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A REVIEW OF WORLD TROGLOPEDETINI (INSECTA, COLLEMBOLA, PARONELLIDAE)

INCLUDING AN IDENTIFICATION TABLE AND DESCRIPTIONS OF NEW SPECIES.

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ABSTRACT

The taxonomy of the tribe Troglopedetini is reviewed and a table to identify the 25 species is given. *Troglopedetes churchillatus* Wilson and *Troglopedetes nepalensis* sp. nov. from the caves of Nepal are described with a brief discussion of their cave dwelling habits. *Troglopedetes madagascarensis* sp. nov. is also described.

RESUMÉ

La taxonomie de la tribu Troglopedetini est revue et un tableau aux 25 espèces est présenté. *Troglopedetes churchillatus* Wilson et *Troglopedetes nepalensis* sp. nov. des grottes de Népal sont décrits avec une brève discussion de leurs coutumes habitudes de vie dans les grottes. *Troglopedetes madagascarensis* sp. nov. est décrit aussi.

INTRODUCTION

During a caving expedition to the Himalaya, studies were made of the biology and micro-climate of the Pokhara Valley caves and others (Turner 1977 a and b; Wilson 1977 a and b; Durrant et al. 1979). Among the many interesting animals collected (table 1 and Appendix) were two undescribed paronelloid Collembola (springtails) which are common in the Pokhara caves. One is a troglobite, the other a troglophile; both belong to the genus *Troglopedetes* within the tribe Troglopedetini. In order to classify these new species effectively and describe them with respect to closely related Collembola, it was necessary to review the literature on the Troglopedetini. Some confusion seems to have developed in the taxonomy of this tribe so it is hoped that this review will clarify several problems.

The taxonomy of the Troglopedetini is muddled. Some difficulties are due to the fact that the tribe appears to be diphyletic (Massoud 1978 pers. com.). The contrasting presence or absence of a sub-divided Antenna IV and the one or two rows of dental spines all within this one tribe encourages me to support Massoud's view. The confusion is made worse by taxonomists' use of different characters to define their species which makes comparisons very difficult. Most Troglopedetini have been described from less than 10 specimens, several from only one individual. In most cases no representatives of these species have been discovered since. Fjellberg (1976), in his interesting paper discussing the occurrence of different forms within the same collembolan species, underlined the dangers of describing a species from a few individuals. If these few individuals are later found to be from the edge of the geographic range of that species, they may not be morphologically characteristic of that species.

TRIBE TROGLOPEDETINI BÖRNER 1913

The Troglopedetini are Entomobryoid Collembola. This means that they have a well developed furca (so they can spring well); abdominal segment IV is at least twice as large as any other body segment and the Post Antennal Organ is absent. The eyes tend to be reduced (i.e. fewer than the maximum of eight on each side) or absent and many species live in caves.

Representatives of the tribe have scales on their bodies. The dens has one or two rows of spines on its posterior face and the mucro tends to be much longer than that of their brothers in the tribe Paronelli. Various taxonomists have placed the Troglopedetini in families: Entomobryidae, Cyphoderidae and the Paronellidae and the tribe certainly provides a link between the three families.

Five genera have been described within the tribe (*Troglopedetes**, *Cyphoderopsis*, *Trogolaphysa**, *Troglopedetina** and *Trogonella*), of which only the three asterisked are here recognised as valid.

Genus *Troglopedetes* Joseph

Troglopedetes Joseph, 1872: 180, Type-species: *Troglopedetes albus* Joseph 1872: 180, by monotypy (Gurtal, S. Austria).

Troglopedetes Absolon 1907: 335, Type-species: *Troglopedetes pallidus* Absolon, 1907: 335 (= *T. albus* Joseph, 1872) by original designation. Junior homonym, independently proposed, of *Troglopedetes* Joseph, 1872, syn. nov.

Cyphoderopsis Carpenter, 1917: 566 Type-species: *Cyphoderopsis kempfi* Carpenter, 1917: 288. Synonymy with *Troglopedetes* Absolon by Bonet, 1931: 362.

Bonet (1931) synonymised *Troglopedetes* and *Cyphoderopsis* because there is no obvious way of separating the two taxa. But despite the overlap between the two genera, several new species have been described in *Cyphoderopsis* since 1931. The taxonomists involved have not commented on their use of the junior synonym.

It is likely that the scale-like appendage that characterises *Cyphoderopsis kempfi* (the type-species) was an aberration of the single specimen seen by Carpenter and, since it is now so deteriorated that it is now hardly recognisable as a Collembolan, the presence of the appendage cannot be confirmed. I currently follow Bonet in his placement of *Cyphoderopsis* as a junior synonym of *Troglopedetes*.

There may, however, be a case for reserving *Cyphoderopsis* for old world Troglopedetini with two rows of dental spines and undivided Antenna IV i.e. *kempfi*, *gracilis* and *lamottei*. Further study and more specimens are required.

DIAGNOSIS

Troglopedetes are with one or two rows of simple dental spines, with or without sub-divided Antenna IV, with or without ommatidia (ocelli).

DISTRIBUTION

Most representatives have been collected from Europe and Asia but two species have been described from Africa. They are often found in caves and over half of the known species are troglobites. If found on the surface, they are most frequently found in leaf litter of under stones. The genus currently contains 19 species.

Catalogue of species of *Troglopedetes*

1. *T. albus* Joseph

Troglopedetes albus Joseph 1872: 180, Type material not located, presumed lost; AUSTRIA.
Troglopedetes pallidus Absolon, 1907: 335, YUGOSLAVIA. Synonymy suggested by Paclt (1946:83)
Troglopedetes pallidus distinctus Absolon & Ksenemann, 1942: 6, YUGOSLAVIA. Joseph's description reads "Ich reihe hieran eine neue augenlose podure *Troglopedetes albus*, sp. nov. mit einem Springschwanz von fast der Länge des Körpers aus den Grotten von Cumpole, Podec und Gurk in Unerkrain ..." i.e. a blind Collembolan with a furca almost as long as the body.

According to Hörn and Kahle (1936) Joseph's specimens have been dispersed: "Joseph, Gustav (1828-ca.1891) Sammlg. 1907 via W. Hoefig, 1920 via Standinger and Bang Haas (Dresden-Blasewitz) vereinzelt" and it seems most unlikely that his types will be recovered.

