp, long: ca. 1/3 of tarsal length, each with a strong seta dorsad of it, a similar seta present on distal part of all preceding joints. Leg joints sparsely setose, growing a little slenderer towards telson, leg-pair 10 particularly reduced, coxae always contiguous. Lateral lobes of sternite 2 in males low and rounded like in *Aulacobolus dysoni* (see CARL 1941, Fig. 68). Segment 7 ventrally with a single flat plate, finely rugose.

Gonopods: Anterior gonopods (coleopods) (Figs 1–3) with a high, membranous, frontally furrow-shaped, concave sternal process (*sp*) rather narrowly rounded at tip. Coxite (*cx*) a little shorter than telopodite (*tp*), subequal in height to “*sp*”, frontally with a large shallow concavity, apically well rounded. Telopodites higher than “*sp*”, distally bifid inner branch (*ib*)



Figs 1–7. *Aulacobolus brevipygus* sp. n.: 1–2 = left coleopod, frontal and caudal view, 3 = caudal view of right coleopod telopodite, 4–5 = right phallopod, frontal and caudal view, 6–7 = end of left phallopod, mesocaudal and mesofrontal view. Scales 1.0 mm each

being a bit higher and considerably slenderer than outer one (*ob*). Caudally with a good fold (*f*).

In posterior gonopods (phallopods, Figs 4–7) tracheal apodemes (*ta*) large, attached to a small sternite at base of the coxite (*cx*), which is delimited at least on caudal side from acropodite. From frontal side an ampulla (*am*) is visible (= "Coxaldrüse") from where seminal canal (*sc*) begins. Telopodite rather slender, suberect, at distal third branching into a smaller inner process (*ip*) (= "Innenarm") and a larger, apically pointed, complex outgrowth carrying a number of teeth on its caudal side. Seminal canal runs almost entirely along frontal side, only subterminally turning to caudal side to end on "*ip*". Latter seems to be movable.

♀ p a r a t y p e : Color pattern also quite dark, similar to that of holotype, the same alternation of greyish marble prozona and yellowish translucent metazona. Over 45 compact ocelli in a round-triangular eye; antennae in situ hardly reaching to end of collum. Anal valves much better margined, similarly regularly rounded. Instead of tarsal pads, 2–3 strong ventral setae. In juveniles coloration paler, whitish to cream.

R e m a r k s : The new species seems to be a good member of *Aulacobolus* POCOCK, 1903, a genus encompassing about 15 nominal species, subspecies and varieties (cf. POCOCK 1892, 1893, 1903; SILVESTRI 1916; CHAMBERLIN 1920; ATTEMS 1936, 1938, 1953; CARL 1941), chiefly restricted to the Indian and Far Indian regions. Of the species only one, *A. rubropunctatus* ATTEMS, 1938 (= *rubrodorsalis* [ATTEMS, 1953], cf. HOFFMAN 1962), has been met with within Indochina (Ream, Cambodia).*

Morphologically, and zoogeographically likewise, the new species displays particularly close affinities with *A. rubropunctatus*, as expressed by the presence of a short tail, the sculpture of the prozona, the low and rounded outer sternal lobes of male leg-pair 2, the gonopod conformation, etc. However, both species are quite distinct by the pattern of metazonal striation, the shape and furcation of the coleopod telopodite, the armature of the distal half of the phallopod, etc. From all congeners, *A. brevipygus* sp. n. is easily distinguished by the shortest epiproct and certain details of gonopod structure. Being together with *A. rubropunctatus* somewhat disjunct in every way as compared to the Indian and Sri Lankan congeners (HOFFMAN 1962), *A. brevipygus* sp. n. represents the first formal record of *Aulacobolus* in Vietnam. To judge whether to treat both as a separate taxon of superspecies level or not, is the question of the future, along with further accumulation of both faunistic and revisionary data.

