

Hepatics from northwestern Sichuan, China, with a checklist of Sichuan hepatics

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A collection of bryophytes by a Finnish–Chinese expedition in northwestern Sichuan in September 1991 includes 50 species of liverworts. The major collecting areas were in Minshan Range in Songpan and Nanping Counties. A smaller collection comes from the valley of the River Suo-Mo North of Qiong-Lai Range in Ma-Er-Kang County and from Hongyuan County from the vicinity of Shua-Jin Temple. *Chiloscyphus itoanus* (H. Inoue) Engel & Schust. is reported for the first time for China, and *Calypogeia cordistipula* (Steph.) Steph. is synonymized with *C. neesiana* (Mass. & Car.) K. Müll. Twenty-six liverworts are for the first time reported for Sichuan. The checklist of Sichuan hepatics is given. A total of 139 species are known to occur there. The flora is remarkably diversified. The major elements of the flora are widely distributed circumpolar boreal taxa, which occur in the humid oroboreal zone in Sichuan. Boreal species of the lichen genera *Cladonia* Hill and *Peltigera* Wild. and the species of the moss families Cinclidiaceae, Mniaceae and Plagiomniaceae show a similar altitudinal distribution in the study area. Species of widely distributed temperate southeast Asiatic taxa occur with an intermixture of some endemic and tropical species. The list includes discussions on the nomenclature, taxonomy, and distribution.

Key words: biodiversity, Bryophyta, China, Hepaticae, Musci, nomenclature, Sichuan, taxonomy

In connection with an ongoing international project to prepare a Bryoflora of China, a Finnish–Chinese excursion was organized to collect bryophytes in northwestern Sichuan in September 1991. The excursion leader was Timo Koponen from the Department of Botany, University of Helsinki, and two other participants were Luo, Jian-

Xing and Wu, Pang-Chen from the Institute of Botany, Academia Sinica, Beijing. The author Koponen also collected some lichens, especially of the Cladoniaceae and *Peltigera*. These collections were reported by Stenroos *et al.* (1994), and the moss families Cinclidiaceae, Mniaceae and Plagiomniaceae were treated by Koponen (1994).

List of Sichuan hepatics

The hepatic flora of Sichuan is insufficiently known. Based on the checklist of Chinese hepatics by Piippo (1990), only 114 species of hepatics were previously known from Sichuan. The present addition raises the number to 139. No detailed local hepatic floras have been published, and the most useful reference work is Nicholson (1930a). Grolle (1966), Hattori and Lin (1985) and Mizutani and Chang (1986) referred to a number of Sichuan specimens. Most of the other records, on which the list below is based, are scattered in the literature and can be traced from Piippo's (1990) work. An additional piece of information comes from Lou (1987). The asterisks mark the novelities reported in the present paper.

* *Acrolejeunea pycnoclada* (Tayl.) Schiffn.
Anastrepta orcadensis (Hook.) Schiffn.
 * *Anastrophyllum michauxii* (F. Web.) Buch
 * *Aneura pinguis* (L.) Dum.
Apometzgeria pubescens (Schrank.) Kuwah.
Asterella khasyana (Griff.) Grolle
A. multiflora (Steph.) Pandè *et al.*
A. mussuriensis (Kashyap) Verd.
A. reflexa (Herz.) Chen
Bazzania bidentula (Steph.) Steph.
B. imbricata (Mitt.) Hatt.
B. oshimensis (Steph.) Horik.
B. praerupta (Reinw. *et al.*) Trev.
B. tricrenata (Wahlenb.) Lindb.
B. tridens (Reinw. *et al.*) Trev.
B. trilobata (L.) S. Gray
Blasia pusilla L.
Blepharostoma trichophyllum (L.) Dum.
 * *Calypogeia neesiana* (Mass. & Car.) K. Müll.
Chandonanthus hirtellus (Web.) Mitt.
Cheilolejeunea khasiana (Mitt.) N. Kitag.
 * *Chiloscyphus itoanus* (H. Inoue) Engel & Schust.
 * *C. minor* (Nees) Engel & Schust.
C. polyanthos (L.) Corda
 * *C. profundus* (Nees) Engel & Schust.
Cololejeunea longifolia (Mitt.) Bened.
 * *C. ornata* Evans
Conocephalum conicum (L.) Dum.
Delavayella serrata Steph.
Drepanolejeunea szechuanica Chen
Fossombronina levieri Steph.
Frullania aposinensis Hatt. & Lin
F. davurica Hampe
F. davurica subsp. *jackii* (Gott.) Hatt.
F. davurica subsp. *jackii* fo. *dorsoblastos* (Hatt.) Hatt. & Lin
F. duthiana Steph. var. *szechuanensis* Hatt. & Gao
F. ericoides (Nees) Mont.

* *F. fuscovirens* Steph. var. *gemmaipara* (Schust. & Hatt.) Hatt. & Lin
F. giraldiana Mass.
F. giraldiana var. *handelii* (Verd.) Hatt.
F. handel-mazzettii Hatt.
 * *F. inflata* Gott.
F. inflexa Mitt.
 * *F. inouei* Hatt.
F. moniliata (Reinw. *et al.*) Mont.
F. muscicola Steph.
F. nepalensis (Spreng.) Lehm. & Lindenb.
F. obovata Hatt.
F. rhytocollea Herz.
F. sinensis Steph.
 * *F. tamarisci* (L.) Dum.
F. tamarisci var. *vietnamica* (Hatt.) Hatt.
F. zangii Hatt. & Lin
Gymnomitrium concinnatum (Lightf.) Corda
Herbertus delavayi Steph.
H. dicranus (Tayl.) Trev.
H. giraldianus (Steph.) Nichols.
H. longifissus Steph.
 * *H. sakuraii* (Warnst.) Hatt.
Heteroscyphus planus (Mitt.) Schiffn.
Jamesoniella autumnalis (DC.) Steph.
Jubula japonica Steph.
Jungermannia lanigera Mitt.
J. macrocarpa Steph.
 * *J. pyriformis* Steph.
Kurzia makinoana (Steph.) Grolle
Lejeunea flava (Sw.) Nees
 * *L. parva* (Hatt.) Mizut.
Lepidozia omeiensis Mizut. & Chang
L. reptans (L.) Dum.
L. subintegra Lindenb.
L. subtransversa Steph.
Lophozia incisa (Schrad.) Dum.
Marchantia paleacea Bertol.
M. polymorpha L.
Marsupella revoluta (Nees) Dum.
M. sprucei (Limpr.) H. Bern.
Metacalypogeia alternifolia (Nees) Grolle
Metzgeria conjugata Lindb.
 * *M. consanguinea* Schiffn.
M. leptoneura Spruce
 * *M. lindbergii* Schiffn.
M. sinensis Chen
Monosolenium tenerum Griff.
Notothylas orbicularis (Schwein.) Sull.
Pallavicinia ambigua (Mitt.) Steph.
 * *P. lyellii* (Hook.) Carruth.
 * *Pedinophyllum truncatum* (Steph.) Inoue
Pellia endiviifolia (Dicks.) Dum.
Phaeoceros bulbiculosus (Brotero) Prosk.
Plagiochasma appendiculatum Lehm. & Lindenb.
P. pterospermum Mass.
Plagiochila chinensis Steph.