Paclt (1946: 83) suggested that *Troglopedetes albus* was a *nomen nudum* but Ellis and Bellinger (1973: 57) correctly indicate that the name is available under the criteria of the International Code of Zoological Nomenclature. Paclt says that it is highly probable that *Troglopedetes albus* Joseph is identical with *Troglopedetes pallidus* Absolon. The geographical distribution of the two species and the scant description of *T. albus* do not negate this view. No other *Troglopedetes* species are known from this part of Europe. However, it is difficult to understand why Absolon should have used the name coined by Joseph without referring to him, unless it was a great coincidence.

According to Bogojevic (1968) this species has been collected again recently from Yugoslavia.

TABLE 1 : SPECIES LISTS FOR SOME HIMALAYAN CAVES

	MAHENDRA GUPHA N. Pokhara: height 1100m. c. 200m of passage	ODERIBUWAHN GUPHA N. Pokhara: height 1100m c. 80m of passage	WINDOW CAVE N. Pokhara: height 1100m c. 20m of passage
COLLEMBOLA	<u>Hypogastrura carpetana</u> <u>Onychiurus yodai</u> (<u>Lobella kraepelina</u>) <u>Sinella sp.</u> <u>Troglopedetes church*</u> <u>T. nepalensis*</u> <u>Isotomeilla minor</u> <u>Cryptopagus thermophilus</u> <u>Folsomides exiguus</u>	Lepidocyrtus sp. <u>Troglopedetes church*</u> <u>T. nepalensis*</u>	<u>Troglopedetes</u> (<u>churchi</u> <u>latus</u>)
THYSANURA	<u>Nicoletia</u>		
EARWIGS	Forcipula sp.	Forcipula sp. Nala nepalensis	
BOOK LICE	<u>Liposcelis sp.</u>	<u>Liposcelis sp.</u>	
BUGS	++		
MOTHS	++	<u>Tinea antricola</u>	++
BEETLES	<u>Cryptobium humerale</u> <u>Philodactylae larvae</u>	<u>Cryptobium humerale</u> <u>Cercyon sp.</u>	Leioidid
ANTS etc.	<u>Brachyponera spp.</u> <u>Lophomyrmex sp.</u> <u>Pachycondyla luteipes</u>	<u>Pheidole sp.A</u>	<u>Pheidole sp.B</u>
FLIES (bat-flies listed below)	<u>Conicera kempii</u> <u>Drosophila sp.</u> <u>Leptocera rufilabris</u>		
MITES	<u>Hypoaspis spp.B,C&D</u> <u>Uropodids</u>	<u>Hypoaspis sp.B</u> <u>Machrocheles sp.</u> <u>Uropodids</u> <u>Schweiba sp.</u> <u>?Linopodes sp.</u> <u>Oribatids</u>	<u>Machrocheles glaber gr.</u>
SPIDERS etc.	<u>Sparassids</u> <u>Linyphiids</u> <u>Salticids</u> <u>Pholcids</u>	<u>Linyphiid</u> <u>Theridiids</u> <u>Pholcids</u>	<u>Sparassids</u> <u>Linyphiids</u> <u>Pseudoscorpiones</u>
MILLIPEDES	<u>Trachyiulus sp.</u>	<u>Trachyiulus wilsonae*</u> <u>Polydesmida sp.</u>	
WOODLICE	++	++	
CRABS	(<u>Potamon atkinsoniamum</u>)		
SNAILS	<u>Macrochlamys sp.</u>	<u>Macrochlamys sp.</u>	
WORMS	<u>Dichogaster sp.</u>	<u>Dichogaster sp.</u>	<u>Dichogaster sp.</u>
BATS each with their bat-flies in []	<u>Rhinolophus macrotis</u> <u>Hipposideros bicolor</u> [<u>Raymondia molossa</u>] <u>Hipposideros armiger</u> [<u>Stylidia ornata</u>] [<u>Brachytarsina sp.</u>] <u>Megaderma lyra</u> [<u>Raymondia molossa</u>]	++	++
PLANTS	Various <u>Phycomycetes</u> 'Wall Fungus'	<u>Phycomycetes, Fungi</u> <u>Imperfecti & inwashed</u> <u>flowering plants.</u>	<u>Phycomycetes</u>

KEY
 Probable Troglobites (ringed)
 Guanophiles underlined
 Accidentals (in brackets)

TABLE 1 continued.

KAARR
JUNGLE CAVE
N. Pokhara:
height 1100m.
c. 20m of passage

HARPAN
RIVER CAVE
S. Pokhara:
height 1000m.
1500m of passage

CHOBHAR
GORGE CAVES
Katmandu:
height 1200m
200m + passage

DOON VIEW
CAVE
N. India
height 1000m
c. 100m of passage

Hypogastrura carp.
Onychiurus yodai

Troglopedetes church*
T. nepalensis*

Sinella
T. nepalensis*

Hypogastrurids
Pseudosinella sp.

Forcipula trispinosa

(Philonthus rivularis)
Neoblemus championi
Gyrinids
Dytiscids

Wegneria cerodelta

W. cerodelta

Histerids
Brachonid

Conicera kempi
(Phebotomus longiductus)

Conicera kempi

Hypoaspis sp.

Uropodids

Hypoaspis sp.A
(Haemaphysalis
montgomeryi)

Linyphiid
Salticids

Harvestmen

Pseudoscorpiones

Podoglyphiulus nepalensis*
Strongylosomida sp. Strongylosomida sp.

(Potamon sp.)

Chorodes; hairworm

Rhinolophus lepidus

Hipposideros armiger

Hipposideros armiger
Rousettus leschenaulti

Hipposideros
cineraceus
[Raymondia molossa]

Hipposideros armiger

Megaderma lyra
[Raymondia molossa]

Phycomycetes

Phycomycetes, Fungi
Imperfecti & "Lichen"

Phycomycetes

Phycomycetes

KEY:
others are Trogloniles
++ group present in cave
most accidentals are omitted
* signifies new species

