THE GENUS ARTHRORHAPHIS IN THE HIMALAYAS, THE KARAKORUM AND THE SUBALPINE AND ALPINE REGIONS OF SOUTH-EASTERN TIBET

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ABSTRACT. The yellow coloured taxa of the genus Arthrorhaphis (i.e. A. alpina var. alpina, A. alpina var. jungens, A. citrinella and A. vacillans) have been revised for the Himalaya Range, the Karakorum and for the south-east Tibetan fringe-mountains. Arthrorhaphis alpina var. jungens, usually growing on sandy soil, appears to be a rather abundant lichen on open alpine (Kobresia-) meadows, often associated with other weakly calciphilous crusts, such as Megaspora verrucosa, Phaeorrhiza nimbosa, Ph. sareptana, Psora decipiens and several Toninia species. Arthrorhaphis vacillans, with generally similar ecological requirements, and A. alpina var. alpina in more sheltered localities, are less frequent. Arthrorhaphis citrinella, growing on mosses or decaying plants rather than over pure soil, is much more scarce in the study area than in the European Alps.

INTRODUCTION

Knowledge of the lichens of the Himalayas and adjacent areas rapidly increased when the series 'Flechten des Himalaya 1–17' was published between 1966 and 1977 (for a summary of the contributions see Poelt 1977: 447). About ten years later, another series 'Beiträge zur Kenntnis der Flechtenflora des Himalaya' ('Contribution to the knowledge of the lichen flora of the Himalayas'): began, in which mainly Prof. J. Poelt (Graz, Austria) and his co-workers presented their studies on different lichen genera or interesting species, i.e. Vezda & Poelt 1988 (gyalectoid and foliicolous lichens), Poelt & Obermayer 1991 (Bryoria), Obermayer 1992 (Lecanora somervellii), Poelt & Petutschng 1992 (Xanthoria, Teloschistes), Poelt & Grube 1992 (Protoparmelia), Poelt & Grube 1993a (Tephromela), Poelt & Grube 1993b (Lecanora, subg. Placodium), Poelt & Hinteregger 1993 (Caloplaca, Fulgensia, Ioplace), Grube & Poelt 1993 (Sporastatia).

The present study continues this monographic treatment of lichen genera from high Asian mountains, dealing with the genus Arthrorhaphis, which is fairly common on the ground in the subalpine and alpine regions of south-eastern Tibet as well as the Himalayas and the Karakorum (see Fig. 1 and Fig. 2). The paper follows from a revisionary study of the genus in Europe and Greenland (Obermayer 1994).

MATERIAL AND METHODS

About 100 specimens from the herbaria B, M and GZU have been examined with

1 Lichenological results of the Sino-German-Joint-Expedition to southeastern- and eastern-Tibet 1994. I.
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a Zeiss Axioskop light microscope. Unless otherwise specified, cited material is housed in GZU. The collectors are abbreviated as follows: W.O. = Walter Obermayer; J.P. = Josef Poelt; S.G.M. = Sabine & Georg Miehe.

Nitric acid has been used either to observe the bright green colour reaction in the epithecium or for the study of young or poorly developed ascospores.

Some Remarks on the Genus Arthrorhaphis

Morphology and anatomy

The taxa of the genus Arthrorhaphis are mainly characterized by the following features (for further details see Obermayer 1994): Thallus crustose (with or without the yellow colouring rhizocarpic acid), initially often parasitic on Baemycetes or Dibaeis species or on decaying lichens, rarely persistently parasitic on Melanelia or Cladonia (Santesson & Tønsberg 1994). Medulla (in A. alpina s.l. and A. vacillans) or (in A. citrinella) without Ca-oxalate-crystals, sometimes hollow. Apothecia black, at least in early stages with a distinct margin. Epithecium green-brown to green-black, the colour intensifying with nitric acid. Paraphyses thin, weakly branched at the top, apices not swollen. Hymenium (or at least epithecium) with oil droplets. Asci clavate, 8-spored or sometimes with less well developed ascospores, slightly thickened at the apex, K/I-, with an ocular chamber. Ascospores colourless, cylindrical to acicular, with no perispore visible in LM, with 3–16 (rarely more) transverse septa. Conidiomata not known. Chemistry: pulvinic acid derivates (rhizocarpic acid, epanorin), atranorin; p.p. lichen substances from the host lichen; p.p. Ca-oxalate-crystals in the medulla (in A. alpina s.l. and A. vacillans). It is striking that no Arthrorhaphis taxa lacking rhizocarpic acid (i.e. A. aeruginosa, A. grisea, A. muddii, A. olivacea) have been found in the material studied.