* *P. debilis* Mitt.
P. delavayi Steph.
P. pseudofirma Herz.
P. wallichiana Steph.
* *P. wilsoniana* Steph.
P. zonata Steph.
Porella caespitans (Steph.) Hatt.
P. caespitans var. *cordifolia* (Steph.) Hatt.
P. caespitans var. *nipponica* Hatt.
P. chenii Hatt.
P. chinensis (Steph.) Hatt.
P. densifolia (Steph.) Hatt.
P. densifolia subsp. *appendiculata* (Steph.) Hatt.
P. densifolia var. *paraphyllina* (Chen) Pócs
P. gracillima Mitt.
P. japonica (Sande Lac.) Mitt.
P. latifolia Lou & Li
* *P. oblongifolia* Hatt.
P. oblongifolia var. *macroloba* (Steph.) Hatt. & Zhang
P. obtusata (Tayl.) Trev.
P. perrottetiana (Mont.) Trev.
P. perrottetiana var. *ciliatodentata* (Chen & Wu) Hatt.
P. revoluta (Lehm. & Lindenb.) Trev. var. *propinqua* (Mass.) Hatt.
P. urceolata Hatt.
Ptychanthus striatus (Lehm. & Lindenb.) Nees
Radula cavifolia Hampe
R. chinensis Steph.
R. constricta Steph.
R. kojana Steph.
* *R. tokiensis* Steph.
Reboulia hemisphaerica (L.) Raddi
Riccardia chamaedryfolia (With.) Grolle
* *R. palmata* (Hedw.) Carruth.
Riccia fluitans L.
R. nigrella DC.
R. sorocarpa Bisch.
Riccocarpos natans (L.) Corda
Scapania ciliata Sande Lac.
S. ciliatospinosa Horik.
S. contorta Mitt.
S. ferruginea (Lehm. & Lindenb.) Gott. *et al.*
* *S. massalongii* (K. Müll.) K. Müll.
S. orientalis Steph.
* *S. parva* Steph.
Spruceanthus semirepandus (Nees) Verd.
Targionia hypophylla L.
Taxilejeunea luzonensis Steph.
Tetralophozia filiformis (Steph.) Urmi
Trachylejeunea chinensis Herz.
* *Trichocolea tomentella* (Ehrh.) Dum.
Trichocoleopsis sacculata (Mitt.) Okam.
* *Tritomaria exsecta* (Schrad.) Loeske
Trocholejeunea infuscata (Mitt.) Verd.
T. sandvicensis (Gott.) Mizut.
Tuzibeanthus chinensis (Steph.) Mizut.
Wiesnerella denudata (Mitt.) Steph.

Study area

The major part of the collections were made in northwestern Sichuan in Minshan Range in Songpan and Nanping Counties. A smaller collection comes from the valley of the River Suo-Mo, North of the Qiong-Lai Range in Ma-Er-Kang County and from Hongyuan County from the vicinity of the Shua-Jin Temple. The situation of the collecting localities and their altitudinal distribution are given in Fig. 1.

Minshan Range and Qiong-Lai Range are parts of the Hengduan Mountain system which separates the "Red Basin" or Chengtu Plateau from the high plateau of Tibet. The area is very broken country characterized by steeply sloping river gorges and high mountain peaks, the highest being Mt. Xue Bao Ding, ca. 6 100 m (18 420 ft.). The lowest elevation visited, the basin of R. Bai-He in Nanping Co., is at ca. 1 800 m and the highest the headwaters of the Fujiang River at Xue-Shan Pass at ca. 3 800 m. On the basis of the frequent presence of lime-demanding bryophytes and lichens the bedrock must be calcareous.

The vegetation and topography were described in an earlier paper (Stenroos *et al.* 1994). In describing the zonation of the vegetation we use the terminology of the Bioclimatic Zone System created and used by Finnish phytogeographers (Hämet-Ahti 1963, 1965, 1981, Ahti *et al.* 1968, Hämet-Ahti & Ahti 1969, Hämet-Ahti *et al.* 1974, and Ahti 1980). Most of the collecting localities were either cool temperate forests at 1 800–2 500 m or oroboreal forests and scrub at ca. 2 500–3 600 m.

The climatic conditions of the study area have a heavy influence on the distribution of hepatics. Within this area, the Yunnan Plateau type of climate prevails. Although the area is outside the direct effect of the summer monsoon, the high mountains get much rain in the summer season when the warm air masses meet the colder air from Siberia. A special feature of the primeval oroboreal forest sites is the thick moss cover on the ground, and the especially numerous epiphytes on conifers. The main occurrence of hepatic species is in these humid high-elevation forests. Many hepatics grow on trunks of such trees as *Abies*. In this respect, the oroboreal vegetation of the Mingshan Range is similar to the vegetation in some other high mountains in China, such as Mt. Chang-bai, for instance (cf. Koponen *et al.* 1983). This is evidently due to the high precipitation and humidity of these high elevation forests. The phenomenon is probably the same as the occurrence of "Atlantic" hepatics in Yunnan, as reported by Nicholson (1930b).

Phytogeography

Four distinct distribution groups or elements of hepatics can be recognized from this material. The following taxa are widespread or nearly cosmopolitan. In the study area they occur mainly in the humid oroboreal zone.

