

FIMBRICYCLOPS JIMHENSONI, NEW GENUS, NEW SPECIES
(COPEPODA: CYCLOPOIDA: CYCLOPIDAE), FROM
BROMELIADS IN PUERTO RICO

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ABSTRACT

Cyclopoid copepods belonging to a new genus and species, *Fimbricyclops jimhensoni*, were collected from bromeliads in Puerto Rico. The genus is distinguished from other members of the family Cyclopidae, subfamily Cyclopinae, by the combined characters of the antennule of the female having 11 articles, the antenna lacking an exopodite seta, the mandible with the palp represented only by 1 seta, the maxilliped having 4 articles and a reduced number of setae on articles 1, 2, and 4, the biarticulate rami of legs 1-4, the leg 5 with the proximal article fused to the somite and the distal article broader than long, and the peculiar somitic ornament consisting of rows of spines on the lateral surfaces of the posterior prosomites and the posterior hyaline membranes of the anterior 2 (in the female) and 3 (in the male) urosomites modified as a spinous fringe. Leg 6 of the male bears 3 plumed appendages of which the medialmost is spiniform and most thickly set with stiff spinules.

Copepods from Puerto Rico sent to me for determination by Dr. Marco F. Suárez included several individuals of a previously unknown genus and species. These are described herein and the new genus compared to other genera of the family Cyclopidae, subfamily Cyclopinae.

The material was hand-sorted from bromeliad vegetative material using a stereomicroscope and fixed in 80% ethanol. Morphological examination was carried out using the methods described by Reid (1991a). The holotype and allotype specimens were measured and drawn in lactic acid; paratype specimens were measured in glycerine. Specimens were deposited in the collections of the Department of Invertebrate Zoology, National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C., U.S.A.

Cyclopoida G. O. Sars, 1886

Cyclopidae Burmeister, 1834

Cyclopinae Dana, 1853,

char. emend. Kiefer, 1927

Fimbricyclops, new genus

Diagnosis.—Cyclopidae, Cyclopinae. Female: Prosomites 3 and 4 and urosomite 1 each ornamented with dorsoventral rows of spines on lateral surfaces. Urosomite 1 and genital segment each with hyaline membrane of posterior margin modified as spinous fringe. Genital segment enlarged, rounded in dorsal view. Seminal receptacle with broad anterior and posterior expan-

sions. Antennule of 11 articles, article 5 with spine, article 10 with esthetasc, terminal 2 articles lacking hyaline membrane. Antenna lacking exopodite seta. Mandible with palp represented by 1 seta. Maxilliped composed of 4 articles with reduced number of setae on articles 1, 2, and 4. Legs 1-4 each with biarticulate rami; spine formula 3,3,3,3; coxa-basipodites and lateral and distal margins of rami of most legs heavily ornamented with rows of accessory hairs and spines. Leg 5 with proximal article fused to somite, remnant seta present on somite, and distal (free) article broader than long, bearing 2 terminal appendages, these subequal in length, medial terminal appendage spiniform and thickly spinulate, lateral terminal appendage setiform, plumose. Leg 6 bearing long, thickly spinulate spiniform appendage and 2 short naked spines.

Male: Prosomites 3 and 4 and urosomite 1 each with dorsoventral rows of spines on lateral surfaces. Lateral surfaces of hyaline membrane on each of posterior 3 urosomites modified as spinous fringe. Antennules geniculate, of 16 articles, article 1 with 3, articles 4 and 10 each with 1 slender aesthetasc. Leg 6 bearing 3 plumed appendages, these subequal in length, medialmost and median appendages spiniform and thickly spinulate, lateralmost appendage setiform, plumose. No sexual dimorphism in antenna, mouthparts, and legs 1-5.

Type Species.—*Fimbricyclops jimhensoni*, new species.

Gender. — Masculine.

Etymology. — The genus name is composed of the Latin *fimbria*, fringe, to describe the peculiar somitic spines and modification of the somitic hyaline membranes, appended to *Cyclops*, the name of the single-eyed monster used in many cyclopid genera.

