

## **Water Mites of Axonopsinae (Acarina, Aturidae) from Korea**

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### **ABSTRACT**

Eleven species of water mites belonging to the subfamily Axonopsinae are described from the eastern area of Korea. They were collected mainly in streams and are composed of 3 species of *Albaxona* (all new), 1 new species of *Javalbia*., 2 species of *Brachypoda* (both new), 2 species of *woolastookia* (both new), 2 species of *Ljania* (1 is new), and 1 species of *Lethaxona* (new record). The descriptions are mainly based on the male specimens.

Key words: Hydracarina. Aturidae. Axonopsinae. New Species. Korea

### **INTRODUCTION**

Among the water mites, Aturidae is one of the largest families incorporating about 700 species in more than 70 genera. This family currently consists of eight subfamilies, i.e., Frontipodopsinae, Axonopsinae, Albiniae, Zelandopsinae, Notoaturinae, Aturinae, Guineaxonopsinae, Japonaxonopsinae. Among them Axonopsinae is the largest subfamily, containing more than 330 species in 38 genera (K.O. Viets, 1987).

Korean Aturidae have been known of 18 species (Chung and Kim, 1991; Kim and Chung, 1993, 1995), with only one of them being an Axonopsinae. These species were collected from washings of mosses and stones immersed in streams, but none of them are of interstitial among sands or small pebbles where the species of Axonopsinae are common.

The materials examined in this report have been collected by the authors from several streams mostly in the eastern side of Korea. When we collected the materials, sands and pebbles immersed in stream water were dug out and stirred using a shovel, and the mixture of water and debris were filtered with a fine net. The filtered materials were in turn examined under the dissecting microscope for water mites. The sorted water mites were preserved in Koenike's fluid of Cook (1974).

Holotypes and undissected paratypes of the new species will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C., United States. The drawings were made with the aid of a camera lucida.

## DESCRIPTION

### *Javalbia (Javalbicula) ovata* n. sp. (Fig. 1)

**Type specimens.** 2 ♂♂ collected in a small stream, near Yonghyunsa-Temple at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995. Holotype will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution.

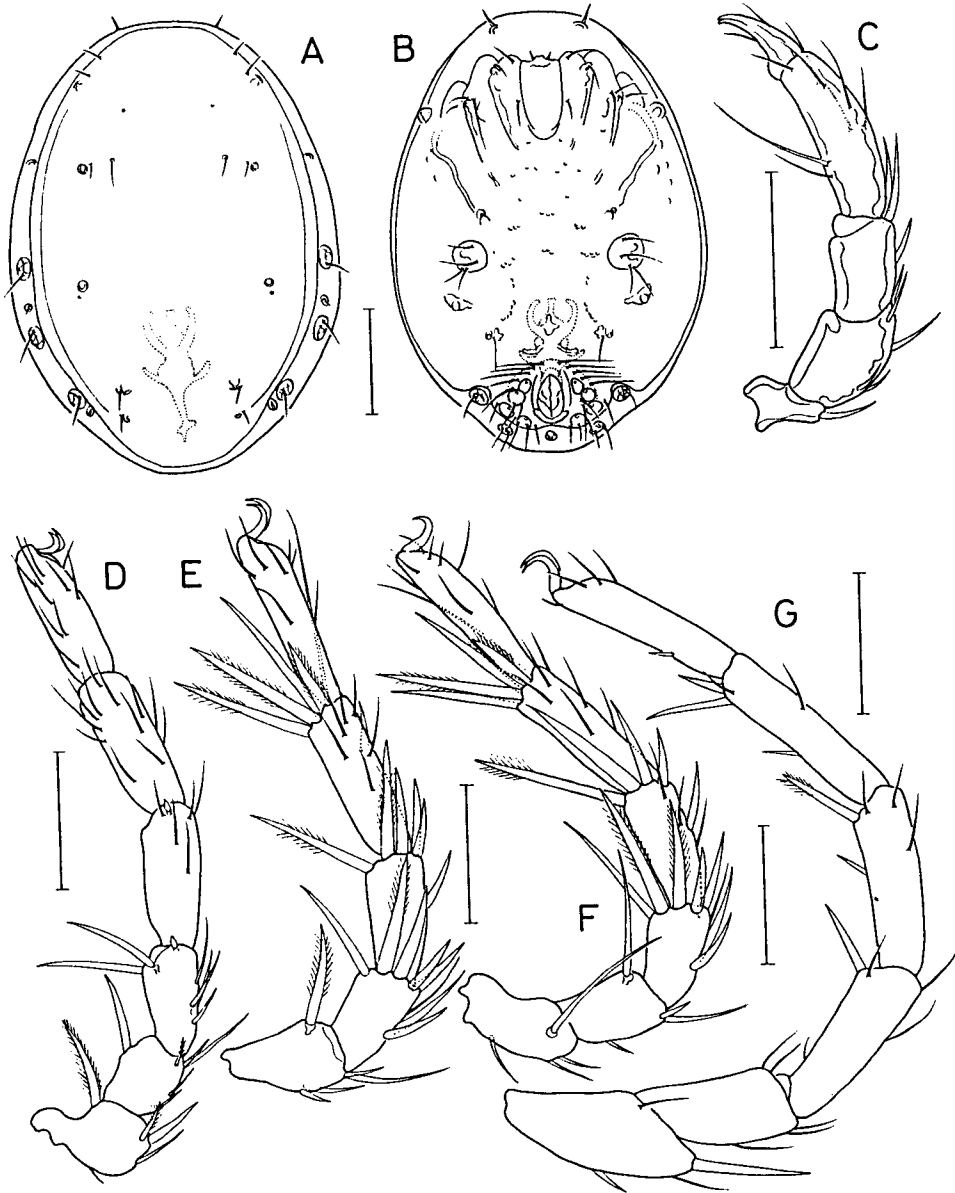
**Male.** Body (Fig. 1A) oval, 430  $\mu\text{m}$  long, and 315  $\mu\text{m}$  wide. Maximum width measured at posterior 0.4 length of body. Dorsal shield separated from ventral shield, 418  $\mu\text{m}$  long, 273  $\mu\text{m}$  wide, bearing preocularia, postocularia, postantenniform glandularia and 4 pairs of dorsoglandularia. Three pairs of lateroglandularia platelets small. Length between anterior end of first coxa and posterior end of venter 378  $\mu\text{m}$ . Preantenniform glandularia located near anterior margin of venter (Fig. 1B). Anterior end of coxae not reach anterior margin of venter. A glandularia located at area anteromedial to insertions of fourth leg. Another pair of glandularia present between insertion of fourth leg and genital field. Genital field fused with the ventral shield. Suture line of genital field indistinct. Width between both lateralmost acetabula 100  $\mu\text{m}$ . Gonopore 40  $\mu\text{m}$  long, and 26  $\mu\text{m}$  wide. Genital acetabula of 4-pairs. One of two pairs of glandularia near genital field located at area lateral to genital field near indentation of ventral shield, and remaining one located posterolateral to genital field. Excretory pore located just posterior to gonopore.

Palp (Fig. 1C) with following lengths of segments: P-I, 28  $\mu\text{m}$ ; P-II, 35  $\mu\text{m}$ ; P-III, 24  $\mu\text{m}$ ; P-IV, 53  $\mu\text{m}$ ; P-V, 28  $\mu\text{m}$ . Terminal segment of palp with bifid tip. Capitulum 83  $\mu\text{m}$  long, including apodeme. Chelicera 113  $\mu\text{m}$  long. First leg (Fig. 1D) with following dorsal lengths of segments: I-Leg-1, 34  $\mu\text{m}$ ; I-Leg-2, 28  $\mu\text{m}$ ; I-Leg-3, 40  $\mu\text{m}$ ; I-Leg-4, 53  $\mu\text{m}$ ; I-Leg-5, 54  $\mu\text{m}$ ; I-Leg-6, 54  $\mu\text{m}$ . Second leg (Fig. 1E) with following dorsal lengths of segments: II-Leg-3, 40  $\mu\text{m}$ ; II-Leg-4, 46  $\mu\text{m}$ ; II-Leg-5, 68  $\mu\text{m}$ ; II-Leg-6, 67  $\mu\text{m}$ . Third leg (Fig. 1F) with following dorsal lengths of segments: III-Leg-1, 42  $\mu\text{m}$ ; III-Leg-2, 34  $\mu\text{m}$ ; III-Leg-3, 39  $\mu\text{m}$ ; III-Leg-4, 49  $\mu\text{m}$ ; III-Leg-5, 63  $\mu\text{m}$ ; III-Leg-6, 63  $\mu\text{m}$ . Fourth leg (Fig. 1G) with following dorsal lengths of segments: IV-Leg-1, 71  $\mu\text{m}$ ; IV-Leg-2, 45  $\mu\text{m}$ ; IV-Leg-3, 66  $\mu\text{m}$ ; IV-Leg-4, 69  $\mu\text{m}$ ; IV-Leg-5, 73  $\mu\text{m}$ ; IV-Leg-6, 74  $\mu\text{m}$ . Fourth leg the longest among legs and followed by second, third, and first. Swimming hairs absent.

**Female.** Unidentified.

**Etymology.** The specific name *ovata* is taken after the ovate body.

**Remarks.** *Javalbia ovata* n. sp. is related to the subgenus *Jabalbia* in the position of excretory pore. However the new species is classified as a member of the subgenus *Javalbicula*, because it has four pairs of acetabula and small lateroglandularia platelets. In this subgenus only a single species, *Javalbia (Javalbicula) lata* Viets and Bottger, 1974, from Central Africa, is recorded. The new species differs from this African species in bearing more elongate body, the indistinct suture line between the genital field and ventral shield (distinct in *J. lata*), and the position of excretory pore which is located on venter (it is located in dorsal shield on *J. lata*).

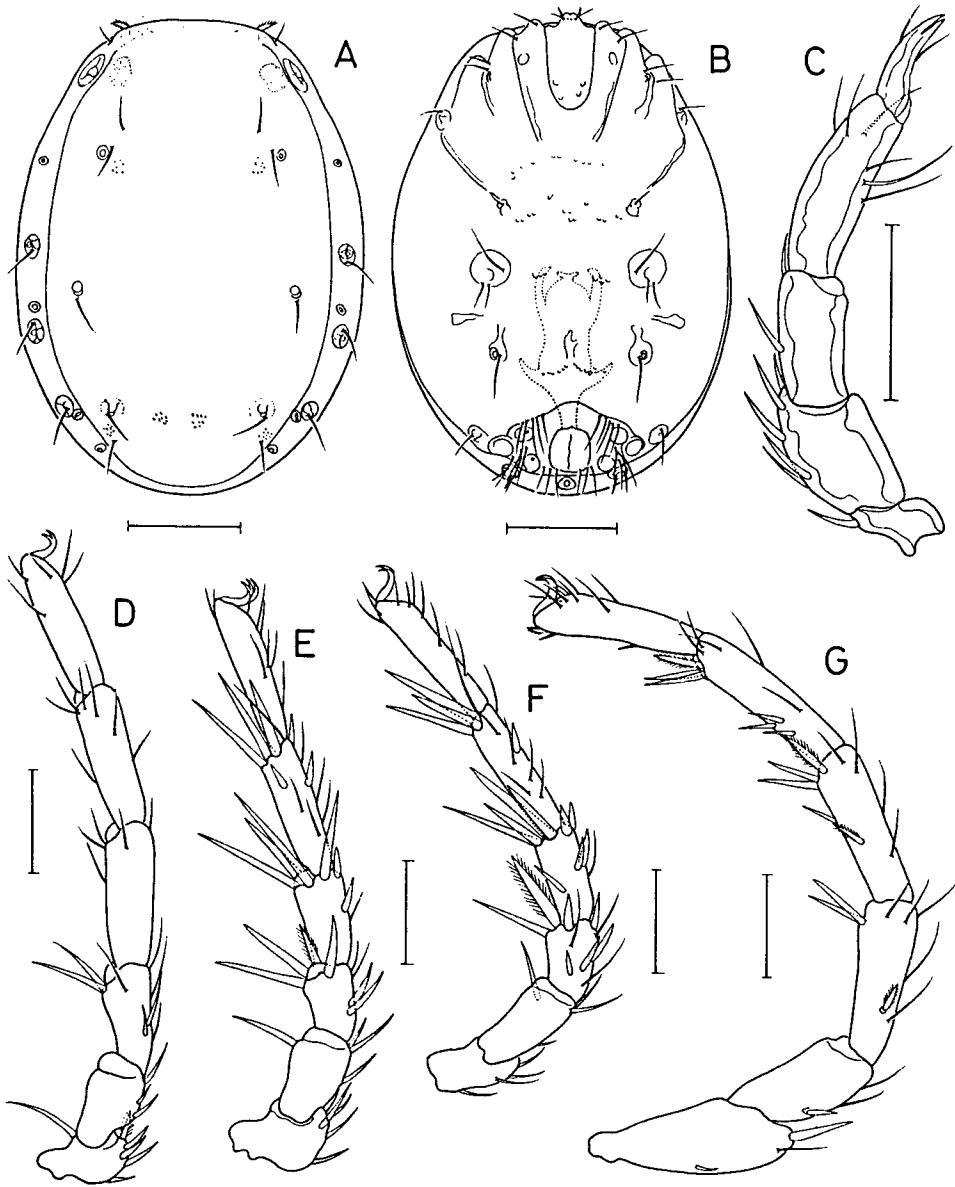


**Fig. 1.** *Javalbia ovata* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C-G = 0.05 mm.

***Albaxona (Albaxona) dubia* n. sp. (Fig. 2)**

**Type specimens.** 7 ♂♂ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995. Holotype ♂ and undissected paratypes (5 ♂♂) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected 1 ♂ paratype is kept in the collection of the senior author.

Other material examined. 2 ♂♂ collected in a stream at Wangsan (37°35' N, 128°46' E) in



**Fig. 2.** *Albaxona dubia* sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C-G = 0.05 mm.

Kangreung, 9 April 1995; 1 ♂ from a stream at Taekwanryong (37°41' N, 128°41' E) in Kangreung, 8 August 1995.

**Male.** Body (Fig. 2A) ovoid, 420  $\mu$ m long, and 310  $\mu$ m wide, with round posterior margin. Dorsal shield 410  $\mu$ m long, 250  $\mu$ m wide, bearing 4 pairs of dorsoglandularia and 1 pair of postocularia. Lateroglandularia platelets small, 3-paired. Venter (Fig. 2B) 423  $\mu$ m long, measured between anterior end of first coxa and posterior end of venter. Anterior coxae extending beyond anterior margin of

body. Genital field 65  $\mu\text{m}$  long, and 141  $\mu\text{m}$  wide, fused with ventral shield. Suture line of genital field distinct. Genital acetabulum 3-paired. Width between each lateralmost acetabulum 143  $\mu\text{m}$ . Gonopore 43  $\mu\text{m}$  long, and 38  $\mu\text{m}$  wide. One of glandularia present at area posterolateral to genital field. Area of soft integument extended over genital field, and bear excretory pore and 1 pair of glandularia.