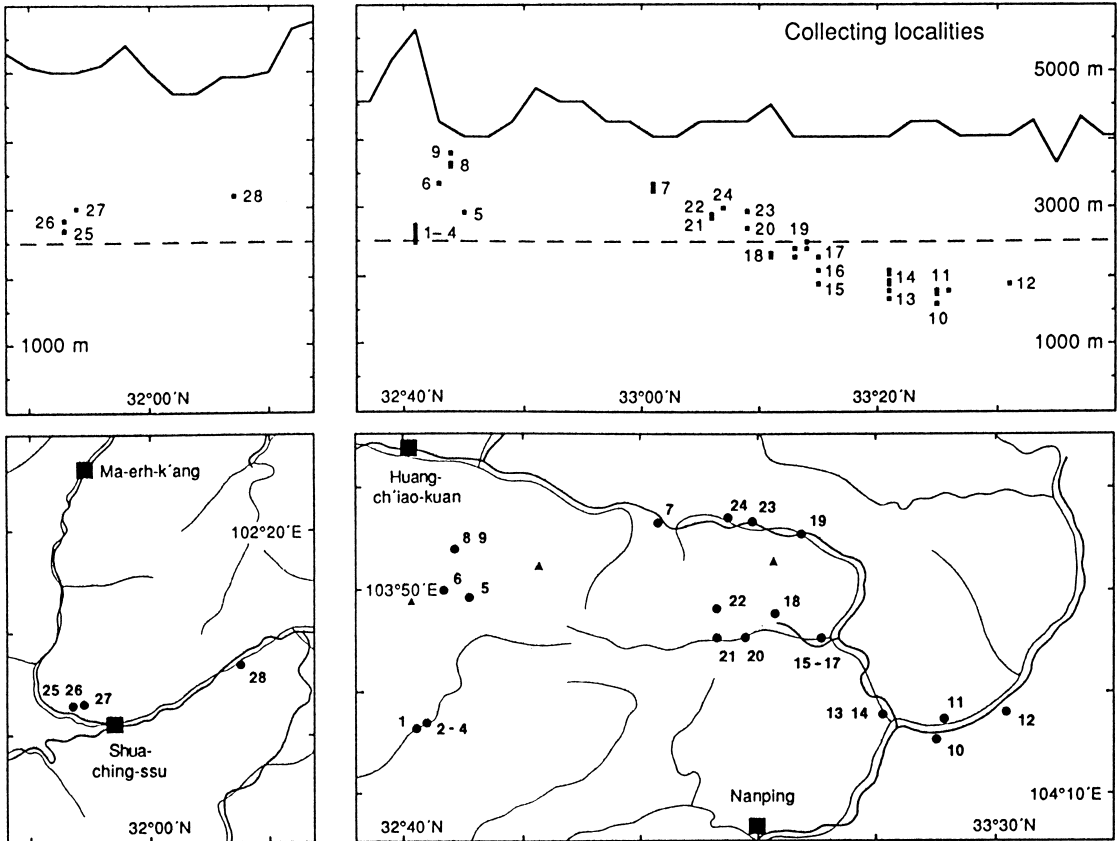


Fig. 1. The study areas and collection localities (1–28) and their altitudinal distribution in Minshan and Qiong-Lai Ranges in Sichuan, China. The broken line at 2 500 m marks the borderline of the orotemperate and lower orohemiboreal zones.

Aneura pinguis
Blepharostoma trichophyllum
Jamesoniella autumnalis
Marchantia polymorpha
Metzgeria leptoneura
Pallavicinia lyellii
Reboulia hemisphaerica
Trichocolea tomentella

Quite a number of Sichuan hepatics have a holarctic, mainly boreal distribution. These occur in the oroboreal zone in the study area (Figs. 2–4). This is in accordance with the previous results for the lichen genera *Cladonia* and *Peltigera* (Stenroos *et al.* 1994) and for the species of the moss families Cinclidiaceae, Mniaceae and Plagiomniaceae (Koponen 1995).

Anastrophyllum michauxii
Calypogeia neesiana
Chiloscyphus minor
C. profundus

Frullania tamarisci
Herbertus sakuraii
Lepidozia reptans
Lophozia incisa
Riccardia palmata
Scapania massalongii
Tritomaria exsecta

The third distinct distribution group of hepatics in the study area is the element of Southeast Asiatic hepatics. Some of them range from Japan to the Himalayas, and the others have a Himalayan range.

Japan – Himalayas
Bazzania bidentula
Chiloscyphus itoanus
Frullania davurica
F. moniliata
F. muscicola
Pedinophyllum truncatum
Porella caespitans var. *cordifolia*

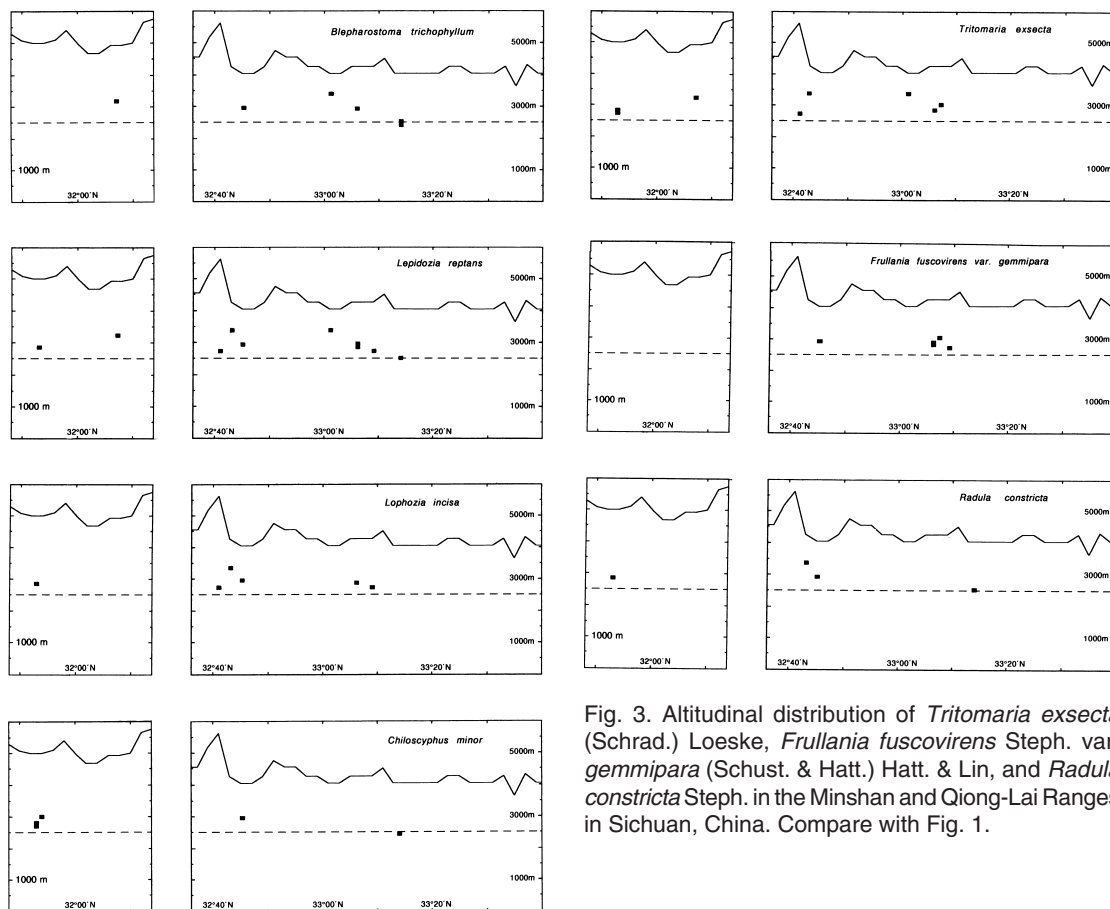


Fig. 2. Altitudinal distribution of *Blepharostoma trichophyllum* (L.) Dum., *Lepidozia reptans* (L.) Dum., *Lophozia incisa* (Schrad.) Dum., and *Chiloscyphus minor* (Nees) Engel & Schust. in the Minshan and Qiong-Lai Ranges in Sichuan, China. Compare with Fig. 1.

