

A new species of the genus *Speocyclops* (Crustacea, Copepoda, Cyclopoida) from the Han-sur-Lesse Cave, a well known and popular cavern, in southeastern Belgium

by Frank FIERS

Abstract

The copepod fauna of the "Grotte de Han-sur-Lesse", the largest and most popular cavern in Belgium, is poorly known. Samples taken during a short visit revealed the presence of a rich and interesting stygobiont copepod fauna. From a natural seepage three different cyclopid species were recovered: *Diacyclops clandestinus* (KIEFER, 1926), *Graeteriella unisetigera* (GRAETER, 1908) and a previously unknown member of the genus *Speocyclops*: *S. fontinalis* spec. nov. The contribution here deals with the description of the new species, and compares it with its congeners.

Key-words: *Speocyclops*, new species, Cyclopidae, Grotte de Han-sur-Lesse, Belgique

Résumé

La faune des copépodes de la grotte de Han-sur-Lesse, la plus grande et la plus populaire des cavernes de Belgique, est méconnue. Des échantillons prélevés au cours d'une brève et rapide prospection ont révélé la présence d'une faune de cyclopidés stygobies riche et intéressante. Trois espèces ont été récoltées dans un suintement naturel: *Diacyclops clandestinus* (KIEFER, 1926), *Graeteriella unisetigera* (GRAETER, 1908), ainsi qu'un membre encore inconnu du genre *Speocyclops*: *S. fontinalis* spec. nov. La nouvelle espèce décrite ici est comparée à ses congénères.

Mots-clefs: *Speocyclops*, nouvelle espèce, Cyclopidae, Grotte de Han-sur-Lesse, Belgique

Introduction

The cavern of Han-sur-Lesse has been known since immemorial time. Numerous archeological treasures gathered in and around the cave are today the silent witnesses of human presence from the neolithic epoch on. Until now, the Han cavern is still a very popular tourist attraction for which some 1.5 km of the interior has been accommodated to facilitate access for the numerous visitors coming to admire the countless marvels of this natural phenomenon.

The Han cavern is known to extend over a total length of more than 12 km in the "massif de Boine", a limestone outcrop of Givetian age. The cave has been formed by the river

Lesse which penetrate the limestone mainly through the "Gouffre de Belvaux" situated at the eastern side of the massif. The river rejoins his epigeal bed through the "Trou du Han" at the northern side of the massif, after 24 hours of hidden subterranean life (the distance in bird-flight between the Gouffre and Trou de Han is about 1200 m).

The vastness and the diversity of phenomena encountered in the cavern have been attracted scientists from many different disciplines, which resulted, over the years, in an impressive number of observations in the fields of archeology, biology, geology, hydrogeology and speleology.

Because of its extent and its richness of habitats the Han cave is known to accommodate a diverse and dense epigeal as well as strict hypogean fauna (DELHEZ *et al.*, 1999). LERUTH (1937) compiled the first detailed list which included more than 50 different invertebrate species. Nowadays, the list comprises 121 different invertebrate species, 12 of them considered as strictly stygobiont. Although the Han cavern is visited annually by thousands of tourists, the limited length of the accommodated section (roughly 12 % of the entire cavern) and the severe protection measurements taken for the larger parts of the cavern, leave us with vast and undisturbed areas where typical subterranean circumstances occur.

The number of copepod species reported from this cavern is surprisingly low. Only 2 cyclopid species, *Paracyclops fimbriatus* (FISCHER, 1853) and *Diacyclops clandestinus* (KIEFER, 1926), were mentioned by LERUTH (1937). Clearly, this list is far from complete. During a short reconnaissance trip in January 2003 samples were collected in the "Galerie des Petites Fontaines" a partly accommodated but still very natural tunnel giving access to the tourist circuit and in the "Salle de l'Alambra" which makes part of the tourist cavern. Samples from the latter location did not contain copepods, but samples from seepages in the tunnel contained 3 different stygobiont cyclopid species: *Graeteriella unisetigera* (GRAETER, 1908), *Diacyclops clandestinus* (KIEFER, 1926) and the here described *Speocyclops fontinalis* spec. nov.