2. *T. kempfi* (Carpenter)
Cyphoderopsis kempfi Carpenter 1917: 566. Holotype, N.E. India (B.M.(N.H.)) (examined)
Troglopedetes kempfi (Carpenter) Bonet 1931: 362.
 I have examined the only existing specimen of *T. kempfi* (at the British Museum). It is in such a poor state of preservation that it is hardly recognisable as a Collembolan. Carpenter gave adequate drawings.
3. *T. gracilis* (Carpenter)
Cyphoderopsis gracilis Carpenter, 1924: 288. N.E. India
Troglopedetes gracilis (Carpenter) Bonet, 1931: 362.
4. *T. absoloni* Bonet
Troglopedetes absoloni Bonet, 1931: 363. SPAIN
5. *T. cavernicola* Delamare
Troglopedetes cavernicola Delamare, 1944: 30. PORTUGAL
Troglopedetes wichmanni Delamare, 1950b: 295. *Nomen nudum* listed from "Grottes de l'Ile de Crete" without description. This animal has never been described but I suspect that this species is identical with *Troglopedetes cretensis* Ellis, 1976: 306. *Troglopedetes cretensis* is so similar to *T. cavernicola* Delamare from Portugal, that I suspect that Delamare decided not to describe *T. wichmanni* as a separate species. The chaetotaxy and other characters of *T. cavernicola* and *T. cretensis* are similar enough to suggest that these are not separate species, but in view of the lack of opportunity to examine specimens, I consider it most satisfactory to leave *T. cretensis* as valid for the present.
Troglopedetes wichmanni Delamare, 1950 is *nomen nudum*.
6. *T. machadoi* Delamare
Troglopedetes machadoi Delamare, 1946: 101. PORTUGAL
7. *T. lamottei* (Delamare)
Cyphoderopsis lamottei Delamare, 1950a: 44. W. AFRICA. I follow Bonet (1931) who synonymized *Cyphoderopsis* with *Troglopedetes*.
8. *T. ruffoi* Delamare
Troglopedetes ruffoi Delamare 1951: 44. ITALY
 Figure 3 shows the chaetotaxy of the specimen held at Museum National d'Histoire Naturelle, Brunoy (Paris). *Troglopedetes ruffoi* has long wing-like basal teeth (on the claw) which are longer than the empodial appendage. The long body setae and enormously long antennae are characteristic adaptations to cave life. This is almost certainly a troglobitic (tbt) species and unlikely ever to be found in the epigeal domain (epig).
9. *T. orientalis* Cassagnau & Delamare
10. *Troglopedetes orientalis* Cassagnau & Delamare 1955: 385. LEBANON
T. vandeli Cassagnau & Delamare
11. *T. canis* Christiansen
Troglopedetes canis Christiansen 1957: 86. LEBANON
12. *T. lindbergi* Stach. Comb. Nov.
Troglopedetina lindbergi Stach, 1960: 546. AFGHANISTAN. Delamare stipulated that *Troglopedetina* is a genus of *Troglopedetini* with sub-divided Antenna IV. *T. lindbergi* has no such subdivision and belongs within *Troglopedetes*. *T. lindbergi* has no ommatidia but does have pigment where the eyes once were.
13. *T. ceylonica* (Yosii) Comb. Nov.
Cyphoderopsis ceylonica Yosii 1966a: 386. CEYLON, N.E. INDIA. Following Bonet (1931) this species belongs within *Troglopedetes*. Yosii (1966b) further described his species with material from Sikkim and Assam (India).
14. *T. sexocellata* (Yosii) Comb. Nov.
Cyphoderopsis 6-ocellata Yosii 1966a: 387, TAIWAN, INDIA. Yosii is again using an abandoned genus without justifying this decision.
15. *T. decemoculata* (Prabhoo). Comb. Nov.
Cyphoderopsis decemoculata Prabhoo 1971: 37. S. INDIA. Prabhoo does not justify his use of the abandoned genus.
16. *T. cretensis* Ellis
Troglopedetes cretensis Ellis, 1976: 306. CRETE
 This species is very close to *T. cavernicola* Delamare 1944 but Ellis justifies its designation as a separate species. *T. cretensis* may be identical with the undescribed *T. wichmanni* of Delamare 1950b: 295.

17. *T. churchillatus* Wilson
Troglopedetes churchillatus Wilson in Durrant, Smart, Turner & Wilson, 1979: 47.
 Lectotype Adult NEPAL (BM(NH)), here designated (examined). See page 220 and Figs. 1-4
 for the description of this species.
18. *T. nepalensis* sp. nov.
 see page 221 and Figs. 3 & 5
 for the description of this species.
19. *T. madagascarensis* sp. nov.
 See page 222 and Figs. 6-8
 for a preliminary description of this species.
- Genus *Trogolaphysa* Mills

Trogolaphysa Mills, 1938, Type-species *Trogolaphysa maya* Mills, 1938, by monotypy.

DIAGNOSIS

Trogolaphysa are with two rows of simple dental spines,
 without a sub-division of Antenna IV,
 with or without ommatidia.

A new world genus found both in caves and on the surface. Salmon (1964: 134) proposed that *Trogolaphysa* is a junior synonym of *Troglopedetes* but I consider the genus sufficiently distinct and therefore valid.

1. *T. maya* Mills
Trogolaphysa maya Mills, 1938: 184. MEXICO
2. *T. millsii* Arlé
Trogolaphysa millsii Arlé, 1946: 28. Two syntypes BRAZIL.
 This species was described from just two individuals from Rio de Janeiro and these are clearly immature. *T. millsii* is quite different from the type-species and its affinities are unclear. Delamare (1950b: 293) placed it in *Troglopedetina* but without justifying this. It has not been collected since and descriptions based upon immature specimens can be misleading. It seems convenient to leave *T. millsii* with the other American species in *Trogolaphysa*, for the present.
3. *T. delamarei* (Massoud & Gruia) Comb. Nov.
Troglopedetes delamarei Massoud & Gruia, 1973: 339. CUBA. The undivided antenna IV and two rows of dental spines and external teeth basally on the empodium of the claw make this species closer to the type-species of *Trogolaphysa* than to the old world *Troglopedetes*.

Genus *Troglopedetina* Delamare

Troglopedetina Delamare 1945: 41. Type-species *Troglopedetina jeanneli* Delamare 1945, by monotypy.

DIAGNOSIS

Troglopedetina are with one row of simple dental spines,
 with a sub-divided Antenna IV,
 with at least 1+1 ommatidia,
 and with numerous elongated scales which are greatly swollen at their apices.

Ommatidia are unreliable taxonomically and can be so variable that Poinso (1971) considered that eye number should not be used to separate species. Absence or number of eyes gives little phylogenetic information, but only shows adaptation to living in caves or sub-soil habitats.