P. caespitans var. *nipponica*
Radula constricta
R. tokiensis

Himalayan

Frullania fuscovirens var. *gemmipara*
F. inouei
F. obovata
F. rhytocollea
F. zangii
Plagiochila debilis
P. delavayi
P. wilsoniana
Porella caespitans var. *caespitans*
P. revoluta var. *propinqua*
Scapania contorta
S. ferruginea
S. parva

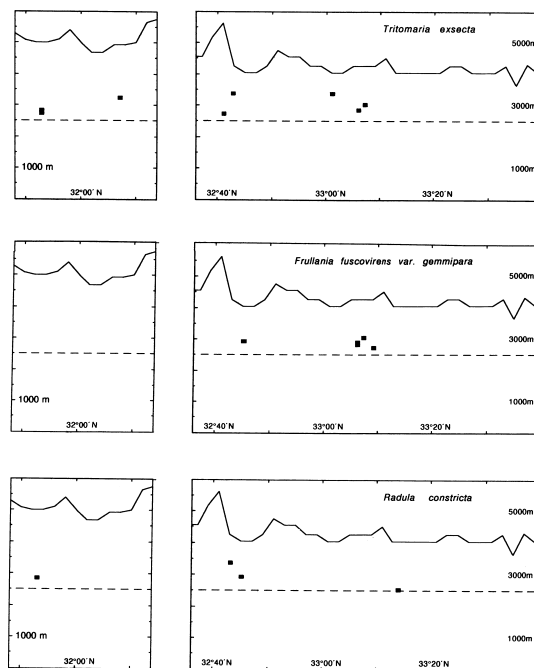


Fig. 3. Altitudinal distribution of *Tritomaria exsecta* (Schrad.) Loeske, *Frullania fuscovirens* Steph. var. *gemmipara* (Schust. & Hatt.) Hatt. & Lin, and *Radula constricta* Steph. in the Minshan and Qiong-Lai Ranges in Sichuan, China. Compare with Fig. 1.

A striking feature of the hepatic flora of north-western Sichuan is the presence of several hepatics which have a southern or even tropical range. Obviously they are here at the northern limit of their distribution, with their presence explained by the high air humidity. There is a corresponding element of moss species, e.g. several species of Meteoriaceae are present in the neighboring Wolung area (Koponen & Luo 1992).

Acrolejeunea pycnoclada
Metzgeria consanguinea
M. lindbergii

Material and methods

This work is mainly based on ca. 2 500 collections made by T. Koponen in 1991 in Sichuan (specimens deposited in H). In the identification of this material we used monographs published on East Asiatic bryoflora, and in the groups not yet monographed we relied largely on original materials from China, previously identified and published.

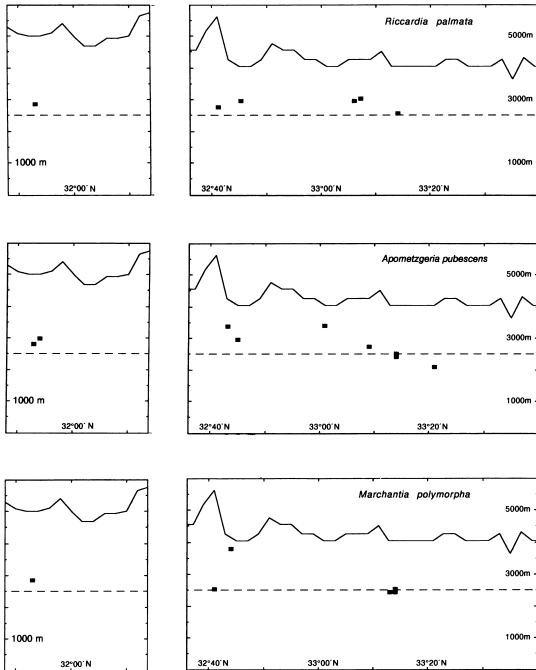


Fig. 4. Altitudinal distribution of *Riccardia palmata* (Hedw.) Carruth., *Apometzgeria pubescens* (Schrank.) Kuwah., and *Marchantia polymorpha* L. in the Minshan and Qiong-Lai Ranges in Sichuan, China. Compare with Fig. 1.

List of localities

The specimens are cited in the order of collecting localities given below (Fig. 1):

China. NW Sichuan. Minshan Range, Songpan Co., 9–12 and 18 September 1991.

- 1c. Valley of R. Fujiang 0.5 km S of Jiangxin village. Orotemperate deciduous forest with *Larix*, on steep slope, alt. 2 500–2 600 m, 32°41' N, 104°4' E.
4. Valley of R. Fujiang 2 km W of Huanglong village. Orohemiboreal deciduous forest with *Larix*, *Abies* and *Picea*, in valley on SW slope, alt. 2 700–2 750 m, 32°41' N, 104°04' E.
- 5c. Valley of R. Fujiang 3 km E of Huanglong hotel. *Picea–Salix–Juniperus* rich fen, alt. 2 900 m, lower oroboreal zone, 32°45' N, 103°52' E.
- 5d. As 5c, but: Lower oroboreal *Picea–Abies* forest with *Acer*, *Lonicera*, *Salix* and *Rosa*, alt. 2 900–2 930 m.
- 6a. Huanglong Temple. Upper oroboreal *Betula utilis–Rhododendron watssonii–Juniperus* forest on E slope 1 km from the main temple, alt. 3 370 m, 32°43' N, 103°50' E.

- 6c. As 6a, but: Upper oroboreal *Betula utilis–Larix–Sorbus–Rhododendron watssonii* forest 1 km NW of the main temple, alt. 3 350 m.
- 7c. Er-Dao-Lin at 93 km from Nanping City. Middle oroboreal *Picea–Abies* forest, alt. 3 300–3 350 m, 33°01' N, 103°42' E.
- 8a. Headwaters of R. Fujiang at Xue-Shan Pass. Pastured meadow with low scrub (*Juniperus*, *Berberis*, *Rhododendron*) and ferns along creek, alt. 3 600 m, orohemiarctic zone, 32°44' N, 103°46' E.
9. 1.5 km W of Xue-Shan Pass. Pastured sloping meadows and cliffs on N slope, alt. 3 760–3 800 m, orohemiarctic zone, 32°44' N, 103°46' E.

China. NW Sichuan. Minshan Range, Nanping Co., 14–20 September 1991.

