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Bryophyte flora of Hunan Province, China. 1. Bryophytes from Mangshan Nature Reserve and Wulingyuan Global Cultural Heritage Area

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This is the first paper of a series dealing with the bryoflora of Hunan Province in China. The vegetation, geology and geological history of Mangshan Nature Reserve and Wulingyuan Global Cultural Heritage Area are described and the collecting sites of the 1997 and 1999 bryological expeditions there are listed. Our 1 000 specimens studied so far represent 55 genera and 105 species in 28 families. A total of 19 genera, 3 species of Anthocerotae, 20 species of hepatics, and 46 species of mosses are for the first time recorded for the Hunan Province. *Diplophyllum serrulatum* (Müll. Frib.) Steph., *Lopholejeunea brunnea* Horik., and *Metzgeria albinea* Spruce are for the first time recorded for mainland China. *Atrichum subserratum* (Hook.) Mitt. extends its range from the Himalayas to Central Chinese mountains, and *Dicranodontium asperulum* (Mitt.) Broth. has a disjunct occurrence in Hunan between the Himalayas and Taiwan.

Key words: Anthocerotae, China, distribution, flora, habitat ecology, Hunan, liverworts, mosses, taxonomy

CONTENTS

INTRODUCTION

This is the first and introductory paper of a series dealing with the bryoflora of Hunan Province in China. We collected the material during a series of excursions, three of which were completed in 1997, 1998, and 1999. A checklist of Hunan bryophytes was prepared and published (Rao *et al.* 1997) before the current field work. Only a part of the 1997 collections is published in this first contribution.

Hunan Province of China

Hunan is located to the south of the middle reaches of the Yangtze River, in the south central part of China (Fig. 1). Geologically it lies mainly in the southern section of the "second platform". Hunan, whose name literally means "lake-south", is so called because much of its land area is situated south of Dongting Hu, the second largest lake in China. The province spans an area of 211 829 km^2 between 24°39´–30°08´N and 108°47´–114°15´E. The population of the province has doubled since 1949 and reached 61.1 million in 1990.

The local primeval vegetation type is evergreen broad-leaved forest, with its upper border at 1 200–1 400 m in the south and at 500–800 m in the north. The dominant components of the forests consist of species of Fagaceae, Lauraceae, Magnoliaceae, and Theaceae, and the lower layer is mainly formed of species of *Eurya, Lindera, Litsea, Neolitsea, Rhododendron,* and *Vaccinium.* There are 69 species of gymnosperms, 3 904 species of angiosperms, and 351 species of pteridophytes recorded in Hunan Province. Among them, 51 species are regarded as endangered, including some remarkable species such as *Cathaya argyrophylla*, *Davidia involucrata, Metasequoia glyptostroboides*, *Pseudotaxus chienii*, etc. The number of mammals species is estimated at 127, and that of insects at ca. 10 000.

Hunan is rich in picturesque natural landscapes. The first national park of China, Zhangjiajie National Forest Park, listed as a Global Cultural Heritage, is located in the north part of the province. Since 1982, 31 nature reserves have been established with a total area of 400 000 hectares in Hunan. Four of them are national.

Studies on the bryoflora

The vascular plant flora of Hunan is comparatively well known but the bryophyte flora is inadequately known. According to Rao *et al.* (1997), only 269 bryophytes (197 mosses, 69 hepatics, 1 hornwort) have been previously reported from the province. The aim of this project is to increase that knowledge, to study the taxonomy, distribution, and habitat ecology of the bryophyte species, and the phytogeographical relationships of the bryoflora. Since the material was mostly collected in conserved areas, our results will be useful in nature conservation and for planning of ecotourism. The project aims at establishing a cryptogamic herbarium in the Hunan Forestry Botanical Garden.

In this first paper a general introduction to two of the collecting areas is given, with a listing of the collections of some bryophyte families and genera, which were familiar to us on the basis of our previous studies.

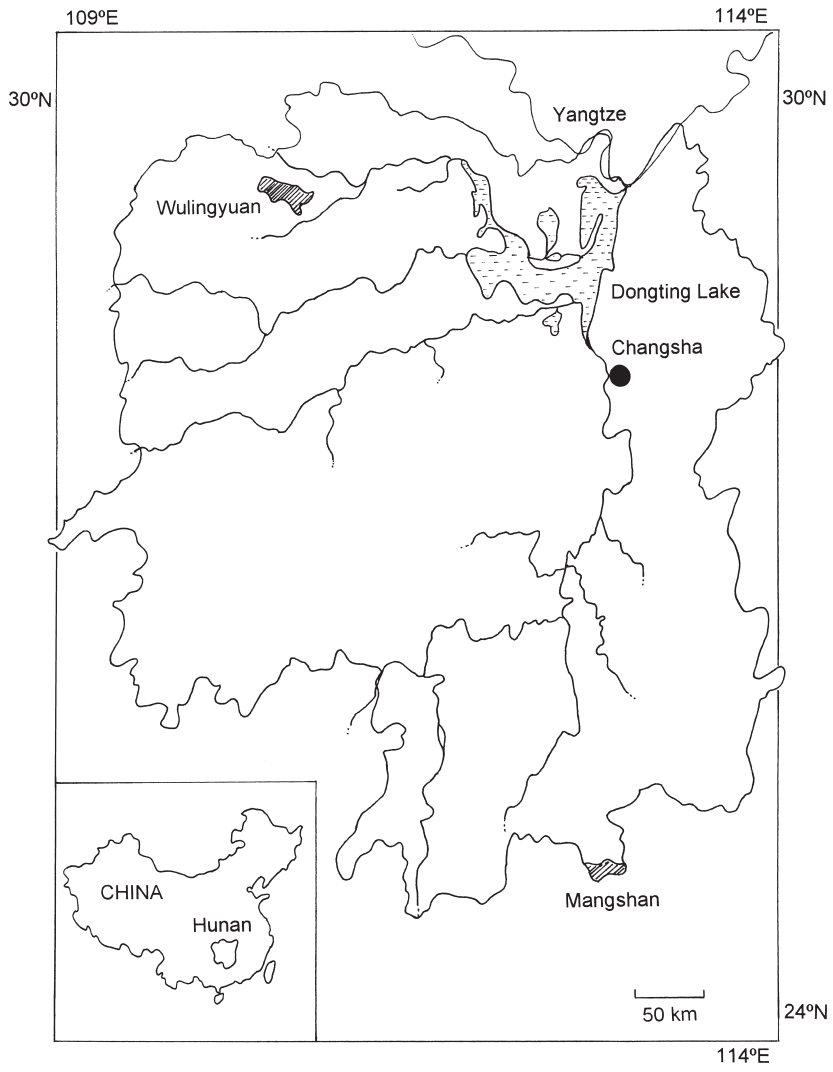

Fig. 1. Map of Hunan Province and the location of Changsha City (collecting locality 1), Mangshan Nature Reserve, and Wulingyuan Cultural Heritage area.

STUDY AREAS (by P. Rao)

Mangshan and Wulingyuan are located in the southernmost and the northwestern part of the Hunan Province, respectively (Fig. 1). Mangshan, between 112°43´19´´–113°0´10´´E and 24°52´0´´–25°3´12´´N, borders on Guangdong Province. It has a total area of ca. 200 km^2. Wulingyuan consists of the Zhangjiajie National Forest Park, the Suoxiyu Nature Reserve, and the Tianzishan Nature Reserve, together covering an area of 500 km^2, 110°22´30´´–110°41´15´´E and 29°16´25´´–29°24´25´´N. Because of its peculiar topography, secondary primeval forest, rich wildlife resources, and picturesque landscape, Wulingyuan has been selected as one of the Global Cultural Heritage areas. Both areas are hot spots of biodiversity conservation in China. A brief description of their tectonic histories and vegetation is given below.

There is no detailed account of the geology of Mangshan and Wulingyuan. A summary of Hunan nature was given by Deng *et al.* (1994), which is our main source of information. The vascular plant floras and vegetation are fairly well known for both areas. The cryptogams — algae, bryophytes, fungi, and lichens — and their presence in plant associations are practically unknown.

Fig. 2. Core area of Mangshan Nature Reserve, collection site 7b. Mountain top covered by *Pinus kwangtungensis* and *Fokienia hodginsii*. Photo Timo Koponen.

Mangshan Nature Reserve

Geology

Mangshan (Fig. 2) was a part of the Xiangnan (southern portion of Hunan) geosyncline in the Proterozoic, while the northwest portion of Hunan was a platform at that time. From the early Cambrian to Silurian, sea ingressions were frequent and sandy sediments covered the area; complex sandy marble was gradually formed. Later, the Caledonian orogenies folded this area and ended the development of geosyncline in this region. Sea ingression continued until the later stages of the Triassic. The climate by then was damp and hot tropical. Subsequently plants such as ferns and gymnosperms began to dominate the area. Afterwards, because of the influence of Indo-China tectonic movement, the whole province was lifted and this ended the marine phase.

From the Jurassic to the Tertiary, the movement of Yanshan moulded the basic topological sketch of the province. Angiosperms, such as species of Fagaceae, Lauraceae, Magnoliaceae, Myrtaceae, Palmaceae, Proteaceae, Rutaceae, and Ulmaceae were dominant; also *Ephedra* was once a dominant genus. The subsequent Himalayan orogeny continuously listed the crust of this region and lowered the Dongting Basin in the northern part of Hunan. The Nanling Mountain Range, running from west to east mainly along the border between Hunan, Jiangxi (in the north) and Guangxi, Guangdong (in the south), was gradually formed. One of its highest peaks, Mengkengshi, is in Mangshan. The terrain and water systems became as they appear today.

Lithological studies have revealed that Mangshan has large expanses of Nanling granite, metamorphic rocks, and sandstone. Among them, some red-colored rocks can be seen. "Mangshan Hong" is one of them, famous for its beautiful reddish grains.

Vegetation

In the vegetational division of China (Wu *et al.* 1980), Mangshan belongs to the *Castanopsis–Altingia* Forest Domaine of the Nanling Hilly Area (coded IVAiib-2), southern sub-zone of mid-subtropical evergreen forest zone. The annual mean temperature is 18–21.1 °C, the mean temperature of the coldest month (January) is 8–10 °C, the minimum temperature is –2 to –6 °C, the maximum temperature is 36.2 °C, and the annual precipitation is 1 400–2 000 mm.

According to previous studies (Wu *et al.* 1980, Qi *et al*. 1987, Xiao 1993), 2 314 species belonging to 838 genera and 214 families of vascular plants are recorded for Mangshan. There is also an important paper by Cheng (1949)*, but we have not had access to it. Two hundred and fifty of the species (83 genera in 40 families) are pteridophytes, 39 species (23 genera in 8 families) gymnosperms, and 2 025 species (732 genera in 166 families) angiosperms. The dominant species (species numbers in parentheses) are mainly from Aceraceae (15), Aquifoliaceae (35), Fagaceae (65),

* Cheng, W.-J. 1949: An observation of the Mangshan forest of Southern Hunan. — *Science* (Beijing) 31(3).

Fig. 3. Wulingyuan World Heritage Area, Zhangjiajie, Huangshizhai. High rock peaks photographed from collection locality 14b. Photo Timo Koponen.

Hamamelidaceae (17), Lauraceae (72), Magnoliaceae (22), Rosaceae (80), Styracaceae (21), Symplocaceae (34), and Theaceae (72).

Wulingyuan Global Cultural Heritage Area

Geology

As a part of the northwest platform of Hunan, Wulingyuan had not experienced sea ingression until the late Devonian, when the continental crust of this region lowered. Sediments from neighbouring areas also moved to this area and, after a long time, formed thick layers of quartzite. Late in the Triassic, the tectonic Indo-China movement uplifted the area. The earlier Yanshan tectonic movement continued to uplift the crust of the province and surrounding areas. Long-term erosion removed most of the terrigenous sediments of the middle and late Jurassic layers. In the late Cretaceous, the Yuan-Ma basin of West Hunan was formed to the south of Wulingyuan. A slow uplift of this area continued, with the mountains and hills eventually reaching up to ca. 800–1 500 meters above sea level.

The tectonic history shows that this is a relative stable area. Bedrocks are mainly of thick quartz-arenaceous rocks, which have an average thickness of ca. 500 meters, with each layer more than 50 cm thick. The rocks slope gently and are thus tightly bound and not sliding down easily even after erosion of the thin layers of the contained fine-grained sandstone and mudstones. This is the current explanation for the evolution of the high rock peaks and the formation of the peculiar topography of this area (Fig. 3). Because of the relatively stable geological structure, many relic plants are found in this area.

Vegetation

Wulingyuan is a part of the *Castanopsis–Machilus* Forest Domaine of Three-Gorge and Wuling Hilly Area (coded IVAiia-5), northern sub-zone of mid-subtropical evergreen forest zone, according to Wu *et al.* (1980). Vegetation covers 97% of Wulingyuan. An inventory (Qi *et al.* 1987*)* recorded 1 637 species in 730 genera and 193 families of vascular plants from Suoxiyu alone, including 190 species of pteridophytes, 32 gymnosperms, and 1 415 angiosperms. Some taxonomically isolated taxa thrive in this area: *Bretschneidera sinensis, Ginkgo biloba, Davidia involucrata, Eucommia ulmoides,* and *Liriodendron chinensis*. In recent years, botanists have also found apparently new and evolving taxa in the area, such as *Carpinus dayongensis, Gynostemma pentagynum, Phyllostachys carnea, Pinus massoniana* var. *wulingensis, Stachyurus chinensis* var. *hypoleucus*, and *Yushania canoviridis*. Twenty families have more

than 20 species. They are Apiaceae (20), Asteraceae (76), Caprifoliaceae (25), Celastraceae (22), Cyperaceae (21), Euphorbiaceae (21), Fagaceae (26), Labiaceae (31), Lauraceae (44 sp.), Liliaceae (40), Orchidaceae (29), Papilionaceae (61), Poaceae (37), Polygonaceae (26), Ranunculaceae (31), Rosaceae (73), Rubiaceae (31), Rutaceae (20), Scrophulariaceae (24), and Vitaceae (23). The dominant species of the forest trees mainly belong in *Castanopsis, Cinnamomum, Cyclobalanopsis, Lithocarpus,* and *Machilus; Fagus*, *Lindera*, *Litsea,* and *Neolitsea* usually dominate the lower layers of the forest.

MATERIAL AND METHODS

The historical collections in the Botanical Museum, University of Helsinki (H) in our use contain the first comprehensive collection ever made in Hunan, by H. Handel-Mazzetti in 1918 (Rao *et al.* 1997) and identified by V. F. Brotherus (1929). Also other old material from China is well represented in the Brotherus Herbarium.

