

Unrecorded liverwort species from Korean flora II

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While preparing a floristic study of Korean hepatics, we discovered four unrecorded species collected from Mt. Geumo, Donggang river, Mt. Deokhang, and Mt. Naebyeon in Korea. *Plagiochila shangaica* Steph., *Porella stephaniana* (C. Massal.) S. Hatt., *Porella chinensis* (Steph.) S. Hatt., *Solenostoma horikawanum* (Amakawa) Váňa, Hentschel & J. Heinrichs are reported for the first time in Korea here.

Keywords: hepatics, Marchantiophyta, new species for Korea

INTRODUCTION

The first collector of hepatics on the Korean Peninsula was U. Faurie. In collaboration with E. Taquet, he collected some hepatics and mosses while amassing a large collection of vascular plants. The collections were studied by Stephani (1909-1912; 1912-1917; 1924 (1917-1924)). Since then, the Korean Hepaticae have been studied mainly by Japanese botanists, such as Nakai (1918), Horikawa (1932; 1934; 1955), Hattori (1943; 1947; 1952; 1956; 1978), Hattori *et al.* (1962a; 1962b), Ando (1955; 1960), Amakawa (1960), and Inoue (1958a; 1958b; 1959a; 1959b; 1962).

The first Korean botanist who studied the hepatics of Korea, was Hong (1960a; 1960b; 1960c; 1966; 1997; 2003). Choe conducted exhaustive bryofloristic research in southern Korea. He reported 201 Korean hepatic taxa in 66 genera (Choe, 1980). Recently Song and Yamada examined the hepatic flora of Jeju, Mt. Gaya, Mt. Jiri (2006; 2009a; 2009b) and Bakalin *et al.* (2009) described a new species (*Tritomaria koreana*) from Mt. Jiri.

During a floristic study of Korean hepatics, we discovered four unrecorded species collected from Korea. In this study, we provide a description and habitat details of the newly collected specimens from Korea.

MATERIALS AND METHODS

The field excursions were carried out in July 2008 (Jeollabuk-do: Mt. Naebyeon), October 2009 (Gangwon-do: Mt. Deokhang), February 2010 (Jeollanam-do: Mt. Geumo) and August 2010 (Gangwon-do: Donggang River) (Fig. 1).

Nomenclature of liverworts follows Konstantinova *et*

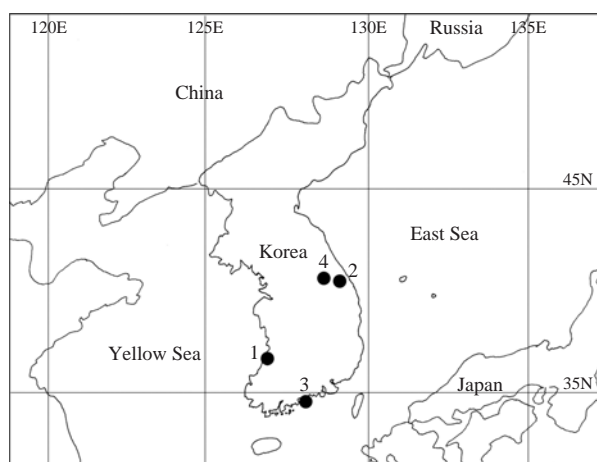


Fig. 1. Locations of the investigated areas. 1=Mt. Naebyeon. 2=Mt. Deokhang. 3=Mt. Geumo. 4=Donggang River.

al. (2009). All the voucher specimens are kept in the herbarium of Chonbuk National University (JNU) and National Institute of Biological Resources (NIBR).

RESULTS

During a floristic study of Korean hepatics, we determined four species turned to be new for the Korean bryophyte flora. The description and details of each species is provided here.

1. *Plagiochila shangaica* Steph., Sp. Hepat. 6: 216, 1921. (Fig. 2)

Korean Name: Hae-an-nal-gae-i-kki (해안날개이끼)