Palp (Fig. 2C) with following lengths of segments: P-I, 23  $\mu\text{m}$ ; P-II, 40  $\mu\text{m}$ ; P-III, 34  $\mu\text{m}$ ; P-IV, 56  $\mu\text{m}$ ; P-V, 30  $\mu\text{m}$ . Capitulum 91  $\mu\text{m}$  long, including apodeme. First leg (Fig. 2D) with following dorsal lengths of segments: I-Leg-1, 38  $\mu\text{m}$ ; I-Leg-2, 30  $\mu\text{m}$ ; I-Leg-3, 53  $\mu\text{m}$ ; I-Leg-4, 68  $\mu\text{m}$ ; I-Leg-5, 70  $\mu\text{m}$ ; I-Leg-6, 70  $\mu\text{m}$ . Second leg (Fig. 2E) with following dorsal lengths of segments: II-Leg-1, 42  $\mu\text{m}$ ; II-Leg-2, 33  $\mu\text{m}$ ; II-Leg-3, 38  $\mu\text{m}$ ; II-Leg-4, 48  $\mu\text{m}$ ; II-Leg-5, 67  $\mu\text{m}$ ; II-Leg-6, 72  $\mu\text{m}$ . Third leg (Fig. 2F) with following dorsal lengths of segments: III-Leg-1, 42  $\mu\text{m}$ ; III-Leg-2, 38  $\mu\text{m}$ ; III-Leg-3, 40  $\mu\text{m}$ ; III-Leg-4, 48  $\mu\text{m}$ ; III-Leg-5, 70  $\mu\text{m}$ ; III-Leg-6, 70  $\mu\text{m}$ . Fourth leg (Fig. 2G) with following dorsal lengths of segments: IV-Leg-1, 99  $\mu\text{m}$ ; IV-Leg-2, 55  $\mu\text{m}$ ; IV-Leg-3, 81  $\mu\text{m}$ ; IV-Leg-4, 83  $\mu\text{m}$ ; IV-Leg-5, 86  $\mu\text{m}$ ; IV-Leg-6, 80  $\mu\text{m}$ . Fourth leg the longest among segments and followed by first, third, and second. Swimming hairs absent.

**Female.** Unidentified.

**Etymology.** The specific name *dubia* is from the Latin *dubius* meaning "uncertain". It is named so because of the lacking of any unique morphological feature in this species.

**Remarks.** The new species may be easily distinguished from other members of the subgenus *Albaxona*, because it has very weak extensions of anterior coxae. In the shape of genital field the new species resembles *A. stoka* Cook, 1967. However the new species differs from *A. stoka* in the shape of body (elongate in *A. stocka*), in the posterior part of body in which the dorsal shield incompletely cover ventral shield, and in the size of postantenniform glandularia platelet which is larger than that of *A. stoka*.

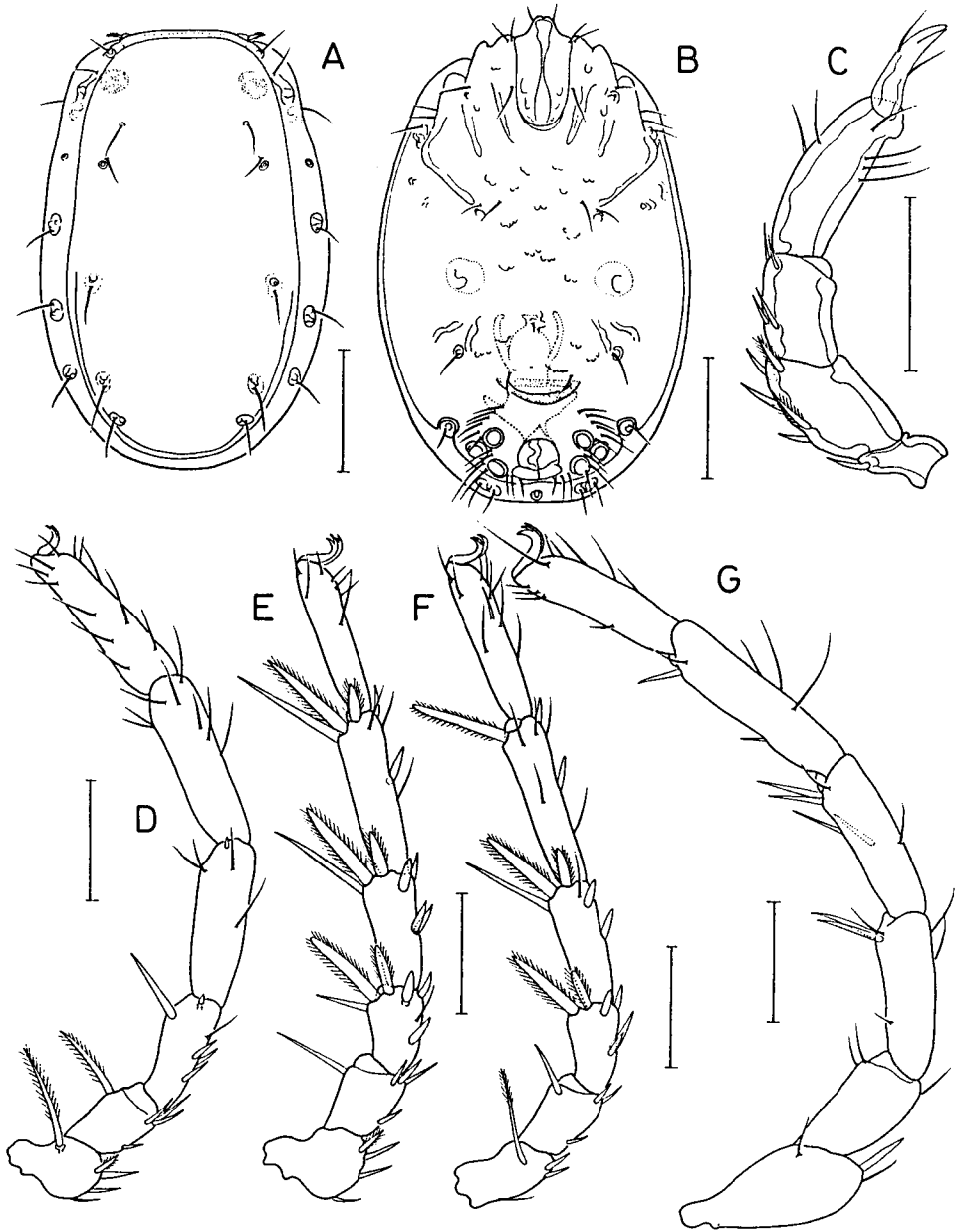
### ***Albaxona (Albaxona) lunata* n. sp. (Fig. 3)**

**Type specimens.** 4 ♂♂ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995. Holotype and undissected paratypes (2 ♂♂) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected paratype (1 ♂) is kept in the collection of the author.

Other material examined. 1 ♂ collected in a stream at Semal (37°30' N, 128°06' E), 9 August 1995.

**Male.** Body (Fig. 3A) rather elongate, 360  $\mu\text{m}$  long, and 238  $\mu\text{m}$  wide, with truncate anterior margin. Dorsal shield 348  $\mu\text{m}$  long, and 190  $\mu\text{m}$  wide, bearing 4 pairs of dorsoglandularia and 1 pair of postocularia. Lateroglandularia platelets small, being of 3 pairs. Length from anterior end of first coxa to posterior end of venter (Fig. 3B) 384  $\mu\text{m}$ . Anterior coxae extending over anterior margin of body. A crescent-shaped ornamentation appearing in front of the genital field. Genital field fused with ventral shield. Suture line of genital field indistinct. Genital acetabula 3-paired. Width between each lateralmost acetabulum 118  $\mu\text{m}$ . Gonopore 43  $\mu\text{m}$  long, and 43  $\mu\text{m}$  wide. Area of soft integument extended over genital field, and bear excretory pore and 1 pair of glandularia.

Palp (Fig. 3C) with following lengths of segments: P-I, 21  $\mu\text{m}$ ; P-II, 40  $\mu\text{m}$ ; P-III, 28  $\mu\text{m}$ ; P-IV, 54  $\mu\text{m}$ ; P-V, 30  $\mu\text{m}$ . Capitulum 96  $\mu\text{m}$  long, including apodeme. Chelicera 144  $\mu\text{m}$ . First leg (Fig. 3D)



**Fig. 3.** *Albaxona lunata* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C-G = 0.05 mm.

with following dorsal lengths of segments: I-Leg-1, 33  $\mu\text{m}$ ; I-Leg-2, 29  $\mu\text{m}$ ; I-Leg-3, 52  $\mu\text{m}$ ; I-Leg-4, 69  $\mu\text{m}$ ; I-Leg-5, 75  $\mu\text{m}$ ; I-Leg-6, 74  $\mu\text{m}$ . Second leg (Fig. 3E) with following dorsal lengths of segments: II-Leg-1, 36  $\mu\text{m}$ ; II-Leg-2, 30  $\mu\text{m}$ ; II-Leg-3, 36  $\mu\text{m}$ ; II-Leg-4, 49  $\mu\text{m}$ ; II-Leg-5, 68  $\mu\text{m}$ ; II-Leg-6, 65  $\mu\text{m}$ . Third leg (Fig. 3F) with following dorsal lengths of segments: III-Leg-1, 39  $\mu\text{m}$ ; III-Leg-2, 32  $\mu\text{m}$ ; III-Leg-3, 38  $\mu\text{m}$ ; III-Leg-4, 52  $\mu\text{m}$ ; III-Leg-5, 72  $\mu\text{m}$ ; III-Leg-6, 70  $\mu\text{m}$ . Fourth leg (Fig. 3G) with following dorsal lengths of segments: IV-Leg-1, 77  $\mu\text{m}$ ; IV-Leg-2, 47  $\mu\text{m}$ ; IV-Leg-3, 68  $\mu\text{m}$ ;

IV-Leg-4, 73  $\mu\text{m}$ ; IV-Leg-5, 87  $\mu\text{m}$ ; IV-Leg-6, 72  $\mu\text{m}$ . Fourth leg the longest and followed by first, third and second. Swimming hairs absent.

**Female.** Unidentified.

**Etymology.** The specific name *lunata* is from the Latin "*lunatus*", meaning "crescent-shaped". It refers to the crescent-shaped ornamentation appearing in front of the genital field.

**Remarks.** In the most members of the subgenus *Albaxona* the outline of genital field is distinct because of clear suture line between the ventral shield and genital field. Unlike these there is no suture line in the new species. The only other hitherto known species in this subgenus that has no suture line is *A. minuta* Szalay, 1944 (based on Fig 224 of Szalay, 1964). In this respect the new species resembles *A. minuta*. In other respects both are not alike. The preocularia of *A. lunata* is located in anterior area of dorsum outside the dorsal shield, but it is located on the dorsal shield in *A. minuta*. Moreover, the crescent-like ornamentation seen in front of genital field in *A. lunata* has not been reported in *A. minuta*.

#### ***Albaxona (Vietsaxona) libera* n. sp. (Fig. 4)**

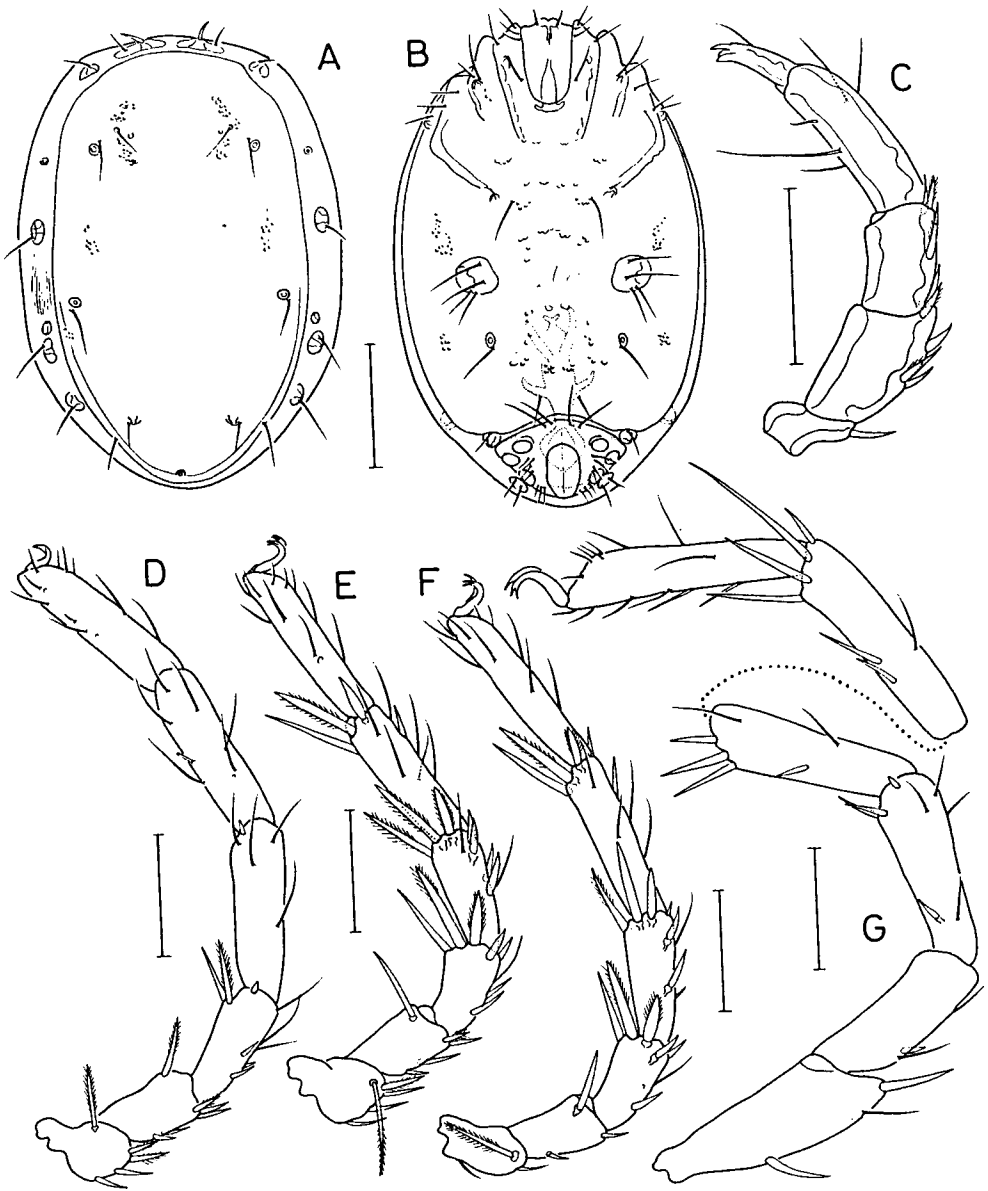
**Type specimens.** 4 ♂♂ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995. Holotype ♂ and undissected paratypes (2 ♂♂) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected paratype (1 ♂) is kept in the collection of the senior author.

**Male.** Body (Fig. 4A) 370  $\mu\text{m}$  long, and 262  $\mu\text{m}$  wide, with rather tapering posterior part. Dorsal shield 350  $\mu\text{m}$  long, 208  $\mu\text{m}$  wide, bearing 4 pairs of dorsoglandularia and 1 pair of postocularia and excretory pore. Lateroglandularia platelets small, being of 3 pairs. Length from anterior end of first coxa to posterior end of venter (Fig. 4B) 396  $\mu\text{m}$  long. Anterior coxae extending over anterior margin of body. Genital field 65  $\mu\text{m}$  long, 108  $\mu\text{m}$  wide, and separated from ventral shield, with distinct suture line. Genital acetabula 3-paired. Gonopore 43  $\mu\text{m}$  long, and 28  $\mu\text{m}$  wide. One of 2 pairs of glandularia near genital field located lateral to genital field, and another one located posterolateral to genital field.