The present material for this study consists of ca. 4 000 specimens collected between 26 September and 12 October 1997, by T. Koponen, S. Huttunen and P. Rao in Mangshan Nature Reserve and Wulingyuan Global Cultural Heritage Area. A smaller collection was made by the aforementioned individuals on Mt. Yuelu in Changsha City. Standard collecting methods were used in the field, including recording the habitats and substrates by the method developed in the Hattori Botanical Laboratory (Iwatsuki 1970). This method favours rapid collecting of a rather large number of specimens in a short time. The specimens were labelled and curated in the Botanical Museum, University of Helsinki. The preliminary identification to genus and family was completed in February 1998. The persons who provided the specific identifications are the authors of this paper and their names are mentioned separately in connection with the taxa they identified.

Our records are given in a sequence of collecting areas and localities (listed below) and collecting numbers. Only one series of collecting numbers was used and the collectors are given on the labels in the order Koponen, Huttunen, Rao. We feel, it is significant to record all specimens even for those taxa which were frequently collected. This is the only method to document which taxa are common and which are rare in the study areas, since we have not yet reached the ability to identify all the taxa in the field. Complete sets of the specimens will be kept in the herbarium of the Hunan Forest Botanical Garden and in the Botanical Museum, University of Helsinki (H). Duplicate sets will be distributed as exchange material from the latter institute.

The citation of the distribution of mosses in China is based on Redfearn *et al.* (1996), and that of hepatics on Piippo (1990) unless stated otherwise. The total ranges given are according to the floras and checklists of the countries dealt with (*see* e.g. Piippo & Koponen 1997).

Collection areas and localities

Changsha City

1. Mt. Yuelu. Subtropical (warm temperate) evergreen Lauraceae-Fagaceae-*Pinus massoniana* forest, alt. ca. 50 m. 28°11´N, 112°E. September 26, 1997, nos. *48951–48986, 49351–49391.*

Mt. Mangshan, Yizhang Co.

(Fig. 4)

2. Mangshan. Yard of the administrative building, subtropical (warm temperate) zone, alt. 500 m, 24°59´N, 112°51´E, October 5, 1997, nos. *51551–51557.*

3. Yiping nursery, 24°58´N, 112°55´E, October 5, 1997.

3a. 1 km E of the sawmill. Along river on cliffs and in second growth subtropical (warm temperate) evergreen mixed forest, alt. 500 m, nos. *51856–51886, 51597–51613, 51765–51774.*

3b. Near the sawmill. Along stream and in second growth subtropical (warm temperate) evergreen mixed forest, alt. 600 m, nos. *51699–51750, 51851–51855, 51558–51596, 51148–51150, 51751–51764.*

4. Jiashui. 24°58´N, 112°55´E, October 4, 1997.

4a. Stone walls at the power station, subtropical (warm temperate) zone, alt. 640 m,

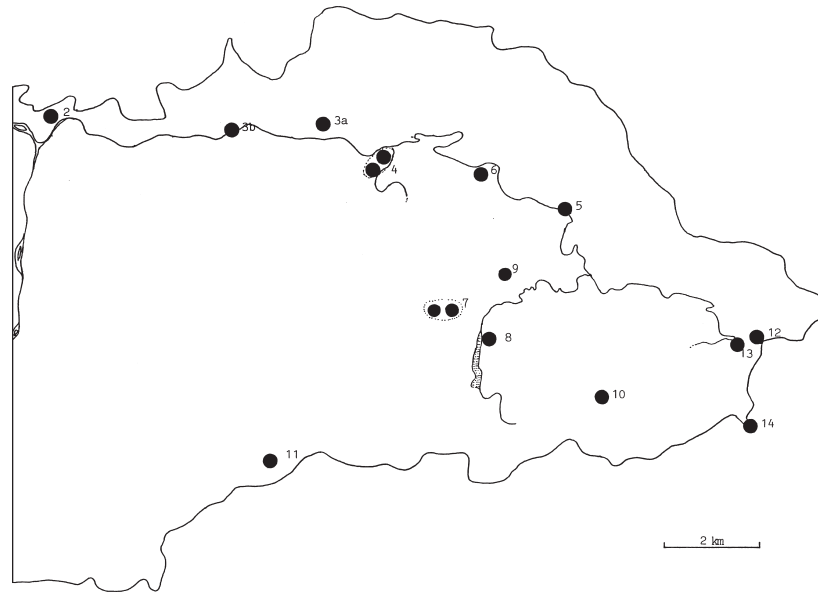

Fig. 4. Map of the core area of the Mangshan Nature Reserve and the situation of the collecting localities 2–14.

nos. *51147, 51544–51550*.

4b. Along river shores and in subtropical (warm temperate) evergreen mixed forest, alt. 640 m, nos. *51420–51450, 51651–51698, 51473–51543, 51128–51146*.

5. Huoshaoao. Along river shores in subtropical (warm temperate) evergreen mixed forest, alt. 800 m, 24°58´N, 112°56´E, October 4, 1997, nos. *51351–51419*.

6. Datangkeng Power Station. Road and brook side cliffs, subtropical (warm temperate) zone, alt. 900 m, 24°58´N, 112°56´E, October 4, 1997, nos. *51196–51250, 51451–51472, 51109–51127*.

7. Guizizhai, core area of the forest reserve, October 2, 1997

7a. Along river bed in primeval subtropical (warm temperate) *Cyclobalanopsis, Lithocarpus, Pinus kwangtungensis, Pseudotaxus, Rhododendron, Schima* forest, alt. 1 135 m, 24°57´N, 112°56´E, nos. *50894–50903, 50917–50983, 51056–51059, 50720–50722*.

7b. Tower-like rocky mountain top with *Fokienia hodginsii, Pinus kwangtungensis,* and *Tsuga longibracteata*, subtropical (warm temperate) zone, alt. 1 160 m, 24°57´N, 112°55´E, nos. *50904–50916, 50723–50738, 51060–51064*.

7c. Primeval subtropical (warm temperate) *Cyclobalanopsis, Lithocarpus, Pinus kwangtungensis, Rhododendron, Schima* forest on slope, alt. 1160 m, 24°57´N, 112°55´E, nos. *50739–50772, 51065–51074*.

7d. Primeval subtropical (warm temperate) *Cyclobalanopsis, Lithocarpus, Exbucklandia, Semiliquidambar, Pinus kwangtungensis, Rhododendron, Schima* forest sloping to river, alt. 1 180 m, 24°57´N, 112°56´E, nos. *50665–50719, 49239–49250, 51051–51055*.

7e. Along river bed in primeval subtropical (warm temperate) *Cyclobalanopsis, Lithocarpus, Pinus kwangtungensis, Rhododendron, Schima* forest, alt. 1 180 m, 24°57´N, 112°56´E, nos. *50623–50650, 50851–50893*.

8. Linziping. Road sides near the reservoir, subtropical (warm temperate) zone, alt. 1 185–1 200 m, 24°57´N, 112°56´E, September 30, 1997, nos. *48987–49018, 49151–49158, 49392–49423*.

9. 1 km N of Linziping, Changchong. 24°57´N, 112°56´E, September 30, 1997.

9a. Evergreen subtropical (warm temperate) Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest with with undergrowth of *Sinarundinaria basihirsuta*, alt. 1 225 m, nos. *49019–49090, 49159–*

49183, 49424–49450, 49501–49532.

9b. At water canal on rather open W slope, subtropical (warm temperate) zone, alt. 1 200 m, nos. *49091–49098, 49533–49535*.

10. Zeziping. 24°56´N, 112°57´E, October 3, 1997.

10a. Second growth forest and bamboo cultivation, subtropical (warm temperate) zone, alt. 1 230 m, nos. *51006–51022, 50773–50843, 51075–51083*.

10b. Cut forest area, subtropical (warm temperate) zone, alt. 1 230 m, nos. *51084–51089*.

10c. Along stream beds and on slopes in second growth subtropical (warm temperate) mixed evergreen forest, alt. 1 250 m, nos. *51023–51050, 51251–51279, 51090–51096*.

11. Langpanhu Swamp. 24°55´N, 112°53´E, October 3, 1997.

11a. Langpanhu Swamp. Subtropical (warm temperate) zone, alt. 1 265 m, *51280–51281, 51101–51103*.

11b. Pinus massoniana plantation with evergreen undergrowth on poor soil, subtropical (warm temperate) zone, alt. 1 265 m, nos. *51282–51317, 51097–51100, 50844–50850, 51151–51171*.

11c. Subtropical (warm temperate) mixed evergreen forest, alt. 1 235 m, nos. *51104–51108, 51318–51350, 51172–51195*.

12. Heikeng on Hunan-Guangdong border. October 1, 1997.

12a. Subtropical (warm temperate) evergreen *Camellia, Cyclobalanopsis*, *Lindera, Machilus* forest (logged in 1960s) in valley along brook, alt. 1 230 m, 24°56´N, 112°59´E, nos. *49216–49237, 49629–49650, 49551–49600, 50651–50655*.

12b. Subtropical (warm temperate) evergreen *Camellia, Cyclobalanopsis*, *Lindera, Machilus* forest (logged in 1960s) in valley along brook, alt. 1 240–1 280 m, 24°56´N, 112°59´E, nos. *49341–49350, 50551–50602*.

12c. Subtropical (warm temperate) evergreen *Camellia, Cyclobalanopsis*, *Lindera, Machilus* forest (logged in 1960s) on slope, alt. 1 280 m, 24°56´N, 112°59´E, nos. *50603–50622*.

12d. On base trunks of *Cryptomeria fortunei* at road. Subtropical (warm temperate) zone, alt. 1 240 m, 24°56´N, 112°59´E, nos. *49238, 50656–50664*.

13. Baigongao. Road side bank, subtropical (warm temperate) zone, alt. 1 385 m, 24°56´N, 112°59´E, October 3, 1997, nos. *50984–51005*.

14. Mengkengshi Peak. 24°55´N, 112°59´E, October 1, 1997.

14a. Along road on cliffs and stone walls, subtropical (warm temperate) zone, alt. 1 750–1 902 m, nos. *49099–49140, 49536–49550, 49451–49472, 49184–49215.*

14b. Pileostegia-Quercus-Rhododendron-Schima elfin forest on mountain top, subtropical (warm temperate) zone, alt. 1 900 m, *49141–49150, 49251–49340, 49473–49500, 49601–49628.*

Wulingyuan Global Cultural Heritage Area
(Fig. 5)

15. Baofeng Lake. 29°20´N, 110°32´E, October 12, 1997.

15a. Brook sides in deep gorge at trail to lake, subtropical (warm temperate) zone, alt. 315 m, nos. *52901–52945*.

15b. Cliffs in deep gorge at trail to lake, subtropical (warm temperate) zone, alt. 315–390 m, nos. *53151–53173, 53391–53400*.

15c. Road side cliffs and banks, subtropical (warm temperate) zone, alt. 375 m, nos. *53207–53230, 52946–52950, 53251–53262, 53410–53413.*

15d. Cliffs in deep gorge, subtropical (warm temperate) zone, alt. 375–390 m, nos. *53401–53409*.

15e. Shore cliffs of the lake, subtropical (warm temperate) zone, alt. 390 m, nos. *53174–53206*.

16. Ten-li Drawing Corridor. 29°22´N, 110°28´E, October 11, 1997.

16a. Along cliffs at dry stream bed near Jiatanwang Village, subtropical (warm temperate) zone, alt. 400 m, nos. *52866–52900, 53147–53150.*

16b. Cliffs at road side W of Jiatanwan Village, subtropical (warm temperate) zone, alt.

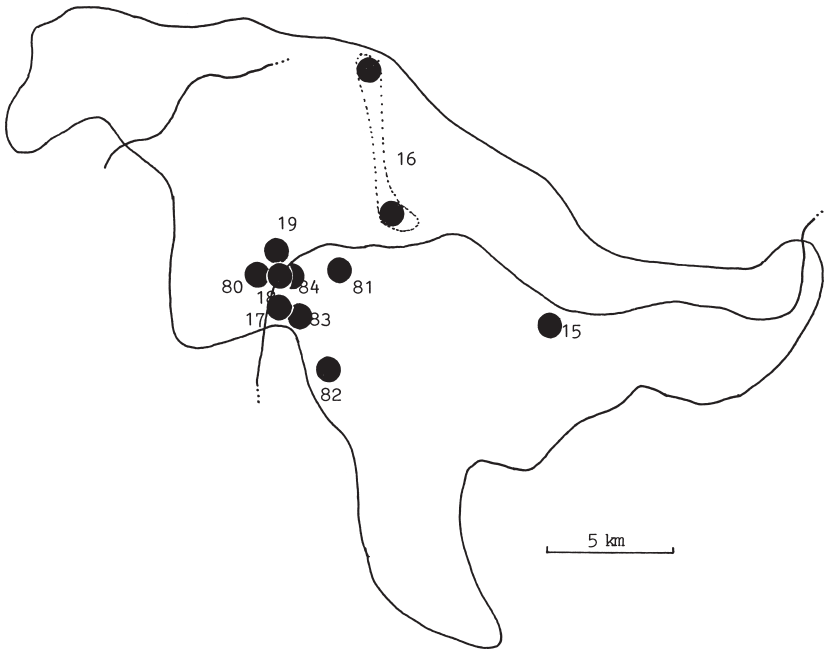

Fig. 5. Map of Wulingyuan Global Cultural Heritage Area and the situation of the collecting localities 15–19 (in 1997) and 80–84 (in 1999).

400–455 m, 29°22´N, 110°28´E, nos. *53076–53146*.

16c. W of Jiatanwan Village. Second growth evergreen forest with some planted *Cunninghamia lanceolata*, subtropical (warm temperate) zone, alt. 470 m, nos. *52694–52750, 52851–52865*.

16d. Between Ten-li Drawing Corridor and Helong Park. Second growth broad-leaved forest with mixture of *Pinus*, subtropical (warm temperate) zone, alt. 600–1 200 m, nos. *52546–52550, 53351–53390*.

17. Zhangjiajie, Jinbianxi (Golden Whip Stream). 29°18´–19´N, 110°25´–26´E, October 9, 1997 and September 17, 1999.

17a. Along stream and on path side cliffs and trunks in second growth evergreen subtropical (warm temperate) forest, alt. 550 m, nos. *51831–51850, 52451–52475, 52147–52150, 52551–52554*.

17b. In second growth evergreen subtropical (warm temperate) forest on slope, alt. 550–580 m, nos. *52370–52450, 52751–52832, 52065–52146*.

17c. Subtropical (warm temperate) zone. Secondary forest with planted *Metasequoia glyptostroboides* and *Cryptomeria japonica*. Main component incl. *Pterocarya stenoptera, Sassafras tzumu, Acer davidii, Ailanthus altissima, Hydrangea paniculata, H. strigosa, Camellia cuspidata, C. oleifera, Alangium chinense, Dichroa febrifuga*, alt. 550 m, September 17, 1999, *Rao 58417–58491*.