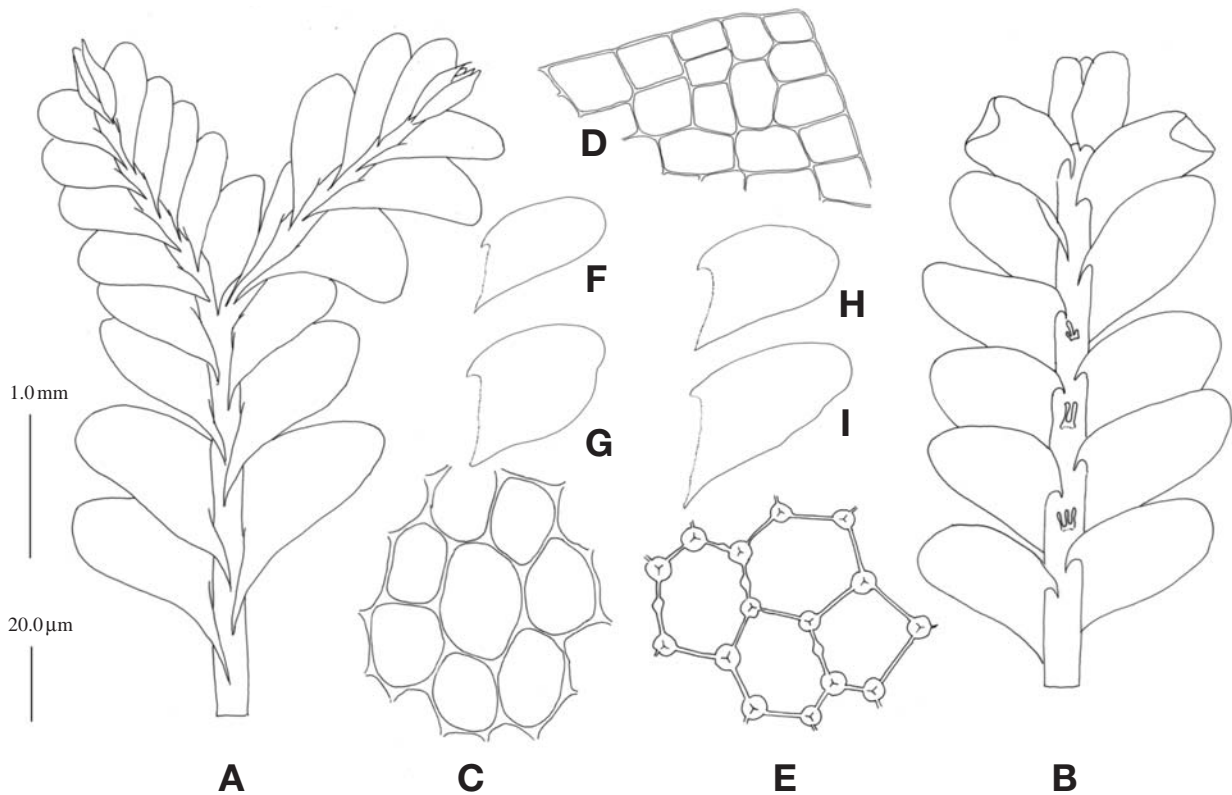


Fig. 2. *Plagiochila shangaica* Steph. A. plant (dorsal). B. plant (ventral). C. median cells of leaf. D. cells at leaf apex. E. basal cells of leaf. F-I. leaves. Scale bars: 1.0 mm for A, B, F-I; 20.0 μ m for C-E.

Plants 30.0-70.0 \times 2.5-3.5 mm, prostrate to ascending, yellowish green to brownish green. Stems dichotomously branched, brownish green to reddish green, cross section ca. 0.25-0.30 \times 0.20-0.25 mm, cortex cells smaller, thick-walled in 2-3 layers, 12.5-17.5 \times 10.0-12.5 μ m, inner cells larger, thin-walled, colorless, 15.0-17.5 \times 12.5-25.0 μ m, trigones concave. Rhizoids scarce. Leaves contiguously to imbricate, horizontally spreading, obliquely inserted, obliquely ovate to oblong, dorsal insertion line straight, recurved, ventral insertion line arched, shortly decurrent, 1.7-2.0 \times 0.7-1.3 mm, margin entire, apex broadly rounded. Cells in the median leaf polygonal, 25.0-30.0 \times 20.0-25.0 μ m, trigones triangular, marginal cells subquadrate 20.0-25.0 \times 17.5-22.5 μ m, trigones concave, basal cells 25.0-40.0 \times 20.0-32.5 μ m, walls intermediate thickenings, trigones convex; cuticle smooth. Oil bodies (2-)4-5(-6) per cells, ovate to elliptical, grape-cluster, ca. 9.0-15.0 \times 6.0-9.0 μ m. Underleaves mostly vestigial, sometimes linear, 0.20-0.25 \times 0.10-0.12 mm.

Habitats. On shaded rocks near the small stream in broad-leaved evergreen forest mixed with deciduous trees.