Palp (Fig. 4C) with following lengths of segments: P-I, 20  $\mu\text{m}$ ; P-II, 42  $\mu\text{m}$ ; P-III, 30  $\mu\text{m}$ ; P-IV, 53  $\mu\text{m}$ ; P-V, 23  $\mu\text{m}$ . Capitulum 78  $\mu\text{m}$  long, including apodeme. Chelicera 111  $\mu\text{m}$ . First leg (Fig. 4D) with following dorsal lengths of segments: I-Leg-1, 33  $\mu\text{m}$ ; I-Leg-2, 32  $\mu\text{m}$ ; I-Leg-3, 53  $\mu\text{m}$ ; I-Leg-4, 73  $\mu\text{m}$ ; I-Leg-5, 74  $\mu\text{m}$ ; I-Leg-6, 76  $\mu\text{m}$ . Second leg (Fig. 4E) with following dorsal lengths of segments: II-Leg-1, 40  $\mu\text{m}$ ; II-Leg-2, 31  $\mu\text{m}$ ; II-Leg-3, 40  $\mu\text{m}$ ; II-Leg-4, 53  $\mu\text{m}$ ; II-Leg-5, 64  $\mu\text{m}$ ; II-Leg-6, 74  $\mu\text{m}$ . Third leg (Fig. 4F) with following dorsal lengths of segments: III-Leg-1, 35  $\mu\text{m}$ ; III-Leg-2, 35  $\mu\text{m}$ ; III-Leg-3, 42  $\mu\text{m}$ ; III-Leg-4, 57  $\mu\text{m}$ ; III-Leg-5, 73  $\mu\text{m}$ ; III-Leg-6, 81  $\mu\text{m}$ . Fourth leg (Fig. 4G) with following dorsal lengths of segments: IV-Leg-1, 101  $\mu\text{m}$ ; IV-Leg-2, 68  $\mu\text{m}$ ; IV-Leg-3, 83  $\mu\text{m}$ ; IV-Leg-4, 88  $\mu\text{m}$ ; IV-Leg-5, 98  $\mu\text{m}$ ; IV-Leg-6, 103  $\mu\text{m}$ . Fourth leg the longest among legs and followed by first, third, and second. Swimming hairs absent.

**Etymology.** The specific name *libera* is taken for the genital field which is well-separated from ventral shield.

**Remarks.** Three species, *A. lundbladi* Motas and Tanasachi, 1947, *A. nearctica* Cook, 1974 and *A. intermedia* Tuzovskij, 1986, are the members of the subgenus *Vietsaxona*. *A. libera* n. sp. resembles *A. intermedia* and *A. lundbladi* in having a pair of glandularia which are isolated from the



**Fig. 4.** *Albaxona libera* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C-G = 0.05 mm.

posterior extremities of ventral shield. The latter two species have the following features that are not observed in *A. libera*.

*A. intermedia*: The genital field of this species is broader and its margin is curved (as in Fig. 1 of Tuzovskij, 1986). The posterior portion of body is broader, not narrowed as in *A. libera*.

*A. lundbladi*: Based on Szalay (1964), the dorsal shield is constricted in the middle. The extension of anterior coxae is weaker than in the new species. The genital field is more broader and bears more than eight small setae (based on Fig. 225C of Szalay, 1964) along the anterior margin, in contrast to



the four, rather large setae of the new species.

The genital field of *A. libera* is similar to that of *A. nearctica*. However *A. libera* have a pair of glandularia free from the posterior extremities of ventral shield as mentioned above, unlike *A. nearctica*, and bears the narrower body (when compared to the measurements and Fig. 1304 of Cook, 1974) and the distinctly longer third segment of palp (48  $\mu\text{m}$ , according to Cook, 1974, in contrast to 30  $\mu\text{m}$  in the new species).

***Brachypoda (Brachypoda) rapida* n. sp. (Figs. 5, 6)**

**Type specimens.** 6 ♂♂, 22 ♀♀ collected in a small stream at Kuma-ri (37°16' N, 129°15' E) in Samchok, 4 August 1992. Holotype ♂, allotype ♀ and undissected paratypes (3 ♂♂, 18 ♀♀) will be deposited in the U. S. National Museum of Natural History, Smithsonian Institution. Dissected paratypes (2 ♂♂, 2 ♀♀) are kept in the collection of the senior author.

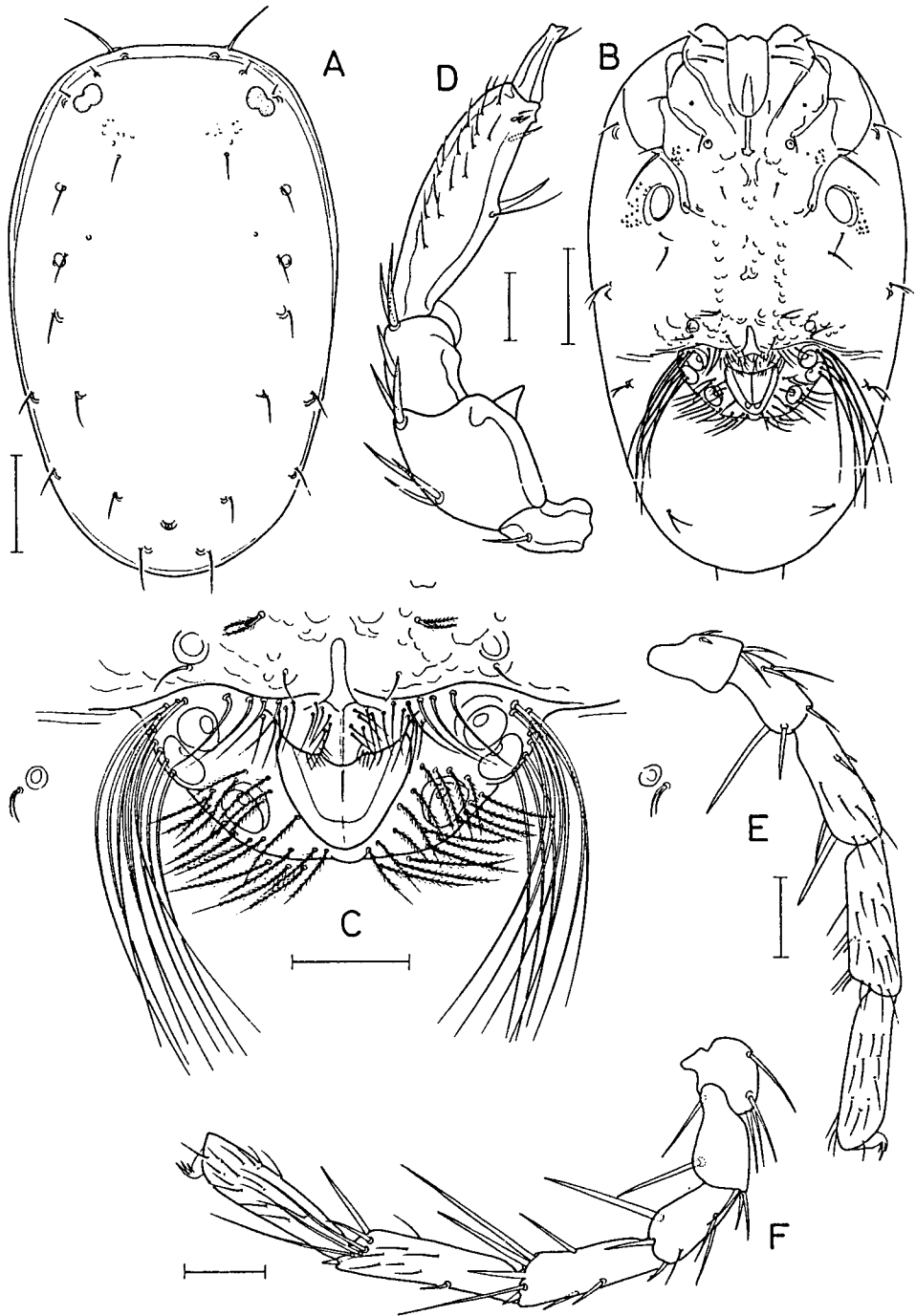
Other material examined. 2 ♂♂, 4 ♀♀ from a stream at Sungsan (37°42' N, 128°49' E) in Kangreung, 25 October 1990; 1 ♂, 4 ♀♀ from a stream near Kyungju (37°48' N, 129°22' E), 22 September 1991.

**Male.** Body (Fig. 5A) rather elongate, 555  $\mu\text{m}$  long, and 350  $\mu\text{m}$  wide, with truncate anterior margin and narrowed posterior part. Dorsal shield bearing 8 pairs of glandularia, 1 pair of postantenniform glandulariaocularia and 2 pairs of ocellaria, and excretory pore. Length between anterior end of first coxa and posterior end of venter (Fig. 5B) 578  $\mu\text{m}$  long. A prominent ridge extended to anterolateral margin of body between third coxa and insertion of fourth leg. Genital field (Fig. 5C) fused with ventral shield, located at about posterior 0.36 length of body, with a tuft of 9, very large setae at each lateral edge. Posterior margin of genital field distinct. Distance between each outermost acetabula 150  $\mu\text{m}$ . Acetabular region with numerous short setae. Genital acetabula 3-paired, first and second pairs located closely. Genital field accompanied by 3 small setae on both sides of ventral shield just behind posterior margin of genital field.

Palp (Fig. 5D) with following lengths of segments: P-I, 32  $\mu\text{m}$ ; P-II, 58  $\mu\text{m}$ ; P-III, 32  $\mu\text{m}$ ; P-IV, 100  $\mu\text{m}$ ; P-V, 30  $\mu\text{m}$ . P-II with a projection on ventral side. Capitulum 125  $\mu\text{m}$  long, including apodeme. Chelicera 103  $\mu\text{m}$ . First leg (Fig. 5E) with following dorsal lengths of segments: I-Leg-3, 58  $\mu\text{m}$ ; I-Leg-4, 90  $\mu\text{m}$ ; I-Leg-5, 102  $\mu\text{m}$ ; I-Leg-6, 98  $\mu\text{m}$ . Second leg (Fig. 5F) with following dorsal lengths of segments: II-Leg-1, 47  $\mu\text{m}$ ; II-Leg-2, 47  $\mu\text{m}$ ; II-Leg-3, 65  $\mu\text{m}$ ; II-Leg-4, 98  $\mu\text{m}$ ; II-Leg-5, 117  $\mu\text{m}$ ; II-Leg-6, 110  $\mu\text{m}$ . Third leg (Fig. 6A) with following dorsal lengths of segments: III-Leg-1, 62  $\mu\text{m}$ ; III-Leg-2, 48  $\mu\text{m}$ ; III-Leg-3, 55  $\mu\text{m}$ ; III-Leg-4, 80  $\mu\text{m}$ ; III-Leg-5, 112  $\mu\text{m}$ ; III-Leg-6, 98  $\mu\text{m}$ . Fourth leg (Fig. 6B, C) with following dorsal lengths of segments: IV-Leg-1, 72  $\mu\text{m}$ ; IV-Leg-2, 47  $\mu\text{m}$ ; IV-Leg-3, 55  $\mu\text{m}$ ; IV-Leg-4, 83  $\mu\text{m}$ , including projection; IV-Leg-5, 152  $\mu\text{m}$ ; IV-Leg-6, 152  $\mu\text{m}$ .

Third leg with long swimming hairs. Fourth leg the longest among legs and followed by second, third, and first. Distal end of fourth segment with strong distal projection tipped by 2 setae of unequal thickness, and on ventral margin 2 extremely heavy setae (proximal one nearly twice as long as distal one) and several ordinary setae. Fifth segment with 11 setae on ventral margin, 3 long swimming hairs on anterodistal border, and setules on posterior side. Sixth segment with numerous setules on posterior side, 3 setae on anterior side, 2 setae on proximal portion of ventral margin.

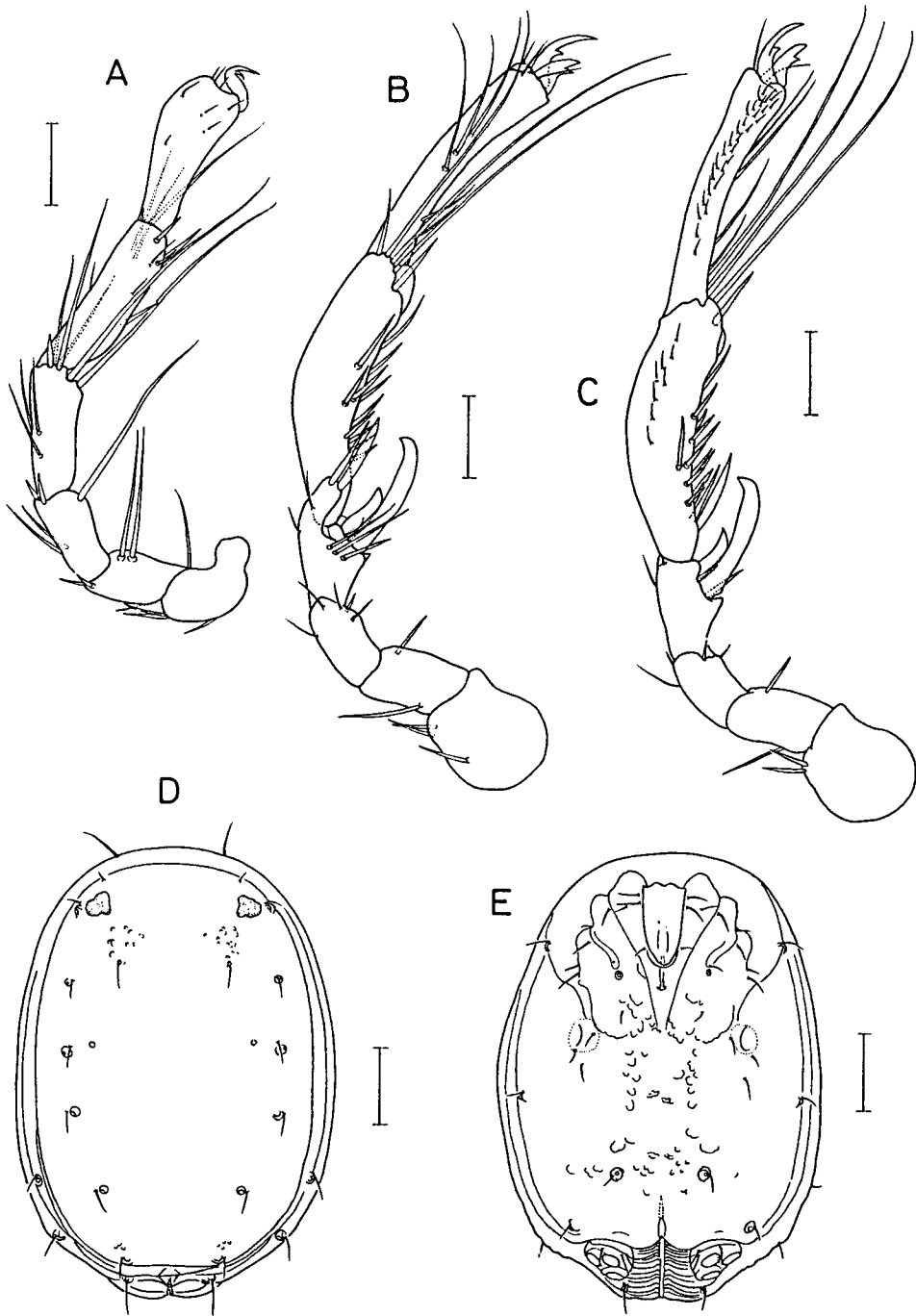
**Female.** Body (Fig. 6D) 758  $\mu\text{m}$  long, 413  $\mu\text{m}$  wide, slightly broader posteriorly, with 3 pairs of glandularia and excretory pore, both located outside dorsal shield. Coxae not extended. Genital field



**Fig. 5.** *Brachypoda rapida* n. sp., male: A, dorsal view; B, ventral view; C, genital field; D, palp; E, first leg; F, second leg. Scales: A, B = 0.1 mm; C, E, F = 0.05 mm; D, 0.02 mm.

dissimilar to that of male, located posterior part of body, with very few setae. IV-Leg-4 without projection. Other morphological features as in male.

Dorsal lengths of palpal segments: P-I, 34  $\mu$ m; P-II, 59  $\mu$ m; P-III, 34  $\mu$ m; P-IV, 87  $\mu$ m; P-V, 33



**Fig. 6.** *Brachypoda rapida* n. sp., male: A, third leg; B, fourth leg; C, fourth leg. Female: D, dorsal view; E, ventral view. Scales: A, B, C = 0.05 mm; D, E = 0.1 mm.

