

## Eutardigrada (Tardigrada) from Korea

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韓國產 眞緩步類(Eutardigrada, Tardigrada)

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### 적 요

1985년 4월부터 1988년 2월 사이에 전국 각 지역에서 채집된 이끼와 지의류 및 연못과 강의 저질등을 조사한 결과, 이중 36개 지소에서 8종의 眞緩步類(Eutardigrada)가 확인되었다. 본 8종은 모두 한국 미기록종인 바 이들에 대하여 기재하였고 아울러 도판을 작성하였다.

Key words: taxonomy, Eutardigrada, Korea.

### INTRODUCTION

In continuation of our taxonomic study on the Korean tardigrades, eight more species of Eutardigrada are now recorded. The specimens examined were those extracted from moss, lichen, or other bottom detritus of a river and ponds collected at different sites in South Korea from April 1985 to February 1988. Of 62 different site samples collected, 36 site samples (Fig. 1) contained the specimens of the eight species, which are described and figured in this paper. Including the 10 species of Heterotardigrada recorded in our previous report (Kim and Moon, 1988), total 18 species of Tardigrada are known to South Korea.

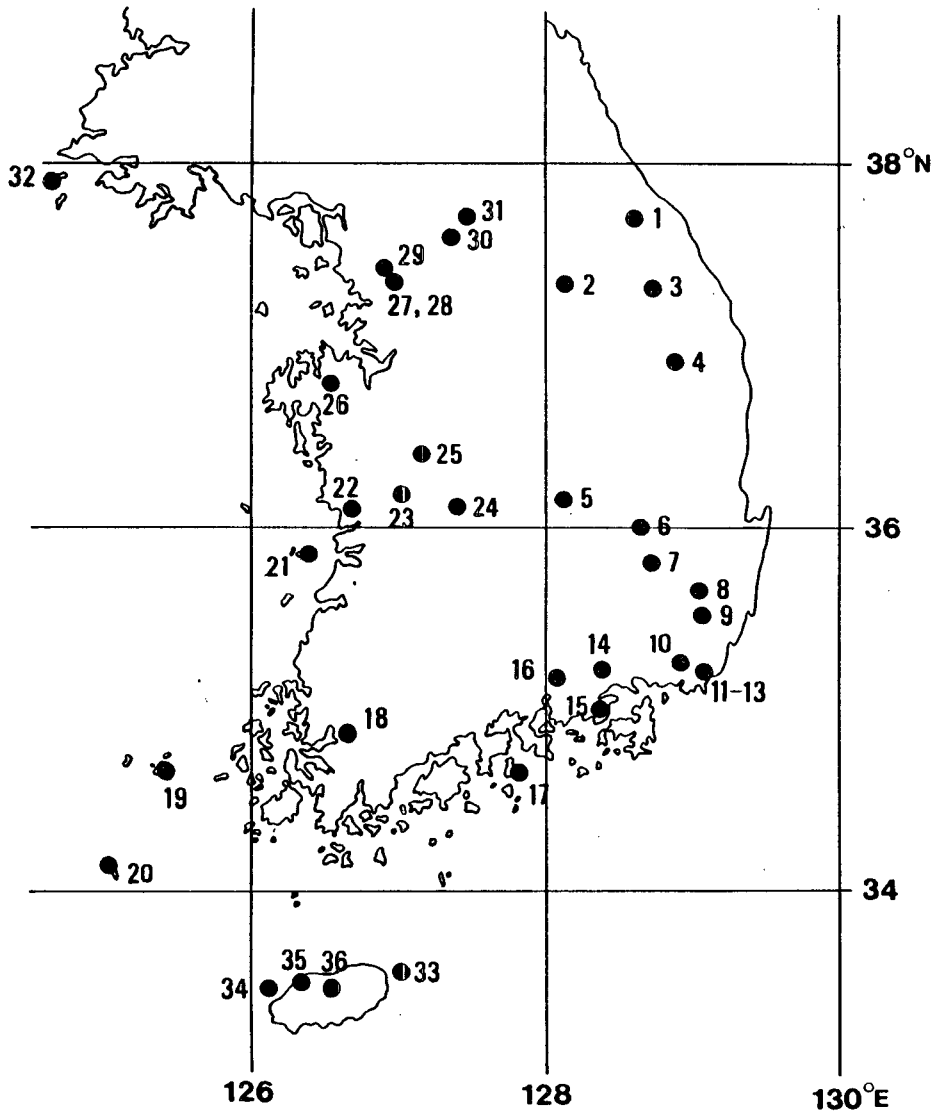


Fig. 1. A map showing the collection sites. 1, Odaesan; 2, Ch'iaksan; 3, Ch'ongsŏn; 4, Ponghwa; 5, Sewol reservoir (Kumi); 6, Kyŏngbuk Nat'l Univ.(Taegu); 7, P'algongsan; 8, Kajisan; 9, Yangsan; 10, Shinŏsan; 11, P'ŏmŏsa (Pusan); 12, Changjŏn-dong (Pusan); 13, Changsan (Pusan); 14, Junam reservoir; 15, Kosŏng; 16, Chinju; 17, Imp'o(Tolsando); 18, Wolch'ulsan; 19, Taehŭksando; 20, Sohŭksando; 21, Sŏnyudo; 22, Sŏ-myŏn(Sŏch' ŏn-gun); 23, Kangkyŏng; 24, Taedunsan; 25, Kyeryongsan; 26, Unsan; 27, Pond in Seoul Nat'l Univ.; 28, Kwanaksan; 29, Han-gang(Yŏuido); 30, Kangch'on; 31, Ch'unch'ŏn; 32, Paengnyŏngdo; 33, Udo; 34, Piyangdo; 35, Hyŏpje; 36, Hallasan.

## DESCRIPTION

Phylum Tardigrada

Class Eutardigrada Marcus, 1927

Order Parachela Schuster, Nelson, Grigarick and Christenberry, 1980

## Family Macrobiotidae Thulin, 1928

Genus *Dactylobiotus* Schuster, Nelson, Grigarick and Christenberry, 1980**1. *Dactylobiotus dispar*** (J. Murray, 1907) (Pl. I, Figs. A-E)