- 11a. Valley of R. Bai-shui, Linjiang Village. Orotemperate deciduous forest (e.g. *Quercus*, *Tilia*) 2 km S of the village, alt. 1 800 m, 33°25' N, 104°04' E.
- 14b. Valley of R. Bai-He, Long-Kan Village 13 km NE of Jiu-Zhai-Gou. Orotemperate *Populus–Ulmus pumila*-mixed deciduous forest in ravine 1 km NE of the village, alt. 1 850–1 900 m, 33°21' N, 104°00' E.
- 14c. As 14b, but: Along trail in orotemperate deciduous forest (*Pinus* cut off) 1.5 km NE of the village, alt. 1 950 m, 33°21' N, 104°00' E.
- 14d. As 14c, but: Orotemperate deciduous forest with *Pinus*, *Abies* and *Juniperus*, on dry slope 3 km NE of the village, alt. 2 000–2 050 m.
- 14e. As 14d, but: Mesic orotemperate deciduous (*Ulmus pumila*, *Acer*, *Tilia*, *Quercus*) forest with *Abies* on steep slope 3 km NE of the village, alt. 2 050–2 100 m.
- 19c. Bai-He River valley 70 km SW of Nanping City and 1 km NE from Jiu-Dao-Guai Bridge. Orotemperate deciduous forest with *Pinus*, *Picea* and *Abies*, alt. 2 350–2 400 m, 33°13' N, 103°45' E.
- 19d. As 19c, but: 2 km NE from Jiu-Dao-Guai Bridge. Orotemperate deciduous (e.g. *Betula utilis*) forest with *Pinus*, alt. 2 400–2 480 m, 33°14' N, 103°46' E.
- 19e. As 19c, but: 3 km NE of Jiu-Dao-Guai Bridge. Orotemperate *Betula utilis–Fraxinus–Prunus–Tilia* forest, alt. 2 480–2 510 m, 33°14' N, 103°46' E.
20. Jiu-Zhai-Gou, Ze-Zha-Wa-Gou, orohemiboreal deciduous (e.g. *Betula*) forest with *Abies* and *Pinus*, alt. 2 700 m, 33°09' N, 103°55' E.
- 21b. Jiu-Zhai-Gou, Ze-Zha-Wa-Gou, Lake Chang-Hai. Lower oroboreal *Picea–Abies–Betula utilis–Juniperus–Acer–Rhododendron* forest at SE shore of the lake, alt. 2 850 m, 33°06' N, 103°55' E.
- 22b. Jiu-Zhai-Gou, Ri-Zie-Gou, Natural Forest Reserve. Lower oroboreal *Picea–Larix–Abies–Acer–Philadelphus–Sorbus–Ulmus* forest, alt. 2 900 m, 33°06' N, 103°52' E.
- 24a. Bai-He River valley 88 km SW of Nanping City. Lower oroboreal *Picea* forest, alt. 3 000 m, 33°07' N, 103°43' E.

China. NW Sichuan. North of Qiong-Lai Range, Ma-Er-Kang Co., 22–23 September 1991.

- 25b. Valley of R. Suo-Mo at 49 km E of Ma-Er-Kang City. Orohemiboreal deciduous (e.g. *Betula*) forest with *Picea* and *Abies* (both mostly cut), at river, alt. 2 600 m, 31°53'N, 102°38'E.
- 26b. Valley of R. Suo-Mo at 38 km W of Shua-Jin Temple. Orohemiboreal deciduous forest with *Picea* and *Abies* (both mostly cut), at river, alt. 2 800 m, 31°53'N, 102°27'E.
- 27b. Valley of R. Suo-Mo at 6 km W of Shua-Jin Temple. Heavily cut and pastured lower oroboreal *Betula*–*Sorbus* forest with young trees of *Abies* and *Picea*, alt. 3 000 m, 31°54'N, 102°38'E.

China. NW Sichuan. Hongyuan Co. Shua-Jin Temple, 22 September 1991.

- 28b. Si-Da-Lang-Gou at 150 km. Along small stream in middle oroboreal *Picea* (mostly cut)–*Salix*–*Sorbus*–*Hippophaë* forest on E slope, alt. 3 200 m, 32°07'N, 102°33'E.

THE HEPATICS OF THE PRESENT STUDY

(* = new for Sichuan)

Herbertaceae

**Herbertus sakurii* (Warnst.) Hatt.

6c. 45515. 26b. 47383. — On cliff. — Distribution area disjunct; in Japan, the Himalayas, China, Taiwan, arctic Alaska, Scotland, and Norway (Schuster 1983, Piippo 1990). From China previously known from Xizang, Anhui, and Taiwan (Piippo 1990).

Pseudolepicoleaceae

Blepharostoma trichophyllum (L.) Dum.

5d. 45167 with *Lepidozia reptans*. 7c. 47059 with *Tritomaria exsecta*. 19d. 46767 with *Scapania parva*, 46768 with *Pedinophyllum truncatum*. 19e. 46909 with *Plagiochila delavayi*, 46910; 46913 with *Chiloscyphus profundus*. 22b. 46254 with *Plagiochila delavayi*, 46257; 46277 with *Trichocolea tomentella*, 46304 with *Lepidozia reptans*. 28b. 47198 with *Anastrophyllum michauxii*, 47200 with *Riccardia palmata*. — On fallen rotten logs and stumps. — Temperate and boreal in the northern hemisphere, also in many tropical areas such as Costa Rica, Venezuela, Colombia, Peru, East Africa, Java, the Philippines, and Papua New Guinea (cf. Gradstein & Váňa 1987). Common

throughout China (cf. Piippo 1990). Oroboral and upper parts of the orotemperate zone in Sichuan (Fig. 2).

Trichocoleaceae

**Trichocolea tomentella* (Ehrh.) Dum. s. lat.

22b. 46258, 46277. — On fallen rotten trunks. — Wide-spread both in northern but also in the southern hemisphere. Widely distributed in southeast Asia (Kitagawa 1973). Previously known in China from Xinjiang, Xizang, Shaanxi, Heilongjiang, Yunnan, Hainan, Fujian, Zhejiang, and Taiwan (Piippo 1990).

Lepidoziaceae

Bazzania bidentula (Steph.) Steph.

6c. 45571. On boulder. — A southeast Asiatic species (cf. Hattori & Mizutani 1958).

Lepidozia reptans (L.) Dum.

4. 45330 with *Chiloscyphus profundus*, 45355, 45360; 45397 with *Lophozia incisa*. 5d. 45130, 45132, 45167, 45170, 45231. 6a. 45662b. 7c. 47059, 47060 with *Tritomaria exsecta*. 19e. 46910 with *Blepharostoma trichophyllum*, 46917, 46971. 20. 46121. 21b. 46062. 22b. 46257 with *Blepharostoma trichophyllum*, 46305, 46304, 46307, 46327. 26b. 47260 with *Lophozia incisa*. 28b. 47200 with *Riccardia palmata*. — On stumps and fallen rotten logs. — The leaf cells have distinct even though small trigones. In European material the trigones are not mentioned. According to Schuster (1969), the trigones are obscure. — Circumboreal, extending south in China, Japan, and Taiwan (Schuster 1969), but also occurring in northern parts of tropical America (Gradstein & Váňa 1987). Oroboral in Sichuan according to this material (Fig. 2).

Calypogeiaceae

**Calypogeia neesiana* (Mass. & Car.) K. Müll. (Fig. 5)

C. cordistipula (Steph.) Steph., Spec. Hep. 3: 400. 1908. — *Cincinnulus cordistipulus* Steph., Mem. Soc. Nat. Sci. Nat. Cherbourg 29: 210. 1894, *syn. nov.* — Type: China. Yunnan, Hokin, Col de Yentze-hay, *Delavay 1623*, hb. Bescherelle (G-10811!). 21b. 46095. In cliff crevice. — Circumboreal, also in Japan and China (cf. Schuster 1969, Konstantinova *et al.* 1990, Smith 1990). Previously known in China from Anhui, Yunnan, and Taiwan (Piippo 1990).