18. Zhangjiajie, at Peak of Yaozizhai Trail, 29°19´N, 110°25´E, October 10, 1997.

18a. *Cunninghamia lanceolata* plantation at trail, subtropical (warm temperate) zone, alt. 600–625 m, nos. *52833–52850, 52951–52972, 52555–52590, 52476–52490*.

18b. Along dry stream bed in second growth mixed evergreen and deciduous forest subtropical (warm temperate) zone, alt. 630 m, nos. *52591–52630, 52693*.

18c. In second growth mixed evergreen and deciduous forest, subtropical (warm temperate) zone, alt. 625–700 m, nos. *52973–53017*.

18d. Echo Gorge, in second growth mixed evergreen and deciduous forest, subtropical (warm temperate) zone, alt. 800–855 m, nos. *53018–53035, 52631–52676*.

18e. Steep NE facing cliffs of the Peak of Yaozizhai Village, subtropical (warm tem-

perate) zone, alt. 855–955 m, nos. *53036–53063, 52677–52691, 52491–52536*.

18f. Top of the Peak of Yaozizhai. Low *Pinus massoniana* var. *wulingensis-Quercus glandulifera* forest, subtropical (warm temperate) zone, alt. 970 m, nos. *53064–53075, 52692, 52537–52545*.

19. Zhangjiajie, Huangshizhai, 29°20´N, 110°25´E, October 8, 1997.

19a. Along stream bed in second growth evergreen subtropical (warm temperate) forest, alt. 620m, nos. *52251–52369*.

19b. On slope in second growth evergreen subtropical (warm temperate) forest, alt. 700 m, nos. *51991–52064*.

19c. On slope in second growth evergreen subtropical (warm temperate) forest, alt. 800 m, nos. *51800–51830*.

19d. On cliffs and in low evergreen forest along path, subtropical (warm temperate) zone, alt. 910–985 m, nos. *51614–51650, 51951–51990*.

19e. *Cryptomeria fortunei-Cunninghamia lanceolata* plantation, and primeval dry forest patches of low evergreen trees on ridge, subtropical (warm temperate) zone, alt. ca. 1 000 m, nos. *51887–51950, 51775–51799*.

80. Zhangjiajie, Pipajie. Subtropical (warm temperate) zone, on the road side, in bushes, alt. 687 m, 29°19´N, 110°24´E., September 15, 1999 *Rao 58351–58387*.

81. Zhangjiajie, Matianya. Subtropical (warm temperate) zone, 29°19´N, 110°27´E, September 16, 1999.

81a. Brook side, alt. 650 m, *Rao 58410–58416*.

81b. *Cunninghamia lanceolata* plantation, alt. 1000 m, *Rao 58388–58409*.

82. Zhangjiajie Village, subtropical (warm temperate) zone, Old-House Field, mixed forest of *Pinus massoniana* and *Liquidambar formosana,* alt. 700–750 m, 29°16´N, 110°26´E, September 18, 1999 *Rao 58492–58495*.

83. Zhangjiajie, Xiejiayu. Subtropical (warm temperate) secondary forest incl. *Castanea sequinii*, *Sassafras tzumu, Acer davidii, Ailanthus altissima, Clerodendron mandarinorum, Pterocarya stenoptera, Machilus lichuanensis, Diospyros lotus, Cyclobalanopsis glauca, Hovenia acerba, Zelkova schneideriana, Idesia polycarpa, Celtis biondii, Camellia pitardii, Zanthoxyllum echinocarpum* etc., alt. 680–850 m, 29°18´N, 110°25´E, September 19, 1999, *Rao 58496–58527, 58529–58543*.

84. Around Zhangjiajie Hotel, Fuqiyan (Couple-Rock Spot). Subtropical (warm temperate) zone. *Cunninghamia* plantation with naturally generated trees, alt. 650 m, 29°19´N, 110°25´E, September 20, 1999, *Rao 58528, 58544–58571*.

FLORA

Anthocerotae (by S. Piippo)

Anthocerotaceae Dum.

Folioceros fuciformis* (Mont.) Bharadw. — **Wulingyuan. *19a.* 52320, on outcrop at 620 m in second growth evergreen subtropical forest. — Previously known in China from Hong Kong, Fujian, and Taiwan (Piippo 1990, Zhang & Lin 1997).

Total range: Palaeotropical (Hasegawa 1984). Afr 3 (Réunion); As 2: Ja Tai; As 4: Borneo Ind (Java, Sumatra) PNG (Piippo 1993).

Phaeoceros carolinianus* (Michaux) Prosk. — **Wulingyuan. *17a.* 52464, on outcrop at 550 m. *19a.* 52305, 52357, on outcrop at 620 m in second growth evergreen subtropical forest. — Hasegawa (1991) and Hässel de Menendez (1987) discussed the taxonomy of *Phaeoceros laevis* (L.) Prosk.) subsp. *carolinianus* and treated as *P. laevis* plants with ventral tubers in the thallus and spores with densely spinulate distal surfaces and densely papillate proximal surfaces, and as *P. carolinianus* plants without ventral tubers and spores with finely granulate proximal surfaces and distal surfaces densely papillate or spinulate. Previously reported in China from Hebei, NE China, Yunnan, Fujian, Zhejiang, and Taiwan (Piippo 1990 as *P. laevis*.

Total range: Am 1–6; Eur; Afr 2–3; As 1–4; Oc (*see* Schuster 1992b).

Dendrocerotaceae (Milde) Hässel

Megaceros flagellaris* (Mitt.) Steph. — **Mangshan. *8.* 49423, on sand at 1 185–1 200 m. *11c.*

51340, on fallen branch at 1 235 m. **Wulingyuan.** *19a.* 52365a, on outcrop at 620 m. At road sides, subtropical mixed evergreen forest and second growth evergreen forest. — Previously known in China in Fujian, Hong Kong, and Taiwan (Piippo 1990, Zhang & Lin 1997).

TOTAL RANGE: Paleotropical (Hasegawa 1984). As 2: Chi Ja Tai; As 3: In Tha; As 4: Ind (Java, West Irian) Phi PNG; Oc: Haw NC Sam Tah (cf. Piippo 1993).

HEPATICAE

Aneuraceae Klinggr. (by S. Piippo)

Aneura pinguis* (L.) Dum. — **Mangshan. *6.* 51467. **Wulingyuan.** *16b.* 53078. *17b.* 52804. *19a.* 52284. — On road and brook side cliffs and second growth evergreen subtropical forest at 400–900 m. — Previously known in China from Jilin, Yunnan, Guizhou, Sichuan, Hainan, Hong Kong, Zhejiang, and Taiwan (Piippo *et al.* 1997, Zhang & Lin 1997).

TOTAL RANGE: Cosmopolitan.

Aytoniaceae Cavers (by S. Piippo)

Reboulia hemisphaerica (L.) Raddi — **Wulingyuan.** *18e.* 52511, 52513a, 52522, 52679. *19d.* 51616. *19e.* 51785. — On cliff (2 specimens), sand (2), boulder (1), and humus (1), at 855–1 000 m. Cliffs along paths in village, low evergreen forest and primeval dry forest on ridge. — Previously known in China from many provinces (cf. Piippo 1990).

TOTAL RANGE: Cosmopolitan (Schuster 1992b).

Conocephalaceae Müll. Frib. ex Grolle (by S. Piippo)

Conocephalum conicum* (L.) Dum. — **Mangshan. *3b.* 51750. **Wulingyuan**. *15a.* 52919. *16a.* 52896. *17a.* 51849. *17b.* 52791, 52796. *19a.* 52277. *19b.* 52000, 52013. *19d.* 51615. — On cliff (4 specimens), trunk (2), outcrop (1), boulder (1), sand (1), and humus (1), at 315–985 m. Along stream and path side cliffs in second growth evergreen mixed forest, brook sides in deep gorge at rail, and on cliffs and slopes in second growth evergreen forests. — Previously known in China from many provinces (cf. Piippo 1990).

TOTAL RANGE: Am 1; Eur; Afr 1; As 1; As 2: Chi Ja Ko Tai; As 3: Bhu Darjeeling NW In Kashmir Ne Pak Si (Furuki & Higuchi 1995).

Conocephalum japonicum* (Thunb.) Grolle — **Mangshan. *10a.* 51075. **Wulingyuan.** *15c.* 53259. *16b.* 53135. *16c.* 52720. *16d.* 53369. *18a.* 52478. *19a.* 52318. *19d.* 51633, 52043. *19e.* 51780, 51896. — On sand (3 specimens), outcrop (3), boulder (2), clay (2), and gravel (1), at 375–1 230 m. In second growth forests, bamboo, *Cunninghamia* and *Cryptomeria* cultivations, road side cliffs and banks, and stream beds in second growth evergreen subtropical forest. — Previously known in China from ten provinces (cf. Piippo 1990, Zhang & Lin 1997).

TOTAL RANGE: As 1 (E Siberia, Kamchatka); As 2: Chi Ja Ko Tai; As 3: Assam Bhu Darjeeling Ne (cf. Long & Grolle 1990, Furuki & Higuchi 1995).

Lejeuneaceae Cas.-Gil. (by S. Piippo)

Cheilolejeunea imbricata* (Nees) Hatt. — **Mangshan. *3b.* 51583, on trunk along stream and second growth subtropical evergreen mixed forest, at 600 m. — Known previously in China from Xizang, Anhui, Yunnan, Guizhou, Guangdong, Hainan, Fujian, Zhejiang, and Taiwan (Piippo 1990, Zhu *et al.* 1994b, X.-L. He 1997).

TOTAL RANGE: Throughout warm temperate and tropical SE Asia, and Samoa (Long & Grolle 1990).

Drepanolejeunea erecta* (Steph.) Mizut. — **Mangshan. *12c.* 50605, on base of trunk in subtropical evergreen *Camellia, Cyclobalanopsis, Lindera, Machilus* forest on slope, at 1 280 m. — Known previously in China from Yunnan, Guangdong, Fujian, Zhejiang, and Taiwan (Piippo 1990, Zhu *et al.* 1994a, 1994b, Zhang & Lin 1997).

TOTAL RANGE: As 2: Chi Ja Tai; As 3: Assam Bhu Ne Si Darjeeling (Long & Grolle 1990).

Lopholejeunea brunnea* Horik. — **Mangshan. *3b.* 51570, on top of outcrop along stream and second growth subtropical evergreen mixed forest, at 600 m.

TOTAL RANGE: Known previously only from Taiwan (Piippo 1990). As 2: Ja Tai (cf. Horikawa 1931).

Mastigolejeunea auriculata* (Wils.) Schiffn. — **Mangshan. *4b*. 51516, on trunk along river shores and in subtropical evergreen mixed forest, at 640 m. — Known previously in China from Xizang, Yunnan, Zhejiang, Guangdong, Hainan and Taiwan (Zhu 1990, Zhang & Lin 1997, Piippo *et al.* 1998).

TOTAL RANGE: Am 1; Afr; As 4: Ind PNG; Austr; Oc: NC Sol (Gradstein *et al.* 1983, Gradstein 1994).

Microlejeunea ulicina* (Tayl.) Evans — **Mangshan. *12a.* 49553, on fallen rotten log in subtropical evergreen *Camellia, Cyclobalanopsis, Lindera, Machilus* forest in valley along brook, at 1 230 m. — Previously known in China from Anhui, Yunnan, Guizhou, Guangdong, Hainan, Jiangxi, Fujian, Zhejiang, and Taiwan (Piippo 1990, Zhu 1990). Also Ko (Yamada & Choe 1997).

TOTAL RANGE: Am 1; Eur; As 2: Ja Chi Tai (cf. Gradstein *et al.* 1983).

Spruceanthus semirepandus (Nees) Verd. — **Mangshan**. *7a.* 50971, on base trunk along river bed in primeval subtropical *Cyclobalanopsis, Lithocarpus, Pinus kwangtungensis, Pseudotaxus, Rhododendron, Schima* forest, at 1 135 m. — Previously known in China from Xizang, Sichuan, Anhui, Yunnan, Guizhou, Hunan, Guangdong, Hainan, Fujian, Zhejiang, and Taiwan (Piippo 1990, Zhu 1990, Zhang & Lin 1997).

TOTAL RANGE: Widespread in tropical and subtropical Asia (Long & Grolle 1990).

Makinoaceae Nakai (by S. Piippo)

Makinoa crispata (Steph.) Miyake — **Mangshan.** *3b*. 51746, 51757. *10a*. 50835. *10c.* 51266. *12a.* 49570, 49593. *12b*. 50578. **Wulingyuan.** *16b*. 53132, 53136. *16c*. 52354. *17b*. 52401. *18a*. 52834. *18b*. 52604. *18c*. 52465a. *19a*. 52322. — On outcrops (5 specimens), sand (4), cliff (3), humus (2), and gravel (1), at altitudes of 400–1 250 m. Along stream beds and second growth evergreen mixed forest, cliffs at road sides, second growth evergreen forests, plantations. — Previously known in China from Liaoning, Anhui, Zhejiang, Hunan, Guangdong, and Taiwan (Piippo 1990, Zhu *et al.* 1998).

TOTAL RANGE: As 2: Chi Ja Tai; As 4: Ind (West Irian) Phi PNG (Piippo 1988a).

Marchantiaceae (Bischl.) Lindley (by S. Piippo)

Marchantia emarginata* Reinw. *et al.* subsp. *tosana* (Steph.) Bischl. — **Mangshan. *3a*. 51612. *4b*. 51542. *8*. 49421. *9a.* 49183. **Wulingyuan**. *16b*. 53143. *17a*. 51845, 52464a, 52552, 52553. *18c*. 52465a (with *Makinoa*). *19a*. 52319. — On outcrop (3 specimens), cliff (3), sand (2), trunk (1), and 2 without habitat, at 400–1 225 m. Along river on cliffs and stream beds in second growth evergreen mixed forests, road sides and stone walls, even in evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest. — Previously known in China from S and SE parts of the country (cf. Piippo 1990).

TOTAL RANGE: As 2: Chi Ja Tai; As 3: Tha Vi (Bischler-Causse 1989).

Marchantia polymorpha L. — **Mangshan**. *3a*. 51613. *4a.* 51544. *8.* 49399. *9a.* 49084. **Wulingyuan**. *15c.* 53210, 53228. *16c*. 52726, 52749. *18c*. 52992. *19c.* 51823. — On cliff (3 specimens), boulders (3), sand (3), and clay (1), at 375–1 225 m. Along river in second growth evergreen mixed forests, road sides and stone walls, even in evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest. — Common in China (cf. Piippo 1990).

TOTAL RANGE: Almost cosmopolitan (cf. Bischler-Causse 1989).