***Fimbricyclops jimhensoni*, new species**
Figs. 1–4

Material Examined. — Holotype ♀, dissected, USNM 251903; allotype ♂, undissected, USNM 251904, each mounted on slide in polyvinyl lactophenol; Puerto Rico, Carretera No. 91, Station 3, bromeliad, 6 March 1990, collected by M. F. Suárez, accompanying copepod species, *Elaphoidella* sp., copepodids. Paratypes: 4 ♀♀ and 7 ♂♂, ethanol-preserved; Puerto Rico, Luquillo, El Yunque, bromeliads, 26 March 1992, collected by M. F. Suárez and M. Amador, USNM 251905. Nonparatypes: 14 copepodids from latter sample, ethanol-preserved, USNM 251906. Accompanying copepod species from El Yunque bromeliads, *Tropocyclops prasinus* (Fischer, 1860), *Elaphoidella bidens* (Schmeil, 1893), and *Elaphoidella sewelli* (Chappuis, 1928)-group.

Type Locality. — Station 3, Carretera 91, Puerto Rico.

Description of Female. — Length of holotype, excluding caudal setae, 440 μm . Range of lengths of paratypes 332–456 μm (median = 376 μm). Body widest at prosomite 1 in dorsal view (Fig. 1a, b). Lateral margins of prosomites 3 and 4 (pedigers 3 and 4) rounded in dorsal and lateral views; prosomite 3 with shallow sculpturing near lateral margin (Fig. 1a, c). Urosomite 1 (pediger 5) with transverse ventral keel between fifth legs (Fig. 1c, d). Genital segment (Fig. 1a, c, d) enlarged, convex in dorsal view, anterior half most expanded; genital segment deeply incised posterior to sixth leg. Seminal receptacle with convex anterior expansion and broader posterior expansion, concave medially; lateral canals slightly curved anteriorly. Urosomites 3 and 4 and anal somite broader than long, broadening posteriorly. Lateral surfaces of prosomites 3 and 4 and urosomite 1 ornamented with dorsoventral rows of spines. Urosomite 1 and genital segment having hyaline membrane on posterior margins modified as spinous fringe, fringe of genital segment with area of long spines near dorsal midline, 2 sections of short spines lateral to dorsal midline, long spines laterally, and spines of medium length ventrally. Hyaline membranes of posterior margins of urosomites 3 and 4 narrow, margins entire. Anal oper-

culum sclerotized, concave between rounded posterolateral corners. Anal somite with short rounded dorsal process extending over each caudal ramus at level slightly lateral to corner of anal operculum. Anal somite ornamented with 2 rows of tiny proctodeal spines and row of small spines beginning lateral to each dorsal sensillum and continuing posteriorly to and around lateral and ventral margins of somite; spines along ventral margin longest. Caudal ramus of holotype 23 μm long and 16 μm broad, thus about 1.4 times longer than broad. Caudal ramus with ventrolateral row of spines near posterior margin. Lateral caudal seta inserted at anterior one-third of caudal ramus near dorsal midline. Dorsal caudal seta (somewhat foreshortened in Fig. 1a, e) finely and sparsely plumed, remaining caudal setae with stiff, thickly set setules. Lengths of caudal setae of holotype in μm : lateral 25, dorsal 47, medialmost to lateralmost terminal 15, 225, 133, 30, respectively.

Antennule (Figs. 1a, 2a) shorter than prosomite 1, composed of 11 articles; article 5 with spine, esthetasc on article 10 reaching midlength of article 11; no hyaline membrane visible on articles 10 and 11. Antenna (Fig. 2b) composed of 4 articles, article 1 lacking exopodite seta and 1 of 2 setae normally present on anterodistal corner; posterodistal corner of article 2 with row of spines, no other ornament visible on surface of any article of antenna. Mandible (Fig. 2c) with palp represented only by 1 slender seta inserted directly on surface of mandible. Maxillule (Fig. 2d, spines on arthrite not visible in mount) with palp having no spines on surface. Maxilla (Fig. 2e) with claw having teeth along most of medial margin. Maxilliped (Fig. 2f) composed of 4 articles, article 1 with 1 rather than normal 3 setae, article 2 with 1 seta and row of spines rather than normal 2 setae; article 4 having 2 rather than normal 3 setae.