$\mu\text{m}$ . Capitulum 125  $\mu\text{m}$  long, including apodeme. Chelicera 106  $\mu\text{m}$ . Dorsal lengths of segments of first leg: I-Leg-1, 38  $\mu\text{m}$ ; I-Leg-2, 38  $\mu\text{m}$ ; I-Leg-3, 50  $\mu\text{m}$ ; I-Leg-4, 71  $\mu\text{m}$ ; I-Leg-5, 83  $\mu\text{m}$ ; I-Leg-6, 83  $\mu\text{m}$ . Dorsal lengths of segments of second leg: II-Leg-1, 34  $\mu\text{m}$ ; II-Leg-2, 55  $\mu\text{m}$ ; II-Leg-3, 58  $\mu\text{m}$ ;

II-Leg-4, 80  $\mu\text{m}$ ; II-Leg-5, 90  $\mu\text{m}$ ; II-Leg-6, 93  $\mu\text{m}$ . Dorsal lengths of segments of third leg: III-Leg-1, 50  $\mu\text{m}$ ; III-Leg-2, 55  $\mu\text{m}$ ; III-Leg-3, 63  $\mu\text{m}$ ; III-Leg-4, 83  $\mu\text{m}$ ; III-Leg-5, 106  $\mu\text{m}$ ; III-Leg-6, 100  $\mu\text{m}$ . III-Leg-5 with 4 swimming hairs. Dorsal lengths of segments of fourth leg: IV-Leg-1, 70  $\mu\text{m}$ ; IV-Leg-2, 63  $\mu\text{m}$ ; IV-Leg-3, 70  $\mu\text{m}$ ; IV-Leg-4, 88  $\mu\text{m}$ ; IV-Leg-5, 120  $\mu\text{m}$ ; IV-Leg-6, 103  $\mu\text{m}$ . Fourth leg the longest and followed by third, second, and first.

**Etymology.** The specific name *rapida* is taken from the Latin *rapidus* (meaning "fast"). It alludes to the fast moving behavior of this water mite.

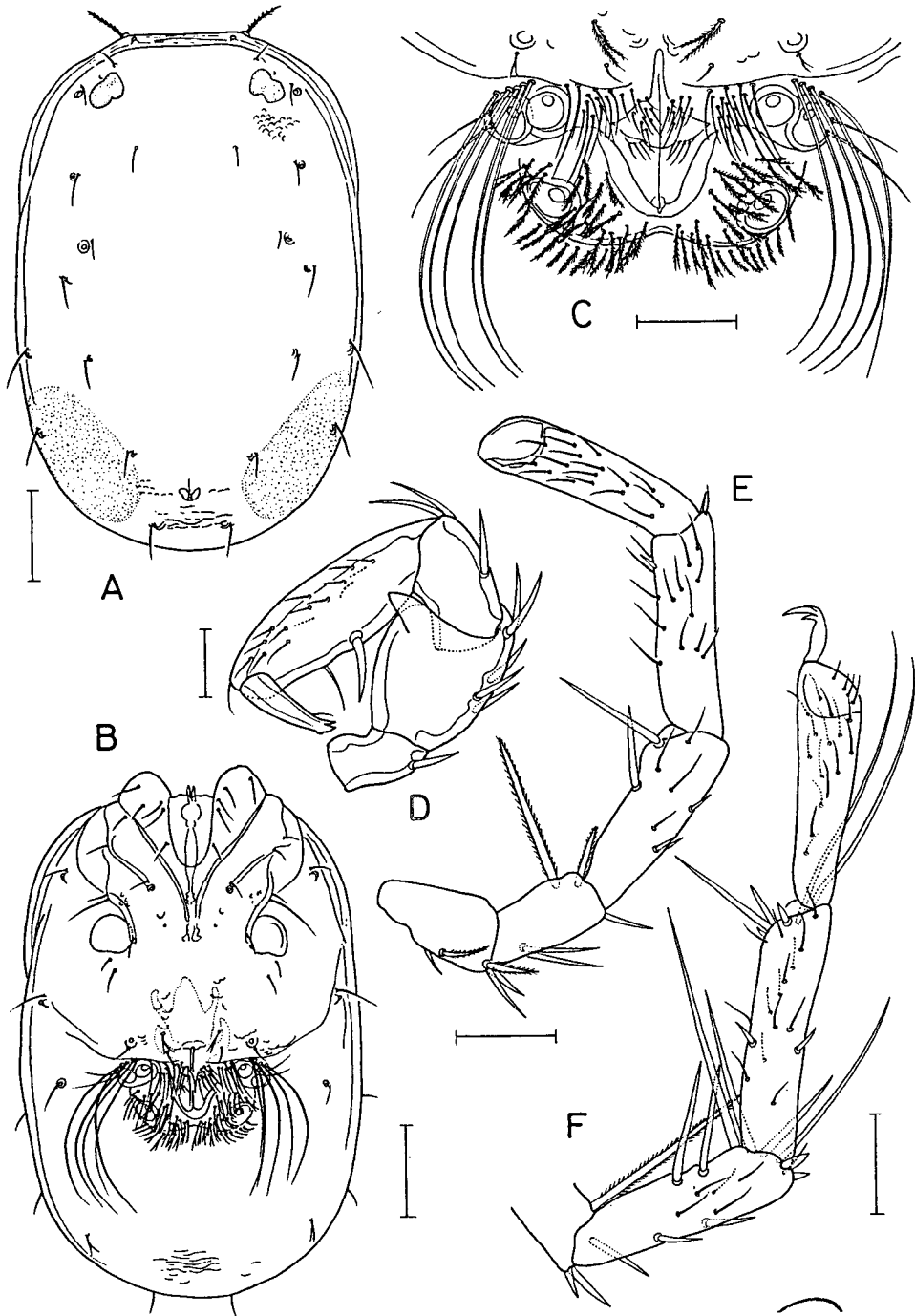
**Remarks.** The new species carries a tuft of seven long setae on each side of genital field. This feature is represented in the members of the subgenus *Ocybrachypoda* (Cook, 1981), and it is shared only by *B. splendens* Cook, 1981 from North America among the nine hitherto known species of the subgenus *Brachypoda*. However *B. rapida* n. sp. belongs apparently to the subgenus *Brachypoda* in the morphology of fourth leg and genital field. It differs from *B. splendens* in having the following features: 1) there is no median ridge on the dorsal shield; 2) the body is more elongated; 3) the excretory pore is more anteriorly positioned; 4) the tuft of long setae on genital field is located nearby the lateralmost acetabulum, while it is distantly isolated from the acetabulum in *B. splendens*.

### ***Brachypoda (Brachypoda) rubidata* n. sp. (Figs. 7, 8)**

**Type specimens.** 5 ♂♂, 30 ♀♀ collected in a pond in Bosung (34°46' N, 127°9' E), Chollanam-do, 26 April 1991. Holotype ♂, allotype and undissected paratypes (3 ♂♂, 28 ♀♀) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected paratypes (2 ♂♂, 2 ♀♀) are kept in the collection of the senior author.

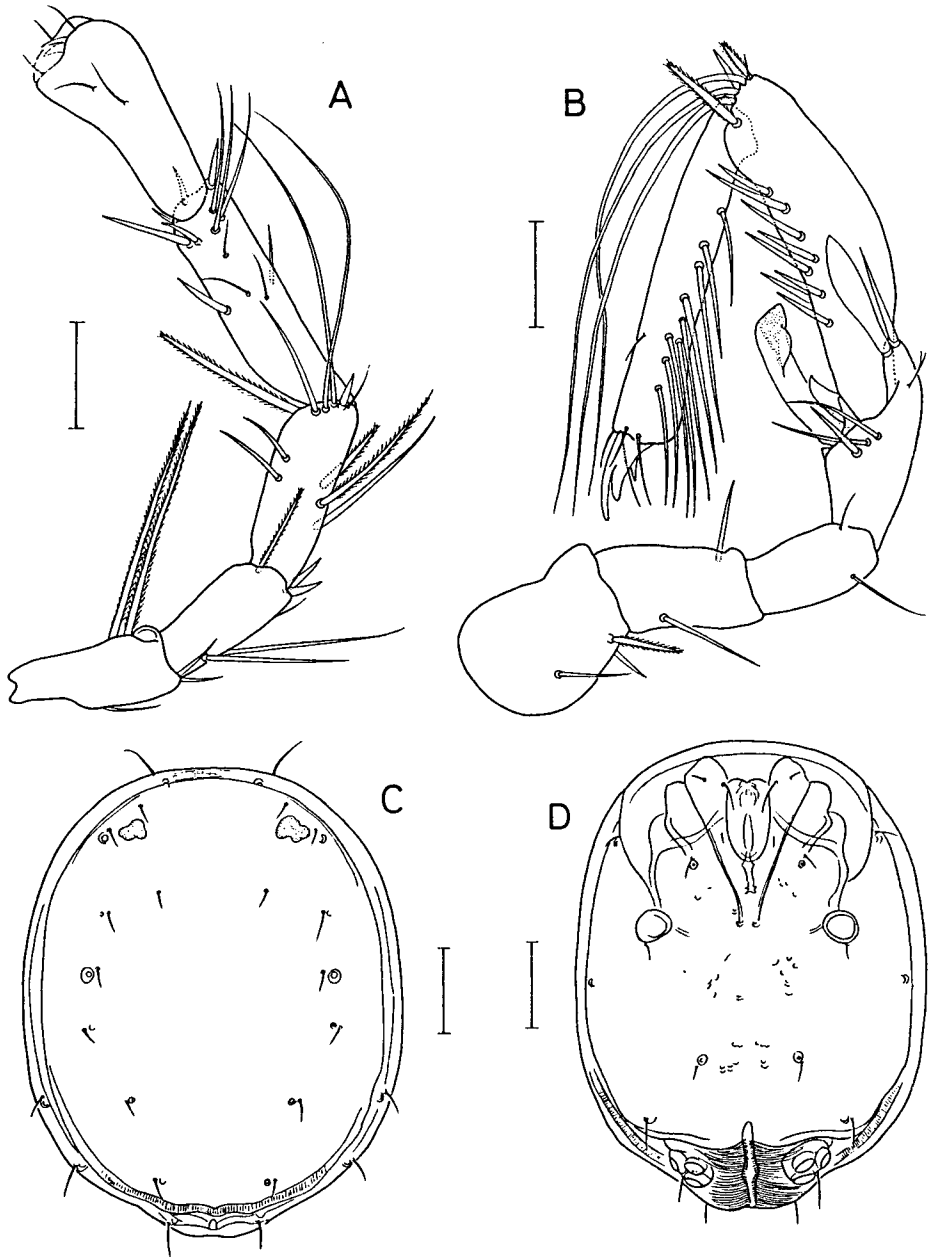
**Male.** Body (Fig. 7A) roughly quadrangular, 564  $\mu\text{m}$  long, and 384  $\mu\text{m}$  wide. Dorsal shield bearing 8 pairs of glandularia, 1 pair of postantenniform glandulariaocularia and 2 pairs of ocularia, and excretory pore. Posterolateral areas of dorsal shield red in color (outline of these areas represented by dotted line in Fig. 7A). Length between anterior end of first coxa and posterior end of venter (Fig. 7B) 584  $\mu\text{m}$  long. A prominent ridge extended to anterolateral margin of body between third coxa and insertion of fourth leg. Genital field (Fig. 7C) fused with the ventral shield, located at about posterior 0.38 length of body, with a tuft of 5 very large setae at each lateral edge. Posterior margin of genital field distinct. Distance between both outermost acetabula 177  $\mu\text{m}$ . Acetabular region with numerous short setae. Genital acetabula 3-paired, first and second pairs located closely. Genital field accompanied by 8 small setae on both sides of ventral shield just behind posterior margin of genital field.

Palp (Fig. 7D) with following lengths of segments: P-I, 35  $\mu\text{m}$ ; P-II, 62  $\mu\text{m}$ ; P-III, 39  $\mu\text{m}$ ; P-IV, 100  $\mu\text{m}$ ; P-V, 38  $\mu\text{m}$ . Capitulum 121  $\mu\text{m}$  long, including apodeme. First leg (Fig. 7E) with following dorsal lengths of segments: I-Leg-2, 44  $\mu\text{m}$ ; I-Leg-3, 63  $\mu\text{m}$ ; I-Leg-4, 103  $\mu\text{m}$ ; I-Leg-5, 117  $\mu\text{m}$ ; I-Leg-6, 112  $\mu\text{m}$ . Second leg (Fig. 7F) with following dorsal lengths of segments: II-Leg-4, 120  $\mu\text{m}$ ; II-Leg-5, 134  $\mu\text{m}$ ; II-Leg-6, 119  $\mu\text{m}$ . Third leg (Fig. 8A) with following dorsal lengths of segments: III-Leg-2, 52  $\mu\text{m}$ ; III-Leg-3, 67  $\mu\text{m}$ ; III-Leg-4, 95  $\mu\text{m}$ ; III-Leg-5, 130  $\mu\text{m}$ ; III-Leg-6, 113  $\mu\text{m}$ . Fourth leg (Fig. 8B) with following dorsal lengths of segments: IV-Leg-1, 78  $\mu\text{m}$ ; IV-Leg-2, 64  $\mu\text{m}$ ; IV-Leg-3, 61  $\mu\text{m}$ ; IV-Leg-4, 104  $\mu\text{m}$ , including projection; IV-Leg-5, 162  $\mu\text{m}$ ; IV-Leg-6, 167  $\mu\text{m}$ . Third leg with long swimming hairs. Distal end of IV-Leg-4 with a strong distal projection tipped by 2 setae of



**Fig. 7.** *Brachypoda rubidata* n. sp., male: A, dorsal view; B, ventral view; C, genital field; D, palp; E, first leg; F, second leg. Scales: A, B = 0.1 mm; C, E, F = 0.05 mm; D = 0.025 mm.

unequal thickness, and on ventral margin 2 extremely heavy setae (proximal one nearly twice as long as distal one) and several ordinary setae. IV-Leg-5 with 8 setae on ventral margin, 3 long swimming hairs on anterodistal border, and setules on posterior side. IV-Leg-6 with numerous setules on



**Fig. 8.** *Brachypoda rubidata* n. sp., male: A, third leg; B, fourth leg. Female: C, dorsal view; D, ventral view. Scales: A, B = 0.05 mm; C, D = 0.1 mm.

posterior side, and 9 setae on ventral margin. Fourth leg the longest and followed by second, third, and first.

**Female.** Body (Fig. 8C) nearly circular, quite different from that of male in shape, 530  $\mu\text{m}$  long, and 435  $\mu\text{m}$  wide. Unlike in male, dorsum with 3 pairs of glandularia and excretory pore, both located outside dorsal shield. Coxae (Fig. 8D) not extended. Genital field dissimilar to that of male, located posterior part of body, with very few setae. IV-Leg-4 without projection. Other morphological

features as in male.

Dorsal lengths of palpal segments: P-I, 36  $\mu\text{m}$ ; P-II, 64  $\mu\text{m}$ ; P-III, 35  $\mu\text{m}$ ; P-IV, 92  $\mu\text{m}$ ; P-V, 37  $\mu\text{m}$ . Capitulum 133  $\mu\text{m}$  long, including apodeme. Dorsal lengths of segments of first leg: I-Leg-2, 42  $\mu\text{m}$ ; I-Leg-3, 52  $\mu\text{m}$ ; I-Leg-4, 82  $\mu\text{m}$ ; I-Leg-5, 89  $\mu\text{m}$ ; I-Leg-6, 87  $\mu\text{m}$ . Dorsal lengths of 3-6 segments of second leg: II-Leg-3, 61  $\mu\text{m}$ ; II-Leg-4, 90  $\mu\text{m}$ ; II-Leg-5, 99  $\mu\text{m}$ ; II-Leg-6, 88  $\mu\text{m}$ . Dorsal lengths of second to sixth segments of third leg: III-Leg-2, 57  $\mu\text{m}$ ; III-Leg-3, 66  $\mu\text{m}$ ; III-Leg-4, 92  $\mu\text{m}$ ; III-Leg-5, 114  $\mu\text{m}$ ; III-Leg-6, 106  $\mu\text{m}$ . Dorsal lengths of segments of fourth leg: IV-Leg-1, 60  $\mu\text{m}$ ; IV-Leg-2, 72  $\mu\text{m}$ ; IV-Leg-3, 73  $\mu\text{m}$ ; IV-Leg-4, 99  $\mu\text{m}$ ; IV-Leg-5, 118  $\mu\text{m}$ ; IV-Leg-6, 102  $\mu\text{m}$ . Terminal segment of fourth leg with more setae than in preceding species. Fourth leg the longest and followed by third, second, and first.