Evidently, several other interesting species of copepods may be expected to occur in this cavern when a more rigorous sampling campaign in this vast subterranean place should take place.

Material and methods

A 5-liter sample was taken with an adapted suction pump (BRANCELJ, 2002) after which the contents of the flask were filtered through a 80 µm sieve and fixed with a buffered formaldehyde solution until a final concentration of roughly 5-10 % was reached. Sorted animals were stored in 70 % alcohol; the dissected holotype and paratype have been mounted in glycerol. Observations were made with a Leitz Diaplan light microscope equipped with phase contrast and a drawing tube. Descriptive terminology follows UEDA & REID (2003). All specimens are deposited in the copepod collection of the Royal Belgian Institute of Natural Sciences, Brussels.

Taxonomy

Copepoda MILNE EDWARDS 1840
Order Cyclopoida, BURMEISTER 1834
Family Cyclopidae DANA 1853
Subfamily Cyclopinæ KIEFER 1927

Speocyclops fontinalis spec. nov.

Description - Female. Body (Fig. 1A) harpacticoid shaped, depressed, gently narrowing from proximal margin of head towards anal somite, without marked distinction between prosome and urosome. Length, including caudal rami, 485 µm. Largest width, 155 µm, near posterior end of cephalothorax. Prosome 1.3 times longer than urosome. Genital double somite distinctly wider than long (1.5/1), with distinct remnant of subdivision line dorsally and laterally. Integument of all somites, except cephalosome and the area around the copulatory pore, densely covered with a pattern of tiny refractile points (cf. *Bryocyclops* see REID, 1999, not illustrated here). Posterior margin of first to fourth prosomal somite without frill. Fifth pedigerous somite with a short, irregularly serrate hyaline frill, laterally. Posterodorsal margin of anterior genital somite with narrow, un-incised frill. Second somite of genital complex and following somites with, posteriorly, a wide and serrate hyaline frill. Distal margin of anal somite with large spines dorsally and ventrally. Anal operculum largely produced posteriorly, with irregularly serrate margin (Fig. 1B-E).

Caudal rami 1.35 times as long as wide, with (Fig. 1D and E) or without (Fig. 1B and C) a dorsal carena parallel to inner margin, and two robust spiniform processes near inner distal dorsal corner. Proximal lateral seta (II: 15 µm long) with dorsal position, accompanied with 3-5 minute spinules at insertion. Distal lateral seta (III) serrate, 40 µm long, and 1.33 times longer than ramus. Medial terminal element (VI) robust, serrate along inner margin, and 18 µm long. Dorsal seta (VII) inserted in distal half, near to inner distal corner of ramus, 26 µm long, and articulating on short basal part. Outer principal terminal seta (IV) 130 µm, and inner one (V) 250 µm long. Both with well developed breaking planes near insertion. Distal margin of rami (Fig. 2A) with group of large spinules near insertion of distal lateral and medial element. Antennule (Fig. 3A) 11-segmented reaching half way

cephalothorax, with setal complement as follows: (Roman numerals indicate segments, Arabic numerals indicate setal number, Aesth means Aesthetasc): I(8)-II(3)-III(8)-IV(3)-V(2)-VI(2)-VII(3)-VIII(2+Aesth)-XI(2)-X(2+Aesth)-XI(7+Aesth). Hyaline element on segment V minute and blunt (Fig. 3B). Aesthetascs on segment VIII linguiform, on segment X filiform, and on segment XI tubiliform. All segments devoid of ornamentation, except segment I having a spinule row on anteriorly directed margin.

Antenna (Fig. 3C) 4-segmented. Basipodite with 2 abexopodal seta, but without exopodal one. Surface of basipodite smooth, lacking spinule ornamentation. First endopodal segment with single outer seta, and a tuft of spinules along inner margin. Second endopodal segment with 7 setae, the outer apical one more robust than the others. Inner margin furnished with spinules. Third endopodal segment with 7 setae, the longest ones pectinated apically. Inner margin with 2 spinule rows.