Swimming legs 1–4 (Figs. 2g, h, 3a–d) each with biarticulate rami. Spine and seta formulae of distal articles of exopodites 3,3,3,3 and 5,5,5,5, respectively. Medial expansion of basipodite of leg 1 with stout, medially bent spine bearing short spinules on distal two-thirds of lateral margin. Lateral seta of basipodite of leg 4 lacking. Leg 4 endopodite article 2 with 1 seta on medial margin, 1 terminal seta and 1 terminal spine, and 1

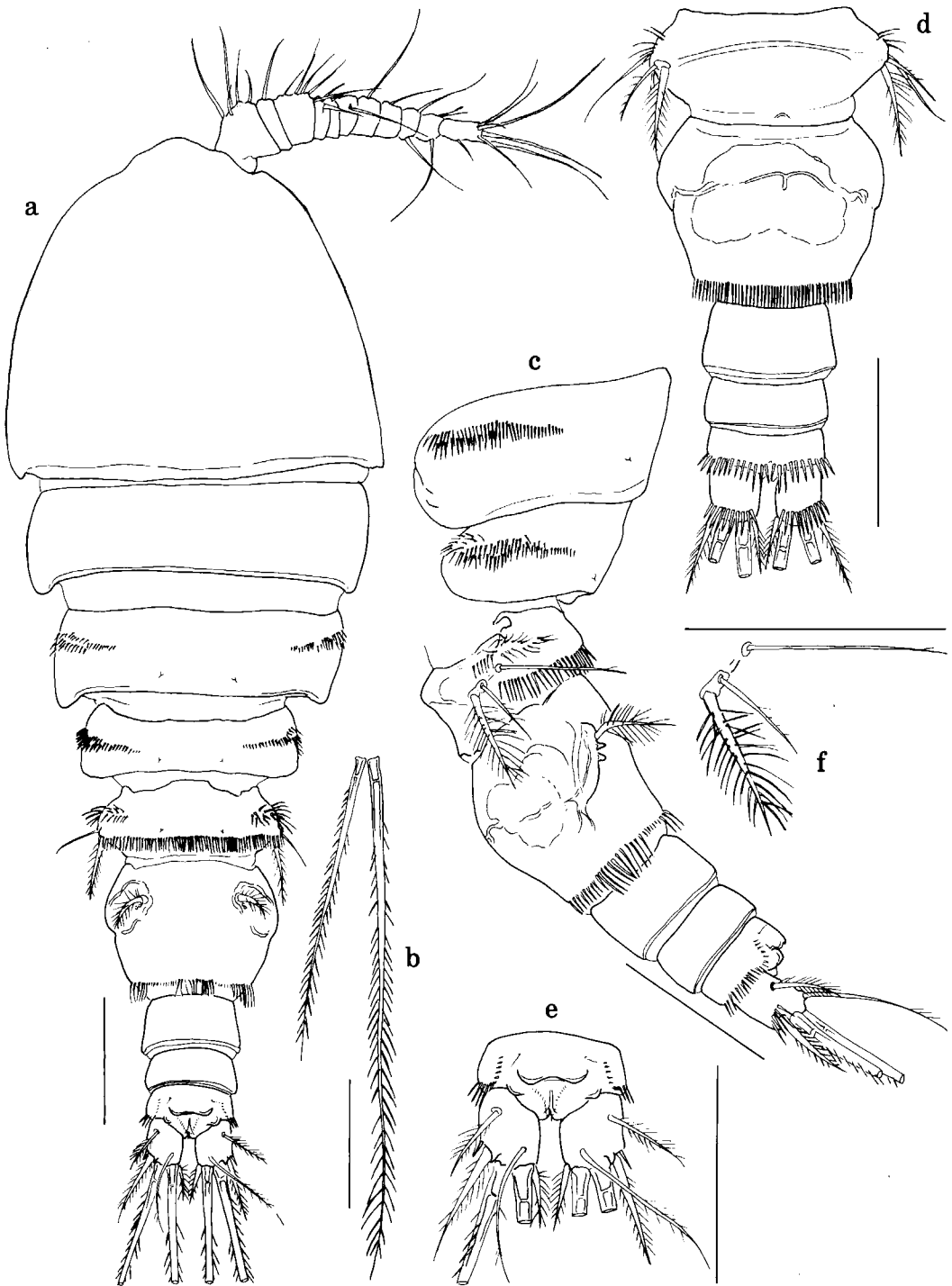


Fig. 1. *Fimbricyclops jimhensoni*, new genus, new species, female holotype, USNM 251903: a, habitus, dorsal, 2 median caudal setae incompletely indicated; b, 2 left median caudal setae; c, posterior prosome and urosome, left lateral; d, urosome, ventral; e, anal somite and caudal rami, dorsal; f, leg 5, left lateral. Each scale indicates 50 μm . Figures drawn at 600 \times from specimen in lactic acid.