*Macrobiotus dispar* J. Murray, 1907a (pp. 6-10, figs. 1-5); 1907c (p. 662, pl. II, figs. 11a-11g); 1907d (p. 676); 1907e (pp. 850-851); Marcus, 1929 (pp. 435-436, fig. 272); 1936 (pp. 187-189, fig. 187); Morgan and King, 1976 (p. 77, fig. 47); Morgan 1976 (pp. 612-613, figs. E-G); Ramazzotti, 1972 (pp. 546-548, fig. 342).

*Macrobiotus macronyx*: Cuénot, 1932 (pp. 69-70, figs. 63-65).

*Dactylobiotus dispar*: Ramazzotti, 1983 (pp. 252-253, fig. 93).

**Material examined:** 1 ind., Han-Gang (Yöüido, Seoul) Nov. 10, 1986 (S. M. Yoon and M. K. Shin); 2 inds., Junam reservoir, Feb. 23, 1988 (C. Y. Chang, G. S. Min & M. O. Song).

**Description:** Freshwater species. Body length 280-528 $\mu$ . Cuticle smooth and finely granulated. Body colorless, brown or yellow pigmented. Eyespots present. Buccal tube wide and buccal aperture surrounded by peribuccal lamellae. Pharyngeal bulb containing apophyses and two rod-like macroplacoids, the first macroplacoid which appears broken or slightly constricted at midpoint longer than the second. Microplacoid absent. Massive doubleclaws characterized by a large, curved principal arm and very short secondary arm, and the two uniting at approximately right angle. Secondary arms better developed on the doubleclaws of the fourth pair of legs. A distinct chitinous bar connects the doubleclaws of each leg. Eggs round, covered with small conical processes separated by interspaces, which are difficult to distinguish from those of *Macrobiotus pullari*, and about 68 $\mu$  in diameter. Two large or small dorsal conical processes between the third and fourth pair of legs may be present.

Genus *Macrobiotus* Schultze, 1834**2. *Macrobiotus pullari*** J. Murray, 1907 (Pl. I, Figs. F-H)

*Macrobiotus pullari* J. Murray, 1907c (p. 663, pl. II, figs. 8a-8c); Marcus, 1928 (pp. 144-145, fig. 168); 1929 (pp. 437-438, fig. 264); 1930 (pp. 374-375, fig. 4); 1936 (pp. 192-194, fig. 190); Petersen, 1951 (pp. 54-56, fig. 15); Schuster, *et al.*, 1977 (p. 124, figs. 7, 8, 21); Ramazzotti, 1972 (pp. 592-593, fig. 388); 1983 (pp. 795-796, fig. 529); Argue, 1974 (p. 919, figs. 1-4); Morgan and King, 1976 (p. 91, fig. 59).