Ecology

As mentioned above, all species are able to begin life as a parasite and later become either an autonomous lichen or remain perthophytic, although in the study area, early parasitic stages were found only rarely. As pointed out in Obermayer (1994: 287), A. alpina s.l. and especially A. vacillans require weakly calcareous substrate, whereas A. citrinella prefers strongly acidic conditions (see below). Pintaric & Türk (1995) recently showed that the thallus size of terricolous and epiphytic foliose and fruticose lichens decreases with increasing amounts of Ca, K and Mg. This may also be true for the spore-(and ascus-)length of crustose lichens (see Obermayer 1994: 299–300).

Although themselves parasitic (at least in their early stages), all taxa of the genus Arthrorhaphis can also act as a host for other lichenicolous fungi. The following species have been observed on thalli of Arthrorhaphis (for more information including a key to the parasitic species see Hafellner & Obermayer 1995): Cercidospora soror, C. trypetheliza, Merismatium decolorans, Stigmidium arthrorhaphidis.

Previous reports of Arthrorhaphis species from Asia

Recent reports of Arthrorhaphis species from the Himalaya Range (incl. Karakorum) are from Poelt (1961: 87), Hertel (1973: 480–482), Poelt & Hafellner (1976:

**Difficulties with determination**

Some material proved difficult to determine even in richly fruiting specimens, often no ascospores could be found because the hymenial layer of every apothecium was completely eaten off by animals. In such cases, as well as in thalli lacking fruiting bodies, specimens have been regarded either as *A. alpina* s.l., including *A. vacillans* (when medullary Ca-oxalate-crystals are present), or as *A. citrinella* (without crystals). Soredia may occur both in *Arthrorhaphis citrinella* and *A. alpina*, thus providing no diagnostic character to separate these taxa. At the species level, it is only in *A. vacillans* that a sorediate thallus never has been observed. For further problems with determination see under the particular taxa.

**KEY TO THE YELLOW COLOURED TAXA OF ARTHRORAPHIS**

1 Thallus sterile ................................................................. 2
1* Thallus with fruiting bodies and well developed ascospores ............... 3
2 Thallus with a white medulla, consisting mainly of Ca-oxalate-crystals (under soredia or under a compact cortex stratum) ....... *Arthrorhaphis alpina* s.l. (and *A. vacillans*)
2* Thallus without a white medulla .......... *Arthrorhaphis cf. citrinella*
3 Ascospores usually more than 50 μm in length, with all spores lying at the same height in the ascus, thallus without any white medullary Ca-oxalate-crystals ... *Arthrorhaphis citrinella*
3* Ascospores mostly less than 50 μm long, usually reaching different heights in the ascus. Ca-oxalate-crystals present in the medulla .......... 4
4 Ascospores 16–22(–25) μm long and mostly with 3 septa .... *Arthrorhaphis vacillans*  
4* Majority of the ascospores either longer or with more septa or both (*A. alpina* s.l.) .... 5
5 Ascospores (25–)30–50(–60) μm long, with 5–10(–14) septa; thallus sorediate or not .... *Arthrorhaphis alpina* var. alpina
5* Ascospores 18–30 μm in length; either with 3 septa and more than 23 μm long or shorter but then with more than 3 septa; thallus never sorediate .... *Arthrorhaphis alpina* var. jungens

**TREATED TAXA**

*Arthrorhaphis alpina* (Schaer.) R. Sant. in D. Hawksw., P. James & Coppins  
Thallus terricolous, muscicolous or (in early stages) lichenicolous (on Baeomyces, Cladonia-squamules or decaying lichens), (green-)yellow coloured (sometimes with a white tinge), sorediate or not, areolae plane to strongly convex (sometimes cracked and hollow at the apex). Medulla (beneath a compact cortex or under soredia) with Ca-oxalate-crystals, white or (if intermixed with rhizocarpic acid) yellow-white. Apothecia mostly with a distinct margin, disc slightly roughened. Hymenium 90–130 μm, with a brown-green epithecium; asci (70–)80–125 μm long. Spores up to 8 per ascus, cylindrical to slightly acicular, 3–14-septate, (16–)22–45(–60) × 3–4.5(–5) μm, reaching different heights in the ascus.