Distribution. Korea, China, Japan (So, 2001).

Specimens examined. Mt. Geumo, Yullim-ri, Dolsan-eup, Yeosu-si, Jeollanam-do, N 34° 35'32.7"E 127° 48' 00.3", Alt. 105 m, 24 Feb. 2010 leg. & det. S.S. Choi 7127

(JNU; NIBR); Mt. Doksil, Gageodo-ri, Heuksan-myeon, Sinan-gun, Jeollanam-do, N34° 04'53.2"E125° 06'22.5", Alt 516 m, 1 Feb. 2008 leg. & det. S.S. Choi 17-28b (JNU; NIBR); Mt. Duryun, Samsan-myeon, Haenam-gun, Jeollanam-do, N34° 28'19.0"E126° 37'09.1", Alt 209 m, 23 Apr. 2010 leg. & det. S.S. Choi 7300 (JNU; NIBR); Sang-wangbong, Daesin-ri, Wando-eup, Wando-gun, Jeollanam-do, N 34° 20'55.0"E 126° 40'20.2", Alt 190 m, 9 Feb. 2010 leg. & det. S.S. Choi 7023 (JNU; NIBR).

Plagiochila shangaica is characterized by (1) stem dichotomously branched, (2) leaves oblong to ovate and (3) leaves margin entire (So, 2001). In the Korean flora, this species is easily distinguished from the other *Plagiochila* species by its entire margin.

New Korean name is given as 'Hae-an-nal-gae-i-kki', is based on the habitat (seacoast) of locality. The 'Hae-an' means seacoast in Korea.

2. *Porella stephaniana* (C. Massal.) S. Hatt., J. Hattori Bot. Lab. 5: 81, 1951. (Fig. 3)

Madotheca stephaniana C. Massal., Mem. Accad. Agric. Verona 73(2): 23, 1897.

Korean Name: Dong-gang-se-jul-i-kki (동강세줄이끼)