Fig. 2. *Fimbricyclops jimhensoni*, new genus, new species, female holotype, USNM 251903: a, left antennule, ventral; b, antenna; c, mandible; d, maxillule; e, maxilla; f, maxilliped; g, left leg 1 and coupler, anterior; h, left leg 2 and coupler, anterior. Scale indicates 50 μm . Figure 2a–f drawn at 1,000 \times using oil immersion lens. Figures g, h drawn at 600 \times . All from appendages mounted in polyvinyl lactophenol.

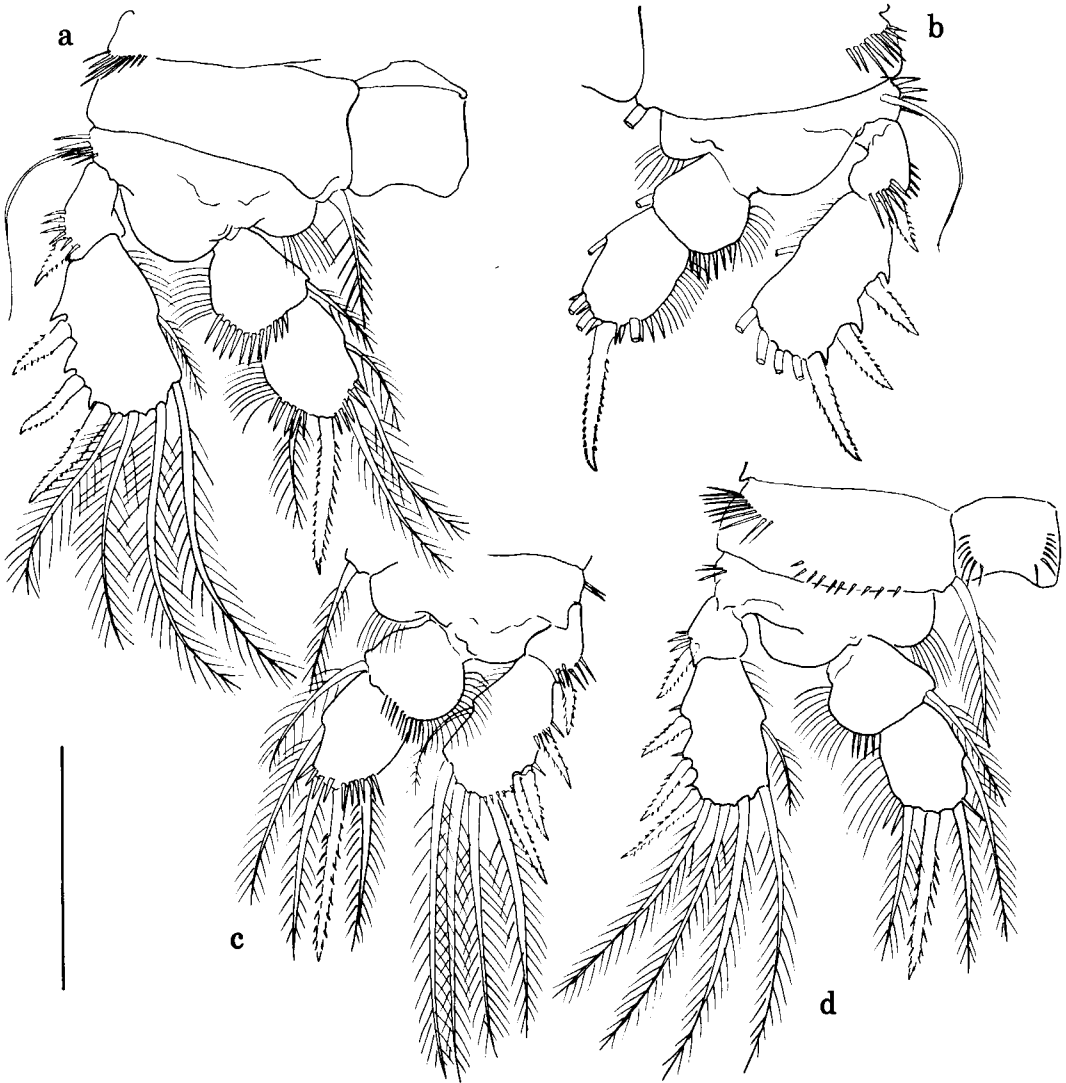


Fig. 3. *Fimbricyclops jimhensoni*, new genus, new species, female holotype, USNM 251903: a, right leg 3 and coupler, anterior; b, detail of right leg 3, posterior; c, left leg 4, anterior; d, left leg 4 and coupler, posterior. Scale indicates 50 μm . Figure drawn at 600 \times . Figure 3a, b from appendages mounted in polyvinyl lactophenol. Figure 3c, d in lactic acid with details later confirmed in PVL mount.

seta subdistally on lateral margin. Coxa-basipodites and lateral and distal margins of rami of most legs thickly ornamented with rows of accessory hairs and spines. Couplers of legs 1–3 without ornament; coupler of leg 4 with 2 diagonal crescentic rows of spines on posterior surface.

Leg 5 (Fig. 1a, c, d, f) inserted laterally on somite. Proximal article completely fused to somite; seta of proximal article inserted in large socket dorsolaterally to and at some distance from free article of leg. Distal (free)

article small, broader than long, bearing 2 terminal appendages, lateroterminal appendage setiform and sparsely plumed along margin, medioterminal appendage spini-form, heavily spinulose on entire surface, these appendages subequal in length, medial appendage slightly longer. Lengths of leg 5 appendages (foreshortened in some figures): seta of fused article 40 μm , lateroterminal appendage of free article 23 μm , medioterminal appendage of free article 32 μm . Leg 6 (Fig. 1a, c) consisting of narrow ovoid