Comments: Features which distinguish this species from Arthrorhaphis citrinella are given under A. alpina var. alpina, differences from A. vacillans can be found under A. alpina var. jungens.

Sterile specimens examined (see Fig. 1): All specimens with Ca-oxalate-crystals in the medulla, giving it a white appearance, and no apothecia or at least no developed ascospores, no difference whether the thalli are sorediate or not, are listed here. Esorediate thalli may belong to A. vacillans, which is not distinguishable from A. alpina s.l.: CHINA, TIBET (=PROV. XIZANG), Tiantiantaweng Shan Mts., 60 km W of Markam (=Gartog), pass 15 km NE of Zogang (=Wangda), 29°43'N/98°00'E, 4950–5010 m alt., 4.VII.1994, W.O. (3820)–Himalaya Range, 130 km SSW of Lhasa, eastside of Puma Yumco (=Pomo Tso), way to the nearest mountain east of Pomo Tso, 28°31'N/90°37'E, alpine meadows with Kobresia, 5300 m alt., 15.VII.1994, W.O. (4113)–ibidem, little summit, 5770–5784 m alt., 15.VII.1994, W.O. (4114)–Himalaya Range, 120 km S of Tsetang (Nedong), 20 km S of Nera Tso (=Ni la Hu), on way to Cona (=Tsona),

Fig. 1. Locations of examined Arthrorhaphis taxa in the Karakorum, the Himalayas and the mountains of south-eastern Tibet: ■ sterile Arthrorhaphis specimens with Ca-oxalate-crystals in the medulla (A. alpina s.l. and A. vacillans); ● Arthrorhaphis citrinella.
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*Arthrorhaphis alpina* var. *alpina*

This taxon is characterised by the spores, which are generally 5–10(–14) septate and (25–)30–50(–60) μm long and by the thallus, which consists of compact areolae or (especially over mosses) is granular-sorediate. (The presence of Ca-oxalate crystals in the medulla is typical for both varieties of *Arthrorhaphis alpina* and for *A. vacillans*.)

Comments: The length of the spores and asci in sorediate morphotypes of *A. alpina* var. *alpina* (with Ca-oxalate crystals beneath the soredia) commonly reach the upper limit of the size given, and thus come close to those of *A. citrinella*. However, the medullary crystals and the spore-arrangement in the ascus (lying not at the same height) support their inclusion in *A. alpina*. It is distinguished from *A. alpina* var. *jungens* by the septation and the length of the spores (see above).

Variety *alpina* specimens were collected between 3500 m alt. and 5500 m alt., but one sterile specimen was found at almost 5800 m (W.O. 4114). *A. alpina* var. *alpina* overgrows mosses less frequently than does *A. citrinella* and instead prefers sandy soil. It has been observed closely associated with the following lichens: *Bryonora stipitata*, *Bryoria* spec., *Cladonia* spp., *Coccocarpia* spec., *Melanelia masonii*, *Mycobilimbia* spec., *Peltigera rufescens* and *Pannaria* spec.

As mentioned under *A. citrinella*, clearly parasitic stages were rarely found. In one specimen the apothecia of *A. alpina* occur both on the typical yellow thallus and on not yellow coloured (?) *Cladonia*-squamules (W.O. 4111). Even *Diploschistes muscorum*
can have yellow coloured patches on its thallus when growing together with *Arthrorhaphis alpina* (W.O. 2921).