Mandible (Fig. 3D) with simple gnathobasis, lacking palp. Biting edge with a cuspidate tooth, 4 simple conical teeth, and a serrate element. Maxillular arthrite with 7 lateral elements, the next to outer one long and plumose, and 4 medial elements (Fig. 3G). Surface of arthrite smooth. Palp (Fig. 3H) with exopodal seta, a distinct endopodal segment (bearing 3 setae) and 3 medial elements. Labrum (not illustrated) with 12 blunt teeth between lateral processes. Maxilla (Fig. 3F) without trace of subdivision of syncoxa. Compact proximal endite with 2 pinnate setae; vestigial median endite represented by single element, and cylindrical distal endite with a robust bipinnate and a smooth slender seta. Basis with robust claw, a robust serrate medial seta, and a short and smooth seta inserted on caudal surface. Maxillar palp unisegmented, bearing 3 slender setae and two robust serrate elements. Maxilliped (Fig. 3E) with syncoxa, having 2 medial setae. Basis and endopodal segment with 1 and 2 setae, respectively. Outer margin of precoxal and coxal parts with spinules. Basis furnished with 3 strong spinules on surface. Legs 1-4 with well differentiated protopodal components and 2-segmented rami. Intercoxal sclerites with produced distal corners, surfaces smooth. Both frontal and caudal surfaces of coxae smooth, except for a series of minute spinules along distal frontal margin. Medial margin of bases crescentic, furnished with hairs in legs 1 to 3, smooth in leg 4. Mediodistal margin of bases with spinules, frontally. Medial spine of leg 1 basis serrate, as long as proximal endopodal segment, and accompanied with some spinules at insertion (Fig. 4A). Exopodites with spine formula 3.4.4.3 and seta formula 4.4.4.3. Complete chaetotaxy as follows:

	<i>Coxa</i>	<i>Basis</i>	<i>Exopodite</i>	<i>Endopodite</i>
Leg 1	0-1	1-1	I.0-III.2.2	0.1-1.II.1
Leg 2	0-1	1-0	I.0-III.II.3	0.1-1.II.1
Leg 3	0-1	1-0	I.0-III.II.3	0.1-1.II.2
Leg 4	0-1	1-0	I.0-II.II.2	0.1-1.II.1

Outer distal and subdistal corner of second endopodal segments in leg 1 to 3 strongly produced, far less however in leg