* HOFFMAN (1962) believes that it is possible that *A. rubropunctatus* is the same as "*Spirobolus*" *dollfusii* POCOCK, 1893 described from South Vietnam (Cochin China). However, he treats by himself *dollfusii* as a *Tonkinobolus* (p. 774), and even questions the generic allocation of *rubropunctatus* within *Aulacobolus* (p. 778).

Physobolus pulvinipes sp. n.

(Figs 8—13)

Locality: Vietnam, Prov. Hoang Lien Son, 17 km SE of Lao Cai, Dang Khao valley, from under bark of trees, 29. Nov. 1971. (No. 163), leg. G. TOPÁL et I. MATSKÁSI, 2 ♂♂ and 2 ♀♀. — Material examined: 4 specimens. — **Holotype** male and two female paratypes are deposited in the HNHM, 1 male paratype in ZMMU.

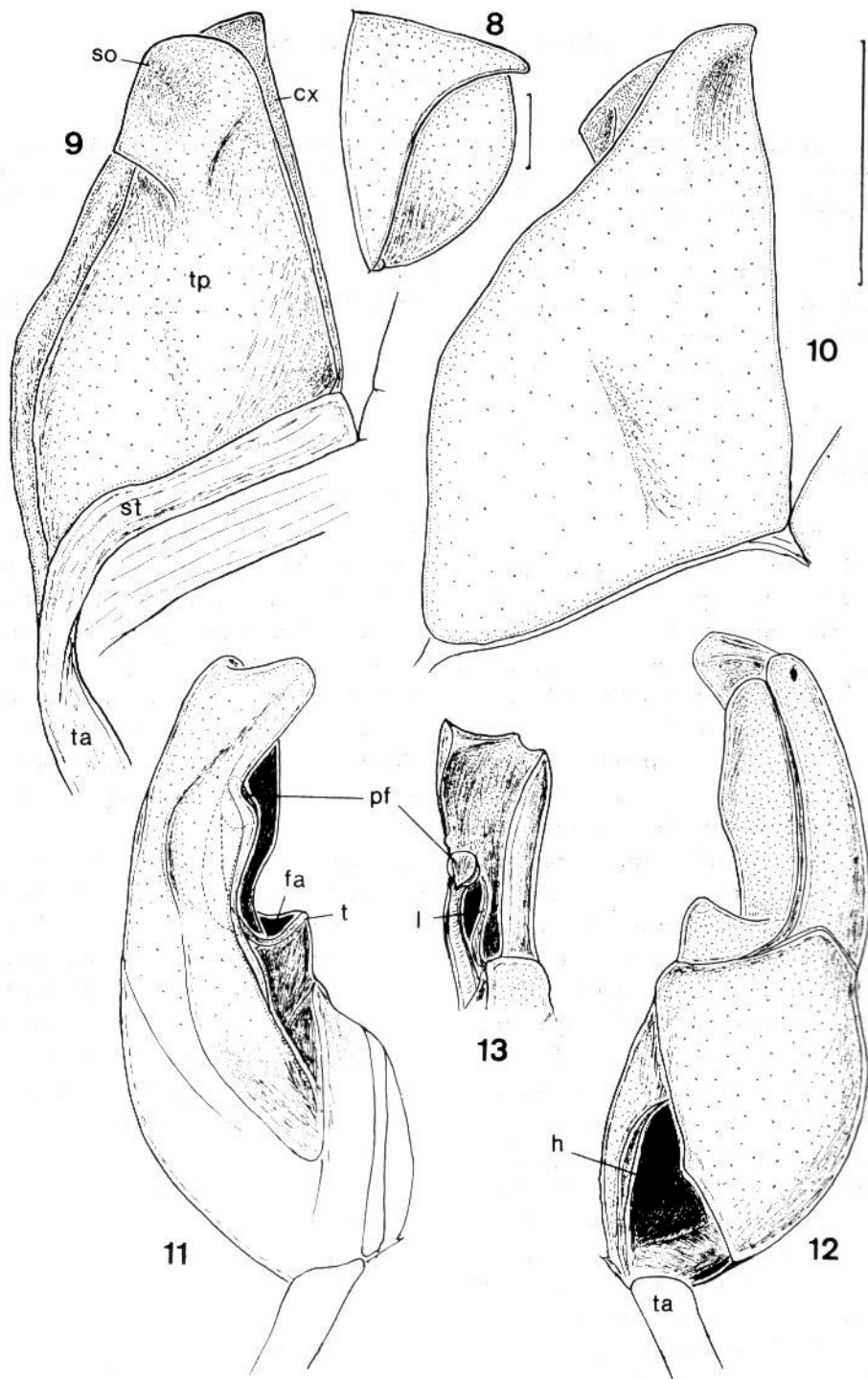
Description: Length ♂ 70—80 mm, ♀ 65—95 mm, width on midbody ♂ 5—6 mm, ♀ 5—7.1 mm, number of segments excluding telson 52—64 (♂), 50—58 (♀).