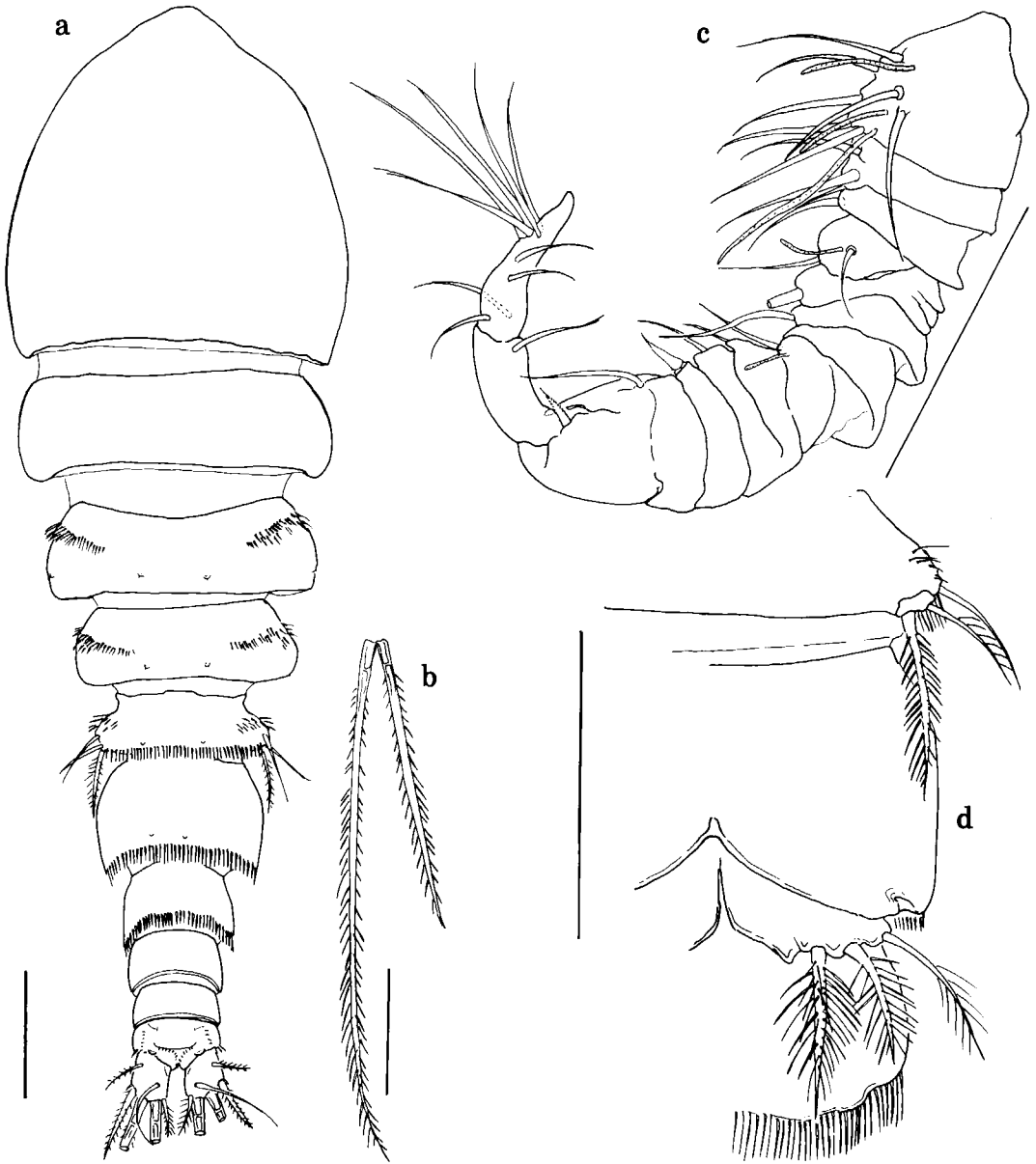


Fig. 4. *Fimbricyclops jimhensoni*, new genus, new species, male allotype, USNM 251904: a, habitus, dorsal, 2 median caudal setae incompletely indicated; b, 2 right median caudal setae; c, right antennule, ventral; d, left legs 5 and 6, ventral. Each scale indicates 50 μm . Figure 4a, b drawn at 600 \times . Figure 4c, d drawn at 1,000 \times using oil immersion lens. All figs. drawn from specimen in lactic acid.

plate inserted in sculptured depression on genital segment, bearing long dorsal spiniform seta and 2 short blunt spines; seta, like medioterminal spiniform appendage of leg 5, thickly spinulate over entire surface; spines naked.

Description of Male.—Length of allotype 420 μm . Range of lengths of paratypes 320–416

μm (median = 400 μm). Habitus (Fig. 4a, b) and somitic ornament similar to female, except urosomites 1–3 having hyaline membranes of posterior margins modified as spinous fringe, lengths of spines in fringe subequal. Antennule (Fig. 4c) geniculate, apparently of 16 articles (counting along posterior margin) with articles 5–7 incom-

pletely divided and usual division of 2 distalmost articles not visible, article 1 with 3, articles 4 and 10 each with 1 slender aesthetasc. Leg 5 (Fig. 4a, d) similar to that of female. Leg 6 (Fig. 4d) composed of crescentic plate, distinctly separate from urosomite, bearing 2 thickly spinulose spini-form appendages and 1 more slender, sparsely plumed setiform appendage on heavily sculptured and sclerotized distal margin. Medialmost spiniform appendage of leg 6 reaching posterior margin of succeeding somite. Antenna, mouthparts, and legs 1–4 similar to corresponding structures of female.