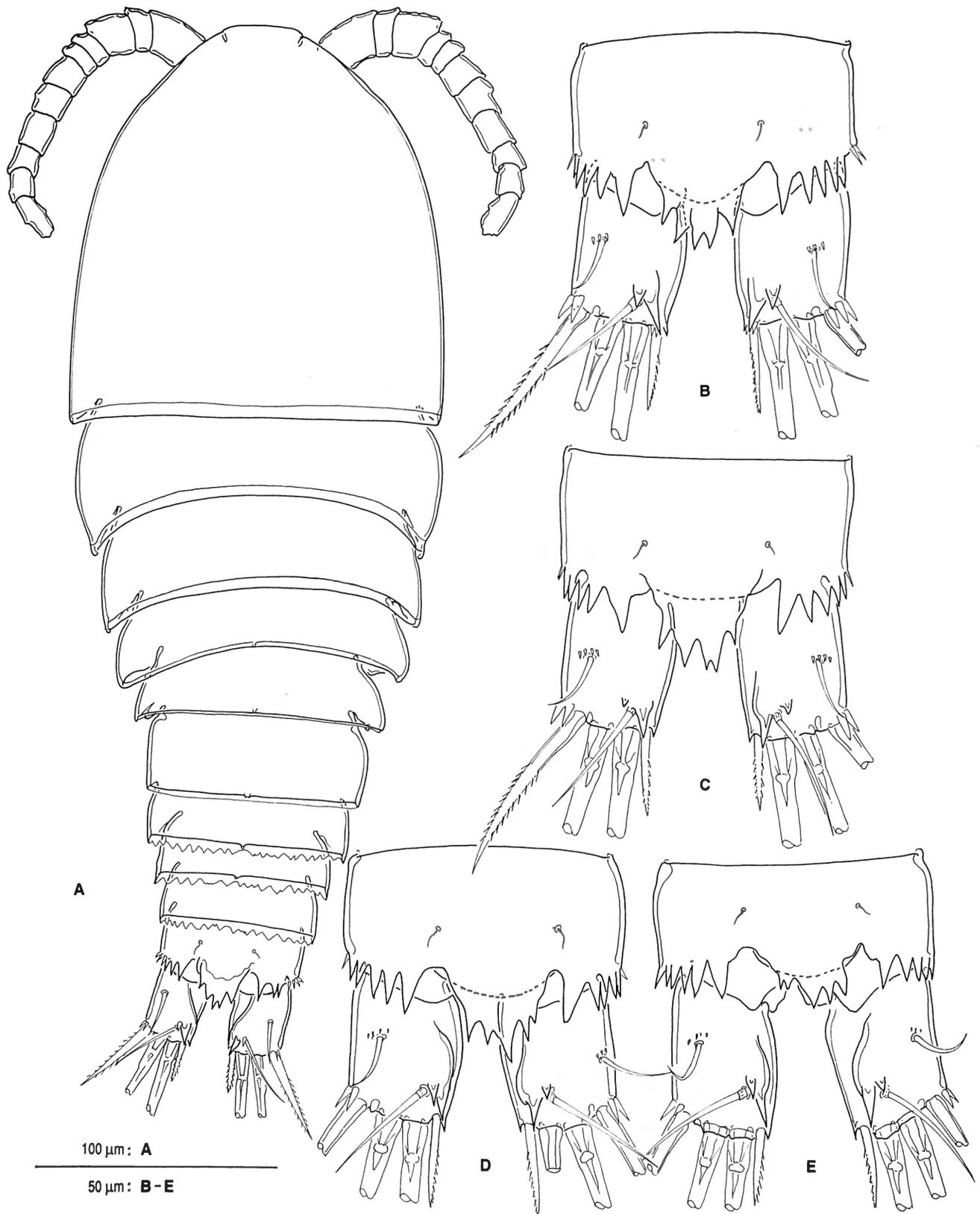


Fig. 1. *Speocyclops fontinalis* spec. nov. A. Habitus, dorsal view; B. Anal somite and caudal rami, dorsal view; C-E. Idem (A-B, holotype; C-E, paratypes)