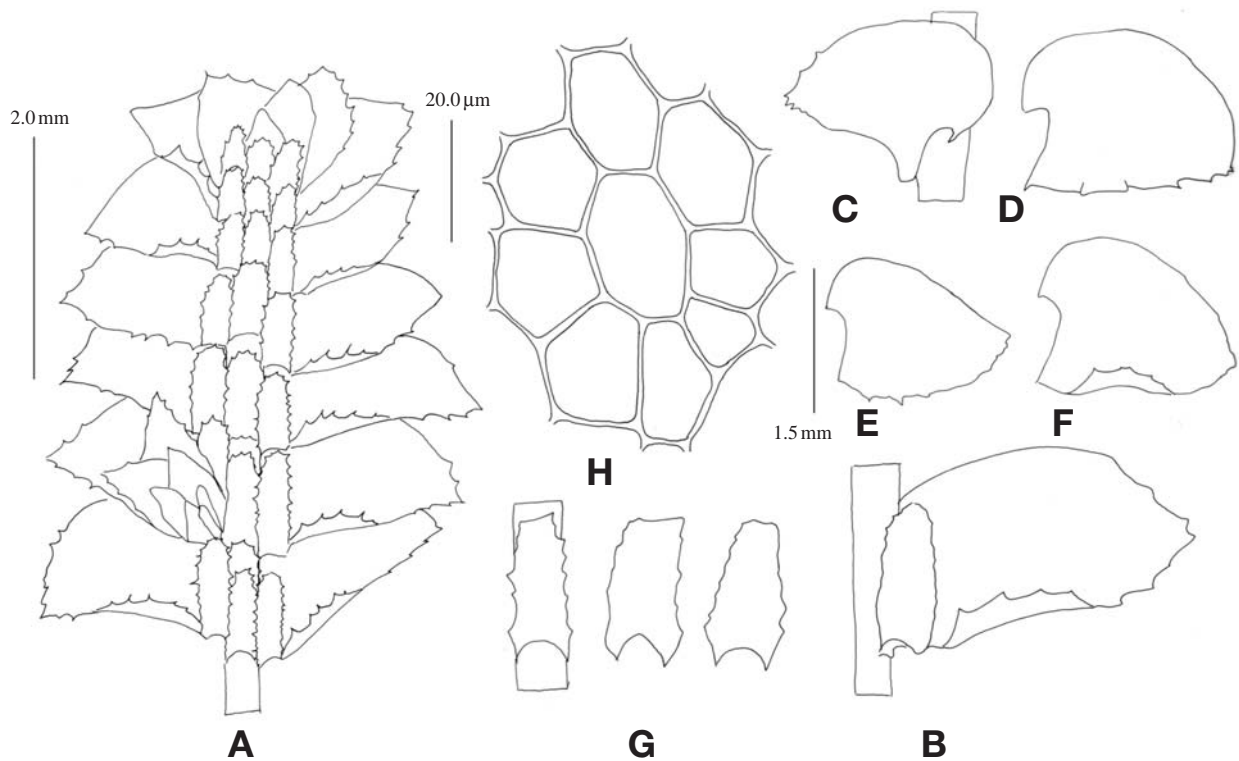


Fig. 3. *Porella stephaniana* (C. Massal.) S. Hatt. A. plant (ventral). B. part of plant (ventral). C. part of plant (dorsal). D-F. leaves. G. underleaves. H. median cells of leaf. Scale bars: 2.0 mm for A, B, G; 1.5 mm for C-F; 20.0 μ m for H.

Plants 30.0-80.0 \times 3.2-3.8 mm, prostrate to ascending, green to dark green. Stems irregularly branched, brownish green to reddish green, cross section ca. 0.25-0.30 \times 0.40-0.50 mm, cortex cells smaller, thick-walled in 1-3 layers, 10.0-15.0 \times 5.0-7.5 μ m, inner cells larger, thin-walled, colorless, 15.0-30.0 \times 12.5-20.0 μ m, trigones concave. Rhizoids scarce. Leaves imbricate, falcately spreading; lobe obliquely inserted, line insertion arched, not decurrent, concave, obliquely ovate to broadly ovate, 1.5-2.5 \times 1.2-1.5 mm, margin slightly crisate, incurved with 2-5 dentate near base, apex acute; lobule transversely inserted, not decurrent, narrowly ligulate, parallel with the stem, 0.8-1.2 \times 0.4-0.5 mm, margin irregularly dentate, apex acute to obtuse. Cells in the median leaf polygonal, 25.0-37.5 \times 20.0-25.0 μ m, trigones concave, marginal cells subquadrate 10.0-15.0 \times 12.5-17.5 μ m, trigones concave, basal cells 37.5-50.0 \times 22.5-30.0 μ m, trigones concave; cuticle smooth. Oil bodies 10-15 per cells, elliptical to spherical, slightly granulate, ca. 5.0-7.0 \times 4.0-6.0 μ m. Underleaves imbricate, transversely inserted, line insertion arched, short decurrent, oblong to narrowly ligulate, 0.9-1.2 \times 0.4-0.5 mm, margin irregularly dentate, apex obtuse to truncate.

Habitats. On shaded limestone near the stream in broad-leaved deciduous forest.

Distribution. Korea, China, Japan (Hara, 1956; Hattori,

1978).

Specimens examined. Donggang River, Yeongwol-eup, Yeongwol-gun, Gangwon-do, N 37° 16'35.9"E 128° 32' 05.8", Alt. 222 m, 17 Aug. 2010 *leg. & det. S.S. Choi* 7937 (JNU; NIBR).

Porella stephaniana is a calcicolous species. This species is characterized by (1) lobe stoutly dentate toward base of the ventral margin, (2) lobule dentate nearly throughout margin and (3) median cells 30.0-35.0 \times 25.0 μ m, marginal cells 20.0 \times 15.0 μ m, walls thin (Hattori, 1978).

New Korean name is given as 'Dong-gang-se-jul-i-kki', is based on the name of locality.

3. *Porella chinensis* (Steph.) S. Hatt., J. Hattori Bot.

Lab. 30: 131, 1967. (Fig. 4)

Madotheca chinensis Steph., Mém. Soc. Sci. Nat. Cherbourg 29: 218, 1894.

Korean Name: Deok-hang-se-jul-i-kki (덕항세줄이끼)

Plants 30.0-80.0 \times 2.0-3.5 mm, prostrate to ascending, green to brownish green. Stems frequently densely bipinnate, brownish green to reddish green, cross section ca. 0.20-0.25 \times 0.25-0.35 mm, cortex cells smaller, thick-walled in 2-3 layers, 12.5-20.0 \times 10.0-12.5 μ m, inner cells larger, thin-walled, colorless, 20.0-30.0 \times 17.5-25.0 μ m,