Coloration: Body dark grey-brown, prozona dark grey, somewhat marble, mottled paler grey-brownish; anterior two-thirds of metazonites dark brown, hind third brownish-yellowish, almost translucent. Head grey-brown, antennae rusty brown, legs pinkish-brown.

Body cylindrical, anterior body constriction very feeble, best expressed on ring 4, continues until segment 6. Antennae short and clavate, in situ a little overreaching hind margin of collum. Cheeks prominently concave for antennae to hinge into. Frontal axial suture quite distinct, 31—33 blackish, flat, compact ocelli in a round-triangular eye. Labrum deeply incised in the middle, with three usual teeth, labral setae 4 + 4, 5 + 6 (♂), 5 + 4 or 6 + 6 (♀). Collum rather broadly and roundly truncate, rimmed along anterior margin from level of eyes to hind edge, on sides laterally with a few incisions. Surface rather roughly and sparsely punctured, dorsally on both pro- and metazona and laterally (above and just below pore level) on prozona finely rugose, below pore level prozona well obliquely striate.

Metazonital striation rather distinct, especially ventrally, tending to grow less expressed towards both ozopores and telson, never reaching to dorsum, but in an increasingly confused way reaching to well above pore level. Striae of metazona, like those of prozona, rather sparse, some three in a square with its side equal to metazonital length below pores. Suture between pro- and metazona indistinct, ring constriction very feeble. Defensive pores inconspicuous, starting from ring 6, lying just in front of suture, practically touching it. Hind tergal limbus smooth. Epiproct moderately long, slender (Fig. 8), in lateral view rather narrowly, in dorsal view rather broadly rounded, somewhat flattened dorsoventrally. Anal valves practically not margined, rather regularly convex throughout, a little flattened only subventrally. Subanal scale spindle-shaped, normal. Legs rather short and stout, particularly leg-pairs 1 and 2, coxae 3—5 distoventrally particularly well swollen, remaining pregonopodal coxae somewhat less so. Tarsal pads missing; claws long, slightly curved, about 1/3 as long as tarsus.

♂♂: Legs with two-three tarsal and one distal strong seta on preceding joints. Prefemora peculiar in having swollen (pregonopodal legs) to much



Figs 8–13. *Physobolus pulvinipes* sp. n. 8 = epiproct, lateral view, 9 = right coleopod, caudal view, 10 = left coleopod, frontal view, 11–12 = right phallopod, frontal and caudal view, 13 = end of right phallopod, lateral view. Scales 1.0 mm each

swollen (postgonopodal legs) ventral sides in the form of pads, usually projecting as a distoventral process or tooth. These prefemoral pads with dorsoventral projections in paratype developed only till midbody, further on gradually decreasing in size almost completely to naught toward telson. Segment 7 ventrally with a high, rounded, single ridge, much narrower than in preceding species. Coxa 2 particularly high, outer sternal lobe straight, slightly rounded.