Metzgeriaceae Klinggr. (by S. Piippo)

Metzgeria albinea* Spruce — **Mangshan. *11c*. 51183, on leaf in subtropical mixed evergreen forest at 1 235 m. — Previously known in China from Taiwan (Piippo 1990).

TOTAL RANGE: Am 2–6; Afr 3 (Seychelles); As 2: Chi Tai; As 3: Sri; As 4: Ind (Java, Sumatra, West Irian) Ma PNG; Oc: Sam (Piippo 1991).

Metzgeria decipiens* (Mass.) Schiffn. — **Mangshan. *4b.* 51523, on rotten stump at 640 m. **Wulingyuan.** *18d.* 52673, on cliff at 800–855 m. Along

river shores and in subtropical second growth evergreen mixed forest. — Previously known in China only from Zhejiang and Anhui (Piippo 1990, Zhu *et al.* 1998).

TOTAL RANGE: Pantropical (cf. Piippo 1991). Am 2–6; Afr; As 2: Chi Ja; As 3: Himalaya Sri Tha; As 4: Ind (Java) Ma Phi PNG; Austr 1–2; Oc: Fij Haw NC Tah.

Metzgeria lindbergii* Schiffn. — **Mangshan. *3b*. 51855a. *10a*. 50810b. *11c*. 51331a, 51350a. *12a*. 49572, 49635a, 49636a, 49640a, 49641a, 49645. *12c*. 50617a, 50622. *14a*. 49455. *14b*. 49148, 49497. **Wulingyuan.** *15a*. 52924. *15c*. 53220, 53221. *16c*. 52722. *17a*. 52473. *17b*. 52074a, 52078, 52105, 52372, 52374, 52400, 52407, 52409, 52411a, 52419, 52774a, 52775, 52787a, 52779, 52780. *18a*. 52567, 52571, 52951a. *18b*. 52595, 52627, 53031. *18d*. 52642. — On tree trunks (22 specimens, incl. *Castanopsis, Machilus chinensis, Hydrangea strigosa*), bushes (7), dead trunks (5), twigs (2), fallen trunk (1), rotten branch (1), clay (1), sand (1), humus (1), and 1 habitat not given, at 375–1 900 m. Along stream in second growth evergreen mixed forest, evergreen *Camellia, Cyclobalanopsis, Lindera, Machilus* forest, *Pilostegia-Quercus-Rhododendron-Schima*-elfin forest, second growth forest with some planted *Cunninghamia*, brook sides in deep gorge at trail, along road sides, and bamboo cultivation. — Schuster (1992a) discussed the taxonomy, variation, and distribution of *M. conjugata* Lindb. and *M. conjugata* subsp. *japonica* Hatt. (= *M. lindbergii*). Previously known in China from Xizang, Yunnan, Sichuan, Zhejiang (? as *M. conjugata*), and Taiwan (Piippo *et al.* 1997).

TOTAL RANGE: As 1 (Sakhalin); As 2: Chi Ja Ko Tai; As 3: NW Himalaya Annam; As 4: Ind (Java, Sumatra) Phi PNG (Kuwahara 1966, 1984, Schuster 1992a).

Metzgeria temperata* Kuwah. — **Mangshan. *14b*. 49493, on trunk in elfin forest on mountain top at 1 900 m. — The species is apparently previously reported for China as *M. fruticulosa* (Dicks.) Evans from Yunnan and Taiwan (cf. Piippo 1990). *Metzgeria temperata* is known from SE N America, Siberia, and Japan (Kuwahara 1976, Schuster 1992a), but *M. fruticulosa* is confined to Western Europe. *Metzgeria temperata* is characterised by non-tapering and tapering thallus apices, the latter ones with marginal gemmae. According to Kuwahara (1976) and Schuster (1992a), the gemmae are restricted to margins, but Kuwahara says that they sometimes do occur on lamina near apex. In the present Hunan specimen the gemmae occur in abundance both at margins and lamina in the tapering apex.

Pallaviciniaceae Migula (by S. Piippo)

Pallavicinia ambigua* (Mitt.) Steph. — **Mangshan. *6.* 51114a, in cliff crevice at 900 m. — Previously known in China from Sichuan, Hainan, and Taiwan (Piippo 1990).

TOTAL RANGE: As 2: Chi Ja Tai; As 3: In Tha; As 4: Ind (Seram) Ma Phi PNG (Grolle & Piippo 1986).

Pallavicinia levieri Schiffn. — **Mangshan.** *7a*. 50897. *10a*. 50782 (cf.), 50804 (cf.). *10c*. 51270. *12a*. 49576. **Wulingyuan.** *15a*. 52921 (cf., with *P. subciliata*). *16c*. 52701. *16d*. 52550, 53365. *19b*. 51999, 52004a, 52017. On humus (3 specimens), outcrops (3), sand (2), cliff (2), clay (1), and tree base (1), at 470–1 250 m. Along river bed in primeval *Cyclobalanopsis, Lithocarpus, Pinus kwangtungensis, Pseudotaxus, Rhododendron, Schima* forest, along stream beds and slopes in second growth mixed evergreen forest, evergreen *Camellia, Cyclobalanopsis, Lindera, Machilus* forest, second growth broad-leaved forest with mixture of *Pinus*, brook sides in deep gorge at trail, and bamboo and *Cunninghamia* cultivations. — Previously known in China from Hunan and Taiwan (Piippo 1990).

TOTAL RANGE: As 2: Chi Ja Tai; As 3: Vi; As 4: Ind (Java) Ma Phi PNG (Grolle & Piippo 1986).

Pallavicinia lyellii (Hook.) Carruth. — **Wulingyuan**. *17b*. 52375, on base of *Sassafras* at 550–580 m in second growth evergreen subtropical forest. — Previously known in China from Liaoning, Yunnan, Guizhou, Hunan, Guangdong, Hainan, Zhejiang, Sichuan, and Taiwan (Piippo *et al.* 1997).

TOTAL RANGE: Subcosmopolitan (Grolle & Piippo 1986, Schuster 1992a). Am 1–6; Afr 1–2; As 2–4; Oc.

Pallavicinia subciliata* (Aust.) Steph. — **Mangshan. *3b*. 51576, 51578. *4b*. 51129, 51479, 51486, 51540. *5*. 51382. *6*. 51115, 51116, 51117a. *7a*. 50978. *7e*. 50633. *9a*. 49040, 49060, 49175. *10a*. 50776, 50791, 50797, 50807a, 50810a, 50822,

50841a, 51014, 51015a. *11c.* 51181a. *12b.* 50572, 50580. *13.* 50985. **Wulingyuan**. *15a.* 52921, 52928. *15b.* 53171, 53392. *16b.* 53111. *16c.* 52851. *18c.* 52999. *18d.* 52647, 52666, 53021, 52664. *19d.* 51978. — On cliff (13 specimens), sand (12), outcrop (5), crevice (3), boulder (2), soil (2), humus (1), gravel (1), and twig (1), at 315–1 385 m. Along stream shores in second growth and primeval evergreen mixed forests with *Camellia*, *Cyclobalanopsis,Lindera, Lithocarpus, Machilus, Pinus kwangtungensis, Pseudotaxus, Rhododendron, Schima*, Araliaceae, Fagaceae, Hamamelidaceae and Magnoliaceae, bamboo and *Cunninghamia* cultivations, road side banks, and cliffs at trail. — Previously known in China from Zhejiang, Guangdong and Taiwan (Piippo 1990, Zhu *et al.* 1998).

TOTAL RANGE: As 2: Ja Chi Tai (Grolle & Piippo 1986).

Pelliaceae Klinggr. (by S. Piippo)

Pellia endiviifolia* (Dicks.) Dumort. — **Mangshan. *4b*. 51130. **Wulingyuan**. *16a*. 52883, 52897. *16b*. 53094 (cf.), 53113. *18e*. 52681. *19b*. 52029. *19c*. 51821, 51822. *19d.* 51642a, 51644, 51645a. — On cliff (8 specimens), sand (2) and clay (2) from 400 to 985 m. On cliffs and slopes in second growth forest, along paths, road sides and at stream beds in evergreen mixed forest. — Previously known in China in Xinjiang, Xizang, Shaanxi, Jilin, Liaoning, Sichuan, Anhui, Zhejiang, and Taiwan (Piippo 1990, Zhu *et al.* 1998).

TOTAL RANGE: Am 1 (?); Eur; Afr 1; As 1; As 2: Chi Ja Tai; As 3: Bhu In Ne Pa Si (Schuster 1992a, Furuki & Higuchi 1995).

Scapaniaceae Migula (by A. D. Potemkin)

Diplophyllum serrulatum* (Müll. Frib.) Steph. — **Mangshan. *4b*. 51495, on sandy soil. *7a.* 51058, on moist boulder. *7b*. 50727, on mull at brook, c. per. *7c.* 50749, on boulder, *c. per.*, androecia, gemmae. Along river shores and in subtropical evergreen mixed forest; along river bed in primeval subtropical *Cyclobalanopsis, Lithocarpus, Pinus kvantungensis, Pseudotaxus, Rhododendron, Schima* forests; and rocky mountain top with *Fokienia hodginsii, Pinus kvantungensis*, and *Tsuga longibracteata*; at 640–1 160 m. — Previously known in China from Taiwan (Piippo 1990).

TOTAL RANGE: As 2: Chi Tai Ja (Amakawa & Hattori 1955).

Scapania* cf. *aspera* M. & H. Bernet — **Mangshan. *3a.* 51769. *6*. 51201. *7a.* 50931. *7b.* 50905. *7c*. 50767a. *7e*. 50626. **Wulingyuan**. *18a*. 52954. *19d.* 51981. Usually with gemmae, often with perianths. On ± shaded to open, moist to mesic rocks. Along river on cliffs and in second growth evergreen mixed forest and in low evergreen forest along path; along river bed in primeval subtropical *Cyclobalanopsis, Lithocarpus, Pinus kvantungensis, Pseudotaxus, Rhododendron, Schima* forests road and brook side cliffs; rocky mountain top with *Fokienia hodginsii, Pinus kvantungensis*, and *Tsuga longibracteata*; at 500–1 180 m. — Known also from Fujian, Jiangxi, Zhejiang (Potemkin, unpubl.). The taxonomic status will be elaborated in further publications of this same series.

Scapania ciliata Sande Lac. — **Mangshan.** *3b*. 51566a, 51760. *4b.* 51477, 51483. *5.* 51359, 51419. *7a*. 50981. *9a.* 49169. *12b.* 49340. *14a.* 49210. **Wulingyuan**. *16c.* 52858. *19d.* 51979. On ± shaded moist to mesic rocks. Often with perianths and gemmae. Along stream and in second growth subtropical evergreen mixed forests; primeval subtropical *Cyclobalanopsis, Lithocarpus, Pinus kvantungensis, Pseudotaxus, Rhododendron, Schima* forests; evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest with undergrowth of *Sinarundinaria basihirsuta*; subtropical evergreen logged *Camellia, Cyclobalanopsis, Lindera, Machilus* forest in valley along brook; along road on cliffs and stone walls in low evergreen forests; at 600–1902 m. The species was reported by Nicholson (1930) as *S. levieri* Müll. Frib. from SW Hunan: Yün-shan bei Wukang, 900–1 180 m, *Handel-Mazzetti*, 7.XIII.1917, 30.VI.1918 (*11130*). The collections of Handel-Mazzetti were unavailable for study.

Scapania griffithii Schiffn. — **SW Hunan**: Yünshan bei Wukang, 950–1 200 m, *Handel-Mazzetti*, 7.XIII.1917, 25.VI.1918 (*12215*). The species was reported by Nicholson (1930), whose specimens were unavailable for study.

Scapania ligulata* Steph. — **Mangshan. *10a.* 50825, on moist rock top. *10c.* 51093, on moist partially shaded rocks. *12b.* 50553, on moist outcrop in open light. **Wulingyuan**. *19a.* 52316, on mesic outcrop in open light. Often with perianths and gemmae. In second growth forest and bamboo cultivation; along stream beds and on slopes in second growth subtropical mixed evergreen forests; and subtropical evergreen logged *Camellia, Cyclobalanopsis, Lindera, Machilus* forest in valley along brook; at 620–1 280 m. — Previously known in China from Anhui, Guangxi, Yunnan (A. Potemkin unpubl.), and Taiwan (Piippo 1990).

TOTAL RANGE: As 2: Chi Ja (Amakawa & Hattori 1954) Tai; As 3: Himalayas (Amakawa 1964).

Scapania stephanii* Müll. Frib. — **Mangshan. *3b.* 51732. *4b.* 51483. *5.* 51359. *7c*. 50754. *7d.* 50689. *7e*. 50634. *9a.* 49041, 49090, 49507, 49516. *10a.* 50808, 50812, 50814a. *12a.* 49225, 49584, 49585, 49587, 49630. *12b.* 50555, 50577a, 50601. **Wulingyuan**. *15c.* 53215. *16c.* 52747. *16d.* 52546. *17b.* 52396, 52425a, 52825. *18a.* 52479, 52487, 52559, 52954, 52957a. *18b*. 52600a. *18c.* 52983, 52997, 53003a. *18d.* 52654, 52631a. *18e*. 52513, 53045. *19a.* 52315. *19b.* 52005, 52046. *19c.* 51800. *19d.* 51964, 51977. Usually with gemmae, often with perianths, sporadically with androecia. — On mesic to moist soil and rocks, in open, partially to full-shaded niches. Along stream and dry stream bed and on slopes in second growth evergreen mixed forests and deciduous forests; primeval subtropical *Cyclobalanopsis, Lithocarpus, Exbucklandia, Semiliquidambar, Pinus kvantungensis, Pseudotaxus, Rhododendron, Schima* forests on slopes and along river bed; evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest with undergrowth of *Sinarundinaria basihirsuta*; second growth forest and bamboo cultivation; subtropical evergreen logged *Camellia, Cyclobalanopsis, Lindera, Machilus* forest in valley along brook; second growth evergreen forests with some planted *Cunninghamia lanceolata* and second growth broad-leaved forest with *Pinus*; on road and trail side cliffs and banks; at 375–1 280 m. — Previously known from Anhui, Fujian, Guangdong, Taiwan (Piippo 1990), Jiagxi (Fang *et al.* 1998). Also found in Yunnan (Potemkin unpubl.).

TOTAL RANGE: As 2: Chi Ja (Amakawa & Hattori 1954) Tai.

Wiesnerellaceae Inoue (by S. Piippo)

Dumortiera hirsuta* (Sw.) Nees — **Wulingyuan. *15c*. 53217. *16b.* 53138a. *16c*. 52742. *17b*. 52397, 52398. *18a*. 52839, 52961. *19a*. 52283a. *19b*. 52010, 52011a, 52032. — On sand (4 specimens), cliff (3), bush (2), outcrop (1), and soil (1), at 375–700 m. Road side cliffs and banks, stream beds, second growth evergreen forests, and *Cunninghamia* plantations. — Previously known in China from Anhui, Yunnan, Guizhou, Guangdong, Fujian, Zhejiang, and Taiwan (Piippo 1990).