**Etymology.** The specific name *rubidata* is from the Latin *rubidus* meaning "red". It alludes the red color pattern of posterolateral areas of dorsal shield.

**Remarks.** *Brachypoda rubidata* n. sp. is allied to the preceding species, *B. rapida* n. sp., in bearing a tuft of long setae on the each side of genital field. These two species can be easily distinguished by the following differences: 1) the posterior portion of body in both sexes is narrowed in *B. rapida* but is broad in *B. rubidata*; 2) each posterolateral portion of body is red-colored in *B. rubidata* but it is not in *B. rapida*; 3) the second dorsoglandularia on dorsal shield of *B. rubidata* are located more medially than in *B. rapida*; 4) the posterolateral margins of genital field are rather expanded in *B. rubidata* but not expanded in *B. rapida*; 5) there are 5 long setae on each side of genital field in *B. rubidata* but are 9 in *B. rapida*; 6) the number of setae on the area just posterior to genital field is 8 on each side in *B. rubidata*, but it is 3 in *B. rapida*. Additionally, it may be worth mentioning that *B. rubidata* was found in a lake, while *R. rapida* was in a stream.

### ***Woolastookia concava* n. sp. (Figs. 9, 10)**

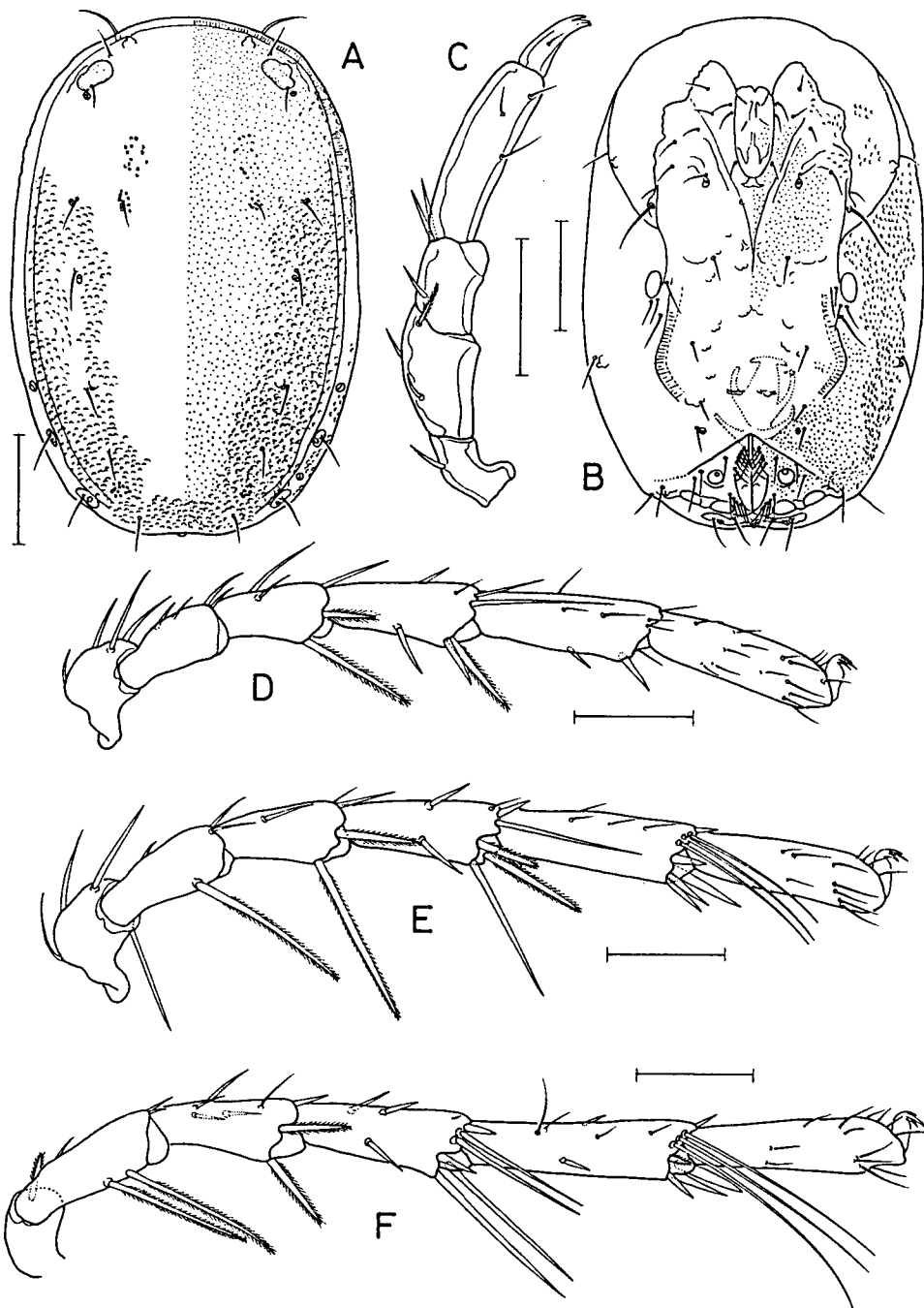
**Type specimens.** 8 ♂♂, 5 ♀♀ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 August 1995. Holotype, allotype and undissected paratypes (6 ♂♂, 3 ♀♀) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected paratypes (1 ♂, 1 ♀) are kept in the collection of the author.

Other material examined. 2 ♂♂ collected in a stream at Ullung Island (37°03' N, 130°50' E), 20 September 1995.

**Male.** Body (Fig. 9A) elongated, 473  $\mu\text{m}$  long, and 323  $\mu\text{m}$  wide. Dorsal shield bearing 5 pairs of glandularia, 2 pairs of ocularia and 1 pair of postantenniform glandularia. Eyes well-developed and located laterally. Dorsal shield flanked by 2 pairs of small lateroglandularia platelets. Length between anterior end of first coxa and posterior end of venter (Fig. 9B) 428  $\mu\text{m}$ . Anterior coxae not extending to anterior margin of venter. Ventral shield with prominent ridge on each side and extended anterolaterally from insertions of fourth leg, and another pair of longitudinal ridge between insertion of fourth leg and genital field.

Genital field fused with ventral shield, with distinct suture line. Gonopore 71  $\mu\text{m}$  long, and distinctly narrowed anteriorly. Genital acetabula of 3 pairs. Width between each lateralmost acetabulum 136  $\mu\text{m}$ .

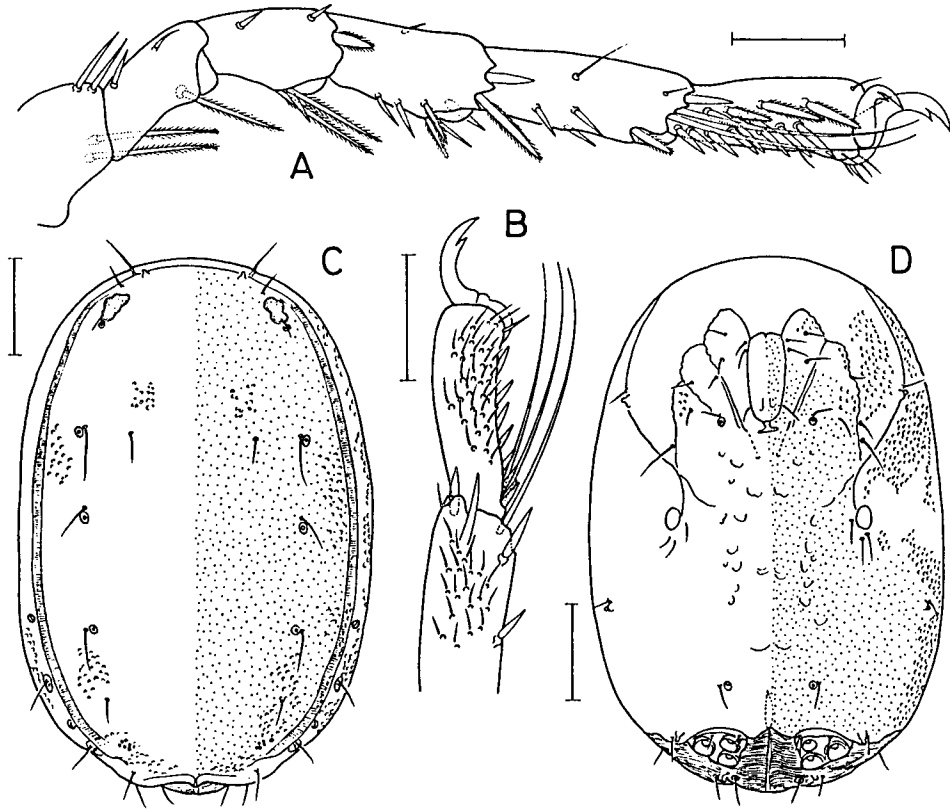
Palp (Fig. 9C) with following lengths of segments: P-I, 34  $\mu\text{m}$ ; P-II, 47  $\mu\text{m}$ ; P-III, 25  $\mu\text{m}$ ; P-IV, 74  $\mu\text{m}$ ; P-V, 29  $\mu\text{m}$ . Capitulum 93  $\mu\text{m}$  long, including apodeme. Chelicera 86  $\mu\text{m}$ . First leg (Fig. 9D)



**Fig. 9.** *Woolastookia concava* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg. Scales: A, B = 0.1; C-F = 0.05 mm.

with following dorsal lengths of segments: I-Leg-1, 36  $\mu$ m; I-Leg-2, 35  $\mu$ m; I-Leg-3, 47  $\mu$ m; I-Leg-4, 65  $\mu$ m; I-Leg-5, 73  $\mu$ m; I-Leg-6, 80  $\mu$ m. Second leg (Fig. 9E) with following dorsal lengths of segments: II-Leg-1, 39  $\mu$ m; II-Leg-2, 45  $\mu$ m; II-Leg-3, 50  $\mu$ m; II-Leg-4, 67  $\mu$ m; II-Leg-5, 85  $\mu$ m; II-





**Fig. 10.** *Woolastookia concava* n. sp., male: A, B, fourth leg. Female: C, dorsal view; D, ventral view. Scales: A, B = 0.05 mm; C, D = 0.1 mm.

Leg-6, 84  $\mu\text{m}$ . Third leg (Fig. 9F) with following dorsal lengths of segments: III-Leg-2, 67  $\mu\text{m}$ ; III-Leg-3, 68  $\mu\text{m}$ ; III-Leg-4, 81  $\mu\text{m}$ ; III-Leg-5, 106  $\mu\text{m}$ ; III-Leg-6, 98  $\mu\text{m}$ . Fourth leg (Fig. 10A, B) with following dorsal lengths of segments: IV-Leg-1, 66  $\mu\text{m}$ ; IV-Leg-2, 53  $\mu\text{m}$ ; IV-Leg-3, 58  $\mu\text{m}$ ; IV-Leg-4, 70  $\mu\text{m}$ ; IV-Leg-5, 94  $\mu\text{m}$ ; IV-Leg-6, 78  $\mu\text{m}$ . IV-Leg-6 relatively narrow, 31-36  $\mu\text{m}$  wide, with concave ventral margin and armature as in Fig. 10A, B. Third leg the longest and followed by fourth, second, and first. Second to fourth legs with long swimming hairs. All legs with clawlets.

**Female.** Body (Fig. 10C) similar to that of male, 563  $\mu\text{m}$  long, and 380  $\mu\text{m}$  wide. Ventral shield without a pair of ridges between insertion of fourth leg and genital field (Fig. 10D). Genital field different from that of male. Other morphological features of venter as in female of other known species of Brachypoda.

Dorsal lengths of palpal segments: P-I, 33  $\mu\text{m}$ ; P-II, 50  $\mu\text{m}$ ; P-III, 29  $\mu\text{m}$ ; P-IV, 76  $\mu\text{m}$ ; P-V, 34  $\mu\text{m}$ . Capitulum 103  $\mu\text{m}$  long, including apodeme. Chelicera 99  $\mu\text{m}$ . Dorsal lengths of segments of first leg: I-Leg-1, 35  $\mu\text{m}$ ; I-Leg-2, 32  $\mu\text{m}$ ; I-Leg-3, 46  $\mu\text{m}$ ; I-Leg-4, 67  $\mu\text{m}$ ; I-Leg-5, 74  $\mu\text{m}$ ; I-Leg-6, 73  $\mu\text{m}$ . Dorsal lengths of segments of second leg: II-Leg-1, 39  $\mu\text{m}$ ; II-Leg-2, 40  $\mu\text{m}$ ; II-Leg-3, 51  $\mu\text{m}$ ; II-Leg-4, 70  $\mu\text{m}$ ; II-Leg-5, 78  $\mu\text{m}$ ; II-Leg-6, 74  $\mu\text{m}$ . Dorsal lengths of segments of third leg: III-Leg-1, 40  $\mu\text{m}$ ; III-Leg-2, 55  $\mu\text{m}$ ; III-Leg-3, 62  $\mu\text{m}$ ; III-Leg-4, 82  $\mu\text{m}$ ; III-Leg-5, 96  $\mu\text{m}$ ; III-Leg-6, 91  $\mu\text{m}$ . Dorsal lengths of segments of fourth leg: IV-Leg-1, 65  $\mu\text{m}$ ; IV-Leg-2, 57  $\mu\text{m}$ ; IV-Leg-3, 66  $\mu\text{m}$ ; IV-Leg-4, 80  $\mu\text{m}$ ; IV-Leg-5, 87  $\mu\text{m}$ ; IV-Leg-6, 85  $\mu\text{m}$ . IV-Leg-6 without concave ventral margin.

**Etymology.** *Woolastookia concava* n. sp. is named so because it has the concave ventral margin of the sixth segment of leg 4.

**Remarks.** *Woolastookia concava* n. sp. is allied to *W. gretae* Viets, 1978. They share the similar fourth leg in which the sixth segment is slender and its ventral margin is concave. The new species can be distinguished from *W. gretae* by having the ventral clawlet on the claw of fourth leg (it is absent in *W. gretae*, according to the description of Cook, 1980), by the anteriorly deeper suture line of genital field, and by having the rows of setae in front of gonopore (the setae are scattered in *W. gretae*).

***Woolastookia spatulata* n. sp. (Fig. 11)**

**Type specimens.** 6 ♂♂, 9 ♀♀ collected in a stream at Ullung Island (37°3' N, 130°50' E), 20 September 1995. Holotype ♂, allotype and undissected paratypes (4 ♂♂, 7 ♀♀) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. Dissected paratypes (1 ♂, 1 ♀) are kept in the collection of the author.