Gonopods: Anterior gonopods (coleopods, Figs 9—10) with tracheal apodemes (*ta*) completely fused to sternite (*st*), latter distinctly divided medially, holding together on frontal side only due to a membrane. Coxite (*cx*) simple, a little longer than telopodite, plate-like, abruptly attenuating from about midheight towards narrowly rounded apex. Telopodite (*tp*) a little smaller, similarly shaped, apically with a subsecuriform outgrowth (*so*), somewhat concave and directed laterad.

Posterior gonopods (phallopods, Figs 11—13) rather simple, suberect, in caudal view distinctly two-segmented. Tracheal apodemes (*ta*) independent, basal joint (coxite?, coxosternum?, "*cx*") with a rather voluminous hollow (seminal gland?, "*h*"). Distal segment three-lobate, frontal lobe exceeding a little in height both other subequal lobes, at base laterally with a peculiar tooth (*t*) with a good apical fovea (*fa*) terminating a well expressed groove, more distad of "*t*" on inner side of frontal lobe another groove is evident, which leads to a smaller fovea (pseudofovea?, "*pf*") situated at about mid-height of second segment. Both grooves seem to make one somewhat basally of "*t*", and proceed further basad towards "*h*". Between "*pf*" and frontal lamellae along the course of the distal groove there is an inconspicuous, short lamina ("*l*").

♀♀: Prefemoral pads missing. Usually only one tarsal seta, preceding joints likewise. Epiproct somewhat shorter than in males.

Remarks: *Physobolus* was established by ATTEMS (1936) as a monobasic genus for *Ph. olivaceus* from Darjeeling District, India. Later ATTEMS added two new species of *Physobolus* from Vietnam: *P. annulatus* and *striatus* (cf. ATTEMS 1953). However, the latter was shown (HOFFMAN 1969, MAURIÈS 1980) actually to be another junior synonym of the cosmopolitan spirobolellid, *Paraspirobolus dictyonotus* (LATZEL, 1895). Regarding the remaining two species, both need a thorough revision, since many important details in the descriptions by ATTEMS are either entirely missing, or uncertain, or too schematic. However, even with the data already available, *Ph. pulvinipes* sp. n. is certainly particularly closely related to the generotype *Ph. olivaceus*.* Indeed, both are quite large species, the telson is similarly shaped, scobina

* The identity of *Ph. annulatus* is less important for a proper allocation of our new species. Furthermore, its description is especially insufficient (ATTEMS 1953), in some points even contradictory.

absent and, what is more important, both coleopods and phallopods have a number of striking similarities. According to HOFFMAN (1969, 1979), the gonopod conformation of *Physobolus*, having the sternum of the coleopods small, transverse, completely fused to the tracheal apodemes and leaving the coxal plates entirely exposed, and the phallopods distinctly two-segmented and supplied with a basal gland, seems to be sufficiently disjunct to warrant a separate subfamilial status for this only genus. From the above diagnosis, despite certain deviations, *Physobolus pulvinipes* sp. n. distinctly falls into the *Physobolinae* of *Spirobolellidae*, although it is easily distinguishable from *Ph. olivaceus* by the ozopores lying on the prozona, the presence of prefemoral pads in the male, medially divided coleopod sternite, the position of "t" on the distal phallopod segment, etc. Some of those characters might prove to deserve a supraspecific category to be applied to *Ph. pulvinipes* sp. n., but, prior to a revision of *Physobolus* and some related spirobolellids (HOFFMAN & MAURIÈS, in litt.), it seems premature to allot our new species any higher status.

Trigoniulus lumbricinus (GERSTÄCKER, 1873)

(Figs 14—22)