TOTAL RANGE: Pantropical, extending to Western Europe (Pócs 1976). Eur; Am 1–6, Afr 2–4; As 2: Chi Ja Tai; As 3: Bhu In Indochina Ne; As 4: Ind Phi PNG; Oc; Austr 2 (cf. Schuster 1992b, Furuki & Higuchi 1995).

Wiesnerella denudata (Mitt.) Steph. — **Wulingyuan**. *17b*. 52428a, on rotten trunk at 550–580 m. *18a.* 52577, on boulder at 600–625 m. *19b.* 52022, on sand at 700 m. In second growth evergreen subtropical forests and *Cunninghamia lanceolata* plantation. — Previously known in China from Xizang, Zhejiang, Sichuan, Yunnan, Hunan, and Taiwan (Piippo 1990, Zhu *et al.* 1998).

TOTAL RANGE: Afr 3 (Mascarenes); As 2: Chi Ja Ko Tai; As 3: Afganistan Himalaya NW In; As 4: Ind (Java, Sumatra) Ma PNG; Oc: Haw (Piippo 1988b, Furuki & Higuchi 1995).

MUSCI

Bartramiaceae Schwaegr. (by T. Koponen)

Philonotis falcata* (Hook.) Mitt. — **Wulingyuan. *16b*. 53107, 53119, on moist cliffs at road side, 400 m. — Widely distributed in China, known from 12 provinces.

TOTAL RANGE: As 1; As 2: Chi Ja Ko; As 3: Bhu Bu In Ne Pa Si Tha; As 4: Phi (distribution map in Koponen 1996).

Philonotis lancifolia Mitt. — **Mangshan**. *6*. 51196, brook side cliff, 900 m. *8*. 49013, water canal, on concrete, 1 200 m. — Reported from twelve Chinese provinces.

TOTAL RANGE: As 2: Chi Ja.

Philonotis mollis* (Dozy & Molk.) Mitt. — **Mangshan. *8*. 48993, road side, on sandy soil. **Wulingyuan**. *15e*. 53179, shore cliffs of lake, 390 m. — Known previously from Guizhow and Taiwan in China.

TOTAL RANGE: As 2: Chi Ja; As 3: In; As 4: Ind Phi PNG.

Philonotis thwaitesii* Mitt. — **Wulingyuan. *16a*. 52880. *16b*. 53126, 53140. *16c*. 52731. *16d*. 53368. *18d*. 51990. *19c*. 51815. *19d*. 51630. In cliff crevices along roads and paths, in second growth forests. Substrates: cliff or boulder (5 specimens), sandy soil (2), and tree trunk (1). — Reported previously from 15 provinces in China.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Sri; As 4: Ind, PNG; Oc: Ton.

Brachytheciaceae G. Roth (by M. Ignatov & S. Huttunen)

Brachythecium buchananii (Hook.) A. Jaeger.— **Changsha**. *1*. 48963a, 48972, 48974. **Wulingyuan**. *15d*. 53406. *15e*. 53203. *19a*. 52303, 53324, 52341, 52345. *19d*. 51614, 51617. *19e*. 51945, 51948, 51949. In evergeen Lauraceae-Fagaceae-*Pinus massoniana* forest, in evergreen second growth forests and *Cryptomeria fortunei-Cunninghamia lanceolata* plantation, and on road and path side cliffs. On stone walls (7 specimens), tree trunks (4), tree base (2), and cliff (1), alt. 50–1 000 m. — Widely distributed in China.

TOTAL RANGE: As 1; As 2: Chi Ja Ko; As 3: Bhu Bu In La Ne Pa Si Tha Vi; As 4: Phi.

Brachythecium garovaglioides* Müll. Hal. — **Wulingyuan. *16c* 52724, on litter in second growth evergreen subtropical forest with some planted *Cunninghamia lanceolata*, alt. 470 m. — Previously reported in China from 15 provinces.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Bu In Ne Pa; As 4: Ind (Java).

Brachythecium plumosum* (Hedw.) B.S.G. — **Mangshan. *14a*. 49100, 49101, 49103, 49107, 49113, 49115, 49117, 49118, 49193, 49544. *14b*. 49607. **Wulingyuan**. *16b*. 53123. *16c*. 52706a. *16d*. 53359, 53386. *17b*. 52114, 52420. *18a*. 52483a, 52957. *18b*. 52602, 52608, 52621, 52622, 52623. *18c*. 52973, 52978. *18d*. 52631, 52640. *18e*. 52510, 52039, 52043, 53046. *19a*. 52258, 52308. *19b*. 51638, 51642, 52015, 52039, 52040. *19e*. 51889a, 51890, 51902, 51947. Along road and trail sides, second growth subtropical forests, subtropical elfin forest on mountain top, and *Cunnighamia lanceolata* plantations, alt. 400–1 900 m. On rocks or boulder s (13), cliffs (13), sand (7), on trunk of *Toona atriata* (1), rotten branch (1), bush (1), on twig of *Hydrangea* (1), and wall of stone (1). — Widely distributed in China.

TOTAL RANGE: Eur; As 1; As 2: Chi Ja Ko; As 3: Bhu In Ne Pa Si Sri; As 4: Ind (Java, Lombok, Sulawesi, West Irian) Ma (Sabah) PNG Phi; As 5; Afr. 1, 2 ; Am 1–4; Oc: Haw; Austr 1, 2.

Brachythecium populeum (Hedw.) B.S.G. — **Wulingyuan**. *17a*. 51833. *17b*. 52087, 52112. *19a*. 52268, 52269, 52287, 52314. In second growth evergreen subtropical forest along river, 550–620 m. It was collected from rock outcrops (3), cliff (1), wall of boulder (1), and tree trunks (2). — Widely distributed in China.

TOTAL RANGE: Eur; Afr. 1, 2; As 1; As 2:, Ja, Ko; As 3: Bhu, In, Ne, Pa; As 5; Am 1.

Brachythecium salebrosum* (Web. & Mohr) B.S.G. — **Mangshan. *14a*. 49112, on bush at road, subtropical zone, 1 750–1 902 m. — In northern and central China, and Taiwan.

TOTAL RANGE: Widely spread in holarctic; As 2: Chi Ja Mo; As 4: In Ne Pa; Austr 1, 2.

Bryhnia novae-angliae* (Sull. & Lesq.) Grout — **Wulingyuan. *15a*. 52933. *16a*. 52894. *16b*. 53095. *17a*. 51848. *17b*. 52381, 52386, 52771. *18c*. 53000. *19a*. 52251, 52252, 52283, 52292, 52317, 52360, 52361, 52365, 52369. On brookside and roadside cliffs, in the second growth subtropical forests, 315–620 m. On rock outcrops or cliffs (14), tree trunks (2), base of tree (1), and bush (1). — Widely distributed in China.

TOTAL RANGE: Am 1; Eur; As 1; As 2: Chi Ja Ko; As 3: In Ne Pa.

Eurhynchium hians* (Hedw.) Sande Lac. — **Changsha. *1*. 49368, 49372, 49379. **Wulingyuan**. *15a*. 52909. *15c*. 53211, 53252. *16b*. 53118. *16c*. 52702, 62725. *17a*. 52458. *17b*. 52380. *19a*. 52281, 52287a, 52326. *19c*. 51808. *19e*. 51777, 51893, 51894. Trail and road sides, brookside

cliffs, second growth subtropical forests and *Cunninghamia lanceolata* plantations, 50–1 000 m. On cliffs (5 specimens), top of stones (2), sand (3), litter (1), clay (2), gravel (1), and on trunk of *Ailanthus altissima* (1). — Previously reported in China in 11 provinces.

TOTAL RANGE: Holarctic; Am 1 Eur; Afr 2; As 1: As 2: Chi Ja As 3: [Bhu (Gangulee (1969–1980); according to Vohra (1983) specimen sited by Gangulee is *Rhynchostegium planiusculum* (Mitt.) A. Jaeger] In, Ne, Pa.

Eurhynchium protractum* Müll. Hal. — **Wulingyuan. *15c*. 53252a. *16a*. 52887a. *16b*. 53091. *16c*. 52708. *18a*. 52477. *19a*. 52326. *19b*. 51997. *19d*. 51629. *19e*. 51775, 51895. On rocks and cliffs on lake shore, along brooks, trails and roads, in *Cryptomeria fortunei-Cunninghamia lanceolata* plantation, in subtropical second growth forest with some planted *Cunninghamia lanceolata,* 400—1 000 m. On sand (3 specimens), clay (3), litter (2), top of stone (2), cliff (1), rotten tree trunk (1) and on stone wall. — Described from Shaanxi Province of China and not reported from other provinces, but it does not seem to be very rare in the central part of China (pers. obs.).

TOTAL RANGE: As 2: Chi.

Palamocladium leskeoides* (Hook.) Britt. — **Mangshan. *9a*. 49524. **Wulingyan**. *16b*. 53144. *18a*. 52572. *18b*. 52596. *18d*. 53026. *19a*. 52344, 52336, 52348. *19b*. 52034, 52038. *19c*. 51811, 51817, 51819. At road sides, in primeval evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest, in subtropical second growth evergreen forests and *Cunninghamia lanceolata* plantations, 400–1 225 m. All specimens were taken from trunks of deciduous trees (*Fagus, Liquidambar formosana, Tapiskia chinensis*). — Rather widely distributed in China.

TOTAL RANGE: Am 1–6; Afr 2–4; As 2: Chi Ja Ko; As 3: In Ne Sri; As 4: Ind (Bali, Java, Lombok, Sumbawa) Phi; Austr. 2 (Hoffman 1997).

Platyhypnidium riparioides (Hedw.) Dix. — **Wulingyuan**. *17a*. 51843, 51846, 52147, 52148, 52149. *19a*. 52271. All specimens were collected from rocks along stream sides in second growth evergreen subtropical forest, 550–620 m. — Widely distributed in China.

TOTAL RANGE: Holarctic and bipolar; Am 1, 2, 6; Afr 1; Eur; As 1; As 2: Chi Ja Ko; As 3: Bhu In Ne Pa Si; As 5.

Rhynchostegiella laeviseta* Broth. — **Mangshan. *3a*. 51882, 51883. **Wulingyuan**. *19c*. 51803. *19d*. 51637. On rocks (2 specimens), gravel (1), and on base of climber (1) in second growth evergreen subtropical forest, alt. 500–985 m. — Previously reported in China from Henan and Hubei.

TOTAL RANGE: As 2: Chi.

Rhynchostegium pallidifolium (Mitt.) Jaeg. — **Mangshan**. *3a*. 51868, 51879. *9a*. 49044. *11a*. 51301. *14a*. 49108, 49139, 49567. **Wulingyuan**. *17a*. 51839, along road and river in second growth evergreen forest, in primeval subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest, and in swamp, 500–1 900 m. On rocks or cliffs (3 specimens), soil (2), litter (1) and on branch of tree (?). — Widely distributed in China.

TOTAL RANGE: As 2: Chi Ja.

Bryaceae Schwaegr. (by T. Koponen)

Anomobryum julaceum* (Gaertn. *et al.*) Schimp. — **Mangshan. *2*. 51557. *4a*. 51546. *6*. 51197, 51222. *7a*. 50952. *8*. 49003. *14a*. 49470. **Wulingyuan**. *15e*. 53206.*16b*. 53127 *16d*. 53387. *19d*. 51620. *Anomobryum julaceum* was collected once in primeval subtropical forest, all the other habitats were influenced by human activities, such as second growth forests, in yards, stone walls, and road side cliffs at 390–1 900 m. Substrates were: stone walls (6 specimens), cliffs (2), rock crevice (1), and sandy soil at road side (1). — Known previously for 11 provinces of China (Redfearn *et al.* 1996). All our specimens had propagules in leaf axils.

TOTAL RANGE: Widely distributed in Northern and Southern Hemispheres.

Brachymenium exile* (Dozy & Molk.) Bosch & Sande Lac. — **Mangshan. *2*. 51554. *8*. 49014. **Wulingyuan**. *15e*. 53183. On man-made substrates, such as roadsides and crevices of stone walls, at 390–1 200 m. — Redfearn *et al.* (1996) listed this plant for several south Chinese provinces.

TOTAL RANGE: Widely distributed, pantropical.

Brachymenium nepalense* Hook. — **Mangshan. *12a*. 49638, 49639, on trunk of dead tree in sec-

ond growth subtropical forest. *14b*. 49147, 49266, 49605, on twigs in elfin forest on mountain top, at 1 230–1 900 m. — Reported from 20 provinces of China (Redfearn *et al.* 1996).

TOTAL RANGE: In Africa, widely distributed in southeast Asia and the Pacific.

Bryum argenteum* Hedw. — **Mangshan. *2*. 51552. *4a*. 51550. *8*. 49416. *14a*. 49111. *14b*. 49150, 49254. **Wulingyuan**. *15e*. 53184. *16d*. 53376, 53388. *19e*. 51786. This "cosmopolitan" moss of ruderal habitats seems to be common in Hunan in crevices of stone walls of road sides and yards (6 specimens), road side cliffs (1) and sandy soil (1) at 390–1 200 m. Three specimens were collected from tree trunk and tree branches in more natural habitats at 1 200–1 900 m. — Known previously from 26 (out of a total of 33) provinces in China (Redfearn *et al.* 1996).

TOTAL RANGE: "Cosmopolitan"; in the arctic, boreal, temperate, and meridional zones, and the mountains of the tropics; however, seems to be lacking in tropical lowland areas (cf. Norris *et al.* 1999).

Bryum billarderii* Schwaegr. — **Mangshan. *3a*. 51863. *7a*. 50919. *9a*. 49020, 49171, 49519. *11b*. 51166, 51315. *12a*. 49600. *13. 50989.* 14a. *49104.* **Wulingyuan**. *15c.* 53251. *16b.* 53114, 53116. In primeval and second growth forests, in disturbed habitats such as road side banks and cliffs and *Pinus massoniana* plantation, at 375–1 900 m. Substrates: On cliffs or boulders (5 specimens), tree bases or tree trunks (4), on litter (1), and on sandy soil (1). — After this report known from 14 provinces of China (Redfearn *et al.* 1996).

TOTAL RANGE: Pantropical.

Pohlia elongata* Hedw. — **Mangshan. *14a*. 49133, on cliff, 49199, 49200 on humus, 49453 on sandy soil on mountain top in disturbed habitat, at 1 750–1 902 m. — Known from 18 provinces in China (Redfearn *et al.* 1996).

TOTAL RANGE: Widely distributed circumpolar and bipolar species.