*Macrobiotus Pullari*: Cuénot, 1932 (pp. 63-64, fig. 52).

**Material examined:** 4 inds., Sewol reservoir (Kumi), Apr. 20, 1986 (S.M. Yoon)

**Description:** Freshwater species. Body length 340-380 $\mu$ . Cuticle smooth and transparent. Body colorless or faintly brown. Eyespots present. Buccal tube about 5 $\mu$  (outside) wide. Pharyngeal bulb containing prominent apophyses and two rod-like macroplacoids. The first macroplacoid constricted at their midpoint may appear as separate pieces, and double the length of the second. Microplacoid absent. Doubleclaws of v-shaped, jointed at the base, relatively much curved with accessory tips. Lunules hardly seen. Eggs round, covered with small conical processes separated by interspaces, and measured up to 100 $\mu$  in diameter including the processes which ranged about 5-6 $\mu$  from base to tip.

## Family Hypsibiidae Pilato, 1969

Genus *Hypsibius* Thulin, 1928**3. *Hypsibius dujardini*** (Doyère, 1840) (Pl. I, Figs. I-K)

*Macrobiotus Dujardin* Doyère, 1840 (cited from Marcus, 1936).

*Macrobiotus islandicus*: Murray, 1905b (p. 690, pl. III, figs. 12a-12c).

*Hypsibius dujardini*: Marcus, 1928 (pp. 202-204, fig. 249); 1929 (pp. 497-500, fig. 337); Petersen, 1951 (pp. 72-73, fig. 27); Schuster *et al.*, 1977 (p. 124, figs. 9, 10); Ramazzotti, 1983 (pp. 550-551, fig. 328).

*Hypsibius Dujardini*: Cuénot, 1932 (pp. 73-74, fig. 74).

*Hypsibius (Hypsibius) dujardini*: Marcus, 1936 (pp. 263-266, fig. 256); Ramazzotti, 1972 (pp. 456-458, fig. 243); Argue, 1974 (pp. 919-921, figs. 5-8); Morgan and King, 1976 (pp. 104-105, fig. 70).

**Material examined:** 1 ind., Pond in Seoul Nat'l Univ., Apr. 10, 1986 (M. K. Shin).

**Description:** Body length 460 $\mu$ . Cuticle smooth and transparent. Body colorless. Eyespots present. Mouth slightly subterminal. Buccel tube narrow, about 1.6 $\mu$  wide. Pharyngeal bulb containing apophyses and two rod-like macroplacoids. The first macroplacoid slightly longer than the second. A throttling of the first macroplacoids which was described as frequent appearance by Ramazzotti (1983) was not observed in our specimen. Microplacoid present. Doubleclaws of typical '*Hypsibius*' type and the principal arms with two accessory points.

**Remarks:** *H. dujardini* was reported to be found both in freshwater and damp to wet terrestrial mosses. Our sample was collected from freshwater habitat.

#### 4. *Hypsibius oberhaeuseri* (Doyère, 1840)

(Pl. I, Figs. L-N)

*Macrobiotus Oberhaeuser* Doyère, 1840 (cited from Marcus, 1929).

*Macrobiotus oberhäuseri*: Murray, 1905b (pp. 692-693); 1907c (pp. 658-659, pl. IV, figs. 27a-27d); 1907 (pp. 673-674); 1911 (p. 93).

*Hypsibius Oberhäuseri*: Cuénot, 1932 (pp. 71-72, figs. 67-69).

*Hypsibius (Hypsibius) oberhaeuseri*: Argue, 1971 (pp. 409-410, figs. 23-25); Ramazzotti, 1972 (pp. 468-469, fig. 254); Morgan and King, 1976 (p. 108, fig. 73); Beasley, 1972 (pp. 25-27, figs. 11-12); 1978 (pp. 136-138, fig. 18).