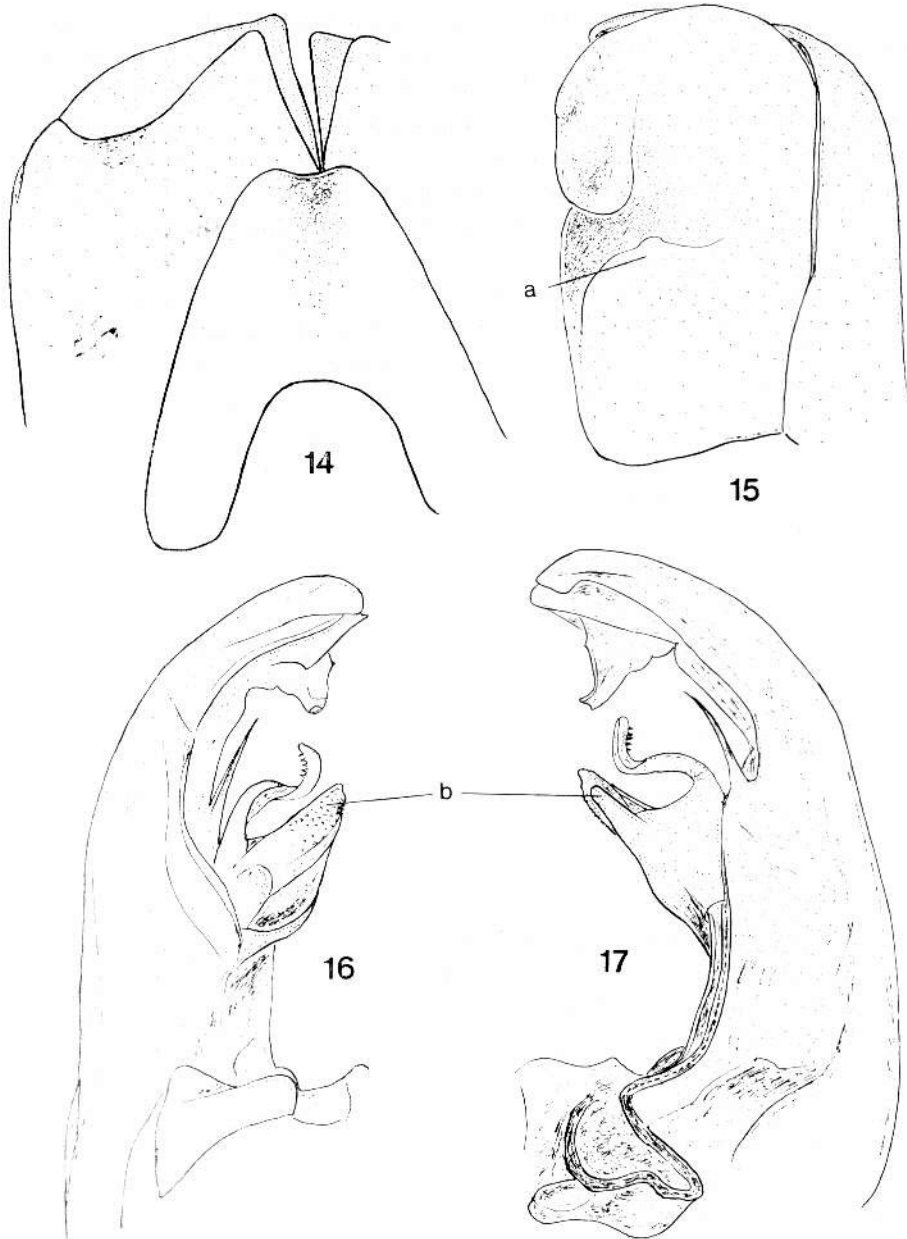
Locality: Vietnam, Xuan dinh, NW of Hanoi, singled from under bricks in ruderal area, 26. April 1966, (No. 187), leg. G. Topál, 3 ♂♂ and 3 ♀♀ (HNHM), 1 ♂ and 1 fragment (ZMMU). — Material examined: 8 specimens.

Width of midbody 3.0—3.3 mm in males and considerably wider, ca. 4.5 mm in females; number of segments excluding telson 49, 51 (complete males) and 50 (only complete female).

The Vietnamese material has usually the coloration greyish to greyish-yellowish, sometimes mottled orange, metazona orange, limbus yellowish pink, more seldom somites feebly marble. Head, antennae uniformly pink-yellowish, eyes blackish, rather compact, sometimes faded, about 40 ocelli in an eye. Legs reddish-brown, same as anal valves. Striation of rings rather confused only subventrally or ventrolaterally, gradually coming to naught above pore-level and towards telson. Limbus finely crenulate, pores begin from sixth segment. Anal valves thickly rimmed, epiproct practically wanting.