The sub-division of Antenna IV and the presence of a single row of dental spines do not separate *Troglopedetina* from other members of the tribe although there is a good case for reserving the genus *Troglopedetina* for all the *Troglopedetini* with sub-divided Antenna IV and one row of spines on the dens: these are mainly the African species. All known *Troglopedetina* species have eyes and are surface dwelling (epigeal).

Three described species are recognised and in addition Delamare (1950b: 293) gave names for six 'new' but undescribed *Troglopedetina* from Kenya and the Ivory Coast. He described these species as having one to three ommatidia on each side of the head. These six species must all be regarded as *nomina nuda* but emphasise that *Troglopedetina* is an African genus.

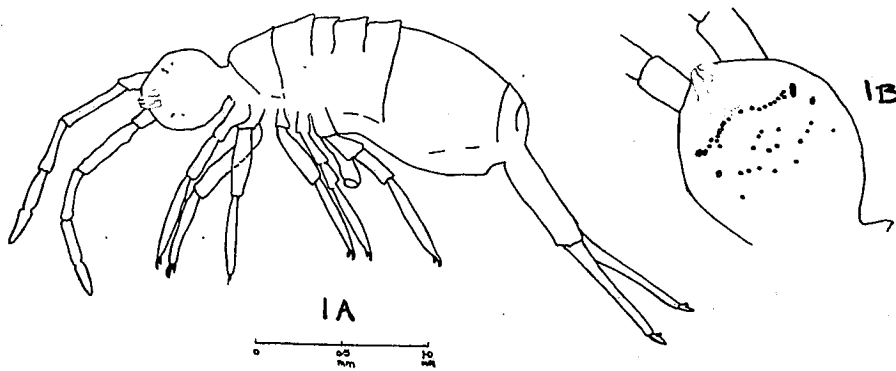


FIGURE 1: *Troglapedetes churchillatus* Wilson

1A Habitus of the Lectotype; 1B Head chaetotaxy and eye-spot pigment of the same individual; 1C The right side of the head behind the first antennal segment showing how the eye-spot pigment may not surround the lenses. The bases of the head setae are shown; 1D Diagram of the right ocellar patch (after Guthrie 1906) showing the position of A, B and F ocelli with their associated pigment patches; the position that the lost C, D, E, G and H ocelli would have occupied is also indicated.

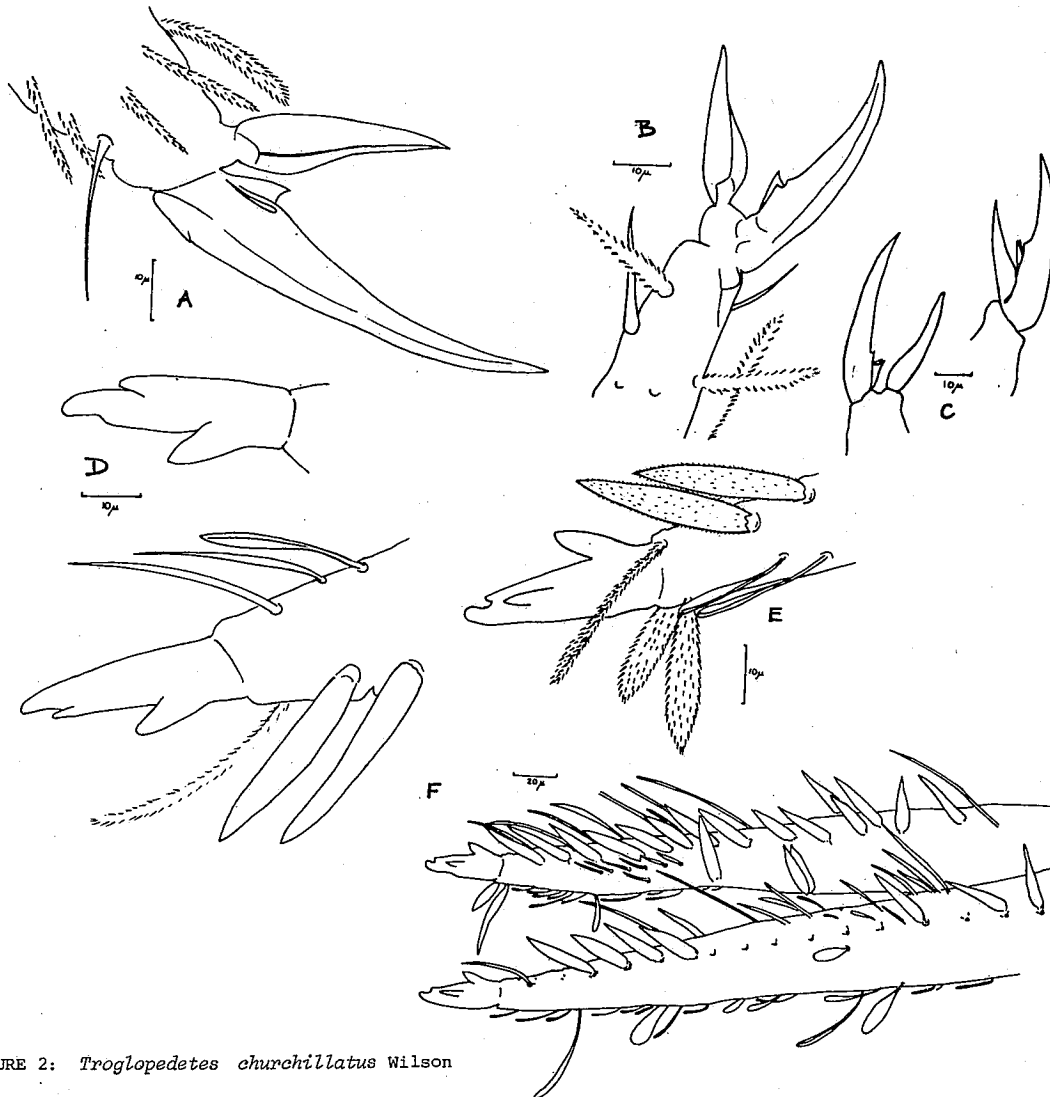


FIGURE 2: *Troglapedetes churchillatus* Wilson

2A Shows the mid-claw and 2B the hind claw on the feet of the lectotype. 2C Is two drawings of the same claw; the apparent differences in shape were achieved by moving the claw on the microscope slide; 2D, E and F Are mucrones on the springing organ (furca) of *T. churchillatus*; 2D shows the mucrones of the same individual; 2E Illustrates the mucro and the finely ciliated spines on the dens; 2F Shows the mucrones and dentes. Note that the dens in thickly covered with scales and setae. One row of dental spines is present on each dens.