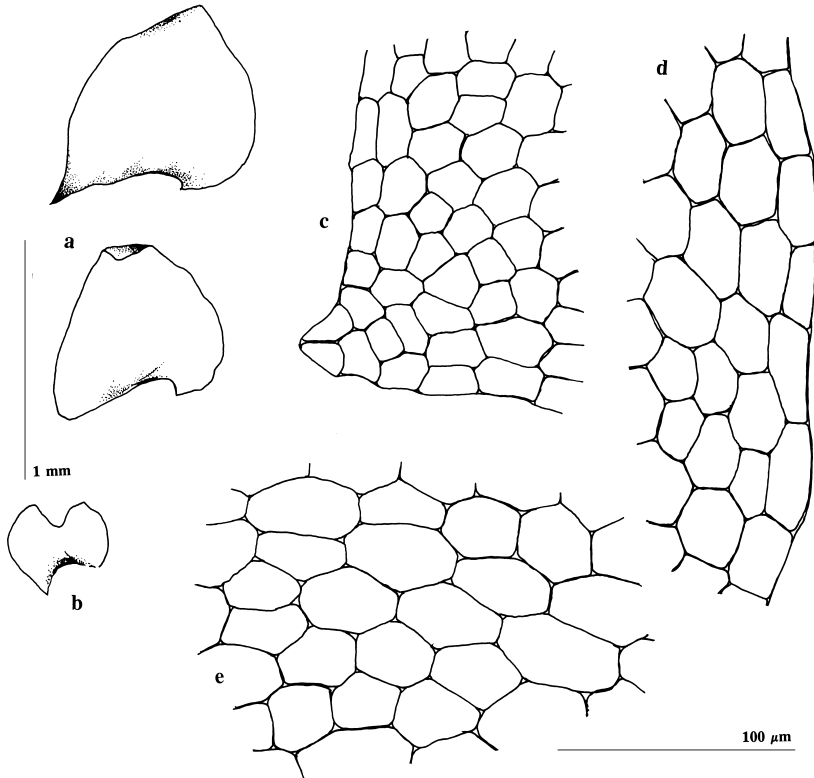


Fig. 5. *Calypogeia neesia* (Mass. & Car.) K. Müll. — a: Leaves. b: Underleaf. c: Cells from apical portion of leaf. d: Cells from the leaf margin. e: Cells from middle portion of leaf. — Drawn from the type of *C. cordistipula* (Steph.) Steph.

Jungermanniaceae (det. by J. Váňa)

* *Jungermannia pyriflora* Steph.

27b. 47480, 47490. — On soil. — Known from Japan, Korea, China, Taiwan, and the Southern Appalachians of North America (cf. Váňa & Inoue 1983). Known previously in China from Xizang, Jilin, and Taiwan (Piippo 1990).

Lophoziaaceae

* *Anastrophyllum michauxii* (F. Web.) Buch

28b. 47198. On stump root. — Almost circumpolar, extending to Japan and China (Schuster 1969). Known previously in China from Shaanxi and Yunnan (Piippo 1990).

Jamesoniella autumnalis (DC.) Steph.

24a. 47114, 47157. — On fallen rotten trunks. — Eurasia, North America, and Venezuela, Colombia, Dominican Republic, Central America, Philippines, and N Borneo (Gradstein & Váňa 1987).

Lophozia incisa (Schrad.) Dum.

4. 45397. 5c. 45053. 6a. 45623. 20. 46136b, 46152. 21b. 46014b, 46024, 46065. 26b. 47260. — On stumps, fallen rotten trunks, and sometimes on soil. — Circumboreal, extending to Japan, China, Taiwan, the Himalayas, Korea, and Sakhalin (Schuster 1969), but also occurring in Central America and northern parts of tropical America (Gradstein & Váňa 1987). In China known from the Himalayas (Xizang, Sichuan, and Yunnan) and Taiwan (Piippo 1990). Oroboreal in Sichuan, according to this material (Fig. 2).

* *Tritomaria exsecta* (Schrad.) Loeske

4. 45397 with *Lophozia incisa*. 6a. 45662b with *Lepidozia reptans*. 7c. 47059, 47060. 19d. 46768 with *Pedinophyllum truncatum*. 21b. 46014b, 46065 with *Lophozia incisa*. 24a. 47114 with *Jamesoniella autumnalis*, 47118b, 47125. 25b. 47453b, 47465. 26b. 47255. 28b. 47216b, 47224. — On fallen rotten trunks and stumps, on soil among *Pogonatum*, and on boulder among *Dicranaceae*. — Holarctic extending to the Himalayas, China, Taiwan, Korea, Japan, and Borneo, Philippines, East Africa, and Mexico (Schuster 1969, Gradstein & Váňa 1987). Previously known in China from Xizang, Shaanxi, Heilongjiang, Jilin, Yunnan, and Taiwan (Piippo 1990). In Sichuan it occurs in oroboreal and upper parts of the orotemperate zone (Fig. 3).

Scapaniaceae*Scapania contorta* Mitt.

21b. 46089. In cliff crevice. — Occurs in Sikkim and in Sichuan of China (Grolle 1966).

S. ferruginea (Lehm. & Lindenb.) Gott. *et al.*

6c. 45527b. On cliff. — The species is known from the Himalayas and Java (Amakawa 1964). Thus far known in China only from Sichuan and Taiwan.

* *S. massalongii* (K. Müll.) K. Müll.

22b. 46257 with *Blepharostoma trichophyllum*. 24a. 47116, 47120, 47121, 47133. — On fallen rotten trunks and stumps. — The marginal leaf cells are thick-walled, forming a border as in *S. carinthiaca* Jack ex Lindb. According to Schuster (1974), the gemmae are 1-celled, in contrast with *S. glaucocephala* (Tayl.) Aust., which has 2-celled gemmae. Both *S. massalongii* and *S. carinthiaca* seem, however, to have 2-celled gemmae, according to Schuster's illustrations; and *S. glaucocephala* both 1- and 2-celled gemmae. Schuster distinguishes *S. carinthiaca* from *S. massalongii* by usually entire-margined leaves and elongated marginal cells, versus the sparingly toothed margins and almost isodiametric marginal cells of *S. massalongii*. The Chinese material tends to fall into *S. massalongii*. — A Eurasian species (see Schuster 1974). Thus far known in China only from Heilongjiang (Piippo 1990).

* *S. parva* Steph.

19d. 46767, on fallen rotten trunk. 21b. 46099, in cliff crevice. — The species is known from the Himalayas and China (Amakawa 1964). Previously known in China from Xizang, Shaanxi, Anhui, and Yunnan (Piippo 1990).

Geocalyceaceae* *Chiloscyphus itoanus* (H. Inoue) Engel & Schust. (Fig. 6)

19d. 46746. On cliff. — Known previously from Japan and southern Korea (Inoue 1974). Reported for the first time for China.