*Hypsibius oberhaeuseri*: Marcus 1928 (pp. 208-209, fig. 225) 1929 (p. 510, fig. 347); 1936 (pp. 278-281, fig. 265); Petersen, 1951 (p. 76, fig. 30); Ramazzotti, 1983 (pp. 561-562, fig. 338)

**Material examined:** 1 ind., P'algongsan, Aug. 19, 1987 (M. O. Song); 2 inds., Hallsan, Feb. 12, 1987 (S. N. Moon).

**Description:** Body length 202-235 $\mu$ . Cuticle densely granulated and reddish brown pigmented in nine transverse and five longitudinal bands. In juvenile specimens the cuticle may be smooth and the color faint. Eyespots absent. Doubleclaws well characterized by one pair nearly equal and jointed at the base, and the other pair having one very slender claw attached to the middle of the back of the shorter claw. Pharyngeal bulb containing apophyses and two granular macroplacoids. The first macroplacoid approximately equal to the second macroplacoids, or slightly larger than the second. Microplacoid absent. Buccal tube narrow, about 1.2 $\mu$  wide, and its length about 25 $\mu$  except the portion inside the pharyngeal bulb.

**Remarks:** This species was found in lichen on rocks and the bark of trees with *Echiniscus spiniger* and *E. montanus*. No eggs were found in the samples.

#### Genus *Isohypsibius* Thulin, 1928

#### 5. *Isohypsibius schaudini* (Richters, 1909)

(Pl. II, Figs. A, B)

*Macrobiotus schaudini*: Murray, 1911 (p. 93, pl. I, figs. 3a-3c).

*Hypsibius schaudini*: Marcus, 1928 (p. 192, fig. 235).

*Hypsibius (Isohypsibius) schaudini*: Marcus 1929 (pp. 482-483, fig. 325); 1930 (pp. 376-377); 1936 (pp. 246-247, fig. 245); Ramazzotti, 1972 (pp. 516-517, fig. 307); Morgan and King, 1976 (p. 117, fig. 87); Beasley, 1978 (p. 138, figs. 19, 20).

*Isohypsibius schaudini*: Petersen, 1951 (pp. 77-78, fig. 32); Ramazzotti, 1983 (pp. 662-663, fig. 420).

**Material examined:** 2 inds., Jangjŏn-dong (Pusan), Aug. 19, 1986 (S. N. Moon); 1 ind., Imp'o (Tolsando), May 1985 (S. N. Moon); 1 ind., Sŏmyŏn (Sŏch'ŏn-gun), July 31, 1986 (S. N. Moon); 2 inds., Chinchu, Oct. 29, 1985 (G. S. Min).

**Description:** Body length 370-430 $\mu$ . Cuticle smooth, ungranulated, or often possesses brown pigmented granules in older individuals. Eyespots present. Mouth subterminal. Buccal tube narrow, about 3 $\mu$  wide. Pharyngeal bulb containing apophyses and three granular macroplacoids increasing in size in rostral-caudal direction. Microplacoid absent. Doubleclaws of each leg differ and of '*Isohypsibius*' type: The principal arm of the more posteriorly placed doubleclaw intersects the secondary arm at a point one third along its length.

**Remarks:** *I. schaudini* is similar to *I. tetradactyloides* in the shape of macroplacoids, but in the latter the macroplacoids are rather ovoid or rod-like in comparison with the granular form of the former seen at a higher focusing. These two species are also distinguished from each other by the doubleclaws. The doubleclaws of *I. tetradactyloides* appear larger and more erect than those of *I. schaudini*. Ramazzotti (1972, 1983) considered *I. schaudini* as a eurytopic species and stated that this species occurred in aquatic situations, submerged moss and in moss subject to desiccation. Our specimens were found in terrestrial moss. Very minute microplacoid may be present, but it was absent in our specimens.

## 6. *Isohypsibius tetradactyloides* (Richters, 1909)

(Pl. II, Figs. C-E)

*Hypsibius tetradactyloides*: Marcus, 1928 (p. 192, fig. 236); Cuénot, 1932 (pp. 81-82).

*Hypsibius (Isohypsibius) tetradactyloides*: Marcus, 1929 (pp. 491-492, fig. 332); 1930 (pp. 378-379); 1936 (pp. 250-252, fig. 248); Beasley, 1968 (pp. 468-469, fig. 5); Ramazzotti, 1972 (p. 521, fig. 312); Morgan and King, 1976 (p. 120, fig. 84); Morgan, 1976 (p. 621, fig. 4, L-N).