Fertile specimens examined (see Fig. 2): CHINA, TIBET (= PROV. XIZANG), Himalaya Range, 160 km S of Lhasa, dry valley of Kuru river, 10 km NW of Lhozag, 28°24'N/90°39'E, N-exposed steep rocks in a glen, 4230 m alt., 17.VII.1994, W.O. (4112) - 280 km E of Lhasa, 70 km E of Gongbo Gymada, close to the shore of the lake Basum Tso, 30°00'N/93°56'-57'E, 3500 m alt., 30.VIII.1994, W.O. (4107) - 360 km E of Lhasa, near the bend of the river Tsangpo, N-side of Gyala Peri, 10 km S of Tongjug village, W-side of the glacier, near a moutain pasture hut, 29°54'N/94°52'E, 3700 m alt., 20.VIII.1994, W.O. (4105) (with *A. citrinella on Baeomyces*) - 350 km E of Lhasa, 20 km NE of Nyingchi, 5 km E of the pass, near the timber line, Juniperus-Abies forest, 29°38'N/94°42'E, 4300 m alt., 26.VIII.1994, W.O. (4111) (p.p. on (?) *Cladonia-squamules*) - Himalaya Range, 60 km ESE of Tsetang (Nedong), 30 km WSW Gyaca, way from Putrang La pass to the Tsangpo valley, 29°02'N/92°22'E, 4600 m alt., *Rhododendron* shrubs, 2.VIII.1994, W.O. (4102b) (together with *A. vacillans*) - PROV. SICHUAN, first pass between Kangding (Dardo) and Litang, 30°05'N/101°48'E, 4300 m alt., alpine meadows with *Kobresia pygmaea*, 23.VI.1994, W.O. (3109) - Shalui Shan Mts., 35 km NNE of Batang, SE of Yidun, 30°16'N/99°28'E, 4200 - 4300 m alt., pasture with shist outcrop and single Juniperus trees, 27.VI.1994, W.O. (3450) - NEPAL, CENTRAL-NEPAL, LANGTANG AREA, slopes N above Nubama Dhang, 4500 m, 1986-09-13, J.P. (N86-L743) - Upper Langtang, W Langschisa, 4590 m, 1986-09-16, G.S.M. (11978b) - slopes N above Langshisa Kharka and moraines of Shalbachun Glacier, 4400 m, 1986-09-16, J.P. (N86-L420) - huge rocks near Kyangjin, 3750 m, 1986-09-10, J.P. (N86-L1323) - Surdscha Kunda, NW exp. Felsspalten, 4730 m, 1986-08-14, G.S.M. (9006b) - Ganja La-(North), upper alpine belt, 4670 m, 1986-07-19, G.S.M. (5758) - EAST-NEPAL, KHUMBU HIMAL, Chukhung Ri, 5546 m, 1981-04-04, S. Remus & M. Menzel (060) (B, with *Cercidospora trypetheliza*).

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**Fig. 2.** Locations of examined *Arthrorhaphis* taxa in the Himalayas and the mountains of south-eastern Tibet: ■ *Arthrorhaphis alpina* var. *alpina*; ■ *Arthrorhaphis alpina* var. *jungens*; ■ *Arthrorhaphis vacillans*. 
Arthrorhaphis alpina var. jungens Obermayer & Poelt


This taxon is characterised by the non-sorediate thallus and by the spores, which are 3–6-septate, (15)18–30 μm long, with either 3 septa and more than 23 μm long or shorter but then with more than 3 septa (see also Obermayer 1995: 4). (The presence of Ca-oxalate crystals in the medulla is typical for both varieties of Arthrorhaphis alpina and for A. vacillans.)

Comments: As given in the description and the key, var. jungens differs from var. alpina by the non-sorediate thallus and the shorter ascospores, generally with fewer septa. A. vacillans has a smoother apothecial disc, and a high percentage of only 3-septate (more or less cylindrical) ascospores, reaching not more than 22 μm in length. This taxon was first recognized by Poelt (1990: 436), whose proposed name Arthrorhaphis vacillans var. "jungens" (now A. alpina var. jungens) indicates its intermediate position (both morphologically and anatomically) between A. vacillans and A. alpina.

Although many specimens are easy to identify, some difficulties in determination (when only poorly developed ascospores are present) may occur, and it appears that the species barrier within Arthrorhaphis is probably rather unstable (see also Obermayer 1994: 299).

A. alpina var. jungens appears to be the most frequent taxon in the alpine regions of the high Asian mountains, spanning altitudes from 3800 to 5100 m. Commonly associated crustose lichens are: Acarospora schleicheri, Baeomyces spec., Bryonora stipitata, Br. yetii, Caloplaca cerina var. muscorum, Candelariella spec., Diploschistes muscorum, Gypsoplasca macrophylla, Lecanora chondroderma, Megaspora verrucosa, Mycobilimbia lobulata, Phaeorrhiza nimbosa, Ph. sareptana, Psora decipiens, Rinodina ssp., Toninia ssp.