Pohlia proligera* (Kindb.) Lindb. ex H. Arn. — **Mangshan. *8*. 48988, 49158, 49408. **Wulingyuan**. *15c*. 53411. *15e*. 53181. *16b*. 53129. *17b*. 52126. *19a*. 52313. Most specimens came from disturbed habitats such as road side cliffs and banks, twice collected in second growth subtropical forest, at 375–1 200 m, on sand (4 specimens), gravel (1), and cliffs or outcrops (2). — In China reported from Guizhow, Heilongjiang, Inner Mongolia, Jilin, Liaoning, Shangdong and Zhejiang (Redfearn *et al.* 1996).

TOTAL RANGE: Widely distributed on the northern hemisphere.

Dicranaceae Schimp. (by P. Rao)

Gao *et al.* (1994) accepted 14 Chinese species of *Dicranodontium*. Frahm (1997), in his worldwide monograph, reduced the total number of species from 39 to seven and accepted six species for China. Gao *et al*. (1999) recognized 8 species for China. The only species that has not been found in China is *D. pulchroalare* Broth. Frahm (1997) defined the genus clearly and it can be well distinguished from related genera, such as *Campylopus* and *Dicranum*. His concepts are mainly followed in this paper, and the identification of the specimens is based on his species concept with few exceptions.

Rao *et al.* (1997) recorded 3 species of *Dicranodontium, D. attenuatum* (Mitt.) Wils. ex A. Jaeger (= *D. didymodon* (Griff.) Paris), *D. filifolium* Broth. (systematic position unknown), and *D. porodictyon* Cardot & Thér. for Hunan. None of them, however, was found in the recent collection. Three other species are here added to the flora of Hunan.

Dicranodontium asperulum* (Mitt.) Broth. — **Mangshan. *7a*. 50982. *7e*. 50625. **Wulingyuan**. *15a*. 52942. Along river bed in primeval subtropical forest and brook sides in deep gorge, on rocks, 315–1 180 m. — Frahm (1997) reported *D. asperulum* from Sichuan and Taiwan in China.

TOTAL RANGE: Am 1; Eur; As 2: Chi Ja; As 3: Ind Ne Si.

Dicranodontium denudatum* (Brid.) Britt. — **Wulingyuan. *18d*. 52661, 53023. *18e*. 53038. Collected only along Yaozizhai Trail on very steeply sloping cliff from rotten tree or cliff, 800–955 m. — Frahm (1997) cited a specimen from Sichuan, and Redfearn *et al*. (1996) cited the species for 14 Chinese provinces.

TOTAL RANGE: Holarctic; Am 1–3; Eur; As 1; As 2: Chi Ja; Eur 3: In Sri; As 4: Phi.

Dicranodontium didictyon* (Mitt.) A. Jaeger — **Wulingyuan.*18b*. 52619. *18d*. 52649.*18e*. 52492, 52498. *19d*. 51959. All localities are on the steep slopes of towering cliff formations of Wulingyuan area and the substrate is rock. — Frahm (1997) recorded it for Sichuan and Yunnan provinces of China.

TOTAL RANGE: As 2: Chi; As 3: In.

Dicranodontium cf. *pulchroalare* Broth. — **Mangshan**. *5*. 51362, along river shore in subtropical partly disturbed evergreen forest, 800 m, on rock. *9a*. 49050, 49172 in evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest with undergrowth of *Sinarundinaria basihirsuta*, 1 225 m, on rock.

The Hunan specimens fit the concept of *Dicranodontium pulchroalare* of Frahm (1997). It can be separated from *D. porodictyon* by its pitted upper laminal cells. Examination of the type material suggests that the upper laminal cells of both species are pitted slightly or distinctly. Based on Frahm's concept of the two species, I (P. Rao) checked the type material of *D. meridionale* (= *D. pulchroalare*) and *D. falcatum* (= *D. porodictyon*), and found a similar situation: the upper laminal cells are slightly pitted in both specimens. Thus, this character is not critical in separation of the two species. On the other hand, I found the enlarged inner laminal cells to be of diagnostic value. They are strongly pitted in *D. porodictyon* but not so in *D. pulchroalare*. In addition, the basal laminal cells are hyaline and thin-walled in *D. porodictyon* but reddish and thick-walled in *D. pulchroalare*. Another clear difference between the two species is in the enlarged inner laminal cells, which form a short group in *D. porodictyon* but a wide and long group in *D. pulchroalare*. This character was also illustrated by (Frahm 1997: figs. 5b, 6b). I believe that our specimens from Hunan are closer to *D. pulchroalare* than to *D. porodictyon*. However, since the latter species is currently known only from South America (Frahm 1997), I report it with reservation; further studies may show that the present specimens represent an undescribed taxon. *Dicranodontium pulchroalare* is the only species of the genus not yet discovered in China (cf. Gao *et al.* 1999).

Hookeriaceae Schimp. (by A. Juslén)

Calyptrochaeta japonica (Cardot & Thér.) Iwats. & Nog. — **Mangshan**. *7d*. 50710, 50711. *12b*. 50587. **Wulingyuan**. *19a.* 52353. Both in primeval and second growth subtropical forests, in valleys on brook sides, tree trunks, and on outcrop along stream bed, 1 180–1 280 m. — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja.

Calyptrochaeta ramosa* (Fleisch.) Tan & H. Rob. subsp. *spinosa* (Nog.) P.-J. Lin & Tan — **Mangshan. *12a*. 49565. *19a*. 52358, 52362, 52364. In second growth subtropical forest, at brook side on outcrops (3 specimens) and on rotten tree trunk (1), 620–1 230 m. — Previously known in China from Guangdong, Guangxi, Hainan, Sichuan, Taiwan and Zhejiang.

TOTAL RANGE: As 2: Chi; As 3: Vi; As 4: Ind Phi.

Distichophyllum collenchymatosum Cardot — **Mangshan**. *3b.* 51748, 51753. Along stream in second growth subtropical forest, on wet cliffs at 600 m. — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja, As 4: Phi.

Distichophyllum maibarae Besch. — **Wulingyuan**. *16b.* 53093. *18d.* 52645, 52667. *19a.* 52278, 52279. *19b.* 52025. In second growth forests and on cliffs at roadside, on wet, partially shaded habitats, 400–855 m. On cliffs (5 specimens), soil (1). — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: In (Lin & Tan 1995); As 4: Ma (Lin & Tan 1995) Phi.

Distichophyllum obtusifolium* Thér. — **Wulingyuan. *15a.* 52930. — In deep gorge, brook side, on cliff, 315 m. — Previously known in China from Guizhow, Hainan and Taiwan.

TOTAL RANGE: As 2: Chi Ja; As 4: Phi.

Hookeria acutifolia Hook. & Grev. — **Mangshan**. *10a.* 50810. *10c*. 51094. **Wulingyuan**. *15a*. 52904. *18a*. 52481. *18d*. 52643. *19a*. 52359. *19b*. 52004. In second growth mixed evergreen and deciduous subtropical forests, *Cunninghamia* plantation in moist habitats such as brook sides at 315–1 250 m. On sand (2 specimens), soil (2), humus

(1), and on cliffs (2). — Widely distributed in China.

TOTAL RANGE: As 1; As 2: Chi Ja Ko; As 3: Bhu In Ne Sri Vi; As 4: Ind Phi; Oc; Am 2–4.

Hypopterygiaceae Mitt. (by A. Juslén)

Cyathophorella kyushuensis* Horikawa & Nog. — **Wulingyuan. *18c.* 52991. On tree runk at 625–700 m in second growth mixed evergreen and deciduous forest. — Previously known in China from Fujian and Taiwan.

TOTAL RANGE: As 2: Chi Ja.

Leskeaceae Schimp. (by Y.-M. Fang & M. Ignatov)

Okamuraea brachydiction* (Card.) Nog. — **Changsha. *1.* 48963, 48969, on the trunk of *Ulmus* and on base of tree in the evergeen Lauraceae-Fagaceae-*Pinus massoniana* forest, 50 m. — Previously reported in China from seven provinces.

TOTAL RANGE: As 1; As 2: Chi Ja Ko.

Pseudoleskeopsis zippelii (Dozy & Molk.) Broth. — **Wulingyuan.** *16b*. 53076, 53098. *17a*. 51840, 52554. All specimens were collected from path and road side cliffs in pure population or associated with *Thuidium kanedae*. — It is known from Anhui, Fujian, Guizhou, Hainan, Hong Kong, Hunan, Liaoning, Taiwan, and Yunnan

TOTAL RANGE: As 1; As 2: Chi Ja Ko; As 3: In Sri Tha Vi; As 4: Ind Ma PNG Phi; Austr 1–2.

Meteoriaceae Kindb. (by S. Huttunen)

Meteoriaceae is treated in the sense of Ignatov (1999).

Aerobryopsis parisii* (Cardot) Broth. — **Mangshan. *4b.* 51514, on tree trunks by the road to power station at 640 m. — Previously reported in China from Fujian, Guangdong, and Taiwan.

TOTAL RANGE: As 2: Chi Ja; As 4: Phi.

Aerobryopsis subdivergens* (Broth.) Broth. — **Mangshan. *3b.* 51739, 51743. *4b.* 51144, 51506, 51698. *6*. 51462. *7a*. 50956. *7d*. 50718. *9a.* 49056. *10a.* 50805, 50816, 50821. *11c*. 51106, 51182. *12a.* 49559, 49568, 49580. *13*. 51005, 51763b. **Wulingyuan**. *16a* 52867, 53150. In second growth subtropical evergreen mixed forest, road sides and brook sides, primeval subtropical evergreen mixed forest, at dry stream bed, and bamboo cultivations, alt. 400–1 235 m. Substrates: On rotten twigs (4), bushes (5), tree trunks (6) and tree bases (2), and cliff (5). — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: Vi; As 4: Phi; Oc: Haw (Noguchi 1976).

Aerobryum speciosum (Dozy & Molk.) Dozy & Molk. — **Wulingyuan**. *17b*. 52752, 52753, 52759, 52810. In second growth evergreen subtropical forest, 550–580 m, on tree trunks (1), bushes (2), and climbers (1). — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: Bhu In La Sri Tha Vi; As 4: Ind Phi PNG.

Meteoriella soluta (Mitt.) Okam. — **Mangshan**. *14a.* 49208 on gravel along road, alt 1 750–1 902 m. *14b.* 49610, 49614 on rotten stump and on trunk in subtropical elfin forest on mountain top, at 1 900 m. — Widely distributed mainly in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: Bhu Vi; As 4: Phi.

Neobarbella comes* (Griff.) Nog. — **Mangshan. *7a.* 50975, on climber, in primeval subtropical forest, at 1 135 m. — Previously reported from nine provinces in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: Bhu In Sri; As 4: Ind Phi.

Mniaceae Schwaegr. (by T. Koponen)

We follow Koponen's (1988, 1993) classification of the Mniaceae and Plagiomniaceae.
Mnium lycopodioides* Schwaegr. — **Wulingyuan. *16a*. 52893. *17b.* 52140, 52435, 52792, 52814. *18b*. 52597. *18c*. 52980. *18e*. 52690. *19b*. 52041. *19d*. 51957. Most of the specimens were collected in second growth subtropical forests and

from cliffs along trails at 400–950 m. On cliffs or outcrops (5 specimens), tree trunks or tree bases (4), and on sandy soil at trail (1). — In China recorded for many provinces under various names (Koponen 1981, Koponen & Luo 1982). The records from Hunan under the name *Mnium thomsonii* Schimp. (Rao *et al.* 1997) may actually be *M. lycopodioides,* and should be confirmed.

TOTAL RANGE: A northern hemisphere boreal and temparate species with a disjunction in New Guinea (Norris *et al.* 1999).

Pyrrhobryum dozyanum* (Sande Lac.) Manuel — **Mangshan. *12a*. 49581. **Wulingyuan**. *17b*. 52806. *18b*. 52693. All specimens were taken in second growth forests and grew on deep soil or humus at 550–1 230 m. — In China it has been previously reported from eight provinces.

TOTAL RANGE: As 2: Chi Ja Ko.

Pyrrhobryum latifolium* (Bosch & Sande Lac.) Mitt. — **Mangshan. *4b*. 51131 ster., 51490 ster. *5*.51383 ster. *6*. 51202 ster., 51225. *7a*. 50896 ster. *7e*. 50872 ster. *7d*. 50699, 50714. *10a*. 50815 ster. *12a*. 49571. *13*. 50992. **Wulingyuan**. *15b*. 53166. *19d*. 51966 ster. All specimens were either female or male plants or sterile. In accordance with Koponen *et al.* (1986), we keep *P. latifolium* specifically distinct from the autoicous *P. spiniforme* (Hedw.) Mitt. *Pyrrhobryum latifolium* was collected both from primeval and second growth forests, and from disturbed sites such as road side cliffs. The substates were: Cliffs or rock outcrops (10 specimens), on humus (2), sandy soil (1), and tree base (1). — For a detailed distribution in China, the records under *P. spiniforme* need confirmation.

TOTAL RANGE: As 2: Chi Ja; As 3: Vi; As 4: Ind, Ma, Phi, PNG.

Trachycystis microphylla (Dozy & Molk.) Lindb. — **Changsha**. *1*. 48951, 48952, 48967, 48976, 49369, 49380. **Wulingyuan**. *15a.* 52911. *15b*. 53396, 53397. *15e*. 53186. *16b*. 53086. *16c*. 52699. *16d*. 53378. *17a*. 51838, 52464. *17b*. 52084, 52102, 52129, 52413, 52430, 52429, 52765. *18a* 52838. *18d.* 52656. *19a*. 52267. *19d.* 51970, 51983, 51988. *Trachycystis microphylla* is a common low altitude (50–1 000 m) moss growing on rather open habitats, most of them disturbed or man-made, such as stone walls and road-side cliffs. In second growth forests it inhabits boulders and tree trunks. The majority of. the specimens were collected from rocky substrates (17 specimens), 4 specimens from sandy soil, and 8 specimens from trunk bases or tree trunks. — Reported from 21 Chinese provinces (Redfearn *et al.* 1996).

TOTAL RANGE: As 2: Chi Ja Ko; Russian Far East (Koponen 1981; distribution map in Koponen & Lou 1982).

Plagiomniaceae T. J. Kop. (by T. Koponen)

Plagiomnium acutum (Lindb.) T. J. Kop. — **Changsha**. *1*. 48975. **Mangshan.** *3a*. 51886, 51884. **Wulingyuan**. *15b*. 53161. *16b*. 53117. *17b*. 52079, 52089, 52103, 52113, 52790. *18a*. 52484, 52561, 52972. *18c*. 52976, 53009, 53010. *18e*. 52507. *19a*. 52366. *19b.* 51998, 52023. *19c*. 51802, 51806, 51807, 51820. *19d*. 51648. *19e*. 51892. Most of the habitats were second growth forests or plantation forests, or other habitats disturbed by man, such as trail side and road side cliffs, or stone walls. The most common substrates were cliffs, boulders or rocks (16 specimens). Other substrates were tree trunks (2), stone walls (2), sandy soil (3), gravel (2), and soil (1). — *Plagiomnium acutum* is widely spread in China and occurs in most of the provinces. All specimens which were not sterile, were either male or female plants. I have not yet seen specimens of the related and synoicous *P. cuspidatum* (Hedw.) T. J. Kop. from China.