*Isohypsibius tetradactyloides*: Ramazzotti, 1983 (pp. 670-671, fig. 428).

**Material examined:** 2 inds., Pŏmŏsa, May 25, 1986 (S. N. Moon); 2 inds., Kangch'on, June 6, 1986 (S. N. Moon); 2 inds., Taehŭksando, July 19, 1986 (M. K. Shin); 1 ind., Changsan (Pusan), July 10, 1986 (S. N. Moon).

**Description:** Body length 180-450 $\mu$ . Cuticle smooth and transparent. Body colorless or faintly brown. Eyespots present. Buccal tube narrow, about 2 $\mu$  wide. Pharyngeal bulb contains apophyses and 3 ovoid or rod-like macroplacoids increasing slightly in length in rostral-caudal direction, or the first and the second equal in length and the third longer. Microplacoid absent. Doubleclaws of each leg relatively long and similar in shape.

**Remarks:** This species was recorded to occur in aquatic situation as well as in terrestrial moss (Ramazzotti, 1983). Our specimens were collected from terrestrial moss.

Genus *Diphascion* Plate, 1889

## 7. *Diphascion scoticum* J. Murray, 1905

(Pl. II, Figs. F-H)

*Diphascion scoticum* J. Murray, 1905a (pp. 162-164, figs. 1a-1c); 1906a (p. 29); 1906b (p. 217); 1907c (p. 665, pl. III, fig. 19); 1907d (p. 678); Cuénot, 1932 (pp. 91-92, fig. 98); Ramazzotti, 1983 (pp. 310-313, figs. 142, 144, 145).

*Hypsibius scoticus*: Marcus, 1928 (pp. 169-170, fig. 206).

*Hypsibius (Diphascion) scoticus* Marcus, 1929 (p. 529, fig. 366); 1936 (pp. 303-305, fig. 285); Ramazzotti, 1972 (pp. 440-441, fig. 228); Argue, 1971 (pp. 412-413, figs. 33-35); Morgan and King, 1976 (p. 118, fig. 82).

**Material examined:** 1 ind., Ch'iaksan, June 2, 1986 (C. Y. Chang).

**Description:** Body length 235 $\mu$ . Cuticle smooth and transparent. Body colorless. Eyespots absent. Buccal tube long, slender, flexible, measured about 1.7 $\mu$  wide. The flexible part of the pharyngeal tube ringed with closely spaced thread-like thickenings. Pharyngeal bulb elongate, about 37 $\mu$  long and 21 $\mu$  wide; containing apophyses, three elongate rod-like macroplacoids and microplacoid. In the macroplacoids, the ratio of first to second to third about 6:5:9. Doubleclaws of each leg differ in shape and of typical '*Hypsibius*' type. Two small chitinous bars near the base of the doubleclaw present.

**Remarks:** The presence of spiral thickenings on the wall of the flexible portion of pharyngeal tube was not mentioned in the description of Ramazzotti (1972, 1983), Marcus (1928, 1929, 1936), and other investigators mentioned above. Argue (1971), however, identified its presence as a new observation in this species. Our specimen collected from Ch'iaksan has also prominent thread-like spiral thickenings.

Order Apochela Schuster, Nelson, Grigarick and Christenberry, 1980

Family Milnesidae Ramazzotti, 1962

Genus *Milnesium* Doyère, 1840

#### 8. *Milnesium tardigradum* Doyère, 1840

(Pl. II, Figs. I-K)

*Milnesium tardigradum* Doyère: Murray, 1905a (p. 162); 1905b (p. 696); 1907b (p. 272); 1907c (pp. 665-666); Marcus, 1928 (p. 217, figs. 264, 265); 1929 (pp. 547-549, figs. 382, 383); 1930 (p. 385); 1936 (pp. 321-324, fig. 302); Cuénot, 1932 (pp. 54-56, figs. 39, 40); Beasley, 1968 (p. 495, fig. 6); 1972 (pp. 27-28, fig. 18); 1978 (pp. 138-139); 1981 (p. 10); Argue, 1971 (pp. 413-414, figs. 39-40); Ramazzotti, 1972 (pp. 618-619, fig. 402); 1983 (pp. 831-834, fig. 560); Morgan, 1976 (p. 626); Morgan and King, 1976 (pp. 72-73, fig. 43).