CHAETOTAXY

T. nepalensis *T. churchillatus* *T. ruffoi*

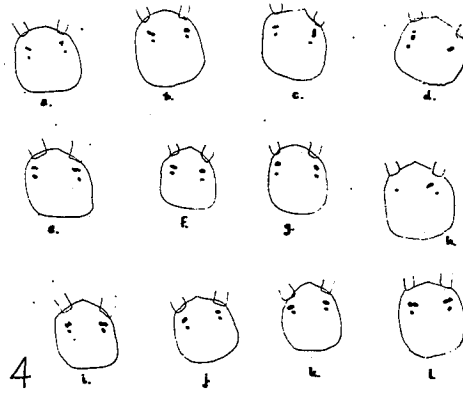
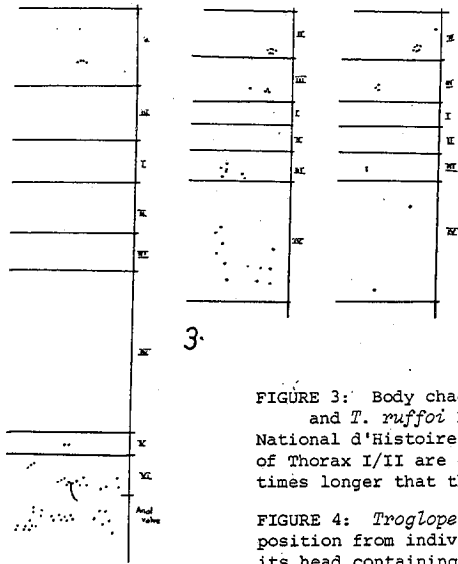


FIGURE 3: Body chaetotaxy of *Troglopedetes nepalensis* sp. nov., *T. churchillatus* Wilson and *T. ruffoi* Delamare. *T. ruffoi* is drawn from the specimen at the Museum National d'Histoire Naturelle, Brunoy. The 2-3 rows of setae at the anterior edge of Thorax I/II are omitted in each case. In *T. ruffoi* these setae are about three times longer than the empodium.

FIGURE 4: *Troglopedetes churchillatus* Wilson. The eye-spot pigment varies in position from individual to individual. 4h has only eye-spot on the left side of its head containing only one lens thus it has just 1+3 lenses. In contrast 4d shows an animal with 3+1 pigment patches containing the normal number of 3+3 lenses.

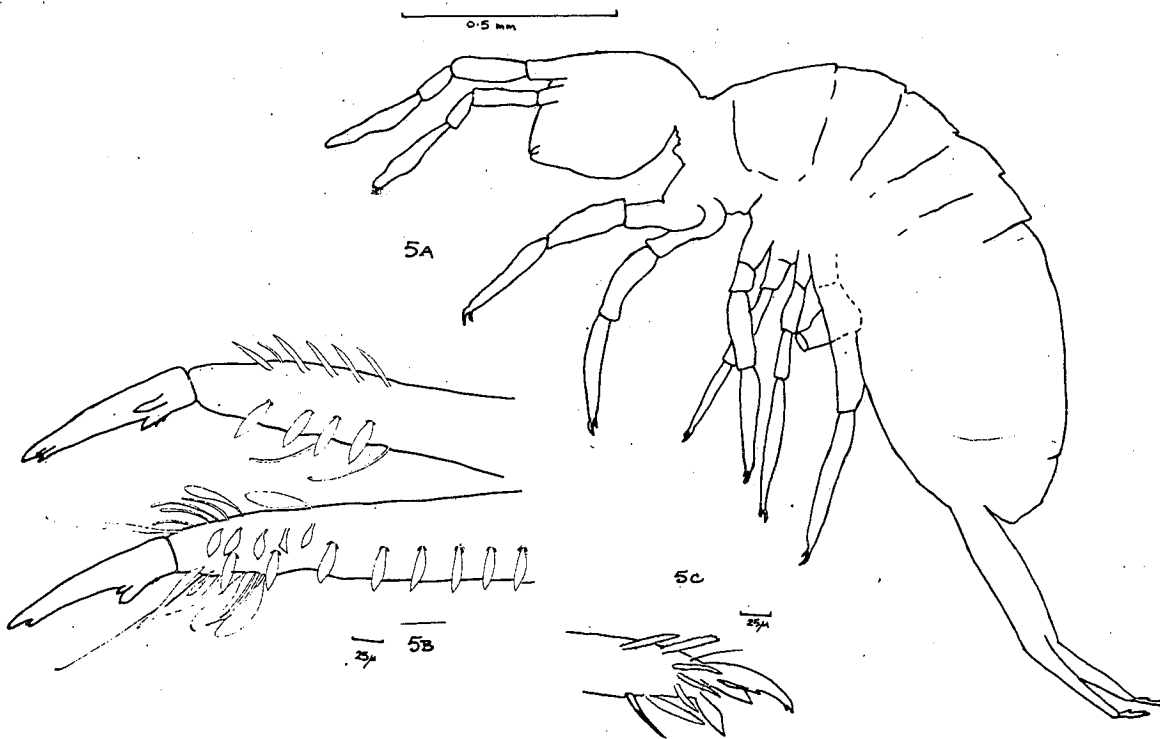


FIGURE 5: *Troglopedetes nepalensis* sp. nov. 5A habitus ; B: mucro and part of the dens; note again the abundance of scales and setae and the single row of dental spines. (Some anterior spines and setae are omitted). 5C shows a typical claw with the pointed tenent hair.

The elongated scales seem to be the only character peculiar to *Troglopedetina*. In the absence of the time and material necessary to investigate the relationships between *Troglopedetina* and *Troglopedetes*, it seems reasonable to recognise *Troglopedetina* as a genus containing:-

1. *T. jeanneli* Delamare
Troglopedetina jeanneli Delamare, 1945: 41. KENYA
2. *T. tridentata* Salmon
Troglopedetina tridentata Salmon 1954: 161. UGANDA.
3. *T. schalleri* Hütner
Troglopedetina schalleri Hütner 1962: 219. SUDAN.

TAXA REJECTED FROM THE TROGLOPEDETINI

Trogonella Delamare, 1951b Type-species *Trogonella pauliani* Delamare, 1951b by monotypy.