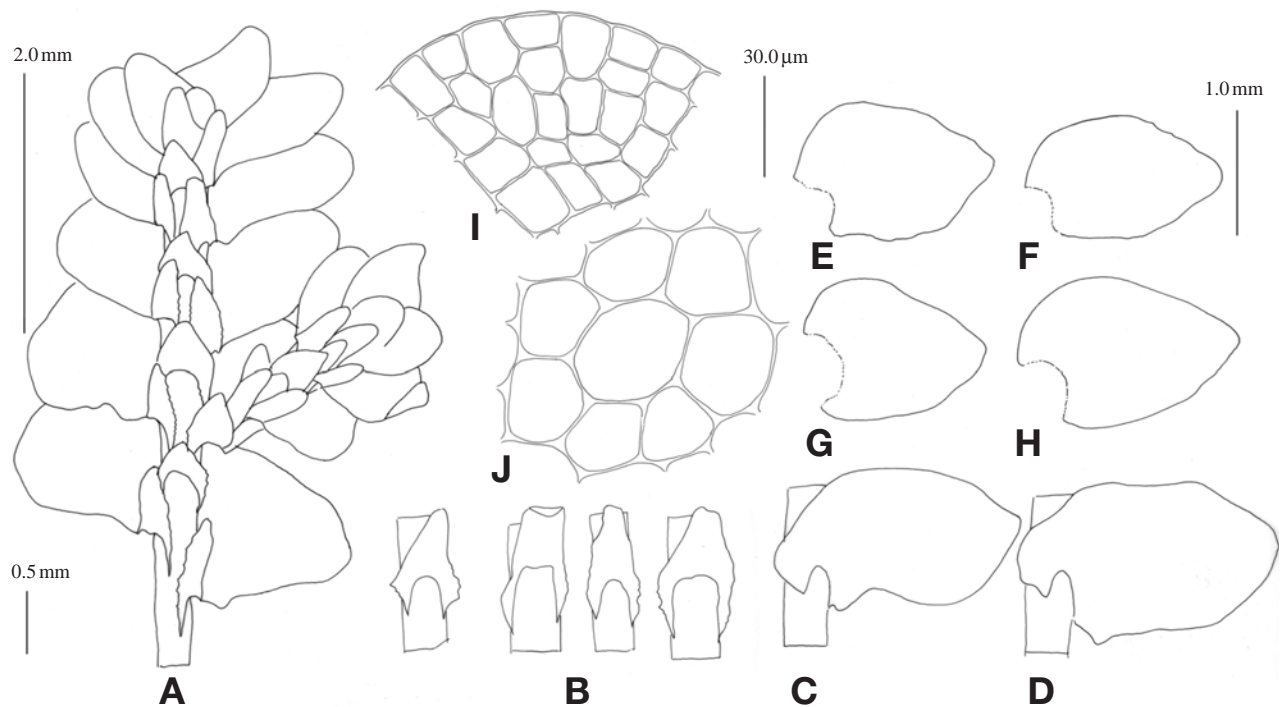


Fig. 4. *Porella chinensis* (Steph.) S. Hatt. A. plant (ventral). B. underleaves. C, D. part of plant (dorsal). E-H. leaves. I. cells at leaf apex. J. median cells of leaf. Scale bars: 2.0 mm for A, C, D, G; 1.0 mm for E-H; 0.5 mm for B; 20.0 μ m for I, J.

trigones concave. Rhizoids scarce, fasciculate at base of underleaves, pale reddish brown. Leaves imbricate; lobe obliquely inserted, line insertion arched, not decurrent, concave, obliquely ovate to broadly ovate, 1.6-2.3 \times 1.0-1.4 mm, margin slightly crisate, slightly incurved, mostly entire to rarely toothed, apex obtuse to rounded; lobule transversely inserted, line insertion curving down from the level of the base of keel to 0.5-1.0 the stem wide, long decurrent, narrowly ligulate, parallel with the stem, 0.5-0.7 \times 0.2-0.3 mm, lateral margins narrowly recurved, irregularly dentate, apex acute to obtuse. Cells in the median leaf polygonal, 30.0-37.5 \times 25.0-30.0 μ m, trigones concave, marginal cells subquadrate 20.0-25.0 \times 15.0-20.0 μ m, trigones concave, basal cells 30.0-37.5 \times 25.0-30.0 μ m, trigones concave; cuticle smooth. Oil bodies 10-20 per cells, elliptical to spherical, homogeneous, smooth, ca. 5.0-6.0 \times 2.0-3.0 μ m. Underleaves contiguous, transversely inserted, line insertion curving up the stem 1.0-1.5 the stem wide, arched, long decurrent, repand-crisate, ovate to ligulate, 0.5-0.8 \times 0.4-0.9 mm, margin irregularly dentate, apex obtuse to acute-rounded.