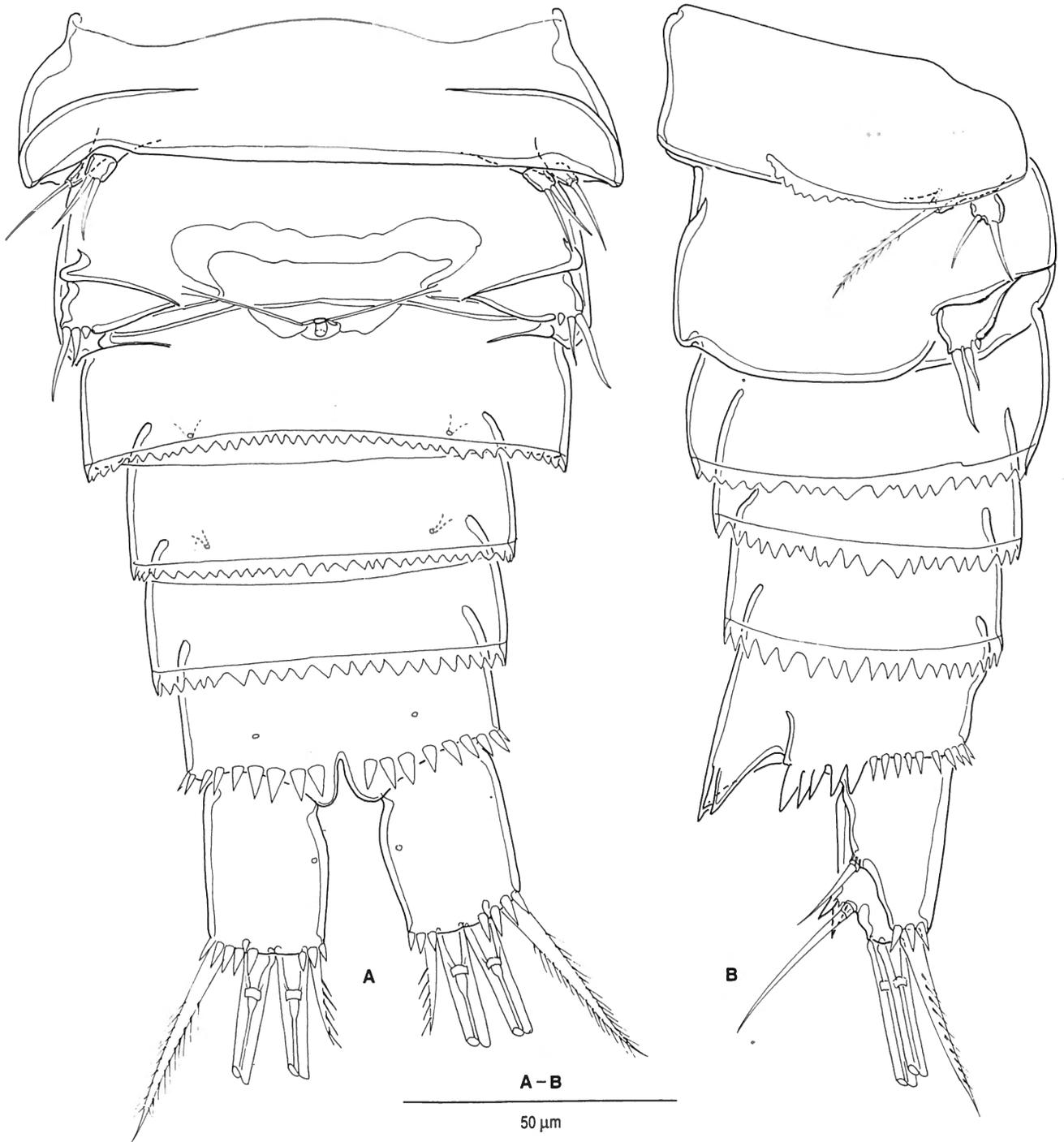


Fig. 2. *Speocyclops fontinalis* spec. nov. A. Urosome ventral view; B. Urosome, lateral view (A-B, holotype)

4. Terminal spine of leg 4 endopodite 1.35 times longer than segment.

Leg 5 (Fig. 2A and B) with distinct cylindrical basipodal and distinct squar exopodal lobes. Seta, representing basipodite twice as long as exopodal elements, the latter sub-equal and twice as long as supporting segment.

Leg 6 vestigial (Fig. 2A and B) as a triangular plate, bearing 3 elements: inner one minute, median one much longer and about half as long as outer one. Surface of leg 6 plate smooth. Copulatory pore leading to receptacle through short cylindrical and straight duct. Anterior part of receptacle expanded anteriorly, posterior part narrow. Lateral arms slender.

Male - Unknown

Type-series - Holotype female, dissected on 4 slides, labeled COP 5006a-d. One paratype female dissected on 2 slides (COP 5007 a, b) and 2 female paratypes, preserved in alcohol (70%), labeled COP 5008.

Type-locality - Rochefort - Han-sur-Lesse (prov. Namur), Massif de Boine, "Grotte de Han-sur-Lesse". Small water seepages close to the northwards directed wall of the "Galerie des Petites Fontaines" (Main entrance of cavern: 50.1215° N-5.1929° E). Leg. F. FIERS & G. MICHEL, 15 January 2003.

Etymology - The specific name *fontinalis* (from the Latin word *fontis*, meaning fountain) refers to the passage "Galerie des petites fontaines" (Gallery of the small fountains) in the "Grotte de Han" where the animals were collected.

Differential diagnosis

Nowadays, the genus *Speocyclops* KIEFER, 1937 contains 40 named species and subspecies (DUSSART & DEFAYE, 1985; PANDOURSKI, 1992, see Fauna Europaea Service, <http://www.faunaeur.org> and LESCHER-MOUTOUÉ, 1966). However, the inaccurate earlier species descriptions, and in many cases the limited number of animals under study, have been the main reasons that species identification is rather difficult. Moreover, the extreme subdivision ("pulverizing" *dixit* DUSSART, 1969: p. 186) of certain species (*S. demetiensis* (SCOURFIELD, 1932) and *S. racovitzai* (CHAPPUIS, 1923)) has largely contributed to amplify the confusion. Apart from the fact that *S. yezoensis* ITÔ, 1954 recently has been removed and placed in a separate genus *Itocyclops* by REID & ISHIDA (2000), no other study dealing with a profound comparative analysis of the different species and subspecies is available yet. This taxon is clearly in urgent need of revision based on as much material as possible.