This monotypic genus was described from just three individuals, which are all apparently immature *Paronella* sp. (Z. Massoud 1978, pers. com.). The genus is therefore a junior synonym of *Paronella*.

Cyphoderus lavaticus (Stach) comb. nov.

Cyphoderopsis lavaticus Stach 1960: 545 *C. lavaticus* has an empodial appendage that is characteristic of *Cyphoderus* (Z. Massoud 1978, pers. com.), and its mucro is unlike any other member of the Troglopedetini and so it has been rejected from this tribe.

SPECIES OF UNCERTAIN POSITION

Troglopedetes nayakensis Stach 1960: 543 is also unlike other troglopedetines. It does not possess the dental spines that are characteristic of the Troglopedetini and the rather scanty description that Stach gives, makes it difficult to know where its affinities lie.

In summary, I restate that *Cyphoderopsis* is a junior synonym of *Troglopedetes*. The genus *Trogonella* is rejected from the Troglopedetini, leaving the tribe with three genera: *Troglopedetes* (with 19 old world species), *Troglopedetina* (with three African species) and *Trogolaphysa* (with three American species).

IDENTIFICATION TABLE FOR SPECIES OF TROGLOPEDETINI

Table 2 has been constructed to facilitate quick and easy identification of the world Troglopedetini. The information it contains is abstracted from published descriptions, supplemented with a few observations on specimens at the British Museum (Natural History) in London and Muséum National d'Histoire Naturelle at Brunoy. Attempts have been made to standardise descriptions but in many cases this was not possible without reference to specimens. Table 2 does show how inadequate many descriptions are - a point that is hidden in dichotomous keys. The table has the advantage over a key in that it can be used to identify mutilated specimens and it should also continue to be useful even after many more species have joined the ranks of the Troglopedetini.

Some of the antenna:head ratios quoted are those I have measured from small-scale published illustrations and so may only be very approximate. These figures are underlined to on Table 2 column 3 to distinguish them from measurements taken from specimens.

The numbers of mucronal teeth quoted in Table 2 should be regarded with caution as ribs, lamellae, serrations and undulations may be interpreted in different ways (P.N. Lawrence 1981, pers. com.). Goto and Ugel (1961) pointed out that there can be substantial intra-specific variation in the mucro and that some "mutants" may even have an abnormal number of mucronal teeth. Ideally this present study should have been based more upon types, but time did not permit a search for the type specimens that are still available. So this is offered as a guide and a basis for further study, rather than a definitive work.

Any species which has only been collected from caves is designated a troglobite (tbt) here. Further collections may well show some of these to be troglaphiles (tphl).

SPECIES DESCRIPTIONS

Troglopedetes churchillatus Wilson in Durrant et al. 1979: 47. (Figs. 1-4).

This interesting Collembolan was named in memory of Sir Winston Churchill.

DESCRIPTION

A lightly pigmented or white collembolan of maximum length 2.6mm. Usually 3+3 eyes. Habitus as in figure 1A; an active, fast-moving species that was never found in aggregations.

Antenna to head length 2.3:1; antenna to head breadth 2.8:1 and antenna to body length (i.e. head and body) 1:1.9. Ratio of antennal segments I-IV as 1:1.8:1.6:2.7 (head length 20.7; breadth 17.2) i.e. 14%:26%:23%:37%. Antenna IV divided into two almost equal sub-segments in the ratio 1.1:1.

The number of ommatidia visible and the position and distribution of eye-spot pigment are variable (see page 4). One individual apparently had 1+3 lenses (figure 4H).

Legs without scales; tibiotarsal hairs not clubbed. Tenent hairs pointed. Empodium tridentate, with an additional minute tooth externally. Lanceolate empodial appendage (with small external tooth), bulging basally (figures 2A, B and C).

Manubrium:dens:mucro ratio 15:16:1 (i.e. 46%:51%:3%). Four teeth on the mucro (figures 2D, E and F). No teeth-like serrations after the basal tooth of the mucro. A single row of dental spines which are covered with minute setae. These are only visible under high magnification so can easily be missed. Usually about 38 spines on each dens; the number varies between 22 and 40 and is even inconsistent between the dens of the same individual. Dens has setae and many scales. Body chaetotaxy as shown in figure 3.

Troglopedetes churchillatus Wilson is close to *Troglopedetes sexocellata* (Yosii, 1966a) comb. nov. but differs in the following:

T. sexocellata has no sub-divided antenna IV.

T. churchillatus has a stouter mucro than *T. sexocellata*, and its mucronal teeth are more pronounced.

Both species have long wing-like basal teeth on the empodium but *T. churchillatus* has an additional notch, i.e. three basal teeth internally.

The maximum length of *T. sexocellata* is quoted as 1.5mm. (Prabhoo 1971), compared to *T. churchillatus* at 2.6mm.

T. churchillatus appears to be restricted to caves, while *T. sexocellata* is an epigeal species. Differences in the ratios of appendages are apparent; see Table 3 below.

Table 3: RATIOS OF APPENDAGES IN SOME ORIENTAL TROGLOPEDETES

	<i>Troglopedetes churchillatus</i>	<i>T. sexocellata</i> (Yosii 1966)	<i>T. kempfi</i> (Carpenter 1917)	<i>Troglopedetes nepalensis</i>	<i>T. ceylonica</i> (Yosii 1966)
Antennae	1:1.8:1.6:2.7	1:1.9:1.1:2.7	1:1.4:1.2:4	1:2.1:1.1:3.1	1:2:1.5:3.5
I:II:III:IV	(14%:26%:23%:37%)	(19%:35%:22%:24%)	(15%:24%:18%:42%)	(17%:29%:16%:42%)	(13%:25%:19%:43%)
Antenna: head	2.3:1	3:1	about 1.5:1	1.7:1	1.7:1
Furca	46%:51%:3	52%:38%:10%	-	51%:37%:13%	54%:36%:10%
Man:dens:mu					

MATERIAL EXAMINED

Lectotype, INDIA: Pokhara, Mahendra Gupha (here designated); J.M. Wilson, Sept-Oct. 1976
16 paralectotypes collected from Mahendra Gupha and Oderibuwahn Gupha (caves) by
the author; 5 from Kaarr Jungle Cave by Christopher Smart and 4 from Window Cave by Gillian
Durrant during September and October 1976. (Wilson, 1977a and b; Durrant et al. 1979).