TOTAL RANGE: As 1: Khabarovsk, Primorye, Sakhalin; As 2: Chi Ja Ko Mo; As 3: Bhu In Ne Vi.

Plagiomnium integrum (Bosch & Sande Lac.) T. J. Kop. — **Wulingyuan**. *17a* 52460 ster. *17b*. 52763, 52764. *19d*. 51969. All specimen came from moist habitats in second growth forests at 550–980 m. On tree trunks (2 specimens), rock (1), and soil (1). — Redfearn *et al.* (1996) recorded *P. integrum* from 18 Chinese provinces, but Koponen and Luo (1982) saw specimens collected only in the southern provinces of China. It is a tropical and subtropical plant ranging from the Himala-

yas to China, New Guinea and some Pacific Islands.

TOTAL RANGE: As 2: Chi; As 3: Bhu Bu In Ne; As 4: Ind Ma Phi PNG Sa; Oc: Fij Van.

Plagiomnium maximoviczii (Lindb.) T. J. Kop. — **Mangshan**. *9a*. 49087, 49505. **Wulingyuan**. *15a*. 52908 ster. *18a*. 52490 ster. *18c*. 52985. *Plagiomnium maximoviczii* was collected both in primeval forest and second growth forest at 315–1 225 m. Three specimens were taken from rocks or boulders and one specimen from tree trunk. It may be emphasized that in Mangshan it grew in the same evergreen subtropical Araliaceae-Fagaceae-Hamamelidaceae-Magnoliaceae forest with undergrowth of *Sinarundinaria basihirsuta* (locality 9a) from where the related autoicous *P. rhynchophorum* was collected. — *Plagiomnium maximoviczii* ranges in temperate and meridional zones from the Himalayas to Japan (Koponen 1981), and it has been reported from 25 Chinese provinces (Redfearn *et al.* 1996).

TOTAL RANGE: As 1: Primorye; As 2: Chi Ja Ko; As 3: In.

Plagiomnium rhynchophorum* (Harvey) T. J. Kop. — **Mangshan. *9a*. 49021, 49069 ster., 49444. *11c*. 51330, 51336. **Wulingyuan**. *16c*. 52716 ster. *17a*. 52457 ster. The Mangshan localities were primeval and the Wulingyuan localities secondary subtropical forests at 470–1 235 m. It grows in a variety of habitats, such as tree trunk or base (2 specimens), rock or boulder (2), fallen tree trunk (1), and sandy soil (1). The specimens marked as ster. were without antheridia and archegonia, the others were synoecious. — Recorded previously from 6 Chinese provinces (Redfearn *et al.* 1996).

TOTAL RANGE: Pantropical (distribution map in Koponen 1982).

Plagiomnium succulentum (Mitt.) T. J. Kop. — **Wulingyuan**. *15a*. 52925. *15b*. 53154. *16b*. 53138. *17b*. 52830, 52831. *18c*. 53001. *19b*. 52037. All specimens were collected in moist to wet cliffs in secondary forests or in deep gorges at brooks at 315–700 m. — Distributed from the Himalayas to Japan and New Guinea (Koponen & Norris 1983), and recorded previously for 25 Chinese provinces (Redfearn *et al.* 1996).

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Bhu Bu In Ne Tha Vi; As 4: Ind Ma Phi PNG.

Myuriaceae Fleisch. (by S. Huttunen)

Oedicladium rufescens* (Reinw. & Hornsch.) Mitt. — **Mangshan. *5*. 51396. *7a*. 50934. *7b*. 50904, 50906, 50911a, 51060a, 51062, 51063. *7c*. 50756. Along river shores in subtropical evergreen primeval forest and in rocky mountain top in subtropical forest, on cliffs, alt. 800–1 160 m. — Previously reported in China from Anhui, Guangdong, Guangxi and Zhejiang.

TOTAL RANGE: As 2: Chi Ja; As 3: Bu Tha Vi; As 4: Ma Phi.

Neckeraceae Schimp. (except Neckera) (by J. Enroth)

Homalia trichomanoides (Hedw.) B.S.G. — **Mangshan.** *1*. 48982, 49386. Both specimens were growing in shady places on tree bases in warm temperate or subtropical Lauraceae-Fagaceae-*Pinus massoniana* forest at ca. 50 m. According to S. He (1997), *Homalia trichomanoides* var. *trichomanoides* is widely distributed mainly in the temperate regions of the northern hemisphere. — In China, it was previously known from several provinces (Redfearn *et al*. 1996).

TOTAL RANGE: Am 1; Am 2 (Mexico); Eur; As 1; As 2: Chi Ja Kor; As 3: Bhu In (S. He 1997).

Homaliadelphus targionianus (Mitt.) Dix. & P. Varde — **Wulingyuan.** *16c*. 52736 (mixed with *Neckera* sp.). *17a*. 52469. *18e*. 52515. *19b*. 51992, 52051. *19c*. 51818.

All specimens were growing on tree trunks (*Liquidambar formosana, Cupressus funebris, Clerodendron mandarinorum, Pterocarya* sp.), four of them in second-growth and one in virgin subtropical forest. — It is widely distributed in southern China and up to Shaanxi and Shandong provinces (Redfearn *et al*. 1996).

TOTAL RANGE: (Noguchi 1989, Tan & Iwatsuki 1993); As 2: Chi Ja Ko; As 3: Bhu (cf. Long 1994) In Ne (Enroth 1994) Tha Vi.

Homaliodendron exiguum* (Bosch & Sande Lac.) Fleisch. — **Mangshan. *4b*. 51441, 51442 (mixed with *Hypopterygium* sp.). The present specimens were growing on a tree trunks in warm temperate or subtropical mixed forest at 640 m. — This is a

tropical-subtropical species, in China known from most of the southern provinces, the northernmost localities being in Xizang and Jiangsu (Redfearn *et al*. 1996).

TOTAL RANGE: Afr 3; As 2: Chi Tai Ja; As 3: In Sri Ne Bu Tha Vi; As 4: Ma Ind Phi PNG; Austr1; Oc: Fij (Ninh 1984, Enroth 1989).

Homaliodendron flabellatum (Sm.) Fleisch. — **Mangshan.** *3b*. 51561, 51736. *4b*. 51134, 51443, 51509, 51517, 51679. *5*. 51391, 51401. *6.* 51217. *7a*. 50929, 50955. 7d. 51054. *7e*. 50642, 50883. *9a*. 49081, 49162, 49429, 49517. *10c*. 51031, 51265. *11c*. 51324, 51329. *12a*. 49579. *12b*. 50575. **Wulingyuan.** *16a*. 52872. *19c*. 51809 (mixed with *Neckera* sp.), 51810. Enroth's (1989) broad concept of this species is followed here. *Homaliodendron flabellatum* has been reported from Hunan as *Homaliodendron ligulaefolium* (Mitt.) M. Fleisch. (Qi *et al*. 1990) and *H. squarrulosum* M. Fleisch. (Redfearn *et al*. 1996). The present specimens were growing on tree trunks (14 specimens), rock outcrops or cliffs (9), tree bases (2), rotten twigs (2), and bush (1), all in moist habitats in subtropical forests. — It is distributed in most provinces in southern and eastern China.

TOTAL RANGE: Am 2 (Mexico, Guatemala, Panama, Costa Rica); Am 3 (Cuba, Haiti, Jamaica); Afr 3; As 2: Chi Ja Ta; As 3: Bhu Bu In La Ne Tha Sri Vi; As 4: Ind Ma Phi PNG. Austr 1 (Queensland). Oc: Haw NC (Enroth 1989, Buck 1997).

Thamnobryum subserratum (Hook.) Nog. & Iwats. — **Wulingyuan.** *17b*. 52092, 52370, 52424, 52431, 52751, 52801, 52809. *18a*. 52485, 52576. *18b*. 52629. *18c*. 52989. *19a*. 52349. On rock outcrops, cliffs or boulders (10 specimens), and trunk of *Lindera megaphylla* (1); one specimen lacks information of substrate. All grew in second growth subtropical evergreen forest, save one, which was collected in a *Cunninghamia lanceolata* plantation. — Previously reported from Hunan by Tan *et al*. (1994), but not cited for the province by Redfearn *et al*. (1996). A partial explication of the taxonomic problems concerning *Thamnobryum subserratum* was provided by Tan (1989). The name *T. subseriatum* (Sande Lac.) Tan has often mistakenly been used for this species. The latter is probably a Japanese endemic (Tan 1989) and therefore Redfearn *et al*. (1996) accepted the records from China "with reservation", pending re-examination of the specimens. Under the name *T. subserratum* the taxon is known in China from Anhui, Gansu, Guizhou, Hubei, Jiangxi, and also from Taiwan (Redfearn *et al*. 1996).

TOTAL RANGE: As 2: Chi Ta; As 3: Bu "Himalayas" In Sri Tha Vi; As 4: Phi Ind (Tan 1989, Tan & Iwatsuki 1993).

Polytrichaceae Schwaegr. (by J. Hyvönen)

Atrichum crispulum Schimp. ex Besch. — **Wulingyuan**. *18b*. 52624, on sand on cliff at 630 m in second growth subtropical forest. — Widely distributed in southeastern part of China (Luo & Koponen 1986, Redfearn *et al.* 1996).

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Tha (Luo & Koponen 1986).

Atrichum rhystophyllum (Müll. Hal.) Par. — **Changsha**. *1*. 48954, 48984. **Mangshan**. *3a*. 51765, 51872. *12a*. 49227. *14a.* 49132a, 49540. **Wulingyuan**. *16b*. 53099. *16c*. 52723. *16d.* 53377. *18a*. 52482, 52833. *18c*. 52987. *18d*. 52653, 52675. *18e*. 52491, 52503, 52685, 53037. *19a.* 52257. *19b.* 52033. *19d*. 51635, 51971. *19e.* 51776, 51942. The habitats are second growth or disturbed forests, plantation forests, or such open habitats as road sides and road side cliffs at 50–1 900 m. On sandy soil (13 specimens), soil (7), clay (3), gravel (2), and silt (1). — Widely distributed in southern and southeastern part of China (distribution map in Luo & Koponen 1986).

TOTAL RANGE: As 2: Chi Ja Ko (Luo & Koponen 1986).

Atrichum subserratum* (Hook.) Mitt. — **Wulingyuan. *17b*. 52121, on gravel at 550–580 m in second growth subtropical forest. — Previously recorded for China from Xizang and Yunnan (Luo & Koponen 1986).

TOTAL RANGE: As 2: Chi; As 3: In Ne (Luo & Koponen 1986).

Pogonatum cirratum* (Sw.) Brid. ssp. *cirratum* — **Mangshan. *5.* 51375. *6.* 51468a. *7d.* 49239, 50713In. *9a*. 49048. *10a*. 50828. *10c*. 51265. *11c*. 51191. *12b.* 50596. **Wulingyuan**. *16c*. 52863a. *16d*. 53370. *18d*. 52660. Along rivers in primeval and second growth subtropical forests, on road and brook side cliffs, in bamboo plantation at 470–

1 280 m. Collected from soil (9 specimens), and sandy soil (3 specimens). — Widely distributed in southern China (Redfearn *et al.* 1996).

TOTAL RANGE: As 2: Chi Ja; As 3: Bhu Si Sri Tha; As 4: Ind, PNG (Hyvönen 1989).

Pogonatum cirratum (Sw.) Brid. ssp. *fuscatum* (Mitt.) Hyvönen — **Mangshan**. *3a*. 51605. *4b*. 51492. *7a*. 50945. *9a.* 49039, 49511. *14a*. 49465. **Wulingyuan**. *17a.* 51850, 52451. *18e.* 52494, 52495. Along river shores and on cliffs in second growth and primeval subtropical forests, and on road side cliffs at 500–1 900 m. — Widely distributed in southern China (Redfearn *et al.* 1996).

TOTAL RANGE: As 2: Chi; As 3: Bhu Bu In La Ne Si Tha Vi; As 4: Ind Ma Phi (Hyvönen 1989).

Pogonatum neesii* (Müll. Hal.) Dozy — **Mangshan. *4b.* 51527. *7d*. 50708. *8.* 48987, 49007, 49015a, 49152, 49154, 49157, 49392, 49400. *9a.* 49435. *10a.* 50798. *12a.* 49224, 49230, 49236, 49237. *12b.* 50573. *13*. 50995. *14a.* 49109. **Wulingyuan**. *16b.* 53125. *16c.* 52745. *16d.* 53353, 53379. *17b*. 52115. *18d.* 52676. *19a*. 52259, 52298. *19b*. 52054. *19d.* 51650. *19e*. 51887, 51918. Both in primeval and second growth forests, in bamboo cultivation, in *Cryptomeria fortunei-Cunninghamia lanceolata* plantation, and road side cliffs and banks at 470–1 900 m on sandy soil, gravel, clay, and laterite. — Widely distributed in China (Redfearn *et al.* 1996)

TOTAL RANGE: Eur: Russia; As 1: Russian Far East; As 2: Chi Ja Ko; As 3: Bhu Bu In La Ne Si Sri Tha Vi; As 4: Ind Ma PNG Phi; Austr 1; Oc: Fij NC Sa Van (Hyvönen 1989).

Pogonatum proliferum* (Griff.) Mitt. — **Mangshan. *8.* 49415, along road sides on sand at 1 185–1 200 m. *9a.* 49025, 49039 (with *P. cirratum* spp. *fuscatum*), 49173, 49424, on soil, clay and gravel at 1 225 m in subtropical forest. *14a.* 49129, 49211, 49472, along road on cliffs on soil at 1 750–1 902 m. — Reported previously for five southeastern provinces of China (Redfearn *et al.* 1996).

TOTAL RANGE: Afr 2: Ruanda, Uganda; As: Chi; As 3: Bu Ind Ne Si Tha; As 4: Ind Phi (Hyvönen 1989).

Pogonatum spinulosum* Mitt. — **Mangshan. *7c*. 50765a, 50766, 51070, on soil and sand in primeval subtropical forest at 1 160 m. *13.* 50994, on gravel on road side bank at 1 385 m. *14a*. 49466a, on soil, along road on cliffs at 1 705–1 902 m. *14b*. 49318, on clay in elfin forest on mountain top at 1 900 m. **Wulingyuan**. *18e*. 52682, 53051, on sand on steep NE cliff at 855–955 m. — Widely distributed in eastern China (Redfearn *et al.* 1996).