Etymology.—The specific name is given in memory of Jim Henson, animator of many fringed and hairy creatures.

Comparisons.—There exists no modern systematic examination of the family Cyclopidae, subfamily Cyclopinæ. In fact, the diagnoses of many genera of this group remain vague and somewhat controversial. Several recently proposed genera do not appear in existing compendia. It seems useful to list briefly all the presently recognized genera of the subfamily and to compare the newly proposed genus with salient distinguishing characters of these, although a complete review is beyond the scope of this paper. For more detailed discussion of genera having appendages reduced similarly to those of *Fimbricyclops*, the reader is referred to articles by Kiefer (1956), Lindberg (1954), Monchenko (1986), Reid (1988), and Rocha and Bjornberg (1987).

Several genera of the subfamily Cyclopinæ have in common a probably plesiomorphic state of most appendages. In particular, these are the antennule of 16 or 17 articles, swimming legs all with triarticulate rami, and leg 5 with 2 or 3 distinct articles. These attributes serve to distinguish their member species from *Fimbricyclops*. These genera are *Cyclops* O. F. Müller, 1776, sensu restricto Kiefer, 1939; *Megacyclops* Kiefer, 1927; *Mesocyclops* G. O. Sars, 1914; *Orthocyclops* E. B. Forbes, 1897; and *Thermocyclops* Kiefer, 1927.