Habitats. On shaded rocks or bark of tree in broad-leaved deciduous forest.

Distribution. Korea, China, Russia (Hattori, 1967; Konstantinova *et al.*, 2009).

Specimens examined. Mt. Deokhang, Anui-ri, Singi-myeon, Samcheok-si, Gangwon-do, N 37° 19' 24.2" E 129°

00' 17.6", Alt. 664 m, 14 Oct. 2009 *leg. & det. S.S. Choi 7006* (JNU; NIBR).

Porella chinensis is characterized by (1) lobe almost entire margin (2) lobule and underleaves long decurrent and (3) stems frequently densely pinnately-branched (Hattori, 1967). In the Korean flora, this species is easily distinguished from *P. grandiloba* by its long decurrent lobule and underleaves.

New Korean name is given as 'Deok-hang-se-jul-i-kki', is based on the name of locality.

4. *Solenostoma horikawanum* (Amakawa) Váňa, Hentschel & J. Heinrichs, Cryptog. Bryol. 31: 137, 2010. (Fig. 5)

Plectocolea horikawa Amakawa, J. Jap. Bot. 32: 219, 1957.

Jungermannia horikawana (Amakawa) Amakawa, J. Hattori Bot. Lab. 22: 34, 1960.

Korean Name: Nun-mang-ul-i-kki (눈망울이끼)

Plants 8.0-12.0 \times 2.5-3.0 mm, prostrate to ascending, yellowish green to green. Stems sparsely branched, yellowish green dorsal part, purple ventral part, cross section ca. 0.25-0.35 \times 0.30-0.35 mm, cortex cells smaller, slightly thick-walled in 1 layers, 20.0-25.0 \times 15.0-25.0 μ m, inner cells larger, thin-walled, colorless, 25.0-50.0 \times 20.0-37.5