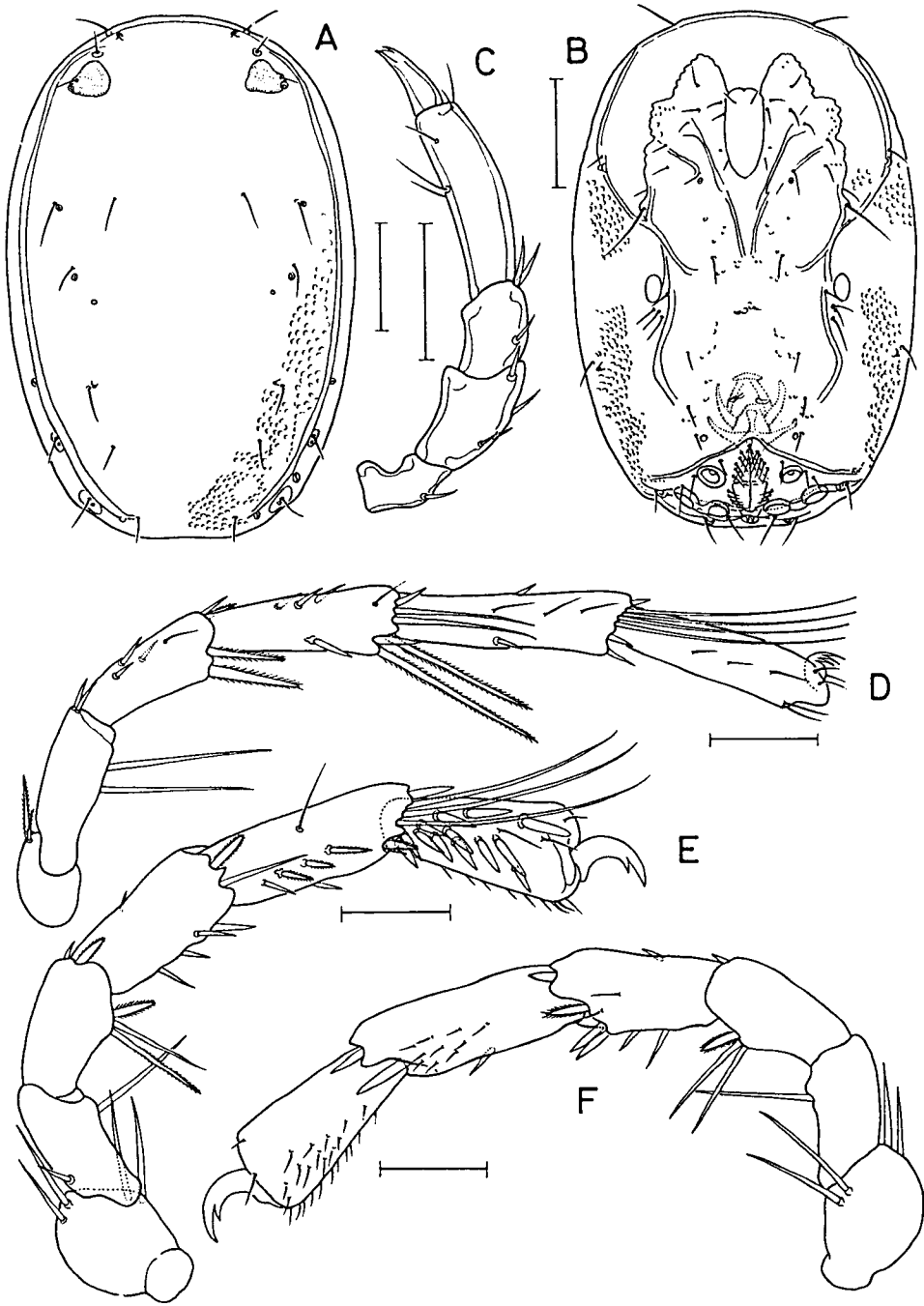
**Male.** Body (Fig. 11A) rather elongate, 475  $\mu\text{m}$  long, and 325  $\mu\text{m}$  wide. Dorsal shield bearing 5 pairs of glandularia, 2 pairs of ocularia and 1 pair of postantenniform glandularia. Eyes well-developed, and located laterally. Dorsal shield flanked by 2 pairs of small lateroglandularia platelets. Length between anterior end of first coxa and posterior end of venter (Fig. 11B) 433  $\mu\text{m}$ . Anterior coxae not extending to anterior margin of venter. Ventral shield with prominent ridge on each side, and extended anterolaterally from insertions of fourth leg, and another pair of longitudinal ridge between insertion of fourth leg and genital field.

Genital field fused with ventral shield, with distinct suture line. Gonopore 75  $\mu\text{m}$  long, and distinctly narrowed anteriorly. Three pairs of genital acetabula present. Width between each lateralmost acetabulum 148  $\mu\text{m}$ .

Palp (Fig. 11C) with following lengths of segments: P-I, 34  $\mu\text{m}$ ; P-II, 47  $\mu\text{m}$ ; P-III, 26  $\mu\text{m}$ ; P-IV, 76  $\mu\text{m}$ ; P-V, 30  $\mu\text{m}$ . Capitulum 95  $\mu\text{m}$  long, including apodeme. Chelicera 97  $\mu\text{m}$ . Dorsal lengths of 3-6 segments of first leg: I-Leg-3, 49  $\mu\text{m}$ ; I-Leg-4, 71  $\mu\text{m}$ ; I-Leg-5, 82  $\mu\text{m}$ ; I-Leg-6, 82  $\mu\text{m}$ . Dorsal lengths of third to sixth segments of second leg: II-Leg-3, 55  $\mu\text{m}$ ; II-Leg-4, 75  $\mu\text{m}$ ; II-Leg-5, 87  $\mu\text{m}$ ; II-Leg-6, 84  $\mu\text{m}$ . Third leg (Fig. 11D) with following dorsal lengths of segments: III-Leg-1, 42  $\mu\text{m}$ ; III-Leg-2, 61  $\mu\text{m}$ ; III-Leg-3, 71  $\mu\text{m}$ ; III-Leg-4, 90  $\mu\text{m}$ ; III-Leg-5, 110  $\mu\text{m}$ ; III-Leg-6, 98  $\mu\text{m}$ . Fourth leg (Fig. 7E, F) with following dorsal lengths of segments: IV-Leg-1, 69  $\mu\text{m}$ ; IV-Leg-2, 58  $\mu\text{m}$ ; IV-Leg-3, 63  $\mu\text{m}$ ; IV-Leg-4, 75  $\mu\text{m}$ ; IV-Leg-5, 103  $\mu\text{m}$ ; IV-Leg-6, 83  $\mu\text{m}$ . IV-Leg-6, 44-45  $\mu\text{m}$  wide, distally broadened, spatulate. Third leg the longest and followed by fourth, second, and first. Second to fourth legs with long swimming hairs. All legs with clawlets.

**Female.** Body 572  $\mu\text{m}$  long, and 390  $\mu\text{m}$  wide. Ventral shield without a pair of ridges between insertion of fourth leg and genital field. Genital field different from that of male. Other morphological features of venter as in general.

Dorsal lengths of palpal segments: P-I, 31  $\mu\text{m}$ ; P-II, 51  $\mu\text{m}$ ; P-III, 30  $\mu\text{m}$ ; P-IV, 80  $\mu\text{m}$ ; P-V, 31  $\mu\text{m}$ . Capitulum 106  $\mu\text{m}$  long, including apodeme. Dorsal lengths of segments of first leg: I-Leg-1, 37  $\mu\text{m}$ ; I-Leg-2, 36  $\mu\text{m}$ ; I-Leg-3, 49  $\mu\text{m}$ ; I-Leg-4, 69  $\mu\text{m}$ ; I-Leg-5, 80  $\mu\text{m}$ ; I-Leg-6, 75  $\mu\text{m}$ . Dorsal lengths of second to sixth segments of second leg: II-Leg-2, 44  $\mu\text{m}$ ; II-Leg-3, 54  $\mu\text{m}$ ; II-Leg-4, 74  $\mu\text{m}$ ; II-Leg-5, 84  $\mu\text{m}$ ; II-Leg-6, 80  $\mu\text{m}$ . Dorsal lengths of segments of third leg: III-Leg-1, 42  $\mu\text{m}$ ; III-



**Fig. 11.** *Woolastookia spatulata* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, third leg; E, F fourth. Scales: A, B = 0.1; C = 0.02 mm; D-G = 0.05 mm.

Leg-2, 58  $\mu$ m; III-Leg-3, 68  $\mu$ m; III-Leg-4, 84  $\mu$ m; III-Leg-5, 102  $\mu$ m; III-Leg-6, 93  $\mu$ m. Dorsal lengths of segments of fourth leg: IV-Leg-1, 73  $\mu$ m; IV-Leg-2, 59  $\mu$ m; IV-Leg-3, 69  $\mu$ m; IV-Leg-4, 84  $\mu$ m; IV-Leg-5, 96  $\mu$ m; IV-Leg-6, 83  $\mu$ m. IV-Leg-6 not spatulate.

**Etymology.** The specific name *spatulata* alludes the distally broadened, spatulate sixth segment of leg 4.

**Remarks.** The genus *Woolastookia* can be divided into two groups: a group bearing the slender, ventrally concave sixth segment of fourth leg and another group bearing the distally broadened, spatulate sixth segment of the same leg. *W. gretae* Viets, 1978 and *W. concava* belong to the former group, and the latter group comprises *W. pilositarsa* (Habeeb, 1953), *W. setosipes* Habeeb, 1964 and *W. spatulata* n. sp.

*W. spatulata* differs from *W. pilositarsa* and *W. setosipes* in the following points. The six long setae on each of first and second segment of fourth leg of *W. setosipes* are not observable in *W. spatulata*. The suture line of genital field of *W. spatulata* is not so deep as in *W. pilositarsa*. The regular arrangement of the setae in front of gonopore of *W. spatulata* does not occur in *W. pilositarsa*, either.

Although *W. spatulata* has the different morphology of fourth leg from *W. concava*, the body shape of both species is quite similar. It should be noted here that our female specimens mixed with both species collected from the same location (in Ullung Island) were impossible to identify.

*W. elongata* (Sokolow, 1934) is described based on female from eastern Siberia. According to the illustration of Sokolow (1940) the female body of this species is much more elongate than the females of the two Korean species, *W. spatulata* and *W. concava*.

### ***Ljania japonica* Imamura, 1956 (Figs. 12, 13B, C)**

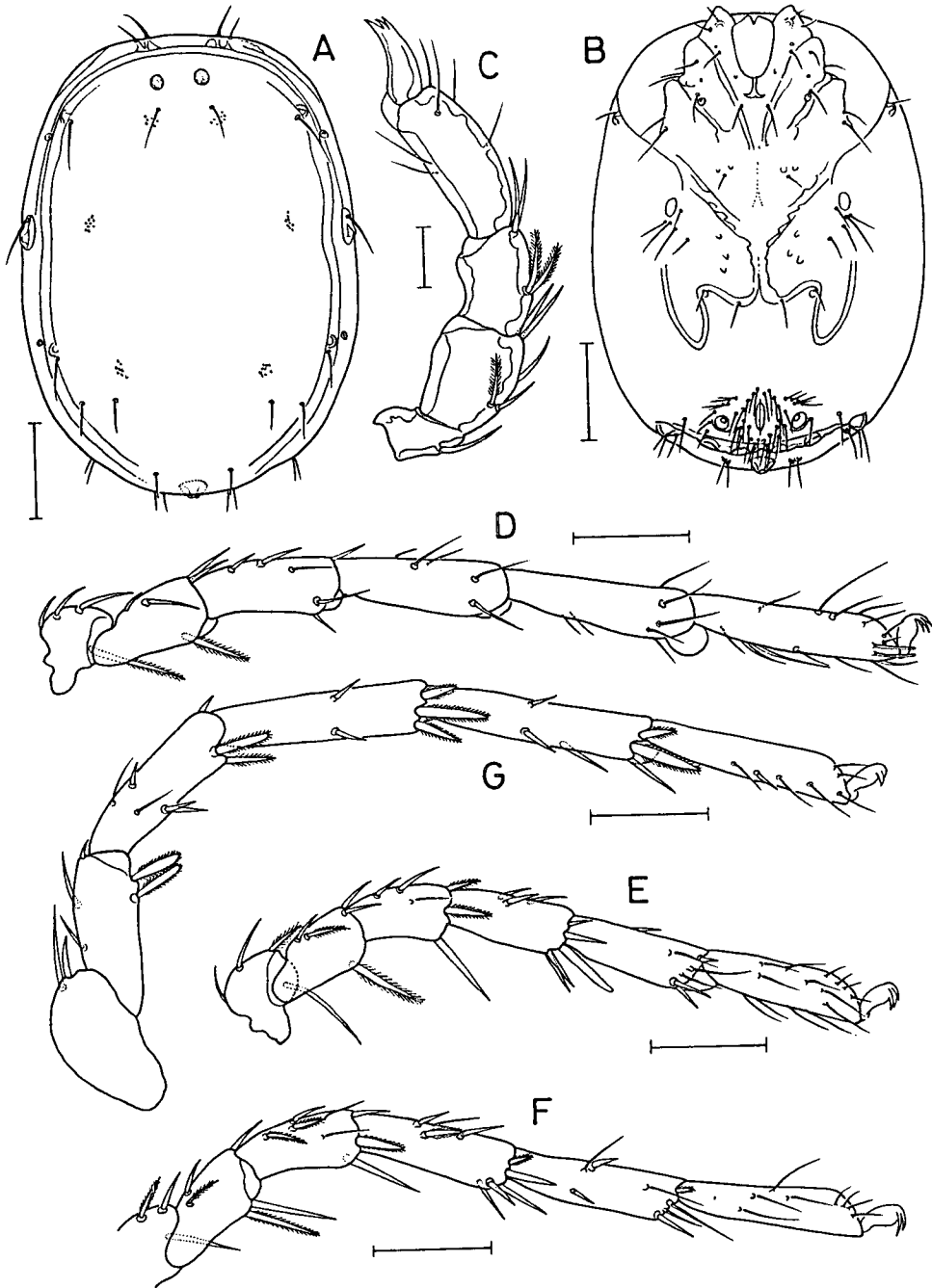
*Ljania japonica* Imamura, 1956, p. 207, Fig. 13a-d.

*Ljania bipapillata bipapillata*: Chung and Kim, 1991, p. 75, fig. 8I-L.

**Material examined.** 5 ♂♂, 7 ♀♀ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995; 1 ♀ from the stream at Murunggye Valley (37°28' N, 129°02' E) in Donghae, 18 November 1990; 1 ♀ from a stream near Kyungju (37°48' N, 129°22' E), 22 September 1991; 1 ♂ from the stream at Songch'on (37°50' N, 128°43' E) in Odae Mountain, 8 August 1994; 1 ♂ from the stream at Wangsan (37°10' N, 128°22' E) in Kangreung, 9 April 1994; 1 ♂, 2 ♀♀ from a small stream at Sagimak in Kangreung, 5 November 1995.

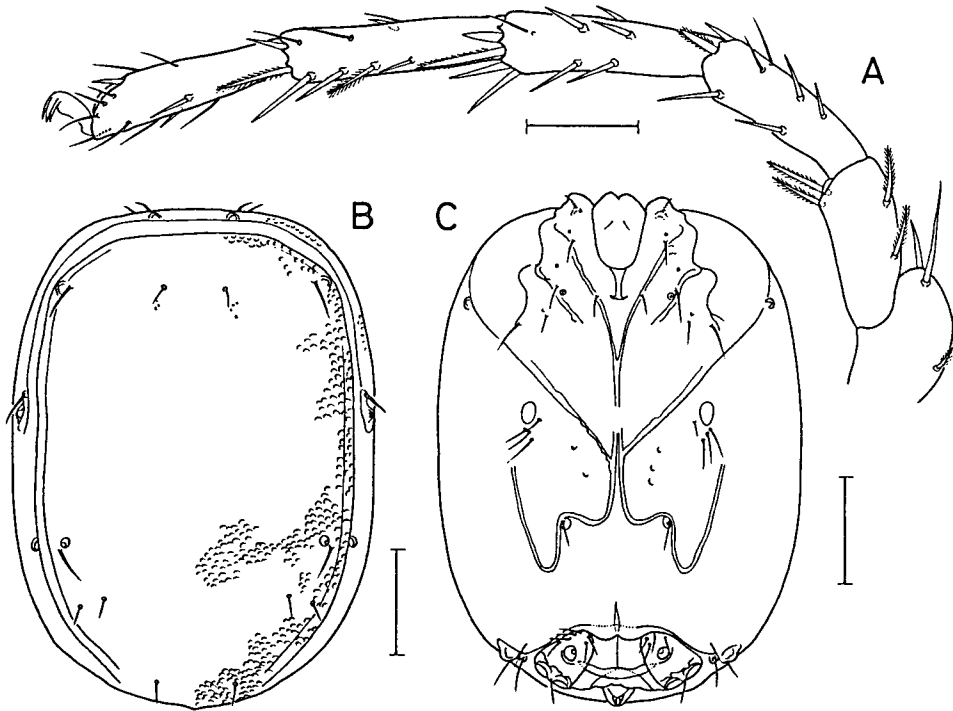
**Male.** Body (Fig. 12A) 483  $\mu\text{m}$  long, and 345  $\mu\text{m}$  wide. Dorsal shield bearing 5 pairs of dorsoglandularia, of which first 2 pairs located along margin of dorsal shield, each with gland. Preantenniform glandularia and preocularia located on anterior margin of dorsum. Length between anterior end of first coxa and posterior end of venter (Fig. 12B) 485  $\mu\text{m}$ . Anterior coxae extending beyond anterior end of body. Postantenniform glandularia located ventrally, concealed by first coxa. Posterior border of fourth coxa distinct, strongly projected posteriorly, indented medially, accompanied with glandularia on ventral shield near indentation. A prominent ridge present on each side and extended anterolaterally from insertion of fourth leg. Genital field fused with ventral shield. Gonopore 28  $\mu\text{m}$  long, surrounded by a circle of numerous small setae. Genital acetabula in 3 pairs, medial 2 pairs of them positioned on transverse bar which is located between gonopore and excretory pore, lateralmost glandularia located near end of bar. Excretory pore tubercular, located terminal portion of body.