Possession of a leg 5 composed of 2 distinct articles likewise distinguishes members of the genera *Acanthocyclops* Kiefer, 1927, *Caspicyclops* Monchenko, 1986, *Diacyclops* Kiefer, 1927, *Kieferiella* Lescher-

Moutoué, 1976, and *Mixocyclops* Kiefer, 1944. The number of articles in the antennule and swimming legs is reduced in some species. Probably in *Teratocyclops* Pleşa, 1981, both articles of leg 5 are distinct; however, this is not completely clear from the figure provided (Pleşa, 1981: 31, fig. 58). *Teratocyclops* requires more precise description, as already noted by Dussart and Defaye (1985).

Several genera have the leg 5 more reduced in its structure and/or the number of appendages than the leg 5 of *Fimbricyclops*. In *Australocyclops* Morton, 1985, *Cryptocyclops* G. O. Sars, 1927, *Idiocyclops* Herbst, 1987, *Microcyclops* Claus, 1893, *Neutrocyclops* Kiefer, 1936, and *Ponticyclops* Reid, 1987, the free article of leg 5 bears only 1 appendage, although this article also may be ornamented with an accessory unsocketed spinule. In *Allocyclops* Kiefer, 1932; *Graeteriella* Brehm, 1926, sensu lato, char. emend. Lindberg, 1954; *Psammophilocyclops* Fryer, 1956; and *Yansacyclops* Reid, 1988, both articles of leg 5 are fused to the somite, with only the 2 setae of the original distal article and in some cases a knob representing the distal article remaining. Furthermore, in *Psammophilocyclops* the maxilliped is composed of 3 articles. The genus *Austriocyclops* Kiefer, 1964, has the leg 5 reduced to a single seta, although all the swimming legs have the plesiomorphic triarticulate rami. In *Bacillocyclops* Lindberg, 1956, the leg 5 is reduced to a single large spine, with the swimming legs having biarticulate rami.

In *Psammocyclops* Kiefer, 1956, the single free article of leg 5 appears to be composed of fusion of both original articles because it bears all 3 setae in both sexes.

Several genera have the leg 5 structured similarly to *Fimbricyclops*, but differ in the number of articles of one or more pairs of swimming legs. *Bryocyclops* Kiefer, 1927, 1928, 1929, 1937; Lindberg, 1953, 1954; Dussart, 1982, sensu lato; and *Hesperocyclops* Herbst, 1984, have both rami of legs 1–3 and the exopodite of leg 4 biarticulate, but the endopodite of leg 4 uniarticulate (see also Rocha and Bjornberg, 1987). *Haplocyclops* Kiefer, 1952, char. emend. 1956 (sometimes considered a subspecies of *Bryocyclops*) has legs 1–3 with biarticulate rami, the leg 4 exopodite of 1 or 2 articles, and

the leg 4 endopodite always of 1 article. Additionally, *Bryocyclops* and *Haplocyclops* have the anal operculum greatly produced and in many species with serrate margins.

There remain for consideration the genera having, like *Fimbricyclops*, fusion of the leg 5 proximal article with the somite, the antennules with a reduced number of articles (i.e., fewer than 17, usually 10 or 11), and the swimming legs all with biarticulate rami. Several of these genera including *Goniocyclops* Kiefer, 1955; *Muscocyclops* Kiefer, 1937, char. emend. Lindberg, 1954, Rocha and Bjornberg, 1987, Reid, 1987; and *Speocyclops* Kiefer, 1937, have the anal operculum produced considerably over the caudal rami and frequently toothed or serrate. Additionally, *Goniocyclops* has legs 1–4 with spine formula 3,3,3,2 and no auxiliary rows of spines or other ornament on the margins of the articles of the rami. *Muscocyclops* has the seminal receptacle transversely elongate and narrow, lacking an anterior expansion; the spine formula 2,3,3,2 and seta formula 5,4,4,4; the leg 1 basipodite lacking a seta on its medial expansion; and leg 6 absent in the female and consisting of 2 short setae in the male. Members of *Speocyclops* have the swimming leg spine formula 3,4,4,3. In both *Metacyclops* Kiefer, 1927, sensu Lindberg, 1961, and *Apocyclops* Lindberg, 1942, the leg 5 free article bears a short naked or slightly serrate medial spine, and the length of this spine is not greater than twice the length of the free article.