**Material examined:** 1 ind., Kangkyöng, Aug. 2, 1986 (S. N. Moon); 2 inds., Unsan (Tangjin-gun), Oct. 6, 1985 (S. N. Moon); 1 ind., Kwanaksan, Apr. 4, 1986 (S. N. Moon); 2 inds., Sönyudo, May 6, 1986 (S. N. Moon); 1 ind., Ch'unch'on, June 6, 1986 (S. N. Moon); 1 ind., Kyöngbuk Nat'l Univ., Apr. 1986 (S. N. Moon); 12 inds., Odaesan, May 14, 1987, (S. N. Moon); 1 ind., Ponghwa, Sep. 1, 1987 (H. S. Kim); 10 inds., Yangsan, June 6, 1987 (S. N. Moon); 4 inds., Shinösan, Mar. 31, 1987 (S. N. Moon); 2 inds., Chöngsön, May 3, 1987 (C. Y. Chang); 1 ind., Kajisan, Jan. 1, 1987 (M. K. Shin); 3 inds., Kosöng, Aug. 21, 1987 (M. O. Song); 5 inds., Wolch'ulsan, Feb. 7, 1987 (C. Y. Chang); 2 inds., Sohüksando, Aug. 25, 1987 (M. K. Shin); 2 inds., Taedunsan, July 4, 1987 (C. Y. Chang & J. H. Park); 2 inds., Kyeryongsan, July 5, 1987 (C. Y. Chang); 2 inds., Paegnyöngdo, July 30, 1987 (H. S. Kim); 5 inds., Udo, Feb. 12, 1987 (S. N. Moon); 1 ind., Piyangdo, Feb. 9, 1987 (S. N. Moon); 3 inds., Hyöpje, Feb., 1987 (S. N. Moon).

**Description:** Body length 260-557 $\mu$ . Cuticle smooth, transparent and often shiny. Body colorless, pink, brown, or red-brown. Eyespots present. Mouth terminal and encircled by flesh six symmetrically arranged papillae. Three dorsal papillae being slightly larger than three ventral ones. Buccal tube short and wide. Pharyngeal bulb lacks placoids and appears pear-shaped. Claws very distinctive with two much elongated singleclaws and two short and stout ones with three branches. Eggs oval, about 80-90 $\mu$  in diameter, often found in shedded tests. Whole body fish-like appearance from dorsal view, widest at the level of three pairs of legs and tapering toward the head and tail.

**Remarks:** This species is cosmopolitan, and was found most often among tardigrades. The color of body may be lacking in young ones, but it becomes yellow and finally pinkish brown with increasing age. Argue (1971) mentioned that the intensity of color seemed to depend somewhat on habitat and the deepest coloration was observed in those living on lichens.

## ABSTRACT

Eight species of Eutardigrada found in Korea are described. They are *Dactylobiotus dispar*, *Macrobiotus pullari*, *Hypsibius dujardini*, *H. oberhaeuseri*, *Isohypsibius schaudini*, *I. tetradactyloides*, *Diphascoen scoticum* and *Milnesium tardigradum*; all are new to Korea.