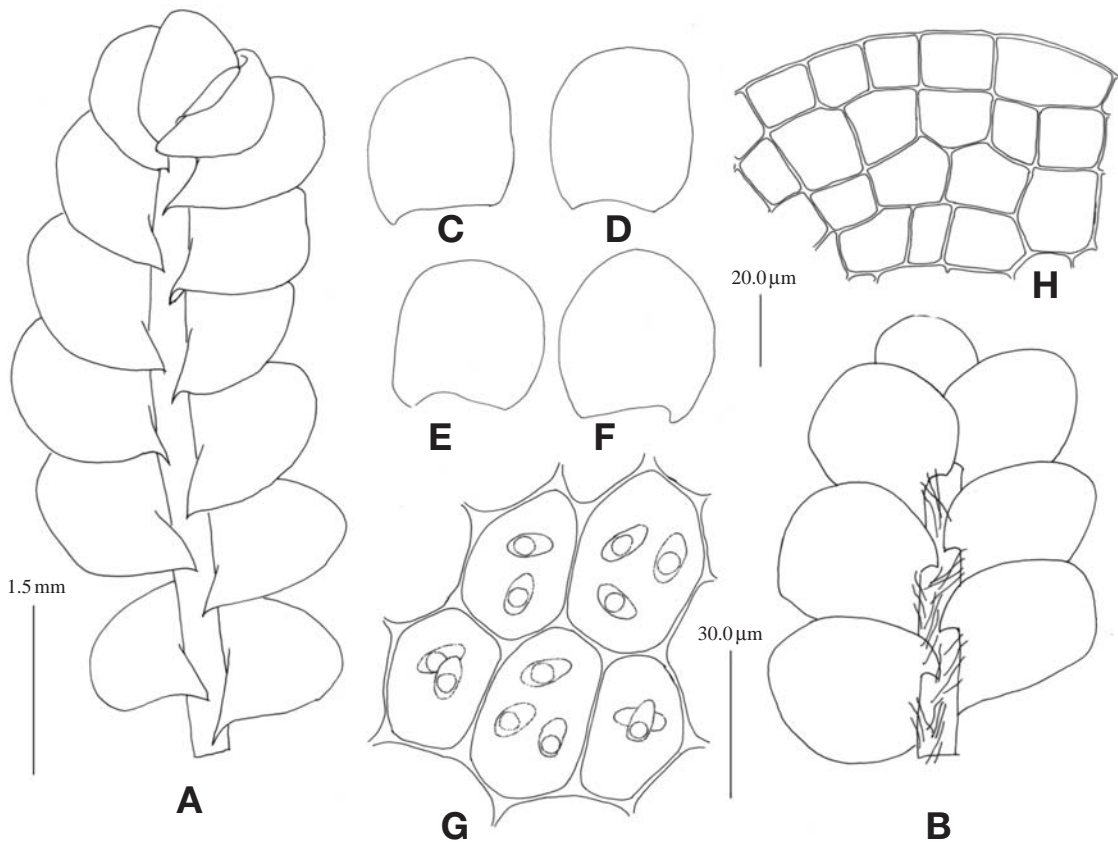


Fig. 5. *Solenostoma horikawanum* (Amakawa) Váňa, Hentschel & J. Heinrichs. A. plant (dorsal). B. plant (ventral). C-F. leaves. G. oil-bodies in median cells of leaf. H. cells at leaf apex. Scale bars: 1.5 mm for A, B; 30.0 µm for G; 20.0 µm for H.

µm, trigones concave. Rhizoids numerous, purple. Leaves contiguously to imbricate, obliquely inserted, obliquely ovate to oblong, slightly concave, 1.1-1.5 × 1.2-1.5 mm, margin entire, apex rounded to truncate. Cells in the median leaf polygonal, 30.0-42.5 × 25.0-37.5 µm, trigones concave to triangular, marginal cells 20.0-25.0 × 17.5-25.0 µm, walls thin, trigones concave, basal cells 50.0-62.5 × 30.0-37.5 µm; cuticle smooth to slightly striolate. Oil bodies 2-4 per cells, elliptical to spherical, glanulate, biconcentric, ca. 15.0-20.0 × 5.0-7.5 µm. Underleaves absent.

Habitats. On exposed wet rocks near the stream in broad-leaved deciduous forest.

Distribution. Korea, China, Japan (Amakawa, 1960).

Specimens examined. Mt. Naeyeon, Seokpo-ri, Jinseomyeon, Buan-gun, Jeollabuk-do, N35° 36'42.6"E126° 34'55.5", Alt. 39 m, 3 Jul. 2008 leg. & det. S.S. Choi 3-18 (JNU; NIBR).

Solenostoma horikawa is similar to *Plectocolea infusca* in having ovate to oblong leaves and similar habitat, but differs in having rhizoids purple versus colorless to slightly purple and oil-bodies 2-4 per cells, biconcentric, narrowly oblong versus 4-8 per cells, not biconcentric, oblong

to spherical (Amakawa, 1960).

New Korean name is given as 'Nun-mang-ul-i-kki', is based on the character of biconcentric oil-bodies in leaves. The 'Nun' means eye in Korea.

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REFERENCES

- Amakawa, T. 1960. Family Jungermanniaceae of Japan. II. J. Hattori Bot. Lab. 22:1-90.
 Ando, H. 1955. A revision of the taxonomic concept of *Madotheca vernicosa* (Lindb.) Steph. based upon a study of the variation. Jour. Sci. Hiroshima Univ., ser. B., Div. 2.