Commonly, the morphology of the leg 5, the presence or absence of a distinct remnant of a suture subdividing the genital-double somite, and the nature of the elements on the leg 6 vestige, are features used to separate groups among the several species and subspecies. The shape of the anal operculum, the proportional lengths of the setae on the caudal rami (III and VI), the setal complement of the legs and the length of the terminal endopodal spine of leg 4 are considered as key features to identify the species and subspecies constitut-

ing the different groups.

Speocyclops fontinalis spec. nov. belongs to the group of species with (1) a distinct medial segment in leg 5 and (2) a complete dorsal remnant of a suture on the genital-double somite. Including the here described species, 14 other species (see keys in CHAPPUIS & KIEFER, 1952; LINDBERG, 1956; BORUTZKY, 1965; DUSSART, 1969; and including *S. kieferi* LESCHER-MOUTOUÉ, 1968 and *S. cinctus* MONCHENKO, 1984) display the combination of these two features. The morphology of the elements on the leg 6 plates in *S. fontinalis* spec. nov., with the dwarfed medial element accompanied with two setiform elements, distinguish the species from most of them. Only *S. racovitzai sensu lato* (CHAPPUIS, 1923), *S. gallicus* CHAPPUIS & KIEFER, 1952, and possibly *S. castareti* LINDBERG, 1954, have the same type of armament on leg 6, although the medial dwarfed element might be completely absent as was observed in female specimens of the latter collected in La Grotte de la Devèze à Corniou (Departement de Herault: LESCHER-MOUTOUÉ (*in lit.*). However, *S. fontinalis* is easily distinguishable from the majority of the subspecies of *S. racovitzai* and from *S. gallicus* by the elaborated shape of the anal operculum. *S. racovitzai boscensis* KIEFER, 1954 (which might turn out to be a separate species, pers. obs.) and *S. castareti*, also possess a largely produced anal operculum with serrate apex, but differ from the present species by the proportional lengths of the setae on the caudal rami, and by the absence of a robust spiniform process near the dorsal seta (VII).

In this respect, *S. fontinalis* spec. nov. resembles most *S. kieferi* known from southern France. The anal operculum from the latter has a more concave aspect and has significantly more teeth along its margin than *S. fontinalis*. Moreover, the proportional lengths of the elements on the caudal rami are clearly different in both species. In *S. fontinalis* the medial one (VI) is less than half as long as the outer apical one (III) while the latter is significantly longer than the dorsal seta (VII) and longer than the length of the ramus.

S. kieferi, as mentioned above, possesses a leg 6 vestige with a large spiniform and serrate medial element, while in the present species this structure is strongly reduced forming a minute transparent outgrowth.

A particular characteristic for *S. fontinalis* spec. nov. is the integument of the pedigerous and urosomal somites which is covered with a dense pattern of refractile points, comparable with those described by REID (1999) for the species of *Bryocyclops* KIEFER, 1927). Thus far, no other *Speocyclops* has been described displaying this feature. However, other species (for example *S. racovitzai boscensis* KIEFER, 1954, pers. obs.) display the same modification of the integument. The presence or absence of these integumental points may turn out to represent a valuable supplementary characteristic in unraveling the taxonomic tangle in the subspecific subdivision of the *racovitzai*-group.