The caves are at an altitude of about 1100m. in the Pleistocene limestone of the north
Pokhara Valley of Nepal. Appreciable quantities of guano have built up in the caves thanks
to the insectivorous bats that roost there, but the Collembola were most often found away from
the guano deposits, on calcite-covered rock.

The types are at the British Museum (Natural History), London; Brit. Mus. 1977-177

ADAPTATION TO THE CAVE ENVIRONMENT

The fact that *T. churchillatus* was not found in the numerous leaf litter and under-
stone habitats searched implies that it is a troglobite (tbt). The Pokhara Valley caves have
developed in soft Pleistocene limestone which is overlaid by conglomerate. As the limestone
(and thus the caves) is very young, the fauna has had little time to adapt to cave life; there
are no older cavernous deposits nearby, so cave-adapted species could not have immigrated from
elsewhere. Barr (1967) stated that most cave-adapted species were isolated in caves during the
Pleistocene or before and so it seems feasible that *Troglopedetes churchillatus* could have evolved
from its surface ancestors some time during the last two million years.

REDUCTION IN EYE NUMBER

Guthrie (1906) made some interesting points on the number and arrangements of collembolan
ommatidia (ocelli). He suggested that throughout the order, lenses A to H could be identified
and that particular ocelli disappear in a characteristic sequence when there is reduction in eye
number. In most *Troglopedetes churchillatus* collected only three lenses
were visible on each side of the head, and these correspond to lenses A, B and F of Guthrie.
Lepidocyrtus sexocellata Guthrie, with 3+3 ocelli, has undergone similar reduction of
eyes, a "considerable portion of the eyespot between the first two (ocelli A and B) and the last (F)
destitute of ocelli. This intermediate space, having lost the ocelli, has also lost its
pigment, and there remain a cephalic and caudal spot containing, respectively, two and one
ocelli" (Guthrie 1906).

Figure 1D has been adapted from Guthrie's diagram of the ocelli of *Lepidocyrtus sexocellata*
and shows the position of ocelli A, B and F with their associated pigment patches, and the
positions that the lost ocelli C, D, E, G and H would be expected to occupy. Figure 4 shows
that the arrangement of pigment patches is variable, 4D showing an animal with 3+3 lenses in
3+3 pigment patches. Figure 1C shows how pigment may not surround the lens.

Troglopedetes nepalensis sp. nov. (Figures 3 and 5)

DESCRIPTION

Blind and white with a maximum length of 1.6mm.; pigment is wanting and there is no
ocellar pigment; habitus as in figure 5A; an active little springtail and quite difficult to
catch.

Antenna to head length in the ratio 1.7:1; antenna to body length 1:2.4. Antennal segments
I-IV as 1:2.1:1.1:3.1 (i.e. 17%:29%:16%:42%). Antenna IV not sub-divided. Scales numerous on
the head.

Claws as in figure 5C; two strong wing-like basal teeth and a weak sub-apical tooth;
lanceolate empodial appendage; 2-3 basal teeth-like serrations before the 5 mucronal teeth; a
single row of spines on each dens; dens densely covered with setae; manubrium:dens:mucro as
51%:37%:13%. The chaetotaxy is shown in figure 3.

Troglopedetes nepalensis is close to both *Troglopedetes kempfi* (Carpenter, 1917)
and *Troglopedetes ceylonica* (Yosii, 1966) but differs from them in several characters.
Like *T. ceylonica*, the claw of *T. nepalensis* bears two strong internal wing-like basal teeth and
both species have a third weak internal tooth. In *T. nepalensis* this is sub-apical, but in
T. ceylonica it is stronger and more proximal. In contrast, *T. kempfi* has two weak internal
teeth in addition to a small basal pair.

T. nepalensis has 5 mucronal teeth compared to the 3 of *T. kempfi* and *T. ceylonica*. *T. nepalensis* and *T. ceylonica* have one row of dental spines which contrasts with the two rows of *T. kempfi*. *T. ceylonica* is described as achaetotic by Yosii, figure 3 shows that *T. nepalensis* has a group of four setae on thoracic segment II

The dental scale-like appendage reported in the one specimen of *T. kempfi* studied by Carpenter, is wanting in *T. nepalensis* and *T. ceylonica*. Ratios of appendages of the three species are in Table 3.

As *Troglopedetes nepalensis* is able to live and reproduce both in caves and on the surface, it should be regarded as a troglophile (tphl). It is tempting to suggest that *T. nepalensis* is no longer found above ground in the Pokhara Valley due to habitat changes brought about by intensive agricultural practices in the area.

MATERIAL EXAMINED

Holotype: INDIA, Pokhara, Mahendra Gupha; J.M.Wilson, Sept.-Oct. 1976.

20 paratypes collected by the author during September and October 1976 from Mahendra Gupha and Oderibuwahn Gupha (caves) at about 1100 m. above sea level in the north of the Pokhara Valley; from the Harpan River Cave (Waltham et al. 1971) at about 1000 m. in the south of the Pokhara Valley near the airport; and from leaf litter under rhododendrons between Naudanda and Suiket at an altitude of about 1300 m. about 16 km. north-west of Pokhara in Nepal. Types are at the British Museum Brit. Mus. 1977-117.

Additional specimens were collected by the author during December 1981 from Gupteswary Cave at Kusma (Waltham et al. 1971:63). The cave is in conglomerate at about 1000 m. and about a 30 km. walk to the west of Pokhara in Nepal. It is quite well known in the area as a Hindu shrine; it must be visited bare-foot. The 27 specimens from Kusma are also lodged at the British Museum; collection number Brit. Mus. 1982-150.

Troglopedetes madagascarensis sp. nov. (figs. 6-8).

A long series of this new species was collected during the course of the 1981 Southampton University Expedition to Madagascar by the author and Mary Wilson.

DESCRIPTION

A white active collembolan that is common in the Dark Zone of the Grotte d'Andrafiabé (cave) in Northern Madagascar.

It is about 2.5mm. long and its habitus is as in figure 6. It is achaetotic and is probably a troglobite.

Most specimens have 1+1 eyes but as there is not usually any pigment associated with the lenses, they are quite difficult to see.

Antennae are a little shorter than the combined length of head and body; ratio of antennal segments I-IV as 1:2:1.7:2.7 (head breadth 1.2; head length 1.8) i.e. 13.6%:27.3%:23.6%:36.4%. Antenna IV is not sub-divided.