* *C. minor* (Nees) Engel & Schust.

5c. 45065. 19d. 46714b. 25b. 47419 with *Riccardia palmata*. 26b. 47355. 27b. 44893b, 47491. — On soil, humus

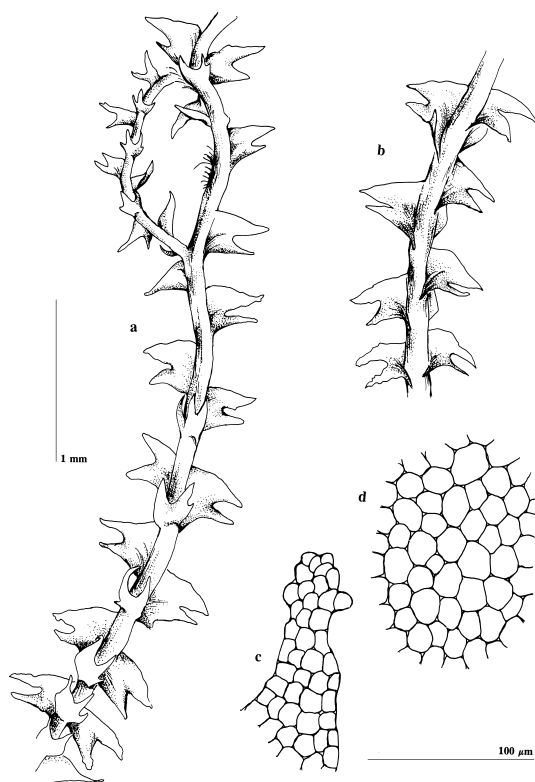


Fig. 6. *Chiloscyphus itoanus* (H. Inoue) Engel & Schust. — a: Habit from ventral side. b: Habit from dorsal side. c: Cells and gemmae from apical portion of leaf. d: Cells from middle portion of leaf. — Drawn from Koponen 46746.

and peat, on a trunk of a deciduous tree, fallen rotten log, and on a fallen decaying trunk of *Betula*. The specimen 44893b is peculiar in having no gemmae. — Imperfectly holarctic extending to the Himalayas, China, and Japan (Schuster 1980). Known previously in China from Xizang, Heilongjiang, Jilin, Liaoning, Anhui, Jiangsu, Hunan, Zhejiang, and Taiwan (Piippo 1990). In Sichuan in the oroboreal zone and upper part of the orotemperate zone (Fig. 2).

* *C. profundus* (Nees) Engel & Schust.

4. 45330. 19e. 46913b. 22b. 46257 with *Blepharostoma trichophyllum* etc., 46326b with *Riccardia palmata*. — On fallen rotten logs and stumps. — Warm-temperate and boreal but extending to Cuba (Gradstein & Vána 1987). Known previously in China from Xizang, Heilongjiang, Jilin, Liaoning, Anhui, Jiangsu, Zhejiang, and Taiwan (Piippo 1990).

Plagiochilaceae*Pedinophyllum truncatum* (Steph.) Inoue

14d. 46586 (det. J. Váňa). 19d. 46768. — On humus and fallen rotten log. — Occurs in Japan and China (Inoue 1974, Schuster 1983, Piippo 1990).

* *Plagiochila debilis* Mitt.

4. 45377. On trunk of *Abies*. — Known from Sikkim and China (Inoue 1965). Previously known only from Yunnan in China (Piippo 1990).

P. delavayi Steph.

5c. 45069, 45092. 5d. 45104, 45143, 45134, 45217. 6a. 45604; 45662b with *Lepidozia reptans*, 45661. 6c. 45533b, 45534, 45567. 8a. 45793. 19d. 46766, 46771. 19e. 46909, 46928. 20. 46141, 46161, 46163. 21b. 46044, 46066. 22b. 46254, 46290, 46308. 24a. 47113b. 27b. 44867, 47471, 47475; 47491 with *Chiloscyphus minor*. 28b. 47223. — On fallen rotten trunks, stumps, roots, trunk of *Rhododendron* and *Betula*, boulders, cliff crevice and soil. — A Chinese endemic, known from Shaanxi, Sichuan, and Yunnan (Piippo 1990). Occurs in orotemperate and oroboreal zones in Sichuan.

* *P. wilsoniana* Steph.

4. 45353. 5d. 45118. 6c. 45535 (cf.). 19d. 46747. 25b. 47401, 47447. 26b. 47367. — On boulders, cliff crevice and humus. — Previously known only from Hebei and Yunnan in China (Piippo 1990).

Radulaceae*Radula constricta* Steph.

5d. 45179. 6a. 45643. 6c. 45339. 19e. 46819. 26b. 47306. 27b. 44883, 44899, 44900. 28b. 47206. — On tree trunks (*Abies*, *Lonicera*, *Salix*, *Sorbus*, *Picea*) and on boulders. — Known from India, Nepal, Korea, Japan, Taiwan, and China (Yamada 1979). Occurs in oroboreal zone in Sichuan (Fig. 3).

R. tokiensis Steph.

5d. 45187, 45204. — On *Abies*. — Known previously only from Taiwan, Korea, and Japan (Yamada 1979).

Porellaceae*Porella caespitans* (Steph.) Hatt.

14e. 46487, 46490. — On cliff. — China, Indo-China, Bhutan, the Himalayas, India (Hattori 1978).

P. caespitans var. *cordifolia* (Steph.) Hatt.

4. 45323. 14e. 46419. 22b. 46288. 25b. 47386. — On boulders, trunk of *Betula* and fallen rotten log. — India, Nepal, China, Taiwan, Korea, and Japan (Hattori 1978 as var. *setigera* (Steph.) Hatt.).

P. caespitans var. *nipponica* Hatt.

14e. 46427, 46450, 46452. 19e. 46872. — On trunks of *Ulmus pumila*, *Prunus*, and *Tilia*. — Japan, China, Taiwan, Bhutan, Nepal, and India (Hattori 1978).

P. chinensis (Steph.) Hatt.

1c. 45250, 45262, 45268, 45418. 5d. 45205b, 45237. 25b. 47394. — On base trunks of *Abies*, *Acer* or other trees, fallen rotten log or cliff. — China, NW India, E Siberia (Hattori 1978).

* *P. oblongifolia* Hatt.

25b. 47442. — On humus. — Japan, Korea, China, and E Siberia (Hattori 1978).

* *P. revoluta* (Lehm. & Lindenb.) Trev. var. *propinqua* (Mass.) Hatt.

4. 45395. — On trunk of *Betula*. — India, Nepal, Sikkim, Bhutan, and China (Hattori 1978). Known previously in China from Xizang, Shaanxi, and Yunnan (Piippo 1990).

Frullaniaceae*Frullania davurica* Hampe

26b. 47262, on stump. — Known from SE Siberia, Korea, China, and Japan (Hattori & Lin 1985). The species is common all over China (cf. Piippo 1990).

F. davurica subsp. *jackii* (Gott.) Hatt.

5d. 45173, on *Abies*.