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## EXPLANATION OF PLATES

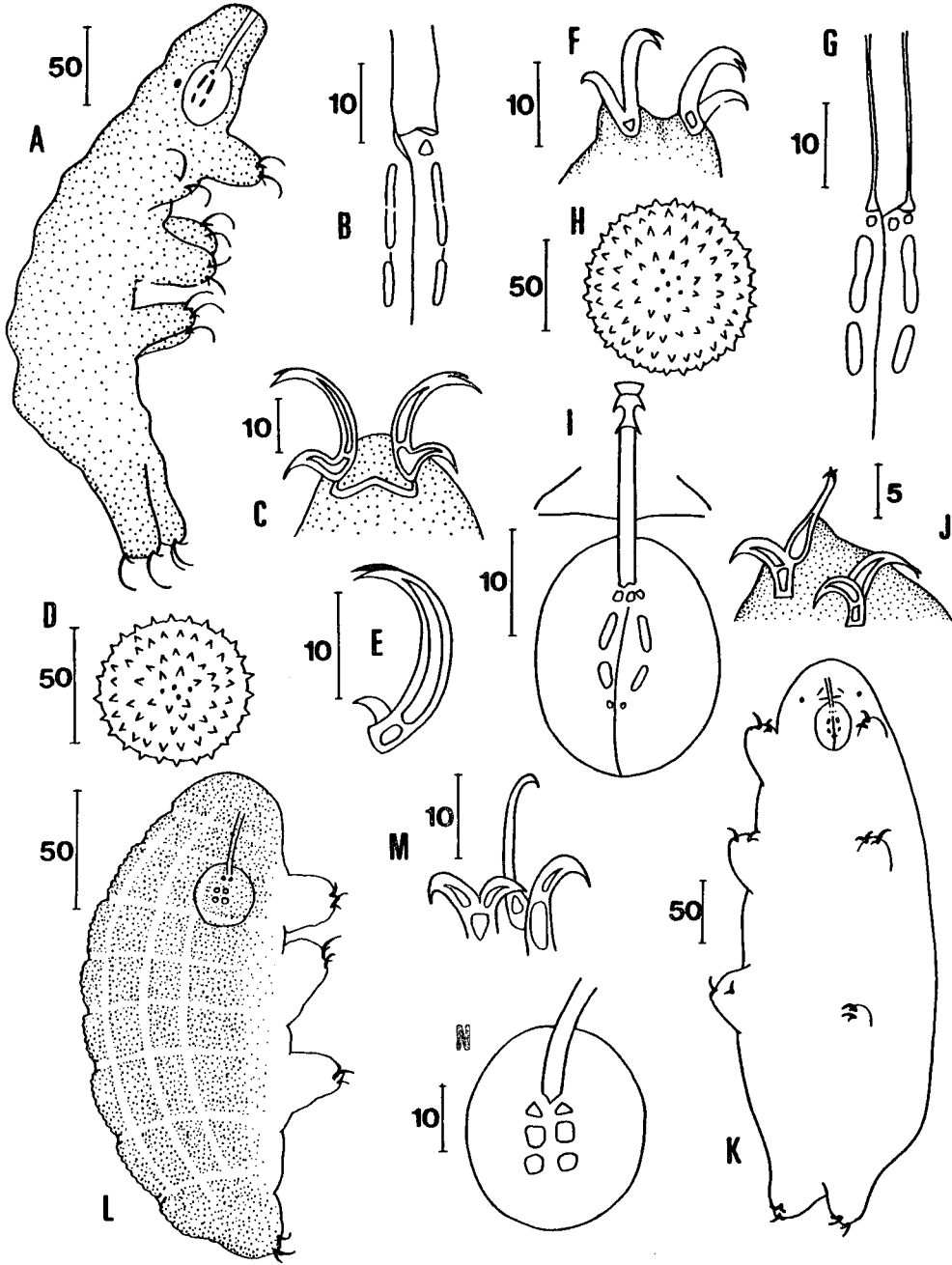
**Plate I. Figs. A-E:** *Dactylobiotus dispar* (A, whole animal; B, buccal apparatus; C, doubleclaws of the fourth pair of legs; D, egg; E, doubleclaw of the other legs). **Figs. F-H:** *Macrobotus pullari* (F, doubleclaws; G, buccal apparatus; H, egg). **Figs. I-K:** *Hypsibius dujardini* (I, buccal tube and pharyngeal bulb; J, doubleclaws; K, whole animal). **Figs. L-N:** *H. oberhaeuseri* (L, whole animal; M, doubleclaws; N, buccal tube and pharyngeal bulb).

**Plate II. Figs. A-B:** *Isohypsibius schaudini* (A, buccal tube and pharyngeal bulb; B, doubleclaws). **Figs. C-E:** *I. tetradactyloides* (C, buccal tube and pharyngeal bulb; D, doubleclaws; E, whole animal). **Figs. F-H:** *Diphascon scoticum* (F, whole animal; G, buccal tube and pharyngeal bulb; H, doubleclaws). **Figs. I-K:** *Milnesium tardigradum* (I, whole animal; J, buccal tube and pharyngeal bulb; K, claws).

(Scales in  $\mu\text{m}$ .)



# PLATE I



# PLATE II