Gonopods as depicted (Figs 14—17), of particular attention seems to be the small size of the tubercle (*a*) on the shelf of the caudal side of the coleopode telopodite, and also the somewhat less heavily folded midheight outgrowth (*b* = "Innenarm" of ATTEMS 1897) of the phallopod.

Remarks: This pantropical species is known to be very common, sometimes referred to as the generotype *T. goesi* (PORAT, 1876), sometimes as *T. lumbricinus*. A full historical account of its geographical distribution may

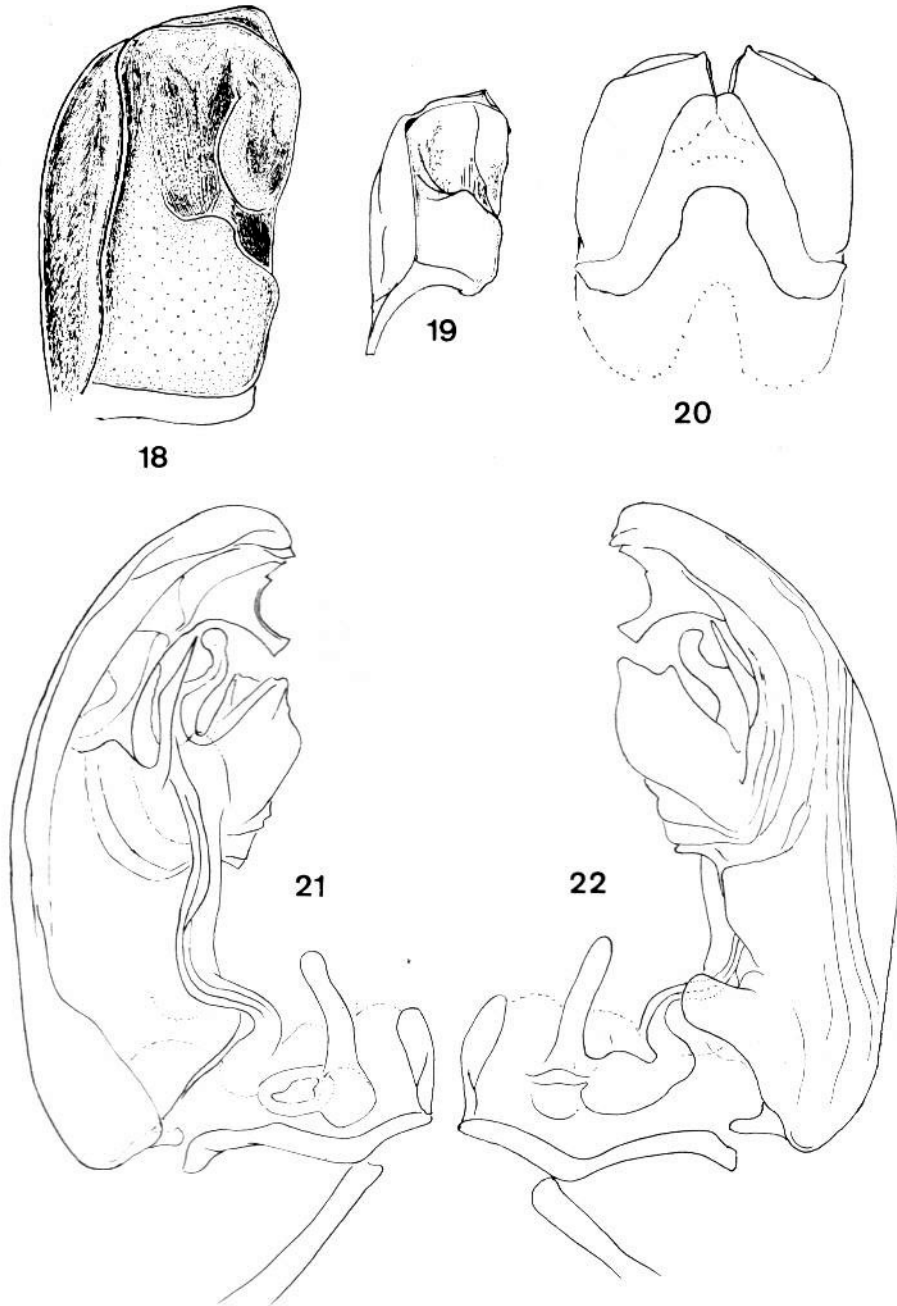


Figs 14–17. *Trigoniulus lumbricinus* (GERSTÄCKER, 1873) from Vietnam, leg. G. TOPÁL: 14–15 = left coleopod, frontal and caudal view, 16–17 = left phallopod, caudal and frontal view. Drawn not to scale

be found in MAURIÈS (1980). One of us (SG) has been privileged to examine for comparative purposes materials of *T. lumbricinus* deriving from Guadeloupe (ded. J.-P. MAURIÈS, Paris), Burma (Rangoon), Thailand (Chiang Mai), Malaysia (Teluk Merbau Malay), Sri Lanka (Colombo), Eastern Samoa (Pago-Pago) (all from the collection of ZMUC), and Western Samoa (Upola, coll. GOLOVATCH). Besides, through the kind assistance and upon permission of DR. MAURIÈS we have been privileged to reproduce here the original sketches of BRÖLEMANN's iconography kept at the MNHN, Paris (Figs 19—22), depicting the gonopods of a male from Parà State, Brasil. As a matter of fact, as regards the gonopod structure, the only reliable feature for a safe identification in almost the entire class Diplopoda, this common species so often referred to in myriapodological literature appears to have been illustrated quite seldom and far from satisfactorily. Thus, the rather small drawing of a phallopod of *T. lumbricinus* given by ATTEMS (1897, Fig. 30) of a specimen from Borneo or Java, as well as VERHOEFF's (1936) drawings of his *Marshallbolus takakuwai* from the Marshall Islands (a junior synonym of *T. lumbricinus*, see e.g. HOFFMAN 1979) are rather schematic and do not give an idea of intraspecific variability.