F. davurica subsp. *jackii* fo. *dorsoblastos* (Hatt.) Hatt. & Lin

26b. 47336, 47372, 47373. 27b. 44889, 44890. — On cliffs and river banks. — Known from W China (Hattori & Lin 1985).

* *F. fuscovirens* Steph. var. *gemmipara* (Schust. & Hatt.) Hatt. & Lin

5c. 45098. 5d. 45110. 20. 46171, 46187. 21b. 46052, 46077. 22b. 46339. 24a. 47143. — On fallen decaying trunks, bush, on trunks, e.g. of *Picea*, *Tsuga*, and *Abies*. — Previously known only from Yunnan (Piippo 1990). It occurs in the oroboreal zone in Sichuan (Fig. 3).

* *F. inflata* Gott.

14b. 46667, on boulder. — North America, Europe (N Italy), Japan, Korea, India, and China (Hattori & Lin 1985). Previously known only from Hubei, Jiangsu, and Yunnan (Piippo 1990).

* *F. inouei* Hatt.

4. 45394, on *Betula*. 26b. 47327, on branch of *Sorbus*. — Previously known only from Taiwan.

F. moniliata (Reinw. et al.) Mont.

25b. 47457, 47467, on boulders. — Soviet Far East, Japan, Korea, China, India, Indo-China (Hattori & Lin 1985). Common in China (cf. Piippo 1990).

F. muscicola Steph.

5d. 45183. 14b. 46656, 46657. 26b. 47303. On *Abies* and *Populus*. — China, India, Korea, Japan, Sakhalin, Mongolia (Hattori & Lin 1985). Common in China (cf. Piippo 1990).

F. obovata Hatt.

6c. 45476, on trunk of *Salix*. — Known only from Sichuan in China.

F. rhytocollea Herz.

5d. 45111. 19e. 46890b. 20. 46226b, 46227. 27b. 44895, 44897, 47436b, 47474. — On *Abies*, *Betula*, bush, and on stump. — Known only from Xizang, Sichuan, and Yunnan in China (Piippo 1990). Also reported from Bhutan (Hattori & Lin 1985).

* *F. tamarisci* (L.) Dum.

6c. 45538. 21b. 46041. — On cliff and on trunk of *Betula utilis*. — North America, Europe, India, SE Asia, Sakhalin, and Japan (cf. Schuster 1983). In China the species is known from Shaanxi, Anhui, Jiangsu, Zhejiang, and Taiwan, and the var. *vietnamica* (Hatt.) Hatt. from Sichuan and Yunnan (Piippo 1990).

F. zangii Hatt. & Lin

26b. 47298, on deciduous tree. — The species is known only from Sichuan and Yunnan (Piippo 1990).

Lejeuneaceae*Acrolejeunea pycnoclada* (Tayl.) Schiffn.

19d. 46715, on fallen *Betula*. — Occurs in tropical Africa, Indo-Malesia, and Pacific (Gradstein 1975). Known previously only from Guangdong in China (Piippo 1990).

* *Cololejeunea ornata* Evans

14e. 46464, on cliff. — North America, Japan, and China. Previously known only from Anhui in China.

Lejeunea parva (Hatt.) Mizut.

20. 46146, on *Abies*. — Known from Xizang, Anhui, Guangdong, Hainan, and Taiwan in China (Piippo 1990).

Pallaviciniaceae* *Pallavicinia lyellii* (Hook.) Carruth.

1c. 45405, on cliff. — Subcosmopolitan (Grolle & Piippo 1986). Known previously in China from Liaoning, Yunnan, Guizhou, Hunan, Guangdong, Hainan, Zhejiang, and Taiwan (Piippo 1990).

Aneuraceae* *Aneura pinguis* (L.) Dum.

19e. 46883, on recently fallen *Fagus* (?). — Cosmopolitan. Known previously in China from Jilin, Yunnan, Guizhou, Hainan, Zhejiang, and Taiwan (Piippo 1990).

* *Riccardia palmata* (Hedw.) Carruth.

4. 45330 with *Chiloscyphus profundus*. 5d. 45130 with *Lepidozia reptans*, 45199. 19e. 46910 with *Blepharostoma trichophyllum* and *Lepidozia reptans*. 46916. 22b. 46257 with *Blepharostoma trichophyllum* etc., 46326b. 24a. 47133 with *Scapania massalongii*. 25b. 47419. 27b. 47509, 47522b. 28b. 47197b, 47200. — On fallen rotten logs and stumps, occasionally on trunk. — From boreal to temperate and subtropical regions (Schuster 1992a). Known previously in China from Yunnan, Hunan, Fujian, Zhejiang, and Taiwan (Piippo 1990). In Sichuan in oroboreal zone (Fig. 4).

Metzgeriaceae*Apometzgeria pubescens* (Schrank.) Kuwah.

5d. 45104 with *Plagiochila delavayi*, 45143 with *P. delavayi*. 6a. 45605. 7c. 47023, 47052, 47091. 14e. 46500, 46558. 19d. 46744; 46746 with *Chiloscyphus itoanus*. 19e. 46861, 46864, 46926. 20. 46215. 26b. 47255 with *Tritomaria exsecta*, 47258. 27b. 47531b. — On cliff, trunk of *Rhododendron*, *Prunus*, *Acer*, or *Abies*, on bush, on fallen rotten tree or branch, stump or soil. — Bipolar, occurring in Eurasia and North America and southern South America (Schuster 1983). Common in China (cf. Piippo 1990). In Sichuan in oroboreal and orotemperate zones (Fig. 4).

* *Metzgeria consanguinea* Schiffn.

19e. 46921. 25b. 47404. 27b. 44896. — On soil, boulder, and fallen rotten log. — Eastern Himalayas, Sri Lanka, Indonesia, New Guinea, tropical Africa, and South America (cf. Kuwahara 1986). Given for China by Piippo (1990).

M. leptoneura Spruce

4. 45373. 26b. 47261. — On humus and stump. — Almost world-wide (Piippo 1991).

* *M. lindbergii* Schiffn.

6a. 45604 with *Plagiochila delavayi*. 22b. 46262b. 25b. 47402. 27b. 47513. — On soil and on tree trunks (e.g. *Acer*

and *Rhododendron*). — Asia and tropical Oceania (Piippo 1991). Previously known from China in Xizang, Yunnan, and Taiwan (Piippo 1990).

Aytoniaceae*Reboulia hemisphaerica* (L.) Raddi

11a. 45921. 26b. 47316. — On soil and cliff. — Cosmopolitan (Schuster 1992b). Known from many provinces of China (cf. Piippo 1990).

Marchantiaceae*Marchantia polymorpha* L.

1c. 45254, 45263b, 45283, 45285. 9. 45750. 19c. 46989. 19d. 46720. 19e. 46847, 46852, 46892. 26b. 47274. — On cliffs, soil, boulders, and occasionally tree trunk. — Almost cosmopolitan (cf. Bischler-Causse 1989). In Sichuan in oroboreal and orotemperate zones (Fig. 4).

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