Fertile specimens examined (see Fig. 2): CHINA, TIBET (=PROV. XIZANG), Ningjing Shan Mts., 9 km W of Markam (=Gartog), 29°40'N/98°32'E, 4200–4400 m, 1.7.1994, W.O. (3018) – way from Quamdo (Changtu) to Nagqu (=Nakchu), 31°05'N/96°10'E, 4800 m alt., 8.VII.1994, W.O. (4080) – Himalaya Range, 150 km S of Lhasa, 25 km NNW of Lhakhang Dzong, 28°18'N/90°57'E, 3900–4300 m alt., 22.VII.1994, W.O. (2921) – Himalaya Range, 280 km ESE of Lhasa, 40 km SW of Mainling, way from a mountain pasture hut (4660 m alt.) to the glacier (5100 m alt.), 29°03'N/93°56'E, 4800–5100 m alt., alpine meadows and boulders, 11.VIII.1994, W.O. (4103) – 170 km SW of Lhasa, 110 km SSW of Tsetang (Nedong), 28°35'N/92°23'E, 4700 m alt., alpine meadows with Kobresia pygmaea, 26.VII.1994, W.O. (3019 with Merismatium decolorans, 4099) – Himalaya Range, 150 km S of Lhasa, 25 km NNW Lhakhang Dzong, 28°18'N/90°57'E, 3900–4200 m, 22.7.1994, W.O. (3009) (with Ceridospora soror) – Ningjing Shan Mts., 9 km W of Markam (=Gartog), 29°40'N/98°32'E; 4200–4400 m, 1.7.1994, W.O. (3017) (with Ceridospora trypetheliza) – 120 km E of Lhasa, Mila-Pass between Lhasa and Gongbo Gyamda, 29°51'N/92°21'E, 4950 m alt., alpine meadows, 2.IX.1994, W.O. (4108) – PROV. SICHUAN, between Kangding and Litang, 30°03'N/101°49'E, 3800–3900 m alt., Rhododendron-Salix-Juniperus shrubs, 23.VI.1994, W.O. (3061) – Shalui Shan Mts., 35 km NNE of Batang, SE of Yidun, 30°16'N/99°28'E, 4200–4300 m alt., pasture with shist outcrops and single Juniperus trees, 27.VI.1994, W.O. (3421) – NEPAL, LANGTANG AREA, Surdscha Kunda, 4840 m, 1986-08-12, G.S.M. (8771) – Karka Sarwa, 4990 m, 22.IX1986, G.S.M. (12543, 12543b) –

Arthrorhaphis citrinella (Ach.) Poelt


Thallus terricolous, muscicolous or (in early stages) lichenicolous (on Baeomyces, Cladonia-squamules or decaying lichens), (green-)yellow coloured, sorediate or not; areolae plane (sometimes slightly concave) to strongly convex and then hollow. Medullary Ca-oxalate-crystals und er the cortex or at the base of the soredia absent. Apothecia with a distinct, relatively broad margin at first, later sometimes immarginate; disc roughened. Hymenium 100–140 μm, with a green-black (to brown-green) epithecium. Asci (90–) 100–140 μm long. Spores 8 per ascus or (rarely) less, arranged within the ascus at the same height, distinctly acicular, 6–9(−14)-septate, (40–)50–100(−110) × 2,5–3,5(−4) μm.

Comments: Arthrorhaphis citrinella is characterised by having no Ca-oxalate-crystals in the medulla, by the thick marginate to immarginate fruiting bodies with a rough disc, and the long, acicular spores, which lie at the same height in the ascus. Specimens with soredia may be difficult to separate from A. alpina var. alpina (see under that taxon). – A. citrinella was found between 3700–5100 m a.l. Contrary to the situation in the Alps, it seems to be much less abundant than A. alpina s.l. It is the most acidophilous species of the yellow-coloured taxa. The thallus usually overgrows mosses or small decaying plants. Sorediate morphotypes of A. citrinella (as well as A. alpina var. alpina) mainly grow in rather sheltered situations.

Only a few samples are obviously parasitic on Baeomyces thalli and bear fruiting bodies on the surface of a yellow, marginally effigurate thallus and not (as is usual) on the margin of or even beside the areolae. This laminal position of the apothecia indicates a recent attack of a host lichen (W.O. 4460). On one occasion, Arthrorhaphis citrinella was observed to develop out of a dead Melanelia masonii (W.O. 4104). – Associated crustose lichens are rare or totally missing. Foliose or fruticose lichens overgrowing the same mosses are Melanelia masonii, Stereocaulon spp. or sterile Cladonia species.