In this respect, all the materials of *T. lumbricinus* accumulated for the present study seem to be rather important, derive from very remote localities throughout the tropical zone of the globe, and allow certain comments to be made at least on individual variability of the species in question. Such a comparison throughout the range of such a common species (a senior synonym of the generotype!) as *T. lumbricinus* is rather important since *Trigoniulus* is certainly one of the largest spirobolidan genera encompassing at present well over hundred nominal forms seemingly indigenous in the Indo-Australian realm.

Although most of the alcohol specimens were identical or almost so in coloration to the pattern observed in the above Vietnamese samples, certain deviations from it were still traced. Thus, the Rangoon examples were mainly greyish-pink, rather greyish than orange on metazona. Colombo material was very dark brownish-red. In Samoa, Upola samples from a coconut plantation were very dark brown, whereas Pago-Pago specimens quite pale. This means perhaps that coloration of at least preserved material ranges significantly and seems to be variable rather individually than geographically. As regards the gonopod structure, usually the coleopods are provided with a better developed tubercle "a" (Figs 18—19), the tip of the coxite sometimes better pointed and varies a bit in height (Figs 14, 20 herein, and also Figs 1—5 in VERHOEFF 1936). The phallopods also display a certain degree of variation concerning the shape, size and armament of the different outgrowths and lamellae (Figs 16—17, 21—22 herein, and also Fig. 30 in ATTEMS 1897, and Figs 7—13 in VERHOEFF 1936).