Lindberg (1954) included *Cyclops staheli* Chappuis, 1917, from Surinam in his new genus *Menzeliella*. In spite of a redescription by Kiefer (1928) from type material, the species remains poorly characterized. The spine formula, corrected by Kiefer (1928) is 3,4,4,3; the lateral caudal seta is inserted in the posterodorsal one-third of the caudal ramus; the anterior and posterior parts of the seminal receptacle are narrow and transversely elongated; and the leg 4 endopodite 2 has 3 medial and 1 lateral setae and 2 terminal spines. Moreover, Kiefer (1928) mentioned that the posterior margins of the urosomites were not toothed. The sum of these differences indicates that there is no close relationship between *Menzeliella* and *Fimbricyclops*.

In *Cochlacocyclops* Kiefer, 1955, the ex-

act structure of leg 5 is uncertain. The leg consists of a fused proximal article with remnant seta and a single free article bearing 2 appendages. The nature of the distomedial appendage is uncertain, having been broken in dissection. Kiefer indicated (Kiefer, 1955: 231, fig. 31, repeated, 1956: 64, fig. 58) that the free article is about twice longer than broad and the distolateral seta is slender. The only known species, *Cochlacocyclops ateles* Kiefer, 1955, 1956, from Madagascar differs from *F. jimhensoni* in the shape of the seminal receptacle, the insertion of the lateral caudal seta at the posterolateral one-third of the caudal ramus, the shape of the free article of leg 5, the smooth hyaline membranes of the urosomites, and the lack of any auxiliary ornament on the somites or swimming legs. Kiefer's (1955) suggestion that *C. ateles* may in fact belong to the genus *Metacyclops* seems likely.

No previously known cyclopine genus includes species having the densely spinous appendages of legs 5 and 6 and the complex somitic ornament of *F. jimhensoni*. Many species of the subfamily of course possess some somitic ornament. Lindberg (1955) described *Bryocyclops fidjiensis* as having "quelques petites épines" on the lateral parts of abdominal segments 1–3, although his figure for the female (Lindberg, 1955: 3, fig. 1a) indicates spinules only on the lateral surfaces of the genital segment. Spines and hairs (small hairlike setae) occur in rows and groups on the urosomite 1 and/or the genital segment of species of *Apocyclops* [cf. Dumont and Maas, 1988(1989)], *Mesocyclops* (cf. Van de Velde, 1984), *Microcyclops*, and *Thermocyclops* (Reid, unpublished observations) and sometimes at other locations such as the leg 6 plate of the male (Reid *et al.*, 1989). However, to my knowledge the pattern of spines on prosomites 3 and 4 and urosomite 1 and the modified spinous fringelike hyaline membrane of the anterior urosomites found in *F. jimhensoni* is unique in the Cyclopoida.

The reduction of the mandibular palp to a single remnant seta is also unusual in the Cyclopinae. *Alloicyclops kieferi* (Petkovski, 1971) shares this feature. *Diacyclops imparilis* Monchenko, 1985, has a small palp with one seta. *Caspicyclops mirabilis* Monchenko, 1986, and *Speocyclops demetiensis* (Scourfield, 1932) lack the mandibular palp

completely, as apparently do species of *Muscocyclops*. Such reduction is probably a more general phenomenon than presently known, since mouthpart structures are rarely included in descriptions. Reid (1991b) reviewed analogous losses of one or more setae from the antenna basipodite, as also occurs in *F. jimhensoni*, and found such losses to occur in more cyclopine genera than had been supposed previously.

The elaborate arrays of auxiliary spines and hairs on the swimming legs, anal somite, and caudal rami of *F. jimhensoni* closely resemble those occurring in many species of *Bryocyclops* and *Muscocyclops*, and also in *Ectocyclops* Brady, 1904, of the subfamily Eucyclopinæ Kiefer, 1927 (cf. Dumont *et al.*, 1986). This ornament appears to be a parallel adaptation for similar semiterrestrial habitats.

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