TOTAL RANGE: As 1: Russian Far East; As 2: Chi Ja Ko; As 4: Phi (Hyvönen 1989).

Pogonatum urnigerum* (Hedw.) P. Beauv. — **Mangshan. *14a.* 49537, along road on cliffs on sand at 1 750–1 902 m. — Widely distributed in China (Redfearn *et al.* 1996).

TOTAL RANGE: Widely distributed in the Northern Hemisphere with southernmost reports from New Guinea and equatorial Africa.

Polytrichastrum formosum* (Hedw.) G. L. Sm. — **Mangshan. *14a*. 49124, 49128, 49197, 49452, along road on cliffs on gravel and on boulder at 1 750–1 902 m. **Wulingyuan**. *19e*. 51920, on soil on cliff in *Cryptomeria fortunei-Cunninghamia lanceolata* plantation at 1 000 m. — Widely distributed in China (Redfearn *et al.* 1996)

TOTAL RANGE: Widely distributed in the Northern Hemisphere.

Racopilaceae Kindb. (by M.-J. Lai)

Racopilum cuspidigerum* (Schwaegr.) Ångstr. — **Mangshan. *3a*. 51885, 50967. *7a.* 50964. *9a*. 49446, 49068. *10a*. 51081. *12a*. 49599. **Wulingyuan**. *15c*. 52950, 53207, 53225. *16a*. 52885. *16b*. 53088. *16c*. 52703, 52717, 52730. *16d*. 53351. *17b*. 52086, 52110, 52387, 52433. *18a*. 52843, 52966. *18b*. 52630. *19b*. 52036. Two of the collecting localities were primeval subtropical evergreen forests, all the other localities were second growth forests, plantation forests, or disturbed habitats such as road side cliffs and banks. On cliffs, rocks or boulders (13 specimens), tree trunks or bases (5), rotten log or stump (2), and on clay soil. — *Racopilum cuspidigerum* has been recorded (Redfearn *et al.* 1996) only from three Chinese provinces. However, since *R. aristatum* Mitt. (De Vries *et al*. 1983) is a synonymous name, it is known from 16 Chinese provinces.

TOTAL RANGE: Widely distributed in the Pacific, Australasia and SE Asia and known under many synonymous names.

Thuidiaceae Schimp. (by Y.-M. Fang)

Bryohaplocladium microphyllum (Hedw.) Watan. & Iwats. — **Mangshan**. *2*. 51551, 51555. **Wulingyuan**. *15a*. 52923a. *15c*. 53224. *16c*. 52718. *19e*. 51794, 51934, 51936. All habitats were it was collected were more or less disturbed, such as yard, path side cliffs, or plantation forests. The elevations were 315–1 000 m and it grew on trunks of trees (5 specimens), log (1), boulder (1), and sandy soil (1). — It is rather widely distributed in China and known from 20 provinces.

TOTAL RANGE: As 1: Siberia; As 2: Chi Ja Ko; As 3: In Si Tha Vi; Eur; Am 1, 3–6.

Bryohaplocladium angustifolium* (Hampe & Müll. Hal.) Watan. & Iwats. — **Changsha. *1*. 49355a. **Mangshan**. *3a*. 51865, 51876. *12a*. 49634a, 49643. **Wulingyuan**. *17a*. 51841, 51842, 51844, c. spor. *17b*. 52073, 52075, 52416, with *Thuidium tamariscellum*, 52417a, 52418, 52754. *18a*. 52574. *18d*. 52670. *19a*. 52288, 52332, with *T. pristocalyx*. *19c*. 51804. *19e*. 51795, c. spor., 51923, c. spor., 51930, 51935, c. spor., 51946. All localities where *Bryohaplocladium angustifolium* was collected were second growth forests or plantation forests at 50–1 000 m. Of 21 specimens from 10 localities, 17 were found on tree trunks, 3 on rocks, and 1 on soil. It is locally abundant occuring in pure population or associating with *Thuidium pristocalyx*, *T. kanedae*, *T. tamariscellum* and *Haplohymenium pseudotriste*. Four of our specimens were with sporophytes. — In China, it is known from 16 provinces.

TOTAL RANGE: As 1: Siberia; As 2: Chi Ja Ko; As 3: Bu In Pa Vi; Eur; Afr; Am 2: Mexico; Am 3: Jamaica.

Claopodium aciculum* (Broth.) Broth. — **Wulingyuan. *15c*. 53231, on road side cliffs, 375 m. *16b*. 53103a, road side cliffs, 400 m. *18e*. 52504, 52505, 52678, 53042, steep NE facing cliffs at trail, on rock and soil, 855–955 m. — It has a southern range in China and is known from Anhui, Fujian, Guangdong, Guizhou, Hainan, Hunan, Jiangsu, Shandong, Shanghai, Sichuan, Taiwan, and Zhejiang provinces.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: La Vi.

Claopodium assurgens (Sull. & Lesq.) Card. — **Mangshan**. *3b*. 51729, 51731. *9a*. 49181, with *Trachypus humilis*. *10a*. 50820. *11c*. 51338. *12a*. 49578. Habitats were primeval or second growth subtropical forests at 400–1 235 m and it grew on tree trunks or logs with *Thuidium pristocalyx*, *T. kanedae*, and *Trachypus humilis*. — The range in China is southern: Fujian, Guangdong, Guizhou, Hainan, Hunan, Jiangsu, Taiwan, Yunnan, and Zhejiang provinces.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Ca In Tha Vi; As 4: Ind.

Thuidium cymbifolium (Dozy & Molk.) Dozy & Molk. — **Mangshan**. *4b*. 51498. *12a*. 49232. *14a*. 49464. **Wulingyuan**. *17b*. 52396a. *18c*. 53002, with sporthytes. *18d*. 52655, with sporophytes. *19a*. 52260, 52354. *19b*. 52030. Most collections were taken in second growth subtropical forests at paths or river beds at 500–1 900 m. Of nine specimens, six were found on rock, two on trunk or log, and one on sandy soil. *Thuidium cymbifolium* is commonly sterile but two of our specimens had sporophytes. — Known from 13 Chinese provinces.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Bhu Bu In La Ne Pa Si Tha Vi; As 4: Ind Ma PNG Phi; Oc: Car Fij Gua NC Sam Van; Austr 1–2; Am 4: Venezuela.

Thuidium delicatulum (Hedw.) Schimp. in B.S.G. — **Mangshan**. *6*. 51458a. *7a*. 50970. *9a*. 49043. *10c*. 51092. *11c*. 51178. *12b*. 49344, 49348. **Wulingyuan**. *18b*. 52616. *18d*. 52635. *Thuidium delicatulum* was collected both in primeval and second growth subtropical forests and grew often along river- and brooksides at 630–1 280 on rocks (5 specimens) and tree trunks (4). All the specimens are without sporophytes. — It is known in China from Anhui, Guangdong, Hainan, Hongkong, Hunan, Sichuan, and Yunnan, and from NE-China.

TOTAL RANGE: As 1. As 2: Chi Ko Ja; Am 1; Am 3: Jamaica; Eur

Thuidium kanedae* Sak. — **Changsha. *1*. 48985, 49364, 49374. **Mangshan**. *3b*. 51730 with *Claopodium assurgens*. *9a*. 49166. **Wulingyuan**. *16a*. 52869. *16b*. 53101, 53122. *17a*. 51840. *17b*. 52068, 52073 with *Haplocladium angustifolium*, 52083, 52146, 52385a, 52403, 52441a. *18a*. 52480, 52573, 52967. *19d*. 51626. *19e*. 51799a, 51901, 51950. Both in primeval and second

growth forests, *Cunninghamia* plantations, and on cliffs at road and path sides at 50–1 225 m. Of 21 specimens, 10 were found on trunks, nine on rocks, and two on sandy soil. It is locally abundant, occurring as pure population or associated with *Thuidium pristocalyx*, *Claopodium assurgens*, *Bryohaplocladium angustifolium*, and *Pseudoleskeopsis zippelli*. Only one specimen (*52480*) had sporophytes. — *Thuidium kanedae* is known from Guizhou, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Sichuan, Taiwan, and Yunnan provinces in China.

TOTAL RANGE: As 2: Chi Ja Ko.

Thuidium pristocalyx* (Müll. Hal.) **Jaeger — **Changsha**. *1*. 49381. **Mangshan**. *3a*. 51857. *3b*. 51559, 51703, 51751, 51855. *4b*. 51438, 51513, 51669, 51671a. *5*. 51351, 51352a, 51398. *6*. 51457. *7a*. 50968a. *7d*. 50693. *8*. 49414. *9a*. 49023, 49064, 49071a, 49166a, c. spor., 49167, c. spor., 49433, 49442, c. spor. *10a*. 50792, 50794a, 50818, 50841, 51013a, 51083. *10c*. 51028. *11c*. 51338a. *12a*. 49632, 49643, 50652. **Wulingyuan**. *15a*. 52902. *15b*. 53156, 53399. *15e*. 53205. *17b*. 52758, 52777. *18b*. 52615. *18d*. 52651, 53020a. *19a*. 52332. *19d*. 51958. *Thuidium pristocalyx* is common in primeval subtropical (warm temperate) evergreen forests characterized by several genera of Lauraceae, *Cyclobalanopsis*, *Lithocarpus*, *Michelia*, *Schima*, and *Exbucklandia*, or in second growth subtropical forests and plantations of *Phyllostachys pubescens* at 50–1 230 m. Of the total of 46 specimens, the substrates were tree trunks (16 specimens), log (5), bush (2), rock (15), sand (6), and humus (1). Only three specimens had sporophytes. — *Thuidium pristocalyx* is known from 14 Chinese provinces.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Bhu Bu In La Ne Si Tha; As 4: Ind Ma Phi PNG.

Thuidium tamariscellum (Müll. Hal.) Bosch & Sande Lac. — **Wulingyuan**. *16a*. 52882. *16c*. 52695. *17a*. 52456. *17b*. 52395, 52396. *18c*. 53013. *19a*. 52306, 52254, 52344, 52367, 52368. All habitats where *T. tamariscellum* was found were rather open or disturbed, such as cliffs at dry stream bed, second growth forests, and *Cunninghamia lanceolata* plantation at 400–700 m. The substrates are rocks (6 specimens) and tree trunks or bush (5). It mostly occurs in pure populations, or associates with *T. cymbifolium*. *Thuidium tamariscellum* is commonly with sporophytes, nine of the 11 specimens. — In China, it is known from southern provinces of Fujian, Hunan, Taiwan, and Yunnan.

TOTAL RANGE: As 2: Chi Ja; As 3: Bhu Bu In Ne Si Tha Vi; As 4: Ind Phi.

Trachypodaceae M. Fleisch. (by Y.-M. Fang and S. Huttunen)

Trachypus bicolor Reinw. & Hornsch. — **Mangshan**. *5*. 51399. *6*. 51122. *7a*. 50954. 50927, 50721. *7e*. 50882. *10c*. 51034. *14b*. 49615. In subtropical secundary evergreen mixed forest, road and brook side cliffs, primeval subtropical forest along river bed and elfin forest in mountain top, alt. 800–1 900 m. On trunks (4 specimens), fallen logs (1), walls of boulder (1), outcrops (1) and cliffs (1). — Widely distributed in southern China.

TOTAL RANGE: As 2: Chi Ja; As 3: Bu In La Ne Si Sri Tha Vi; As 4: Ind Phi PNG; Oc: Haw Fij; Am 2–5; Afr 2–4.

Trachypus humilis* Lindb. — **Mangshan. *3a*. 51881, *3b*. 51560, 51733. *4b*. 51423, 51515, 51659, 51681. *5*. 51406. *7a*. 50963, 50966. *7d*. 49241, 50709, 50695. *9a*. 49181, 49449, 49521. **Wulingyuan**. *15b*. 53395. *16a*. 52868. *16b*. 53097. *16d*. 53355, 53374. *17b*. 52768. *18c*. 53005. *19b*. 52035. In primeval and second growth forests, on cliffs at paths and roads at 315–1 225 m. Of 23 specimens from 12 localities, 20 were taken from tree trunks or logs, and 3 from rocks. Mostly the species occurs as pure populations, sometimes associated with *Claopodium assurgens*. — It is previously known from the following Chinese provinces: Anhui, Guizhou, Hainan, Hong Kong, Sichuan, Taiwan, and Zhejiang.

TOTAL RANGE: As 2: Chi Ja Ko; As 3: Bu Ca In Sri Tha Vi; As 4: Ind Ma Phi PNG; Austr 1; Oc: Haw NC.

DISCUSSION

In this paper only about one fourth (1 000 specimens of the total of ca. 4 000 specimens) of the material collected in 1997 is treated so that any far-reaching conclusions of the flora are not yet

possible. However, it can be generally stated that the Hunanese forests we studied are among the few existing primeval forests within the subtropical or warm temperate vegetation zone in Asia. This first publication gives examples of the species content of some families and genera. A fact worth emphasizing is the 19 previously unrecorded genera and the large number of species, 69, common in the area but not previously reported from Hunan. This shows how poorly the bryoflora of Hunan was known before our studies. The following genera, not mentioned by Rao *et al.* (1997) are for the first time recorded for Hunan.

Anthocerotae: *Folioceros, Megaceros, Phaeoceros.*

Hepaticae: *Conocephalum, Microlejeunea, Dumortiera, Lopholejeunea, Mastigolejeunea, Microlejeunea.*

Musci: *Anomobryum, Brachymenium, Bryhnia, Bryohaplocladium, Cyathophorella, Neobarbella, Oedicladium, Okamuraea, Pyrrhobryum, Racopilum.*

Many of the species reported for first time belong in widely distributed groups of bryophytes. Some of them are "cosmopolitan" (*Aneura pinguis, Reboulia hemisphaerica*, *Bryum argenteum*), pantropical (*Metzgeria decipiens, Dumortiera hirsuta, Brachymenium exile, Plagiomnium rhynchophorum*,) have a wide distribution in East Asia, or are holarctic. However, there are some remarkable range extensions, such as *Lopholejeunea brunnea*, *Metzgeria albinea*, and *Diplophyllum serrulatum*, which are for first time reported from continental China. Some of the species have only few earlier reports; an example is *Scapania ligulata*. The following species rare in China represent southern flora elements: *Metzgeria decipiens, Pallavicinia ambigua*, *P. levieri, P. subciliata, Aerobryopsis parisii, Cyathophorella kyushuensis, Distichophyllum obtusifolium, Philonotis mollis,* and *Rhynchostegiella laeviseta.*

The range of *Atrichum subserratum* is are extended from the Himalayas (Sichuan, Yunnan and Xizang provinces) to central Chinese mountains, and *Dicranodontium asperulum* is disjunct from Himalayas and Taiwan.

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