Palp (Fig. 12C) with following lengths of segments: P-I, 23  $\mu\text{m}$ ; P-II, 37  $\mu\text{m}$ ; P-III, 36  $\mu\text{m}$ ; P-IV, 53  $\mu\text{m}$ ; P-V, 29  $\mu\text{m}$ . Capitulum 88  $\mu\text{m}$  long, including apodeme. Chelicera 95  $\mu\text{m}$ . First leg (Fig. 12D)



**Fig. 12.** *Ljanja japonica* Imamura, male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C = 0.02 mm; D-G = 0.05 mm.

with following dorsal lengths of segments: I-Leg-1, 32  $\mu\text{m}$ ; I-Leg-2, 37  $\mu\text{m}$ ; I-Leg-3, 62  $\mu\text{m}$ ; I-Leg-4, 72  $\mu\text{m}$ ; I-Leg-5, 79  $\mu\text{m}$ ; I-Leg-6, 92  $\mu\text{m}$ . Second leg (Fig. 12E) with following dorsal lengths of segments: II-Leg-1, 33  $\mu\text{m}$ ; II-Leg-2, 33  $\mu\text{m}$ ; II-Leg-3, 43  $\mu\text{m}$ ; II-Leg-4, 54  $\mu\text{m}$ ; II-Leg-5, 59  $\mu\text{m}$ ; II-



**Fig. 13.** *Ljania propinqua* n. sp, male: A, fourth leg. *Ljania japonica* imamura, female: B, dorsal view; C, ventral view. Scales: A = 0.05 mm; B, C = 0.1 mm.

Leg-6, 70  $\mu\text{m}$ . Third leg (Fig. 12F) with following dorsal lengths of segments: III-Leg-2, 35  $\mu\text{m}$ ; III-Leg-3, 53  $\mu\text{m}$ ; III-Leg-4, 69  $\mu\text{m}$ ; III-Leg-5, 74  $\mu\text{m}$ ; III-Leg-6, 79  $\mu\text{m}$ . Fourth leg (Fig. 12G) with following dorsal lengths of segments: IV-Leg-1, 66  $\mu\text{m}$ ; IV-Leg-2, 48  $\mu\text{m}$ ; IV-Leg-3, 79  $\mu\text{m}$ ; IV-Leg-4, 91  $\mu\text{m}$ ; IV-Leg-5, 97  $\mu\text{m}$ ; IV-Leg-6, 98  $\mu\text{m}$ . Fourth leg the longest and followed by first, third, and second.

**Female.** Body roughly quadrangular, 490  $\mu\text{m}$  long, and 370  $\mu\text{m}$  wide. Morphological features as in male, except for genital field. Length between anterior end of coxae and posterior end of venter 505  $\mu\text{m}$ .

Dorsal lengths of palpal segments: P-I, 24  $\mu\text{m}$ ; P-II, 38  $\mu\text{m}$ ; P-III, 38  $\mu\text{m}$ ; P-IV, 55  $\mu\text{m}$ ; P-V, 32  $\mu\text{m}$ . Capitulum 95  $\mu\text{m}$  long, excluding apodeme. Chelicera 98  $\mu\text{m}$ . Dorsal lengths of segments of first leg: I-Leg-1, 34  $\mu\text{m}$ ; I-Leg-2, 38  $\mu\text{m}$ ; I-Leg-3, 62  $\mu\text{m}$ ; I-Leg-4, 76  $\mu\text{m}$ ; I-Leg-5, 83  $\mu\text{m}$ ; I-Leg-6, 95  $\mu\text{m}$ . Dorsal lengths of segments of second leg: II-Leg-1, 39  $\mu\text{m}$ ; II-Leg-2, 32  $\mu\text{m}$ ; II-Leg-3, 44  $\mu\text{m}$ ; II-Leg-4, 57  $\mu\text{m}$ ; II-Leg-5, 62  $\mu\text{m}$ ; II-Leg-6, 68  $\mu\text{m}$ . Dorsal lengths of 2-6 segments of third leg: III-Leg-2, 35  $\mu\text{m}$ ; III-Leg-3, 54  $\mu\text{m}$ ; III-Leg-4, 69  $\mu\text{m}$ ; III-Leg-5, 73  $\mu\text{m}$ ; III-Leg-6, 78  $\mu\text{m}$ . Dorsal lengths of segments of fourth leg (: IV-Leg-1, 68  $\mu\text{m}$ ; IV-Leg-2, 50  $\mu\text{m}$ ; IV-Leg-3, 77  $\mu\text{m}$ ; IV-Leg-4, 93  $\mu\text{m}$ ; IV-Leg-5, 97  $\mu\text{m}$ ; IV-Leg-6, 85  $\mu\text{m}$ .

**Remarks.** After examination of the present male specimens of this species, we found that Chung and Kim (1991) was erroneous when they identified their female specimens as *Ljania bipapillata* Thor. In fact they were *L. japonica* Imamura, 1956.

Our male specimens resembles *L. japonica* and *L. michiganensis* Cook, 1974 in bearing the

circular arrangement of setae surrounding the gonopore. The specimens seem to belong to *L. japonica* judging from the elongate body and the prominently extended first coxa. However some minor incongruities are observed. Our specimens have the second pair of dorsoglandularia that is more laterally located than in the Japanese specimens. However this is thought as a minor difference.

One female among our specimens is found to have the second pair of dorsoglandularia that is more separated from the lateral margins of dorsal shield (Fig. 13B) than that of other female specimens. This is assumed to be a variation within species.

Species of *Ljanina* has an unique disposition of ocularia and glandularia, and especially the postantenniform glandularia is located on venter and concealed by the first coxa unlike in the genera of Axonopsinae in which the postantenniform glandularia is located on dorsum.

***Ljanina propinqua* n. sp. (Figs. 13A, 14)**

**Type specimens.** 1 ♂ (dissected and mounted in lactophenol) collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 5 November 1995. Holotype will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution.

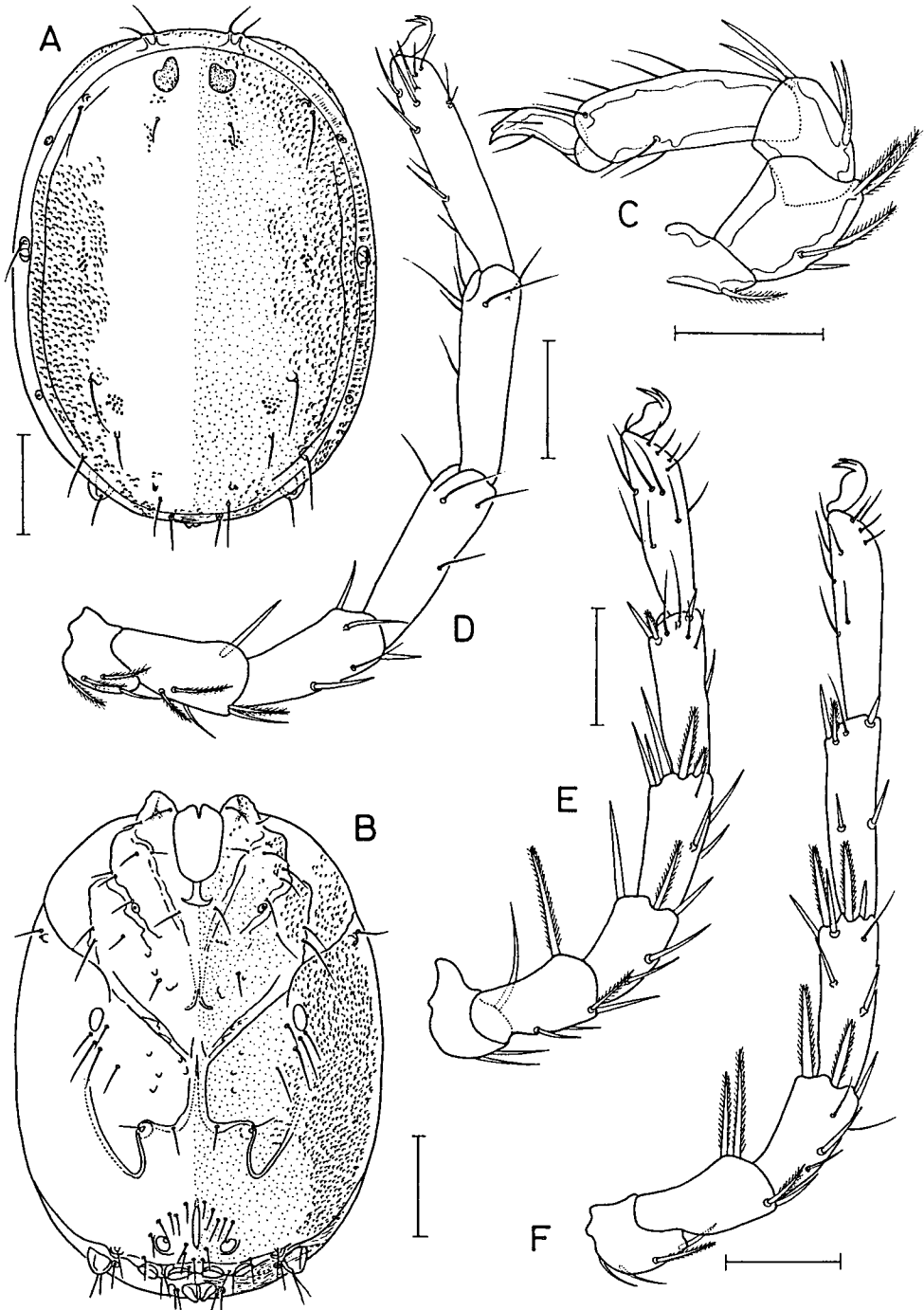
**Male.** Body (Fig. 14A) 500  $\mu\text{m}$  long, and 366  $\mu\text{m}$  wide. Dorsal shield with 5 pairs of glandularia, second pair of them located distantly from lateral margin of dorsal shield. Preantenniform glandularia and preocularia located at end of dorsum. Length between anterior end of first coxa and posterior end of venter (Fig. 14B) 513  $\mu\text{m}$ . Anterior coxae extending beyond anterior end of body. Postantenniform glandularia located ventrally, concealed by first coxa. A prominent ridge present on each side and extended anterolaterally from insertion of fourth leg. Posterior border of fourth coxa distinct, strongly projected posteriorly, indented medially, accompanied with glandularia on ventral shield near indentation. Genital field fused with ventral shield. Genital acetabula of 3 pairs. Gonopore accompanied anterolaterally by about 10 setae and posteriorly by about 6 setae. Posterior margin with prominent transverse bar just posterior to the first pair of acetabula.

Palp (Fig. 14C) with following lengths of segments: P-I, 31  $\mu\text{m}$ ; P-II, 49  $\mu\text{m}$ ; P-III, 41  $\mu\text{m}$ ; P-IV, 71  $\mu\text{m}$ ; P-V, 30  $\mu\text{m}$ . Capitulum 102  $\mu\text{m}$  long, including apodeme. Chelicera 110  $\mu\text{m}$ . First leg (Fig. 14D) with following dorsal lengths of segments: I-Leg-1, 39  $\mu\text{m}$ ; I-Leg-2, 41  $\mu\text{m}$ ; I-Leg-3, 71  $\mu\text{m}$ ; I-Leg-4, 84  $\mu\text{m}$ ; I-Leg-5, 91  $\mu\text{m}$ ; I-Leg-6, 104  $\mu\text{m}$ . Second leg (Fig. 14E) with following dorsal lengths of segments: II-Leg-1, 34  $\mu\text{m}$ ; II-Leg-2, 39  $\mu\text{m}$ ; II-Leg-3, 52  $\mu\text{m}$ ; II-Leg-4, 64  $\mu\text{m}$ ; II-Leg-5, 71  $\mu\text{m}$ ; II-Leg-6, 78  $\mu\text{m}$ . Third leg (Fig. 14F) with following dorsal lengths of segments: III-Leg-1, 44  $\mu\text{m}$ ; III-Leg-2, 41  $\mu\text{m}$ ; III-Leg-3, 60  $\mu\text{m}$ ; III-Leg-4, 74  $\mu\text{m}$ ; III-Leg-5, 86  $\mu\text{m}$ ; III-Leg-6, 87  $\mu\text{m}$ . Fourth leg (Fig. 13A) with following dorsal lengths of segments: IV-Leg-2, 54  $\mu\text{m}$ ; IV-Leg-3, 81  $\mu\text{m}$ ; IV-Leg-4, 99  $\mu\text{m}$ ; IV-Leg-5, 103  $\mu\text{m}$ ; IV-Leg-6, 92  $\mu\text{m}$ . Fourth leg the longest and followed by first, third, and second. All legs without swimming hairs.

**Etymology.** The specific name *propinqua* is originated from the Latin *propinquus* (meaning "close") alluding to the second pairs of dorsoglandularia which are closely located each other.

**Remarks.** The single male type specimen of this species was discovered together with *L. japonica*. It was easily differentiated from *L. japonica* because it has the medially located first pair among two, gland-bearing dorsoglandularia and because it has different arrangement of setae on genital field.

Among the known species of *Ljanina*, *L. procera* Walter, 1947 alone has the same arrangement of dorsoglandularia as the new species. Although the exact comparison of both species is impossible



**Fig. 14.** *Ljanía propinqua* n. sp., male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg. Scales: A, B = 0.1 mm; C-F = 0.05 mm.

because the latter species is known only of female, they can be distinguished by the position of the excretory pore which is located at the end of body in *L. propinqua*, but is located on the



posterodorsal surface in *L. procera*.

The new species has five small setae on area posterior to gonopore as in *L. bipapillata bipapillata*. Otherwise, both are not related.

***Lethaxona (Lethaxona) hyogoensis* Imamura, 1956 (Figs. 15, 16)**

*Lethaxona hyogoensis* Imamura, 1956, p. 200, fig. 7a-c; 1957, p. 364, fig. 14a-c.

*Lethaxona (Lethaxona) hyogoensis*: K.O. Viets, 1987, p. 468.

**Material examined.** 3 ♀♀ collected in a small stream at Sagimak (37°47' N, 128°47' E) in Kangreung, 30 April 1995; 2 ♂♂ collected in the same stream, 5 November 1995.