Fertile specimens examined (see Fig. 1): CHINA, TIBET (=PROV. XIZANG), Himalaya Range, 280 km ESE of Lhasa, 40 km SW of Mainling, 29°03′N/93°58′E, 4400–4500 m alt., 12. VIII.1994, W.O. (3014) (with Stigmidium arthrorhaphidis) – ibidem, way from a mountain pasture hut (4660 m alt.) to the glacier (5100 m alt.), 29°03′N/93°56′E, 4800–5100 m alt., alpine meadows and boulders, 11. VIII.1994, W.O. (4110c) (together with A. alpina s.l.) – 330 km E of Lhasa, near the bend of the river Tsangpo, pass between Nyingchi and Tangmai, 29°37′N/ 94°39′E, 4500 m alt., alpine meadows with boulders, 28.VIII.1994, W.O. (4106) – 360 km E of Lhasa, near the bend of the river Tsangpo, N-side of Gyala Peri, 10 km S of Tongjug village,
The genus *Arthrorhaphis* in the Himalayas


**Arthrorhaphis vacillans** Th. Fr. & Almqu. ex Th. Fr.

Botaniska Notiser: 107. 1867.

Thallus yellow (often with a white tinge when damaged), areolae plane to convex, never sorediate. Medulla white, always containing Ca-oxalate-crystals. Apothecia flat, with a distinct, relatively narrow margin, disc smooth, often slightly shiny. Epithecium green-brown. Hymenium 70-100 μm tall. Ascii 60-100 μm. Ascospores (14-)16-22 (-25) × 3-3.5(-4) μm, a high percentage with only 3 septa (4-5-septate spores may occur). (The presence of Ca-oxalate crystals in the medulla is typical for *A. vacillans* as well as for both varieties of *Arthrorhaphis alpina*.)

Comments: The plane, narrow-marginate, often shiny apothecia and the short, cylindrical, 3-septate spores are diagnostic for *Arthrorhaphis vacillans* (see also under *A. alpina* var. *jungens*).

Its altitudinal distribution ranges from 4000 to 5100 m a.s.l. True *A. vacillans* specimens (comparable with those from the European Alps) are less common than the intermediate form between *A. vacillans* and *A. alpina* named *A. alpina* var. *jungens*. Based on the observations of the author in the south-east Tibetan mountains and in the north-east facing Himalaya Range, *A. vacillans* as well as *A. alpina* var. *jungens* can be found mostly growing over sandy soil on rather open sites, especially in alpine *Kobresia* meadows. Whilst *A. vacillans* can spread out on quite flat areas, fertile parts of *A. alpina* s.l. carrying fruiting bodies are often restricted to steep surfaces. Commonly associated crustose lichens are in general similar to those of *Arthrorhaphis alpina* var. *jungens*.

The following localities, which include also the correct data given by Hertel (1973: 480-482) must be added to the distribution map given in Obermayer (1994: 289):

Fertile specimens examined (see Fig. 2): CHINA, TIBET (= PROV. XIZANG), 120 km E of Lhasa, “Mila-Pass”, pass between Lhasa and Gongbo Gyamda, 29°51'N/92°21'E, 4950 m alt., 2. IX.1994, W.O. (2918, 3422) (with Cercidospora trypetheliza) – Ningjing Shan Mts., 9 km W of Markam (= Gartok), 29°40'N/98°32'E, 4200-4400 m, 1.VII.1994, W.O. (3696) – Himalaya Range, 170 km SE of Lhasa, 80 km SE of Tsetang (Nedong), 2nd pass on way from Tsetang to Lhünze, 28°38'N/92°14'E, 5000 m alt., alpine meadows and debrise cones, 25.VII.1994, W.O. (3423) – Himalaya Range, 60 km ESE of Tsetang (Nedong), 30 km WSW Gyaca, Putrang La

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REFERENCES


Magnusson, A. H. 1944. Lichens from Central Asia II. Reports from the scientific expedition to the north-western provinces of China under the leadership of Dr. Sven Hedin. The Sino-Swedish-Expedition. Publ. 22. XI. Botany 2. Stockholm.