Figs 18–22. *Trigoniulus lumbricinus* (GERSTÄCKER, 1873): 18 = right coleopod of a specimen from Guadeloupe, caudal view, 19–22: gonopods from a specimen from Parà State, Brasil, reproduced after BRÖLEMANN's unpublished iconography, 19 = right coleopod, caudal view, 20 = both coleopods, frontal view, 21–22 = right phallopod, frontal and caudal view. Drawn not to scale

However, despite its vast pantropical range and certain variability, *T. lumbricinus* is a good, easily recognizable species. At present it is known to occur in Indonesia, Thailand, Burma, India, Sri Lanka, Marshall Islands, Samoa, Seychelles, Zanzibar, Comores, Cape Verde Islands, Antilles, Brasil. In Vietnam, *T. lumbricinus* has been reported by ATTEMS (1953) from the southern part of the country (Cochinchina = Chungbo), our present record concerns the northern part (Tonkin = Nambo), substantiating GOLOVATCH's (1983) data.

REFERENCES

- ATTEMS, C. (1897): Myriopoden. — Abh. senckenb. naturforsch. Ges., **23**: 471—536.
- ATTEMS, C. (1936): The Diplopoda of India. — Mem. Indian Mus. Calcutta, **11**: 133—323.
- ATTEMS, C. (1938): Die von C. Dawydoff in Französisch Indochina gesammelten Myriopoden. — Mém. Mus. natn. Hist. nat. Paris, n. s., s. A, **6**: 187—353.
- ATTEMS, C. (1953): Myriopoden von Indochina. Expedition von Dr. C. Dawydoff (1938—1939). — Mém. Mus. natn. Hist. nat. Paris, n. s., s. A, **5**: 133—230.
- CARL, J. (1941): Diplopoden von Südindien und Ceylon. 2. Teil: Nematophora und Juliformia. — Revue suisse Zool., **48**: 569—714.
- CHAMBERLIN, R. (1920): On some new myriapods collected in India in 1916 by C. A. Kofoid. — Univ. Calif. Publs. Zool., **19**: 389—402.
- GOLOVATCH, S. I. (1983): Millipedes (Diplopoda) of the fauna of Vietnam. — In: Fauna and Ecology of Animals of Vietnam. "Nauka" Publ., Moscow, pp. 178—186. (in Russian).
- HOFFMAN, R. L. (1962): Studies on spiroboloid millipeds IV. Systematic and nomenclatorial notes on the family Pachybolidae. — Revue suisse Zool., **69**: 759—783.
- HOFFMAN, R. L. (1969): Studies on spiroboloid millipeds VII. A remarkable new genus and subfamily of the Spirobolellidae from Vera Cruz, Mexico. — Proc. biol. Soc. Wash., **82**: 177—188.
- HOFFMAN, R. L. (1979): Classification of the Diplopoda. — Mus. Hist. Nat., Genève, pp. 237.
- MAURIÈS, J.-P. (1980): Myriapoda — Diplopoda. Contributions à l'étude de la faune terrestre des îles granitiques de l'archipel des Séchelles. — Revue zool. afr., **94**: 138—168.
- POCOCK, R. I. (1892): Report upon two collections of Myriopoda sent from Ceylon by Mr. E. E. Green, and from various parts of Southern India by Mr. E. Thurston, of the Government Central Museum, Madras. — J. Bombay nat. Hist. Soc., **7**: 131—173.
- POCOCK, R. I. (1893): Viaggio di Leonardo Fea in Birmania e regioni vicine LV. On the Myriapoda of Burma. — Annali Mus. civ. Stor. nat. Genova, **33**: 386—406.
- POCOCK, R. I. (1903): Remarks upon the morphology and systematics of certain chilognathous diplopods. — Ann. Mag. nat. Hist., ser. 7., **12**: 515—532.
- SILVESTRI, F. (1916): Four new species of Aulacobolus Poc. (Diplopoda, Spirobolidae) from India. — Rec. Indian Mus., **12**: 41—48.
- VERHOEFF, K. W. (1936): Über einige ostasiatisch-oceanische Chilognathen gesammelt von Herrn Y. Takakuwa in Tokyo. — Trans. Sapporo nat. Hist. Soc., **14**: 228—235.