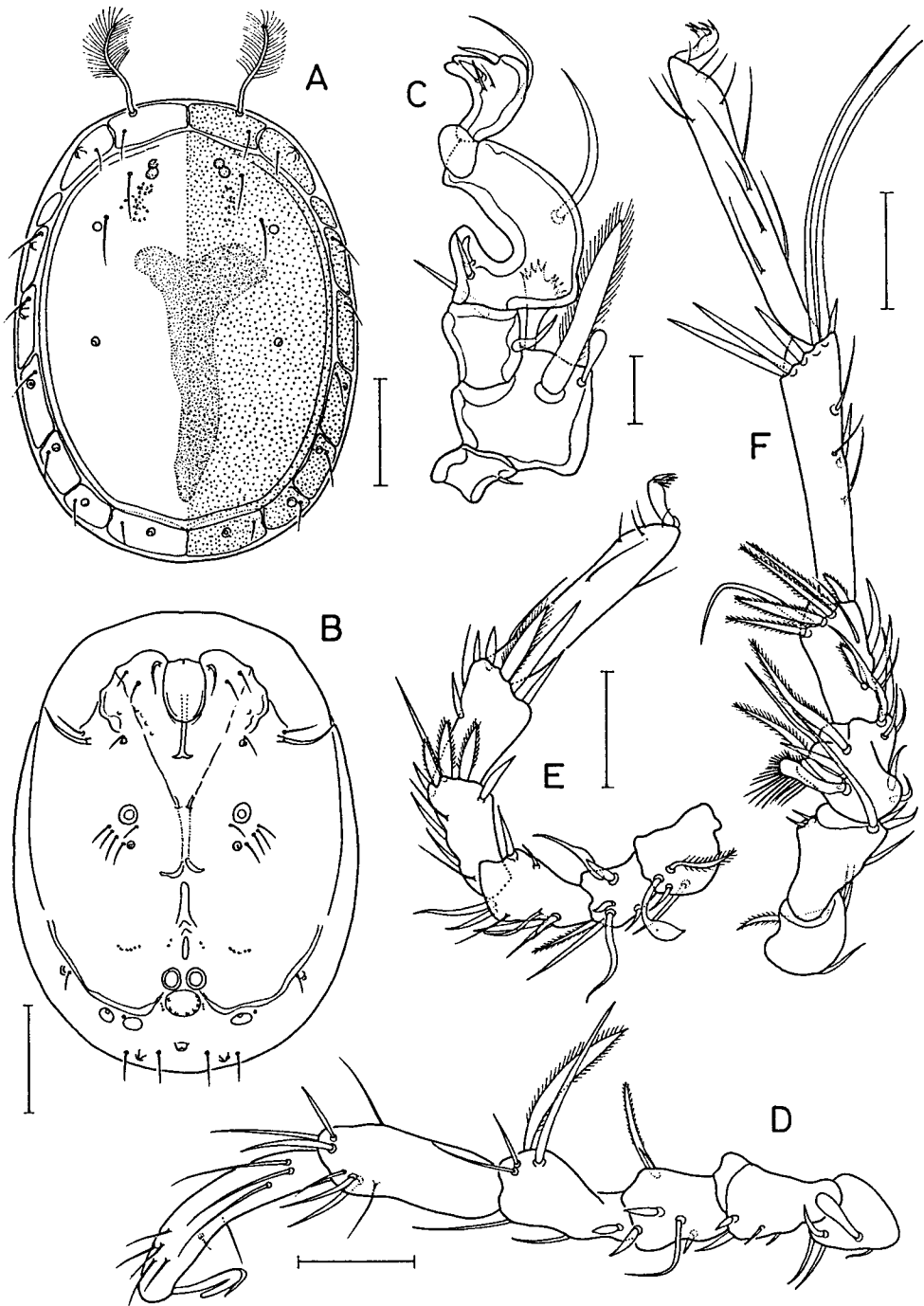
**Male.** Body (Fig. 15A) 433  $\mu\text{m}$  long, and 328  $\mu\text{m}$  wide, with round margins. Entire dorsal shield 375  $\mu\text{m}$  in length, 273  $\mu\text{m}$  in width. Dorsum consisting of large central plate, 2 pairs of glandularia and 1 pair of postocularia both located on central plate, and 9 pairs of platelets along periphery. Anterior first platelet with preantenniform glandularia and preocularia. Second platelet with postantenniform glandularia. Third platelets without glandularia. Other platelets each bearing 1 glandularium. Length between anterior end of first coxa and posterior end of venter (Fig. 15B) 395  $\mu\text{m}$ . First to third coxae located anteriorly. Frontal margin of first coxa rounded. Insertions of fourth legs located relatively close to each other. One of glandularia located just posterior to insertion of fourth leg. Genital acetabula 2-3 in pairs, one pair of them rather large, located posterior to gonopore or near inner end of suture line of fourth leg. Gonopore small and slit-like. A circular structure located posterior to anterior acetabula. Excretory pore located posteromedial portion of ventral shield.

Palp (Fig. 15C) highly modified, with following lengths of segments: P-I, 17  $\mu\text{m}$ ; P-II, 36  $\mu\text{m}$ ; P-III, 12  $\mu\text{m}$ ; P-IV, 53  $\mu\text{m}$ ; P-V, 26  $\mu\text{m}$ . Second segment quadrish, greatly expanded laterally, with 3 modified setae near posterodorsal area; ventralmost one of them distally broadened and serrated; lateral one enlarged, very thick and feathered; dorsalmost one club-shaped. Third segment not expanded. Fourth segment strongly curved, with broad proximoventral projection, and 2 setae near base of proximoventral projection. Capitulum 93  $\mu\text{m}$  long, including apodeme.

First leg (Fig. 15D) with following dorsal lengths of segments: I-Leg-1, 40  $\mu\text{m}$ ; I-Leg-2, 35  $\mu\text{m}$ ; I-Leg-3, 40  $\mu\text{m}$ ; I-Leg-4, 59  $\mu\text{m}$ ; I-Leg-5, 77  $\mu\text{m}$ ; I-Leg-6, 90  $\mu\text{m}$ . Dorsal lengths of segments of second leg (Fig. 15E): II-Leg-1, 41  $\mu\text{m}$ ; II-Leg-2, 29  $\mu\text{m}$ ; II-Leg-3, 47  $\mu\text{m}$ ; II-Leg-4, 53  $\mu\text{m}$ ; II-Leg-5, 57  $\mu\text{m}$ ; II-Leg-6, 99  $\mu\text{m}$ . Third leg (Fig. 15F) with following dorsal lengths of segments: III-Leg-1, 39  $\mu\text{m}$ ; III-Leg-2, 34  $\mu\text{m}$ ; III-Leg-3, 47  $\mu\text{m}$ ; III-Leg-4, 50  $\mu\text{m}$ ; III-Leg-5, 114  $\mu\text{m}$ ; III-Leg-6, 136  $\mu\text{m}$ . One of setae on first segment of leg 1 club-shaped, dorsal one on fourth segment enlarged and feathered. Second leg (Fig. 15E) with 1 distally expanded, foliaceous seta, 1 feathered seta, and 2 ordinary setae on first segment. Other segments armed as in Fig. 15E. Third leg (Fig. 15F) with curvatures on third segment. One of setae on third segment spatulate and bearing thick setules. One of distal setae on same segment roughly lanceolated. Several setae on third segment enlarged. Fifth segment with 2 swimming hairs.

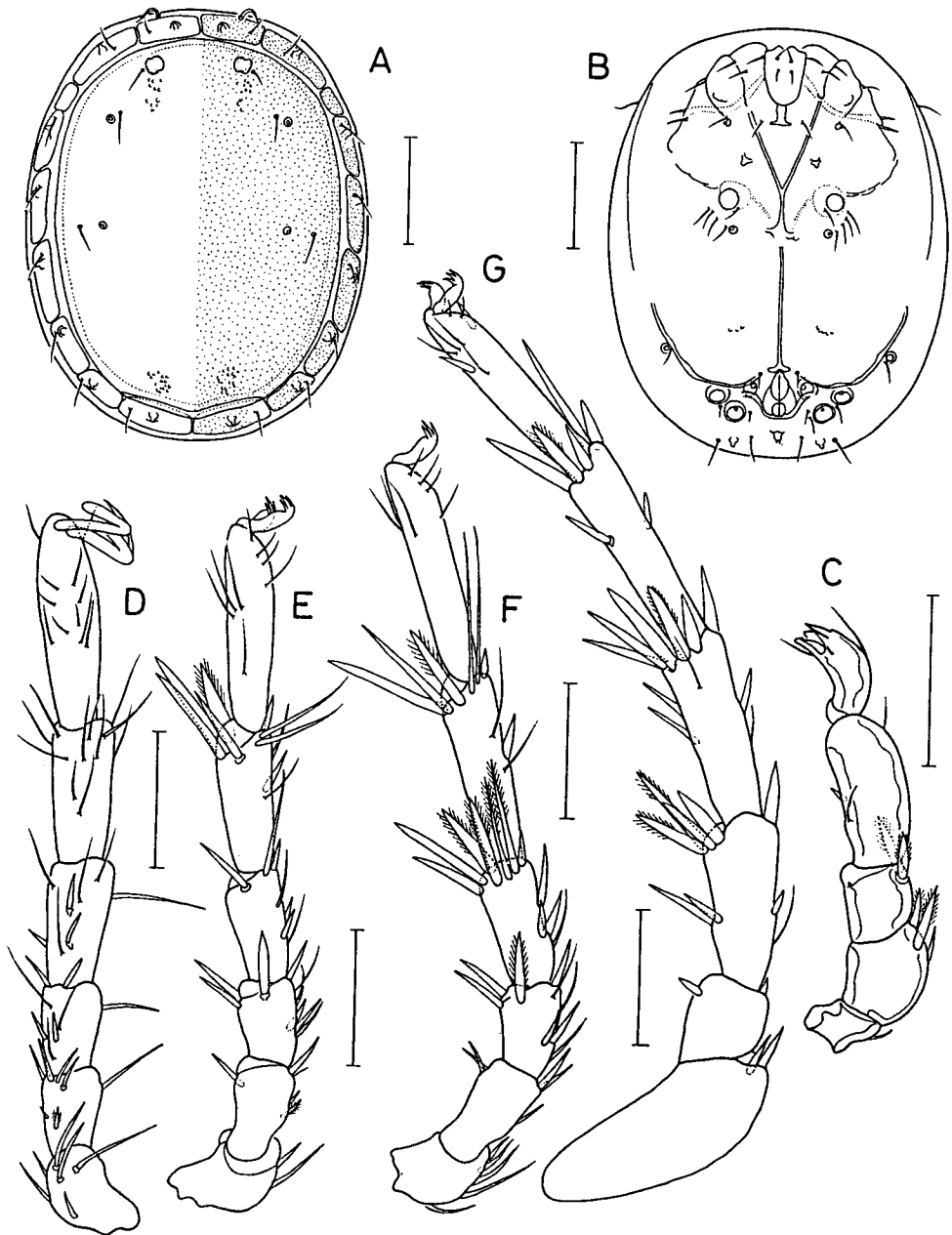
Fourth leg as in general, without modified seta. Dorsal lengths of segments of fourth leg: IV-Leg-1, 94  $\mu\text{m}$ ; IV-Leg-2, 30  $\mu\text{m}$ ; IV-Leg-3, 71  $\mu\text{m}$ ; IV-Leg-4, 84  $\mu\text{m}$ ; IV-Leg-5, 100  $\mu\text{m}$ ; IV-Leg-6, 96  $\mu\text{m}$ . Fourth leg the longest and followed by third, first, and second.

**Female.** Body (Fig. 16A) slightly stockier than that of male, 400  $\mu\text{m}$  long, and 316  $\mu\text{m}$  wide. Seta



**Fig. 15.** *Lethaxona hyogoensis* Imamura, male: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg. Scales: A, B = 0.1 mm; C = 0.02 mm; D-F = 0.05 mm.

on preanteniform glandularia small and not feathered. Other morphological features as in male. Length between anterior end of first coxa and posterior end of venter (Fig. 16B) 398  $\mu$ m. Median suture line between fourth coxae well-developed. Gonopore located just posterior to end of median



**Fig. 16.** *Lethaxona hyogoensis* Imamura, female: A, dorsal view; B, ventral view; C, palp; D, first leg; E, second leg; F, third leg; G, fourth leg. Scales: A, B = 0.1 mm; C-G = 0.05 mm.

suture line of fourth coxae or between inner ends of posterior suture lines of fourth coxae. One of 3 pairs of genital acetabula located lateral to gonopore, and remaining 2 pairs located posterolateral to gonopore.

Palp (Fig. 16C) with following lengths of segments: P-I, 16  $\mu\text{m}$ ; P-II, 32  $\mu\text{m}$ ; P-III, 18  $\mu\text{m}$ ; P-IV, 46  $\mu\text{m}$ ; P-V, 28  $\mu\text{m}$ . Capitulum 73  $\mu\text{m}$  long, including apodeme. Chelicera 79  $\mu\text{m}$ . First leg (Fig. 16D)

with following dorsal lengths of segments: I-Leg-1, 35  $\mu\text{m}$ ; I-Leg-2, 32  $\mu\text{m}$ ; I-Leg-3, 32  $\mu\text{m}$ ; I-Leg-4, 45  $\mu\text{m}$ ; I-Leg-5, 53  $\mu\text{m}$ ; I-Leg-6, 76  $\mu\text{m}$ . Second leg (Fig. 16E) with following dorsal lengths of segments: II-Leg-1, 39  $\mu\text{m}$ ; II-Leg-2, 26  $\mu\text{m}$ ; II-Leg-3, 34  $\mu\text{m}$ ; II-Leg-4, 40  $\mu\text{m}$ ; II-Leg-5, 52  $\mu\text{m}$ ; II-Leg-6, 73  $\mu\text{m}$ . Third leg (Fig. 16F) with following dorsal lengths of segments: III-Leg-1, 38  $\mu\text{m}$ ; III-Leg-2, 30  $\mu\text{m}$ ; III-Leg-3, 37  $\mu\text{m}$ ; III-Leg-4, 47  $\mu\text{m}$ ; III-Leg-5, 72  $\mu\text{m}$ ; III-Leg-6, 83  $\mu\text{m}$ . Fourth leg (Fig. 16G) with following dorsal lengths of segments: IV-Leg-1, 94  $\mu\text{m}$ ; IV-Leg-2, 28  $\mu\text{m}$ ; IV-Leg-3, 64  $\mu\text{m}$ ; IV-Leg-4, 73  $\mu\text{m}$ ; IV-Leg-5, 83  $\mu\text{m}$ ; IV-Leg-6, 76  $\mu\text{m}$ . All legs unmodified, without swimming hairs, nor with modified setae. Fourth leg the longest and followed by third, first, and second.

**Remarks.** This is the first record on the male of this species. Based on the comparison of females, our specimens are identified as this species. However the Korean females specimens reveal a difference from the Imamura's (1956, 1957) Japanese specimens in the relative length of body. A nymph of Imamura (1956) was recorded as 274  $\mu\text{m}$  long and 252  $\mu\text{m}$  in body size (ratio of length to width 1.09), and the holotype was recorded as 360  $\times$  290  $\mu\text{m}$ , ratio 1.24, (Imamura, 1957). The size of our two Korean female specimens are 400  $\times$  316  $\mu\text{m}$  (ratio 1.27) and 410  $\times$  317  $\mu\text{m}$  (ratio 1.29) respectively. Accordingly it is assumed that the female body of this species becomes slender with size. Therefore the difference of relative length between the Korean and Japanese specimens is thought to be of less taxonomic importance. Our male specimens do not agree with other species where the male is known.

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## 한국산 Axonopsinae아과의 물진드기

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### 요 약

한국 강원도 지역에서 채집된 Axonopsinae아과에 속하는 물진드기 11종을 기재하였다. 이들은 주로 냇물에서 채집되었으며, 그 구성이 *Albaxona*속 3신종, *Javalbia*속 1신종, *Brachypoda*속 2신종, *Woolastookia*속 2신종, *Ljania*속 1신종 1미기록종, 그리고 *Lethaxona*속 1미기록종이다. 기재는 주로 수컷을 기준으로 하였다.