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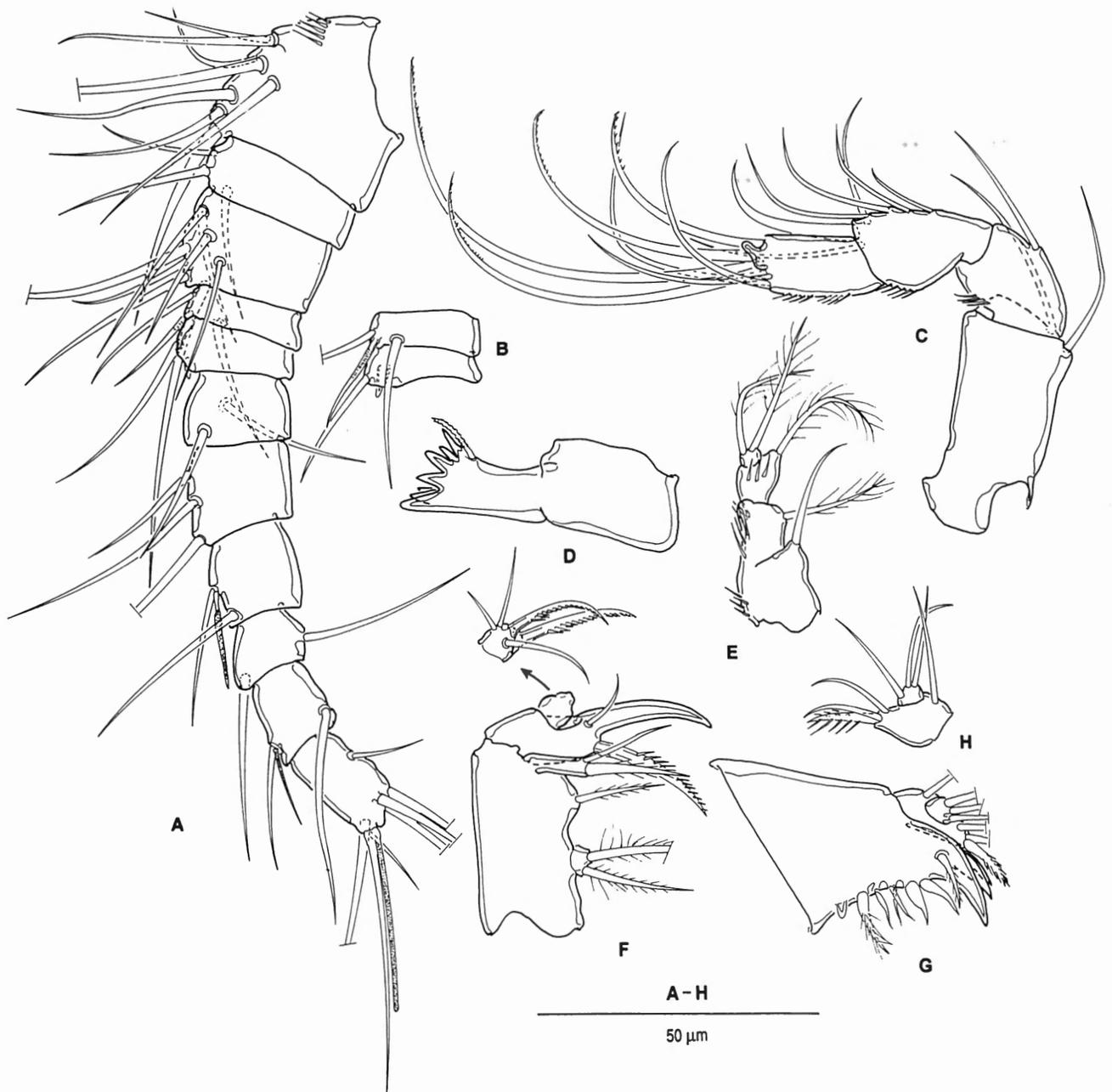


Fig. 3. *Speocyclops fontinalis* spec. nov. A. Antennule, ventral directed surface; B. Antennular segments IV and V, dorsal directed surface; C. Antenna, frontal; D. Mandible; E. Maxilliped; F. Maxilla, palp detached; G. Maxillule; H. Maxillular palp (A-B, D-E, holotype; F-H, paratype)



Fig. 4. *Speocyclops fontinalis* spec. nov. A. Leg 1, frontal; B. Leg 2, caudal; C. Leg 3 caudal; D, Leg 4, caudal (A, holotype; B-D, paratype)

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