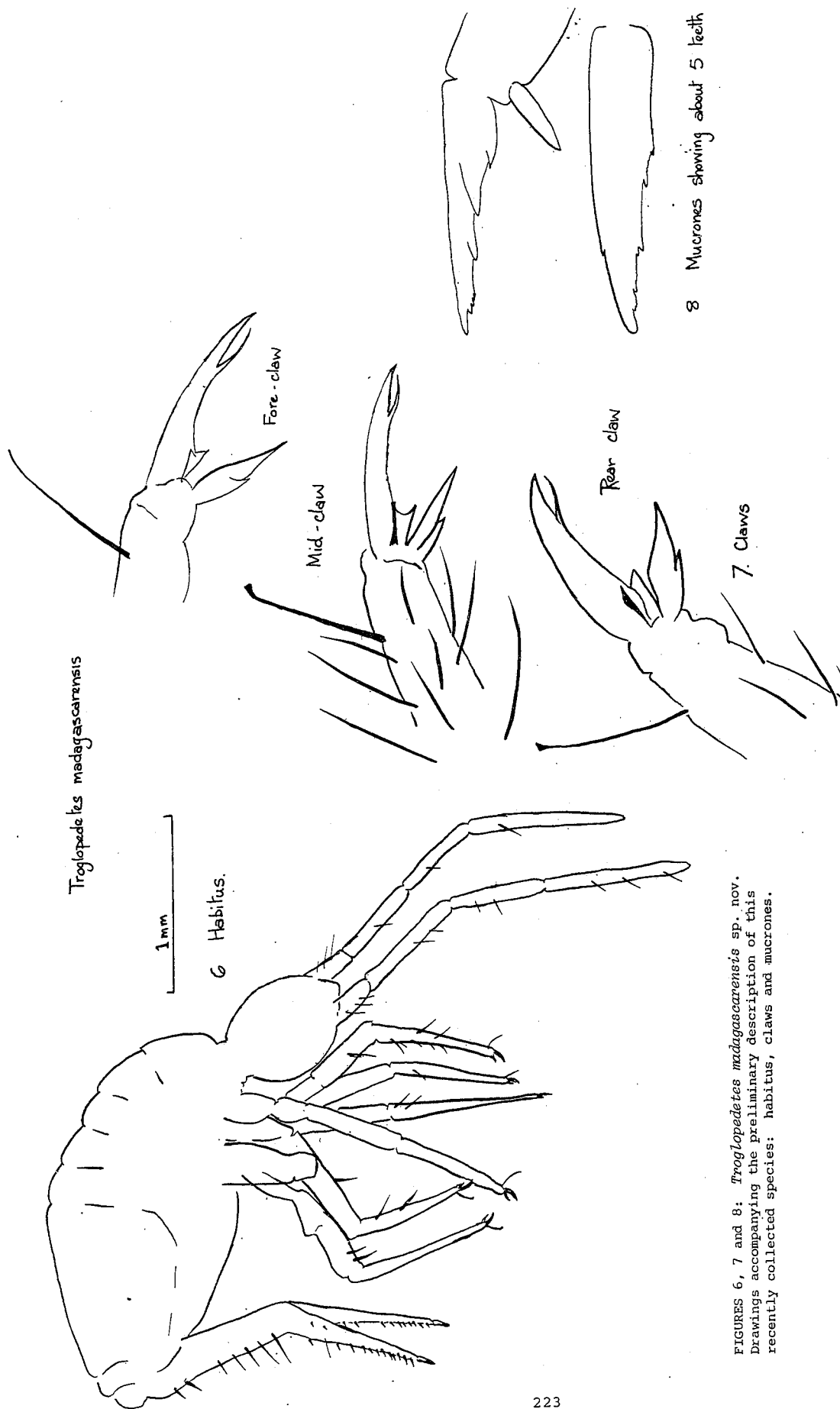
The claw has two wing-like basal teeth on the empodium and a long distinctive additional tooth apically. The empodial appendage has a large external notch which is an unusual feature among the Troglopedetini. The tenent hair can be either pointed or clubbed; in most specimens both forms were present. Tibiotarsal hairs are pointed.

The mucrone is elongate and bears about 5 tiny teeth; the numerous serrations on the mucrone make it difficult to determine the exact number of teeth present; the thick dental spines on the posterior face of the furca are arranged in two rows; under high magnification it can be seen that each is covered with minute setae. Manubrium:dens:mucro are in the ratio 12.2:13.3:1 i.e. 45.9%:50%:3.8%.

This brief description will be elaborated at a later date.

MATERIAL EXAMINED

Holotype and 42 Paratypes are at the British Museum (Natural History) Brit. Mus. 1982-160. Representative specimens have also been presented to the Malagasy National



FIGURES 6, 7 and 8: *Troglopedetes madagascariensis* sp. nov. Drawings accompanying the preliminary description of this recently collected species: habitus, claws and mucrones.

Collection at the Jardin Zoologique et botanique de Tsimbazaza in Tananarive, Madagascar.

All specimens were found on or near bat guano or carcasses in the Dark Zone of the Grotte d'Andrafiabé. This is an 11 km. long cave system in the extreme north of Madagascar; it is in the middle Jurassic limestone that lies about 40 km. north of Ambilobé and 60 km. south of Diégo-Suarez. A description of the cave is given by Boase, Wilson and Wilson (1982) and a full description of the ecology of the cave will be published later.

APPENDIX

HIMALAYAN FAUNA COLLECTED BY THE SPELEOLOGICAL EXPEDITION 1976

Among the specimens collected during this six month expedition were many of interest. For example, a long-legged new centipede has been described by Dobroruka (1979). A complete list of the hypogean fauna collected by us from the Indian and Nepali caves is in the expedition report (available from the author) and Table 1 summarises this. The new millepedes listed are described in two papers by Mauriès (1982). The blood-feeding sandfly was of sufficient interest to feature in a paper by Lewis (1981) and the cave-dwelling moths are mentioned by Robinson (1980:100,110).

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The collections made in Madagascar would have been impossible without the active help and encouragement I received from other members of the 1981 Southampton University Madagascar Expedition. I am also indebted to Simon Howarth for his company while collecting in Gupteswary Cave in Nepal.

Our 135-page Himalayan Expedition report is available from the author at £1.50 plus postage (presently 50p inland).

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