- 7:45-62.
- Ando, H. 1960. Ecological notes on the *Porella* complex. *Hibokobia* 2:45-62.
- Bakalin, V.A., S.S. Choi and B.-Y. Sun. 2009. A new species of *Tritomaria* (Lophoziaceae) from the Korean Peninsula. *Arctoa* 18:163-166.
- Choe, D.M. 1980. Musci, Hepaticae. Illustrated flora and Fauna of Korea. 24. Seoul. pp. 1-790.
- Damsholt, K. 2002. Illustrated flora of the Nordic liverwort and hornworts. *Nord. Bryo. Soc.*, Lund.
- Hara, H. 1956. A review of *Porella* from Shikoku, southern Japan. *Res. Rep. Kochi Univ.* 4(12):1-27.
- Hattori, S. 1943. Notulae de Hepaticae. VI. *Jour. Jap. Bot.* 19: 345-356.
- Hattori, S. 1947. Contributio ad Floram Hepaticarum Yakushimensis I. *J. Hattori Bot. Lab.* 1:1-26.
- Hattori, S. 1952. Hepaticae of Shikoku and Kyushu, southern Japan (2). *J. Hattori Bot. Lab.* 7:21-46.
- Hattori, S. 1956. Notulae de Hepaticae Japonicis (18). *Jour. Jap. Bot.* 31:201-204.
- Hattori, S. 1967. Studies on the Asiatic species of the genus *Porella* (Hepaticae). I. *J. Hattori Bot. Lab.* 30:129-151.
- Hattori, S. 1978. Studies on the Asiatic species of the genus *Porella* (Hepaticae). VII. A synopsis of Asiatic Porellaceae. *J. Hattori Bot. Lab.* 44:91-120.
- Hattori, S., W.S. Hong and H. Inoue. 1962a. On a small collection of Hepaticae made on Querpert Island (Koera). *Jour. Hattori Bot. Lab.* 25:126-134.
- Hattori, S., W.S. Hong and H. Inoue. 1962b. A small collection of Hepaticae from the Chii Mountains (Korea). *J. Hattori Bot. Lab.* 25:279-286.
- Hong, W.S. 1960a. Notes on Hepaticae of Mt. Setugakusan, Korea. *Misc. Bryol. Lichenol.* 2:52 (in Japanese).
- Hong, W.S. 1960b. The flora of bryophytes on Mt. Kwanak, with some new additions to the Korean flora. *J. Plant Biol.* 3:19-25.
- Hong, W.S. 1960c. The bryophytes on Mt. Soyo, with some new additions to the Korean flora. *J. Plant Biol.* 3:26-31.
- Hong, W.S. 1966. The Leafy Hepaticae of South Korea and Their Phytogeographic Relationships, Especially to the Flora of North America. *Bryologist* 69:393-426.
- Hong, W.S. 1997. The Hepaticae and Athocerotae of Korean peninsula: annotated list of taxa. *Lindbergia* 22:134-142.
- Hong, W.S. 2003. The Hepaticae and Athocerotae of Korean peninsula: identification keys to the taxa. *Lindbergia* 28: 134-147.
- Horikawa, Y. 1932. Studies on the Hepaticae of Japan. VII. *Journal of Science of Hiroshima University. Ser. B. Div. 2.* 1:121-134.
- Horikawa, Y. 1934. *Symbolae florae Bryophytae Orientali Asiae.* I. *Bot. Mag. [Tokyo]* 48:452-462.
- Horikawa, Y. 1955. Distributional Studies of bryophytes in Japan and the adjacent Regions. *Phytotax. Geobot. Lab. Hiroshima Univ.* 27:1-152.
- Inoue, H. 1958a. The family Plagiogochilaceae of Japan and Formosa. I. *J. Hattori Bot. Lab.* 19:25-59.
- Inoue, H. 1958b. The family Plagiogochilaceae of Japan and Formosa. II. *J. Hattori Bot. Lab.* 20:54-106.
- Inoue, H. 1959a. A review of Japanese species of *Lophocolea* Dum. *J. Hattori Bot. Lab.* 21:214-230.
- Inoue, H. 1959b. On *Metacalypogeia*, a new genus of Hepaticae. *J. Hattori Bot. Lab.* 21:231-235.
- Inoue, H. 1962. Two new species of *Plagiogochila* Dum. *J. Hattori Bot. Lab.* 37:187-190.
- Konstantinova, N.A., V.A. Bakalin, E.N. Andrejeva, A.G. Bezgodov, E.A. Borovichev, M.V. Dulin and Yu.S. Mamonov. 2009. Checklist of liverworts (Marchantiophyta) of Russia. *Arctoa* 18:1-64.
- Nakai, T. 1918. The Survey Report on Plants of Mt. Kumkang (Diamond). Seoul. pp. 200-203.
- So, M.L. 2001. *Plagiogochila* (Hepaticae, Plagiogochilaceae) in China. *Systematic Botany Monographs* 60:1-214.
- Song, J.S. and K. Yamada. 2006. Hepatic flora from Jeju (Cheju) Island, Korea. *J. Hattori Bot. Lab.* 100:443-450.
- Song, J.S. and K. Yamada. 2009a. Liverworts from Mt. Kaya (Gaya), South Korea. *J. Phytogeogr. Taxon.* 57:35-38 (in Japanese).
- Song, J.S. and K. Yamada. 2009b. Liverworts of Mt. Jiri and its adjacent areas, South Korea. *Natural Environmental Science Research* 22:15-21 (in Japanese).
- Stephani, F. 1909-1912. *Species Hepaticarum IV.* Genève. pp. 401-468.
- Stephani, F. 1912-1917. *Species Hepaticarum V.* Genève. pp. 987-988.
- Stephani, F. 1924 (1917-1924). *Species Hepaticarum VI.* Suppl. ad. Vol. I-V. Genève. pp. 8-471.

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